Township of Centre Wellington

Stormwater Management Master Plan for Centre Wellington (Elora, Salem and Fergus)

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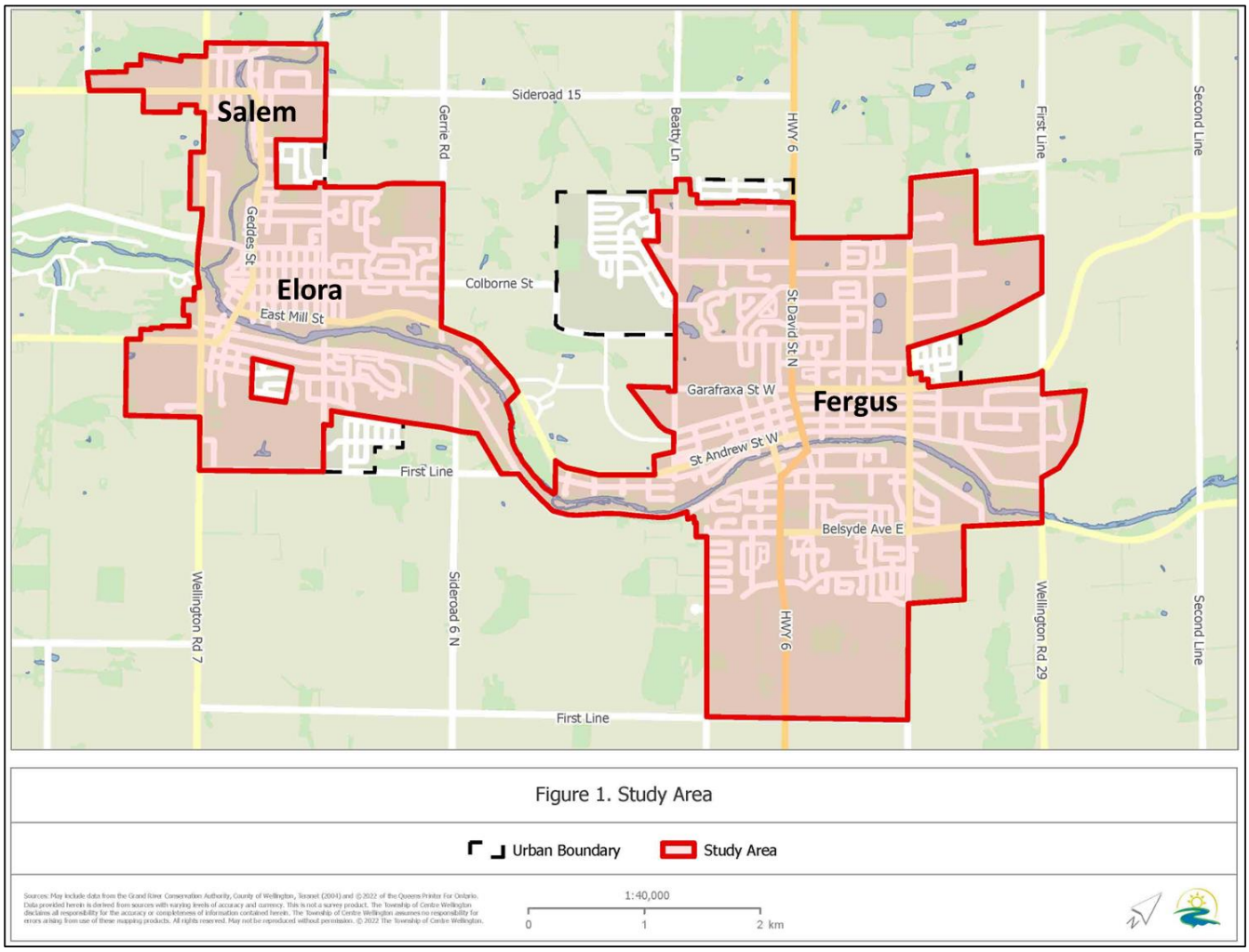
1 Introduction and Background

1.1 Introduction

The Township of Centre Wellington has completed a Municipal Class Environmental Assessment Study for a Stormwater Management Master Plan (SWM MP) for the communities of Elora, Salem and Fergus. A key objective of this SWM MP is to ensure that stormwater (runoff generated by rainfall and snowmelt) is effectively managed. The assessment conducted as part of the SWM MP has identified the capacities and constraints of the existing stormwater management system, evaluated opportunities to improve conveyance and water quantity and quality control, and provides short- and long-range planning alternatives to improve the Township's stormwater infrastructure including an implementation plan.

The Study Area for this assessment is presented in Figure 1-1 and generally consists of the existing limits of the communities of Elora, Salem and Fergus (pending development areas have been excluded as it is expected that these areas would follow current and municipally and Provincially supported stormwater management practices).

Figure 1-1: Study Area



This Study was carried out in accordance with the Master Plan process as outlined in the Municipal Engineers Association's Municipal Class Environmental Assessment document (amended in 2023). This study fulfilled the requirements of Approach #1 of the Master Plan process (the requirements and steps related to this approach are explained further in Section 1.3).

1.2 Objectives

The main objective of the Stormwater Management Master Plan (SWM MP) is to develop a long-term plan for the safe and effective management of stormwater runoff while maintaining, and where possible improving, the associated ecosystem health and ecological sustainability of the Township's water resources. The SWM MP is intended to consider matters such as stormwater quantity and quality control, as well as evaluation and planning of the existing storm conveyance system. The development and delivery of a modern and operational storm system model (integrated hydrology and hydraulics) has also formed part of this project. Overall objectives are as follows:

Water Quantity

- Ensure sufficient conveyance capacity of the Township's drainage system to minimize risk to public health and safety as well as property damage due to flooding

Water Quality

- Improve existing surface water quality to the extent feasible.

Natural Environment

- Stormwater management should assist in managing the existing quantity and quality of stormwater runoff to receiving natural watercourses, wetlands and recharge facilities by replicating pre-development hydrologic processes (match pre to post infiltration, rate, volume)
- Stormwater management should protect, maintain and enhance natural features and functions such as wetlands, and watercourses.

1.3 Master Plan Process

As noted above, this Master Plan was completed under the Municipal Class Environmental Assessment (Class EA) process (2023), which is an approved planning process under Ontario's Environmental Assessment Act. This section explains the Class EA process, as it applies to municipal infrastructure projects.

The Ontario Environmental Assessment Act (R.S.O. 1990, c. E.18; EA Act) (Government of Ontario, 1990)) was put into place to provide for the protection, conservation and wise management of the environment within the province. The EA Act applies to all projects being undertaken by provincial, municipal or other public bodies within the province (unless explicitly exempted). It defines the environmental assessment works that must be completed prior to commencement of any undertaking, as well as the proponent's obligations to consult with all affected and/or interested parties. Under the EA Act, projects are classified as approved, subject to screening, subject to an approved Class EA process, or subject to a full Individual Environmental Assessment.

As noted above, the Municipal Class EA process is an approved process under the EA Act. All municipalities in Ontario are required to follow this approved process for road, water, wastewater, and transit planning projects. It allows for planning of projects on an individual basis (for example, a new pumping station). It also allows for planning of a group of related projects, or an overall system, e.g., water and wastewater network. This process is called Master Planning Process.

The Class EA process classifies projects according to their level of complexity and potential environmental impacts.

- **Exempt Projects:** These projects include projects that involve various municipal maintenance, operational activities, rehabilitation works, minor reconstruction or replacement of existing facilities, and new facilities that are limited in scale and have minimal adverse effects on the environment. These projects are exempted from the requirements of the Environmental Assessment Act. Most of these projects were formerly classified as Schedule A and A+ projects.
- **Projects Eligible for Screening to Exempt:** Some projects may be eligible for exemption based on the results of a screening process. Proponents may choose to complete the applicable screening process to determine whether their project is eligible for exemption from the Environmental Assessment Act or proceed with the applicable Schedule B or C process.
- **Schedule B Projects:** These include projects that involve improvements and minor expansion to existing facilities. There is a potential for some adverse environmental impacts and, therefore, the proponent is required to proceed through a screening process, including consultation with those affected. Schedule B projects are required to proceed through Phases 1, 2 and 5 of the Class EA process.
- **Schedule C Projects:** These include projects that involve construction of new facilities and major expansion of existing facilities. These projects proceed through the environmental assessment planning process outlined in the Class EA document. These projects are required to fulfil the requirements of all five phases of the Class EA process.

The Class EA process is comprised of up to five (5) phases, depending on the project classification. A description of the Class EA planning phases is provided below. A flow chart showing the Municipal Class EA process is provided in Figure 1-2.

- **Phase 1** involves identifying the problem (deficiency) or opportunity.
- **Phase 2** involves identifying and evaluating alternative solutions to address the problem or opportunity by taking into consideration the existing environment and establish the preferred solution considering public and review agency input.
- **Phase 3** involves identifying Alternative Design Concepts for the preferred solution implementation by taking into consideration the existing environment and establish the preferred design concept by considering public and review agency input.
- **Phase 4** involves documenting the environmental assessment process including the design and consultation process in an Environmental Study Report for public review.

- **Phase 5**: Complete contract drawings and documents and proceed to construction and operation. Monitor construction for adherence to environmental provisions and commitments. Where special conditions dictate, also monitor the operation of the completed facility.

Master Plans are long range plans which integrate infrastructure requirements for existing and future land use with environmental assessment planning principles. Master Plans typically recommend a set of works which are distributed geographically, and which are to be implemented over an extended period of time.

Master Plans provide the context for the implementation of the specific projects which make up the plan and satisfy, as a minimum, Phases 1 and 2 of the Class EA process. Notwithstanding that these works may be implemented as separate projects, collectively these works are part of a larger management system. Master Plan studies in essence conclude with a set of preferred alternatives and, therefore, by their nature, Master Plans will limit the scope of alternatives which can be considered at the implementation stage.

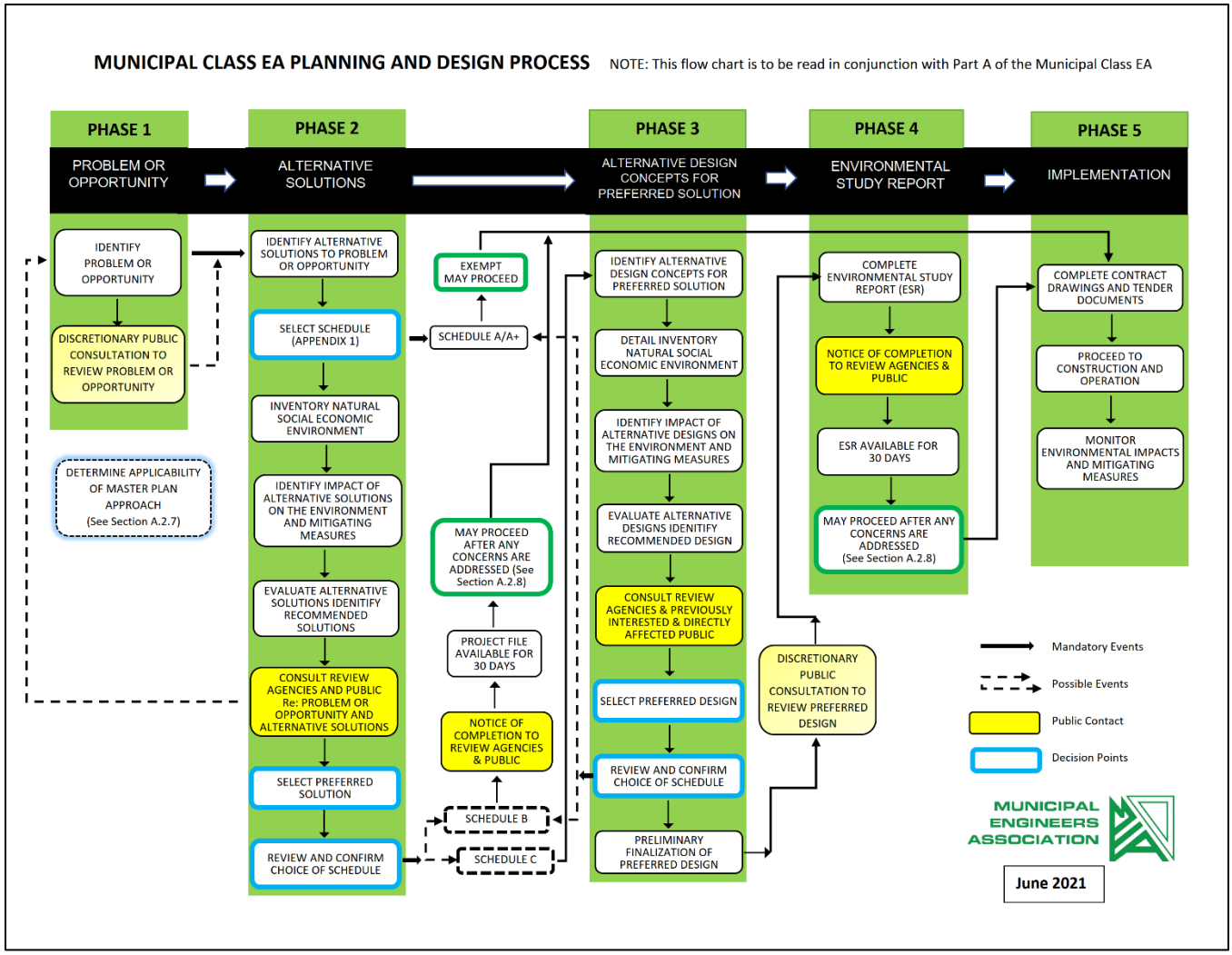
There are four (4) approaches to completing master plans. **As noted above, this study was completed in accordance with Approach #1 of the Master Plan process.** The four (4) approaches of Master Plan process are described below.

- **Approach #1 - Broad Master Planning where identified projects are subject to project specific requirements:** Approach #1 involves the Master Plan being undertaken with a broad scope and level of assessment. This involves analysis on a regional or systems scale, which enables the proponent to identify needs and establish broader infrastructure alternatives and solutions. The inventory of the natural, social and economic environments which are to be considered when assessing the alternative solutions may also be broader/more general. Specific projects that are required to achieve the preferred solution may be identified within the Master Plan document, however the level of detail at a project-specific level is minimal. Therefore, more detailed investigations at the project-specific level are required in order to fulfil the Class EA requirements for the specific Schedule B and C projects identified within the Master Plan. The Master Plan would therefore become basis for, and be used in support of, future investigations for the specific Schedule B and C projects identified within it.
- **Approach #2 - Detailed Master Planning where identified Schedule B projects have completed the MCEA process but identified Schedule C projects are subject to project specific requirements:** Approach #2 involves the Master Plan being undertaken with detailed assessment work to appropriately meet the requirements of Schedule B projects. Specific projects that are required to achieve the preferred solution described in the Master Plan are identified within the Master Plan document. The level of investigation, consultation and documentation are sufficient to fulfil the requirements for the Schedule B projects identified within the Master Plan. For example, more detailed inventories of the natural, social and economic environments are prepared for the areas where specific Schedule B projects are proposed to be located as part of the Master Plan process. These detailed inventories should be considered in identifying and assessing project specific impacts and mitigation measures for each project. The Master Plan must at a minimum meet the requirements of Phase 1 and 2 of the Class EA for both Schedule B and C projects. The level of study completed for the Master Plan is not sufficient to fulfil the

requirements for any Schedule C projects identified. The Master Plan would therefore become the basis for, and should be used in support of, future investigations for the specific Schedule C projects identified within it.

- **Approach #3 – Comprehensive Master Planning where the Class EA process has been completed for identified Schedule B and C projects.** Approach #3 involves comprehensive assessment work being done to appropriately address Schedule B and C projects in the Master Plan. Specific projects that are required to achieve the preferred solution described in the Master Plan are identified within the Master Plan document. The level of investigation, consultation and documentation are sufficient to fulfil the requirements for the Schedule B and C projects identified within the Master Plan. For example, more detailed inventories of the natural, social and economic environments are prepared for the areas where specific Schedule B and C projects are proposed to be located as part of the Master Plan process. These detailed inventories should be considered in identifying and assessing project specific impacts and mitigation measures for each project. The Master Planning process would also include fulfilling all the relevant phases of the MCEA process.
- **Modified Approach #2 or #3:** As mentioned above, depending on the scope of the Master Plan, approach #2 or #3 may result in extensive documentation should the Master Plan include numerous Schedule B and/or C projects. Further, some projects may need to be implemented sooner than others. Accordingly, proponents may choose to complete a Master Plan following approach #2 or #3 for some of the identified projects but not for all. For a Modified Approach #2, this would mean that the level of investigation, consultation and documentation are sufficient to fulfil the requirements for specific Schedule B projects identified within the Master Plan, but not all of them and not the Schedule C projects. For a Modified Approach #3, this would mean that the level of investigation, consultation and documentation are sufficient to fulfil the requirements for all Schedule B projects identified within the Master Plan, and some of the Schedule C projects, but not all of the Schedule C projects. These modified approaches are meant to provide flexibility to proponents to accommodate their needs, timing and resources.
- **Integration with the *Planning Act*:** This approach allows integrating the Master Plan process with approvals under the *Planning Act*. The integrated approach still involves the completion of the procedural requirements of the Class EA process, however proponents can reduce duplication by simultaneously complying with *Planning Act* and Class EA processes using shared notification, consultation, studies, technical reports and documentation opportunities. Essentially both processes may be satisfied at the same time using some of the same information/studies/documentation, as along as the level of detail and assessment completed appropriately captures the requirements of both processes.

Figure 1-2: Municipal Class Environmental Assessment Process



2 Problem or Opportunity Statement

The problem\opportunity statement for this project is set out as follows:

The Township of Centre Wellington is a growing community with a mixture of older areas which pre-date the requirements of modern stormwater management, and newer areas which have developed or are developing with more current stormwater management. In such areas, there can be problems with respect to limited drainage system conveyance capacity, and issues with respect to water quality and impacts to the receiving environmental systems.

The Township of Centre Wellington has undertaken a Stormwater Management Master Plan (SWM-MP) for the primary communities of Elora, Salem and Fergus. The Study Area limits generally encompass the municipal limits for these communities apart from ongoing\planned development areas which have been excluded. The SWM-MP has considered how existing areas can strive toward sustainable approaches to address the requirements of conveyance, quantity and quality control. In addition, updates to the Township's stormwater management design guidelines are proposed to ensure that future development applies current requirements.

The current study has defined a clear and balanced view of infrastructure deficiencies and requirements to address water quantity and quality management for the communities of Elora, Salem and Fergus. In addition, there are many other emerging considerations, including contemporary asset management principles, climate change influences, Provincial criteria and others, which have prompted Centre Wellington to advance this study. The Master Plan developed a comprehensive plan for short-term and long-term implementation.

3 Stormwater Management Policy Framework

This section provides a summary of the legislation, plans, and policies applicable to stormwater management. Its intent is to provide the current framework for the planning and design of stormwater management systems in the Township study area, relevant to the management of the quantity and quality of runoff and the protection of environmental systems reliant on water.

3.1 Provincial Legislations, Policies and Plans

3.1.1 Ontario Water Resources Act

The *Ontario Water Resources Act (OWRA, RSO 1900 and amendments)* prohibits activities that introduce pollutants into natural waterbodies, such as creeks, rivers and lakes. Specifically, Section 30 (1) of *OWRA* states that "*Every person that discharges or causes or permits the discharge of any material of any kind into or in any waters or on any shore or bank thereof or into or in any place that may impair the quality of the water of any waters is guilty of an offence.*"

The OWRA gives the Ontario Ministry of the Environment, Conservation and Parks (MECP) the authority to regulate water supply, sewage disposal and to control sources of water pollution, which includes surface waters and groundwater in Ontario. The MECP formerly (prior to the CLI ECA – see below) issued Environmental Compliance Approvals under Section 53 of the *OWRA* for the treatment and disposal of sewage by municipal and private systems, which includes Stormwater Management (SWM) facilities. Stormwater is defined as "sewage" under the *OWRA*. Stormwater facilities constructed prior to the mid-1950s (when the *OWRA* was first applied) would not have received approval. A Director, as defined in the *OWRA*, has the power to order the owner of a sewage works (e.g., a municipality owning a SWM pond or a storm sewer system) that may discharge deleterious material into a watercourse to carry out works or activities to reduce or alleviate the water quality impairment. This power has not been applied to Municipalities for normal operation of storm sewer and SWM systems, although it could be.

The Township of Centre Wellington holds a Consolidated Linear Infrastructure Environmental Compliance Approval (CLI-ECA), which provides it authority over all of its stormwater conveyance and control assets and provides the Township with the ability to manage changes to the system over time. More information about this CLI ECA is provided in Section 4.1.9.

3.1.2 Provincial Water Quality Objectives

Provincial Water Quality Objectives (1994) (PWQO) are the numerical and narrative criteria which serve as chemical and physical indicators representing a satisfactory level for Ontario's surface and ground waters under the OWRA, based on public health and aesthetic considerations. The PWQO are intended to provide guidance in making water quality management decisions and are often used as the starting point in deriving requirements included in provincial Environmental Compliance Approvals (ECAs). They are also used to assess ambient water quality conditions, infer use impairments, assist in assessing spills, and monitoring the effectiveness of remedial actions.

3.1.3 Clean Water Act

The Ontario Clean Water Act (2006) ensures communities are able to protect their municipal drinking water supplies by developing collaborative, locally driven, science-based protection plans (i.e. Source Protection Plans). Under this Act, communities are required to identify existing and potential threats to their current and future water supplies and take action to reduce or eliminate the significant threats and risks. This requires municipalities to work in collaboration with regional government (where applicable) and Conservation Authorities, leading to programs and criteria to be developed and incorporated into municipal policies.

The Township of Centre Wellington falls within the boundaries of the Grand River Source Protection Plan (Lake Erie Region Source Protection Committee, 2022). This plan provides policies for the protection of drinking water sources from prescribed drinking water threats.

3.1.4 Provincial Policy Statement

The Provincial Policy Statement (PPS), 2020 provides policy direction for appropriate development while protecting resources of provincial interest, public health and safety, and the quality of the natural and built environment. The PPS supports improved land use planning and management, which contributes to a more effective and efficient land use planning system (Ministry of Municipal Affairs and Housing , 2020). The PPS is issued under the authority of Section 3 of the *Planning Act, 1990*. The current PPS came into effect on May 1, 2020, and replaced the PPS issued on April 30, 2014.

Policies related to stormwater management are provided in Section 1.6.6.7 of the PPS (2020) (Ministry of Municipal Affairs and Housing, 2020). In relation to this project, these policies direct that planning for stormwater management shall:

- *minimize, or, where possible, prevent increases in contaminant loads,*
- *minimize erosion and changes in water balance and prepare for the impacts of a changing climate through the effective management of stormwater, including the use of green infrastructure.*
- *mitigate risks to human health, safety, property and the environment,*
- *promote stormwater management best practices, including stormwater attenuation and re-use, water conservation and efficiency, and low impact development*

3.1.5 Growth plan for the Greater Golden Horseshoe

A Place to Grow is a growth plan issued under the Places to Grow Act, 2005. It provides a more detailed framework for where and how growth should be accommodated in the Greater Golden Horseshoe (GGH). The Act allows the Provincial government to plan for population growth, economic expansion and the protection of the environment, agricultural lands and other resources in a coordinated and strategic manner. The Growth Plan was updated in 2020 to reflect growth planning to 2051, guiding decisions on transportation, infrastructure planning, land-use planning, urban form, housing, natural heritage, and resource protection. It provides direction on where growth can occur, the form of future development and future population and employment forecasts.

Section 3.2.7 of the Growth Plan requires municipalities to develop stormwater master plans for serviced settlement areas (Ministry of Municipal Affairs and Housing, 2020).

3.1.6 Proposed Planning Statement

In 2023, the Ministry of Municipal Affairs and Housing issued a Proposed Planning Statement to integrate the *PPS, 2020* and *a Place to Grow (Growth Plan) (amended in 2020)* into one document to outline provincial policies for an integrated province-wide land use planning. The stormwater management related policies in this document are consistent with the polices of the *PPS, 2020* and *a Place to Grow (Growth Plan) (amended in 2020), as noted above* (Ministry of Municipal Affairs and Housing, 2023).

3.1.7 Stormwater Management Planning and Design Manual

The MECP (formerly Ministry of Environment (MOE)) produced the Stormwater Management Planning and Design Manual (SWMPDM) in 2003. The SMWPDM is intended to provide guidance on the procedural and technical aspects of SWM practices as they are planned and designed to achieve the SWM development criteria for a site. The SWM development criteria, as outlined in the SWMPDM, include water balance, water quality, erosion control, and water quantity criteria.

Water balance criteria are intended to offset the reduction in groundwater recharge resulting from urbanization. Modelling should be completed to determine the water balance requirements for a site. Where computer modelling is not completed, the SWMPDM provides an outline of the Thornthwaite and Mather method (1957), which determines the potential and actual amount of the hydrologic cycle components (i.e. precipitation, evapotranspiration, runoff, and infiltration) for various soil types and vegetation covers.

Water quality criteria are intended to protect receiving habitats from deleterious substances that are entrained in stormwater runoff from a site. Water quality protection is based on a reduction of total suspended solids (TSS) loading. The level of protection required for a site is to be based on the characteristics of the receiving waters. There are three (3) levels of protection: Enhanced Protection (80% TSS removal), Normal Protection (70% TSS removal), and Basic Protection (60% TSS removal). Table 3.2 in the Manual outlines the water quality storage volume requirements for site, which is dependent on the imperviousness and SWM BMP type selected for the site (i.e. infiltration, wetland, wet pond, hybrid wet pond/wetland).

Erosion control criteria are intended to protect receiving waters from erosion potential created by the change in hydrologic characteristic associated with urbanizing a site. Erosion protection requirements are to be determined based on the characteristics of the receiving waters. Erosion protection is commonly provided in an end-of-pipe facility or infiltration SWM BMP.

Water quantity criteria are intended to offset the increase in peak flow rates from a site resulting from urbanization. The generally accepted criteria are to control post-development peak flows to pre-development levels for the 2 year, 5 year, 10 year, 25 year, 50 year, and 100 year return period storm events. Water quantity control is typically provided in an end-of-pipe facility.

The SWMPDM also provides guidance on the selection and design of SWM BMPs to achieve the aforementioned criteria. SWM BMPs are split into three categories: lot-level controls, conveyance controls, and end-of-pipe controls. Lot-level controls are controls at the source of

the runoff. These include BMPs such as reduced lot grading, rooftop storage, and disconnection of roof leaders. Conveyance controls are controls that form part of a site's conveyance system, such as grassed swales and pervious pipe systems. End-of-pipe controls are controls located at the end of a storm sewer system and receive drainage from the majority of the site. End-of-pipe controls include wet ponds, wetland, dry ponds and infiltration basins.

3.1.8 Daft Low Impact Development Stormwater Management Guidance Manual

The Daft Low Impact Development Stormwater Management Guidance Manual (2022) (LID Guidance Manual) has been developed as a method to outline guidance for LID methods and protect waterways and water quality, reduce flood risks and potential for damage, and increase resilience to increasing climate change events throughout the Province of Ontario. This manual encourages innovative practices, designs, and technologies for LID measures, as well as early adoption within the development process.

The LID Guidance Manual provides performance guidance on Runoff Volume Control Target using the 90th percentile precipitation event where the rainfall amount ranges from 23 mm to 32 mm based on local precipitation patterns throughout Ontario. These figures were determined through hourly rainfall analysis using a 12-hour minimum inter-event time. Stormwater management measures should be utilized in a hierarchical approach that target runoff retention followed by LID filtration and then conventional stormwater management. The purpose for these guidelines is for municipalities, developers, and other interested parties to utilize in order to implement green infrastructure and practices that infiltrate, evapotranspire, or harvest and reuse stormwater.

Introducing LID practices into developments or existing structures improves water and energy conservation, reduces the urban heat island effect, creates species habitat, and provides aesthetic green spaces to the area. Every project should have tailored combinations of LID practices that are created early in the planning process. This incorporates better site design techniques such as preserving natural areas and open space, distributing run off, absorbent landscaping, buffers for adjacent watercourses, and reducing impervious pavement if possible. LID practices also reduce pollutant run off and should be applied throughout developments, but in particular on sites with high-risk pollutant activities. Pollution prevention methods include utilizing less pollutant materials, equipment, and process on-site, spill prevention, and recovery of waste. Better site design, pollution prevention, and LID practices are cost-effective, lower maintenance, and better performing and more effective during extreme storms in comparison to their traditional counterparts.

3.2 Municipal Policies and Plans

3.2.1 Wellington County Official Plan

The County Official Plan is a legal document intended to give direction over the next 20 years, to the physical development of the County, its local municipalities and to the long-term protection of County resources.

The County's Official Plan designates three land use systems. These are: the Greenlands system, the Rural system and the Urban system. The Greenlands system is comprised of natural heritage features. The Rural system is comprised of prime agricultural areas. The

Urban system is comprised of hamlets and urban centres. In the Township of Centre Wellington, there are three Urban Centres, Fergus, Elora-Salem and Belwood. The remainder of the Township is part of the Greenlands and Rural systems. The Township of Centre Wellington has developed its own Official Plan that applies to the Elora and Fergus Urban Centres, including Salem and Belwood. Since this study focuses on the communities of Elora, Salem and Fergus, the policies of Township's Official Plan are applicable.

Policies in regard to stormwater management are provided in Section 11.3 of the County Official Plan. These policies require development of the best management practices and techniques to maintain storm water quality and quantity in order to control flooding, ponding, erosion and sedimentation and to enhance water quality and aquatic habitat including fish habitat or other natural habitat which depend upon watercourses and other waterbodies for their existence (County of Wellington, 2023).

3.2.2 Township Official Plan

The Official Plan of the Township of Centre Wellington is a policy document that sets out the Township's vision on how land should be used. As noted above, the Township of Centre Wellington's Official Plan only applies to the Elora and Fergus Urban Centres, including Salem and Belwood.

Policies regarding stormwater management are provided in Section C.7 of the Township's Official Plan. These policies encourage the effective management of storm water drainage and run-off through the implementation of best management practices and storm water management techniques in accordance with applicable provincial policies and guidelines. These policies further require that storm water management systems shall provide quality control for all receiving water bodies that contain fish habitat. Infiltration of storm water at, or near, the source is the preferred method of treatment.

The Township's Official Plan also provides policies for the conservation of cultural heritage resources and, protection and enhancement of natural environment. Relevant policies are summarized below.

Policies under Section C.2 require the Township, when undertaking public works within the Heritage Areas, to evaluate the impacts on the heritage of the area, determine potential public safety considerations, identify alternatives, and implement any remedial measures to eliminate or reduce any adverse impacts. The policies in the same section also require completion of archaeological survey and the preservation or rescue excavation of significant archaeological resources that might be affected in any future development.

Policies under Section C.3 encourage the protection and enhancement of the natural heritage of the Township. With these policies, the Township will give consideration to the protection, preservation and enhancement of significant natural features when planning for future growth. Significant natural features include rivers and streams and their valley lands, wetlands, flood plains, headwaters and water catchment areas, ground water supplies, environmentally significant features, wildlife and fish habitats and lands with ecological functions.

4 Study Area Characterization

Various approaches for completing Master Plans under the Class EA process were described in Section 1.3 of this report. As noted therein, this Master Plan was completed following Master Plan Approach #1. This approach involves completing the Master Plan with a broad scope and level of assessment based on an analysis conducted on a regional or systems scale, which enables the proponent to identify needs and establish broader infrastructure alternatives and solutions. Under Approach #1, the inventory of the natural, social and economic environments may also be broader/more general. Specific projects that are required to achieve the preferred solution may be identified within the Master Plan document, however the level of detail at a project-specific level is typically less detailed. Therefore, more detailed investigations at the project-specific level may be required in order to fulfil the Class EA requirements for the specific Schedule B and C projects identified within the Master Plan.

Accordingly, the Study Area characterization for this study has been limited to inventorying the existing stormwater management system within the communities of Elora, Salem and Fergus to the limits of the study area presented in Figure 1-1. In terms of natural heritage, the scope was limited to documenting the natural heritage designation as outlined in County of Wellington Official Plan. Project-specific ecological screenings are recommended as future commitments. Similarly, project-specific studies to identify built heritage resources and cultural heritage landscapes, and archaeological resources are also recommended as future commitments (see Section 8.4 for future commitments).

4.1 Background Information

4.1.1 Information Received

The following information has been reviewed in support of the current study:

- **Reports, Drawings and other Miscellaneous Information (Centre Wellington)**
  - SWM Reports and Copies of Certificates of Approval for various SWM Facilities
  - Storm Sewer Study (Elora) – Existing and Proposed Storm Sewers and Drainage Areas (Drawings Only - Triton Engineering, October 2015)
  - 2021 State of the Infrastructure and Asset Management Plan for Gravel Roads (4 Roads Management Services, September 2, 2021)
  - Information Related to Township's Consolidated Linear Infrastructure – Environmental Compliance Approval (May 26, 2022)
  - Township of Centre Wellington Asset Management Plan (2022)
  - Township of Centre Wellington Development Manual – DRAFT (May 2023)
- **GIS Data (Centre Wellington)**
  - Municipal Boundary
  - Official Plan Land Use Layers
  - Zoning Land Use Layers

- Property Parcels
- Buildings
- Roads
- Storm Sewers, Maintenance Holes, Catchbasins, and Outfalls
  - Base Data (provided June 29, 2022)
  - Updated Invert Data Layer (provided November 14, 2022)
- Stormwater Retention Ponds
- Bridges and Culverts
- Water and Wastewater Servicing Layers
- Subdivision Construction Year Mapping

- **GIS Data (GRCA)**
  - Watercourses, waterbodies, and wetlands
  - Subcatchment Boundaries
  - Regulated Area Limit
- **GIS Data (Other Sources)**
  - Lake Erie 2016-2018 Lidar DTM – Package W (OMAFRA – Ontario GeoHub)

4.1.2 Infrastructure Data Screening

Asset Information

A summary of the available stormwater infrastructure within the communities of Elora, Salem and Fergus was provided with the original study Terms of Reference (i.e. as supplied by the Township). WSP has separately completed a review of the GIS information supplied for this study. Information related specifically to end-of-pipe SWM facilities within the study area is presented in Table 4-1.

Figure 2 (attached) presents an overview of stormwater infrastructure, and in particular end of pipe SWM facilities and storm sewer outfalls, including Centre Wellington Asset numbers. Figures 2A and 2B represent the views for the communities of Elora\Salem and Fergus respectively.

As evident from Table 4-1, there are a total of four (4) SWM facilities within the study area for Elora, and eleven (11) for Fergus, for a total of 15. There are 31 SWM retention ponds in the overall community, however, this reflects the extent of the full Township rather than the scoped study area (as per Figure 1-1).

In addition to the preceding, three (3) oil/grit separators are noted in Fergus and one (1) in Elora within the study area limits. Fourteen (14) OGS units are noted overall within the Township's GIS database, however, the majority appear to be intended to service new development areas, outside of the study limits.

Table 4-1: Summary of SWM Facilities within the Study Area

Community	SWM ID	C of A or ECA	Outfall Reference	Name
Elora	SW-00002	3-078-94-006	SO-00037	Irvine Street SWM Area
Elora	SW-00003	N/A	SO-00038	Patrick Boulevard SWM Area
Elora	SW-00004	3-0713-97-006	SO-00017	Bridge Street SWM Area
Elora	SW-00005	N/A	SO-00105	Clarke Street SWM Area
Fergus	SW-00009	N/A	N/A	Burnett Court SWM Area
Fergus	SW-00010	N/A	SO-00114 (SO-00015)	Gibbons Drive SWM Area
Fergus	SW-00011	8041-5QDNLZ	SO-00007 and SO-00008	Gordon Street SWM Area
Fergus	SW-00012	3-1125-89-006	SO-00015	Black Street SWM Area
Fergus	SW-00013	3-0421-99-006	SO-00007 and SO-00008	Bellamy Crescent SWM Area
Fergus	SW-00014	N/A	SO-00106	Glencoe Park SWM Area
Fergus	SW-00015	4070-4P3RBF	SO-00012	Cherry Hill Place SWM Area
Fergus	SW-00016	3-1011-93-006	SO-00109	Belsyde Avenue SWM Area
Fergus	SW-00017	5122-7TGK2N	SO-00107	Westminster SWM Area
Fergus	SW-00018	N/A	SO-00108	Highway 6 South SWM Area
Fergus	SW-00025	4545-AMUSBR	N/A	Gregson Crt SWM Area

The preceding information, in conjunction with the overall assessment of drainage network boundaries (refer to Section 4.2.1) has been used to estimate those areas of the Township within the study area that do or do not receive some degree of stormwater management. The information for end-of-pipe SWM facilities in Table 4-1 has undergone further review (refer to subsequent sections) to determine to what degree quantity and quality control are currently provided. The SWM reports have also been reviewed further to confirm that there is sufficient information regarding the operational stage-surface area (or stage-storage) and stage-discharge relationships, for incorporation into the hydrologic\hydraulic modelling (as described in Section 5 specifically).

Note that the GIS information supplied by the Township includes a total of sixty (60) stormwater outfalls to receivers, numbered sequentially. As part of its review, WSP has identified a number of additional potential outfalls, although in many cases these are internal system outfalls (i.e. discharge to an intervening watercourse and then back to an ultimate storm sewer system\outfall). Notwithstanding, these additional internal outfalls have been numbered separately on the drainage figures (100 series ID).

Based on the supplied storm sewer GIS data, within the study area, there are a total of:

- *Storm Sewers: 8,319 sections (106 km)*
- *Maintenance Holes: 534*
- *Catchbasins and Catchbasin Maintenance Holes: 3,351*

A key initial data gap with respect to storm sewer data related to the availability of elevation information; this information gap is reviewed further in the following sub-section.

Data Gaps

As noted previously, the information with respect to end-of-pipe SWM facilities requires further query (likely through the information supplied via SWM reports and copies of Certificates of Approval) to confirm the level and degree of SWM currently provided, to better assess and understand existing levels of quantity and quality control for the communities of Elora, Salem and Fergus. In addition, as noted, operational rating curve information is required for incorporation into subsequent hydrologic\hydraulic modelling (as described in Section 5).

The primary identified data gap through the initial screening review has been the lack of storm sewer and maintenance hole elevation information, specifically storm sewer invert data. Based on the identified data gaps (discussed with Township staff on September 29, 2022), Township staff undertook an extensive review of available record drawings to assist in populating the storm sewer GIS database with available invert information. An updated storm sewer dataset was supplied to WSP on November 14, 2022.

As per the updated dataset, of the 4,090 sections of storm sewer within the updated dataset, 559 (14 %) were indicated as being > 300 mm in diameter and missing both inverts (i.e. both upstream and downstream). Some sections of storm sewer remained with only one (1) invert (i.e. either upstream or downstream) however these gaps were considered fillable through interpolation. The primary remaining gap areas were identified as being within the downtown Elora area (generally south of David Street, and between North Queen Street and Wellesley Street). Other minor isolated sections of storm sewers throughout the study area with residual invert gaps have been noted as well.

To address the remaining data gaps, WSP deployed field staff to conduct field investigations to open MH lids and measure depths below the rim between December 12 and 16, 2022. This additional information has been used as part of the importation of relevant data into the hydraulic modelling database; this is discussed further in Section 5.

4.1.3 Existing Rainfall Data

The Township of Centre Wellington's currently approved rainfall intensity-duration-frequency (IDF) data are purported to be based on 2010 data from the nearby Environment Canada (EC) Station at Shand Dam. The EC approach for statistical data interpretation employs a two-parameter equation ($i= A * T^B$), where i = rainfall intensity (mm/hr) and T = time (hours).

Currently approved parameters are presented in Table 4-2; resulting intensities in Table 4-3.

Table 4-2: Currently Approved (Existing) IDF Parameters

PARAMETER	IDF PARAMETER BY RETURN PERIOD (YEARS)					
	2-YEAR	5-YEAR	10-YEAR	25-YEAR	50-YEAR	100-YEAR
A	23.3	30.7	35.6	41.8	46.4	51.0
B	-0.699	-0.699	-0.699	-0.699	-0.699	-0.699

Table 4-3: Rainfall Intensities (mm/hr) based on Existing IDF

DURATION	RAINFALL INTENSITY (mm/hr) BY RETURN PERIOD (YEARS)					
	2-YEAR	5-YEAR	10-YEAR	25-YEAR	50-YEAR	100-YEAR
5 min	132.3	174.4	202.2	237.4	263.6	289.7
10 min	81.5	107.4	124.6	146.3	162.3	178.4
15 min	61.4	80.9	93.8	110.2	122.3	134.4
30 min	37.8	49.8	57.8	67.9	75.3	82.8
1 hr	23.3	30.7	35.6	41.8	46.4	51.0
2 hr	14.4	18.9	21.9	25.7	28.6	31.4
6 hr	6.7	8.8	10.2	11.9	13.3	14.6
12 hr	4.1	5.4	6.3	7.4	8.2	9.0
24 hr	2.5	3.3	3.9	4.5	5.0	5.5

The parameters noted in Table 4-2 (in the Township's Development Manual) are based on the MTO's IDF lookup tool for the year 2010.

The 2010 IDF update from Environment Canada (EC) includes data up to and including 2003; there does not appear to be an update that includes data up to and including 2010. The 2019 update includes data up to and including 2007. Versions from 2020 onwards include data up to and including 2016.

The currently available IDF data version from EC (2022) appears to be consistent with that from 2020 (and presumably 2021; although this is not currently accessible) and includes annual maxima data up to and including 2016 as noted which reflects different parameters and intensities than those presented in the preceding tables. Thus, the current dataset does not include the last six (6) years' worth of available annual data (2017-2022).

Overall, the current EC IDF values (up to and including 2016) appear generally less than those presented in Table 4-2.

It is noted that an initial time of concentration of 5 minutes is specified in the Development Manual (10 minutes for single-family residential units and park areas) for application using the Rational Method.

4.1.4 Gravel Road Condition Assessment

The Township has identified eight (8) existing gravel roads which are planned to be converted to hard top surfaces. This conversion may bring forward the need to upgrade and/or change the storm servicing system from rural to semi-urban or urban, including consideration for associated SWM. The identified sections of roadway include:

- **Elora (all located at the north end; north of CR18\Woolwich Street)**
  - *Victoria Street (Woolwich to North End)*
  - *Water Street (Woolwich to William Street)*
  - *Williams Street (Wellington Road 7 to Washington Street)*
  - *George Street (James Street to Washington Street)*
  - *Washington Street (Woolwich Street to Closed Bridge)*
  - *James Street (Woolwich Street to North End*)
- **Fergus (industrial area near Beatty Line and Groves Memorial Hospital)**
  - *St. George Street West (Maple Street to Beatty Line North)*
  - *St. Patrick Lane (Beatty Line to Breadalbane Street*)

The subject roadways require further review to confirm what storm infrastructure may be required and what drainage improvement opportunities exist.

The above-noted areas have been considered for any potential overlap with recommended stormwater management measures. In general, any road paving would need to consider appropriate stormwater management controls to offset expected increases in runoff and peak flows, and decreased water quality. Further, it is generally recommended that rural road cross-sections (i.e. ditching) be preserved where possible to maintain opportunities for infiltration. Other opportunities in this regard may also include hybrid road drainage sections with curb and gutter outlets to ditching and short run storm sewers.

4.1.5 Snow Disposal Sites

The Township of Centre Wellington is considering potential areas to implement a snow disposal and management site. Three (3) preliminary alternatives sites are proposed by Centre Wellington including:

- *Fergus East Works Garage (assumed to be 600 Glengarry Crescent, Fergus)*
- *West Garafaxa Works Garage (assumed to be 7444 Wellington Country Road 21, Elora)*
- *Operations Centre (965 Gartshore Street, Fergus)*

A conceptual Site Plan has been provided for the Operations Centre (October 1, 2021) which outlines the proposed Operations Building, Vehicle Storage Pole Barn, Salt Shed, and greenhouse. An area at the north end of the site is noted for a “Storm Pond” however sizing assumptions are not clear, and it is noted that the area is located within both the GRCA

Regulation Limit and the 100 m buffer limit around a well. Information on the other two (2) sites has not been provided.

Ultimately, a systematic assessment of these areas would be required, in order to determine a preferred location, using Class EA evaluation criterion, including consideration of environmental screening data and a summary of best practices for the management of snowmelt (treatment train typically) given the high solids and chloride levels associated with snowpack from roadways. It is expected that this effort will be completed separately from the primary Stormwater Master Plan document.

4.1.6 Environmental Data Assembly

While not cited explicitly in the study Terms of Reference (TOR), given that this is a Master Plan being prepared under the MEA Class Environmental Assessment protocol, WSP has suggested that the Township consider documenting a variety of core environmental data, based upon available desktop information. This would specifically include items such as: aquatic habitat, terrestrial habitat, hydrogeology/groundwater, surface water quality, groundwater quality and creek systems information. This information would then be able to be used to in part fulfill the Township's goals and objectives with respect to the environment and the management of impacts. Depending on the Master Plan recommendations, there may be a future need for additional locally-specific environmental investigations (including possible fieldwork), however, these are expected to be most appropriately and preferably established during the implementation stage, as opposed to during the Master Plan.

No comprehensive environmental data were available from the Township, beyond what was available in Official Plan mapping. This should be considered further in the event any subsequent projects are identified which necessitate a Schedule B or C follow-up Class Environmental Assessment (Class EA). Typical information required would include: Ecological Land Classification (ELC) mapping and mapping of areas of Natural and Scientific Interest (ANSIs).

In addition, aquatic ecology data from the Grand River Conservation Authority (GRCA) should be considered in the future. GRCA makes data available through its GRIN GIS-based service, as well as direct data requests to GRCA planners.

A further evaluation of ecological\environmental data has not been considered as part of the current SWM-MP; it has been considered at a high-level as part of the screening of alternatives as detailed in subsequent sections.

4.1.7 Areas of Interest

In support of the understanding of where Township staff frequently encounter problematic drainage issues, and the subsequent screening and prioritization of alternatives, WSP requested that staff provide information on areas of interest. This was provided on October 10, 2023. Two (2) locations were identified in Elora, and a further seven (7) in Fergus. Locations are presented in Figures 6A and 6B (attached) respectively.

In addition, feedback was received from the public as part of PIC #1 (refer to the consultation summary for further details). Three (3) additional locations (all in Fergus) were also added to the summary Figure 6B based on the feedback received.

Overall, the majority of the identified issues appear to be nuisance related, and in many cases issues that only occur during the spring freshet period and are not common occurrences otherwise. Regardless, these areas of interest have been considered as part of subsequent sections of this report.

4.1.8 Development Manual

A draft copy (May 2023) of the Township of Centre Wellington's Development Manual provides a comprehensive summary of requirements for engineering submissions and designs. The manual remains in draft and includes areas for future updating. The manual is divided into general areas of interest, of relevance to the current study are Storm Sewers (Section E) and Stormwater Management (Section F).

The Township's standard rainfall IDF parameters are included in Section E.1.1.5 of the document. Other standard design parameters, including Manning's Equation and Rational Method, are also specified in Section E. Relevant Standard Drawings (OPSD) are also noted.

Section F makes reference to key reference documents for stormwater management (SWM), and provides the requirements for quantity, quality and erosion control in the absence of subwatershed study guidance. The sections on computer simulation modelling (including design storm distributions and acceptable models) is in progress. Reference is made to the MECP's Draft Low Impact Development Guidelines (2022), including a hierarchy of controls. Requirements for end of pipe stormwater management facilities are also included.

4.1.9 Consolidated Linear Infrastructure Environmental Compliance Approval (CLI-ECA)

The Township of Centre Wellington holds CLI-ECA 098-S701, which provides it authority over all of its stormwater conveyance and control assets and provides the Township with the ability to manage changes to the system over time. As part of this approval by MECP, an inventory and summary of relevant assets was prepared, including end of pipe SWM facilities specifically.

The CLI-ECA also provides for a number of different management requirements, including operations and maintenance. An Operations and Maintenance Manual (Issue Number 1.0, May 19, 2023) is included with the CLI-ECA. The manual includes the requirements for inspection (including frequency) and maintenance of all the Township's various SWM system components, including catchbasins, oil/grit separators, storm sewers, maintenance holes and outfalls, open channels, and SWM facilities.

4.1.10 2022 Asset Management Plan

The Township of Centre Wellington prepared its Asset Management Plan in 2022. This document notes that Township's stormwater system includes storm sewers, catch basins, maintenance holes, storm ponds and rural ditching system(s) (included in road assets). According to the 2022 Assessment Management Plan, the Township maintains 130.6 km of storm sewer pipes, 4,760 related point assets, such as catch basins and maintenance holes

and 25 stormwater ponds. This includes the entirety of the Township (i.e. beyond the current study focus only on the selected areas of the communities of Elora, Salem and Fergus).

4.2 GIS Analyses

4.2.1 Overall Catchment Delineation

In order to characterize the storm drainage systems within the communities of Elora, Salem and Fergus, an overall catchment (drainage network) analysis has been undertaken. Overall drainage boundaries have been established for areas contributing to identified storm sewer outfalls to receivers (i.e. the Grand River and Irvine Creek). As noted previously in Section 4.1.2, the sixty (60) outfalls identified in the Township GIS database have been supplemented by additional outfalls as identified by WSP (labelled as 100-series to distinguish the two). In some cases, these reflect more intermediate outfalls (i.e. discharges to a more local watercourse prior to its discharge to the primary watercourse receiver). However, this typically allows for a better differentiation of drainage areas for larger drainage systems, and in such cases, both outfalls can be referenced (the upstream and ultimate numbering). Based on the preceding understanding, the initial sixty (60) outfalls have been supplemented through the addition of a further eighteen (18) outfalls as identified by WSP.

Drainage network boundaries\catchments have been delineated based on the previously noted outfalls and available topography and property boundary limits. Drainage networks have been numbered based on the receiving outfall number and are presented in Figures 3 (Overall), 3A (Elora\Salem) and 3B (Fergus), attached. For reference purposes, the subcatchment boundaries available from GRCA (GRIN) have also been presented. A summary is presented in Table 4-4; detailed information is provided in Table 4-5 (Elora) and Table 4-6 (Fergus).

Table 4-4: Summary of Overall Drainage Networks

COMMUNITY	NUMBER OF NETWORKS	AVERAGE SIZE (ha)	MINIMUM SIZE (ha)	MAXIMUM SIZE (ha)
Elora	32	9.26	1.87	71.26
Fergus	32	18.87	1.03	98.38

In general, the drainage networks range in size but are not considered overly large, with smaller networks overall indicated in Elora (average of 9 ha +\-) as compared to Fergus (average of 19 ha +\-). In both cases several larger drainage networks have been identified (>50 ha), with the largest being near 100 ha (Network 007\008 – Fergus). These have been reviewed for further discretization in subsequent sections.

Note that there are several small\minor outfalls that are not presented. These areas do not warrant modelling due to their small size and as such have not been included.

As evident from Figure 3B, there is an external drainage area upstream of network 114, and thus upstream of outfall 015 that requires inclusion in the modelling (along with the natural area near Beatty Line and Garafaxa Street) to ensure that flows to downstream receivers are adequately represented.

Table 4-5: Overall Drainage Network Boundaries – Elora

NETWORK	AREA (ha)	DIRECT OUTFALL	ULTIMATE OUTFALL
16	2.22	16	Same
17	11.36	17	Same
18	6.72	18	Same
019 and 020	2.45	019 and 020	Same
21	15.48	21	Same
22	2.22	22	Same
23	10.02	23	Same
25	8.14	25	Same
26	3.82	26	Same
27	19.54	27	Same
28	7.38	28	Same
29	10.67	29	Same
30	10.29	30	Same
031 and 033	4.66	031 and 033	Same
34	20.14	34	Same
35	1.97	35	Same
36	21.99	36	Same
37	10.51	37	Same
38	71.26	38	Same
44	2.48	44	Same
45	8.31	45	Same
54	5.83	54	Same
55	2.65	55	Same
56	2.60	56	Same
57	3.62	57	Same
60	1.87	60	Same
100	3.98	100	Same
101	2.21	101	Same
102	3.68	102	Same
103	1.89	103	Same
104	7.20	104	Same
105	9.12	105	Same

Table 4-6: Overall Drainage Network Boundaries - Fergus

NETWORK	AREA (ha)	DIRECT OUTFALL	ULTIMATE OUTFALL
1	15.43	1	Same
2	6.72	2	Same
3	6.13	3	Same
4	1.03	4	Same
6	2.67	6	Same
007 and 008	98.38[1]	007 and 008[1]	007 and 008
9	44.57	9	Same
10	3.12	10	Same
11	2.25	11	Same
12	45.38	12	Same
15	32.75	15	Same
39	3.87	39	Same
40	5.98	40	Same
41	28.86	41	Same
42	4.26	42	Same
43	2.57	43	Same
51	26.55	51	Same
52	21.68	52	Same
58	5.60	58	Same
59	3.76	59	Same
106	3.44	106	Same
107	19.55	107	Same
108	24.56	108	Same
109	74.03	109	Same
110	8.08	110	Same
111	3.71	111	Same
112	4.60	112	Same
113	14.09	113	015
114	62.48	114	015
115	16.45	115	Same
116	7.37	116	Same
117	4.03	117	015

Table Note 1: Includes sections of open channel; likely warrants splitting.

Although the recent development in Elora in the vicinity of York and Waterloo Streets is located outside of the study boundary, the flows from this area appear to contribute to the adjacent Network 036. As such, some simplified representation of these contributing flows is required (including SWM facility 024; Granwood SWM area, not included in Table 4-1).

Overall, the drainage network boundaries presented are considered approximate overall limits only; these have been further refined as part of subsequent hydrologic model development which will include the development of more refined subcatchment boundaries, which is presented in Section 5.

As noted previously, the drainage network boundaries (and component subcatchments) have also been used as part of future summaries to outline the areas of the Township which currently do or do not receive SWM, and in particular quality control (refer to Section 7).

4.2.2 Depression Storage and Overland Flow

Available topography data (Lake Erie 2016-2018 DTM as per Section 4.1.1) have been used in conjunction with GIS-based tools to develop a better understanding of potential topographic constraints within the study area. Two (2) different analyses have been undertaken in this regard; a review of surface depressions, and a review of major overland flow routes. These are presented in the following sub-sections.

Depression Storage

To create a depression storage areas layer, GIS tools have applied the “Fill” tool to the base DEM/DTM, which fills all depressions or sinks in the DEM where there is no flow from pixel to pixel within a hydrologic unit. The next step is to use the “Minus” tool which uses the raw or original DEM and the filled DEM. This tool subtracts the value of the second input raster (filled DEM) from the value of the first input raster (original DEM) on a cell-by-cell basis. The output of the minus layer has then been classified to identify areas where the depression depth is equal to or greater than 0.3 meters. While 0.3 metres is acknowledged to be a somewhat arbitrary depth threshold, this depth has been applied to similar analyses by WSP in other jurisdictions and is a general indication of where there may be potential issues. The 0.30 m is a typical threshold in engineering practice for safe ponding on select classifications of roadways and on private sites.

The findings for the preceding assessment as might be expected result in an extensive number of small areas (approximately 10,000 individual polygons). As a first step, minor areas (i.e. less than 25 m2, or approximately 5 m x 5 m) were deleted. This greatly reduced the number of areas (to 811). The resulting areas were then further reviewed to remove areas where ponding would be normally expected. This included SWM facilities and man-made ponds, roadside ditches (provided the identified ponding was confined to the ditch and not on the roadway) and natural areas (woodlots, wetlands, etcetera). This process resulted in a further reduction in the number of areas (to 488). The results of this assessment are presented in Figures 4 (overall), 4A (Elora\Salem), and 4B (Fergus) respectively (attached).

In general, the results indicate a low number of surface depressions within the study area. The study area is generally well-graded with positive drainage towards the Grand River.

Notwithstanding, the following potential areas of concern have been noted based on the results:

- **Elora**
  - *Princess Street between Moir Street and Colborne Street*
    - Noted as a reported area of concern by Township staff (refer to Area A1 in Figure 6A, attached)
  - *Hill Street near County Road 7 and 1st Line (may be due to location at the corner of study area limit)*
    - Noted as a reported area of concern by Township staff (refer to Area A2 in Figure 6A, attached).
- **Fergus**
  - *Gordon Street at Highway 6 (appears to have been recently developed on the corner)*
    - Area further upstream noted as area of concern by Township staff (refer to Area A3 in Figure 6B, attached)
  - *Albert Street (Highland Park and Jim Tye Diamond)*
    - Not noted as an area of concern by Township staff

The preceding areas have been reviewed in conjunction with the overland flow assessment in the following sub-section as well as the subsequent hydrologic\hydraulic modelling results to confirm whether the results indicate surface ponding and major overland flow issues.

Overland Flow

In addition to the preceding, an overland flow analysis has been completed using the same currently available topography (Lake Erie DTM) for the study area. GIS tools have again been applied to identify flow accumulation pathways. Following the initial assessment using GIS tools, the results have been further screened to avoid duplication with existing identified watercourses, as the focus is to review overland flow routes within the urbanized area. Note that this is a preliminary analysis only. The DEM\DTM does not consider the presence of sewers or culverts, which in some cases may have sufficient capacity to address all or part of the overland flow.

The results are presented on Figure 4 (overall), 4A (Elora\Salem), and 4B (Fergus) respectively (attached). The following potential areas of concern have been noted:

- **Elora and Salem**
  - *Rear yard drainage between Victoria Street and Water Street*
  - *Rear yard drainage north of Woolwich Street*
  - *Drainage through property east of Geddes Street (north of John Street)*
  - *Rear yard drainage in the vicinity of Erb Street and Sophia Streets*

- *Princess Street between Moir Street and Colborne Street (consistent with an area of identified depression storage; storm sewer is also located along this pathway)*
- *Rear-yard drainage in the vicinity of Cuthbert Street and Wellington Drive*
- *Rear-yard drainage in the vicinity of High Street and Nichol Street*

- **Fergus**
  - *Overland flow through the urbanized downtown area (near Provost Lane; path of trunk storm sewer for Network 015; depression storage area identified north of St. George Street)*
  - *Rear-yard Drainage between St. George Street and St Andrew's Street both east and west of Gartshore Street*
  - *Overland flow along the path of trunk sewer (Network 109) north of Belsyde Ave (just west of Scotland Street)*
  - *Overland flow adjacent to Albert Street (Highland Park and Jim Tye Diamond depression area) leading towards Princes Street*

These identified areas have been considered as part of the subsequent modelling effort (Section 5) which has included consideration of potential areas for remediation.

4.3 Field Monitoring Program

4.3.1 Program Setup

As per the approved scope of work, a flow monitoring program was established to collect actual data to characterize the runoff properties of the Elora, Salem and Fergus study areas in terms of the quantity of runoff. The resulting data have been used to calibrate and validate the hydrologic and hydraulic modelling tools (as per Section 5) to ensure that they reasonably represent existing conditions and performance and that any potentially identified drainage system upgrades are reasonable and appropriate; neither over-sized (from modelling that tends to over-predict peak flows) or under-sized (modelling that may under-predict peak flows). Typically, hydrologic modelling tends to over-predict peak flows (i.e. conservative), however, data collection is necessary to confirm the runoff response from area drainage networks and the degree to which adjustments are warranted.

As per the approved scope of work, a total of ten (10) temporary monitoring gauges were advanced. Township staff provided a suite of potential areas of interest which were considered in the gauge location selection process. WSP undertook a review of these locations and the overall storm sewer and drainage system. An initial long list of twenty-five (25) potential locations (7 within Elora; 18 within Fergus) were then developed and assessed through field reconnaissance to identify preferred locations based on safety, accessibility, technical feasibility, and other factors. Based on this process, ten (10) preferred locations were identified. Locations are presented in Figure 5 (overall), 5A (Elora\Salem) and 5B (Fergus) respectively (attached). A summary is also provided in Table 4-7.

As per Table 4-7, all gauge installations were within the storm sewer system with the exception of F03, which was located in a wet pond SWM facility. All gauges were installed on July 27,

2022, with the exception of gauges E07, F03, and F08 which were installed on August 2, 2022. Gauges were all removed on November 28, 2022, prior to the onset of winter conditions (gathering approximately four (4) months of data). The gauges recorded data on a five (5)-minute time interval.

As per WSP's approved scope, Solinst Levelogger™ gauges were employed. These gauges record water level and temperature at pre-set intervals. In order to avoid confined space entries, WSP typically employs an alternative gauge installation technique. An example is presented in Figure 4-1.

Table 4-7: Summary of Field Monitoring Gauges

COMMUNITY	GAUGE ID	LOCATION	CW MH ID	NOTE
Elora	E01	Bridge Street south of Grand River	ES-SM-00295	750 mm diameter storm sewer
Elora	E05	Irvine Street at Church Street	ES-SM-00329	750 mm diameter storm sewer
Elora	E06	Queen Street at Church Street	ES-SM-00323	750 mm diameter storm sewer
Elora	E07	Melville Street south of Mill Street (Bissell Park)	ES-SM-00320	675 mm diameter storm sewer
Fergus	F03	Wellington Road 19 at Robinson Road	N\A	In SW-00021 (Summerfield SWM Area)[1]
Fergus	F08	Forfar Street east of St. David's	ES-SM-00150	600 mm diameter storm sewer
Fergus	F09	Sideroad 19 at Burnett Court	ES-SM-00177	525 mm diameter storm sewer
Fergus	F11	Black Street at Woodhill Drive	ES-SM-00001	825 mm diameter storm sewer
Fergus	F16A	Hillside Drive south of Queen Street	ES-SM-00171	1050 mm diameter storm sewer
Fergus	F17	Princes Street near Perth Street	ES-SM-00139	1050 mm diameter storm sewer

Table Note 1: This location is outside the study area boundary but still provides characterization of runoff potential.

Using this approach, the monitoring gauges are mounted to a piece of angle iron, which is adjusted to the required depth and then installed in the sump of a maintenance hole. Additional angle iron is employed at the top of the MH structure to prevent the gauge from rotating or shifting. The data cable runs along the angle iron to the surface, where a connection port allows communication with the gauge and data downloading. During field visits, the in-situ water level is recorded to ensure that measured data are adjusted to match field recordings. Theoretical flows can then be determined using a rating curve approach, or water levels can be directly measured against simulated results.

Figure 4-1: Typical Storm Sewer Monitoring Gauge Installation (E01)



4.3.2 Results Summary

In order to relate the 4-month runoff monitoring period to rainfall, available precipitation data from the area (as provided by the Township) have been reviewed and analyzed. Data from a total of three (3) stations have been provided for use:

- Fergus WWTP (near Union St\Arhol St in Fergus) – daily precipitation totals only
- Fergus Shand Dam (from GRCA) – hourly precipitation data
- Elora RCS (from GRCA – Elora WWTP on Wellington Rd 7 south of Grand River) – hourly precipitation data

The monthly data have been compared to the long-term climate normal for the Fergus Shand Dam Station 1981-2010) to summarize overall trends. The results are presented in Table 4-8.

In addition, Figure B1 (refer to Appendix B) presents a cumulative plot of precipitation over the monitoring period.

Table 4-8: Summary of Field Monitoring Gauges

MONTH	FERGUS SHAND DAM NORMAL (1981-2010)	FERGUS SHAND DAM		FERGUS WWTP		ELORA RCS	
		OBSERVED	DIFFERENCE	OBSERVED	DIFFERENCE	OBSERVED	DIFFERENCE
August	96.6	106.8	+11%	94.4	-2%	166.6	+72%
September	93.1	30.2	-68%	35.3	-62%	78.4	-16%
October	77.2	37.8	-51%	32.6	-58%	44.2	-43%
November	93.0	35.6	-62%	27.8	-70%	38.8	-58%
TOTAL	**359.9**	**210.4**	**-42%**	**190.1**	**-47%**	**328.0**	**-9%**

The results indicate that August was a typical month for precipitation at the Fergus gauges, however, the Elora monitoring gauge indicated a larger-than-normal precipitation total. The balance of the fall monitoring period (September to November) was consistently well below normal precipitation totals at all gauges, on the order of 40 to 70% below normal.

The more resolute hourly rainfall data from the two (2) GRCA gauges have been further analyzed to assess key storm events of interest (>10 mm); these are presented in Table 4-9.

Table 4-9: Summary of Notable Daily Rainfall Events (mm)

DATE	FERGUS SHAND DAM	FERGUS WWTP	ELORA RCS
August 3 - 4, 2022	34.8	35.6	49.4
August 16 – 17, 2022	0	0	42.8
August 21 – 22, 2022	4.8	1.6	42.4
August 25 - 26, 2022	33.4	27.8	2.2
August 30, 2022	13.6	8.8	19.2
September 19, 2022	1.6	0	15.4
October 13, 2022	14.0	15.2	14.0

Consistent with the results presented in Table 4-8, the results presented in Table 4-9 indicate that the Elora RCS gauge indicated larger rainfall totals for the majority of the August 2022 events, with the exception of the August 25-26 event. The events of August 16-17 and 21-22 were also notable yet resulted in zero or a negligible rainfall response at the two (2) Fergus gauges. The September 19, 2022 event similarly resulted in approximately 15 mm at the Elora gauge, but zero or negligible rainfall at the Fergus gauges. The August 3-4, August 30 and October 13 events were reasonably consistent between all gauges. The lack of notable storm events for the fall period is also again evident, with only two (2) storm events of note between September and November.

A summary of the most notable observed water levels at the ten (10) monitoring gauges is presented in Table 4-10; full data series plots have been included in Appendix B.

Table 4-10: Summary of Notable Water Level Responses

DATE	GAUGE	TIME	PEAK WATER LEVEL (m)	PERCENT OF FULL PIPE DEPTH
August 3, 2022	E06	18:00	0.25	33%
	E07	18:15	0.94	**139%**
	F03	18:15	0.37	N/A
	F08	18:10	0.26	43%
	F09	18:10	0.22	42%
	F11	18:10	0.31	38%
	F16a	20:15	0.31	30%
	F17	18:10	0.62	**59%**
August 4, 2022	F03	14:50	0.35	N/A
	F08	13:10	0.21	35%
	F11	13:10	0.24	29%
	F16a	13:50	0.36	34%
	F17	13:55	0.48	46%
August 22, 2022	F17	14:45	0.39	37%
August 25, 2022	F03	14:40	0.55	N/A
	F09	14:45	1.32	**251%**
	F11	14:35	0.61	**74%**
	F16a	14:50	0.33	31%
	F17	14:40	0.91	**87%**
August 29, 2022	F17	13:20	0.68	**65%**
August 30, 2022	F17	12:50	0.39	37%
September 19, 2022	F17	12:55	0.48	36%

Differences are clearly evident from the rainfall events presented in Table 4-9 and the observed storm responses in Table 4-10. No notable responses were indicated for the August 16-17 period despite the large, recorded rainfall at the Elora RCS gauge. Likewise, no notable response was indicated for the October 13, 2022, event, although this was a lower (but consistent) rainfall. Conversely, a notable water level response was indicated at the F17 gauge for the August 29, 2022, event, however only minor rainfall totals were noted at the available gauges.

As evident from the figures in Appendix B, no notable responses were noted at gauges E01 or E05 for the monitoring period. The minimal response at gauge E01 may reflect the benefit of the upstream SWM Facility (Bridge Street SWM Facility; SWM 004). For E05, some of the contributing upstream streets do not have a fully urban road cross-section (i.e. no curb and gutter) which may have reduced the direct inflow to the storm sewer system.

Conversely, other gauges indicated relatively high degrees of responsiveness. Gauge F17 indicated the most frequent storm responses, with a notably larger number of peaks than any of the other gauges. This may be consistent with this location being one of the largest storm sewers (1050 mm diameter). The gauge indicates the sewer was greater than 50% full for three (3) separate events.

Surcharge (water level greater than pipe obvert) was indicated at gauge E07 (August 3, 2022) and gauge F09 (August 25, 2022). These events\locations are therefore of particular interest for the model calibration effort.

In some cases, minor variations in water levels are indicated during dry weather periods (to depths generally less than 0.05 m). Based on further review, this appears to be attributable to minor variations in the barometric (atmospheric) pressure data correction, which was based upon a gauge installed in the maintenance hole at gauge F11. Overall, these minor variations are not considered to notably affect the overall response during storm events.

In all cases, the plots included in Appendix B (and preceding data analysis) have applied hourly precipitation data. For model calibration and validation purposes, higher resolution rainfall data (i.e. 5-minute) would be more appropriate. However, based on further review with Township and GRCA staff, it was noted that these data are not available, as such, this greatly limits the potential model calibration\validation effort; this is discussed further in subsequent sections. Rating curve development (establishment of relationships for each site to enable the conversion of water levels to flows) has also therefore not been advanced further.

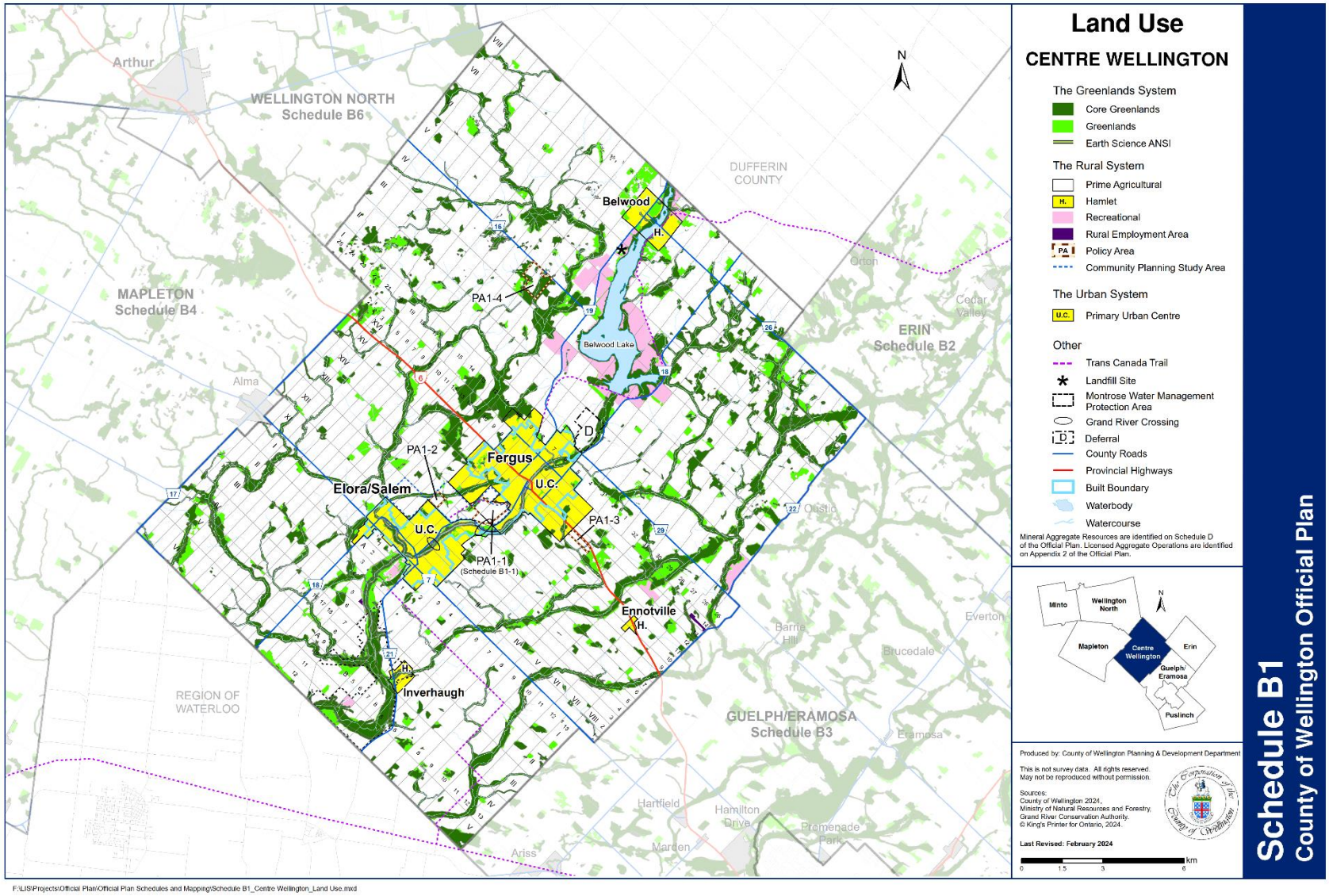
4.4 Greenlands System

As previously noted, the County of Wellington's Official Plan designates County's natural heritage features under the Greenlands System. This Greenlands System contains landscapes, resources and ecological systems that are essential to environmental and public health in Wellington. The County of Wellington is committed to:

- Maintaining clean water, clean air and a healthy, diverse and connected Greenlands system;
- Promoting a natural heritage systems approach to watershed management that includes protecting the County's Greenlands System and public health and safety;
- Ensuring the quality and quantity of groundwater and surface water are protected as an essential resource for urban and rural water supplies, agricultural production, the maintenance of the Greenland system, and future growth.

The Greenlands System is designated on Schedule B of County's Official Plan and is composed of many natural heritage features, flood prone areas and hazardous lands. The Greenlands System is shown in Figure 4-2.

Figure 4-2: Schedule B1 (Land-use) - County of Wellington Official Plan



5 Hydrologic and Hydraulic Modelling and Analysis

5.1 Overall Modelling Approach

As an initial task, an integrated hydrologic-hydraulic model is needed. Consistent with WSP's original work plan, WSP recommended the application of an EPA-SWMM based tool, specifically PCSWMM. PCSWMM has been widely applied in southern Ontario for similar stormwater master plans, including by WSP for the City of Guelph's 2012 Stormwater Master Plan and Town of Oakville's Stormwater Master Plan (2020), among others. Models created in PCSWMM use the EPA-SWMM engine, and therefore can be opened and run in EPA-SWMM if necessary (freeware, publicly maintained and promoted by the US-EPA). PCSWMM also provides a suite of GIS and other modelling tools to support model development and results analysis. As such, subsequent model development tasks have employed PCSWMM (Version 7.6.3620; EPA-SWMM engine version 5.1.015).

5.2 Hydrologic Modelling

5.2.1 Subcatchment Refinement

Hydrologic modelling involves the estimation of flows to the drainage system receivers based on the drainage area, land coverage, and rainfall in question. Key modelling steps are described herein.

Overall catchment boundaries were developed as part of previous steps (refer to Table 4-4) using GIS tools. GIS tools can generally be applied (using the DEM\DTM) to estimate contributing areas to each MH or node of interest. As part of subsequent model building steps, these boundaries have been refined and updated to reflect the DEM data provided for use in this study. Subcatchments have been delineated using the Watershed Delineation Tool (WDT) provided in PCSWMM, which processes the topographic data at a user defined threshold for target drainage area size; this has been set to a target of approximately 0.5 hectares per subcatchment, which generates a resolute level of detail, particularly for the current master plan level of study.

The resulting subcatchments have been further reviewed and refined based upon contour data, aerial mapping, parcel data and storm sewer infrastructure mapping to ensure appropriate delineation within the respective sewershed and ultimately routing to outlets. A total of 1,078 subcatchments were developed using this process which contribute to MHs or nodes of interest. An additional catchment area has been included on the easterly side of Fergus between County Road 19 and Saint Andrew Street East. No storm sewer data are available for this area and a roadside ditch conveys stormwater to a channel.

Table 5-1: Summary of Detailed Subcatchment Areas

COMMUNITY	NUMBER OF SUBCATCHMENTS	AVERAGE SIZE (ha)	MINIMUM SIZE (ha)	MAXIMUM SIZE (ha)
Elora	378	0.87	0.10	17.2
Fergus	700	1.16	0.12	44.11

5.2.2 Hydrologic Parameterization

Following the development of updated subcatchment boundaries, initial hydrologic model parameterization (imperviousness in particular) has focused upon an estimated "existing" land use condition (i.e., 2023 era based on available aerial photography and Official Plan land use planning and zoning data available from the Township). The supplied data have generally been used as the basis to develop a GIS layer of estimated existing land coverage for hydrologic modelling purposes. This allows for greater clarity on hydrologic model development and reproduction in the future as needed.

The received Official Plan land use planning and zoning data were updated to better represent different types of residential land use (i.e., Low Density, High Density, etc.) and an impervious percentage was assigned to each land use type based on the values provided in Table 5-2. Using the spatial weighting method in PCSWMM each subcatchment has been assigned an overall imperviousness percentage.

Table 5-2: Land Use – Impervious Percentage

LAND USE	PERCENTAGE IMPERVIOUS
Low Density Residential	40%
Residential	50%
Future Residential	10%
Residential Transition	60%
Central Business District	85%
Commercial	85%
Industrial	85%
Future Development	10%
Future Employment Lands	10%
Open Area	4%
Recreational	7%

In addition to imperviousness, another key parameter is the definition of infiltration potential. Typically, either the SCS Curve Number, Horton, or Green and Ampt infiltration routines are applied. Given that the modelling tools developed as part of the current study are largely expected to be used for event-based hydrologic modelling, and given their widespread use in Ontario, the SCS Curve Number methodology has been proposed for application. This method determines the infiltration potential of the pervious lands based upon the hydrologic soil type, land cover and condition.

An open-access soil layer from the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) has been used to determine soil types present within the study area. The soil layer has been areally-weighted over subcatchments to better represent the soil characteristics of each subcatchment. Through review of the soil layer, the predominant hydrologic soil groups were found to be Hydrologic Soil Group B (i.e., Silt Loam) in both Elora and Fergus. The SCS Curve Numbers (CN) have been sourced from Table 2-2a in the Urban Hydrology for Small Watersheds (ref. TR-55), which summarizes the various CN for urban areas.

The overland flow length, as defined in the EPA SWMM 5 manual, represents the length of the sheet flow path (shallow flow). For larger subcatchments, this parameter typically becomes a calibration factor, however for smaller catchments the modelling is generally insensitive. The subcatchment slope represents the average gradient across the subcatchment surface.

For this model, flow length and slope were initially determined using the WDT process tool using the DEM provided for this study. The resulting flow length automatically calculated for each subcatchment has then been reviewed and refined to ensure reasonableness based upon the average length for sheet flow, before entering the urban storm sewer collection system. For example, sheet flow in residential areas has been typically assumed to occur lengthwise across the parcel, such as from the roof line to the roadway, assuming lots are graded to drain towards the roadway. This may not be represented in the automatically generated flow lengths and has therefore been spot checked to represent the urbanized site grading, and shorter flow paths prior to being intercepted by the urban collection system in the roadway.

Overland slopes for each subcatchment have been initially determined automatically using the DEM, and then these values have been further reviewed/refined to ensure accuracy and reasonableness with respect to the flow path, and to simplify the ranges in an effort to avoid excessively large or small slope values.

Based on previous studies and literature recommended values, Table 5-3 provides a summary of the standard values applied for other hydrologic parameters such as Manning's roughness coefficient and depression storage.

Table 5-3: Hydrologic Input Parameters

PARAMETER	VALUE
Impervious Area Roughness	0.013
Pervious Area Roughness	0.25
Impervious Area Depression Storage	1
Pervious Area Depression Storage	5
% of Impervious Area with No Depression Storage	25%

5.3 Hydraulic Modelling

5.3.1 Storm Sewer Data

As noted in Section 4, invert data were notably missing in the original storm sewer information provided by the Township. The Township however undertook a gap filling effort based on the review of record drawings, which were used to update the dataset to the extent possible. As noted, there remained a 14% data gap for storm sewers > 300 mm in diameter, which was supplemented by the use of interpolation wherever feasible, and a scoped field data collection effort by WSP, where deemed necessary.

Storm sewer information is fundamental to the initial hydraulic model development effort, and as such accurate data in a GIS database format which can readily be imported into a hydraulic model are important. Typically, the importation process involves:

1. **Importation of the MH layer.** Layer requires unique identifiers for each structure (no duplication) and should also contain both the rim elevation and the lowest invert elevation.

2. **Importation of the storm sewer layer.** Layer requires a unique identifier for each section of pipe, as well as information regarding the ID of the upstream and downstream MH to which the section of pipe is connected, and then the invert elevations of the upstream and downstream elevations.

Based on WSP's review of the currently available data, the following considerations were required as part of the subsequent data importation process:

1. Consistency of vertical datum of data was identified as a concern. Township staff has noted that they currently employ the CGVD:2013 vertical datum as standard; this is consistent with the datum applied as part of the Lake Erie DTM dataset. However, as there are extensive areas of the Township which pre-date this datum implementation, assumptions are required. In general, based on development era GIS mapping provided by the Township, elevation data from "older" areas have required adjustment to match the current vertical datum. For older areas, the typical CGVD28:78 vertical datum has been assumed. It has been assumed that the standard datum did indeed change in the Township in 2013. Development plans provided by the Township were used to identify areas developed before 2013 and a vertical datum shift was applied to the storm sewer main inverts in those areas.

2. MH data were included both within the storm MH layer and the catchbasin layer (i.e. for catchbasin maintenance holes). These two data sources have been combined to generate an overall MH layer for modelling purposes. Given previous asset management efforts by the Township, features had unique identifiers (ID numbers).

3. For consistency, MH rim (surface) elevations have been re-sampled from the Lake Erie DTM. Any notable outliers have been reviewed to confirm reasonableness relative to any information that may be available in the database. However, only limited rim elevation data were noted in the database and this was not included as part of the Township's data-filling efforts, as such data verification efforts have been limited.

4. MH invert elevations have been estimated from the updated\adjusted storm sewer invert elevation; a GIS query was required to confirm the lowest elevation and then this applied accordingly.

5. The storm sewer database does not contain the "from" and "to" MH information. As such, a GIS query was necessary to confirm this. A brief review was completed to confirm reasonableness.

6. Despite the preceding, some missing invert elevations remained. These have been filled using data interpolation where possible. An additional site visit was completed on May 10, 2023 to confirm invert elevations in key missing areas. Data have been reviewed for reasonableness based on a review of storm sewer profiles in the model to confirm consistent, positive grades.

7. A total of 797 sections of storm sewer pipe were identified that did not contain a pipe size (diameter) following the receipt of data from the Township. In these cases, some were confirmed through the preceding supplemental field check; the balance were estimated based on adjacent storm sewer sizes.

8. Where no information on pipe material is provided, a default roughness of 0.013 has been assumed, consistent with assumptions for HDPE, PVC and concrete pipe. A roughness of 0.024 has been applied for CSP pipes.

Using the preceding approach, a 1-dimensional (1D) model of the storm sewer (minor system) has been developed in the PCSWMM modelling. This allows for the development of a "minor system" only model which conservatively assumes full inlet capacity (no restrictions) and is generally consistent with typical Rational Method and Manning's Equation sizing methods for storm sewers.

5.3.2 Overland Flow Modelling

In addition to the preceding importation of storm sewer data, additional steps were taken to develop a "dual drainage" model. This form of model creates a secondary system of hydraulic conduits to reflect overland flow pathways (which would become more prevalent during more formative storm events) and also incorporates the inlets and connections between minor and major systems. Key model building steps have included:

1. **Development of an overland flow route (major system) representation.** The approach conducted by WSP involved combined parallel 1-dimensional (1D) systems. This involves constructing a parallel 1D overland flow system (i.e. roadways) that is linked to the minor system (base elevation of major system conduits is set to the rim elevation of the storm sewer system). The 1D conduits have typically applied Township standard road transects based on the type of road and ROW width. Transects used in the modelling include:

    a. Typical Local Rural Road
    b. Typical Local Urban Road
    c. Typical Arterial 2-lane Urban Road
    d. Major Arterial 4-lane Urban Road (i.e. Highway 6)

    Adjustments have been required where overland flow paths do not follow the roadway (as per Section 4.2.2) or overland flow paths do not follow storm sewer paths. Adjustments have also been required where sections of open channel are required; open channel transects in these cases have been manually extracted from the same source DEM\DTM.

2. **Representation of inlet capacity.** The major and minor systems are linked at maintenance holes by a representation of the available inlet capacity. Typically, this is approximated by the number of catchbasins present within the tributary area to that particular MH. Two (2) approaches are typically applied. Under one option, an outlet "rating curve" is applied which defined the stage-inlet capacity relationship based on MTO data for grate types and road grading (notably different for on-grade vs sag points; typically an on-grade CB has a capacity of 60 L\s +\-). As an alternative approach, WSP has

previously applied equivalently-sized orifices (based on OPSD details for CBs) to represent the grate opening. This option allows for better connectivity in the event of surcharged storm sewers which may backflow to surface for larger storm events (i.e. 100-year); the rating curve approach assumes one-way flow (in) which therefore can cause model instabilities in cases of backwater.

3 **Review and confirmation of tailwater levels\model boundary conditions.** Drainage systems all ultimately outlet to a watercourse, primarily the Grand River, however many drainage networks in Elora also outlet to Irvine Creek. A brief sensitivity analysis of tailwater levels is considered appropriate to determine the impact on results. In general, the response timing of the local drainage systems is much quicker than that of the Grand River watershed, as such, it is considered unlikely that synchronous peaks would occur. Further, in WSP's experience elevated tailwater levels typically only affect the first few sections of storm sewer; further upstream the impacts are negligible. Given the relatively steep grades in both communities it is considered unlikely this will be a major factor. Local impacts may be expected in direct proximity to watercourse receivers, however Township staff has not noted past issues in these areas.

5.4 Model Validation

5.4.1 Monitoring Data Comparison

The flow monitoring data collected through this study (refer to Section 3) has been applied by simulating storm events of interest (using the rainfall data provided by the Township) and then comparing the simulated flow responses at the monitoring gauges to the observed responses. Based on the recorded data, model calibration\validation has been considered for the three (3) largest events as follows (refer to Section 4.3.2):

- August 3, 2022
- August 4, 2022
- August 25, 2022

A "global" calibration is considered most appropriate, where the combined results of all ten (10) gauges are applied to ensure a consistent adjustment as required to match observed responses.

Hourly rainfall data provided by GRCA for Shand Dam station were applied and the model was run from August 1 to 7, 2022 and later from August 23 to 26, 2022. Preliminary results were extracted from the PCSWMM model and are compared with the monitoring data in Table 5-4.

The results indicate variable agreement; some gauges indicate fairly close agreement whereas others indicate much greater variability. This is considered attributable to the spatially variable nature of many of the storm events (i.e. summer thunderstorms) and the low temporally resolution of the source rainfall data (i.e. hourly data; 5-minute data are typically preferred for model calibration\validation purposes).

Overall, a further model validation process was considered warranted; this is discussed further in Section 5.4.2.

Table 5-4: Comparison of Notable Water Level Responses

DATE	GAUGE	TIME	PERCENT OF FULL PIPE DEPTH (MONITORING)	PERCENT OF FULL PIPE DEPTH (MODEL)
August 3, 2022	E06	18:00	33%	28%
	E07	18:15	**139%**	19%
	F03	18:15	N/A	N/A
	F08	18:10	43%	30%
	F09	18:10	42%	28%
	F11	18:10	38%	27%
	F16a	20:15	30%	30%
	F17	18:10	**59%**	31%
August 4, 2022	F03	14:50	N/A	N/A
	F08	13:10	35%	20%
	F11	13:10	29%	18%
	F16a	13:50	34%	18%
	F17	13:55	46%	16%
August 25, 2022	F03	14:40	N/A	N/A
	F09	14:45	**251%**	34%
	F11	14:35	**74%**	33%
	F16a	14:50	31%	36%
	F17	14:40	**87%**	37%

5.4.2 Comparison to Previous Designs

Given the concerns with the resolution of the available rainfall data and the ability to fully calibrate\validate the modelling using this approach, a separate model validation effort was undertaken. Township staff was able to provide storm sewer design sheets (using Rational Method) for three (3) different recent storm sewer reconstruction projects in the communities of Elora, Salem and Fergus. Locations include:

- Elora Street from Perth Street to Guelph Road (Fergus)
- Melville Street south of Church Street (Elora)
- Metcalfe Street west of McNab Street (Elora)

The base PCSWMM modelling was first verified to ensure general consistency in overall drainage boundaries. The model was then run using 5-year design storm distributions (using the same rainfall intensity-duration-frequency data) to compare results at the most downstream location. Full results are included in Appendix C.

Two (2) different soil infiltration methods were tested (SCS CN and Green-Ampt); overall the SCS CN was confirmed to generate the most consistent results with the original design sheets. Overall, peak flows were considered reasonably consistent between the two and the PCSWMM modelling was therefore considered to be valid and appropriate for use.

5.5 Existing Conditions Model Results

5.5.1 Rainfall Input

Rainfall input is necessary to simulate the expected hydrologic response of the drainage system. Currently approved rainfall intensity-duration-frequency (IDF) data for the Township of Centre Wellington were previously presented in Section 4.1.3.

Using the draft development manual provided by the Township of Centre Wellington, 4-hour Chicago design storm distributions, based on currently approved Township IDF parameters have been used for this assessment.

A 5-year storm event has been used to assess the performance of the minor system (storm sewers) and a 100-year storm event has been used to assess the major system (overland flow) as per Township standards. These results are presented in subsequent sub-sections.

Climate change-adjusted rainfall (as per Section 5.5) has not been considered in the assessment of baseline performance assessments but should be considered as part of future upgrades and works to ensure system resilience and avoid decreased performance.

5.5.2 Minor System Capacity Assessment (5-Year Storm)

The capacity of the minor system (i.e. storm sewer network) has been assessed for the 5-year storm event, consistent with Township standards and as noted previously. In order to support a conservative assessment (and consistent with typical storm sewer design methodology using the Rational Method\Manning's Equation), inlet capacity restrictions have been neglected; subcatchment flows have been directly connected to the minor system nodes in the modelling.

A graphical presentation of the simulation results is presented in Figures 7A (Elora and Salem), 7B (North Fergus) and 7C (South Fergus) respectively. Simulated performance has been presented on the basis of flow capacity, where the simulated peak flow has been compared to the theoretical maximum flow capacity (i.e. based on Manning's Equation). This approach avoids considering storm sewers that may be surcharged due to backwater\tailwater and may otherwise have sufficient conveyance capacity. It is noted however that in some cases if node flooding is occurring (discharge to surface), the modelling may under-estimate the actual degree of flow surcharging. However, this will be considered as part of the assessment of storm sewer upgrades (refer to Section 6). A 25% threshold has been applied to differentiate between mild and heavy flow surcharging (i.e. less or more than 125% of the theoretical full flow capacity). The simulation results have also been summarized by overall drainage area in Table 5-5 by length, and in Table 5-6 by percentage (note that in some cases totals do not exactly equal 100% due to rounding).

Table 5-5: Summary of Storm Sewer System Capacity (by length)

COMMUNITY	TOTAL LENGTH (m)	UNSURCHARGED LENGTH (m)	SURCHARGED LENGTH (m)	HEAVILY SURCHARGED LENGTH (m)
Salem	2,237	1,060	335	842
Elora (North)	17,519	8,745	3,945	4,829
Elora (South)	8,137	4,863	1,496	1,778
Fergus (North)	31,144	12,861	6,545	11,738
Fergus (South)	22,819	9,887	4,870	8,062
TOTAL	**81,856**	**37,416**	**17,191**	**27,249**

Table 5-6: Summary of Storm Sewer System Capacity (by percentage)

COMMUNITY	TOTAL LENGTH (m)	UNSURCHARGED LENGTH (%)	SURCHARGED LENGTH (%)	HEAVILY SURCHARGED LENGTH (%)
Salem	2,237	47%	15%	38%
Elora (North)	17,519	50%	23%	28%
Elora (South)	8,137	60%	18%	22%
Fergus (North)	31,144	41%	21%	38%
Fergus (South)	22,819	43%	21%	35%
TOTAL	**81,856**	**46%**	**21%**	**33%**

Overall, the results indicate that approximately 46% of storm sewers in the study area are within the limits of the intended flow capacity. The remaining 54% of storm sewers would require some type of capacity increase to meet current Township standards (this is reviewed further in Section 6); this includes 21% which are mildly surcharged and 33% which are indicated as heavily surcharged (using the 125% of flow capacity definition). Note that these percentages may alter slightly as part of the storm sewer upgrade assessment, since upgrading select lengths of pipe may result in increased flows to other locations in some cases.

Overall, the results are generally consistent by area. South Elora indicates the highest percentage of unsurcharged storm sewers. Salem and North Fergus indicate the highest percentage of heavily surcharged storm sewers.

It should be noted that the risk of storm sewer surcharging, although beyond Township criteria, may not necessarily result in adverse impacts to residents. In many cases, storm sewers may surcharge only slightly and may therefore not affect surface drainage. Further, if the storm sewer is sufficiently deep, or there are no direct residential connections (i.e. foundations) to the storm sewer (i.e. no private lateral gravity drains) the risk to residences of storm sewer surcharging may be low. Overall, as per the review of areas of concern (as per Section 4.1.7), there are limited areas of reported flooding or surcharging issues within the community.

5.5.3 Major System Capacity Assessment (100-Year Storm)

The capacity of the major system (i.e. overland flow – roadways) has been assessed for the 100-year storm event, consistent with Township standards and as noted previously. This version of the modelling considers the restrictions of inlets, with subcatchment flows directed to the surface (major system) of the model.

A graphical presentation of the simulation results is presented in Figures 8A (Elora and Salem), 8B (North Fergus) and 8C (South Fergus) respectively. Simulated performance has been presented on the basis of road section type (rural – ditches, or urban – curb and gutter) and performance relative to the approximate limits of the roadway right-of-way (i.e. Township-owned property vs private property). The simulation results have also been summarized by overall drainage area in Table 5-7 by length, and in Table 5-8 by percentage (note that in some cases totals do not exactly equal 100% due to rounding).

Table 5-7: Summary of Major System Capacity (by length)

COMMUNITY	TOTAL LENGTH (m)	RURAL ROADS		URBAN ROADS		
		WITHIN ROW (m)	BEYOND ROW (m)	WITHIN CURB (m)	WITHIN ROW (m)	BEYOND ROW (m)
Salem	2,171	1,294	232	588	57	0
Elora (North)	20,964	1,436	0	18,045	812	671
Elora (South)	9,258	1,137	0	7,701	401	19
Fergus (North)	38,280	1,029	0	34,180	2,503	568
Fergus (South)	24,309	0	0	22,024	1,671	614
TOTAL	**94,982**	**4,896**	**232**	**82,538**	**5,444**	**1,872**

Table 5-8: Summary of Major System Capacity (by percentage)

COMMUNITY	TOTAL LENGTH (m)	RURAL ROADS		URBAN ROADS		
		WITHIN ROW (%)	BEYOND ROW (%)	WITHIN CURB (%)	WITHIN ROW (%)	BEYOND ROW (%)
Salem	2,171	60%	11%	27%	3%	0%
Elora (North)	20,964	7%	0%	86%	4%	3%
Elora (South)	9,258	12%	0%	83%	4%	0%
Fergus (North)	38,280	3%	0%	89%	7%	1%
Fergus (South)	24,309	0%	0%	91%	7%	3%
TOTAL	**94,982**	**5%**	**0%**	**87%**	**6%**	**2%**

Overall, the results indicate that there are very limited issues with the simulated performance of the major (overland flow) system. Only 2% of the total modelled system indicates exceedance of the roadway right-of-way (ROW). The majority of the roads within the study area are urban, and the majority of those (87%) are indicated as having 100-year water levels within the curb limits.

The preceding appears to be consistent with the results of the previous GIS-based analysis (refer to Section 4.2) which noted that overland flow was generally consistent and positive towards watercourses, primarily the Grand River but also Irvine Creek in Elora. There were also minimal sag points or low spots where water would pool or collect.

In conjunction with the preceding, the performance of the modelled stormwater management (SWM) facilities was also reviewed to confirm expected performance during the 100-year storm event. In particular, the SWM facilities (SWMF) were reviewed to confirm if 100-year inflows were contained within the SWMF (as would have been originally intended\designed), or if overtopping\overflow would be expected. The results indicated that only one (1) SWMF

would be expected to overtop, namely SW-00010 located near Gordon Street and Gibbons Drive (and Gibbons Drive Park). Further review may therefore be warranted of this SWM facility to confirm if any further actions are warranted to ensure the intended level of performance in this case.

5.6 Rainfall Analysis

The currently approved IDF for Centre Wellington is based on existing recorded data, in this case from the Environment Canada (EC) station at Fergus Shand Dam (approved data are noted to be to 2010; most current data are available up to 2016 as per discussion in Section 2.1.3). It is noted however that the currently approved IDF appears to be more intense than the updated dataset including data up to 2016. As such, updating the IDF data would slightly reduce the conservativeness of stormwater design levels. It is possible that by including additional data (i.e. 2017 to 2022) different values may result; however, this would necessitate obtaining more detailed data from EC and then reviewing the results to confirm.

Notwithstanding, the use of historic data is premised on the assumption of stationarity, i.e. that past data will be consistent with future expected precipitation patterns. Climate Change runs counter to this assumption. It is generally expected that with a warming atmosphere, the moisture holding capacity will increase, and more intense rainfall patterns can be expected. In order to account for this, the Township of Centre Wellington is proposing to update its IDF to account for climate change impacts.

A number of publicly available tools exist which can provide a range of potential future rainfall patterns. Potential tools include:

1. IDF-CC Tool (Simonovic, S.P., A. Schardong, R. Srivastav, and D. Sandink (2015), IDF_CC Web-based Tool for Updating Intensity-Duration-Frequency Curves to Changing Climate – ver 6.5, Western University Facility for Intelligent Decision Support and Institute for Catastrophic Loss Reduction, open access https://www.idf-cc-uwo.ca).
2. Ontario Climate Change Data Portal (as per http://ontarioccdp.ca/)
3. MTO IDF Curve Lookup (as per https://idfcurves.mto.gov.on.ca/)

A large range of potential future IDF parameters are available given the uncertainty associated with these predictions. Typically, input is required with respect to both the emissions scenario (i.e. how global rates of greenhouse gas emissions will vary with time) and also the projection year to be used (with later time periods expected to have more measurable impacts, typically).

For the purposes of an initial assessment, the results predicted by these tools have been assessed for the study area for a 24-hour duration. A 2080 timeframe (2070 to 2099 for IDF-CC OCCDP) has been selected where required, and the mid-range RCP 4.5 (SSP2.45) emission scenario considered. The co-ordinates associated with the Fergus Shand Dam have been applied for consistency with that location. The resulting rainfall depths are presented in Table 5-9; differences (in percentages) are presented in Table 5-10.

Table 5-9: Comparison of Climate Change Generated Rainfalls – 24-hour Rainfall Depth (mm)

IDF DATA SOURCE	2-YEAR	5-YEAR	10-YEAR	25-YEAR	50-YEAR	100-YEAR
Existing Fergus Shand Dam	60.65	79.91	92.66	108.80	120.77	132.74
MTO IDF Curve Lookup	69.60	88.80	103.20	117.60	129.60	141.60
Ontario Climate Change Data Portal	56.40	79.20	94.32	113.52	127.92	141.84
UWO IDF Climate Change Tool (GEV)	59.20	77.86	90.36	108.05	119.42	132.62

Table 5-10: Percentage Increases in 24-hour Rainfalls between Existing and Climate Change Generated 24-hour Rainfall Totals

IDF DATA SOURCE	2-YEAR	5-YEAR	10-YEAR	25-YEAR	50-YEAR	100-YEAR
MTO IDF Curve Lookup	+16%	+12%	+10%	+9%	+8%	+7%
Ontario Climate Change Data Portal	-6%	0%	+1%	+5%	+7%	+7%
UWO IDF Climate Change Tool (GEV)	-1%	-2%	-3%	0%	0%	0%

The 24-hour rainfall results indicate that the MTO IDF Curve tool generates the greatest rainfall depths, with results between 7 and 16% greater than currently approved IDF. The OCCDP dataset indicates mixed results, with lower rainfalls for the 2-year event, but higher rainfalls for the 10-year event and greater (between 1 and 7%). The UWO IDF-CC tool generates results that are very close, but slightly less than the existing IDF, with a maximum difference of -3%.

Based on discussions with Township staff (ref. e-mail Maiden-Senior, October 11, 2023), the results from the OCCDP predictions were generally considered appropriate, however on the basis of the increases only (i.e. do not specify any decreases or reductions in rainfalls). The OCCDP results generally appeared to simulate an “average” adjustment as compared to the other two tools. However, it was noted (ref. meeting of December 14, 2023) that a further review of other rainfall durations would be required.

A more detailed review of the different climate change adjusted IDF was undertaken for all durations; full results are included in Appendix D. Overall, the results indicate that many of the results vary notably from the existing IDF for different durations. The MTO tool indicates an average increase of 6%, although differences range from 2% to 16%. The OCCDP tool generates an overall average decrease of 6%, and a high variability in results, from -61% to +34% overall. The UWO IDFCC tool indicates an average increase of 19%, with a variability of between -22% and +83%.

Overall, both the OCCDP and UWO IDFCC tools appear to generate a very high degree of variability in the overall results, with large negative and positive increases. Also, the results from the MTO IDF tool appear to generate the most consistent and reasonable increases, with an average overall increase of 6%. As such, it is recommended that the Township consider updating its IDF parameters based on the MTO IDF generated values. Updated IDF parameters have been fit to the resulting data and are presented in Table 5-11. Updated intensities are presented in Table 5-12, and a comparison to existing IDF in Table 5-13.

Table 5-11: Proposed Updated IDF Parameters

PARAMETER	IDF PARAMETER BY RETURN PERIOD (YEARS)					
	2-YEAR	5-YEAR	10-YEAR	25-YEAR	50-YEAR	100-YEAR
A	25.39	32.79	37.71	43.85	48.46	52.97
B	-0.682	-0.686	-0.687	-0.690	-0.691	-0.691

Table 5-12: Rainfall Intensities (mm/hr) based on Proposed IDF

DURATION	RAINFALL INTENSITY (mm/hr) BY RETURN PERIOD (YEARS)					
	2-YEAR	5-YEAR	10-YEAR	25-YEAR	50-YEAR	100-YEAR
5 min	138.2	180.3	207.8	243.4	269.6	295.0
10 min	86.2	112.1	129.1	150.9	167.1	182.7
15 min	65.3	84.9	97.7	114.1	126.3	138.1
30 min	40.7	52.7	60.7	70.7	78.2	85.5
1 hr	25.4	32.8	37.7	43.9	48.5	53.0
2 hr	15.8	20.4	23.4	27.2	30.0	32.8
6 hr	7.5	9.6	11.0	12.7	14.1	15.4
12 hr	4.7	6.0	6.8	7.9	8.7	9.5
24 hr	2.9	3.7	4.3	4.9	5.4	5.9

Table 5-13: Percent Increase in Proposed IDF as compared to Existing IDF

DURATION	RAINFALL INTENSITY BY RETURN PERIOD (YEARS)					
	2-YEAR	5-YEAR	10-YEAR	25-YEAR	50-YEAR	100-YEAR
5 min	4%	3%	3%	3%	2%	2%
10 min	6%	4%	4%	3%	3%	2%
15 min	6%	5%	4%	4%	3%	3%
30 min	8%	6%	5%	4%	4%	3%
1 hr	9%	7%	6%	5%	4%	4%
2 hr	10%	8%	7%	6%	5%	4%
6 hr	12%	9%	8%	7%	6%	5%
12 hr	14%	10%	9%	7%	6%	6%
24 hr	16%	12%	9%	9%	8%	7%

6 Alternative Solutions (Conveyance)

Phase 2 of the Class EA process requires identification of various reasonable solutions to address the problem or opportunities identified in Phase 1. The potential solutions are then evaluated against various criteria related to natural, social, and cultural environments, and technical and cost considerations. Based on the evaluation, the preliminary preferred solution is identified. The preliminary preferred solution is then presented to the public, impacted property owners, Indigenous Nations, Government Review Agencies, and key stakeholders for review and input.

The primary alternatives to be considered relate to improvements to the minor storm drainage conveyance system, i.e. storm sewers. This is reviewed further in the following sub-sections.

Other measures have been proposed as part of the overall preferred stormwater management strategy which do not necessitate a fulsome alternative assessment; these are reviewed further in the subsequent sub-sections of the report.

6.1 Alternative Solutions

Based on the results presented in Section 5.5.2, there are identified storm sewer deficiencies. The following potential alternatives have been identified to address the storm sewer deficiencies:

- **Do Nothing:** Do not undertake any planned storm sewer upgrade
- **Upgrade to meet Township Standards:** Improving system so it can handle the amount of water from a storm that on average happens once in 5 years or a 20% chance of occurrence in any given year (current Township standard).
- **Upgrade to a Higher Standard:** Upgrading system so it can handle the amount of water from a larger storm that on average happens once in 100 years (or a 1% chance of occurrence in any given year) to reduce surface ponding and provide additional capacity (greater than current Township standard).

6.2 Evaluation Criteria

Alternative Solutions were evaluated as per criteria below (negative, neutral or positive):

- **Functionality**: Ability to address the identified concern
- **Social Environment:** Community\neighbourhood impact of construction and long-term safety, impact to property (public and private)
- **Natural Environment:** Impacts to natural environment (terrestrial and aquatic) and climate change resiliency
- **Economic Environment:** Initial design and construction costs and longer-term operation and maintenance costs

6.3 Evaluation of Alternative Solutions

Based on the high-level evaluation of alternatives, it was identified that the recommended solution for storm sewer upgrades is to “Upgrade to meet Township Standards”. The evaluation is illustrated in the figure below.

Figure 6-1: Evaluation of Alternative Solutions

Alternative	Functionality	Social Environment	Natural Environment	Economic Environment	Overall Ranking
Do Nothing					(Not Preferred)
Upgrade to 5-Year					(Preferred)
Upgrade to 100-Year					(Not Preferred)

6.4 Assessment of Preferred Solution (Conveyance)

6.4.1 Technical Assessment (Modelling and Prioritization)

Based on the preceding, the preferred solution is to design all of the storm sewers within the current limits of assessment to meet Township standards, to convey the 5-year storm event (current IDF) without surcharging. The developed minor-system modelling (i.e. conservatively neglecting inlet capacity restrictions) has been applied for this purpose. The modelling has been run iteratively to determine required pipe increases, such that the simulated peak flow is less than 100% of the theoretical pipe conveyance capacity. Upgrades have been completed incrementally using standard pipe sizes. It has been assumed that all CSP pipes would be replaced by PVC or concrete pipe, such that a consistent Manning's Roughness coefficient of 0.013 would be applied in all cases. The magnitude of the required pipe upgrade has been tracked (i.e. number of standard pipe size increases required) to assess areas with greater upgrade requirements. As noted previously, due to the dynamic nature of the modelling, in some cases pipes which were previously indicated as unsurcharged may become surcharged due to upstream pipe upgrades, which would contribute additional flows. The same process has been applied for all pipes to determine required upgrades.

The results of the preceding approach are summarized in Figures 9A (Salem and Elora), 9B (North Fergus) and 9C (South Fergus), as well as in Table 6-1 (by length) and Table 6-2 (by percentage). Percentages may not exactly equal 100% due to rounding.

Table 6-1: Summary of Proposed Storm Sewer Upgrades (by length)

COMMUNITY	TOTAL LENGTH (m)	NO UPGRADE (m)	UPGRADE BY 1 PIPE SIZE (m)	UPGRADE BY 2 PIPE SIZES (m)	UPGRADE BY 3 PIPE SIZES (m)	UPGRADE BY 4+ PIPE SIZES (m)
Salem	2,237	955	357	187	174	564
Elora (North)	17,528	7,314	3,444	3,684	1.795	3,084
Elora (South)	8,137	4,730	2,034	917	455	0
Fergus (North)	31,156	11,823	7,108	5,920	4,497	1,808
Fergus (South)	22,872	9,770	5,645	4,980	1,334	1,143
TOTAL	**81,930**	**34,592**	**18,588**	**15,688**	**6,462**	**6,599**

Table 6-2: Summary of Proposed Storm Sewer Upgrades (by percentage)

COMMUNITY	TOTAL LENGTH (m)	NO UPGRADE (%)	UPGRADE BY 1 PIPE SIZE (%)	UPGRADE BY 2 PIPE SIZES (%)	UPGRADE BY 3 PIPE SIZES (%)	UPGRADE BY 4+ PIPE SIZES (%)
Salem	2,237	43%	16%	8%	8%	25%
Elora (North)	17,528	42%	20%	21%	0%	18%
Elora (South)	8,137	58%	25%	11%	6%	0%
Fergus (North)	31,156	38%	23%	19%	14%	6%
Fergus (South)	22,872	43%	25%	22%	6%	5%
TOTAL	**81,930**	**42%**	**23%**	**19%**	**8%**	**8%**

As per the above, approximately 42% of the existing storm drainage system is indicated as sufficient (does not require an upgrade); this is generally consistent with the results presented previously in Table 5-6 (46% unsurcharged). The minor difference is attributable to changes (increases) in flows due to the iterative\dynamic upgrade process. Of the remaining 58% which require some kind of upgrade, the majority (42 of the 58%) are relatively nominal upgrades, 1 or 2 standard pipe sizes. The balance would require more substantial upgrades (3 or more standard pipe sizes).

The results are also generally consistent by area. The Salem area indicates a larger proportion of overall storm sewer upgrades (3 or more sizes) than the majority of the other areas. Conversely, the Elora South area indicates a higher percentage of pipes which do not require upgrades, and no pipes requiring upgrades by 4 or more standard pipe sizes.

A suite of higher priority storm sewer upgrades has been developed on the basis of the modelling results, including degree of storm sewer upgrade required, corresponding major system deficiencies, and areas of previously reported drainage problems. Areas with capital re-construction planned already in the near-term would also be prioritized given the overall synergies with the planned capital works. A total of seven (7) projects have been identified through this process; these are summarized in Table 6-3 and also in Figures 9A, 9B and 9C (attached).

Table 6-3: Summary of High Priority Storm Sewer Upgrade Projects

COMMUNITY	PROJECT NUMBER	LOCATION DESCRIPTION	LENGTH (m)
Salem	1a	Water Street and Victoria Street (William Street to CR18)	506
Elora (North)	2a	Melville Street (David Street to the Grand River)	1,000
	2b	North Queen Street (David Street to Grand River)	859
	2c	Irvine Street (Sophia Street to Grand River)	1,061
	2d	Colborne Street (Wilson Crescent to Gerrie Road) and Wilson Crescent	1,165
Elora (South)	N/A	No projects identified	N/A
Fergus (North)	3a	Anderson Street (Belwood Road to St. Andrew Street)	822
Fergus (South)	4a	Albert Street (St David's to Highway 6\Tower Street) and Princes Street (Tower St\Hwy 6 to Perth Street) and Braeside Road	1,167

The preceding projects would be suggested for implementation within approximately the next 10-year capital project planning list. As these projects involve upsizing existing storm sewers within existing road right of ways, these projects fall within the Exempt Project categories, per the MEA Class EA process, as described in Section 1.3 of this report. These projects are exempted from the requirements of the Environmental Assessment Act and can proceed to detailed design and construction. Other storm sewer upgrade projects identified should be implemented opportunistically (i.e. if full-depth reconstruction works are proposed) but would again be considered to be Exempt projects.

6.4.2 Financial Assessment (Costing)

In support of capital planning, a preliminary financial (costing) assessment of the recommended storm sewer upgrade works has been undertaken, using the magnitude of the expected pipe size upgrade identified in the previous section.

Preliminary construction costing at a Master Plan level of study is understood to be high-level only as it inherently cannot consider all the various components that would be included with a detailed design and tender development process. Costing has been undertaken using current (2023) concrete pipe supply costs, multiplied by 3 to account for the costs of installation and appurtenances (including maintenance holes and catchbasins). Costs have been rounded up to the nearest $1,000.

Costs do not include contingency, nor any design or construction phase support costs. Other utility works (sanitary sewers and watermains) are not included in the cost, nor would additional road restoration and landscaping costs. Costs should be re-visited periodically to adjust for the impacts of inflation and construction cost escalation. Further, more detailed costs should be developed for specific projects as part of any future preliminary and detailed design effort. Notwithstanding, the developed preliminary costs are considered useful in the development of an overall capital budget for stormwater management projects and works.

The estimated costs for the identified priority projects are presented in Table 6-4. Total costs for all works (including priority projects) are presented in Table 6-5. All of the identified priority projects appear to be along Township owned roads.

The preceding indicates a total of seven (7) priority projects, with a total cost of $11.3M. As noted, all of the projects would be part of Township roads and infrastructure.

The total cost for all proposed conveyance upgrades (including priority works) is $60.9M, for 47.3 km of overall storm sewer upgrades. The majority of this would be the Township's cost, with an estimated $56.0M (42.5 km of sewers). Approximately 8% would be Wellington County Roads, with an estimated cost of $4.9M (4.9 km of roadways).

Table 6-4: Summary of Estimated Costs for High Priority Storm Sewer Upgrade Projects

COMMUNITY	PROJECT NUMBER	TOTAL LENGTH[1] (m)	PRELIMINARY CONSTRUCTION COST (2023 $)
Salem	1a	506	$698,000
Elora (North)	2a	1,000	$894,000
	2b	859	$1,108,000
	2c	1,061	$1,577,000
	2d	1,165	$2,497,000
Elora (South)	N/A	N/A	$0
Fergus (North)	3a	822	$908,000
Fergus (South)	4a	1,167	$3,633,000
TOTAL	**N/A**	**6,580**	**$11,315,000**

1. Total length includes total length of overall storm sewers within limits (including first length of each connecting side street) but may not reflect actual length to be upgraded if no deficiency or upgrade need is noted for certain lengths within overall project.

Table 6-5: Summary of Estimated Costs for all Storm Sewer Upgrade Projects (including Priority Projects)

COMMUNITY	TOTAL LENGTH OF UPGRADES (m)	TOTAL COST OF UPGRADES (2023 $)	TOWNSHIP ROADS		COUNTY ROADS	
			LENGTH (m)	PRELIMINARY CONSTRUCTION COST (2023 $)	LENGTH (m)	PRELIMINARY CONSTRUCTION COST (2023 $)
Salem	1,282	$13,244,000	9,104	$12,381,000	1,026	$863,000
Elora (North)	10,214	$2,724,000	2,454	$2,288,000	433	$436,000
Elora (South)	3,407	$25,373,000	19,316	$24,080,000	1,721	$1,293,000
Fergus (North)	19,333	$17,868,000	10,937	$16,403,000	1,148	$1,465,000
Fergus (South)	13,102	$1,722,000	657	$847,000	540	$875,000
TOTAL	**47,338**	**$60,931,000**	**42,468**	**$55,999,000**	**4,868**	**$4,932,000**

Overall, storm sewers are expected to have a lifespan of between 50 to 100 years. While it is suggested that priority works be constructed in the next 10 years, the remainder would be expected to be completed in conjunction with normal asset renewal works, nominally over an additional 50-year span. This would therefore result in annual costs of:

- $1,132,000 per year for priority storm sewer upgrades on Township Roads (over 10 years)
- $894,000 per year for additional storm sewer upgrades on Township Roads (over the following 50 years)

This would equate to an average annual cost of approximately $934,000 per year over the total 60-year period (rounded up to $940,000 per year).

Given the magnitude of the estimated capital costs, a long-term implementation and financing strategy will be required. Implementation and financing considerations have been reviewed further in Section 8.

7 Water Quality

7.1 Existing Level of Treatment

In order to understand the existing level of water quality treatment and control within the communities of Elora, Salem and Fergus, a graphical summary has been prepared based on the locations of existing water quality treatment devices (both oil/grit separators and end of pipe stormwater management facilities). The results are presented in Figures 10A, 10B and 10C (attached) for the areas of Elora, Fergus North and Fergus South respectively. The areas receiving treatment have been developed using the modeled subcatchment boundary limits, which do not align completely with the approximate\overall drainage network boundaries discussed previously.

Note that the analysis considers only publicly owned water quality treatment; privately owned\operated water quality controls (if any) have not been included as no information has been provided to support this addition. The Township should however endeavour to maintain a comprehensive database and summary of all private controls to ensure they are identified and considered in future studies, and that private operations and maintenance responsibilities are clear. Newer development areas (outside of the study limit) have also not been included; however, these areas would be expected to all provide quality controls.

The results of the analysis have been presented in Table 7-1 by overall community.

Table 7-1: Summary of Existing Areas with Water Quality Treatment

COMMUNITY	MODELLED DRAINAGE AREA (ha)	MODELLED IMPERVIOUS AREA (ha)	DRAINAGE AREA RECEIVING WQ TREATMENT (ha)	IMPERVIOUS AREA RECEIVING WQ TREATMENT (ha)	PERCENT OF AREA TREATED (%)	PERCENT OF IMP AREA TREATED (%)
Salem	45.16	18.62	0	0	0%	0%
Elora (North)	197.79	96.10	8.76	4.38	4%	5%
Elora (South)	88.51	41.07	17.51	8.15	20%	20%
Fergus (North)	563.32	258.05	36.71	13.59	7%	5%
Fergus (South)	249.68	113.91	65.24	28.01	26%	25%
TOTAL	**1,144.46**	**527.75**	**128.22**	**54.13**	**11%**	**10%**

Overall, the results indicate that only approximately 11% of the study area receives water quality treatment. Larger proportions are indicated in Elora South and Fergus South, which have a greater proportion of more recent residential development.

The preceding reflects the original age of development, and that much of the community was constructed prior to the requirements for on-site quality controls (generally considered to be the implementation of the 1994 Ministry of the Environment and Energy Stormwater Management Practices Planning and Design Manual).

Notwithstanding, the preceding indicates a potential opportunity to improve the existing level of water quality treatment within the communities of Elora, Salem and Fergus, consistent with the

overall goals of the stormwater management master plan. This is reviewed further in the following sub-section.

7.2 Review of Water Quality Enhancement Opportunities

7.2.1 Retrofit Works

It is understood that any new (greenfield) development would be required to implement water quality controls as per the Township's Development Manual.

For existing urban areas, generally there are two (2) methods to increase the level of water quality treatment:

- Through re-development (infill\intensification); requiring these sites to implement modern water quality controls regardless of pre-existing land use\coverage; and
- Through active retrofits and re-construction works for areas which have no existing treatment (typically for full depth road reconstructions).

It is recommended that the Township implement both methodologies as part of its preferred strategy.

The first approach would be addressed through updates to the Township's Development Management Manual, as discussed further in Section 8.1. Costs would be expected to be borne by the developers.

The second approach would require capital planning, and the allocation of an additional budget stream to fund the design and construction of such measures.

Municipally led SWM quality retrofits typically take three (3) forms:

- New end of pipe SWM facilities (i.e. construction of new SWMF in available public spaces);
- Retrofit end of pipe SWM facilities (i.e. dry ponds or other existing SWM facilities that provide limited quality control); or
- Retrofit water quality controls (including LID BMPs) as part of road reconstruction works.

Based on a cursory review, there appear to be limited opportunities (due to a lack of available public lands) within the communities of Elora, Salem and Fergus for the implementation of new end of pipe SWM facilities. In addition, conversion of such lands is typically problematic as it may reduce available park space, unless sub-surface measures are proposed.

Existing end of pipe SWM facilities within the study area were all constructed fairly recently (to more current standards), and as such, there are no clear candidates for enhancements\retrofits. The SWM facility at Belsyde Ave and Scotland Street (refer to Figure 10C) may be a potential candidate for retrofit but appears to already include separate quality (RP-00008 and RP-00009) wet pond and quantity (RP-00010) dry pond cells. Further assessment would be required to confirm if a retrofit is warranted for this site.

As such, it is expected that road reconstruction retrofits are likely the most promising opportunity. It is considered that the most effective method would be to implement\combine retrofit measures as part of planned full-depth road reconstructions to minimize additional construction impacts and to realize synergies in reconstruction effort and costs. Retrofits

would ideally be targeted to high impervious areas, in particular commercial and industrial areas.

The costs for retrofit roadway water quality measures would clearly depend on the type and extent of the measures to be implemented. In constrained areas (where more fulsome LID BMP installations are not possible), typical measures would be expected to include:

- Oil/Grit separators (OGS) and other engineered devices (filters)
- Catchbasin inserts
- Low Impact Development Best Management Practices (LID BMPs)
  - Exfiltration pipes
  - Tree pits and soil retention systems
  - Permeable pavement (generally for lay-by and parking areas)

Low Impact Development Best Management Practices (LID BMPs) are discussed further in Section 7.2.3. In less constrained areas, more fulsome/surface-based LID BMPs should be considered (i.e., bioretention areas and bioswales, etcetera).

Stand-alone OGS units may vary in construction cost from approximately $150,000 to $300,000 depending on the size of the unit and area treated. It is suggested that the Township consider implementing two (2) water quality retrofits each year as part of selected road reconstruction projects. Based on an average construction cost, an annual budget of $450,000 is suggested for these works.

7.2.2 Stormwater Quality Operation and Maintenance Works

Other potential water quality enhancement measures which could be considered as part of ongoing operations and maintenance works include:

- Cross-connection testing to ensure that sanitary flows are not connected to storm sewer systems;
- Periodic grab (water quality) sampling to test the storm sewer and identify any potential areas of relatively higher contaminant loads (which may warrant further testing and/or prioritization for retrofit works) as well as to satisfy emerging CLI-ECA monitoring plan requirements (although this is not clearly noted in the Township materials provided);
- A regular and defined street sweeping program, particularly in the early spring. Typical costs are $100 per km, and approximately 100 km of roadway to be swept. Township staff has confirmed that this work is completed already by staff (2 machines); as such costs have not been included in capital cost summary.

Approximate costs for the preceding measures have been presented in Table 7-2. These costs would require further refinement based on contractor quotes (assuming work will be tendered).

Table 7-2: Approximate Annual Costing for Water Quality O&M Works

MEASURE	ANNUAL COST (2023 $)
Cross-Connection Testing Program	$100,000
Water Quality Grab Sampling and Monitoring Program	$200,000
Street Sweeping Program	$0
TOTAL	**$200,000**

In addition to the preceding annual costs, there are other one-time measures which may be considered.

Development of a road salt/sand management plan to minimize the use of salt and sand to the extent possible and consider potential alternative products where feasible. It is assumed that a one-time capital cost of up to $50,000 would be required for the completion of the study.

Consideration of a defined snow management site (as per Section 4.1.5) will also assist in mitigating environmental impacts for snowmelt. The ongoing (annual) costs to manage these works have not currently been estimated.

7.3 Green Infrastructure (GI) and LID BMPs

Green Infrastructure (GI) and Low Impact Development Best Management Practices (LID BMPs) are broad terms that generally refer to measures which mimic natural hydrologic processes and promote at source infiltration and runoff volume control. Typical examples of LID BMPs for roadworks in particular include (but are not limited to):

- Bioretention areas and bioswales
- Enhanced grass swales
- Soakaway pits and infiltration trenches and chambers
- Perforated\exfiltration pipes
- Preconstructed tree planters and soil support systems
- Permeable pavements
- Engineered devices (manufactured filters, etcetera)

With respect to road retrofits specifically, guidance is provided in “Grey to Green Road Retrofits” (CVC); available at: https://files.cvc.ca/cvc/uploads/2014/08/Grey-to-Green-Road-ROW-Retrofits-Complete_1.pdf.

For other applications, other forms of GI and LID BMPs may include green and blue roofs, rainwater harvesting and cisterns, and other similar measures.

Reference is also made to the MECP’s Draft Low Impact Development Stormwater Management Guidance Manual (available at: https://ero.ontario.ca/notice/019-4971). While the guidelines remain in draft form, it is expected that once adopted, these measures will become the Provincial standard to mandate the implementation of LID BMPs as part of all stormwater management practices.

LID BMPs further enhance water quality treatment (among numerous other benefits) through the promotion of filtration and infiltration at source, reducing contaminant loadings to

downstream receivers. As such, LID BMPs should be encouraged for implementation both within the water quality measures required for new developments and re-developments, but also as a part of road reconstruction projects. Specific updates to the Township's Development Manual should be considered that further support this intent, as discussed in Section 8.1. It is noted that the current Development Manual includes explicit reference to such measures, and in particular the application of a hierarchical approach to SWM practices (as per Section F.8 of that document; retention, then detention, then end of pipe controls). However, the specific approach should ensure alignment with MECP definitions and hierarchy.

Further to the preceding, it is generally recommended that existing rural road sections (ditching) be preserved and enhanced (i.e. implementation of formal Low Impact Development measures) wherever possible to maintain and improve water quality and water balance conditions. Road urbanization typically removes at source infiltration which in turn results in increased stormwater discharges and increased contaminant loads to downstream receivers.

8 Stormwater Management Strategy

8.1 Storwmater Updates to Development Manual

Based on a review of the Township's current Development Manual (Draft – May 2023) and the discussion and recommendations provided in previous sections, the following key updates are recommended:

- Requirement that all stormwater assessments utilize the updated rainfall intensity-duration-frequency (IDF) curves recommended herein, which reflect the forecasted increases due to climate change.
- Providing an updated suite of typically applied design storm distributions and clarifying that a sensitivity analysis should be undertaken in all cases.
- Updated the list of acceptable hydrologic and hydraulic models to consider more current software programs and removing legacy programs, with a preference for open source or publicly supported software.
- Requirement that all new site developments provide a minimum capture and retention of the first 5 mm of rainfall on site. References should be added to current MECP guidance on LID BMPs and hierarchy of control, including management of the 90th percentile rainfall. An updated discussion of specific and acceptable LID BMPs is required. The discussion within Section F.8 of the current Development Manual ("Hierarchy of Stormwater Management practices" should be updated accordingly.
- Specific requirements for qualifying and approving stormwater management technologies such as proprietary stormwater storage and treatment devices, with consideration for applicable standards such as the CA-ETV program.

It is expected that WSP will separately support the Township in an updated draft of Stormwater components of the Development Manual (as part of the overall Stormwater Management Master Plan) to reflect the above-noted recommendations.

8.2 Operations and Maintenance Requirements

In addition to the items noted in Section 7 (which are related primarily to new, water quality related initiatives), there are other stormwater management related operations and maintenance requirements which would be required. Many are as specified in the Township's CLI-ECA (as per Section 4.1.9). Expected tasks are presented in Table 8-1, along with approximate costs. Total costs have been rounded up to the nearest $10,000.

Based on the Table 8-1, the highest cost element would clearly be the SWMF cleanouts (sediment removal) projects. An average cost has been noted based on comparable costs per area of SWMF; however, this should be further refined using actual sediment volumes and clean-out thresholds. Another higher cost item would be the CB inspections and sediment removal (using hydrovac or equivalent) given the number of units.

Table 8-1: Approximate Overall O&M Costing

MEASURE	NUMBER[1]	ASSUMED FREQUENCY	APPROXIMATE COST (2023 $)	EFFECTIVE ANNUAL COST (2023 $)
Storm Sewer CCTV Inspection and Potential Flushing	137 km	Every 10 years	$5/m	$69,000
Catchbasin inspections and assumed cleanout	2,722[2]	Every 10 years	$500 per CB	$136,000
OGS inspections	14	Annually	$500 per OGS	$7,000
OGS cleanouts	14	Every 2 years	$1,000 per OGS	$7,000
SWMF inspections	31[3]	Annually	$0[5]	$0[5]
SWMF bathymetric surveys	31[3]	Every 5 years	$3,000 per SWMF	$19,000
SWMF cleanouts	31[3]	Every 20-25 years	Average cost of $500,000 per[4]	$689,000[4]
TOTAL	**N/A**	**N/A**	**N/A**	**$930,000**

1. For entirety of communities of Elora, Salem and Fergus (including recent developments outside study area).
2. Excludes CBMHs
3. 31 Retention Pond areas, 26 SWM areas (many overlap); using the higher value.
4. Average CW SWMF surface area is 2,000 m^2. Approximate cost developed based on per m^2 average from area SWMF cleanouts for other municipalities. Cost to be refined based on average SWMF sediment volumes. Timing for startup to cleanouts dependent on findings of bathymetric survey work but costing assumes cleanout frequency noted, starting immediately.
5. SWMF inspections already completed by Township staff.

8.3 Financing and Implementation Plan

8.3.1 Total Estimated Costs

The estimated costs for works presented in the previous sections have been compiled and are presented in Table 8-2.

Table 8-2: Total Annual Costs for Preferred SWM Strategy

MEASURE	ANNUAL COST (2023 $)
Storm Sewer Upgrades	$940,000
Stormwater Quality Retrofits	$450,000
Stormwater Quality O&M	$300,000
Overall O&M Requirements	$930,000
TOTAL	**$2,620,000**

Note that the preceding is based on the previously stated assumptions and is for the communities of Elora, Salem and Fergus only (does not include requirements for other areas within the Township).

In addition to the preceding, one-time costs would also include:

- Road salt and sand management plan (estimated cost of $50,000)
- Stormwater financing study (estimated cost of $150,000)
- Cost associated with snowmelt management facility (costs not yet determined)

8.3.2 Financing Strategies

A general overview of potential funding sources for the preferred SWM strategy is provided herein. The preceding has assumed that the majority of future funding would be sourced from the Township's Capital Budget (which in turn would be funded from the Township's General Tax Base), however multiple potential options for funding should be considered.

General tax base

The Township's tax levy is used in part to support the Township's storm water services on an annual basis. The most common municipal funding practice for maintaining municipal storm water management infrastructure not related to proposed development is property taxes. Property taxes are established based upon the value of private properties and the services provided and may be adjusted over time based upon changing property values and operating costs by the Municipality.

Development Charges

Development Charges represents funding based on percentage levied from all new developments for new municipal services. Development Charges are assigned to new developments, based upon the anticipated costs to implement (and maintain) the requisite infrastructure to support the new development. Development Charges are obtained at the time of development implementation to cover the cost of the required new infrastructure, hence it is not considered a viable source of revenue to support the construction of stormwater retrofit works not directly related to development activities, unless a "cash-in-lieu" approach for an adjacent development can be leveraged.

Storm Water User Pay Rates (Storm Water Utility)

Storm Water User Pay Rates are charged to users for runoff discharged from their property based on land use classification, property size, estimated impervious area and the intensity of runoff contribution to the Township's storm water management system infrastructure. Storm Water User Pay Rates (also referred to as Storm Water Utility Fees) have been widely implemented across the United States for decades and have become an increasingly popular source of dedicated storm water funding in Canada. Similar programs have been initiated or are being studied in various Municipalities within Ontario such as Waterloo, London, Kitchener, Guelph, Richmond Hill, St. Thomas, Aurora, Brampton, Mississauga, Vaughan, Windsor, Cambridge, and Hamilton.

The revenue generation capacity of a Storm Water User Pay Rate or Storm Water Utility Fee is similar to that of the real property tax, except that the utility fee is directly linked to the impervious surface cover or another measurable characteristic, rather than assessed value. Determining a legally defensible rate needed to generate revenue sufficient to finance the local storm water needs would require the local government to engage in a "Storm Water Utility Rate Study". During such a study, important policy decisions are made that can have significant implications for the selected rate. An important first step in the process is to

determine the average impervious land cover in square metres for a single-family residential lot. Although it is common for all single-family lots to be charged a flat fee, the Equivalent Residential Unit (ERU) can be applied to all other classifications of land. In addition to technical determinations, local governments must address a range of policy questions that ultimately impact the structure of the utility, as well as the storm water utility rate. The study can help the municipality determine the preferred approach that meets its needs.

Grant Opportunities

Funding from upper-level governments can sometimes be available to help offset the cost of storm water management infrastructure improvements.

Examples of government grant programs are the Province's Municipal Infrastructure Investment Initiative through Infrastructure Ontario and the recent Federal Infrastructure Stimulus funding, including the Clean Water and Wastewater (CWW) program and the National Disaster Mitigation Adaptation Fund (DMAF).

While grant opportunities should be leveraged to the extent possible to support proposed measures, they do not represent a steady or long-term source of available funding. Further, many of the proposed measures may not qualify (i.e. water quality works likely would not qualify for DMAF funding).

Overall

It is considered that a stormwater utility is likely the most appropriate and sustainable solution to ensure a long-term funding mechanism for the required stormwater management program. As noted, the first key step would be for the Township to initiate a Stormwater Utility Rate Study to assess the feasibility and determine the preferred form of utility and associated policy questions, as well as assembling the required base information. For budgeting purposes, it is suggested that the Township consider a provisional budget of $150,000 for the completion of the study. It is recommended that this study be prioritized for completion in the next 1-2 years in order to confirm the preferred funding mechanism to implement the preferred stormwater management strategy.

8.4 Future Commitments

8.4.1 Future Studies

As noted, future studies that should be completed include:

- Snow Disposal Site Assessment (to be completed by WSP as a separate component of the overall Stormwater Management Master Plan)
- Updated draft of Stormwater Management components of the Township's Development Manual (to be completed by WSP as a separate component of the overall Stormwater Management Master Plan)
- Road salt and sand management plan (estimated cost of $50,000)
- Stormwater financing study (estimated cost of $150,000)

8.4.2 Other Supporting Studies

As noted earlier, this Master Plan was completed following Master Plan Approach #1. This approach involves completing the Master Plan with a broad scope and level of assessment based on an analysis conducted on a regional or systems scale, which enables the proponent to identify needs and establish broader infrastructure alternatives and solutions. As a minimum, the following project specific studies shall be completed for the recommended storm sewer works as part of their detailed design phase:

- Ecological Screening (including Species at Risk) to determine each project's impacts on the natural environment and propose appropriate mitigation measures.
- *Criteria for Evaluating Archaeological Potential* and *Criteria for Evaluating Marine Archaeological Potential* to determine if an archaeological assessment is needed. If the project area exhibits archaeological potential, then an archaeological assessment (AA) should be undertaken by an archaeologist licensed under the *Ontario Heritage Act* and submitted for Ministry of Citizenship and Multiculturalism (MCM) review.
- Cultural Heritage Screening to determine whether any built heritage resources and cultural heritage landscapes would be impacted by project works.

9 Consultation Program

Consultation is a vital component of the MEA Class EA process, as it provides opportunity for engagement with all potentially affected parties, including Government Agencies, Indigenous Nations, members of the public, and stakeholder groups. As part of consultation process, various activities were undertaken to ensure a transparent and responsible planning process, all of which have been summarized below.

9.1 Study Contact List

A Study Contact List was developed at the commencement of the Study. This list included contacts from the federal, provincial, and municipal government agencies, utility companies, Indigenous Nations, and key stakeholder groups. The Study Contact List was updated throughout the Study. The final Study Contact List is provided in Appendix A.

9.2 Study Notices

9.2.1 Notice of Study Commencement

A Notice of Study Commencement was issued to introduce the Master Plan Study and invite the public, Indigenous Nations, government agencies and stakeholder groups to participate in the Study process. The notice was issued via following means. The notice is provided in Appendix A.

Table 9-1: Distribution Method for the Notice of Study Commencement

Notice Distribution Method	Date
Information Report to Committee of the Whole	13 Mar 2023
Posting on Project Webpage	16 Mar 2023
Publication in Local Newspaper (Wellington Advertiser)	16 Mar 2023
Email Circulation to Agencies, and Key Stakeholder Groups	17 Mar 2023
Email Circulation to Indigenous Nations	20 Mar 2023

9.2.2 Notice of Public Information Centre #1

A Notice of Public Information Centre #1 was issued to invite the public, Indigenous Nations, regulatory agencies and stakeholders to participate in the Public Information Centre #1. The notice was issued via following means.

Table 9-2: Distribution Method for the Notice of Public Information Centre #1

Notice Distribution Method	Date
Sharing on Township's Social Media Platform (Facebook)	21 Sep 2023; 26 Sep 2023; 28 Sep 2023; 02 Oct 2023; 04 Oct 2023; 09 Oct 2023; 13 Oct 2023; 16 Oct 2023
Township's Website under News and Announcements	12 Oct 2023; 16 Oct 2023
Email Circulation to Agencies, and Key Stakeholder Groups	17 Oct 2023
Email Circulation to Indigenous Nations	17 Oct 2023
Posting on Project Webpage	18 Oct 2023

9.2.3 Notice of Public Information Centre #2

A Notice of Public Information Centre #2 was issued to invite the public, Indigenous Nations, regulatory agencies and stakeholders to participate in the Public Information Centre #2. The notice was issued via following means.

Table 9-3: Distribution Method for the Notice of Public Information Centre #2

Notice Distribution Method	Date
Posting on Project Webpage	8 Feb 2024
Email Circulation to Agencies, and Key Stakeholder Groups	14 Feb 2024
Email Circulation to Indigenous Nations	14 Feb 2024
Sharing on Township's Social Media Platform (Facebook)	21 Feb 2024, 7 Mar 2024, 12 Mar 2024, 26 Mar 2024

9.3 Public Consultation

A key component of this Municipal Class EA Study is engagement with Indigenous Nations, the public, government agencies and interested stakeholders. Two (2) Public Information Centres were held to share study information and to provide an opportunity to receive feedback on the study finding and recommendations.

9.3.1 Public Information Centre #1

Public Information Centre (PIC) #1 was held to share preliminary findings of this study and gather feedback on the key areas of concerns within the Township, as it relates to stormwater management. This PIC was hosted in two formats:

In-person Open House: The Township of Centre Wellington hosted "Key Projects Open House" on Thursday, October 19, 2023, from 6pm – 8 pm at the Centre Wellington Community Sportsplex. Interested individuals were invited to attend this event where they had the opportunity to meet with staff and team members on major Township projects and initiatives, including the Stormwater Management Master Plan Study Team.

Virtual Information: In addition to the in-person event, a project presentation package was made available on Township's community engagement platform, *Connect CW*, starting October 19, 2023. Interested individuals were invited to review this information on their own time and submit any comments by November 2, 2023. The project presentation package and online comment form were made available on: https://www.connectcw.ca/swm-master-plan.

Public Input: During the In-person Open House, the Study Team had made available large roll-out figures showing the areas of drainage concern in the communities of Elora, Salem and Fergus. The attendees were invited to review these figures and identify any additional areas of concern. The Study Team received input from the attendees on these figures. These figures were subsequently updated and are included in Figure 6B (attached).

No further comments were received from the members of the public as part of t PIC #1.

9.3.2 Public Information Centre #2

PIC #2 was held to share held to present the Preferred Stormwater Management Strategy for the Township (communities of Elora, Salem and Fergus). This PIC was hosted in two formats:

In-person Open House: The Township hosted an In-person Open House on Wednesday, February 21, 2024, from 6pm – 8 pm at the Jefferson Elora Community Centre. Interested individuals were invited to attend this event where they had the opportunity to meet with team members of the Stormwater Management Master Plan Study Team.

Virtual Information: In addition to the in-person event, a project presentation package was made available on Township's community engagement platform, *Connect CW*, starting Wednesday, February 21, 2024. Interested individuals were invited to review this information on their own time and submit any comments by Thursday, March 7, 2024. The project presentation package and online comment form were available on: https://www.connectcw.ca/swm-master-plan.

Public Input: Public input received during PIC #2 and Study Team's responses are summarized below:

- A local dairy farmer shared concern about a pending stormwater utility and what that would mean for agricultural land and the importance of recognizing rural land management (quantity and quality). The individual also indicated that Wellington County has a stewardship type program (in conjunction with GRCA) that works at doing improvements for rural properties that should be leveraged and considered. The Study Team provided responded that there is flexibility in the form of utilities and the Township can select appropriate approach and take the noted items into consideration.
- A few individuals shared concerns about new development and both the impact they have during construction and also what they see after (waste and debris in the ponds, etc.). The Study Team responded that the Township staff would be responsible to enforce erosion and sediment control measures during construction and the Township is also required to

inspect and maintain ponds and other infrastructure once these are assumed from the developer as part of their municipal Consolidated Linear Infrastructure Environmental Compliance Approval (CLI-ECA).

- One individual noted a particular concern related to water quality and what was being proposed. The Study Team clarified modern stormwater management approaches and that is the intended function of the ponds to provide water quality. It was also noted that the ponds would need to be inspected and maintained. Where possible, the Township will also consider implementing retrofit water quality as part of road reconstruction projects.
- A family inquired if the pond behind Holman Park was functioning properly and noted that they have never seen any maintenance occurring on the pond. The Study Team noted that pond has been identified previously by the public (PIC #1) as an area of concern and would be assessed as part of the Township's required inspection work to determine further tasks.
- Some residents raised concern over how future land is going to be developed and how stormwater will be treated for quality and quantity. The Study Team responded that future development would be required to match pre-construction to post-construction flow rates (quantity control) and would also be required to provide quality control to Township standards.
- A resident of Irvine Street inquired about the 5-year system along that street. The Study Team explained that while mapping shows surcharging this is based on computer modelling; surcharging may not have impacted residents directly in the past. The roadway in those sections was also noted as being capable of conveying the 100-year storm based on the modelling results.
- A resident raised concern on the limits of the Study and its focus on water quantity while excluding water quality, and the exclusion of areas under current or proposed development. The Study Team explained that these developers are required to submit stormwater management plans, which are ultimately reviewed by Township staff and then approved by Council. The resident provided various suggestions to support a comprehensive and effective Stormwater Management Master Plan, such as placing a moratorium on new stormwater discharges, establishing a regulatory framework, advocating for green infrastructure, and engaging the community.

9.4 Agency Consultation

A Technical Advisory Committee (TAC) was established to provide technical input on this Master Plan study. It was comprised of technical staff from the Township of Centre Wellington, Wellington County and Grand River Conservation Authority. Meetings were held with this committee at key project milestones to seek input. A summary of TAC meetings is provided below. Minutes of meetings and email correspondence with TAC are provided in Appendix A.

9.4.1 Technical Advisory Committee Meeting #1

TAC Meeting #1 was held on July 6, 2023. The purpose of this meeting was to share the Study purpose and scope, and a brief summary of findings of background information, gap analysis and study area characterization. Meeting participants asked general questions related to the study methodology, which were addressed during the meeting. Refer to the meeting minutes for more information.

9.4.2 Technical Advisory Committee Meeting #2

TAC Meeting #2 was held on February 26, 2024. This meeting discussed study progress since the TAC Meeting #1. The Study Team presented content from the PIC #2 slides. Meeting attendees identified the known drainage issues, including the Elora-Cataract Trail at Gartshore Street and East Mill Street at Metcalfe Street in Elora. Study Team noted the overland flow modelling was confirmed to consider outlets to watercourses and potential obstructions. The inclusion of agricultural/rural areas in stormwater utilities was discussed, with a decision to be made in a future study. The current study recommends a 5% increase in rainfall intensities based on climate change forecasting models. Recommendations of the study were suggested to be clearly split for County Roads and Township Roads. Wellington Road 18/Woolwich Street was confirmed to be reconstructed and removed from the priority projects list. Priority locations for stand-alone stormwater quality retrofits were discussed. The Study Team requested any feedback on the content of PIC #2 from the County and GRCA by March 7, 2024.

9.4.3 Ministry of the Environment, Conservation and Parks

On March 13, 2023, the MECP shared Ministry's acknowledgement letter in response to the Notice of Study Commencement. Via this letter, the Ministry shared its "Areas of Interest" document, which provides guidance regarding the Ministry's interests with respect to the Class EA process. The Ministry advised to address all areas of interest in the EA documentation at an appropriate level for the EA study.

Further, the Ministry delegated the procedural aspects of rights-based consultation to the Township of Centre Wellington for this study through this letter. The MECP advised that the proponent is required to consult with the following communities who have been identified as potentially affected by the proposed project:

- Mississaugas of the Credit First Nation
- Six Nations of the Grand River (Elected Council and Haudenosaunee Confederacy Chiefs
- Council with a copy to Haudenosaunee Development Institute)

With respect to MECP's areas of interest, as noted in Section 1.3, this study was completed in accordance with Master Plan Approach #1, as outlined in the Municipal Class EA document (amended in 2023). This approach involves completing the Master Plan with a broad scope and level of assessment. The inventory of the natural, social and economic environments may also be broader/more general. Specific projects that are required to achieve the preferred solution may be identified within the Master Plan document, however the level of detail at a project-specific level is minimal. Therefore, more detailed investigations at the project-specific level are required in order to fulfil the Class EA requirements for the specific Schedule B and C projects identified within the Master Plan.

Accordingly, the Study Area characterization for this study was limited to inventorying the existing stormwater management system within the communities of Elora and Fergus. As the Master Plan covered the entire communities of Elora and Fergus (not including more recent developments), it was not within the current project scope to complete the inventory of the natural, social and economic environments. Such an inventory is being deferred to any potentially required future project-specific studies (as identified) to satisfy the Class EA requirements for the specific Schedule B and C projects identified within this Master Plan.

Correspondence with the MECP is provided in Appendix A.

9.4.4 Ministry of Citizenship and Multiculturalism

On April 11, 2023, the MCM shared a letter in response to the Notice of Study Commencement. The letter identified MCM's interest in this master plan study relating to its mandate of conserving Ontario's cultural heritage, which includes archaeological resources, built heritage resources and cultural heritage landscapes. Via this letter, the Ministry also provided advise on how to incorporate consideration of cultural heritage in the master planning process by outlining the technical cultural heritage studies and the level of detail required to address cultural heritage in master plans.

As noted above, this study was completed in accordance with Master Plan Approach #1, as outlined in the Municipal Class EA document (amended in 2023). This approach involves completing the Master Plan with a broad scope and level of assessment. Accordingly, the Study Area characterization for this study was limited to inventorying the existing stormwater management system within the communities of Elora and Fergus. As the Master Plan covered the entire communities of Elora and Fergus, it was not within the project scope to complete the inventory of the cultural heritage and archaeological resources. Such an inventory is being deferred to any potentially required future project-specific studies (if identified) to satisfy the Class EA requirements for the specific Schedule B and C projects identified within this Master Plan.

Correspondence with the MCM is provided in Appendix A.

9.4.5 Grand River Conservation Authority

On March 27, 2023, the Grand River Conservation Authority (GRCA) shared a letter in response to the Notice of Study Commencement. GRCA requested to be notified of any information pertaining to the Class EA as it becomes available and shared that the Study Area contains natural hazard and natural heritage features including the Grand River, Irvine Creek and other associated tributaries, as well as floodplain, slope erosion, slope valley, wetlands, and the associated regulated allowances to these features. These features and their allowances are regulated under *Ontario Regulation 150/06*. Any future development or site alteration within the regulated areas may require the issuance of a Development, Interference with Wetlands and Alterations to Shorelines and Watercourses permit from the GRCA. GRCA also shared resource mapping for the Study Area.

On April 2, 2024, the GRCA responded to PIC #2 with feedback. GRCA offered high-level advisory comments for future projects, considering the proposed upgrades to the existing storm sewer systems. GRCA's comments are noted below:

- Impacts of the proposed upgrades to receiving watercourses must be reviewed, and it must be demonstrated that there will be no increase to the risk of flooding or erosion of the watercourse as a result of the proposed works.
- Any features impacted by the proposed works should be clearly identified and appropriate design criteria should be applied to protect the feature. Future consultation with GRCA may be required.

Correspondence with GRCA is provided in Appendix A.

9.5 Indigenous Nations Engagement

As noted in Section 9.4.3 above, the MECP delegated the procedural aspects of rights-based consultation to the Township of Centre Wellington for this study through a letter on March 13, 2023. The Ministry advised that the proponent is required to consult with the following communities who have been identified as potentially affected by the proposed project:

- Mississaugas of the Credit First Nation
- Six Nations of the Grand River (Elected Council), and
- Haudenosaunee Confederacy Chiefs Council as represented by Haudenosaunee Development Institute

Accordingly, the Study Team shared project notices at key project milestones to these Indigenous Nations. The Study Team also sent follow-up emails to inquire if the Indigenous Nations had an interest in this project and/or if they wanted to meet to discuss this project. No responses were received to date.

Copies of correspondence with the Indigenous Nations are provided in Appendix A.

10 References

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