AECOM

Stormwater Master Plan Report

Town of Halton Hills

Project Number: 60662686

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1. Introduction and Objectives

AECOM has been retained by the Town of Halton Hills (the Town) to complete a Stormwater Management Master Plan (SWMP). The SWMP is to provide the Town with an understanding of how the existing stormwater network is functioning, identify vulnerabilities, and inform short- and long-range planning to improve the Town's stormwater infrastructure. The SWMP will assist in identifying opportunities to address issues before stormwater assets fail or are otherwise unable to fulfill their intended purpose. Another purpose of this study is to evaluate the existing stormwater management system and make recommendations to bring the Town's storm infrastructure up to date with current best management practices and to adequately prepare for the anticipated impacts of climate change.

The overall objectives of the Stormwater Management Master Plan are to:

- Decrease the likelihood of flooding that would result in property damage or safety issues;
- Minimize the impacts of erosion on aquatic and terrestrial habitats and property;
- Build resiliency against and adapt to the impacts of climate change (i.e., increasing number of high intensity storm events);
- Mitigate historic problem drainage areas;
- Seek opportunities to improve Stormwater Management (SWM) planning practices; and,
- Seek opportunities to improve water quality.

In recent years, the techniques for designing storm sewer infrastructure have become more efficient with the use of hydraulic models, detailed historical site information, and precipitation data. A potentially increasing number of locally extreme rainfall events with much higher intensities than those seen in the past, earlier snowmelt, and increased flood risks may pose challenges to the existing infrastructure.

To complete this study a multiphase assessment and implementation plan development process was carried out including the following key steps:

- Condition assessment of linear storm infrastructure
- Condition assessment of SWMFs and OGS units
- Flow and precipitation monitoring
- Stormwater quality monitoring
- Updates to the Town's Intensity-Duration-Frequency curves
- Development of a dual drainage model

- Identification and prioritization of upgrades and retrofits
- Life cycle cost estimates of existing and proposed infrastructure
- Review of stormwater management financing strategies
- Public and Agency consultation including four meetings with a Technical Advisory Committee and two Public Information Centres

As part of this study a stormwater management and drainage assessment for all existing stormwater infrastructure within the study area was completed utilizing an updated, calibrated hydrologic model to assess existing SWM system capacity deficiencies. The calibrated model was run to simulate the 2-year through 100-year storm events. The storm events were developed using updated IDF values as described herein. There are stormwater deficiencies in some of the existing infrastructure which make portions of the Town's existing system incapable of meeting the current level of service requirements for the contributing areas they serve, while other portions of the network have incurred structural degradation or damage over time. A preliminary assessment of deficiencies associated with the minor system (i.e., the storm sewer network) has been completed as part of the Town's 2109 Stormwater Management Strategy (AMEC, 2019) and was further investigated in detail as part of this study. Furthermore, as part of this study an assessment of the major system using 2016 LiDAR data was carried out to identify sag locations where there is a risk of flooding and spillover onto private property or other areas outside of the road right-of-way (ROW). Within many older areas of the Town there may not be a properly defined major drainage system flow route (i.e., the roadway surfaces, boulevards, storage areas, and roadside ditches that handle runoff in excess of the minor drainage system). A more detailed evaluation of the major drainage systems has not been carried out to date, however.

One of the Town's strategic goals is to ensure the town has resilient infrastructure to reduce impacts on the community while protecting and enhancing biodiversity and preserving natural heritage features in the community. This requires that the necessary stormwater controls be applied to address both the quantity and quality of the water being conveyed to the natural environment. The Town of Halton Hills has a comprehensive database of the Town's storm sewer network, as well as stormwater management ponds, oil/grit separator (OGS) units and infiltration galleries. These engineered controls manage the risk of flooding and pollution that is discharged from the stormwater system, but these water quality controls currently cover only a small portion of the Town. In this Master Plan study, the assessment of deficiencies in minor and major system capacity, together with information on where water quality treatment measures exist, has been used to identify and prioritize areas for improvement and possible remedial measures. Remedial measures are described, and preliminary cost estimates developed to inform the Town's implementation strategy.

1.1 Background and Other Planning Efforts

A number of background documents were reviewed to inform the development of the Stormwater Master Plan. These include the following:

1.1.1 Official Plan and Vision Georgetown Secondary Plan (June 27, 2018)

The Places to Grow Act in 2006, identified an additional 130,000 people and 50,000 jobs allocated to the Region of Halton between 2021 and 2031. Following the release of the Places to Grow Act, the Region undertook a detailed planning exercise with the local municipalities ('Sustainable Halton') to determine where and how the population/ employment targets would be distributed within the Region. This work resulted in Regional Official Plan Amendment ('ROPA') 38, which allocated population growth of approximately 20,000 people to the Town of Halton Hills to be accommodated on new urban land in the form of Greenfield development. ROPA 38 also identified the Vision Georgetown lands as the major location of the new urban Greenfield land for residential purposes.

1.1.2 Guidelines

The current guidelines and standards in use by the Town are:

- Engineering Department Town Standards (1988), and
- Town of Halton Hills Subdivision Manual (1999).
- Consolidated Linear Infrastructure Environmental Compliance Approval (CLI-ECA 328-S701 – Issued September 27th 2023)

1.1.3 Regulatory Setting

Stormwater management in Ontario is regulated by a variety of legislation, for example, provincial legislation gives various levels of authority and power to municipal governments and conservation authorities to regulate the management of stormwater. This section outlines the regulations and policies that apply to stormwater management in Ontario that must be considered as part of this study.

1.1.3.1 Federal Legislation

There is currently no federal legislation that relates directly to stormwater, although the federal government has two main pieces of legislation focused on its constitutional responsibility for protecting fisheries and navigation. In addition, the Canadian Environmental Protection Act (SC 1999, c.33) also relates to stormwater management by mandating emergency planning for industrial accidents and the guidelines for the Act include treatment of stormwater before runoff containing toxic substances reaches ecosystems.

1.1.3.1.1 Department of Fisheries and Oceans

The Department of Fisheries and Oceans (DFO) administers the Fisheries Act (RSC 1985, c F-14), which prohibits the release of deleterious substances into fish habitat, which is defined very broadly in the Act and can include roadside ditches and watercourses that are only intermittently wet. Proponents conduct a self-assessment to determine if DFO authorization is required.

1.1.3.1.2 Transport Canada

Transport Canada requires works that affect navigable waters, such as bridges and culverts, to obtain approval through the Navigation Protection Act (RSC 1985, c N-22), formerly named the Navigable Waters Act, if the affected waterway is included in the Act's List of Scheduled Waters. Although most waterways in Canada are not included in the list, the public right to navigation exists for all navigable waters under Common Law. Proponents of work on navigable waterways not included in the List of Scheduled Waters can opt in and seek Transport Canada's approval, making the application subject to Transport Canada's compliance monitoring and enforcement regime.

1.1.3.2 Provincial Legislation

Provincial legislation is administered by multiple ministries of the Ontario government and grants powers and obligations to other government actors, such as Conservation Authorities and municipalities, in matters relating to stormwater management.

1.1.3.2.1 Credit Valley Conservation Authority, Conservation Halton and Grand River Conservation Authority

The Conservation Authorities Act (RSO 1990, c-27) grants conservation authorities (CAs) the power to control the flow of surface waters to prevent flooding and to reduce adverse effects within their regulated areas. The Conservation Authorities Act was amended under O.Reg. 41/24 in February 2024. The Credit Valley Conservation Authority (CVC), Conservation Halton (HRCA) and Grand River Conservation Authority (GRCA) provide input and review of land use planning to municipalities and developers in accordance with provincial, federal, and conservation authority policies and regulations. Territories that are not covered by a Conservation Authority in the Province of Ontario fall under the jurisdiction of the MNRF. Any development within the approximate regulated areas will require a permit from the Conservation Authority. Regulated areas include (but are not limited to):

- All watercourses including streams, rivers and creeks and area adjacent;
- All wetlands (including Provincially Significant Wetlands) plus 30 metres surrounding the wetland;

- Land lakes and shorelines plus 15 metres landward from the 100 year flood level;
- Ravines, valleys, steep slopes and talus slopes;
- Hazardous lands (associated with flooding, erosion, dynamic beaches or unstable soil and bedrock); and

The Regulation applies to development including (but not limited to):

- the construction, reconstruction, erection or placing of a building or structure of any kind,
- any change to a building or structure that would have the effect of altering the use or potential use of the building or structure, increasing the size of the building or structure or increasing the number of dwelling units in the building or structure,
- site grading, or

1.1.4 the temporary or permanent placing, dumping or removal of any material, originating on the site or elsewhere;Municipal Class Environmental Assessment (MCEA) Process

Following *Master Plan Approach #1* this SWMP was completed with a level of assessment that will become the basis for, and be used in support of, future investigations for the Schedule A, A+, B and C projects identified within it. Schedule B projects would require the filing of the Project File for public review while Schedule C projects would have to fulfil Phases 3 and 4 prior to filing an Environmental Study Report (ESR) for public review. This framework allows the Town to plan for future SWM infrastructure improvements and can directly feed into financial planning such as preparing for a stormwater funding study.

This Master Plan report ties together all components of the study and will document Phases 1 and 2 of the Class EA process. It will include a listing and description of all identified projects (i.e., Schedule A, A+, B and C) with applicable MCEA planning schedule, preliminary cost estimate and implementation timeline. The report reflects relevant comments received through the consultation process, from the Town and other stakeholders including key agencies such as MECP and CAs as well as Indigenous Communities.

Since any projects recommended herein may be subject to separate Environmental Assessments in addition to detailed design prior to project implementation, the following elements will be considered at that stage:

- Impacts to source water (Wellhead Protection Areas or Intake Protection Zones)
- Identify and assess any surface water features potentially impacted by the construction of the recommended works and their ecological functions and develop appropriate mitigation measures and monitoring plans to be implemented during and post construction to ensure that the project will achieve a net benefit to the natural environment.
- The expected level of greenhouse gas emissions generated during construction
- Any impacts to air quality and any required dust and noise control measures during constriction
- Mitigation measures required to protect natural heritage, including species at risk (SAR) and local ecosystems, including erosion and sediment control, during construction
- Contaminated and excess soil management
- Potential impacts to archeological resources
- Potential impacts to built heritage resources and cultural heritage landscapes

2. Study Area Characterization

2.1 Geographical Context

The Town of Halton Hills is comprised of several settlement areas of varying size and a substantial rural area. The Study Area shall be the Town of Halton Hills, inclusive of all urban and developed areas serviced by Town-owned stormwater management infrastructure; namely Georgetown, Acton, Glen Williams, and Limehouse, and exclusive of the Premier Gateway area. The Study Area is shown in **Figure 1**. The intent of this study is not to perform an analysis of the larger rural drainage areas, but to focus on the urban centres.

The Study Area includes older areas of Town that were developed prior to the application of the conventional stormwater management practices employed in recent decades. There are newer areas of Halton Hills, along Highway 401 in particular, that were not included in the study area as they were built using more recent stormwater management criteria.

The Town has several significant environmental and topographical features including:

- the Credit River Valley system, including the Georgetown Credit Valley which has been recognized as an Area of Natural and Scientific Interest (ANSI),
- the Niagara Escarpment, including the Bruce Trail system;
- several Environmentally Sensitive Areas, including the Fairy Lake Marsh, Black Creek, Hungry Hollow Ravine, and the Limehouse Cliffs and Woods; and,
- woodland and wetland areas that support diverse wildlife communities.

2.2 Subwatershed Context

The Study Area falls within the Credit River watershed and the Sixteen Mile Creek watershed, both of which outlet to Lake Ontario. The majority of the Study Area, including Acton, Limehouse, Glen Williams, and portions of Georgetown fall within the Credit River watershed (including the Black Creek, Silver Creek and Levi Creek subwatersheds), regulated by the CVC. A portion of Georgetown falls within the Sixteen Mile Creek watershed, regulated by the HRCA. Subwatersheds are shown in **Figure 2**.

Figure 1: Study Area

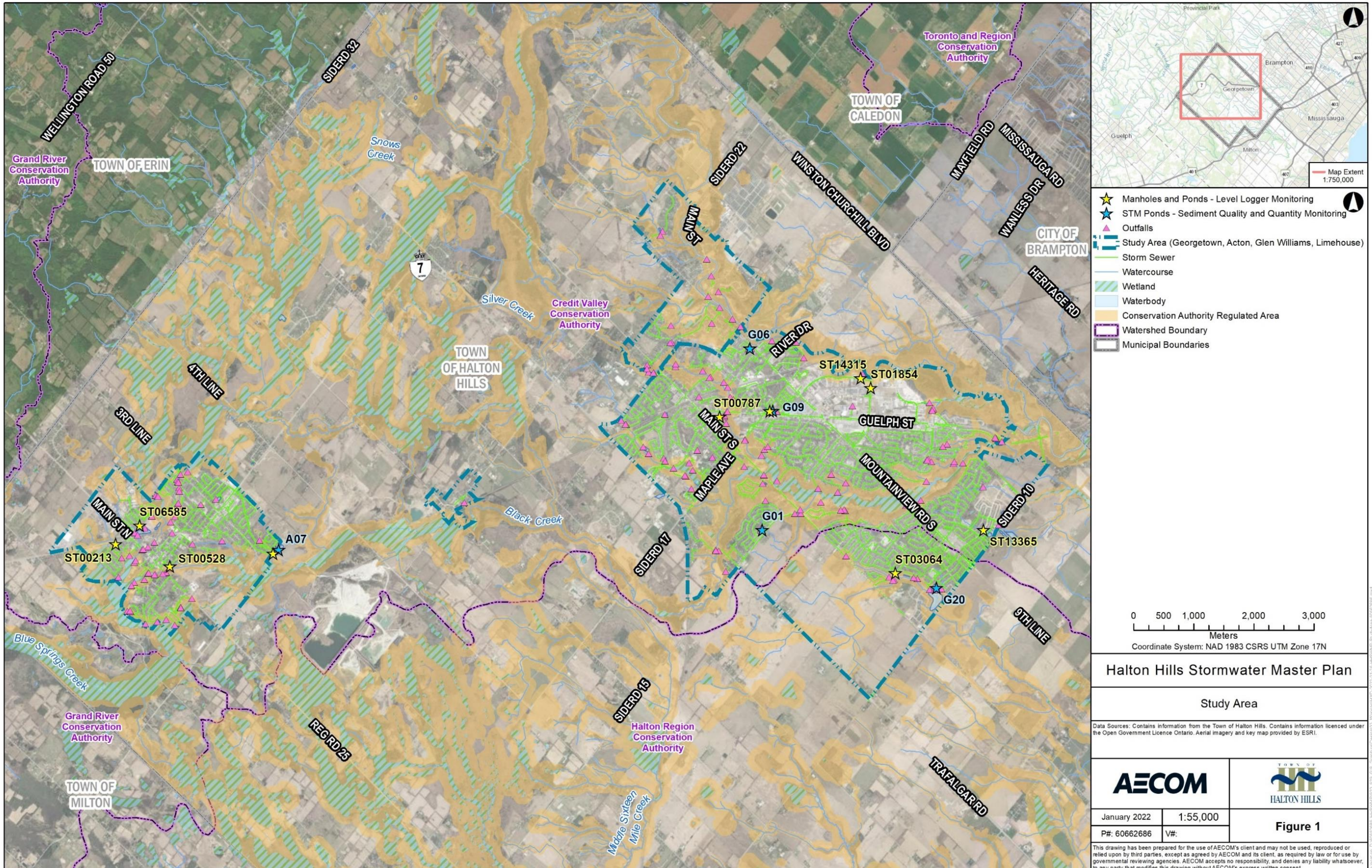
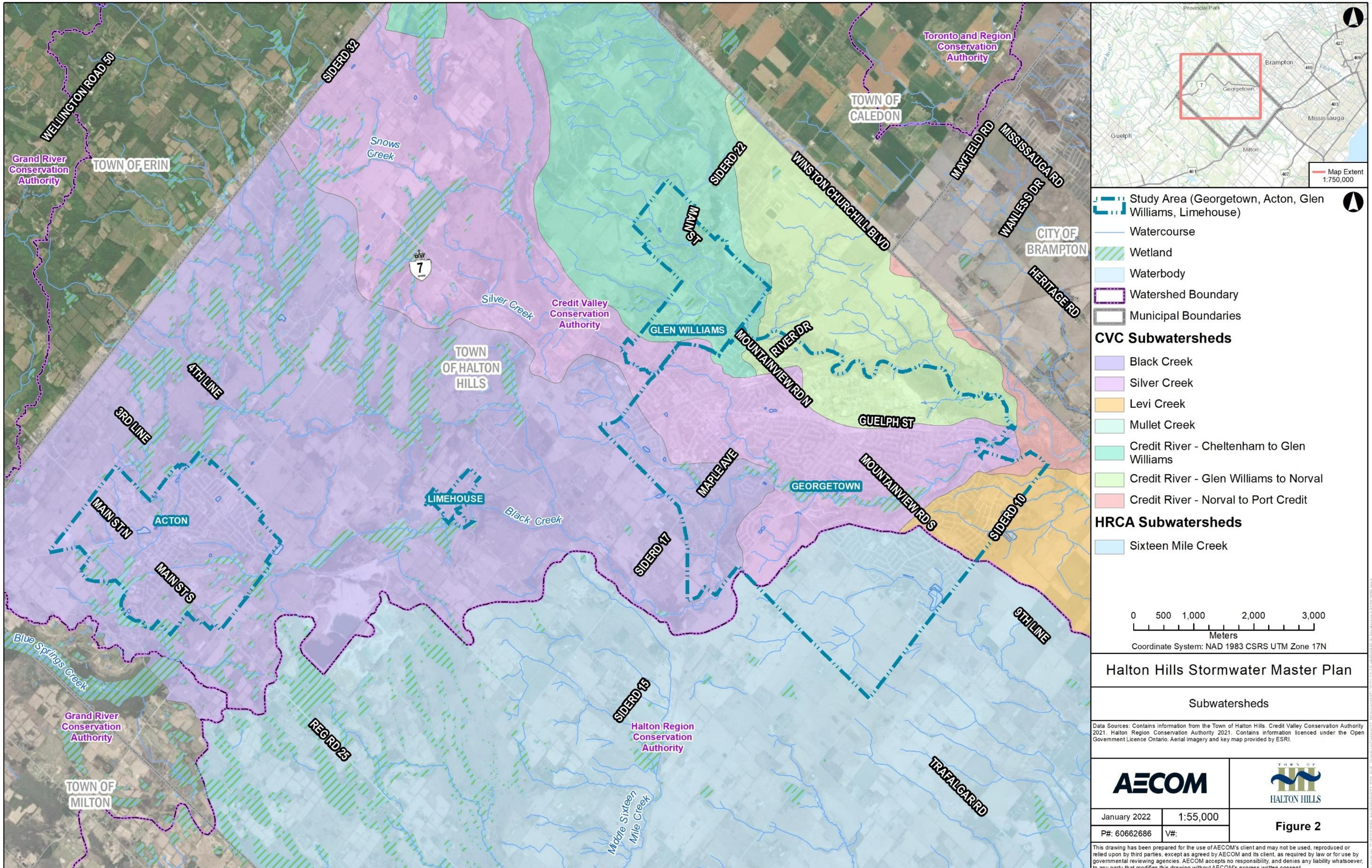


Figure 2: Subwatershed Context of the Study Area



2.3 Review of Background Information

2.3.1 Review of Historical Drainage Problems

Records of historical drainage problems such as basement flooding were provided by the Town, as compiled from the Town's customer service software and Stormwater Master Plan website tool. The records were reviewed and mapped. Records which fall outside of the Study Area were excluded from consideration.

While some flooding concerns relate to maintenance, such as in instances where catch basins may become blocked with leaves, debris, or snow, there were reports of surface flooding, such as in yards, as well as reports of basement flooding. Areas with reported drainage issues were considered during the study. Localized areas with reported drainage problems include, but are not limited to, the following:

- Mill Street East, Acton,
- 22 Side Road, Limehouse,
- Wildwood Road, Glen Williams,
- Bishop Court, Glen Williams,
- Charles Street, Georgetown,
- Delrex Boulevard, Georgetown,
- Eagleview Way, Georgetown,
- Fagan Drive, Georgetown,
- John Street, Georgetown,
- Meadowglen Boulevard, Georgetown,
- Mill Pond Drive, Georgetown, and
- Sinclair Avenue, Georgetown.

2.3.2 Review of Storm Sewer Outfalls

Within the Study Area, there are approximately 340 storm sewer outfalls (see **Figure 1** above) which discharge to watercourses and stormwater management facilities. To support model development, several outfalls (or manholes immediately upstream of outfalls) were monitored for flow (see **Section 2.6.2** below).

2.3.3 Background Data Collection and Data Gaps

AECOM has collected and reviewed all available background information from the Town, Conservation Halton, Credit Valley Conservation, and Halton Region including but not limited to:

- GIS data;
- Stormwater Management (SWM) Reports;
- Environmental Compliance Approvals (ECAs);
- Stormwater Management Strategy (AMEC Foster Wheeler, May 2019);
- Key Climate Indicators Report (Klimaat Consulting & Innovation Inc., November 2018);
- Town of Halton Hills Climate Change Adaptation Plan (Canadian Urban Institute, 2020);
- Halton Hills Climate Change Vulnerability Assessment of Town Infrastructure (Mott Macdonald, February 2021); and
- Corporate Asset Management Program, State of Infrastructure Report (Halton Hills, 2018).

2.4 Linear Stormwater Infrastructure Assessment

2.4.1 Linear Storm Infrastructure Condition Assessment (Zoom Inspections)

As part of the SWMP, linear stormwater infrastructure was inspected. The intent of the analytical services was to assess the condition and rationalize rehabilitation requirements of the 95 km of storm sewers screened using zoom camera techniques, which involve a preliminary, rapid assessment completed from within the manhole only. Data analysis involved the targeted review of all zoom videos provided by AquaTech. Inspections were imported into InfoAsset Manager and those with a calculated Internal Condition Grade (ICG) of one or two received a cursory review to verify the absence of defects and to confirm no significant impact on structural performance. Structural Performance Grades (SPGs) were assigned to match the ICG, except where the observed condition warranted a more detailed review. Each defect captured needs to be categorized and evaluated further to determine if it could have an impact on issues such as overall condition and infiltration rates of groundwater into the main. Sewers with an ICG of five have been reviewed to assess the need for immediate attention through the Emergency Repair program. Those not requiring immediate attention were assessed along with sewers with ICGs of three or four. Supplementary criteria were also considered when assigning the SPG, such as, soil type, frequency of surcharging, past maintenance history, method of construction (tunnel or open cut), implications of live load, evidence of accelerated deterioration and other unique features.

The detailed Zoom Inspection Condition Assessment Report and PACP Inspection Reports are included in Appendix A.

2.4.2 Culvert Inspections

AECOM completed inspections for 82 culverts within the Study Area. Two additional culverts - AECOM IDs #12 and #13 - were within a construction zone on 22-Side Road, east of Elizabeth Street and hence were not visited by field staff. In addition to a PACP code, a service grade and structural grade, the inspections summarize observations such as depth of sediment and depth of standing water, an overview of the condition (poor, good or excellent) and observations related to vegetation, erosion, rusting of CSP culverts etc. Ultimately, a recommendation is given whether the culvert is ok, needs cleaning, needs lining or needs replacing. **Table 1** below provides a summary. The inspection report summary table for the remaining 82 culverts can be found in Appendix B.

Table 1: Culvert Inspections Results

Recommendation	Quantity
Ok	45
Needs Cleaning	19
Needs Lining	2
Needs Replacing	6
Inconclusive	10

2.5 Bathymetric Surveys and Sediment Testing

2.5.1 SWMF Bathymetric Survey

Bathymetric surveys were completed at six Town-owned stormwater management facilities (SWMFs). The purpose of the surveys was to provide estimates of sediment volumes. The survey included bathymetric surveys completed using a Trimble RTK GPS unit, which was used to capture the top of sediment and the pond bottom topography at a minimum 5 m grid. Top of sediment was measured by advancing a survey rod through the water column until the point of resistance, indicating sediment. At each point the elevation was recorded using the Trimble RTK GPS. Sediment and bottom surfaces for the ponds were processed using AutoCAD Civil3D to create appropriate topographic surfaces for evaluation. The surfaces were then used to estimate the quantity of sediment accumulated within each pond. Results of the field collected data and analyzed surfaces (using Civil 3D) are summarized in **Table 2** below. More details on the sediment survey methodology and results can be found in Appendix C.

Table 2: 2021 Sediment Survey Results

Pond #	Pond ID	Pond Name	Type	Forebay Permanent Pool Volume (m^3)	Forebay Sed. Volume (m^3)	Main Cell Permanent Pool Volume (m3)	Main Cell Sed. Volume (m3)	Percent Full	Percent Full Forebay	Percent Full Main Cell
1	A7	Acton East Phase 3	Wet	N/A	N/A	4,273.2	1,537.2	36%	N/A	36%
2	G1	Fernbrook,	Wet	1,899.4	724.1	2,923.0	1,153.2	39%	38%	39%
3	G6	Meadowglen	Wet	N/A	N/A	1,032.0	571.3	55%	N/A	55%
4	G9	Parallax – Dominion Gardens	Wet	1,765.4	675.9	3,479.7	340.4	19%	38%	10%
5	R1	Deer Run Crescent – Williams	Wet	N/A	N/A	2,202.5	1,353.8	61%	N/A	61%
6	G20	Fernbrook Mountainview	Wet	4,417.0	1,560.5	2,895.8	770.0	32%	35%	27%

2.5.2 SWMF Sediment Quality Testing and Preliminary Characterization

AECOM collected sediment samples from the seven surveyed stormwater management facilities (SWMFs) to provide the Town with a preliminary assessment of the quality of the sediment and to characterize its suitability for reuse or disposal. Sediment samples were collected during the completion of the SWMF bathymetric surveys for facilities G01, G06 A07, R16, G09, G20 and R01.

Three sediment samples were collected from each facility, with each sample in turn being comprised of a composite of three area-specific sub-samples. The three area-specific composite samples from each SWMF included one from the forebay/inlet area, one from the main cell area and one from the outlet area. The sediment samples were submitted for the following analyses:

- Grain size analysis;
- Moisture Content;
- pH;
- Conductivity;
- Sodium Absorption Ratio (SAR);
- Cyanide;
- Metals and Organic / Inorganic Carbon;
- Volatile Organic Compounds (VOCs);
- Petroleum Hydrocarbons (in the range of F1 to F4), as well as BTEX;
- Polycyclic Aromatic Hydrocarbons (PAHs);
- Semi-Volatile Organics;
- Organochlorinated Pesticides (OCPs) and total PCBs;
- Toxicity Characteristic Leaching Procedure (TCLP).

These analyses have been selected based on the requirements noted in the RFP. Furthermore, this testing was completed before O.Reg. 406 was being implemented. As such, the sediment samples were compared to Ontario Regulation No. 153/04 soil standards. Table 2 of Ontario Regulation No. 153/04 may be applied to any reuse site and any volume of sediment and is considered to be the appropriate comparison when reuse/disposal locations have not been identified in advance. Table 2 lists generic site condition standards for soil and considers potable groundwater conditions. Within the Standards the values are listed according to land use category (agricultural or other, residential/parkland/institutional, industrial /commercial).

In the case that the minimum soil standards cannot be met, and the sediment is not considered appropriate for beneficial reuse, Toxicity Characteristic Leaching Procedure (TCLP) testing has been conducted in accordance with O.Reg. 347/90 to determine whether the sediment would require specialized disposal (e.g., disposal within a lined landfill facility), or if the material may be considered fit for disposal at a traditional licenced landfill. TCLP testing is designed to characterize material based on its ability to leach in a simulated landfill solution. TCLP analysis was completed for one sample (Main cell) from each SWM facility, identified by the "M" suffix in the sample code. TCLP testing was completed for all ponds, except for Ponds A07 and G20.

Based on the initial sediment analyses and leachate testing results as they compare to Ontario Regulation No. 153/04 standards, re-use of the material from any of the seven ponds does not appear to be feasible at this time. However, initial sample results did not exceed the Toxicity Characteristic Leaching Procedure (TCLP) as outlined in Ontario Regulation 347/90, and this indicates that the material does not require disposal at a hazardous waste facility. Further testing of the dewatered sediment in accordance with the newly implemented O. Reg. 406/19 – including modified Synthetic Leachate Testing Procedure (mSPLP) testing – will be required prior to sediment removal activities in order to confirm whether or not the sediment meets the quality limits prescribed by the Regulations.

Detailed sediment survey and testing data are provided in Appendix C.

2.5.3 OGS Sediment Quality Test

The purpose of an OGS unit is to treat stormwater by settling sediment and particulate matter, screening debris, and separating free surface oils from stormwater runoff. The Town requested that AECOM utilize scheduled OGS maintenance work as an opportunity to sample the sediment to obtain a general understanding of the OGS unit sediment composition and assess if the findings could benefit the applicable Fairy Lake Water Quality Study that the Town was undertaking. Sediment within the OGS units is ultimately representative of sediment that was removed from road runoff and not necessarily indicative of what is being washed off of urban surfaces. As such, analysis of OGS sediment quality is not a conventional approach to assessing water quality concerns within a downstream waterbody like Fairy Lake, which is located in Action, Halton Hills and has numerous outfalls located around its perimeter. However, due to the incomplete removal performance of OGS units, it is not unreasonable to assume that there is some degree of similarity between the quality of sediment removed by an OGS unit and that which eludes capture within the device.

Sediment samples were collected by AECOM and Halton Hills representatives between August 22 and August 26, 2022. Six samples were obtained; one sample from each of the following OGS units, as identified by Halton Hills, in **Table 3**, below:

Table 3: Sampled OGS Unit Information

OGS I.D.	Nearest Location or Street to Sampled OGS	Location Description	Location Co-ordinates
OGS3	Acton Blvd	Acton Blvd by #142	Lat: 43.64123° N Lon: 80.03727° W
OGS12	Fairy Lake	Fairy Lake – End Tyler Avenue at Fairy Lake	Lat: 43.63054° N Lon: 80.04854° W
OGS13	Fairy Lake	Fairy Lake – End of Elmore Drive at Fairy Lake	Lat: 43.62766° N Lon: 80.04946° W
OGS28	MacDonald Blvd	between Acton Blvds - near #128 Acton Blvd	Lat: 43.64089° N Lon: 80.03639° W
OGS29	Bovis Park	Off Division Street in Bovis Park	Lat: 43.63666° N Lon: 80.03725° W
OGS30	Halton Hills Public Library Acton Library	17 River Street, Acton - located in staff parking lot off School Lane	Lat: 43.63220° N Lon: 80.04391° W

The sediment samples were submitted for the following analyses, selected by the Town:

- Particle size distribution (full spectrum desirable, if not, then % Grain size <0.75 millimetres) - Full Hydrometer; Particle size <0.75 millimetres
- Total phosphorus
- Total nitrogen (TKN)
- Metals (Mg, Al, Cd, Cu, Fe, Pb, Ni, and Zn)
- Chloride
- Specific conductivity
- Oil and grease
- SAR

Sediment quality results were compared against O.Reg. 406/19 Table 1 values, the Canadian Council of Ministers of the Environment (CCME) Sediment Quality Guidelines for the Protection of Aquatic Life Freshwater and Marine ISQG/PEL and the Provincial Sediment Quality Guidelines (PSQGs). A summary of the results can be found in Appendix D. The key findings are as follows:

- OGS 28, 29, and 30 appear to have higher heavy metal and soluble salt concentrations, as well as higher EC and SAR values than OGS 3, 12, and 13.
- OGS 28, 29, and 30 reported EC values above 2.0 mS/cm, suggesting that the sediment within the units was somewhat saline. This determination is consistent with the high concentration of calcium, magnesium, and soluble sodium ion content within sediments collected from these units.

- Sediment samples from OGS units 28, 29, and 30 all exhibited SAR levels above 13. As such, the sediment is considered to be sodic.
- Based on the observed sediment Particle Size Distribution (PSD) data, five of six of the sampled OGS units have a relatively coarse sediment classification. It is possible that the absence of fine sediments means that none are present in the raw road runoff; however, it is likely that most of the fine sediments are bypassing the OGS units and entering Fairy Lake. This is problematic since it is the fine sediments which tend to consist of the highest concentrations of contaminants of emerging concern (CEC), as fine sediments are often associated with the bulk of sediment-bound nutrient and metal transport.
  - Therefore, it is likely that an appreciable fraction of the total copper, zinc, phosphorus and lead (among other metals) are passing through the OGS units and washing into Fairy Lake, as evidenced by the elevated concentrations of these parameters in the sampled sediment, and by the relative absence of fine sediments from the PSD results.
- Direct sampling of Lake sediment and water quality is recommended in order to assess whether the OGS sediment sample results are reflective of the quality of water which is ultimately discharged to Fairy Lake.
- Salt mitigation strategies and a regular program of street sweeping should be implemented by the Town, particularly in the areas of land which drain to Fairy Lake, as evident by the sediment results.
- It is important to determine if businesses that discharge “subject contaminants” have implemented and are following a Pollution Prevention (P2) Plan.

2.6 Stormwater Monitoring

2.6.1 Flow and Precipitation Monitoring

To understand existing conditions flow within the storm network, and to facilitate model development and calibration, level loggers were installed on Sept 16, 2021 at 10 locations as shown on **Figure 3** and **Figure 4**. Flow monitoring of the storm system was carried out from September 2021 to November 2022. Locations included a combination of storm manholes and SWMFs, and are denoted by the following locational IDs:

- ST00213 (between Guelph Street and Elmore Drive);
- ST06585 (on Dairy Drive, upstream of a storm outfall);
- ST00528 (intersection of Agnes Street and Willow Street South);
- A07 (inlet of Pond A07, near Third Line and Rachlin Drive);

- ST00787 (on Park Avenue between Guelph Street and Mill Street);
- G09 (inlet of Pond G09, near intersection of Guelph Street and Maple Avenue);
- ST14315 (on Armstrong Avenue);
- ST01854 (on Sinclair Avenue, between Todd Road and Armstrong Avenue);
- ST03064 (near intersection of Argyll Road and Huffman Drive); and
- ST13023 (Danby Road Between Hartwell Road and Barber Drive).

Figure 3: Monitoring Locations – Acton

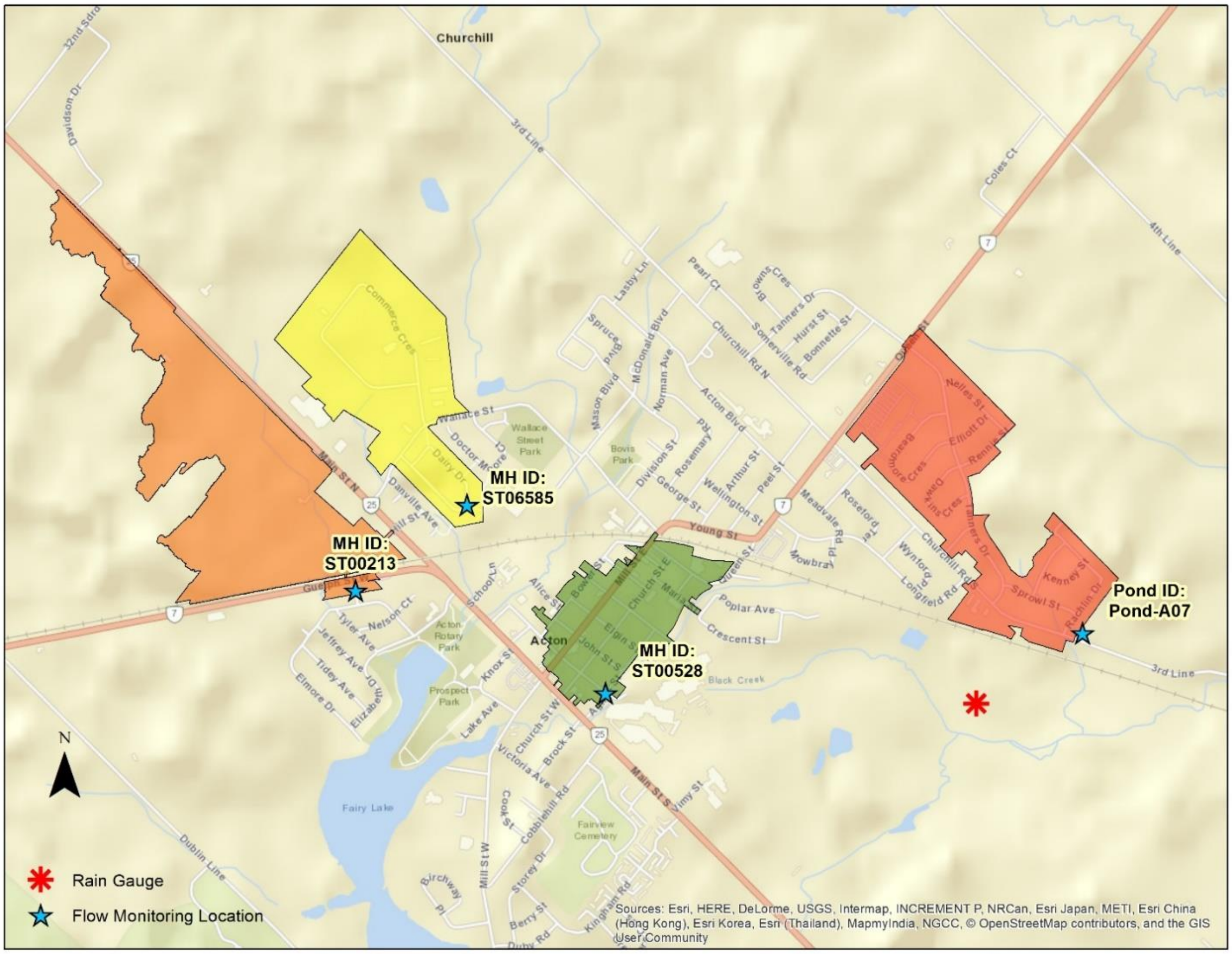
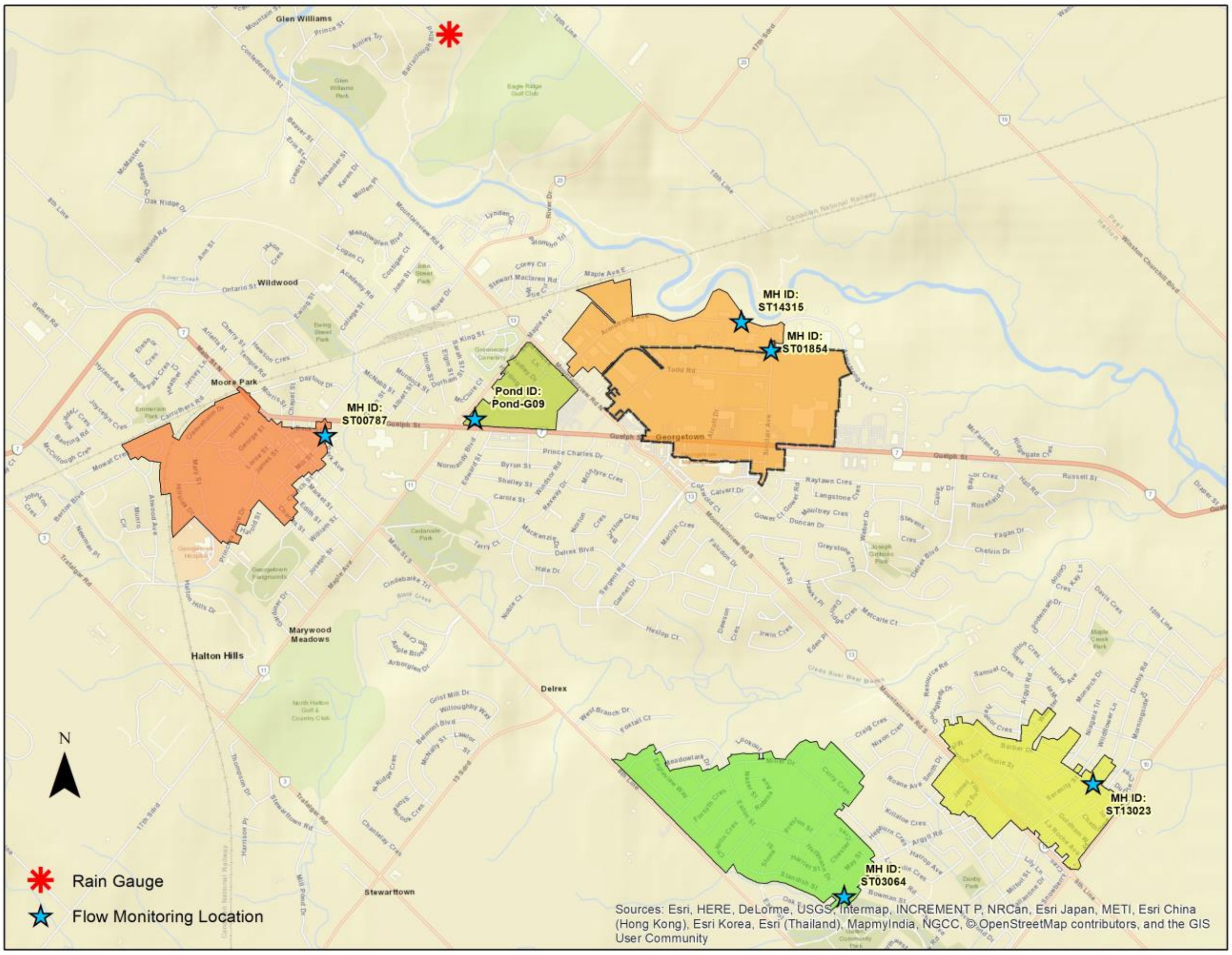


Figure 4: Monitoring Locations – Georgetown



Monitored water level information was collected and used in conjunction with known pipe geometry and hydraulic grade line (HGL) information in order to compute flows at the locations noted. This information was used in conjunction with the available rainfall information to support model calibration and refinement.

Precipitation monitoring data was provided by Credit Valley Conservation Authority, covering the duration of the flow monitoring period (from September 2021 to November 2022). Storm events with a minimum total depth of 10 mm, and an inter-event period of 12 hours or greater were identified. Eighteen rainfall events were recorded over the monitoring period. The recorded rainfall events are summarized in **Table 4.**

Table 4: Summary of Rainfall Events

Event	Total Accumulation (mm) Acton WWTP	Total Accumulation (mm) Meadows	15 min-Maximum Rainfall Intensity (mm/hr) Acton WWTP	15 min-Maximum Rainfall Intensity (mm/hr) Meadows	Comments
10/3/2021	22.0	14.8	8.8	5.6	Marginal, variable, and very low intensity
10/9/2021	23.8	22.2	11.2	15.2	Marginal, very low intensities and low flows
10/15/2021	13.2	13.2	8.0	11.2	Marginal, low volume and very low intensities
10/25/2021	28.6	29.8	4.0	4.0	Unsuitable event, drizzle all day
10/29/2021	29.4	29.0	4.0	4.0	Unsuitable event, drizzle all day
12/5/2021	24.6	31.6	46.4	14.4	Snowmelt
12/11/2021	18.2	21.0	12.8	16.0	Snowmelt
3/23/2022	23.6	29.0	12.0	12.0	Snowmelt
5/3/2022	22.4	24.2	5.6	4.8	Unsuitable event, drizzle all day
5/16/2022	8.2	7.2	16.8	12.0	Marginal, very low total volume
5/21/2022	9.0	12.6	21.6	47.2	Extremely variable storm
6/6/2022	24.4	27.6	8.0	8.8	Marginal, very low intensity
7/5/2022	10.8	10.4	9.6	9.6	Marginal, low volume and very low intensities
8/4/2022	3.0	22.6	9.6	51.2	Extremely variable storm
8/21/2022	7.8	36.0	4.8	31.2	Extremely variable storm
8/25/2022	48.0	20.0	43.2	20.0	Extremely variable storm
9/12/2022	10.2	11.6	10.4	20.8	Unsuitable event, drizzle all day
10/13/2022	27.6	16.2	22.4	7.2	Variable storm, rainfall pattern does not follow runoff pattern

2.6.2 Stormwater Quality Monitoring

Concurrent to the in-pipe flow monitoring described above, AECOM also collected water quality grab samples at the inlet locations of five separate SWMFs: A07, R01, G01, G06 and G09. In accordance with the terms of reference, AECOM collected two dry weather and three wet weather grab samples; for all samples, laboratory analysis was done for total suspended solids (TSS), turbidity and chloride and field measurements for temperature, pH, conductivity and dissolved oxygen (DO) were completed using a ProPlus YSI 9500. The following is a summary of the findings. See Appendix E for the detailed results.

- An exceedance in TSS was observed on one instance (Pond R01) during dry-weather sampling, however TSS exceedances of the PWQO were observed at all five sampled inlets during the February 11, 2022, rain-on-snow / wet weather sampling event.
  - Outlet monitoring is recommended to determine if each pond is providing a tangible water quality benefit, with particular emphasis on the SWM ponds with high observed sediment accumulation as well as elevated inlet TSS concentrations.
- Chloride exceedances above both the short- and long-term CCME Guideline occurred in each pond across multiple sampling events. Chloride – likely derived from de-icing salts - is a common pollutant associated with winter road maintenance, and it is expected that such salts are widely used in the upstream urbanized lands during the winter months. Thus, the development of a salt management plans is recommended to control runoff chloride concentrations “at-source”.
  - Elevated conductivity readings also suggest that there is a high dissolved salt content within each watercourse.
- pH did not fall outside of the PWQO / range at any of the Town’s ponds for any of the five sample events that occurred between November 2021 and March 2022. Since a decrease in pH was observed later into the spring months, additional targeted spring sampling is recommended in order to assess the degree of depression in freshet pH due to salt wash off.
- In general, it appears that while exceedances in TSS were observed at inlets of ponds A07, G01, G06 and G09, the inlet water quality is generally typical of corresponding land uses when compared to reported values in the NSQD. Thus, the exceedances that have been identified to date are likely attributable to typical upstream residential and commercial activities that may impact water quality (i.e., traffic, winter road maintenance operations, etc.). It should

be noted that since no outlet sampling was completed as part of the scope of work for this Project, it cannot be determined whether or not the elevated TSS concentrations persist at the facility outlets. High sediment volumes in each pond, however, may be contributing to reduced TSS removal efficiency between inlet and outlet locations of each pond. Outlet monitoring is recommended to determine if each pond is performing as expected, particularly due to observed high sediment accumulation as well as elevated TSS concentrations that have been observed at the pond inlets.

- If there are elevated TSS loadings at pond outlets or since sediment accumulation as observed to be high, standard water quality treatment BMPs – including Low Impact Development (LID) – should be considered in targeted catchment areas where a water quality improvement is sought. This could include at source-control measures like catch basin pre-treatment devices, oil-grit separator units, rain gardens or pocket bioretention features, in addition to treatment conveyance measures like bioswales or vegetated filter strips.

3. Analysis and Assessment of Existing Stormwater Management System

3.1 Hydrologic and Hydraulic Modelling

Detailed hydrodynamic assessments of the existing drainage system were undertaken by modelling the storm sewer and overland drainage system within the study area. The model was developed using PCSWMM.

The existing sewer networks were built utilizing the sewer network databases provided by the Town. A data-gap analysis and rectification procedure were undertaken to fill and rectify data through a series of inferred assumptions and engineering judgements. The developed model was fully calibrated and validated against flow monitoring data. Then the calibrated model was used to assess the existing condition of the storm sewer system within the study area.

3.1.1 Model Development

The model set up is based on dual micro-drainage modelling completed using PCSWMM software. The dual micro-drainage modelling approach is the most precise, physically based method for evaluating drainage systems in urban areas. Dual drainage represents the surface (major) and underground (minor) flow systems as an interconnected network.

In general, the overall drainage system is divided into minor (storm sewer) and major (overland) networks. To account for flows within each system type, the subcatchments were discretized from maintenance hole to maintenance hole. The key to successful dual drainage system modelling is to have an accurate representation of the major overland flow system, and to capture the correct amount of flow entering into the minor system through catchbasin capture capacity. The details of the dual drainage model set up are provided in Appendix F.

3.2 IDF Curve Update

Before this study, the IDF curve used for stormwater design was established in 1988. As part of this assignment AECOM completed a rainfall analysis and IDF curve update to ensure that the study recommendations are based on the most current design rainfall estimates. While it was found that the existing 2 – 25 storm IDF curves were more conservative than the updated values, there was a shortcoming between the current and updated IDF curves for the 50 and 100 year events. Further study and analysis of the impacts and the development of a transition plan is required before implementing these updates. Appendix G summarizes rainfall data collection, rainfall and IDF curve analysis, and the associated findings.

3.3 Assessment of Existing System

The calibrated model was run to simulate the 2-year through 100-year storm events, and to identify areas with SWM system capacity deficiencies such as surcharged nodes, and pipes under capacity. The storm events were developed based on updated IDF values provided in **Table 5** below and in Appendix G.

The existing sewer system performance was assessed using the following criteria:

- The peak flow in the system shall not be more than capacity flow, and
- HGL in the storm sewer MH shall not be less than 1.8 m below the surface elevation, which coincides with the assumed basement elevation for homes with direct basement connections to the storm sewer.

3.3.1 Minor System Storm Sewer Network

3.3.1.1 Pipe Capacity

Figure 5, Figure 6 and **Figure 7** below show minor system capacity deficiency locations for the 5-year design storm event (the current design level of service requirement). Results of the capacity assessment for all other storm events can be found in Appendix F.

As presented in **Table 6** below, approximately 24% of the pipes surcharge during 100-year design storm, and 11% of storm pipes surcharge (see **Table 7**) during the 5-year design storm (level of service).

Under existing conditions the majority of the storm pipes can convey 5-year design storm flows without surcharging but 11% (398 out of 3,543) of all storm sewer pipes across Acton, Georgetown and Limehouse have capacities which are less than the corresponding 5-year storm flows to those locations.

Table 5: Recommended IDF Curve Data Points –Updated Pearson (1950-2020) – mm/hr

Storm Return Period	Rainfall Intensity – mm/hr 5 min	Rainfall Intensity – mm/hr 10 min	Rainfall Intensity – mm/hr 15 min	Rainfall Intensity – mm/hr 30 min	Rainfall Intensity – mm/hr 60 min	Rainfall Intensity- mm/hr 120 min	Rainfall Intensity – mm/hr 360 min	Rainfall Intensity – mm/hr 720 min	Rainfall Intensity – mm/hr 1440 min
2-yr	101	74	61.3	40	23	13.1	5.6	3.2	1.8
5-yr	134.6	99.2	82.1	55.2	32.2	18.6	7.9	4.4	2.5
10-yr	156	114.9	95	64.8	38.4	22.7	9.8	5.5	3.1
25-yr	176	129.3	106.7	73.7	44.4	27	11.9	6.7	3.7
50-yr	201.4	147.1	121	84.7	52.3	33.1	15.1	8.6	4.8
100-yr	220.1	160	131.4	92.7	58.3	38.1	18	10.4	5.8

Table 6: Minor System Performance for Design Storms – Existing Condition

	Return Period 2 year	Return Period 5 year	Return Period 10 year	Return Period 25 year	Return Period 50 year	Return Period 100 year
Total Surcharged Pipes (%) i.e. Peak Flow > Pipe Capacity	8%	11%	16%	18%	21%	24%
Nodes for Surcharged Pipes with HGL < 1.8 m Below Surface (%)	2%	3%	4%	5%	7%	9%

Table 7: Pipe Capacity Assessment – 5-Year Design Storm

Scenario	Description	Number of Pipes
Existing Condition	Q Peak/Q Capacity >100%	398
Existing Condition	% of Total Sewers	11%

Figure 5: Existing Storm Sewer Performance 5-year Design Storm – Acton

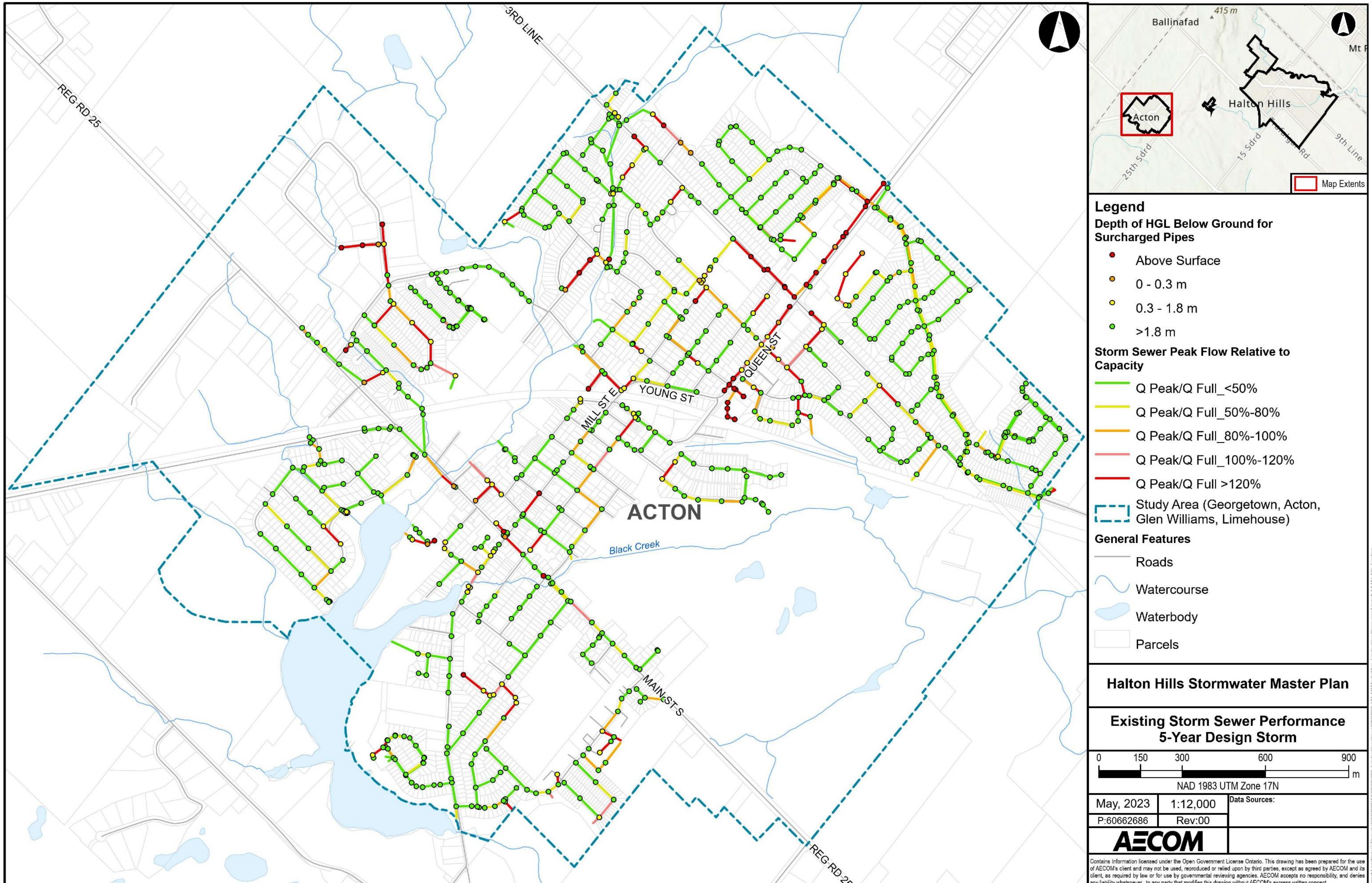


Figure 6: Existing Storm Sewer Performance 5-year Design Storm – Limehouse

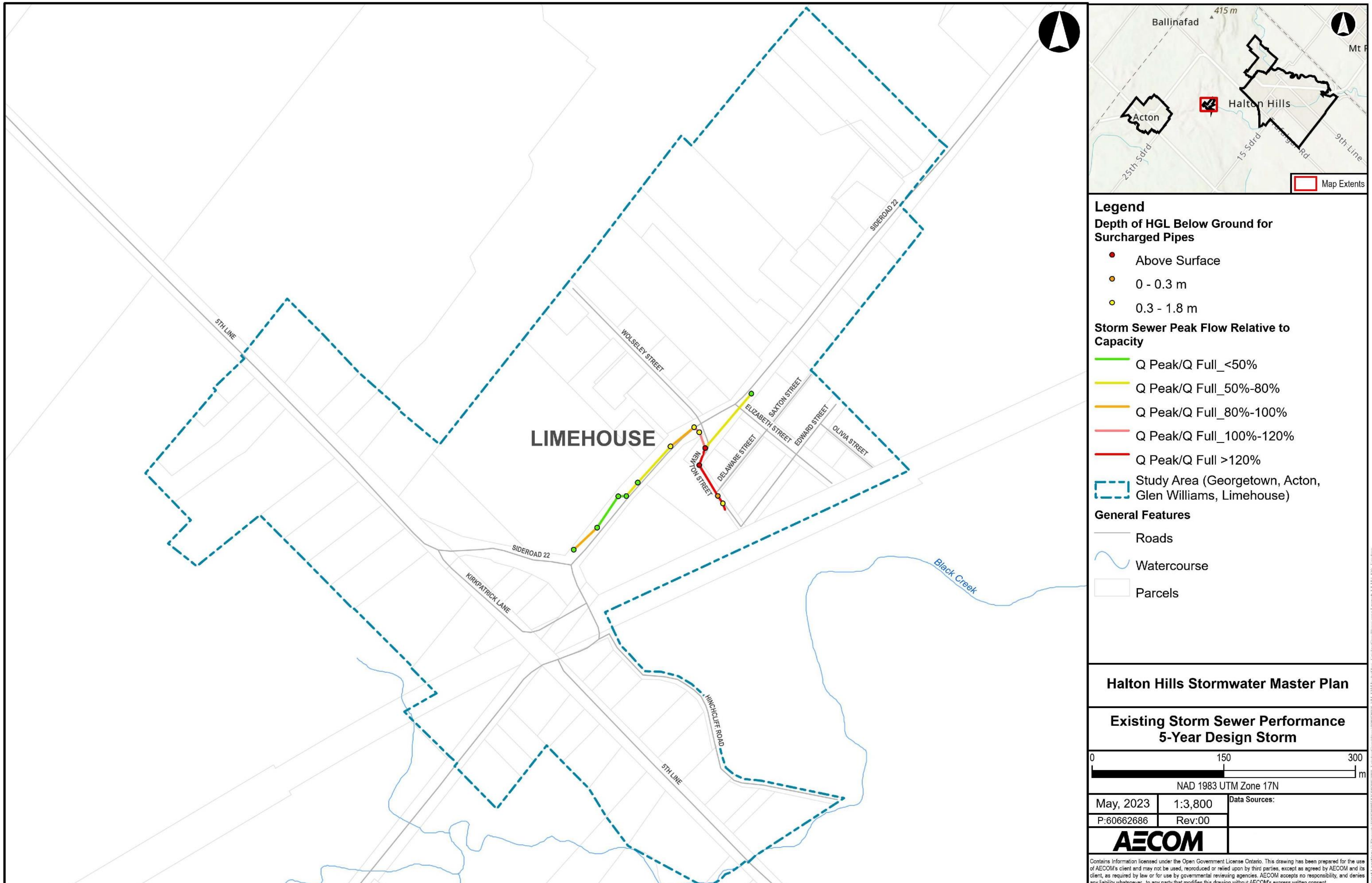
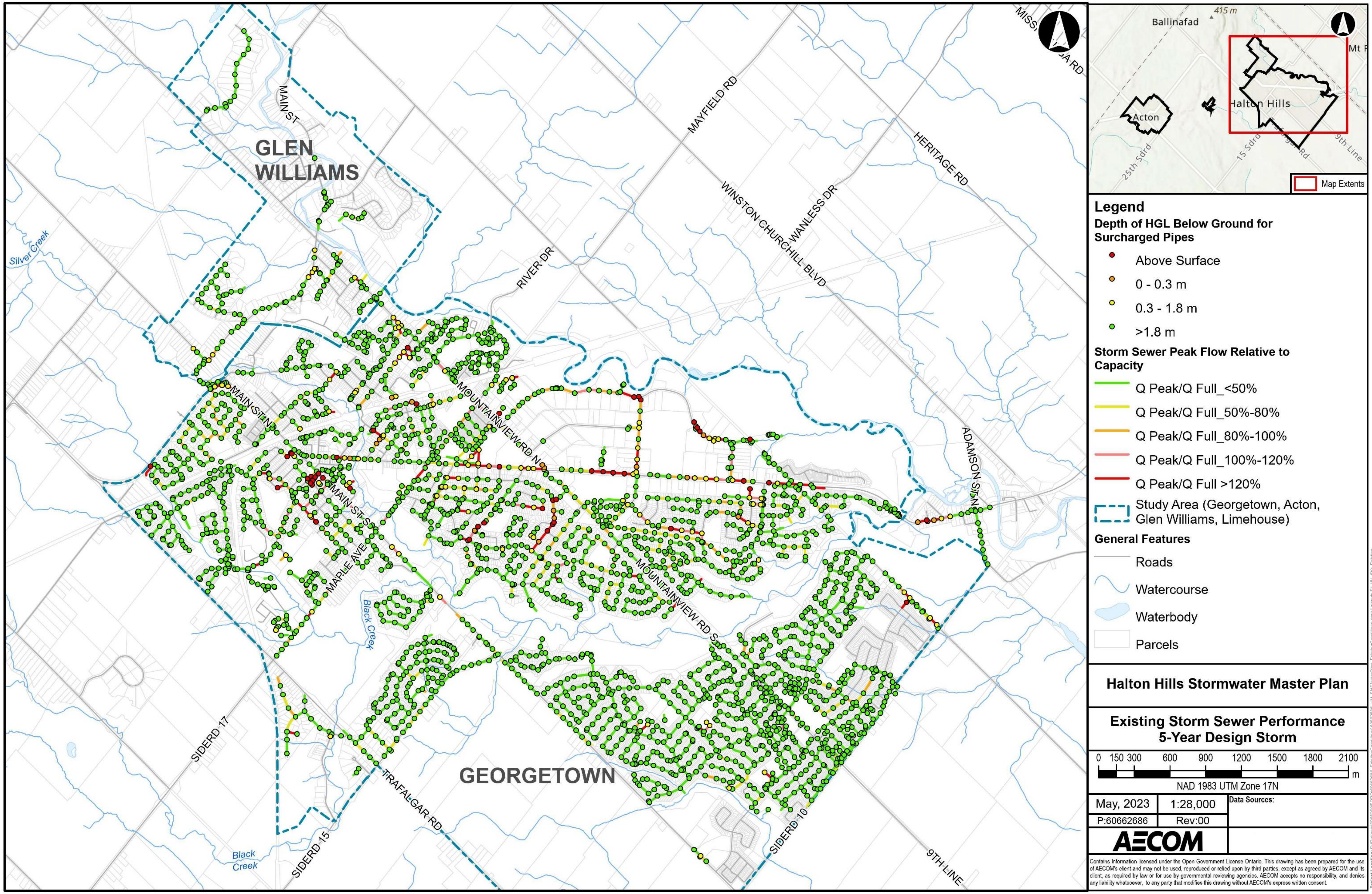


Figure 7: Existing Storm Sewer Performance 5-year Design Storm – Georgetown



3.3.1.2 Surcharging Manholes

Those pipes that did experience surcharging during the 5-year design storm were further assessed using the hydraulic grade line to determine level of surcharging according to the following criteria:

- Hydraulic grade line (HGL) under surcharged conditions shall not be less than 1.8 m below the surface elevation, which coincides with the assumed basement elevation for homes with direct basement connections to the storm sewer.

Table 8 below shows results of the basement flooding risk assessment for existing minor system under the 5-year storm.

Table 8: Summary of Basement Flooding Potential Risk Assessment, 5-Year Design Storm

Scenario	Description	Number of MHs
Existing Condition	HGL Depth < 1.8 metres, connected to under-capacity sewer	343
Existing Condition	% of Total MHs	10%

There were 1,023 MHs identified where the HGL was less than 1.8 m away from the local ground surface but only 343 MHs were connected to under-capacity sewer segments. As presented in **Table 8,** under existing conditions for the level of service, 343 out of 3,452 MHs (approximately 10%) may pose potential basement flooding risk due to apparent HGL depth to surface and connection to under-capacity sewers. This should be reviewed in greater detail on a site-specific basis to confirm the level of risk.

Table 9 below further categorized the 343 MHs identified in **Table 8** into three subcategories based on how close the HGL elevation is to the surface.

Table 9: Existing Condition HGL Depth to Surface Categories

Category	Number of MHs
Above Surface	94
HGL Depth 0-0.3 m	31
HGL Depth 0.3-1.8 m	218

Figure 8, **Figure 9** and **Figure 10** below show the locations of the three categories of potential basement flooding locations within the minor system for the 5-year design storm event (design level of service requirement). Results of the capacity assessment for all other storm events can be found in Appendix F.

Figure 8: Potential Risk of Basement Flooding – Minor System 5-year Design Storm Event – Acton

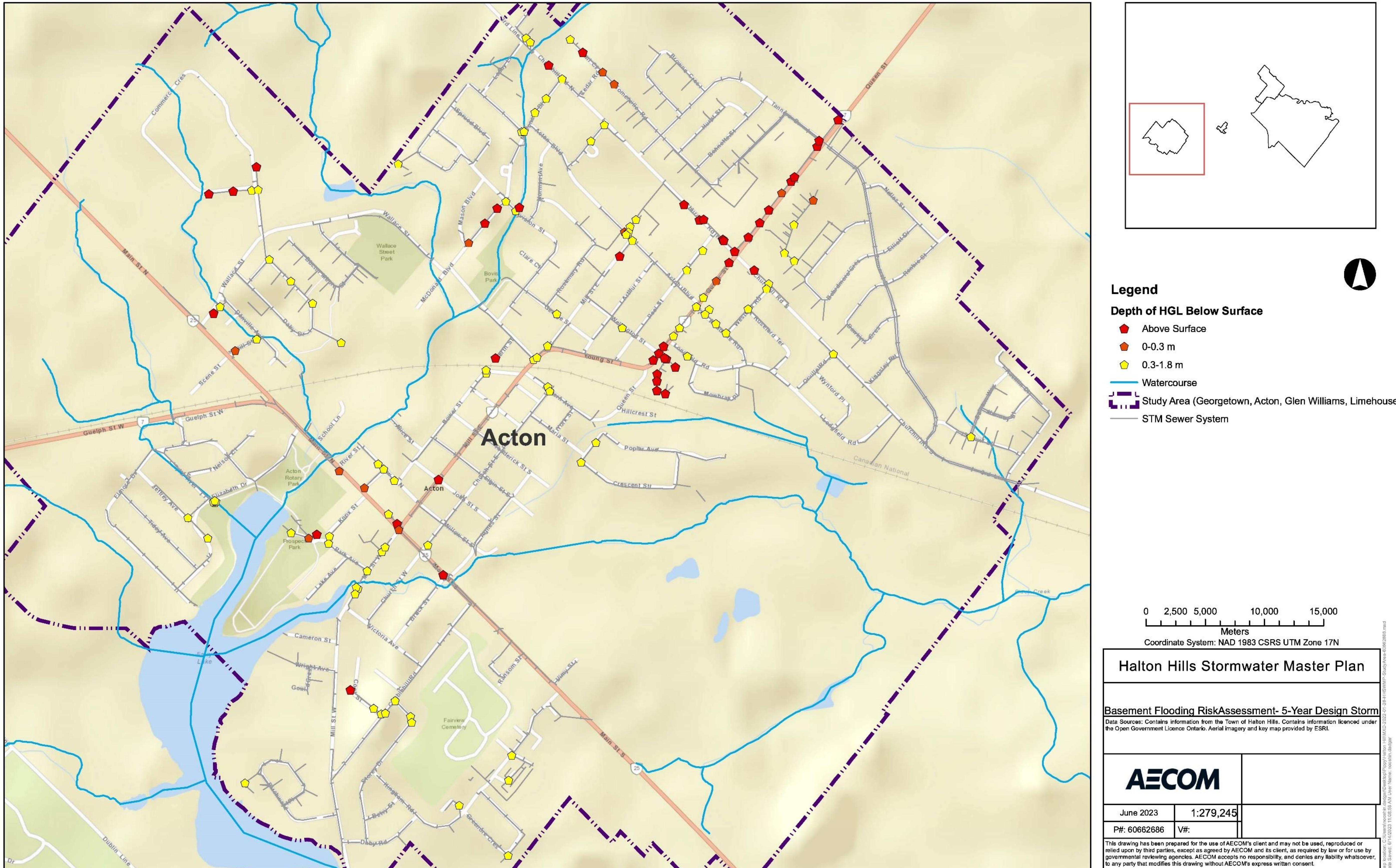


Figure 9: Potential Risk of Basement Flooding – Minor System 5-year Design Storm Event – Limehouse

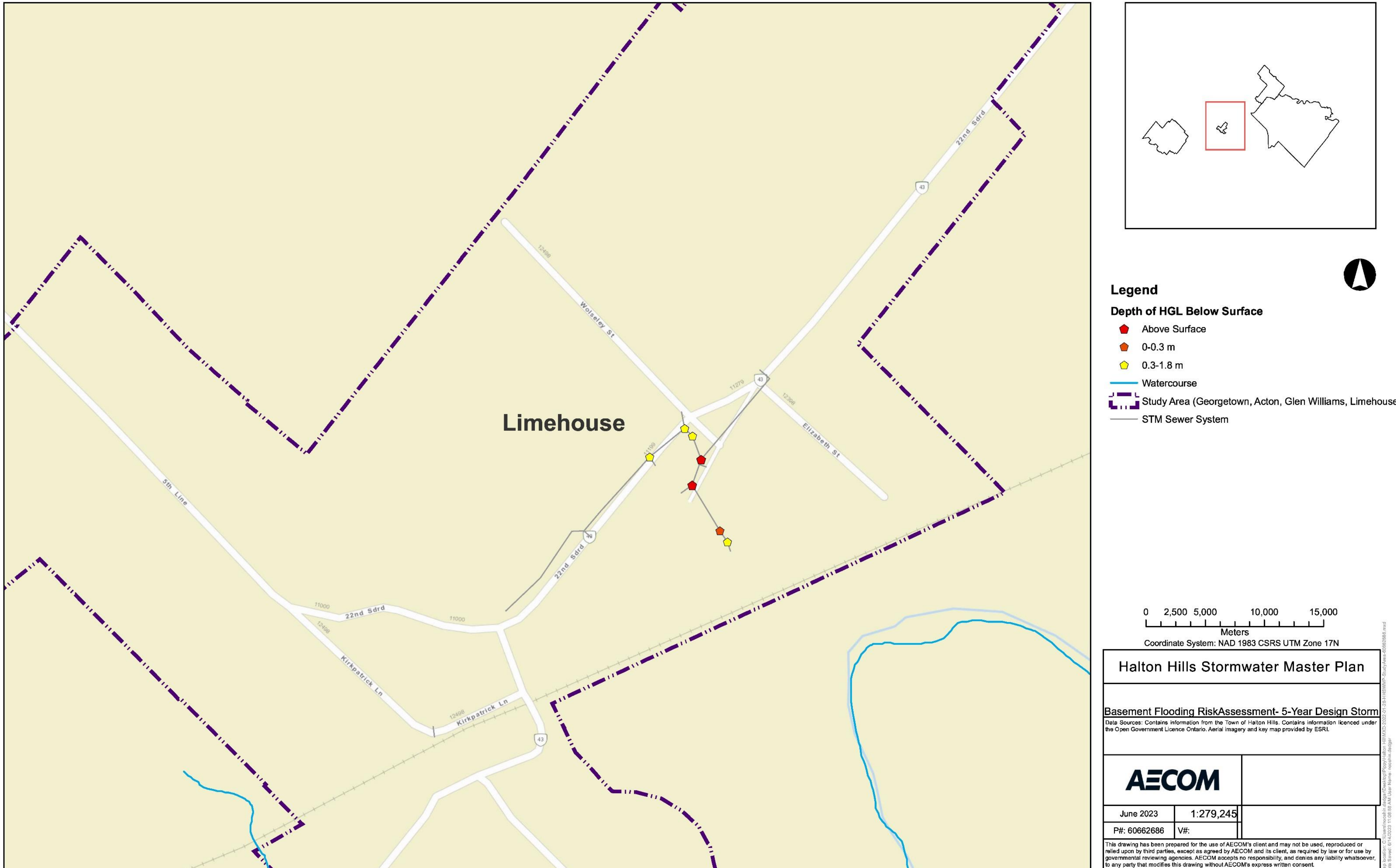
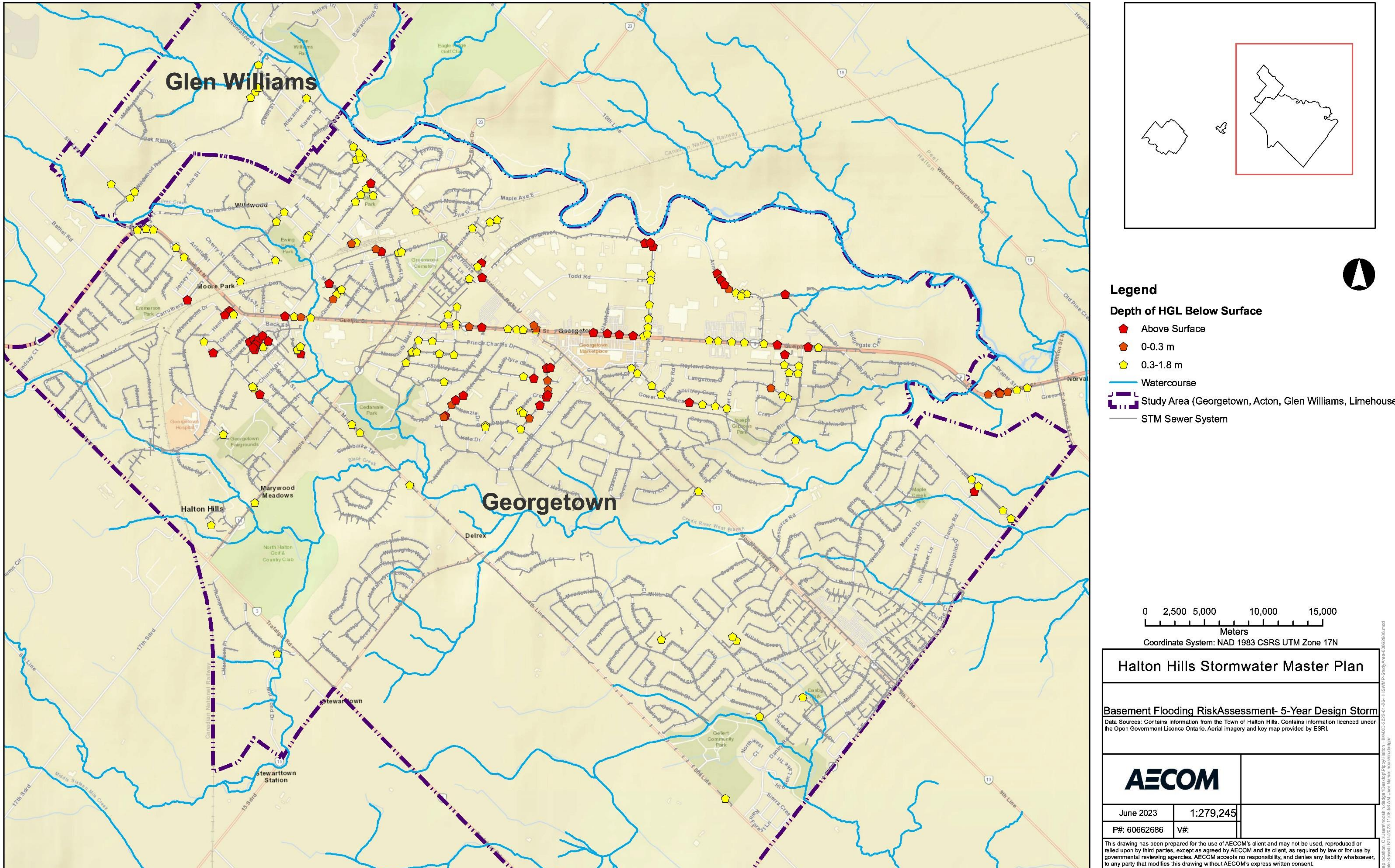


Figure 10: Potential Risk of Basement Flooding – Minor System 5-year Design Storm Event – Georgetown



3.3.2 Major System Performance

3.3.2.1 Surface Ponding

The existing overland system performance was assessed according to the following criteria:

- Flow depth > 0.3 metres

There are 3,212 nodes and 3,674 overland segments in the major system model. **Table 10** below summarizes the total number of junctions with flow depths greater than 0.3 m. As can be seen under the 5-year design storm, the majority of the nodes have a flooding depth below 0.3 m, but in 0.5% of the nodes the flooding depth is greater than 0.3 m. Under the 100-year design storm, 1.8 % of the nodes have a flooding depth which is greater than 0.3 m. **Figure 11**, **Figure 12** and **Figure 13** below show ponding surface locations for the 5-year design storm. Results of the overland performance analysis for other storm events are provided in Appendix F.

Table 10: Overland System Performance for Design Storm – Existing Condition (Percentage of Nodes Under Each Design Storm)

Description	2yr	5yr	10yr	25 yr	50yr	100yr
Depth of Flooding > 0.3 m	0.3%	0.5%	0.9%	1.0%	1.6%	1.8%

Table 11 below summarizes the total number of nodes with surface ponding depths greater than 0.3 m. For the 100-year design storm, 2% of the nodes have a ponding depth greater than 0.3 m.

Table 11: Overland System Performance for 100- Year Design Storm

Scenario	Description	Number of Nodes Exceed the Criteria
Existing Condition	Ponding Depth >0.3m	58
Existing Condition	% of Total MHs	2%

Figure 11: Overland Existing System Performance 5-Year Design Storm – Acton

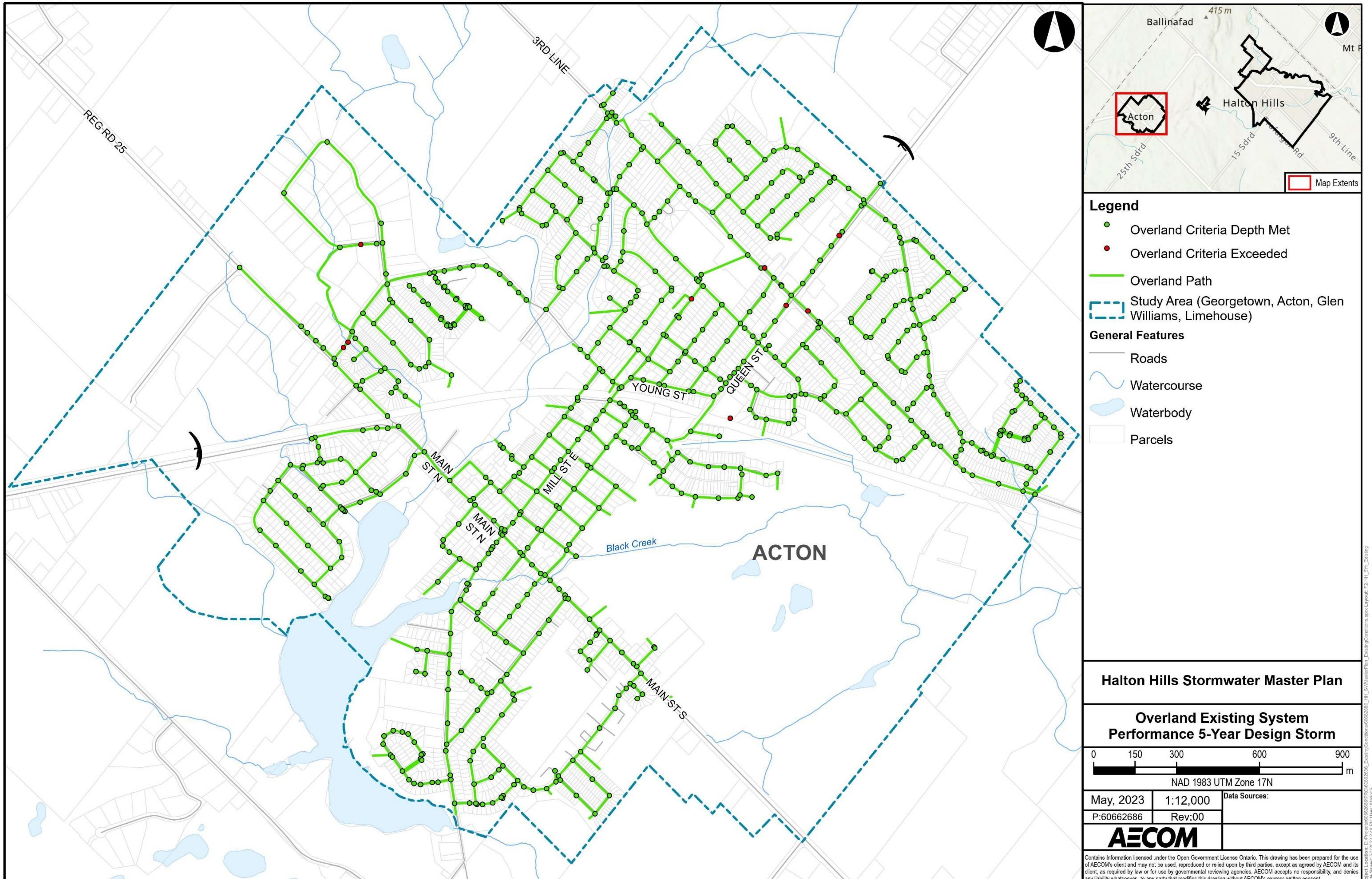


Figure 12: Overland Existing System Performance 5-Year Design Storm – Limehouse

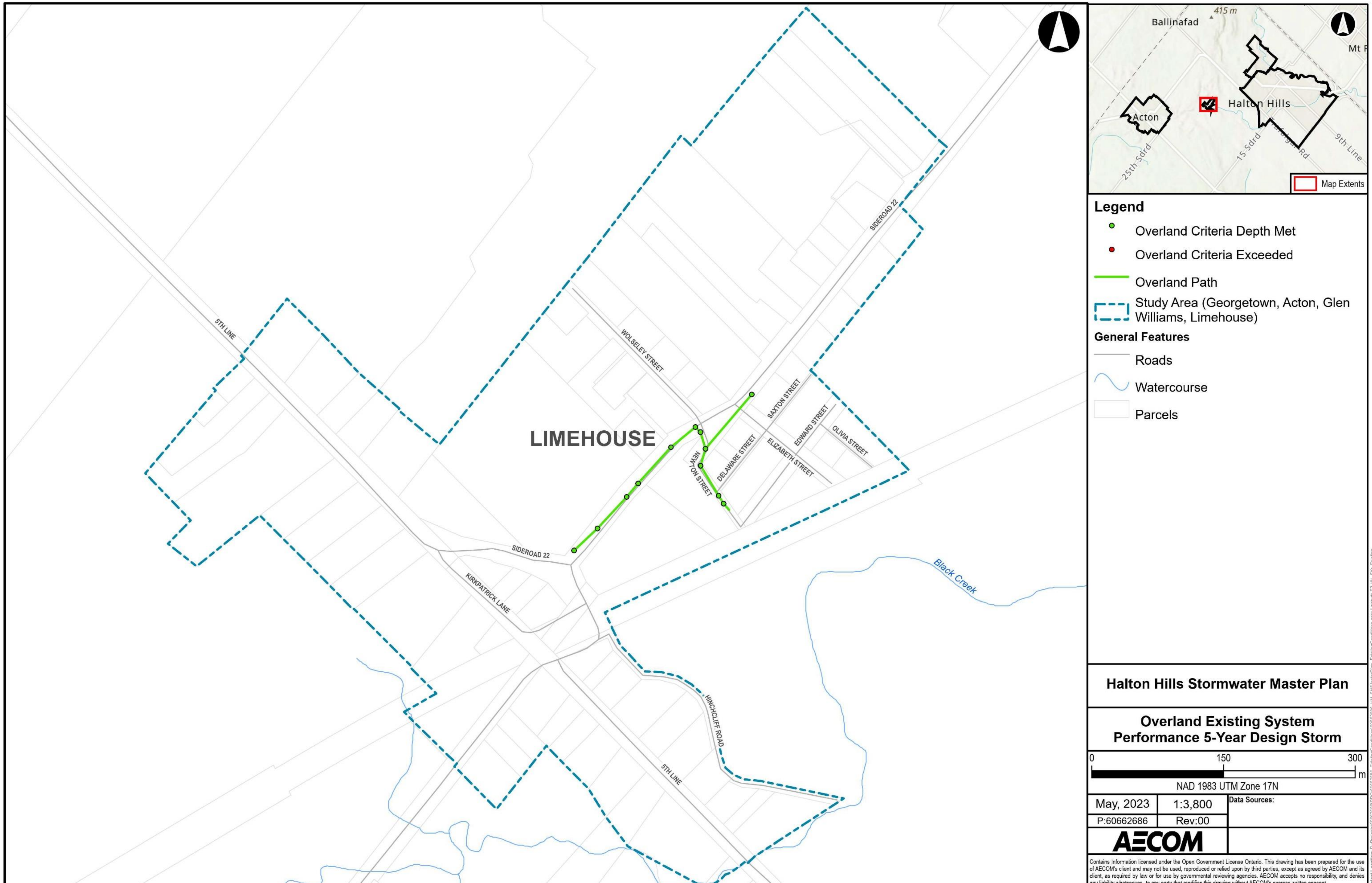
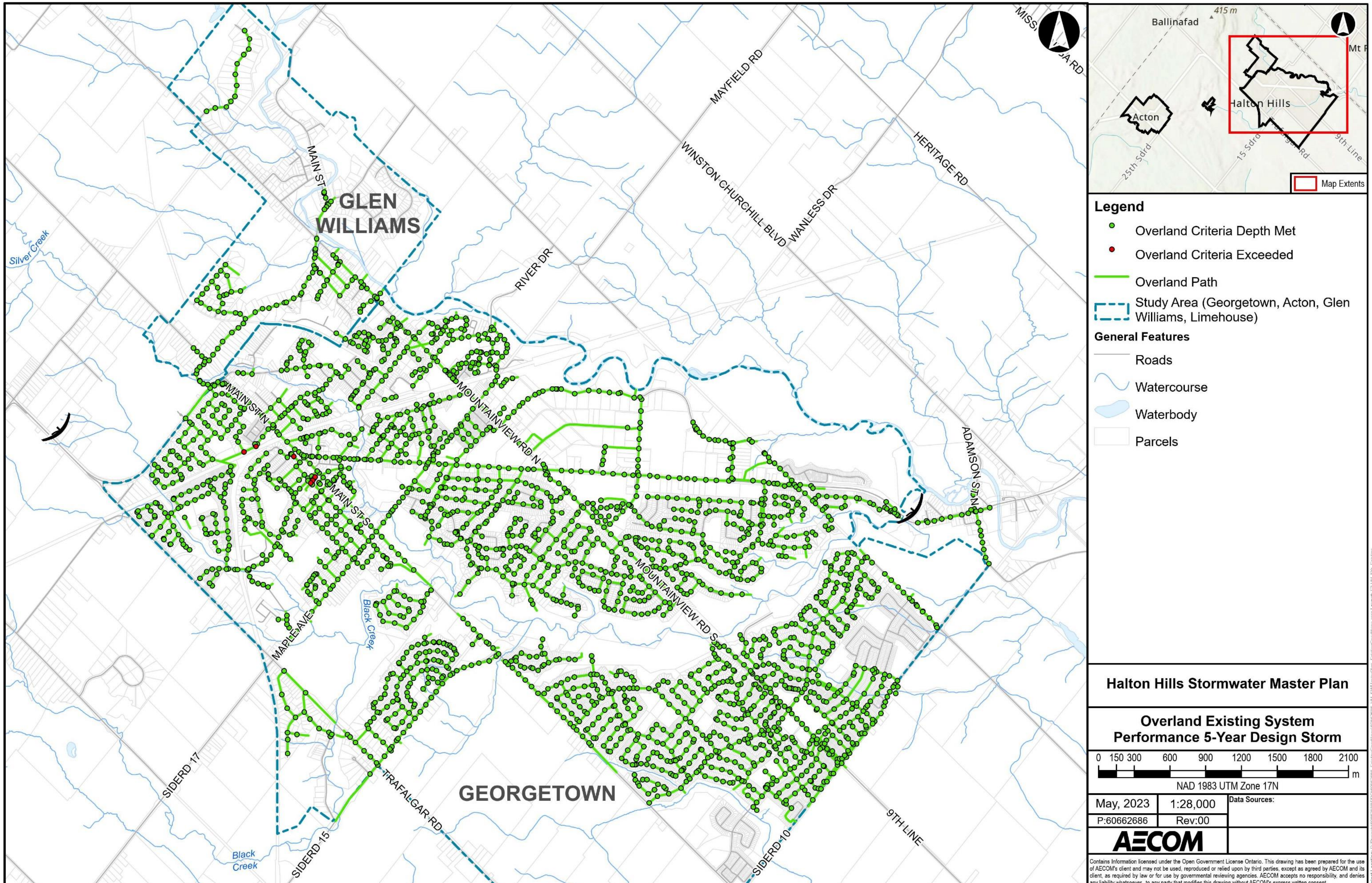


Figure 13: Overland Existing System Performance 5-Year Design Storm – Georgetown



3.3.2.2 Potential Spill Locations

There are 10 locations where the model predicts overland flow spilling outside the road for the 100-year storm: 9 locations in Georgetown and 1 in Acton. A summary of the potential spill locations is provided in **Table 12.** These spills would potentially impact the properties and buildings along the spill route, and could reasonably be expected to cause flooding. The greatest flooding depth, which is almost 1 m, occurs at John Street at one of the previously identified major sag areas which currently lacks a sufficient overland outlet.

Table 12: Summary of Potential Spill Locations -100 Year Design Storm

Overflow Path Name	Max Flow (m^3/s)	Ponding Depth above Catchbasin (m)	Street Name	Study Area
C73	3.03	0.26	Main St S	Georgetown
CB_1903_ST12716-S.2	7.86	0.7	Mill St E	Acton
D_8719934841.1	0.73	0.22	Meadowglen Blvd	Georgetown
MH_196_ST06017-S.1	3.04	0.3	Hewson Crescent	Georgetown
MH_2046_ST01007-S.1	0.20	0.94	John St	Georgetown
MH_2175_ST01241-S.1	0.02	0.17	Flamingo Ct	Georgetown
MH_2204_ST01011-S.1	0.14	0.2	Mountainview Rd N	Georgetown
MH_2356_ST02499-S.1	0.09	0.15	Watson Rd	Georgetown
MH_2512_ST04665-S.1	2.51	0.51	Guelph St	Georgetown
MH_2847_ST00684-S.1	0.01	0.23	Ontario St	Georgetown

3.4 Assess Effects of Future Growth and Climate Change

Potential impacts of future growth on the STM system capacity and overland system were assessed using a future conditions scenario which was developed based on the 2031 urban build-out condition and a 20% increase in IDF rainfall intensities, with the latter being included to account for the anticipated effects of Climate change. The growth data were obtained from Amendment No. 32 to the Official Plan for the Town of Halton Hills-Vision Georgetown. **Table 13** presents updated rainfall intensities incorporated in the future growth model.

Table 13: Future IDF – Updated Pearson (1950-2020) with 20% Increase for Climate Change / Resilience (Rainfall Intensities)

Storm Return Period	5 min (mm/hr)	10 min (mm/hr)	15 min (mm/hr)	30 min (mm/hr)	60 min (mm/hr)	120 min (mm/hr)	360 min (mm/hr)	720 min (mm/hr)	1440 min (mm/hr)
2-yr	120.7	90.3	72.7	46.8	28.3	16.4	6.6	3.7	2
5-yr	160.8	121.2	98.2	64.1	39.3	23.1	9.6	5.5	3.1
10-yr	186.3	140.3	113.9	75	46.6	28	12.1	7	4.1
25-yr	210.3	157.7	128.2	85.1	53.8	33	14.8	8.8	5.2
50-yr	240.6	179.2	145.8	97.8	63.1	39.8	18.8	11.6	7.1
100-yr	263	194.7	158.4	107.2	70.3	45.3	22.2	14.1	8.9

Based on the official zoning and growth plan for the Town of Halton Hills (at the time of development of this document) there is no future development planned for Acton within the assessed planning horizon and there are three areas of future development identified within Georgetown, as follows:

- Stewarttown (15.5 ha). Phasing: 2031- Future residential/mixed use.
- SE Georgetown (40 ha). Phasing: 2031- Future residential/mixed use.
- Vision Georgetown (412 ha). Growth forecast: 2031

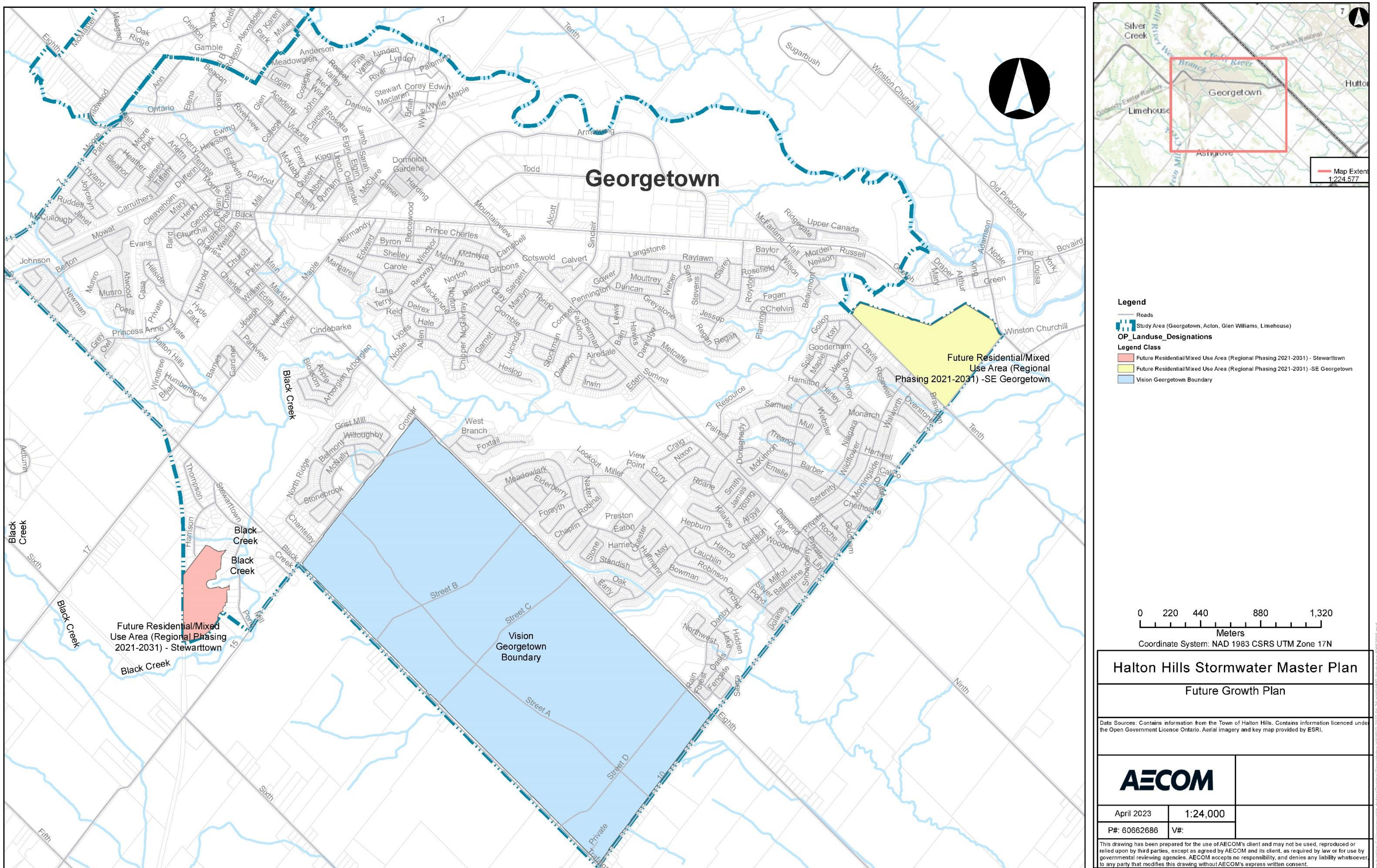
It should be noted that there is a separate growth area near the 401, but it was beyond the geographical scope of the current study and hence was not included as part of any of the assessments completed. Future growth areas were added to the model and were connected to the system using the closest existing storm manhole. **Figure 14** illustrates the location of the future developments within Georgetown.

Percent imperviousness of the future developments was estimated from the Town's development guidelines and Conservation Halton's Guidelines for Stormwater Management Engineering Submission-Conservation Halton 2021 and are summarized in **Table 14**.

Table 14: Future Growth Data

Name	Area	Land Use	%imp	Assumed Outfall
Stewarttown	15.5	Future residential/mixed use.	65	MH_1273_ST07849
SE Georgetown	40	Future residential/mixed use.	65	MH_280_ST03044
Vision Georgetown	412	Weighted % Imp	49	MH_2374_ST11531, MH_225_ST11620, MH_3015_ST03172

Figure 14: Future Growth Plan



3.4.1 Minor System

Future STM sewer system performance was assessed according to the criteria stated above. **Figure 15**, **Figure 16** and **Figure 17** below show Minor system capacity deficiency locations for the 5-year design storm event (Level of Service). Results of the capacity assessment for all other storm events is summarized below and more detail can be found in Appendix F.

Table 15: Minor System Performance for Design Storms – Future Condition

Performance Characteristic Description	Return Period 2 year	Return Period 5 year	Return Period 10 year	Return Period 25 year	Return Period 50 year	Return Period 100 year
Total Surcharged Pipes (%)*	11%	16%	20%	23%	27%	30%
Increase in the Total Surcharged Pipes Compared to Existing Condition (%)*	3%	5%	4%	6%	6%	6%
Nodes for the Surcharged Pipes with HGL < 1.8 m (%)*	3%	5%	7%	9%	11%	14%
Increase in the Total Nodes for the Surcharged Pipes with HGL >1.8 m Compared to Existing Condition (%)*	1%	2%	3%	3%	4%	5%

Note: *Relative to the Total number of Nodes and Storm Sewers

Figure 15: Future Condition and Climate Change Storm Sewer Performance 5-year Design Storm – Acton

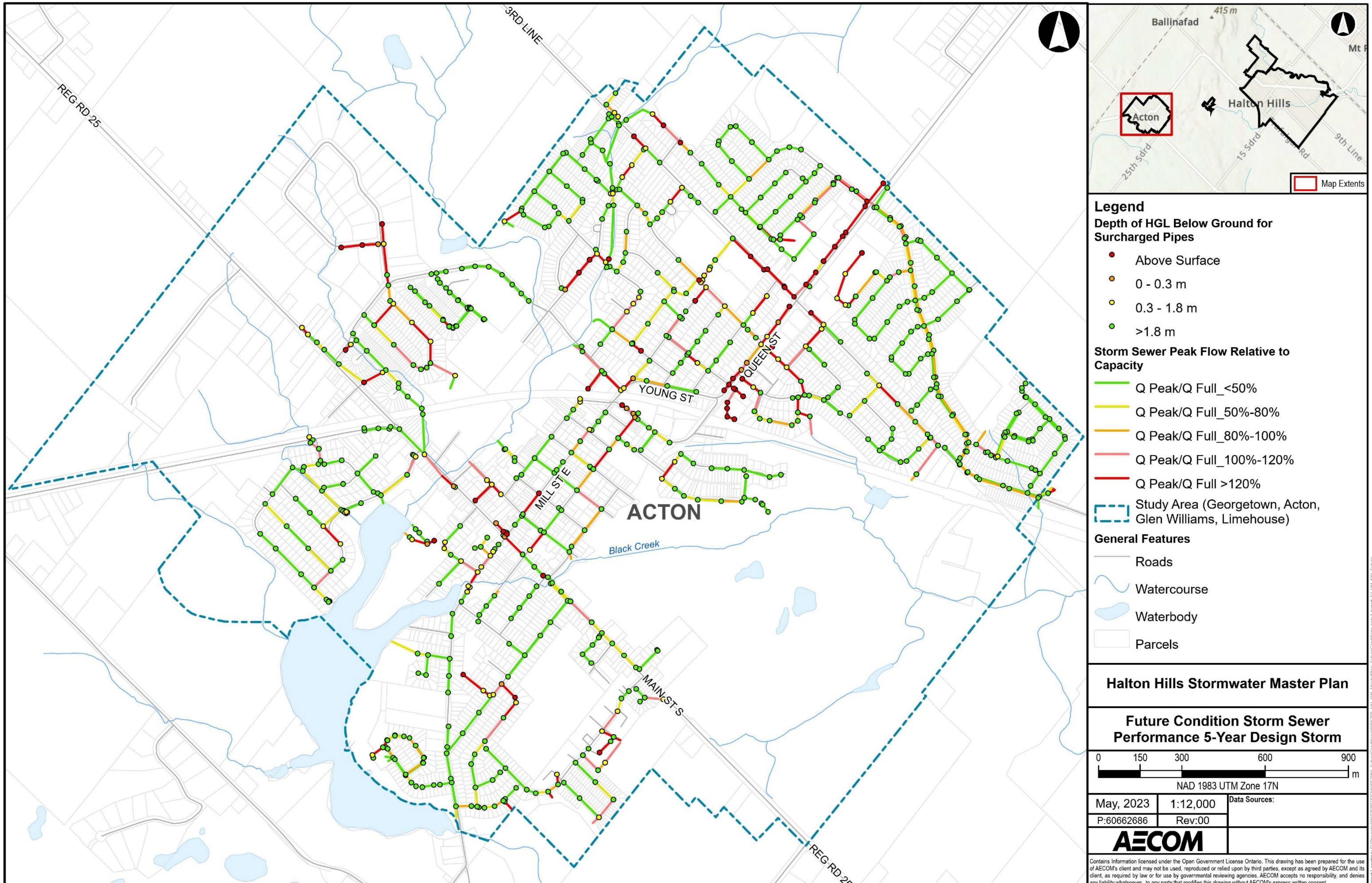


Figure 16: Future Condition and Climate Change Storm Sewer Performance 5-year Design Storm – Limehouse

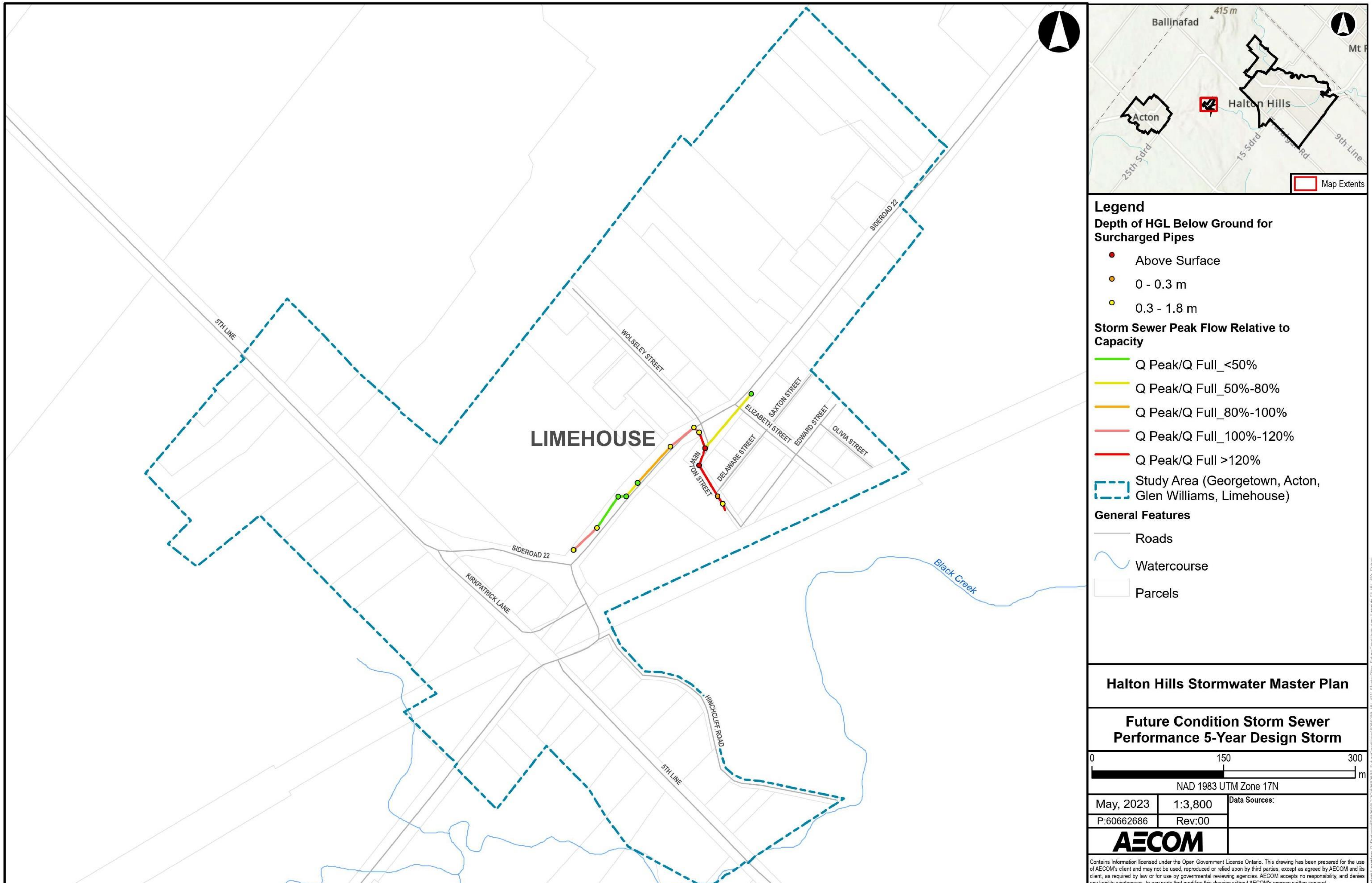
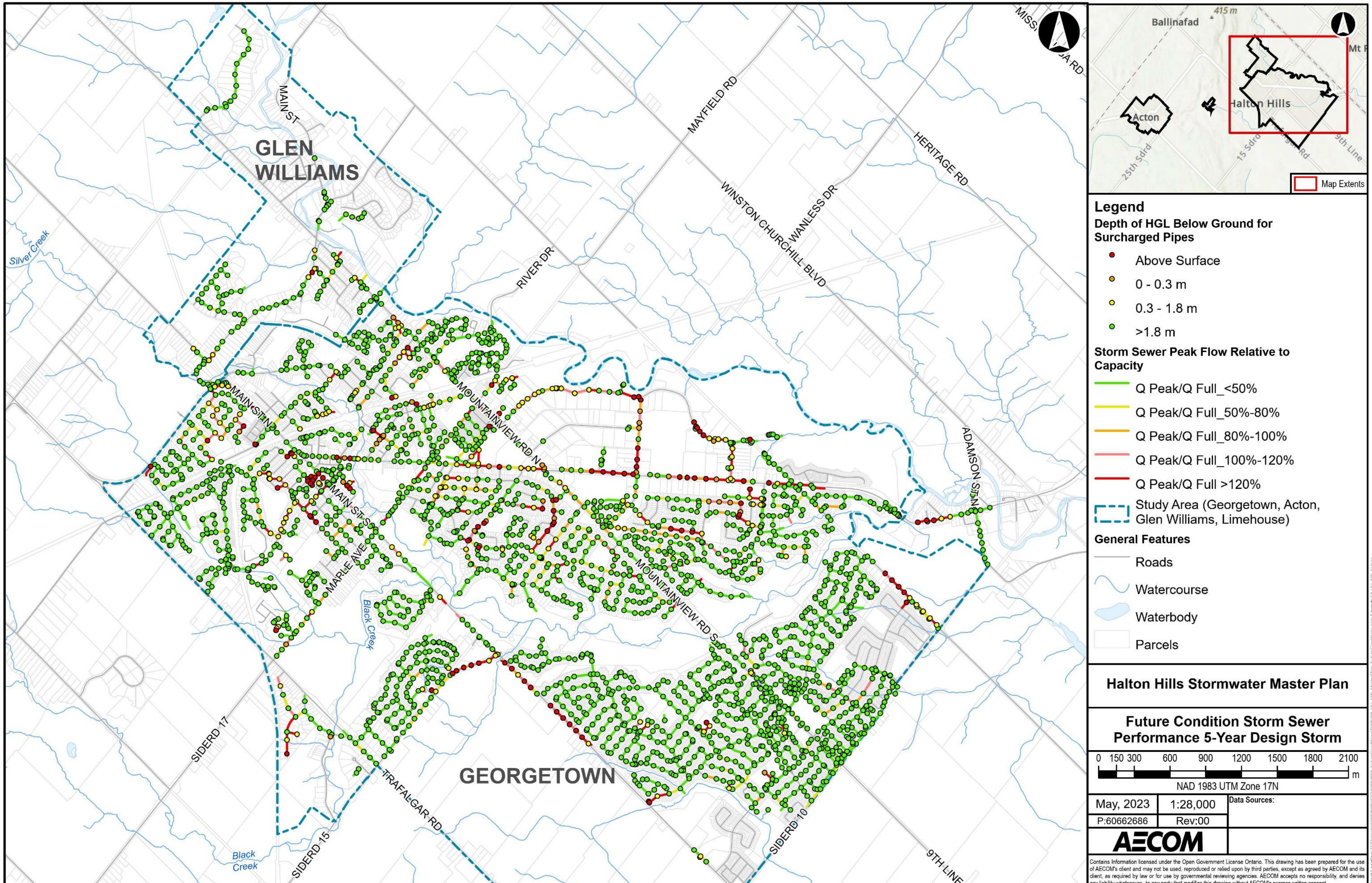


Figure 17: Future Condition and Climate Change Storm Sewer Performance 5-year Design Storm – Georgetown



3.4.2 Major System

3.4.2.1 Surface Ponding

There are a total of 3,207 junctions within the major system in the model. **Table 16** below shows the total number of junctions with flow depths more than 0.3 m. As can be seen under the 5-year design storm, flow depths at the majority of the nodes are below 0.3 m and 1.5% of the junctions have flow depths more than 0.3 m, which is an increase of 1% compared to the existing condition model results. Under the climate adjusted 100-year design storm, 4% of all major system junctions experience flooding to depths greater than 0.3 m which is 2.2% more than existing condition model results. **Figure 18, Figure 19** and **Figure 20** show surface ponding locations during the 5-year design storm. Results of the overland performance analysis for other storm events are provide in Appendix F.

Table 16: Overland System Performance for Design Storm – Future Condition

Performance Characteristic Description	Design Storm 2 year	Design Storm 5 year	Design Storm 10 year	Design Storm 25 year	Design Storm 50 year	Design Storm 100 year
Nodes with Surface Ponding> 0.3 m (%)*	0.9%	1.5%	2.1%	2.6%	3.4%	4.0%
Increase in the Total Nodes with Surface Ponding Compared to Existing Condition (%)*	0.6%	1.0%	1.2%	1.5%	1.8%	2.2%

Note: * Relative to the Total number of Nodes and Storm Sewers

Figure 18: Overland Future Condition System Performance 5-Year Design Storm – Acton

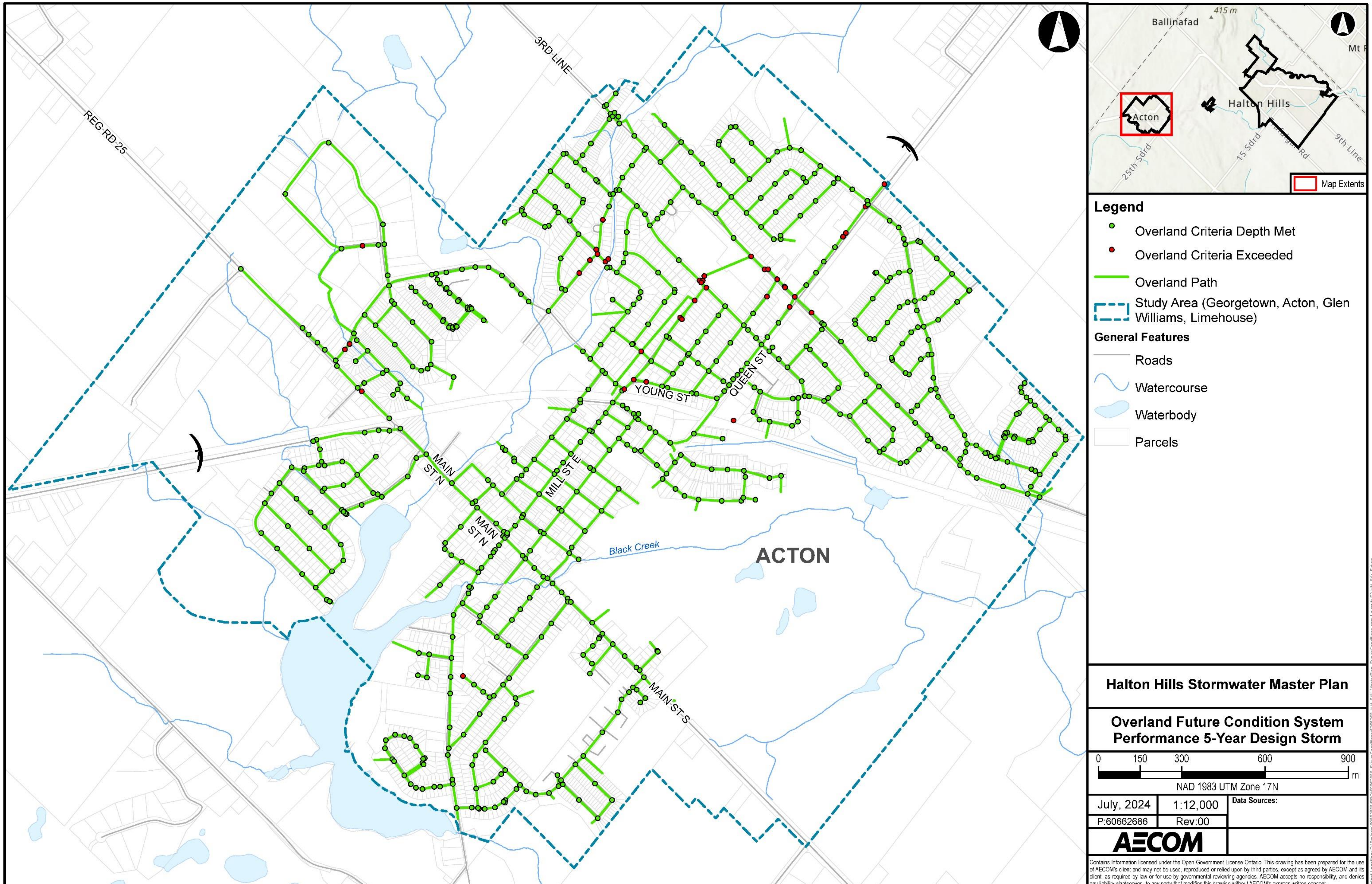


Figure 19: Overland Future Condition System Performance 5-Year Design Storm – Limehouse

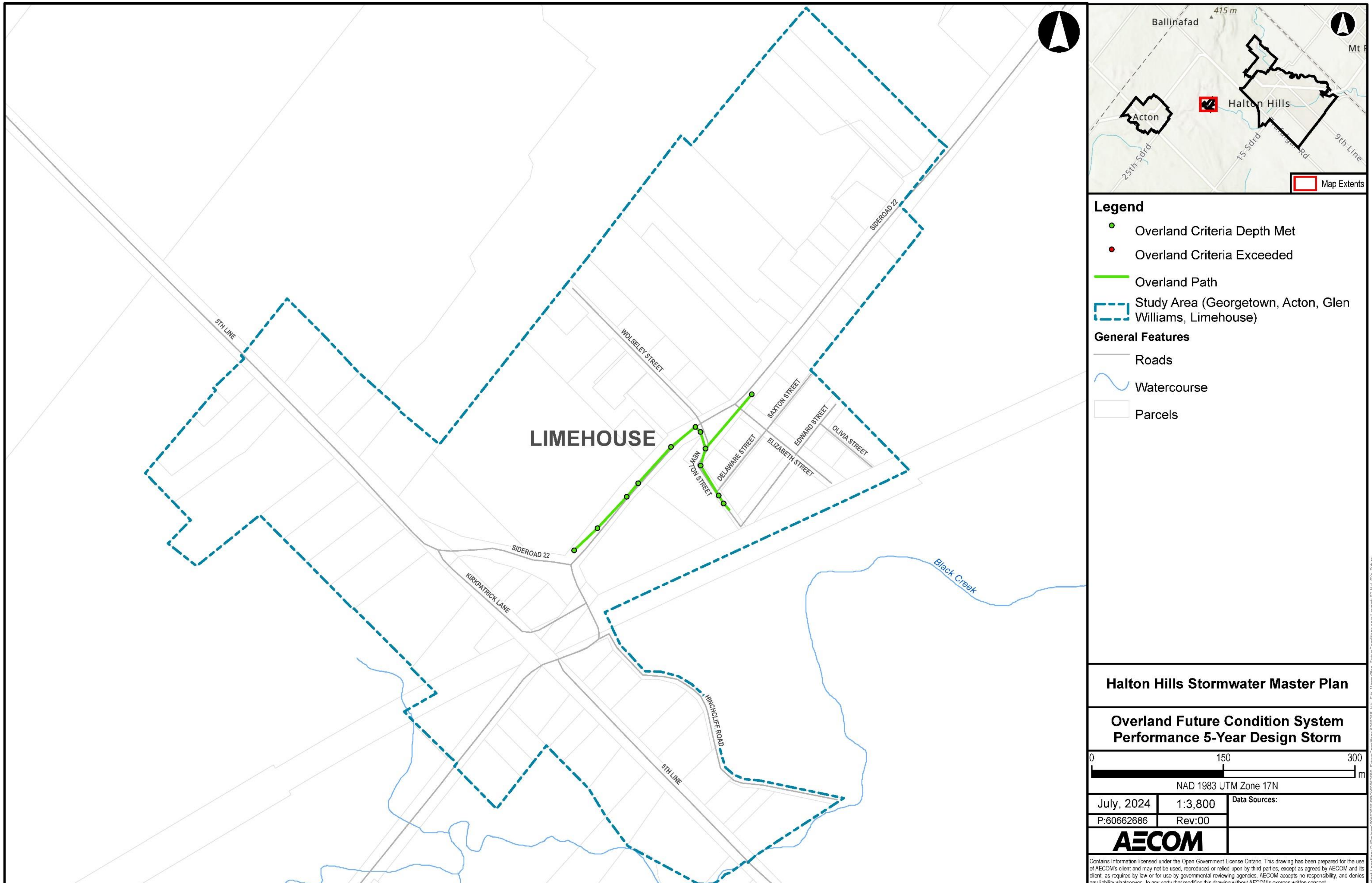
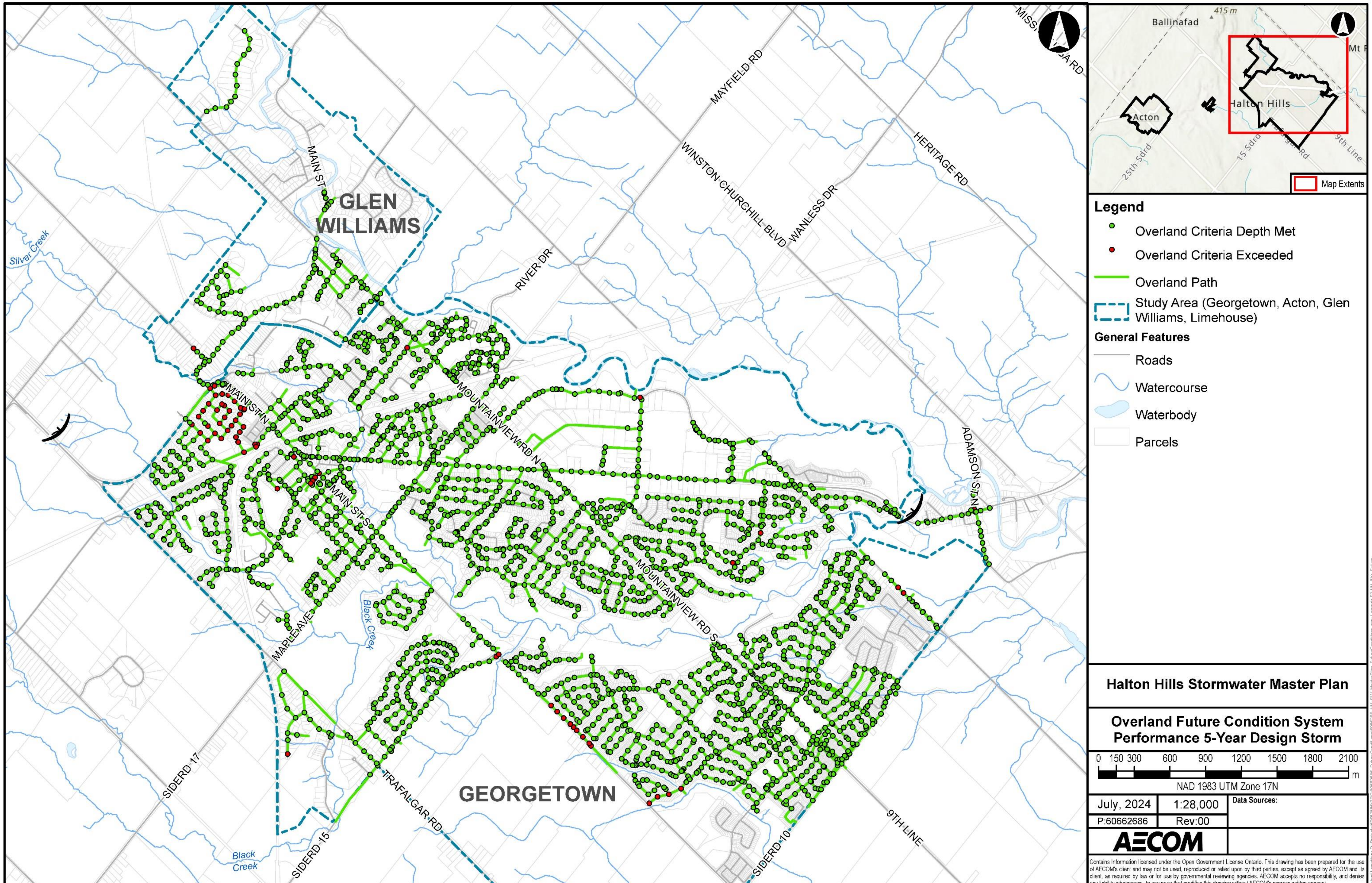


Figure 20: Overland Future Condition System Performance 5-Year Design Storm – Georgetown



4. Evaluation of Alternatives

4.1 Mitigation Measures for System Deficiencies

As described in **Section 3** above, the minor and major system performance was assessed under the 2-year through 100-year design storm events for multiple scenarios. Since the current intended level of service of the minor system is the 5-year storm, the above assessment results focus on performance issues under this storm event. Based on the results of this performance assessment, feasible mitigation measures have been identified and are discussed below.

4.1.1 Pipe Size Deficiencies

Many pipe segments in the existing storm sewer network surcharge under a 5-year storm event. This can be because segments of the storm network were designed according to a previous design criterion which is no longer applicable (e.g., 2-year design storm) or due to increased imperviousness/loading on the system resulting from subsequent development following original installation of the pipe segment in question. Excess loading on the existing storm sewers can cause the hydraulic grade line to rise in connected manholes. In some cases, pipes may only surcharge slightly, causing a slight rise in water level in connected manholes, while in other cases water may overflow to basements through direct connections or to ground level, causing surface flooding. Remedial measures should be prioritized to address the more serious occurrences first. There are various remedial actions that can be taken.

4.1.1.1 Pipe Upsizing

Where existing pipes are surcharging and causing basement flooding or flooding at ground level due to inadequate pipe size, one solution is to simply replace the undersized pipes with larger ones. An iterative analysis was carried out based on the existing flow to a surcharging pipe segment to determine what pipe size would be required to accept the flows in a given location.

4.1.1.2 Inlet Control Devices

Under certain conditions, the risk of pipe surcharging can be reduced using inlet control devices (ICDs). These devices generally consist of an orifice plate which restricts flow into the storm sewer and causes more water to flow on the street surface, helping to maintain capacity in the downstream storm sewer network. This type of retrofit can be implemented in areas where the overland flow paths can safely accept larger flows, and intermittent surface ponding caused by the installation of such devices will not pose a risk to residents, property, or infrastructure. ICDs are low cost, especially when compared to the cost of replacing pipes.

4.1.1.3 Storage/Low Impact Development

In some cases, storage elements can be added to capture and attenuate excess flows to a downstream section of pipe that is undersized but cannot be replaced due to access challenges (i.e., under buildings and/or on private property). Adding storage can be effective where there is space in the right-of-way or in other public lands (e.g., park space). In some cases, low impact development (LID) features could be used to provide storage as well as water quality treatment, or in areas with good infiltration rates, provided significant volume reduction. Various types of LID features and their associated benefits are described further in **Section 4.1.4** below.

4.1.2 Pipe Repairs

As described in **Section 2.4.1**, there are various pipe condition issues that were discovered when assessing the storm sewers throughout the network. Various remedial measures exist for pipes with existing problems. **Table 17** shows the various types of proposed repairs required to address category 4 - 'very poor' - and 5 - 'failure' - pipe conditions.

Table 17: Pipe Repair Strategies

Pipe Scope	Description	Structural	Service
CHEM_GROUT	Chemical Grouting	_	2
CLEAN	Clean	_	31
CLEAN+CHEM_GROUT+CON*	Clean, Grouting & Connection Repair	_	_
CLEAN+CON*	Clean & Connection Repair	_	_
CLEAN+TPR	Clean & Trenchless Point Repair	12	3
CON*	Connection Repair	2	_
LINE	CIP Liner	41	2
LINE+CON*	CIP Liner & Connection Repair	1	_
LINE+EPR*	CIP Liner & External Point Repair	8	_
SA	Survey Abandoned	2	_
TPR	Trenchless Point Repair	123	1
TPR+CON*	Trenchless Point Repair & Connection Repair	5	_

Note: * Disturbance/Excavation in ROW

4.1.3 Surface Ponding and Flooding Relief

In areas where significant overland flow causes surface ponding or spilling onto neighbouring private properties, flooding can be mitigated through similar measures to what is described above (pipe upsizing and addition of storage/LID controls). Additional measures that can be used to relieve surface flooding issue is the addition of a relief sewer or increased inlet capacity.

4.1.3.1 Addition of Relief Sewer or Increase Inlet Capacity

If ponding cannot be relieved through increasing the size of an existing outlet sewer in the area, the addition of a relief sewer 'could alleviate the issue. Furthermore, there may be a need to increase inlet capacity to an existing or upsized sewer to ensure adequate flows can be conveyed into the new sewer.

4.1.4 Quantity and Quality Control

4.1.4.1 Stormwater Management Facilities

Since there are large portions of the Town that are currently not serviced by stormwater management facilities, many areas have stormwater runoff that discharges uncontrolled and largely untreated into nearby watercourses. As required under the new CLI-ECA (#328-701S) an inventory of all storm sewersheds is required to determine the level of quantity and quality treatment they receive. As part of this assessment, an investigation should be done to determine if a stormwater management facility could feasibly be added to the downstream end of any existing catchment areas. Ponds or large storage reservoirs can be added to areas where a large portion of available public land, such as a park or clearing, exists near a currently uncontrolled outfall.

4.1.4.2 Low Impact Development (LID)

LID features are customizable to suit site constraints and meet stormwater management objectives and can be used in the Town of Halton Hills to meet water quality objectives in currently uncontrolled areas. LID-based SWM approaches emphasize the management of stormwater at its source, followed by ongoing treatment along its path of travel (source and conveyance controls). This "treatment train" approach to SWM attempts to mimic natural hydrologic processes by slowing down, filtering, and attenuating stormwater, by making beneficial use of it on the landscape, and also by retaining a portion of it for infiltration into native soils. In addition to water quality benefits, LID systems can also provide quantity and peak flow control benefits. More detail is included in Appendix H on the types of LID, their benefits and design considerations.

4.1.4.3 Oil and Grit Separators (OGS)

Oil and grit separator (OGS) units are proprietary devices designed to separate and settle hydrocarbons and suspended solids from stormwater runoff. They are typically utilized as in-line or end-of-pipe solutions to provide treatment prior to discharge. OGS units could be utilized upstream of each outfall where a stormwater pond or LID feature may not be feasible or in conjunction with a pond or LID feature to enhance treatment. They could be used in conjunction with catch basin inlet pre-treatment measures to reduce maintenance frequency while increasing gross solid / sediment capture, or could even be used to provide pre-treatment upstream of LIDs. Benefits to utilizing OGS units include minimizing the treatment footprint compared to other treatment measures as they often occupy the same footprint as a standard maintenance hole for small catchment areas. For large catchment areas, they would need to be sited in an area with sufficient space such as a wide median, cul-de-sac or intersection with relatively limited utilities. They do not provide any quantity control or water balance benefit.

4.2 Evaluation Methodology and Criteria

Given the numerous deficiencies within the stormwater management system throughout the Town of Halton Hills and various approaches and alternatives that can be used to address these issues, remediation efforts should be prioritized to begin with the most critical, effective and cost-efficient solutions. The following constraints and criteria are proposed to help prioritize remedial works.

The following factors were applied to the identified deficiencies to short list those that are considered “critical” and require immediate attention.

1. Any location where there is a pipe in critical condition (category 4 or 5 in pipe condition assessment)
2. Any location where a manhole surcharges above ground under the 5-year event
3. Any location where there is significant flood/spillover from the right-of-way onto private property during the 100-year storm event

By focusing on the categories above a short list of critical problem areas was identified, summarized below in **Table 18**.

Table 18: Summary of SWM System Performance Issues – Critical Problem Areas

Problem	Type of Occurrences	Number of Occurrence
Segments of pipe with critical structural or service condition problems (condition grade 4 and 5)	Number of pipes with critical structural or service condition problems	233
Areas where manholes are at risk of surcharging above the ground surface	Number of manholes with 5-Yr HGL > Ground Surface	94
Areas where there is spillover from the road unto private property for the 100-year storm event	Number of locations where overland flow ponds on the road and spills to private property	5

Even with the focus on the critical problem categories summarized above, a large number of critical problem areas requiring remediation remain. In consultation with the Town of Halton Hills, the following criteria and associated weightings (see **Table 19** and **Table 20** below) were identified in order to facilitate prioritization of the most effective and cost-efficient areas to focus on. For each criterion, both weightings and categorical rankings were identified.

Table 19: Remedial Effort Prioritization Criteria and Weightings

Criteria		Initial Weight (%; Examples Included)
1	**Cost Per Benefitting Property**	25
2	**Benefiting Drainage Area (ha)**	10
3	**Construction Schedule**	5
4	**EA Schedule**	10
5	**Constructability Risk**	10
6	**Overall Capital Cost**	10
7	**Operation and Maintenance Requirements**	10
8	**Service Life of Existing Infrastructure to be Replaced**	5
9	**Water Quality Impacts**	10
10	**Downstream Trunk/Outfall Impacts**	5
Total		**100**

Table 20: Criteria and Rating Categories

Cost Per Benefitting Property Weight: 25% Criteria	Cost Per Benefitting Property Weight: 25% Rating	Benefiting Drainage Area (ha) Weight: 10% Criteria	Benefiting Drainage Area (ha) Weight: 10% Rating	Construction Schedule Weight: 5% Criteria	Construction Schedule Weight: 5% Rating	EA Schedule Weight: 10% Criteria	EA Schedule Weight: 10% Rating	Constructability Risk Weight: 10% Criteria	Constructability Risk Weight: 10% Rating	Overall Capital Cost Weight: 10% Criteria	Overall Capital Cost Weight: 10% Rating
< $20,000	10	> 10 ha	10	< 1 Month (0-50 m)	10	Exempt	10	No constructability issues	10	< $100,000	10
< $34,000	8	5 ha- 10 ha	7	1-2 Months (50-100 m)	8	B (adding LID to ROW and/or property acquisition required)	6	Mature trees in ROW, sewers > 4 m deep, or sewers close to mature trees	5	$100,000 - $250,000	8
< $68,000	5	2 ha – 5 ha	5	2-3 Months (100-500 m)	6	C	0	Traffic, property access, lane closures of major roads	4	$250,000 - $500,000	6
< $100,000	1	< 2 ha	3	4-6 months (500-1000 m)	4	-	-	Sewers > 3 m wide	3	$500,000- $750,000	4
> $136,000	0	-	-	-	-	-	-	Physical Constraints (overpasses, buildings)	3	$750,000 - $1M	2
-	-	-	-	-	-	-	-	Large diameter watermain crossing	1	> $1M	0
-	-	-	-	-	-	-	-	Sewers > 5 m deep, > 3 m wide	0		

Operation and Maintenance Requirements Weight: 10% Criteria	Operation and Maintenance Requirements Weight: 10% Rating	Service Life of Existing Infrastructure to be Replaced Weight: 5% Criteria	Service Life of Existing Infrastructure to be Replaced Weight: 5% Rating	Water Quality Impacts Weight: 10% Criteria	Water Quality Impacts Weight: 10% Rating	Downstream Trunk/Outfall Impacts Weight: 5% Criteria	Downstream Trunk/Outfall Impacts Weight: 5% Rating
Regular maintenance	10	Watermains, storm sewers, or sanitary sewers are > 70 years old	10	No existing water quality controls and retrofit can include 'Enhanced' level of treatment	10	No Impact (<10% flow increase)	10
Box culvert (not storage) > 1.5 m width	7	Watermains, storm sewers, or sanitary sewers are > 50 years old	6	No existing water quality controls and retrofit can include 'Normal' level of treatment	6	Low Impact (Minor Erosion, <50% flow increase)	6
Inspection and cleaning of ICDs or LIDs or OGS	5	Watermains, storm sewers, or sanitary sewers are > 20 years old	4	No existing water quality controls and retrofit can include 'Basic' level of treatment	4	Moderate Impact (Increase D/S surcharge risk or outlet erosion potential, <100% flow increase)	4
Any storm inline storage (controlled by orifice), SWMF sediment removal	2	Watermains, storm sewers, or sanitary sewers are < 20 years old	0	Retrofit would provide no water quality treatment in an area which currently lacks water quality controls	0	High Impact (Increase D/S surcharge risk or outlet erosion potential, >100% flow increase)	0
Any sanitary inline storage (controlled by orifice)	0	-	-	-	-	-	-

To apply these criteria in a meaningful way, the occurrences of each type of critical problem were overlayed in a map and discrete project areas were delineated and given project identification numbers. Further details on the delineation of project areas can be found in Appendix H. A total of 140 project areas were identified, of which 43 had critical problems: 25 in Georgetown, 17 in Acton and 1 in Limehouse.

For each issue within a critical project area, a suitable mitigation measure (from those outlined in **Section 4.1** above) was identified and used to estimate the project benefits and costs. In areas that are not served by existing stormwater ponds, potentially suitable low impact development (LID) measures were included to address water quality treatment objectives, with the rationale that such measures could be included as part of any invasive remediation work requiring excavation within the right-of-way (ROW). The project areas were then screened through the criteria above.

5. Preferred SWM Strategy

5.1 Critical Projects

The prioritization criteria outlined in the above section was applied to the 43 critical project areas. After scoring of all the projects, AECOM has identified the fifteen highest priority projects for further consideration. There are 5 projects with overland flow overtopping the road and these were considered the most critical due to risk of damage to private property and are thus placed first. Following these are the next 10 highest scoring projects. Beyond these, there are 28 other critical projects for future consideration. A summary of these projects are presented in **Table 21** below with further detail in Appendix I (i.e., contributing drainage area, number of benefiting properties, cost per property, each of the criteria weightings, the final score and a figure showing the project area).

Table 21: Summary of Critical Projects

Project ID	Surcharging mHs AG[1]	Potential Overland Spill Location	Recommended Mitigation Measures Pipe Repair	Recommended Mitigation Measures Existing	Recommended Mitigation Measures Proposed[2]	LID[3]	Estimated Capital Cost[4]	Estimated Annual Maintenance	EA Schedule
G35	1	Yes - Provide flood relief by adding capacity along Rosset Valley Crt.	-	67.0 metres of 450 milli metres	67.0 metres of 600 milli metres	Bioretention in boulevard along South side of Rosset Valley Crt.	$100,000	$7,000	B
G17	0	Yes - Provide flood relief by adding capacity along Hewson Cres.	-	49.5 m of 250 mm, 29.9 m of 250 mm, 43.7 m of 350 mm, 36.7 m of 350 mm	49.5 m of 300 mm, 29.9 m of 300 mm, 43.7 m of 525 mm, 36.7 m of 450 mm	Add OGS at outlet to provide water quality treatment	$120,000	$2,000	Exempt
G70	1	Yes – Provide flood relief by adding capacity along Guelph St. and Armstrong Ave.	-	63.3 m of 750 mm, 87.3 m of 825 mm, 100.8 m of 825 mm, 23.0 m of 825 mm, 21.3 m of 400 mm, 94.0 m of 400 mm, 77.0 m of 400 mm 93.7 m of 900 mm, 89.6 m of 900 mm, 69.8 m of 900 mm	63.3 m of 750 mm, 87.3 m of 975 mm, 100.8 m of 900 mm, 23.0 m of 900 mm, 21.3 m of 675 mm, 94.0 m of 675 mm 77.0 m of 675 mm, 93.7 m of 1050 mm, 89.6 m of 1050 mm, 69.8 m of 1050 mm	Within SWM Pond area	$950,000	$2,000	Exempt
G2/3	11	Yes – Provide flood relief by adding a relief capacity along Mill St and/or a relief sewer along Cross St/Back St	-	51.9 m of 650 mm 53.5 m of 650 mm, 48.9 m of 650 mm, 31.2 m of 650 mm, 40.9 m of 650 mm, 49.3 m of 900 mm	48.9 m of 900 mm, 19.6 of 900 mm, 51.9 m of 825 mm, 53.5 m of 1200 mm, 48.9 m of 1050 mm, 31.2 m of 1050 mm, 40.9 m of 1350 mm, 49.3 m of 1350 mm, Add 332 of 1200 mm on Cross/Back St	EES/CHBR/IG under Main St, Mill St, Cross St and Back St	$1,800,000	$5,000	B
A38	1	Yes – Provide flood relief by adding attenuation storage within the school property and add a relief sewer along Mill St. E. and George St.	Trenchless Point Repair + Connection Repair on mill St East.		345 m of 1500 m	CHBR under school property and EES/CHBR/IG under Mill St E	$2,200,000	$6,000	B
-	-	-	-	-	-	**Subtotal for five most critical projects with private property flood risk**	**$5,170,000**	**$22,000**	-
G5	1	-	-	70.0 m of 300 mm, 72.9 m of 600 mm, 16.6 m of 675 mm, 22.4 m of 675 mm	70.0 m of 425 mm, 72.9 m of 750 mm, 16.6 m of 750 mm, 22.4 m of 750 mm	EES/CHBR/IG under Churchill Cres and Charles St	$260,000	$2,000	B

1. Manholes surcharging above ground surface. E
2. Estimated pipe size required to avoid surcharging under 5-year event, to be confirmed during detailed design
3. Proposed LID options (EES=Etobicoke Exfiltration System, CHBR=Underground Storage Chamber, IG=Infiltration Gallery), specific type to be confirmed during detailed design
4. Where multiple LID options exist, cost includes lowest cost LID feature, generally EES

Project ID	Surcharging mHs AG[1]	Potential Overland Spill Location	Recommended Mitigation Measures Pipe Repair	Recommended Mitigation Measures Existing	Recommended Mitigation Measures Proposed[2]	LID[3]	Estimated Capital Cost[4]	Estimated Annual Maintenance	EA Schedule
A24	1	-	-	5.8 m of 300 mm 7.6 m of 300 mm 5.1 m of 300 mm 12.3 m of 300 mm 91.0 m of 300 mm	5.8 m of 375 mm 7.6 m of 375 mm 5.1 m of 375 mm 12.3 m of 375 mm 91.0 m of 375 mm	EES/CHBR/IG under Main St	$130,000	$2,000	B
A31	3	-	-	13.9 m of 350 mm 79.1 m of 350 mm 60.3 m of 300 mm, 33.9 m of 300 mm,	13.9 m of 450 mm 79.1 m of 450 mm 60.3 m of 525 mm, 33.9 m of 525 mm,	Bioretention along McDonald Boulevard both sides	$490,000	$39,000	B
A22	1	-	-	17.8 m of 250 mm,	17.8 m of 450 mm,	EES/CHBR/IG under Main St	$20,000	$1,000	B
A4	1	-	-	27.5 m of 300 mm	27.5 m of 525 mm	Bioretention on Wallace St south side	$60,000	$5,000	B
G43	2	-	-	57.3 m of 250 mm 37.7 m of 250 mm, 32.0 m of 250 mm, 73.3 m of 250 mm, 31.0 m of 300 mm	73.3 m of 675 mm, 31.0 m of 375 mm	Can enhance the existing swale to a bioswale at Mountainview and Armstrong corner	$140,000	$12,000	Exempt
G20	1	-	-	64.9 m of 250 mm, 46.8 m of 375 mm, 33.2 m of 375 mm,	64.9 m of 300 mm, 46.8 m of 450 mm, 33.2 m of 450 mm,	EES/CmBR/IG under Guelph St	$160,000	$2,000	B
G55	1	-	-	91.8 m of 300 mm, 74.0 m of 300 mm	91.8 m of 375 mm, 74.0 m of 375 mm	Bioretention along McIntyre Cr	$390,000	$32,000	B
G38	1	-	-	9.1 m of 200 mm, 87.6 m of 750 mm, 41.6 m of 300 mm	9.1 m of 750 mm, 87.6 m of 750 mm, 41.6 m of 300 mm	-	$10,000	$1,000	Exempt
A36	1	-	-	56.4 m of 300 mm, 87.0 m of 300 mm, 51.4 m of 250 mm	56.4 m of 600 mm, 87.0 m of 450 mm, 51.4 m of 375 mm	Bioretention along Somerville Rd and Pearl Crt	$280,000	$19,000	B
-	-	-	-	-	-	**Subtotal for 10 Remaining high priority critical projects**	**$1,950,000**	**$115,000**	-
G78	1	-	-	76.9 m of 250 mm, 12.3 m of 300 mm, 54.5 m of 350 mm, 64.8 m of 350 mm, 74.5 m of 350 mm	76.9 m of 375 mm 12.3 m of 450 mm, 54.5 m of 450 mm, 64.8 m of 450 mm, 74.5 m of 450 mm	EES/CmBR/IG along Guelph St.	$300,000	$3,000	B
G56	5	-	-	25.6 m of 300 mm, 88.1 m of 375 mm 63.6 m of 450 mm, 17.6 m of 525 mm, 72.2 m of 525 mm, 117.0 m of 525 mm, 97.2 m of 525 mm	25.6 mof 375 mm, 88.1 m of 525 mm 63.6 m of 675 mm, 36.0 m of 675 mm 17.6 m of 750 mm, 72.2 m of 750 mm, 117.0 m of 750 mm, 97.2 m of 750 mm	Bioretention in Prince Charles Dr boulevard along west side	$810,000	$62,000	B
G53	3	-	-	43.8 m of 250 mm, 61.9 m of 350 mm, 88.2 m of 350 mm, 13.7 m of 300 mm, 66.8 m of 533 mm	43.8 m of 450 mm, 61.9 m of 450 mm, 88.2 m of 450 mm, 13.7 m of 450 mm, 66.8 m of 675 mm,	Bioretention along Rexway Dr and Delrex Blvd	$500,000	$62,000	B

Project ID	Surcharging mHs AG[1]	Potential Overland Spill Location	Recommended Mitigation Measures Pipe Repair	Recommended Mitigation Measures Existing	Recommended Mitigation Measures Proposed[2]	LID[3]	Estimated Capital Cost[4]	Estimated Annual Maintenance	EA Schedule
A47	10	-	CIP Liner + External Point Repair on Longfield Rd.	31.7 m of 525 mm, 43.6 m of 300 mm 26.3 m of 300 mm 27.7 m of 250 mm, 22.9 m of 250 mm, 37.5 m of 250 mm, 6.6 m of 300 mm, 54.9 m of 450 mm, 21.2 m of 350 mm, 30.0 m of 350 mm, 27.4 m of 350 mm	31.7 m of 525 mm, 43.6 m of 525 mm, 26.3 m of 525 mm, 27.7 m of 300 mm, 22.9 m of 525 mm,	Bioretention in wide grass boulevard on Queen St east side. EES/CHmB/IG on Queen St west wide.	$210,000	$11,000	B
L53	2	-	-	43.1 m of 250 mm, 9.2 m of 250 mm, 20.2 m of 250 mm, 55.7 m of 250 mm, 34.6 m of 250 mm, 8.3 m of 250 mm, 19.1 m of 250 mm, 20.7 m of 250 mm, 40.9 m of 250 mm, 10.4 m of 250 mm	43.1 m of 250 mm (add ICD), 9.2 m of 250 mm (add ICD), 20.2 m of 250 mm (add ICD), 55.7 m of 250 mm (add ICD), 34.6 m of 250 mm (add ICD), 8.3 m of 250 mm (add ICD), 19.1 m of 250 mm (add ICD), 20.7 m of 375 mm (add ICD), 40.9 m of 250 mm, 10.4 m of 250 mm	CmBR under 22nd Side Rd to provide attenuation storage	$150,000	$1,000	B
G68	1	-	-	70.5 m of 500 mm, 81.5 m of 450 mm, 89.6 m of 375 mm, 91.6 m of 300 mm	70.5 m of 600 mm, 81.5 m of 600 mm, 89.6 m of 600 mm, 91.6 m of 600 mm	Bioretention in boulevards on each side	$820,000	$111,000	B
A34	1	-	-	60.2 m of 250 mm 70.6 m of 500 mm, 55.4 m of 450 mm, 50.3 m of 525 mm	60.2 m of 450 mm 70.6 m of 600 mm, 55.4 m of 600 mm, 50.3 m of 600 mm	-	$120,000	$1,000	Exempt
G7	3	-	-	29.5 m of 250 mm, 43.4 m of 250 mm	29.5 m of 250 mm, 43.4 m of 375 mm	CHBR under Henry St to provide attenuation storage	$170,000	$1,000	B
G21	1	-	-	36.2 m of 400 mm, 29.8 m of 400 mm, 2.4 m of 250 mm 33.5 m of 250 mm	33.5 m of 525 mm	CHBR under Park Ave to provide attenuation storage	$130,000	$1,000	B
G44	1	-	-	94.9 m of 825 mm, 85 m of 825 mm, 91.1 m of 750 mm, 87.5 m of 675 mm	94.9 m of 900 mm, 85 m of 975 mm, 91.1 m of 900 mm, 87.5 m of 825 mm,	Within SWM pond area	$510,000	$1,000	Exempt
G1	1	-	CIP Liner + External Point Repair needed at mill St and Edith St.	93.0 m of 750 mm, 85.0 m of 600 mm, 80.0 m of 400 mm, 60.0 m of 250 mm	93.0 m of 825 mm, 85.0 m of 750 mm, 80.0 m of 600 mm, 60.0 m of 450 mm	EES/CHBR/IG under Mill St and Charles St. Bioretention at corner of Charles St and James St, where a wide grass boulevard already exists.	$480,000	$6,000	B

Project ID	Surcharging mHs AG[1]	Potential Overland Spill Location	Recommended Mitigation Measures Pipe Repair	Recommended Mitigation Measures Existing	Recommended Mitigation Measures Proposed[2]	LID[3]	Estimated Capital Cost[4]	Estimated Annual Maintenance	EA Schedule
A29	1	-	-	48.3 m of 400 mm 13 m of 400 mm, 84.8 m of 400 mm, 81.3 m of 300 mm	48.3 m of 525 mm, 13 m of 525 mm, 84.8 m of 525 mm, 81.3 m of 375 mm	Bioretention in boulevard where Mill St meets Young St and along Wallace St where boulevard widens to 7 m	$550,000	$77,000	B
A43	1	-	CIP Liner + External Point Repair on Queen St south of Churchill Rd S	35.7 m of 450 mm, 65.3 m of 450 mm, 69.8 m of 300 mm	35.7 m of 750 mm, 65.3 m of 750 mm, 69.8 m of 750 mm	Bioretention in wide grass boulevard sections and on west side	$490,00	$35,000	B
A12	1	-	-	92.3 m of 300 mm, 29.2 m of 300 mm, 13.2 m of 300 mm, 48.6 m of 250 mm, 68.3 m of 350 mm, 18.8 m of 350 mm, 71.0 m of 350 mm	92.3 m of 350 mm, 29.2 m of 400 mm, 13.2 m of400 mm, 48.6 m of 400 mm, 68.3 m of 500 mm, 18.8 m of 500 mm, 71.0 m of 525 mm	Bioretention in grassed boulevards	$770,000	$96,000	B
G19		-	Trenchless Point Repair + Connection Repair along John St near College St.	-	-	Bioswale with periodic check dams on Boulevard.	$180,000	$17,000	B
A41	8	-	-	48.9 m of 400 mm, 56.5 m of 300 mm, 61.5 m of 450 mm, 48.0 m of 500 mm, 3.9 m of 500 mm, 86.3 m of 400 mm 13.0 m of 350 mm, 67.5 m of 450 mm, 91.0 m of 400 mm	48.9 m of 750 mm, 56.5 m of 750 mm, 61.5 m of 750 mm, 48.0 m of 1050 mm, 3.9 m of 1050 mm, 86.3 m of 1050 mm 13.0 m of 1050 mm, 67.5 m of 1050 mm, 91.0 m of 1050 mm	Bioretention along Queen St boulevard east side	$1,450,000	$54,000	B
G11		-	Trenchless Point Repair + Connection Repair	-	-	EES/CHBR/IG under Moore Park Crescent on south side only	$170,000	$1,000	B
G12		-	Trenchless Point Repair + Connection Repair	-	-	EES/CHBR/IG under Moore Park Crescent on both sides of the road	$240,000	$2,000	B
A26		-	Trenchless Point Repair + Connection Repair on Church St E	-	-	EES/CHBR/IG under Church St	$240,000	$2,000	B
A1	3	-	-	71.3 m of 750 mm, 76.3 m of 675 mm, 57.3 m of 675 mm, 20.0 m of 450 mm, 112.8 m of 900 mm, 37.7 m of 900 mm	71.3 m of 1200 mm, 76.3 m of 900 mm, 57.3 m of 900 mm, 20.0 m of 675 mm, 112.8 m of 1050 mm, 37.7 m of 1350 mm	With SWM Pond Area	$710,000	$1,000	Exempt

Project ID	Surcharging mHs AG[1]	Potential Overland Spill Location	Recommended Mitigation Measures Pipe Repair	Recommended Mitigation Measures Existing	Recommended Mitigation Measures Proposed[2]	LID[3]	Estimated Capital Cost[4]	Estimated Annual Maintenance	EA Schedule
A44	1	-	CIP Liner + External Point Repair, Connection Repair on Westcott Rd	36.7 m of 600 mm, 61.8 m of 300 mm, 84.7 m of 400 mm, 101.7 m of 400 mm, 19.9 m of 200 mm, 44.6 m of 600 mm, 42.2 m of 600 mm, 72.5 m of 525 mm, 51.4 m of 525 mm, 64.2 m of 600 mm, 45.6 m of 600 mm, 54.3 m of 575 mm, 24.7 m of 575 mm	36.7 m of 600 mm, 61.8 m of 300 mm (add ICD), 84.7 m of 400 mm, 101.7 m of 600 mm, 19.9 m of 200 mm (add ICD), 44.6 m of 600 mm, 42.2 m of 600 mm, 72.5 m of 750 mm, 51.4 m of 750 mm, 64.2 m of750 mm, 45.6 m of 750 mm, 54.3 m of 750 mm, 24.7 m of 750 mm	Bioretention in grass boulevards. EES/CHmB/IG where boulevard doesn't allow for bioretention	$1,590,000	$116,000	B
G60	3	=	=	123.5 m of 900 mm, 39.8 m of 900 mm, 31.3 m of 1200 mm	123.5 m of 1350 mm, 39.8 m of 1350 mm, 31.3 m of 1350 mm	Bioretention on Armstrong Ave south side close to Sinclair Ave Large OGS at outlet to Credit River	$1,360,000	$48,000	B
G61	4	=	=	98.0 m of 1050 mm, 43.8 m of 1050 mm, 94.4 m of 1050 mm, 75.1 m of 1050 mm, 95.6 m of 900 mm, 61.9 m of 825 mm, 29.6 m of 675 mm, 74.5 m of 675 mm, 95.5 m of 675 mm, 84.1 m of 675 mm, 96.0 m of 675 mm	98.0 m of 1200 mm, 43.8 m of 1200 mm, 94.4 m of 1200 mm, 75.1 m of 1200 mm, 95.6 m of 1200 mm 61.9 m of 1200 mm, 29.6 m of 900 mm, 74.5 m of 1200 mm 95.5 m of 1200 mm 84.1 m of 1200 mm 96.0 m of 1200 mm	Bioretention on both sides of Guelph St and Sinclair Ave boulevards	$3,040,000	$180,000	B
A40	6	=	=	105.2 m of 300 mm, 69.8 m of 300 mm, 117.9 m of 300 mm, 17.2 m of 300 mm, 47 m of 450 mm, 65.8 m of 400 mm	105.2 m of 600 mm, 69.8 m of 450 mm, 117.9 m of 600 mm, 17.2 m of 750 mm, 47 m of 750 mm, 65.8 m of 750 mm	Bioretention in boulevards	$2,080,000	$326,000	B
G71	1	=	=	71.8 m of 450 mm, 96.0 m of 450 mm, 94.6 m of 525 mm, 93.3 m of 525 mm, 26.4 m of 525 mm, 95.4 m of 525 mm	71.8 m of 600 mm, 96.0 m of 600 mm, 94.6 m of 600 mm, 93.3 m of 600 mm, 26.4 m of 600 mm, 95.4 m of 600 mm	Bioretention in South side boulevards, EES/CHmB/IG on North side	$1,330,000	$136,000	B

Project ID	Surcharging mHs AG[1]	Potential Overland Spill Location	Recommended Mitigation Measures Pipe Repair	Recommended Mitigation Measures Existing	Recommended Mitigation Measures Proposed[2]	LID[3]	Estimated Capital Cost[4]	Estimated Annual Maintenance	EA Schedule
G69	3	=	=	40.9 m of 750 mm, 51.9 m of 750 mm, 44.1 m of 750 mm, 56.1 m of 750 mm, 47.7 m of 900 mm, 21.2 m of 250 mm, 28.6 m of 900 mm, 46.8 m of 900 mm, 11.2 m of 900 mm, 11.1 m of 1200 mm, 145.1 m of 3000 mm, 25.5 m of 900 mm, 42.0 m of 1500 mm, 12.4 m of 900 mm, 37.4 m of 900 mm, 69.8 m of 825 mm, 89.6 m of 825 mm, 93.7 m of 825 mm	40.9 m of 825 mm, 14.1 m of 900 mm, 37.8 m of 900 mm, 44.1 m of 900 mm, 56.1 m of 1350 mm, 47.7 m of 1050 mm, 21.2 m of 250 mm (add ICD), 28.6 m of 1050 mm, 60.7 m of 1050 mm, 46.9 m of 900 mm, 11.2 m of 900 mm, 11.2 m of 1200 mm, 145.1 m of 3000 mm, 25.5 m of 1500 mm, 42.0 m of 1500 mm 12.4 m of 900 mm, 37.4 m of 1050 mm, 69.8 m of 900 mm, 89.6 m of 900 mm, 93.7 m of 900 mm	Within SW m pond area	$980,000	$2,000	Exempt
-	-	-	-	-	-	**Subtotal for** Remaining **28** Critical Projects	**$19,350,000**	**$780,000**	-
-	-	-	-	-	-	**Total**	**$26,470,000**	**$920,000**	-

5.2 Addressing Lack of Water Quality/Quantity Controls

For most of the critical project areas where significant excavation was required to address a flooding issue, LID was included as a recommended water quality mitigation measure in catchments where stormwater ponds do not currently exist. In addition to recommending LID at the street level, other possible water quality retrofit approaches were also identified. This includes identification of stormwater management facilities (wet/dry ponds or subsurface storage) and OGS units to be located at a catchment area's outfall. This assessment involved a systematic review of the outfalls where no stormwater quality controls exist in conjunction with a consideration of the surrounding topography to determine if the addition of a stormwater management facility, OGS unit or a combination of both may be practical. A summary of this analysis is presented in **Table 22** below, with further details in Appendix I. These projects are separate from the shortlist of 43 flooding related critical projects highlighted above and need further consideration and integration with other Town priorities (i.e., use of park space). SWM pond retrofits would require that existing open space (i.e., parklands) be utilized for pond construction / stormwater diversion. In many instances this may involve undesirable or impractical trade-offs which make such retrofits infeasible.

Table 22: Summary of Possible Water Quality/Quantity Controls

Project ID	Details	LID	Estimated Capital Cost	Annual Maintenance Cost
A54	Significant catchment area outlets uncontrolled to a ditch. There is a clearing beside a soccer field that could be used to construct a SWMF.	SWMF in park clearing with OGS	$1,500,000	$22,500
A55	Major roadway outlets to a watercourse without any controls.	OGS	$200,000	$1,250
A56	Large area outlets to Black Creek without any controls.	OGS	$200,000	$1,250
A57	Large area outlets to a ditch in Sir Donald Mann Park.	SWMF in park clearing with OGS	$1,500,000	$21,250
A58	Large area outlets to stream uncontrolled.	OGS	$200,000	$1,250
G16	A medium sized catchment drains to Ontario St and Jason Cres without any quantity or quality control.	OGS	$200,000	$1,250
G88	3 major outfalls, draining a large catchment area directly to Silver Creek without quantity and quality control. Adjacent to Cedarvale Park where a large, grassed area exists with potential for a SWMF.	Cedarvale Park SWMF with OGS	$1,500,000	$22,500
G89	Large drainage area comes to a cul-de-sac at the end of Sargent Road and outlets to Credit River without any quantity or quality control.	OGS	$200,000	$1,250
G90	Large drainage area comes to a cul-de-sac at the end of Noble Crt and outlets to Credit River without any quantity or quality control.	OGS	$200,000	$1,250
G92	Two outfalls draining a large catchment area come to this point. Appears to have space for a potential SWMF.	SWMF with OGS	$1,500,000	$22,500
G93	A large area drains through Joseph Gibbons Park to the Credit River. Could have space for a potential SWMF	SWMF	$1,500,000	$22,500
G94	A large area drains to the Credit River without controls. Could have space for a potential SWMF or large OGS. Area is steeply sloped so may only be able to put an OGS.	OGS	$200,000	$1,250
G95	A large area drains to Maple Creek Park, which has a large area that could have space for a potential SWMF.	SWMF with OGS	$1,500,000	$22,500
G96	Large drainage area outlets to Credit River without any quantity or quality control. There is a large, paved area beside the river with room for an OGS.	OGS	$200,000	$1,250
G97	Large drainage area outlets to Credit River without any quantity or quality control. There may be space beside the road with room for an OGS.	OGS	$200,000	$1,250
G98	Outlet to credit river without controls, runs beside River Rd with large grass median on the east side, could site OGS there.	OGS	$200,000	$1,250
G99	Outlet to credit river without controls. Passes through Lilac Lane, which has a parking area where an OGS could be placed	OGS	$200,000	$1,250
G100	Large area drains to Silver Creek without controls. Large grass median between Highway 7 and Wildwood Rd may be able to hold an OGS unit	OGS	$200,000	$1,250
Total	-	-	**$11,400,000**	**$150,000**

6. Stormwater Implementation Plan

6.1 Life Cycle Cost Estimate

A life cycle cost estimate for both the Town's existing and proposed SWM infrastructure was developed to assist with planning and budgeting for future stormwater capital and maintenance costs. This comprehensive life cycle cost estimate includes the following:

- Capital cost and annual maintenance cost estimates for proposed critical remediation projects (43 critical projects, as presented in **Section 5.1** above).
- Capital cost and annual maintenance cost estimates for proposed water quality remediation projects (18 water quality projects, as presented in **Section 5.2** above).
- Annual Maintenance Costs of existing stormwater management infrastructure.

A summary of the total capital and maintenance costs are provided in **Table 23** below with details on how these costs were developed in Appendix J.

Table 23: Total Capital and Maintenance Costs

Description	Capital Costs	Annual Maintenance Costs
Remediation Projects – Top 5 High Priority Projects with Private Property Flooding	$5,170,000	$22,000
Remediation Projects – Next Top 10 High Priority Projects	$1,950,000	$115,000
Remediation Projects – Remaining 28 Projects	$19,350,000	$780,000
Recommended (18) Water Quality projects	$11,400,000	$150,000
Existing Stormwater System Infrastructure		$ 2,464,000
Total	**$37,870,000**	**$3,531,000**

6.2 SWM Financing Options

There are four general types of funding mechanisms used by Ontario municipalities to generate revenue for their stormwater programs. These include:

1. **Tax levies** are mandatory levies authorized through provincial legislation, identified on property tax bills, and revenue is collected by the local government. General tax levies are not related to any specific benefit or public service (i.e., general services to support the public good), whereas special area levies have specific designations and limitations for use (i.e., street lighting, transit, etc.).

2. **Development related charges** and levies are allocated to offset a specific cost (e.g., stormwater servicing) that is attributable to growth and development by private interests, including new development or infill/re-development. These charges are generally applied as part of the land development process (e.g., development charges).
3. **User fees and charges** are allocated to offset the cost of a specific service and payable by those who benefit from the service (includes stormwater rates). These charges are generally identified on utility bills (e.g., water/sanitary bills, hydro bills, etc.).
4. **Other** options include financing practices such as public-private partnerships, federal or provincial economic stimulus grants for infrastructure investment, debentures, and long-term debt-financing strategies.

Note that many municipalities use a combination of the funding mechanisms listed above (e.g., a development charge for development related works, grants when available for certain projects, and a stormwater fee for the remaining stormwater program).

At the time of this report, it is understood that in additional to general tax levies, the funding mechanism currently in place within the Town of Halton Hills is a form of development charge where maintenance charges for a 25-year period are charged to developers at the time of SWM infrastructure assumption by the Town. The amount charged is then held in an interest-bearing account until required for rehabilitative maintenance.

In reviewing the advantages and disadvantages of each option outlined above, the main issues to consider are:

- Ability to sustainably fund the Town’s stormwater program.
- Ease and cost of implementing the funding program, including ongoing administration and the experience of other, similar municipalities.
- Legally defendable.
- And any other attributes as per the Town’s Guiding Principles, which may include equity, promoting sustainable practices, ability to provide credits, ability to phase in, etc.

Property taxes are the primary source of funding for SWM programs in Canada, although stormwater rates are becoming increasingly used.

6.3 Policy and Engineering Development Standards Recommendations

Through the review of existing infrastructure, identification of deficiencies as well as analysis of the processes related to operation, monitoring, maintenance of existing infrastructure the following policies have been identified for consideration by the Town:

- The Town should formalize its street sweeping program to reduce sediment loading to OGS units, SWMFs and downstream receivers. This provides significant water quality benefits and can serve to reduce costly maintenance requirements for SWMFs.
- The Town should develop a sediment forecasting program to understand the current maintenance needs of the Town's various stormwater management facilities (SWMFs), and to support the development of a fully-costed plan to maintain SWMFs on a rotating basis. Bathymetric surveys are recommended to be completed for each SWMF once every five years, at a minimum. Bathymetric surveys should be complemented by periodic sediment sampling to identify suitable reuse/disposal options and to refine budgetary forecasts.
- During the construction of any new SWMF, invasive species should be managed and removed where possible.
- The Town should develop and implement a catchbasin cleaning program that seeks to clean all catchbasins once every 24 months, at a minimum.
- To maximize the utility of catchbasin cleanout efforts, the Town should consider a catchbasin retrofit program to enhance the pre-treatment functionality of municipally-owned catchbasins. Initial priority should be given to catchbasins located in legacy development areas which otherwise lack water quality controls.
- It is recommended that the Town develop a policy surrounding the implementation of low impact development (LID) retrofits as part of road reconstruction or other capital improvements programs. This should include the development of a preferred short list of retrofit feature types which takes into consideration the costs and performance/benefits of such features, as well as the operational capabilities of the Town.
- LID engineering standards and design details should be advanced and included with the Town's development and engineering standards documents.
- The Town should undertake a stormwater management financing study in order to identify a sustainable source of stormwater funding which meets the

Town's needs and is congruent with existing Town processes and administrative capabilities.

- It is recommended that the Town continue to undertake CCTV inspections of their existing linear stormwater assets to confirm condition and to identify prioritized locations where repair or replacement may be needed. It is recommended that CCTV of all underground infrastructure occur every 10 years.
- Based on the review and update of IDF curves (outlined in **Section 3.2** above), it is recommended that the Town develop a transition plan to implement updated IDF curves for the 50- and 100-year events. IDF curves should be regularly updated at each Master Plan phase (minimum on a 10-year interval) and the need for climate change increases incorporated.

6.4 Monitoring Recommendations

The Province of Ontario has begun implementing a new Consolidated Linear Infrastructure Environmental Compliance Approval (CLI-ECA) process which requires municipalities to prepare and implement operations and maintenance procedures for infrastructure as well as monitoring of system performance. The Town's CLI-ECA (328-S701 – Issued September 27th, 2023) requires that a monitoring plan be developed and implemented on or before October 1st, 2025 or within 24 months of the date of the publication of the Ministry's monitoring guidance, whichever is later. The monitoring plan should achieve the following aims, described in **Section 4** of Schedule E of CLI-ECA:

- Verify that operational performance of the authorized system is as designed.
- Assess the environmental impact of the system.
- Outlines procedures for any corrective action to address deficiencies from the above two conditions.

The CLI-ECA outlines the details that the plan should include:

- Identification of the components to be monitored, including outlets and quality/quantity control elements.
- Identification of key receivers to be monitored and the monitoring locations.
- Consideration of relevant municipal and environmental planning documents
- Characterization of water quality and quantity conditions and identification of water users to be protected.
- Identification of water quality and quantity goals
- Identification of rainfall gauges to be used.

- Identification of inspections, measurements, sampling, analysis and/or other monitoring activities used as a basis for the plan and to inform future updates.
- Details of the monitoring plan should include:
  - Hydrological, chemical, physical and biological parameters
  - Ensure water levels of SWMFs are measured with a water level gauge.
  - Monitoring methodology, including the frequency and protocols for sampling, analysis and recording with consideration of dry and wet weather events and timing of sampling during wet weather events
  - Ensure time of all samples or measurements are recorded.

In order to achieve the above two aims, the following preliminary recommendations are provided. A detailed monitoring plan, which is beyond the scope of this Master Plan, is required, as outlined above.

- Verify operational performance of Town's SWM system:
  - Periodic water level and quality sampling of inlet and outlet SWMFs to confirm performance.
  - Pre-assumption facility monitoring should be carefully scrutinized to verify performance.
  - Subwatershed studies should be considered when assessing monitoring parameters of concern and should also be used to inform strategic monitoring of outfalls/assets should the CLI-ECA monitoring guidance ultimately dictate this.
- Assessing environmental impact:
  - AECOM recommends strategic monitoring which capitalizes on current efforts being undertaken by others. Conservation Authorities', for example, carry out monitoring, which can be leveraged to provide decision making support to the Town and support adaptive management. The Town should leverage existing Conservation Authority monitoring data to meet the requirements outlined in the Town's CLI-ECA (328-S701). Monitoring stations summarized in **Figure 21** and **Figure 22** below managed as part of CVC's IWMP/PWQMN have been identified as suitable candidate sites for tracking water quality indicators from the Town.

Figure 21: Acton CVC-IWMP/PWQMS Monitoring Stations

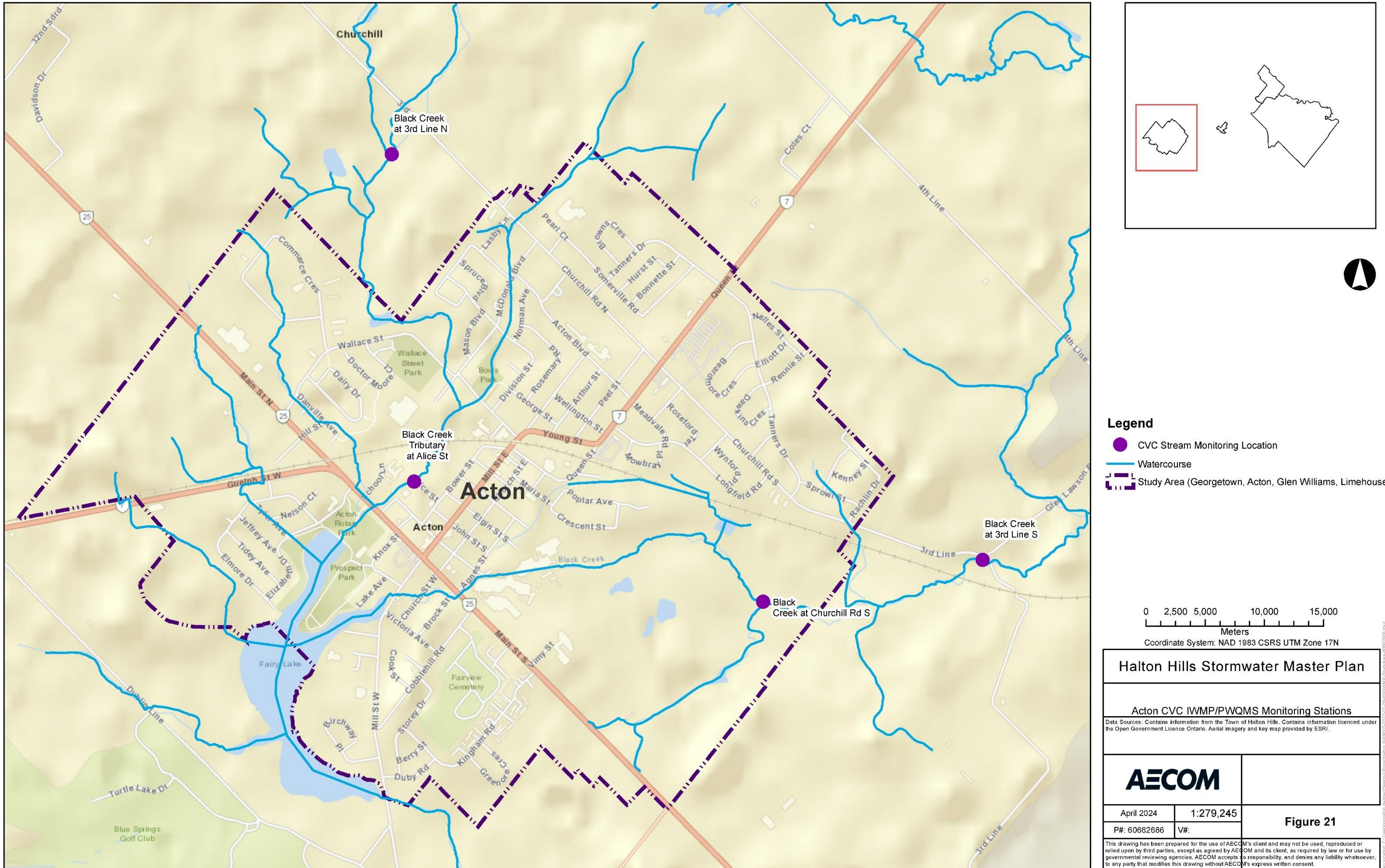
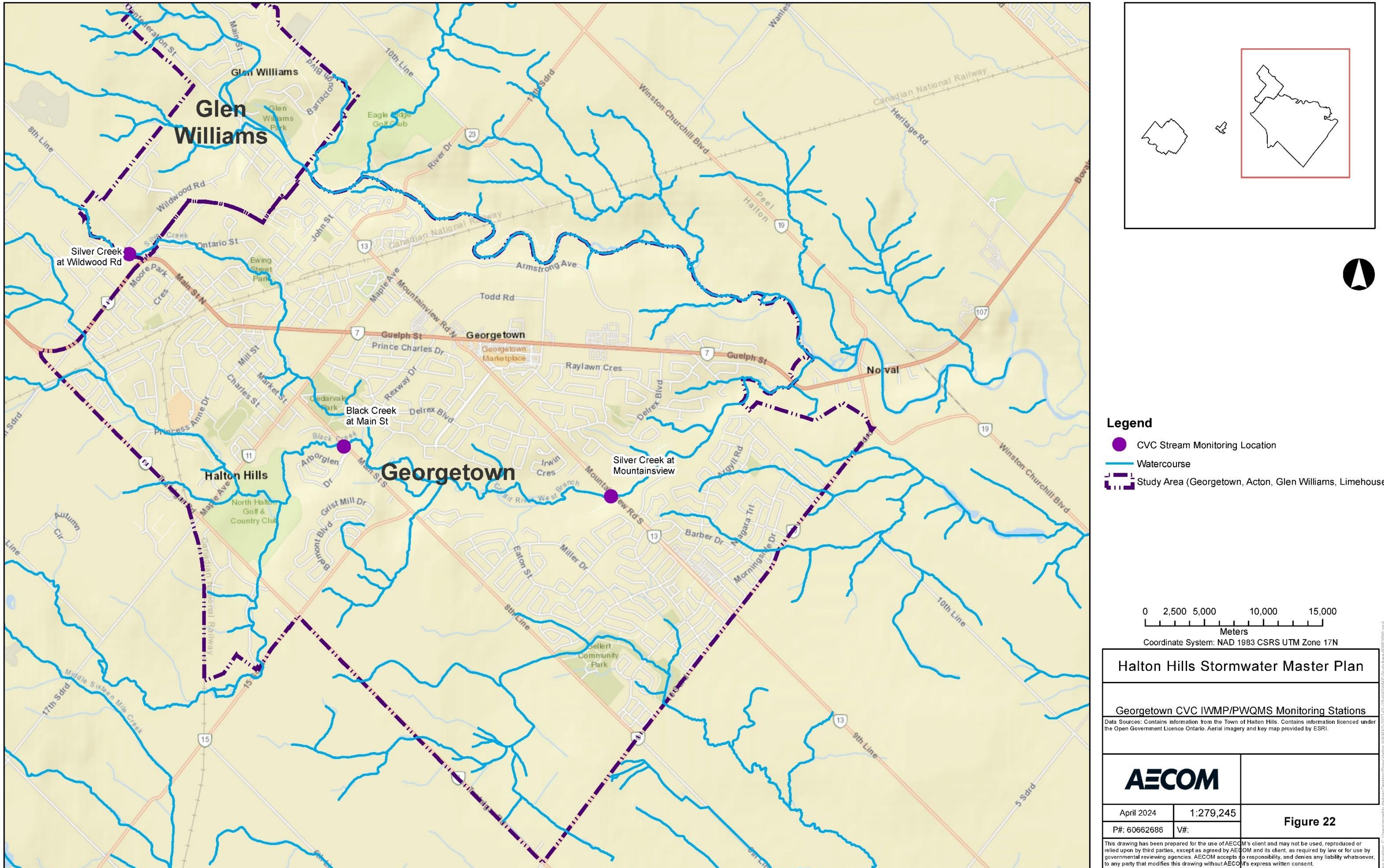


Figure 22: Georgetown CVC-IWMP/PWQMS Monitoring Stations



6.5 Other Considerations

6.5.1 Applicable Provincial Policies

The projects outlined in this master plan may be subject the Provincial Policy Statement (PPS) 2024 and the Greenbelt Plan (GBP) 2017. In accordance with Section 3.6 of the PPS, the proposed projects aim to reduce increases in stormwater volumes and contaminant loads, include green infrastructure where possible and mitigate risks to human health, safety, property and the environment. In accordance with the GBP, the proposed stormwater master plan aims to protect water quality, reduce flood risk and use low impact development where possible.

6.5.2 Permit to Take Water

The proposed projects may need a Permit to Take Water (PTTW) for construction dewatering purposes. If the construction includes the discharge of any collected water from the dewatering activities into surface water features, or a stormwater sewer that directly discharges into a surface watercourse, appropriate treatment and control/mitigation measures will be required to ensure that the proposed discharge will not result in any undesirable impacts on the receiving waters. Dewatering and discharge plans should be provided during the PTTW application process when all the detailed information, including the dewatering and discharge plan, as well as the monitoring, contingency, and erosion and sediment control plans for the proposed construction dewatering activities, are developed.

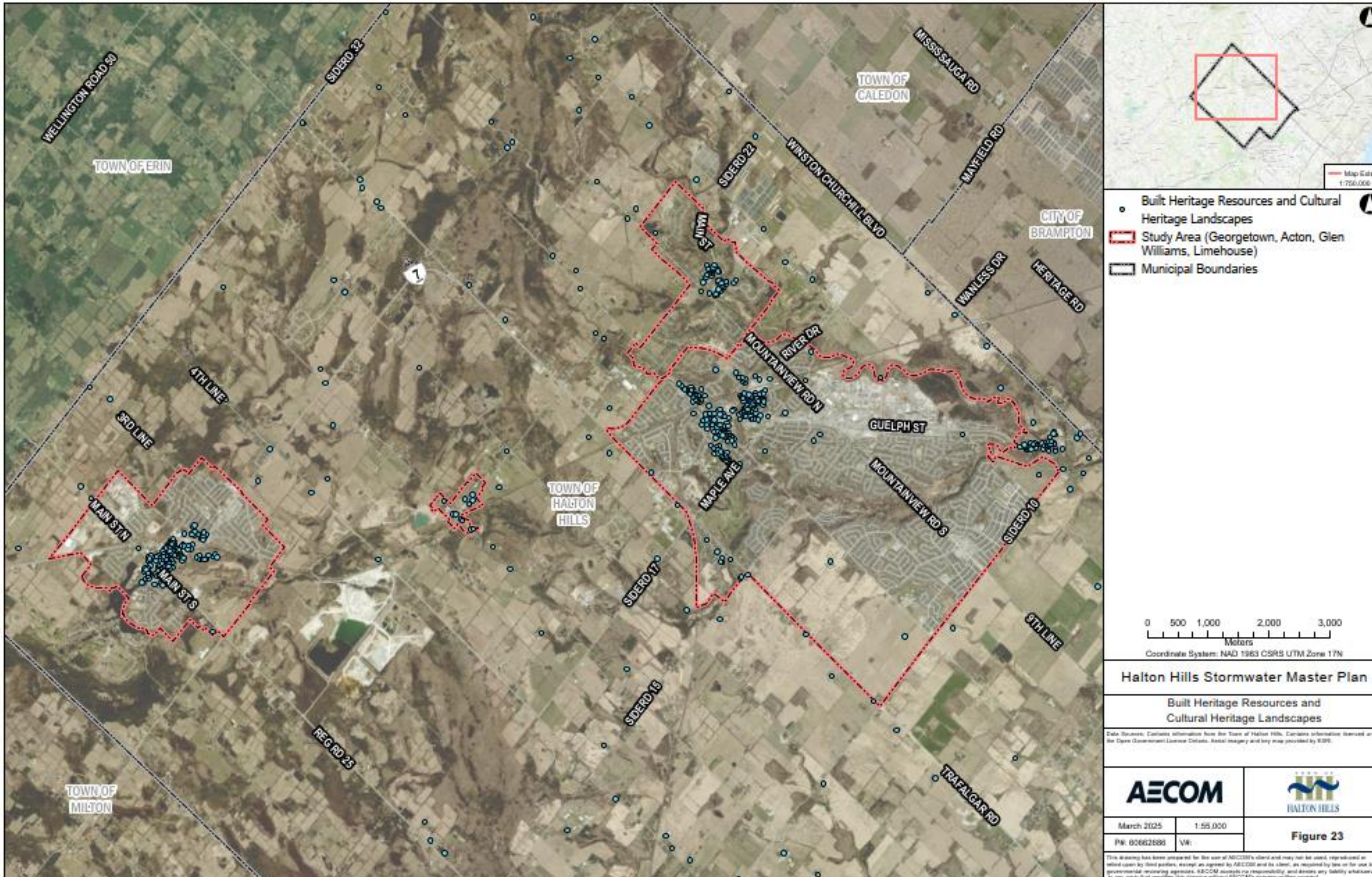
6.5.3 Areas of Archaeological Potential

The potential project areas that are identified within this master plan would be subject to future Archaeological Screening and/or Stage 1 Archaeological Assessments at the detailed project stage. Assessment by a licensed archeologist is required before any ground disturbing activities are carried out.

6.5.4 Built Heritage Resources and Cultural Heritage Landscapes

There are numerous built heritage resources and cultural heritage landscapes (see Figure 23 below) within the study area. Technical heritage studies should be carried out at the project specific level to assess the impact of the proposed projects on these features.

Figure 23: Built Heritage Resources and Cultural Heritage Landscapes



7. Approach to Consultation

7.1 Public and Agency Consultation

This Master Plan report ties together all components of the study and documents Phases 1 and 2 of the Class EA process. It includes a listing and description of all identified projects (see **Table 21** above and Appendix I) with applicable MCEA planning schedule and preliminary cost estimate. The report reflects relevant comments received through the consultation process, from the Town and other stakeholders including key agencies such as MECP and Conservation Authorities as well as Indigenous Communities (see Appendix K).

- A Technical Advisory Committee (TAC) was formed ’which was comprised of experts from the following agencies. Four TAC meetings were held.
- Halton Region
- Conservation Halton
- Credit Valley Conservation
- Department of Fisheries and Oceans
- Ministry of Transportation
- Railway (CP/CN/Metrolinx)
- Ministry of Natural Resources and Forestry
- Ministry of Environment, Conservation, and Parks
- Ministry of Agriculture, Food and Rural Affairs
- Town of Milton

The TAC meetings were held on the following dates:

- Technical Advisory Committee Meeting #1 February 25, 2022
- Technical Advisory Committee Meeting #2 May 18, 2022
- Technical Advisory Committee Meeting #3 May 11, 2023
- Technical Advisory Committee Meeting #4 November 1, 2023

These meetings included an overview of findings to date related to the analysis and assessment of the existing SWM system, identification of deficiencies, overview of proposed remedial measures and prioritization of capital projects. Comments were received and addressed during the meetings where possible or following the meetings as needed.

Furthermore, two Public Information Centres were held virtually. The PICs comprised of a narrated slide presentation providing an overview of the findings to date and was uploaded to the Town's "Let's Talk Halton Hills" public engagement platform. The "Let's Talk Halton Hills" project website was used to garner input related to drainage concerns, update the public about upcoming events and share project outputs. Following these PICs, numerous comments and questions were received and responded to accordingly. The project team maintained a stakeholder database to ensure that groups who wanted to stay in touch were tracked and communication was co-ordinated in a uniform manner.

8. Additional Studies Recommendations

AECOM recommends the following studies be carried out as next steps to support the strategic implementation of the improvements outlined throughout this Master Plan document.

1. SWM Financing Feasibility Study: Such a feasibility study would include a review and evaluation of potential funding options (tax levies, development related charges, user fees, other grants/partnerships etc.) compared against the desired level of service and timeline in which improvements should be made. Assessment of the user fee option will consider the funding gap and look at land parcel data and levels of imperviousness to estimate the total billing units and rate for each property required to close the gap.
2. Road Retrofit Implementation Study: Such a study would review road resurfacing requirements and their related schedules and identify priority retrofit locations that can be tied to the timing of road repairs and reconstructions. This would provide efficiencies as the cost to add LID as part of road reconstruction work is often much less than if carried out as a standalone project.
3. Low Impact Development Design Standards: To make LID implementation more streamlined, it is recommended that the Town develop a short list of preferred LID servicing options along with design standards that be implemented for all projects. This also allows for standardized operation and maintenance procedures for the Town.
4. Communications and Community Outreach Plan: To build awareness of all the above studies and to enhance engagement and build support for LID pilots and demonstration projects, a strong communication and outreach plan is required, tailored to the affected groups/localities within the Town.