Community of Angus

Infrastructure Master Plan
Schedule 'B' Class Environmental Assessment

Summary Report

FINAL DRAFT

Township of Essa
September 2022

Greenland Project No. 21-G-4202

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1.0 INTRODUCTION AND BACKGROUND

The Township of Essa (Township) retained Greenland International Consulting Ltd. (Greenland) in 2021 to complete an Infrastructure Master Plan (IMP) for the Community of Angus (Angus). The purpose of the IMP is to complete a 25-year forecast (ultimate development horizon) of proposed capital projects for water, wastewater and stormwater management (SWM) infrastructure servicing requirements to facilitate future growth expected in Angus and to assist the Township with the on-going development of their municipal infrastructure Asset Management Plan (AMP), through updates to infrastructure modeling for Angus and decision support with respect to project prioritization. Transportation needs were also assessed as part of the AMP component (limited to pavement condition inventory (PCI) for existing infrastructure). We also note that the SWM component of the study was limited to high level desktop assessment and development of existing conditions hydrologic modeling to assist with assessment of pending and future development applications by the Township.

1.1 BACKGROUND

Angus is one of three (3) urban centers in the Township. Per the 2001 Official Plan (OP) and current County and Provincial growth strategies, Angus is a main growth area in the Township and dependent on full water and sanitary servicing. The Township is currently undergoing an update to its OP which is expected to be completed in 2022. The Township's current asset management plan (AMP) will also need to be updated by 2024.

The Angus IMP is being completed under the provisions of the Class Environmental Assessment Act. Per Section 4 of the Municipal Engineers Association (MEA) Class Environmental Assessment (Class EA) procedures, Master Plans must address Phase 1 (identify the problem or opportunity) and Phase 2 (identify alternative solutions and establish the preferred solution) of the Class EA process. The final report produced at the conclusion of the Planning Process will complete the requirements for proposed Schedule 'B' projects under the Municipal Class EA process, allowing these projects to proceed towards implementation (Phase 5), while also identifying any additional required technical studies and/or Schedule 'C' projects, which require the completion of Phases 3 and 4 of the Class EA process prior to implementation.

1.1.1 Description of the Study Area

The Township of Essa is one of 16 lower tier municipalities located in Simcoe County. It is bordered by CFB Borden and the Township of Adjala-Tosorontio to the west, the Town of Innisfil and City of Barrie to the east, the Town of New Tecumseth to the south and by the Township of Clearview and Township of Springwater to the north. As a lower tier municipality, Essa is responsible for providing such services as fire protection, public works, water and wastewater, parks and recreation, building and planning and development control.

The Township consists of six (6) settlement areas: Colwell, Utopia, Ivy, Baxter, Thornton and Angus. The Community of Angus is the Township's primary settlement area considered to be a complete community providing full municipal services and a full range and mix of facilities.

Per flow data provided by the Ontario Clean Water Agency (OCWA), Angus has an existing water / wastewater serviced population of approximately 11,849 persons. It is bisected by the Nottawasaga River which flows through the community in a south to north direction through the Community, and the by the

Pine River, which flows northeast where it joins with the Nottawasaga River within the settlement area boundary. The study area, is shown below in **Figure 1-1.**

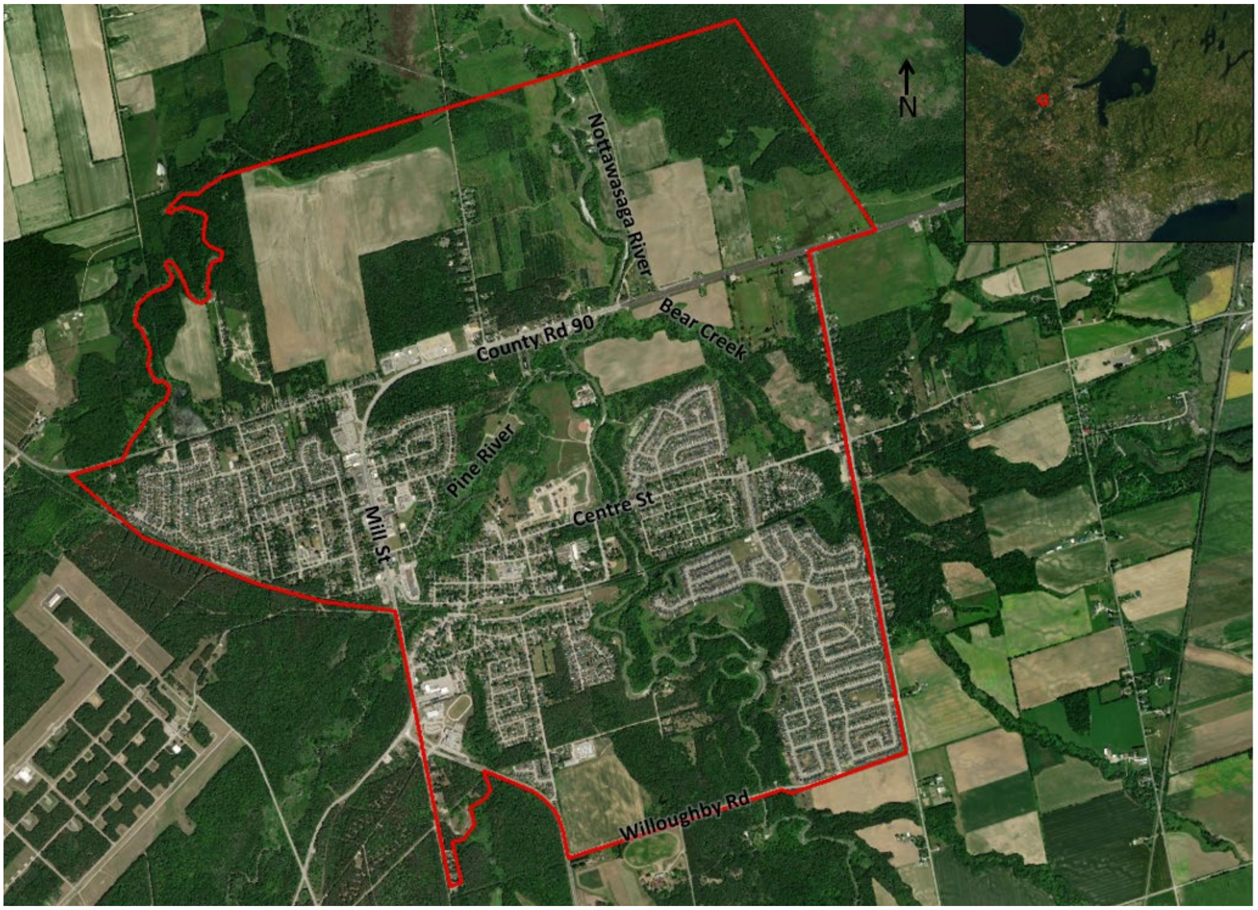

Figure 1-1 Study Area

1.1.2 Project Objectives and Approach

The objective of this assignment is to prepare an Infrastructure Master Plan (IMP) for the Community of Angus, in accordance with the municipal Class EA process (a Schedule 'B' activity as defined by the Municipal Engineers Association Class EA documentation) while simultaneously updating and developing important water, wastewater, SWM and transportation asset management details including inventories, mapping and modelling, with sufficient detail to ensure the municipality has a reliable baseline framework for assessment of future development projects and infrastructure needs, including both capital and maintenance projects.

1.1.3 Studies and Reports

The following studies provided by the Township and provincial guidelines were referenced during completion of the existing conditions models:

- Ainley Group. 2018. *Township of Essa Growth Strategy*;
- Ainley Group. 2020. Township of Essa - *Angus 2019 Capacity Allocation Report*;
- Hemson. 2021. *Essa Land Needs Assessment (LNA) – Draft*;
- Hemson. 2022. *Community Area Land Needs Assessment*;

- Ministry of Environment Conservation and Parks (MECP). 2008. *Design Guidelines for Drinking-Water Systems*;
- Ministry of Environment Conservation and Parks (MECP). 2008. *Design Guidelines for Sewage Works*;
- Township of Essa. 1989. *Engineering Design Standards*;
- Township of Essa. 2022. *Engineering Design Standards & Specifications Manual (DRAFT).*

1.2 THE CLASS ENVIRONMENTAL ASSESSMENT PROCESS

The Class Environmental Assessment process is carried out in five (5) phases:

- Phase 1: The problems and opportunities are identified.
- Phase 2: Alternative methods of resolving the problem are identified, environmental impacts are considered and a preferred solution is chosen.
- Phase 3: Alternative design concepts are identified for the preferred solution selected during Phase 2. Environmental impacts are considered, and a preferred design concept is chosen.
- Phase 4: The preparation of an Environmental Study Report (ESR) which summarizes the work completed in Phases 1 to 3.
- Phase 5: The project is implemented and any monitoring provisions and commitments made during the EA process must be followed.

This process is shown schematically in **Figure 1-2.**

NOTE: This flow chart is to be read in conjunction with Part A of the Municipal Class EA

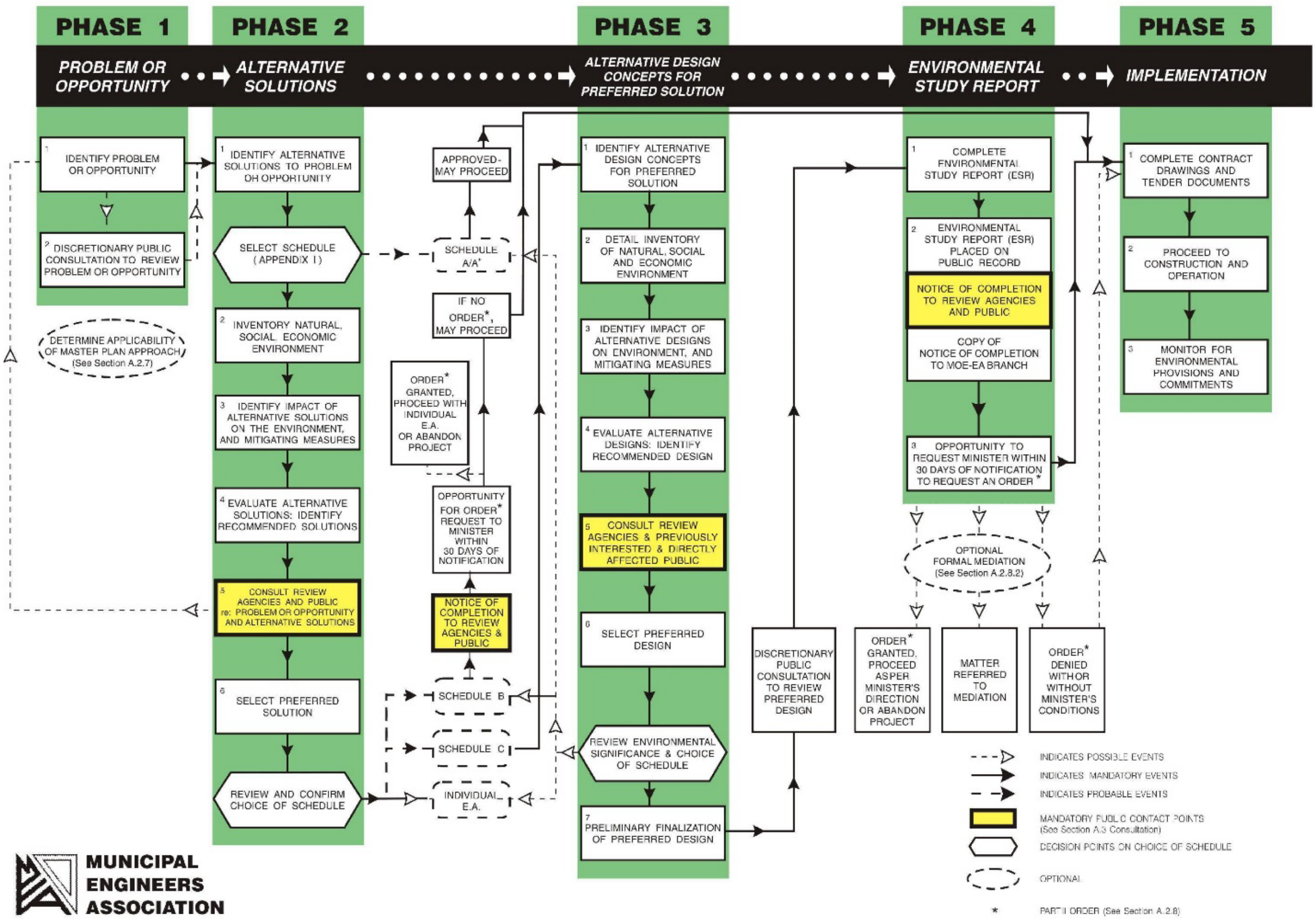

Figure 1-2 Class EA Process

Projects subject to the Class EA process are classified into four (4) possible "Schedules" depending on the degree of potential impact on the environment; Schedule 'A', Schedule A+, Schedule 'B' and Schedule 'C'. Schedule 'A' and 'A+' projects are considered exempt from detailed evaluation requirements while Schedule 'B' projects are approved subject to agency screening following completion of Phases 1-2 of the EA process. Schedule 'C' projects require the completion of a Phases 1-4 of the EA process including the filing of an Environmental Study Report (ESR) documenting the process. Phase 5, Implementation, follows the completion of the requisite Phase for each EA schedule described herein.

Schedule 'A' Projects

Schedule 'A' type projects are considered minor operation and maintenance activities and are selected for pre-approval without requirements for further assessment. Projects that fall under this classification are typically limited in scale and present minimal adverse impacts to the surrounding environment. An example of a Schedule 'A' project would include minor upgrades or extension of existing potable water or sanitary piping systems within a municipal system. This type of project is pre-approved and the proponent may proceed without following the procedures set out in any other part of the Class EA process.

Schedule 'A+' Projects

As part of the 2007 amendments to the Municipal Class EA process, Schedule 'A+' was introduced. Although Schedule 'A+' projects are pre-approved (like Schedule A), it is required that the public be advised prior to the project implementation. The purpose of this is "to ensure some type of public notification for certain projects that are pre-approved under the Municipal Class EA" (Municipal Class EA). An example of a Schedule 'A+' project would be surface improvements made to a road and/or a road reconstruction project.

Schedule 'B' Projects

These projects require screening of alternatives for their environmental impacts and completion of Phases 1 and 2 of the Class EA planning process. If outstanding issues remain after the public review period, they must be addressed prior to proceeding to Phase 5. Provided no significant impacts are identified and no requests for a Part II order are received, Schedule 'B' projects are approved and may proceed directly to Phase 5: Implementation. Schedule 'B' projects generally include improvements and minor expansions to existing facilities. An example of a Schedule 'B' wastewater project would be the establishment, extension or enhancement of a sanitary system and all required works to connect the system to an existing sanitary outlet. The facilities must not be in an existing road allowance or utility corridor.

Schedule 'C' Projects

Schedule 'C' projects have the potential for significant environmental effects and therefore must proceed under the full planning and documentation procedures of the Class EA process. Schedule 'C' projects require that an Environmental Study Report (ESR) be prepared and filed for review by the public and review agencies and generally consist of construction of new facilities and major expansions to existing facilities. Phase 3 involves the identifying alternative methods for carrying out the project and public consultation for the preferred conceptual design. Phase 4 includes preparation of an Environmental Study Report that is filed for public review. If no significant impacts are identified and no requests for a Part II order are received, Schedule 'C' projects are then approved and may proceed to Phase 5: Implementation. An example of a Schedule 'C' project would be construction of a new sanitary system, including the construction of treatment facility and/or an outfall to a receiving water body and/or a constructed wetland for treatment.

The Angus IMP Class EA will complete Phases 1 and 2 of the Class EA process. As such, all Schedule 'B' projects identified in the final report can proceed to Phase 5: Implementation on completion of the IMP Class EA, unless otherwise identified herein for additional study. Schedule 'C' projects identified in the Infrastructure Master Plan will need to proceed to Phases 3 and 4 of the Class EA process prior to proceeding to Implementation (Phase 5). Public Consultation is an important part of the Class EA process. One (1) Public Information Centre (PIC) was held once the modelling for the future conditions (ultimate build-out) was completed, and the short-list of alternatives had been developed.

1.3 PROJECT ORGANIZATION

1.3.1 Project Team

A project team was established at the outset to provide guidance in the decision-making process and to ensure that all issues were adequately addressed. Greenland is providing the prime consultant services on the project for all matters pertaining to water, wastewater and stormwater servicing. StreetScan was also retained as a sub-consultant to Greenland to assist with road network related assessments in preparation of this IMP.

1.4 PUBLIC INVOLVEMENT

Public consultation is an important part of any Class EA Process, and consultation with the affected public has been carried out throughout all stages of the Angus IMP. Notices associated with the process have been provided in **Appendix A-1**, with copies of all presentations provided in **Appendix A-2**.

A record of all comments received from members of the public and from relevant approvals agencies can be found in **Appendix A-3**.

1.4.1 Notice of Commencement

The Notice of Study Commencement (NOSC) was posted on the Township's website (http://www.essatownship.ca). Copies of the NOSC and associated circulation lists can be found in the Public Consultation Record (**Appendix A-1**).

1.4.2 Public Information Centre (PIC) No. 1

A notice of the Public Open House (PIC) No. 1 was published on the Township's website, the Township's social media channels and through email to local land owners/stakeholders two weeks prior to the hosting of the PIC. The Notice for PIC No. 1 is provided in **Appendix A-1**.

PIC No. 1 was held on 14 July 2022. The purpose of the meeting was to present:

- The Class EA process;
- The study area and a summary of existing conditions (including SWM);
- The evaluation of water supply, distribution and storage; wastewater collection, treatment, and disposal alternatives and,
- The next steps in the project and the Class EA process.

The PIC No. 1 presentation, display panels and hand-out material are provided in **Appendix A-2.** The public and review agencies had the opportunity to review the Class EA material and provide input on the information provided to date. The presentation slides were made available online via the Township website and email addresses for project representatives were provided so attendees could provide comments or queries.

With the exception of several emails requesting direction to locate the online version of the slide presentation, no comments or queries from members of the public were received following PIC No. 1. Copies of received requests for documents and responses issued by Greenland and the Township to each are provided in **Appendix A-3**. The Notice of Commencement and PIC presentation was emailed to a provided list of local stakeholders including agencies and First Nations groups.

1.4.3 Issuance of Notice of Completion

The Notice of Completion for the Angus Infrastructure Master Plan Class Environmental Assessment Summary Report was published on 12 September, 2022.

The notice was published on the Township's website and emailed to a provided list of local stakeholders (including PIC attendees/respondents) including agencies and First Nations groups.

A copy of the Notice of Completion is provided in **Appendix A-1**.

1.5 REPORT ORGANIZATION

The purpose of this Master Plan Summary Report (Report) is to provide details on the development and comprehensive evaluation of servicing alternatives for water, wastewater, stormwater management and road infrastructure within the Study Area.

In accordance with the intentions of the Class EA process, preliminary consideration was given to all potential solutions, including (but not limited to) a "do nothing" option, and servicing options which facilitate the full build-out scenario within the study area.

The process of preliminary consideration generally included screening of the long list of options against preliminary assessment criteria to arrive at a short list of servicing solutions for additional detailed evaluation. These shortlisted solutions were then evaluated in terms of their impacts to the social and natural environments as well as on the basis of their technical and economic merits to arrive at a preferred servicing solution for each infrastructure category.

This Report has been structured in order to provide a detailed summary of this process, which can generally be summarized as follows:

- Summary of Background Information and Development of a Study Area Profile;
- Existing Conditions Modelling
- Ultimate Conditions Modelling
- Development of Evaluation Criteria and Screening Methodology for Servicing Options;
- Long List of Wastewater Treatment and Disposal Options;
- Preliminary Evaluation and Summary of Shortlisted Wastewater Treatment Options;
- Detailed Evaluation and Selection of Preliminary Preferred Wastewater, Treatment and Disposal Solution;
- Long List of Water Supply Options;
- Preliminary Evaluation and Summary of Shortlisted Water Supply Options;
- Detailed Evaluation and Selection of Preliminary Preferred Water Supply Solutions;
- Long List of Water Storage Options;
- Preliminary Evaluation and Summary of Shortlisted Water Storage Options;
- Detailed Evaluation and Selection of Preliminary Preferred Water Storage Solutions;
- Summary of Overall Preferred Servicing Solutions; and,
- Development of Mitigation Strategies for Implementation and Phasing of the Preferred Solutions.

2.0 STUDY AREA PROFILE

The following subsections expand upon the background information presented in **Chapter 1** to provide a detailed existing conditions profile of the Study Area.

2.1 EXISTING POPULATION AND POPULATION PROJECTIONS

The Municipal Comprehensive Review (MCR) is currently being completed by the County of Simcoe to determine updated future population allocations to the lower tier municipalities. The Growth Forecasts and Land Needs Assessment (LNA) completed by Hemson in 2022 as part of the MCR, estimates the Township population to be 23,810 persons, as of 2021. This exceeds the provincial growth plan's previous population projection of 21,500 persons by 2031. As much of the development has occurred in Angus, it is important that existing and future development water and wastewater servicing allocation is monitored to ensure that capacity is not exceeded, without infrastructure in place to support the new development.

The existing population of Angus was taken from the 2018 flow data provided by OCWA. Since 2018, several developments have been constructed or are under construction, and therefore were not accounted for in the existing serviced population number provided in the OCWA data. The population associated with these developments was added in to the existing conditions water and wastewater models developed for this IMP to arrive at an updated existing population for Angus of 13,669 persons.

Consideration in the IMP was given to the 'Ultimate Build-out' for Angus under the existing Settlement Area. As there are currently no approvals from the Province for settlement boundary expansion, no consideration was given to development that expands the existing settlement area. It is anticipated that this development scenario will be reached within 25 years, therefore it will be critical to ensure that infrastructure is capable of meeting capacity demands.

Proposed future development projections were determined based on active pre-consultations and/or active development applications with the Township.

there are currently 3,058 equivalent residential units proposed for development for wastewater collection and treatment and 3,002 equivalent residential units for water supply and distribution, including:

- 2,809 residential units;
- 10.1 ha commercial development;
- 60 hotel units.

The County's LNA has allocated the Township a new target population of 34,740 by 2051, a growth of 10,930 persons. Per the Township's 2018 Growth Strategy, the majority of future growth in Essa will continue to be allocated to Angus. Based on the modelling completed for this study, the population of Angus is projected to be 22,096 by 2046. This is in keeping with the Township's Growth Strategy.

The proposed population used in the model was determined from the proposed units for development, provided by the Township, and the population density (people per unit) calculated from the provided flow data (OCWA) used in the model calibration process, further discussed in **Sections 3.2.5** (Water) and **3.3.6** (Wastewater). The residential population is summarized below in **Table 2-1**.

Table 2-1 Angus Existing and Proposed Population

	Residential Units	Residential Population	Equivalent Residential Units	Equivalent Residential Population
Existing Population (OCWA Data)	3,981	11,849	-	-
Updated Existing Population	4,581	13,669	4,591 (Water) 4,610 (Wastewater)	13,773 (Water) 13,830 (Wastewater)
Ultimate Population	7,390	22,096	7,526 (Water) 7,577 (Wastewater)	22,578 (Water) 22,731 (Wastewater)

The equivalent residential population is a value determined by converting flows from commercial and institutional land uses into equivalent residential units (ERUs), then multiplying them by the population density (3 people per unit). Non-residential (Institutional, Commercial and Industrial, or ICI) equivalent populations, which were not included in the OCWA data, were then added to the residential population.

2.2 EXISTING INFRASTRUCTURE DATA

The Township provided Greenland with all available existing water and sanitary infrastructure data. This included:

- CAD files of the sanitary sewer and water distribution network (2018);
- 2010 WaterCAD model;
- 2021 aerial imagery;
- Sanitary manholes shapefile;
- Water Hydrants and control valves shapefiles;
- Water Distribution Valves shapefile; and,
- Parcel Fabric shapefile.

In addition to the GIS and CAD spatial data, the Township provided all available As-Built drawings, which were used to supplement the available data and were the basis for updating the existing conditions SWM hydrologic model.

The infrastructure digital CAD files provided by the Township were updated in ArcGIS using As-Built drawings. This included updating the geometry of the water and sewer networks from the original CAD files, as there were inaccuracies in the 2018 CAD files which had to be adjusted manually. Once this adjustment was complete, further adjustments were made to the water / sanitary networks including: adding / removing points based on the As-Built drawings, such as water valves, hydrants, sanitary manholes; updating sewer and watermain networks to match the updated point shapefiles and As-Built drawings; updating attribute tables to include the pipe diameter; and, addition/correction of ground and invert elevations as required.

The resulting asset infrastructure is summarized below.

Water
Distribution system water valves: 532
Water Hydrants: 370
Watermain: 62,220m
Pumping Stations: 3
Underground Reservoirs: 4
Wells: 6

Sanitary
Manholes: 713
Gravity Main: 49,785m
Force Main: 1,952m
Sewage Pumping Stations: 4 (1 private)
Wastewater Treatment Plant (WWTP): 1

A list of stormwater management facilities (SWMF) within the study area was also provided by the Township. This list was supplemented using SWM reports and As-Built drawings provided by the Township (see **Section 2.12** & **Section 3.4** for additional details).

2.2.1 Data Gaps

As-Built drawings supplied by the Township provided extensive coverage of Angus. Above ground servicing drawings were available for the entire watermain and sewer networks to update the geometry of the provided CAD files. This information was sufficient for the water model, and no data gaps were identified.

In order to create the sanitary model, upstream and downstream invert elevations of pipes were required at each manhole node. While plan and profile drawings were included with most above ground servicing drawings, missing information was noted for some manhole locations. This was resolved at manholes where no data was available by using the available invert elevation data upstream and downstream of the problem nodes and assuming a constant slope between the two points with available data. Using the lengths of the pipe sections, invert elevations were interpolated.

This interpolation process was completed for:

- Masonic Way;
- The connection between River Drive and Water Street;
- North Water Street;
- South Osborn Street;
- East Cecil Street; and,
- Mill Street between Summerset Place and Roth Street.

The scope of assessment for SWM modeling was limited to high level existing conditions hydrologic models based on the provided SWMF and topographic data (see **Section 3.4**). For the purpose of this high-level assessment, no data gaps were identified.

2.3 WATER AND WASTEWATER DESIGN CRITERIA

Design criteria used for the existing conditions in Angus were derived during model development and calibration, further detailed in **Chapter 3**. Design criteria used for the existing water supply system are summarized in **Table 2-2**.

Table 2-2 Existing Conditions Water Supply System Design Criteria (Calibrated)

Single Family Dwelling Density:	3	p/unit
Residential ADD:	214	L/p/d
Residential PF (Peak Day):	2.05	
Campsite ADD:	225	L/site/d
Campsite equivalent:	1.5	p/site
Institutional dwelling:	1.5	p/unit
Institutional ADD:	70	L/p/d
Institutional PF (Peak Day):	1.5	
Commercial ADD:	7	m^3/ha/d
Commercial PF (Peak Day):	1.5	
Fire Flow Minimum Pressure:	140	kPa
Fire Flow Needed (Residential):	38	L/s
Fire Flow (Upper Limit):	120	L/s

Design criteria used for the existing wastewater collection and treatment system are summarized in **Table 2-3**.

Table 2-3 Existing Conditions Wastewater System Design Criteria (Calibrated)

Residential ADF:	235	l/p/d
Residential PF (Peak Day):	1.9	
Campsite ADF:	160	l/p/d
Campsite PF:	1.9	
Institutional ADF:	70.0	l/p/d
Institutional PF:	1.5	
Commercial ADF:	6.0	m^3/ha/d
Commercial PF:	1.5	

Design criteria used for all future development in the ultimate conditions scenario were obtained from the 2022 Draft Township Design Standards. Future development design criteria for the water supply system are summarized in **Table 2-4**, and design criteria for the wastewater collection and treatment system are summarized in **Table 2-5**.

Table 2-4 Future Development Water Supply System Design Criteria

Single Family:	3	p/unit
Residential ADD:	450	L/p/d
Residential PF (Peak Day):	2.05	
Commercial ADD:	28	m^3/ha/d
Commercial PF (Peak Day):	1.5	
Fire Flow Minimum Pressure:	140	kPa
Fire Flow Needed (Residential):	150	L/s

Table 2-5 Future Development Wastewater System Design Criteria

Residential ADF:	450	l/p/d
Residential PF (Peak Day):	1.9	
Institutional ADF:	90.0	l/p/d
Institutional PF:	1.5	
Commercial ADF:	28.0	m^3/ha/d
Commercial PF:	1.5	

2.4 EXISTING CONDITIONS WATER SUPPLY SYSTEMS

Angus is currently serviced by a Municipal well system with an approved average daily water taking capacity of 9,585 m^3/d as per MECP Permit to Take Water (PTTW) #0411-93LSQW (expiry date, December 31, 2022). The water distribution system in Angus consists of approximately 62 km of PVC watermain, ranging from 150mm to 300 mm in diameter. The system currently includes 6,154 m^3 of water storage across three (3) reservoirs with fire protection (i.e. hydrants, reservoir storage).

Angus has three (3) pumping stations, each with their own treatment and storage reservoir. The information for each was provided by the Township and OCWA. The approved design capacity for the McGeorge Pumphouse, Mill Street Pumphouse and Brownley are 2,592 m^3/d, 3,928 m^3/d and 4,255 m^3/d, respectively.

Brownley Pumping Station details are as follows:

- Two 200 mm diameter and one 150 mm diameter groundwater wells;
- Provides maximum 4,255 m^3/d of potable water;
- Storage in an underground reservoir, with a total capacity of 2,500 m^3; and,
- 3 x vertical turbine high lift pumps, rated at 75 L/s at a TDH of 53 m.

McGeorge Pumping Station details are as follows:

- Two 203 mm diameter groundwater wells;
- Provides maximum 2,592 m^3/d of potable water;
- Storage in an underground reservoir, with a total capacity of 252 m^3; and,
- 2 x submersible high lift pumps, one rated at 6.5 L/s at a TDH of 42 m and one rated at 20.1 L/s at a TDH of 46 m.

Mill Street Pumping Station details are as follows:

- One 610 mm diameter groundwater well;
- Provides maximum 3,928 m^3/d of potable water;
- Storage in two underground reservoirs with capacities of 2,500 m^3 and 902 m^3; and,
- 4 x vertical turbine high lift pumps, three rated at 70 L/s at a TDH of 53m and one rated at 106 L/s at a TDH of 42 m.

Existing residual capacity of the water supply system was determined based on capping near-term development at 80% capacity of the water supply system, which is also the standard MECP threshold required for a WTP Class EA to be initiated. Additional studies will need to be undertaken (in accordance with the Class EA Act) to confirm servicing of additional units beyond this 80% capacity threshold, which is presented in **Table 2-6.** Based on the available capacity of the system, we anticipate there is capacity for a minimum of 568 ERUs. This residual capacity calculation is based on 3 persons per unit and a peaking factor of 2.05 for the Maximum Daily Demand (MDD) required to be supplied by the system.

Table 2-6 Water Supply System, 80% Capacity

Available Water Supply - m^3/d (80% Capacity)	Available Water Supply – ERU (80% Capacity)	MDD, 2021 model - m^3/d	MDD, 2021 model - ERU	Residual Capacity - m^3/d	ERU (450 l/c/d)
7,668	5,159	6,096	4,591	1,572	568

Note: Existing MDD was determined through the calibrated existing conditions water demand model (214 l/c/d ADD, 2.05 PF, 3 ppu); Residual capacity (ERU) was calculated using the calibrated existing conditions model and updating future demand values to be consistent with the Township Standards (450 l/c/d ADD, 2.05 PF, 3 ppu)

Requirements associated with servicing beyond the remaining **568 ERU** (residual) threshold have been summarized in subsequent sections of this report. It will be the responsibility of the Township to review these water supply demands annually to ensure there are no major variations that will impact system capacity. All water capacity calculations were completed based on water supply capacity as the limiting factor; treatment capacity (ex. chlorine contact time) was not assessed separately in the IMP. Treatment capacity will need to be expanded to match ultimate conditions supply capacity during implementation.

2.5 PROPOSED ULTIMATE WATER SUPPLY SERVICING CONDITIONS

As part of this IMP, water storage and distribution options were assessed for future conditions based on the existing supply system capacity and in accordance with the Class EA process. Recommendations for additional studies and approvals to support the proposed options will be provided (i.e. completion of required pump tests, acquisition of an updated PTTW and mitigation and monitoring) subject to the options presented. Modelling of the existing and proposed systems was completed by Greenland as part of this IMP to determine deficiencies under the existing and ultimate development conditions.

Water demands required to service the ultimate buildout are presented in **Table 2-7**.

Table 2-7 Ultimate Build-out Water Demands

	ERU	Pop/ Unit	Equiv. Pop	Water L/c/d	Avg. Daily Demand (cu.m/d)	Max Daily Demand (cu.m/d)
Existing Conditions	4,591	3	13,773	214	2,947	6,096
Ultimate Development, Additional	2,935	3	8,805	450	4,005	8,124
Total	7,526	3	22,584	-	6,952	14,220

2.6 EXISTING WATER STORAGE CONDITIONS

The Community of Angus has a total water storage capacity of 6,154m^3, as detailed in the Angus 2019 Capacity Allocation Report. The MECP guidelines provide a calculation to determine required storage for water storage systems providing fire protection.

As outlined in the MECP manual, the Water Storage Capacity is calculated as the sum of the Fire Storage, Equalization Storage and Emergency Storage.

Where:

Fire Storage = Fire Flow x Fire Flow Duration
Equalization Storage = 0.25 x MDD
Emergency Storage = 0.25 x (Fire Storage + Equalization Storage)

For the purposes of this study, the following values were used to assess water storage capacity:

	Existing Condition
Serviced Population	13,669 persons
Fire Flow	224.9 l/s
Fire Flow Duration	3.2 hours
MDD	6,096 m^3/d

Fire flow and fire flow duration were calculated based on the MECP design guidelines for the equivalent population of the study area. Based on the above values, the current required water storage for Angus is 5,144 m^3. **Table 2-8** summarizes existing water storage residual capacity.

Table 2-8 Existing Water Storage Residual Capacity

	Reservoir Capacity - m^3	Required Storage Capacity - m^3	Residual Capacity - m^3	Operating Capacity
Current MDD	6,154	5,144	1,010	83.6%

It should be noted that there is a single pressure zone in Angus, and as such, the existing available water storage can be considered available to the entire system, regardless of the physical location of the storage.

2.7 PROPOSED WATER STORAGE CONDITIONS

To determine total water storage required for full build-out of the study area, the following values were used:

	Potential Build-Out (450 l/c/d)
Serviced Population	22,584 persons
Fire Flow	288.0 l/s
Fire Flow Duration	4.56 hours
MDD	14,220 m^3/d

The potential build-out scenario assumes that all approved developments and development in pre-consultation with the Township are developed, as described in the following section. Based on the above values, the current required water storage for Angus is 5,144 m^3. **Table 2-9** summarizes existing water storage residual capacity, as well as the residual capacity assuming full build-out of the proposed developments.

Table 2-9 Water Storage Residual Capacity

	Reservoir Capacity - m^3	Required Storage Capacity - m^3	Residual Capacity - m^3	Operating Capacity
Potential MDD (450 l/c/d)	6,154	10,353	(4,199)	168.2%

The total required storage, assuming that all proposed developments are built-out, has been calculated using 450 l/c/d ADD, and a peaking factor of 2.05 for all new development. On this basis, a total of **10,353 m^3** of storage is required to service all proposed development in Angus. There is currently insufficient storage to service all the proposed development. Requirements for servicing the 'built-out' scenario will be addressed in **Section 10.0** of this report.

Water storage is also less likely to be a limiting factor in development, as upgrades to the system storage can be provided on-site for large developments if determined to be necessary or advantageous.

2.8 EXISTING WASTEWATER TREATMENT & DISPOSAL CONDITIONS

Angus is currently serviced by one (1) centralized Wastewater Treatment Plant (WWTP), with a treatment capacity of 5,511 m^3/d. All raw sewage in Angus is pumped to the Angus Wastewater Treatment Plant where it is treated and discharged to the Nottawasaga River. The existing sewer network consists of approximately 50 km of gravity main and 2 km of force main.

Angus has four (4) sewage pump stations, which were added to the model. The information for each was provided by the Township and OCWA.

Sewage Pumping Station No. 1 details are as follows:

- 2 x Flygt (Model CT3231) submersible pumps on Variable Frequency Drives (VFDs);
- 159 Liters/second at 31.8 meters Total Dynamic Head (TDH);
- 90 hp / 1150 rpm / 600 volts / 3 phase / 60 hz; and,
- A wetwell/drywell type pumping station located at 131 Elizabeth Street.

Sewage Pumping Station No. 2 details are as follows:

- 2 x Flygt (Model NP3202) non-clogging submersible pumps on VFDs;
- 89.8 Liters/second at 27.8 meters TDH;
- 60 hp / 1775 rpm / 600 volts / 3 phase / 60 hz; and,
- A 3.0 m x 4.0 m x 9.0 m deep wetwell type pumping station located at 19 Centre Street.

Sewage Pumping Station No. 3 details are as follows:

- 2 x GSW Barnes (Model 4 SHE-505) submersible pumps;
- 37.0 Liters/second at 6.4 meters TDH;
- 7.5 hp / 1750 rpm / 600 volts / 3 phase / 60 hz; and,
- A 3.0 m diameter wetwell type pumping station located at Mill Street and Commerce Road.

Sewage Pumping Station 305 Mill Street details are as follows:

- 2 x Flygt (Model DP3068) submersible pumps;
- 3.6 Liters/second at 8.2 meters TDH;
- 2.4 hp / 208 volts / 3 phase / 60 hz; and,
- A 1.5 m diameter wetwell type pumping station located at 305 Mill Street.

Greenland recommends capping near term development approvals at 80% of the available WWTP capacity (near-term capacity), which is also the standard MECP threshold required for a WWTP Class EA to be started. Additional studies will need to be undertaken to confirm servicing of additional units beyond this threshold, which is presented in **Table 2-10**. Based on the available near-term capacity, we anticipate there is capacity for 858 ERUs.

Table 2-10 Near Term WWTP Capacity (80%)

Near Term WWTP Capacity - m^3/d (80% Capacity)	Near Term WWTP Capacity – ERU (80% Capacity)	ADF, 2021 m^3/d	ADF, 2021 ERU	Near-Term Residual Capacity m^3/d	Near-Term ERU (450 l/c/d)
4,409	5,468	3,250	4,610	1,159	858

Note: Existing ADF was determined through the calibrated existing conditions sanitary model (235 l/c/d ADD, 3 ppu); Residual capacity (ERU) was calculated using the calibrated existing conditions model and updating future demand values to be consistent with the updated Township Standards (450 l/c/d ADF, 3 ppu)

Requirements associated with servicing beyond this threshold (**858 ERU**) will be confirmed in further sections of the report. In general, it will be imperative that each major development application prove that there is sufficient capacity for development through a servicing assessment. This value represents an upper limit of remaining capacity at the WWTP and should be reviewed annually by the Township, to ensure that ADF is not changing drastically, resulting in greater or less capacity at the WWTP than concluded based on historic flow rates.

2.9 PROPOSED ULTIMATE WASTEWATER SERVICING CONDITIONS

As part of this IMP, wastewater treatment and collection options were assessed for future conditions based on the existing collection system capacity and in accordance with the Class EA process. Recommendations for additional studies and approvals to support the proposed options will be provided (i.e. assimilative capacity and mitigation and monitoring). Modelling of the existing and proposed systems was completed by Greenland as part of this EA to determine deficiencies under the existing and ultimate development conditions.

Greenland has completed wastewater flow calculations using flow values from the Draft engineering standards. Estimated flows for the ultimate full build-out scenario are summarized in **Table 2-11** below.

Table 2-11 Ultimate Build-out Wastewater Flows

	ERU	Pop/Unit	Equiv. Pop	Wastewater L/c/d	Avg. Wastewater Flow (cu.m/d)
Existing Conditions	4,610	3	13,830	235	3,250
Ultimate (New) Development	2,967	3	8,901	450	4,005
Total	7,577	3	22,731	-	7,255

2.10 EXISTING ROAD NETWORK CONDITIONS

The existing road network in Angus consists of approximately 71 kilometres of road. The breakdown of the road length by owners is summarized below in **Table 2-12.**

Table 2-12 Angus Road Lengths, by Owner

Road Owner	Length (km)
County	8.1
Local	55.7
Private	0.8
Unassumed	5.5
Unopened	0.9
Total	71.0

The Township is currently responsible for all Local roads, and will eventually assume responsibility for roads labelled Unassumed, which are currently the responsibility of the developer(s). A detailed breakdown of the current road conditions (pavement condition index) and how they were determined, is provided in **Section 3.5.**

2.11 PROPOSED ULTIMATE ROAD NETWORK CONDITIONS

There are currently no plans to expand the road network in Angus, beyond internal roads as part of new developments, or to change ownership of roads within the Community. The assessment of road conditions in Angus will focus on the pavement condition index (PCI) and proposed maintenance suggestions and associated costs for the existing road network. As new roads are opened, they will be added to the model to assess as conditions deteriorate.

2.12 EXISTING STORMWATER MANAGEMENT CONDITIONS

Existing Stormwater Management (SWM) infrastructure in the community of Angus includes approximately 26 km of storm sewers, 24 km of ditching and ten (10) SWM facilities. The breakdown of pipe sizes is summarized in **Table 2-13** (taken from the Township's combined linear infrastructure ECA). For the purpose of this IMP, the scope of SWM investigations was limited to development of existing conditions hydrologic modeling on behalf of the Township for the purposes of assessing future development against existing conditions requirements on a case-by-case basis (see **Section 3.4** for more details).

Table 2-13 Existing Stormwater Infrastructure

System Type	Pipe Diameter (mm)	Length (km)	System Totals (km)
Storm Sewers	Up to 250	0.23	--
Storm Sewers	> 250 - 500	9.69	--
Storm Sewers	> 500 - 1050	14.64	--
Storm Sewers	> 1050	1.41	--
Total Storm Sewers	--	--	25.96
Ditches / Swales	--	--	23.64
Total System Length (km)	--	--	49.60

2.13 IMP PROBLEM AND OPPORTUNITY STATEMENT

The problem/opportunity statement that is the basis for this study is as follows:

> *The Objective of the Angus Infrastructure Master Plan (IMP) is to identify and select preferred alternative water supply and storage, wastewater collection, treatment and disposal servicing strategies for the Community of Angus and its ultimate development horizon which minimizes impacts to both the natural and social environments and are both technically feasible and economically sensible. The IMP will also provide existing conditions infrastructure modeling and asset management/planning recommendations for all of these systems as well as stormwater management and road infrastructure.*

3.0 EXISTING CONDITIONS MODELLING

3.1 SERVICED POPULATION

Population data was given as part of the wastewater data provided by the OCWA, as a number of serviced persons. For consistency, the information provided as part of the data set for the WWTP was also used for the water model. As discussed in **Section 2.1**, the serviced residential population used for the existing conditions models was 11,849 for the years 2018 to 2021. The existing serviced population does not include under construction developments (Queensgate/Briarwood, Previn Court, South Brownley), which were added to the existing conditions model after calibration. The total 2021 serviced population for the purposes of the IMP was 13,669.

3.1.1 Population Density

The population density was calculated based on the existing serviced area, parcel fabric, and serviced population. The number of existing serviced units excluding Queensgate/Briarwood, South Brownley and Previn Court subdivisions (under construction) used in model development was initially 3,981. Based on the previously established total existing serviced residential population of 11,849 for the study area, the calculated population density was confirmed to be 3.0 persons per unit (ppu). Once the population density was determined, the in-process developments were added to the model, increasing the total number of existing residential units to 4,581 as of 2021 (13,669 persons). Non-residential (ICI) uses were not considered or accounted for in the total number of residential units or serviced population, nor were they included in the OCWA data. ICI units were converted to ERU's accordingly and added to the numbers presented above, for a total of 4,591 ERUs (13,773 persons).

3.2 EXISTING CONDITIONS WATER MODEL DEVELOPMENT

The following subsections provide additional details on the development process and results of the initial existing conditions water distribution system model. The WaterGEMS software by Bentley was used to develop the water distribution system model.

3.2.1 Water Distribution Network

A WaterCAD file of the Angus water distribution system was provided to Greenland by the Township at the outset of this assignment. The network provided in the WaterCAD file included inaccuracies when compared to infrastructure shapefiles and orthophotos. As-Built information (cross and tee locations) and aerial imagery were used to update the water distribution network to accurately represent the location of the existing infrastructure. The As-Built data was also used to ensure that the elevations in the model were accurate. Finally, the watermain network was checked for new development that has been built since the original model was developed (2010) and against development that is proposed but which has not yet been constructed. Only the areas that have been constructed were included in the Final Existing Conditions model.

The 2010 WaterCAD model from the Township was exported and opened as a WaterGEMS model. The layers that needed updates to their geometry were exported as shapefiles, edited in GIS and re-imported into the WaterGEMS model using ModelBuilder. The information that was changed in the new model includes: the geospatial location of the objects; the addition/removal of junctions to match current existing conditions; and, the calculated flows at each junction based on the land use and density data. The water distribution model schematic for existing conditions is provided in **Figure 3.1** below.

The Thiessen Polygon tool in WaterGEMS was used to split the study area based on the junctions in the water distribution network. This tool was used to define the service area geometry for each junction. A Land use and population density information layer was then developed based on the Draft Official Plan Schedule 'C' provided by the Township, which delineates existing land use within the study area (shown in **Figure 1-1**). The land use types assigned were: Residential, Recreational (Campsite), Institutional, Commercial or Industrial. The same delineated service area polygons were also used for the sanitary drainage area catchments and are shown in **Figure 3-4**.

The flows were generated using the LoadBuilder tool in WaterGEMS. This tool utilizes the Thiessen Polygons and the land use/density layer described above to assign flows at the junctions for each service area based on population and assigned per capita flow in the service area. The per capita flows were added manually within the LoadBuilder for the Average Daily Demand (ADD) and Maximum Day Demand (MDD) conditions. Per capita flows and Peaking Factor (PF) criteria from the Township Standards and MECP design criteria were used initially to populate LoadBuilder and run the ADD and MDD conditions. The model parameters were later calibrated based on historical data from the Water Treatment Plants (WTP) to match the existing water demand conditions in Angus. Details regarding the calibration process and iterative results can be found in **Section 3.2.5**.

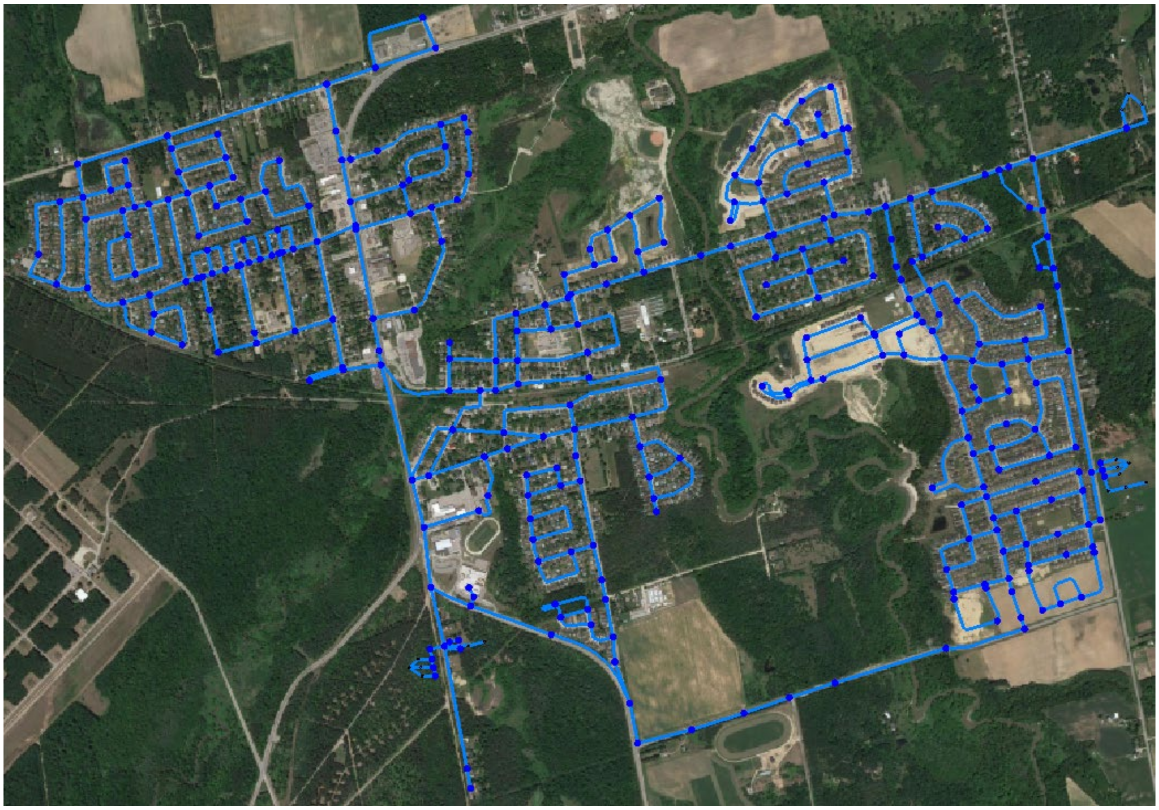

Figure 3-1 WaterGEMS Water Distribution Network

3.2.2 Fire Flow Scenario

The existing Township standards state that the minimum fire flow to be achieved in residential areas is 38 L/s and in industrial areas it is 75 L/s. The Community of Angus currently has only residential, institutional, recreational (campground) and commercial areas. It was assumed for the purposes of initial model development that the institutional and commercial areas were governed by the 75 L/s and the residential by the 38 L/s. Calibrated fire flow conditions are discussed in **Section 3.2.7**.

3.2.3 Initial Model Design Criteria

As noted in Section 3.2.1 above, the study area was broken down into water supply catchments (using the Thiessen Polygon tool) for the purpose of assigning attributes, such as land use and unique identifiers to different areas. This method was found to be ideal during the concurrent development of the SewerGEMS model (see **Section 3.3**) as it provided consistency of catchment geometry between the two models.

Information determined for each catchment included the number of units within the catchment boundaries, the area, population density, and the total population for the catchment. The density was calculated using the area (in ha) and associated population of each catchment area. These catchments were used solely to assign population density and land use information to junctions (nodes) in the model, and do not represent water supply (pressure) zones in the distribution network. The water distribution network in Angus is all connected as one (1) water supply zone.

As discussed in **Section 3.2.2**, these catchment service areas were used to assign water demand rates and peaking factors to specific areas/populations, ultimately resulting in a flow demand at each junction calculated using these same parameters. The design criteria used to develop junction demands were based on the Township's Design Standards (1989) and MECP Design Criteria (2008), unless otherwise specified. The initial model parameters assigned to model junctions are presented in **Table 3-2**. Where criteria have a range of possible design values, the initial model was developed using the lowest value from the design criteria range.

Table 3-1 Water Design Criteria

Single Family:	3.0	PPU	(Town; adjusted based on service pop)
Residential ADD:	270-450	L/p/d	(Town)
Residential PF (Peak Day):	2.0	(Town)	
Residential PF (Peak Hour):	4.5	(Town)	
Campsite ADD:	225-570	L/site/d	(MECP)
Campsite equivalent:	1.5	p/site	
Campsite PF (Peak Day):	2.0		(same as residential)
Institutional Units/ha:	18.05	units/ha	(equivalent, calculated)
Institutional dwelling:	1.5	PPU	(equivalent, calculated)
Institutional ADD:	70-140	L/p/d	(MECP)
Institutional PF (Peak Day):	1.5		(MECP)
Commercial ADD:	$28m^3$/ha/d		(MECP)
Commercial PF (Peak Day):	1.5		(MECP)
Industrial ADD:	35-55	m^3/ha/d	(MECP)
Industrial PF (Peak Day):	2-4		(MECP)
Fire Flow Minimum Pressure:	140	kPa	(Town)
Fire Flow Needed (Residential):	38	L/s	(Town)
Fire Flow Needed (Industrial):	75	L/s	(Town)
Fire Flow (Upper Limit):	150	L/s	(WaterCAD model)

3.2.4 Model Calibration

Model calibration was completed using the data from the year with the highest average daily demand and maximum daily demands from the available historical flow data (2019 for ADD and 2018 for MDD). Since the data being used to calibrate the model was from 2018 and 2019, the calibration model watermain network was updated to reflect the development conditions at this time, and as such, the South Brownley, Queensgate/Briarwood and Previn Court developments were removed from the calibration model. Adjustments to the water demand rates and peaking factors were made iteratively in the model to meet recorded water demands. Some of the iteration results can be seen in **Table 3-3** and **Table 3-4**. The calibrated Design Criteria that most accurately represented the demand data from the OCWA are presented in **Table 3-5**. These values were used in the Final Existing Conditions model, which is further discussed in **Section 3.2.6**.

Typically, the Peak Hour and Minimum Hour Scenarios would also be calibrated and run during model development. However, based on the demand data that was provided by the Town and OCWA, this data was not available. Inquiries were made to determine if this data exists, however at the time of model completion, it had not been supplied and so was not included as part of the calibration process.

3.2.5 Model Results

The Average Day Demand (ADD) calibration model was originally run with the lower end of the design criteria ranges found in **Table 3-2**. The residential demand rate was then changed to calibrate the model to match the highest ADD demand from the data provided by the Town and OCWA **(Table 3-1** – 2019: 32.5 L/s). Examples of the iteration process can be seen in **Table 3-3**.

Table 3-2 WaterGEMS Model Calibration – ADD Scenario

Iteration	Model Inputs	Demand Rate	Total (L/s)
1	Residential	270 L/p/d	40.21598
	Institutional	70 L/p/d	
	Campsite	225 L/site/d	
	Commercial	28 m^3/ha/d	
2	Residential	210 L/p/d	31.98569
	Institutional	70 L/p/d	
	Campsite	225 L/site/d	
	Commercial	28 m^3/ha/d	
3	Residential	214 L/p/d	**32.53464**
	Institutional	70 L/p/d	
	Campsite	225 L/site/d	
	Commercial	28 m^3/ha/d	

The Maximum Day Demand (MDD) calibration model was then run with the calibrated demands from the ADD scenario and suggested maximum day factors from **Table 3-2**. The maximum day factors were adjusted iteratively to match the highest MDD demand from the data provided by the Town and OCWA (**Table 3-1** – 2018: 65.0 L/s). Examples of the iteration process can be seen in **Table 3-4**.

Table 3-3 WaterGEMS Model Calibration – MDD Scenario

Iteration	ADD Total (L/s)	Model Inputs	Max Day Factor	MDD Total (L/s)
1	32.53464	Residential	2.0	63.59091
		Institutional	2.0	
		Campsite	1.5	
		Commercial	1.5	
2	32.53464	Residential	2.1	66.52638
		Institutional	2.0	
		Campsite	1.5	
		Commercial	1.5	
3	32.53464	Residential	2.05	**65.05864**
		Institutional	2.0	
		Campsite	1.5	
		Commercial	1.5	

The Demands and Peaking factors that were used in the final iteration of the Calibrated model are summarized in **Table 3-5**. The correlation between the calibrated model demands and the demands from the Town/OCWA are shown in **Table 3-6.** The percent difference in both the ADD and MDD scenarios is less than 0.1%.

Table 3-4 Calibrated Water Model Design Criteria

Single Family:	3	p/unit	
Residential ADD:	214	L/p/d	(270-450 from MECP)
Residential PF (Peak Day):	2.05		(2.0 from MECP)
Campsite ADD:	225	L/site/d	(225-570 from MECP)
Campsite equivalent:	1.5	p/site	
Institutional dwelling:	1.5	p/unit	
Institutional ADD:	70	L/p/d	(70-140 from MECP)
Institutional PF (Peak Day):	1.5		(From MECP)
Commercial ADD:	7	m^3/ha/d	
Commercial PF (Peak Day):	1.5		(From MECP)
Fire Flow Minimum Pressure:	140	kPa	(From Town)
Fire Flow Needed (Residential):	38	L/s	(From Town)
Fire Flow (Upper Limit):	120	L/s	(WaterCAD model)

Table 3-5 Calibrated Model Demands

Scenario	Existing Conditions (L/s)	Model (L/s)	Percent Difference (%)
ADF	32.50	32.53	0.09
MDF	65.00	65.06	0.09

The calibrated model was then updated to include all existing infrastructure as of 2021, including the South Brownley, Previn Court and Queensgate/Briarwood developments. The calibrated model inputs from **Table 3-5** were used in the final model to determine the flows generated by the existing population and to analyze the fire flow conditions. The results from the final model, including all under construction areas is summarized below in **Table 3-7**.

Table 3-6 Final Model Flow Results

Scenario	Existing Conditions (L/s)
ADD	34.96
MDD	70.03

3.2.6 Calibrated Model Fire Flow Assessment

The residential areas of Angus were analyzed using the required flow of 38 L/s and a minimum pressure of 140 kPa, per the existing 1989 Township Engineering Standards. The commercial and institutional areas were analyzed using a required flow of 75 L/s and a minimum pressure of 140 kPa. All nodes in the system passed the Fire Flow Constraints. The pressure ranged from 486 kPa to 626 kPa in the MDD Fire scenario.

Maps of the available Fire Flow and pressure at each junction under the MDD File Flow scenario can be found in **Appendix C**.

We note that the Township recently completed an update to the municipal engineering standards and that fire flow requirements for future development have changed as a result of this process. Based on the draft standard updates, there is an increased fire flow requirement of 100 L/s proposed for detached residential and 150 L/s for residential townhomes. As a conservative scenario, the model was run using the 150 L/s requirement. Under current conditions, the model indicates that the system will not be able to provide this level of fire service at 124 of 312 nodes (junctions).

3.3 EXISTING CONDITIONS SANITARY MODEL DEVELOPMENT

The following subsections provide additional details on the development process and results of the initial existing conditions model. The SewerGEMS software by Bentley was used to develop the sanitary model.

3.3.1 Sewer Network

The sewer system files were provided by the Township of Essa in CAD format as described in **Section 2.2**. The layers included: gravity mains, forcemains, and manholes. A shapefile of the sanitary manholes was also provided. The data provided did not include system elevations or diameters. In addition, it had to be updated for the most recent development (2018 onward).

To complete this update, the CAD file was converted to a shapefile of the sewer network. It was discovered that the original sewer network in CAD had spatial inaccuracies when compared to the manhole shapefile and aerial imagery. To address the inaccuracies, the sewer network shapefile was manually adjusted to match the provided As-Built drawings. The manhole and pipe information (geometry, invert elevation, diameter, upstream junction, downstream junction) were also updated based on As-Built drawings.

The SewerGEMS model was created by importing the manhole and sewer shapefiles using ModelBuilder. The flows were generated based on the land use file and population using LoadBuilder. The average daily flow and peaking factor criteria are provided in **Section 3.3.5**. A schematic of the sewer network is provided in **Figure 3-2**.

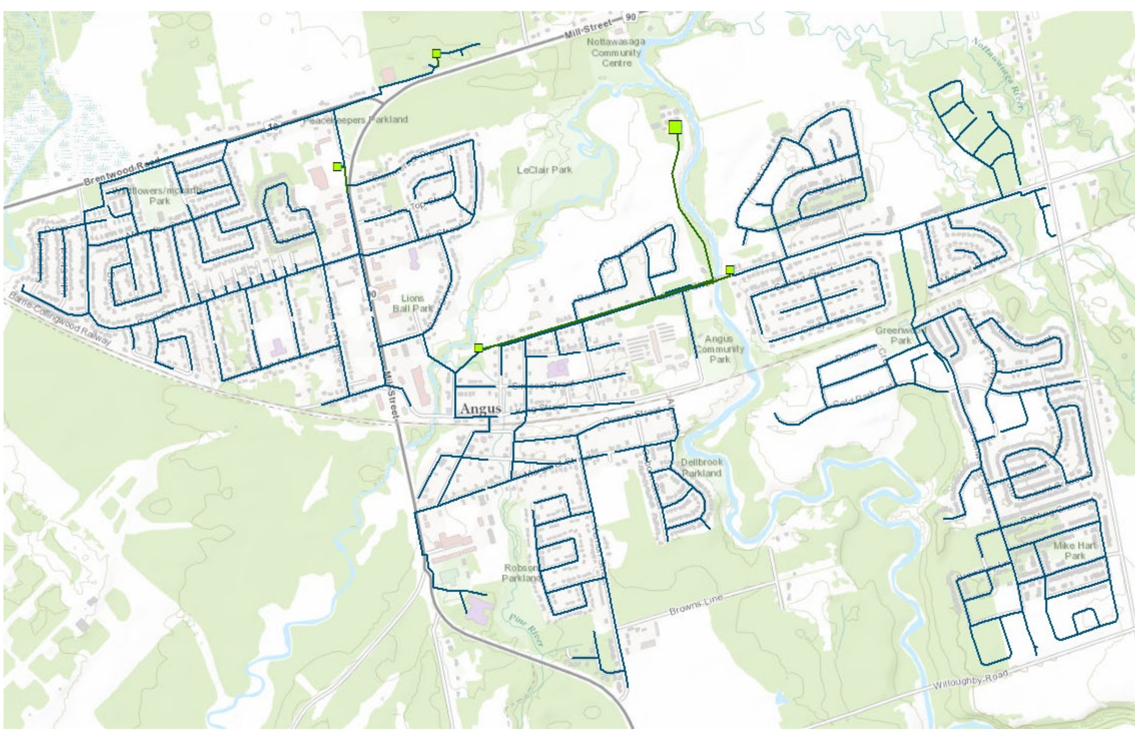

Figure 3-2 SewerGEMS Sewer Network Schematic

3.3.2 Topography

Land Information Ontario coordinates public and private sector organizations to collect high resolution aerial imagery for Ontario. As part of the South-Central Ontario Orthophotography Project, digital imagery was collected for areas in South Central Ontario in the spring and fall of 2018/2019 (SCOOP 2018). The resulting Digital Elevation Model (DEM) has a resolution of 50 cm.

The SCOOP2018 DEM was used for assigning the ground elevation to manholes in the SewerGEMS model (while invert elevations were derived from As-Built drawing data).

3.3.3 Historical Flow

All raw sewage in Angus is pumped to the Angus Wastewater Treatment Plant (WWTP) where it is treated and discharged to the Nottawasaga River. In order to calibrate the model, historic daily flow data from 2018-2021 was provided by OCWA. The average day flow (ADF) and peak day flow for earlier years (2015 to 2017) was obtained from the 2019 Angus Capacity Allocation Report (Ainley). **Table 3-8** summarizes the most recent seven years of sewage flows.

Table 3-7 Angus Wastewater Flows

Year	ADF (m^3/d)	Peak Day Flow (m^3/d)
2015	2,156	2,941
2016	2,436	5,530
2017	2,770	6,647
2018	2,682	6,310
2019	2,640	5,172
2020	2,796	5,697
2021	2,823	4,618

The flow data provided by OCWA included only SPS 1 and 2 and total flow. All flow data provided for SPS 2 was listed as 0.12 L/s for each day. Therefore, only total flow (SPS 1) was used in calibration. SPS 2 ultimately discharges to SPS 1, therefore only using flow data at SPS 1 was sufficient to calibrate the entire network.

3.3.4 Dry Weather Flow and Wet Weather Flow

The 2018 to 2021 rainfall data was applied to historic flow data to calculate the dry weather flow (DWF) and wet weather flow (WWF). The rainfall station at 16 Michael St., Angus (IESSA7) from Weather Underground (wunderground.com) was used for this analysis. Where data was missing, the rainfall data at Borden AWOS (611B002) from Environment and Climate Change Canada was used.

The daily flow data and rainfall data was compiled in a spreadsheet (**Figure 3-3**). The DWF and WWF separation point was set as a previous two-day precipitation of 3 mm. During the summer months, less than 3mm of precipitation over a minimum period of two (2) days was considered DWF. For the months from March to May, the ground is wet due to snowmelt occurring. Therefore, flow during this period was also considered WWF. When there was rain or snowmelt in spring/winter time, the flow was also determined to be WWF. The WWF was calculated based on previous two-day precipitation of greater than 3 mm during summer time and snow melt season from March to May. **Table 3-9** summarizes the DWF and WWF analysis.

Table 3-8 DWF and WWF

Year	DWF *ADF (m^3/d)*	DWF *Peak Day Flow (m^3/d)*	WWF *ADF (m^3/d)*	WWF *Peak Day Flow (m^3/d)*
2015	-	-	-	2,941
2016	-	-	-	5,530
2017	-	-	-	6,647
2018	2,461	3,734	2,847	6,310
2019	2,458	3,456	2,836	5,172
2020	2,753	4,382	3,026	5,697
2021	2,705	3,387	2,881	4,618

	Raw Sewage / Flow - m^3/d											3
Date	Total IH					Average	Max	Min	PF		Rainfall	2-day Rainfall
2018-01-01	2332				2018	2682	6310	1983	2.35	2018-01-01	0.5	
2018-01-02	2118				2019	2640	5172	1855	1.96	2018-01-02	1	1.5
2018-01-03	2102				2020	2796	5697	2267	2.04	2018-01-03	0	1
2018-01-04	2083				2021	2823	4618	2339	1.64	2018-01-04	1.5	1.5
2018-01-05	2100				2021					2018-01-05	2	3.5
2018-01-06	2334									2018-01-06	3	5
2018-01-07	2476									2018-01-07	3	6
2018-01-08	2113									2018-01-08	1.5	4.5
2018-01-09	2123					DWF				2018-01-09	m	1.5
2018-01-10	2119					Average	Max	Min	PF	2018-01-10	0.5	0.5
2018-01-11	2381	2018-01-01	2018-02-28	2018-06-01	2018-12-31	2461	3734	2024	1.52	2018-01-11	0.5	1
2018-01-12	2611	2019-01-01	2019-02-28	2019-06-01	2019-12-31	2458	3456	1952	1.41	2018-01-12	7	7.5
2018-01-13	2708	2020-01-01	2020-02-29	2020-06-01	2020-12-31	2753	4382	2287	1.59	2018-01-13		7
2018-01-14	2788	2021-01-01	2021-02-28	2021-06-01	2021-12-31	2705	3387	2339	1.25	2018-01-14	0	0
2018-01-15	2334									2018-01-15		0
2018-01-16	2256									2018-01-16	1	1
2018-01-17	2245					Wet Weather Flow				2018-01-17	0	1
2018-01-18	2228	2018-01-01	2018-02-28	2018-06-01	2018-12-31	2847	6310	1983	2.22	2018-01-18	0	0
2018-01-19	2204	2019-01-01	2019-02-28	2019-06-01	2019-12-31	2836	5172	1855	1.82	2018-01-19	0	0
2018-01-20	2396	2020-01-01	2020-02-29	2020-06-01	2020-12-31	3026	5697	2267	1.88	2018-01-20	0	0
2018-01-21	2658	2021-01-01	2021-02-28	2021-06-01	2021-12-31	2881	4618	2383	1.60	2018-01-21	0	0
2018-01-22	2509									2018-01-22		0
2018-01-23	2828									2018-01-23		0
2018-01-24	2697									2018-01-24	0	0
2018-01-25	2531									2018-01-25	0	0
2021-09-20	2614									2021-09-20	0.25	0.25
2021-09-21	2631									2021-09-21	5.08	5.33
2021-09-22	3326									2021-09-22	71.37	76.45
2021-09-23	4618									2021-09-23	6.35	77.72
2021-09-24	4179									2021-09-24	0	6.35
2021-09-25	4066									2021-09-25	9.4	9.4
2021-09-26	4209									2021-09-26	0	9.4
2021-09-27	3632									2021-09-27	3.05	3.05
2021-09-28	3528									2021-09-28	0	3.05
2021-09-29	3387									2021-09-29	0	0
2021-09-30	3231									2021-09-30	0	0
										2021-10-01	0	0

Figure 3-3 Flow and Rainfall Data

3.3.5 Drainage Area and Design Criteria

The sanitary sewer drainage areas were delineated based on the known sewer network geometry and property parcel information. Each drainage area was assigned to a sanitary manhole. Land use was then determined for each drainage area. The land use types assigned for each drainage area are: Residential, Recreational (Campsite), Institutional, Commercial or Industrial. The delineated sanitary drainage area catchments are shown in **Figure 3-4**. The land use was assigned based on the Draft Official Plan Schedule 'C' provided by the Township, which delineates existing land use within Angus, included in **Appendix D**.

The design criteria used to set up the modelling were based on the Township Design Standards (1989) and MECP (2008), with certain items updated to reflect the calculated results of actual data where such data was available (i.e. The persons per unit rate was adjusted based on the sewer serviced population (11,849) and flow data from OCWA.) and as specified below in **Table 3-10.**

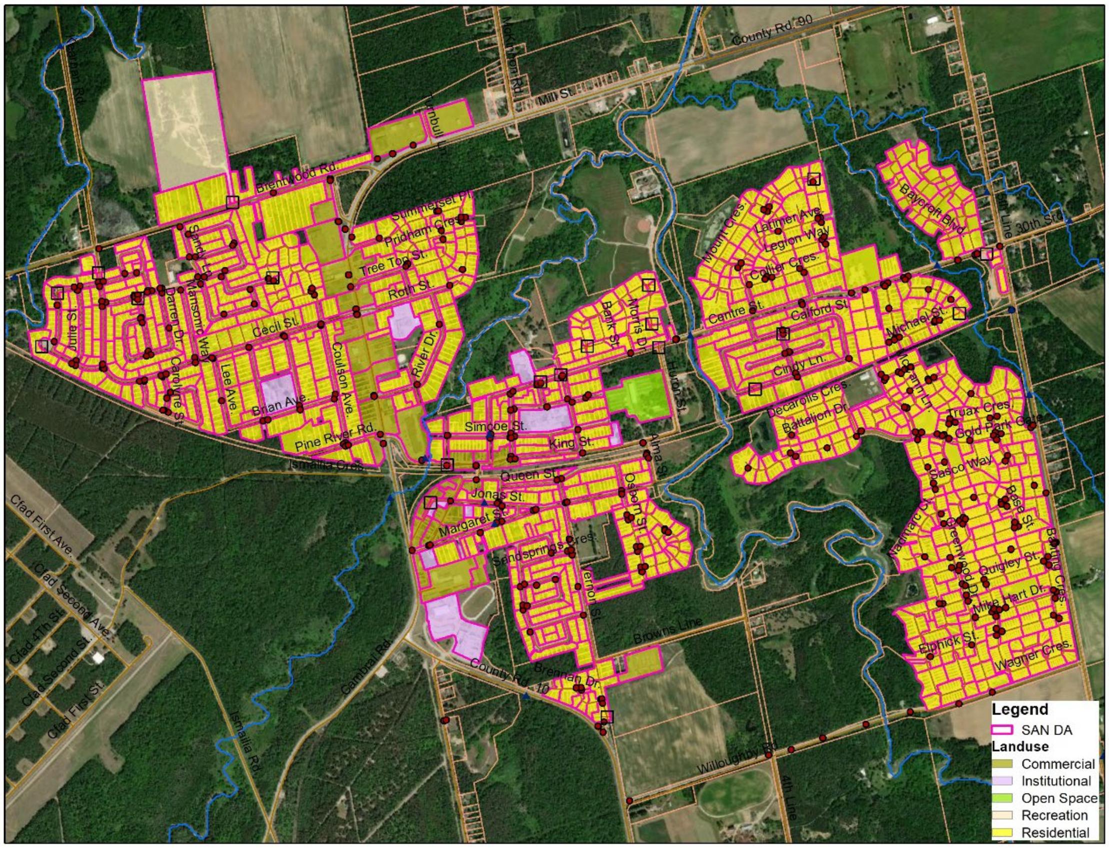

Figure 3-4 Sanitary Drainage Area and Land Use

Table 3-9 Sanitary Design Criteria

Single Family:	3.0	ppu	(calculated based on service population)
Residential ADF:	450	l/p/d	(Town)
Residential PF (Peak Hour):	3.7	(4.5 to 2.85) (Harman)	(Town)
Residential PF (Peak Day):	1.9		(MECP)
Campsite ADF:	570	l/d/unit	(MECP)
380	l/p/d		
Campsite PF:	4.0		(MECP)
Institutional Units/ha:	18.05	units/ha	(equivalent)
Institutional dwelling:	1.5	ppu	(equivalent, calculated)
Institutional ADF:	90.0	l/p/d	(MECP)
Institutional PF:		1.5	(MECP)
Commercial ADF:	28	m^3/ha/d	(MECP)
Commercial PF:	1.5		(MECP)
Industrial ADF:	40	m^3/ha/d	(MECP)
Industrial PF:	3		(MECP)

The wet weather infiltration rate used in the initial model run was 20,000 litres/hectare/day (0.2315 litres/hectare/second) in accordance with the Township of Essa Engineering Design Standards.

The dry-weather inflows were loaded into the model using LoadBuilder based on the population for Residential, Recreational and Institutional, and land use area for Commercial and Industrial. The wet weather inflows were loaded based on the drainage area.

The calculated residential population of the study area is 11,851, excluding under construction developments.

3.3.6 Model Calibration

Model calibration was completed using the maximum peak daily flow from the available historical flow data, 2020 for DWF and 2017 for WWF. Adjustments to the loading and peaking factors were made iteratively in the model to meet recorded flows. This was completed for both the DWF and WWF models.

3.3.7 Dry Weather Flow Model

The dry weather flow model only includes residential, institutional, recreational (campsite) and commercial loadings, as there are currently no industrial uses within the study area. The under-construction development areas of Previn Court, South Brownley and Queensgate/Briarwood were not included during the calibration process, as flows from these developments were not included in existing flow data. These areas were added to the model after calibration.

The calibrated loading and peaking factors are listed below in **Table 3-11**.

Table 3-10 Calibrated Sanitary Model Design Criteria

Residential ADF:	235	l/p/d	(225 to 450 for MECP)
Residential PF (Peak Day):	1.9		(MECP)
Campsite ADF:	160	l/p/d	(150 to 380 for MECP)
Campsite PF:	1.9		(MECP)
Institutional ADF:	70.0	l/p/d	(70 to 140 for MECP)
Institutional PF:	1.5		(MECP)
Commercial ADF:	6.0	m^3/ha/d	
Commercial PF:	1.5		(MECP)

The calibrated maximum DWF was determined to be 4,412 m^3/d at SPS 1, the final downstream junction in the network pumping directly to the WWTP.

3.3.8 Wet Weather Flow Model

The calibrated wet weather infiltration rate was found to be 7,000 litres/hectare/day. The calibrated wet weather flow to the WWTP is 6,662 m^3/d (Maximum day).

3.3.9 Final Existing Conditions Model

The final existing conditions model results are presented below. The Previn Court and South Brownley subdivisions were added to the model, as construction is nearly complete. At the request of the Township, Queensgate/Briarwood was also added to the existing conditions model. The updated serviced population is 13,669, with a total wet weather Maximum Day Flow of 8,718 m^3/d at SPS 1. The total equivalent population is 13,830 (4,610 ERU).

The model was executed using peak wet weather flow to identify constraints in the system. The results will be used to identify potential projects needed to support future growth in the Community. The following maps have been developed from the model:

- Flooded Manholes (flow elevation exceeds rim elevation);
- Surcharged Manholes (hydraulic grade-line exceeds pipe elevation);
- Maximum Velocity Sewers; and,
- Low Velocity Sewers.

The above noted model result mapping is shown in **Appendix D.** Further details on each of the identified problem areas and potential capital projects to address these problems is addressed in **Chapter 6**.

3.4 EXISTING CONDITIONS STORMWATER MODEL

The following subsections provide details on the development process and results of the initial existing conditions hydrologic model. PCSWMM was used to develop the stormwater model. This preliminary model focused on using lumped catchments for existing development. Greenland set target nodes on the various streams and rivers in the watershed and re-discretized smaller catchments specific to Angus in ArcGIS.

3.4.1 Existing Hydrologic Model

In 2019, an updated Nottawasaga River hydrology study was prepared by AHYDTECH Geomorphic Ltd. The HEC-HMS model provided by the NVCA was utilized in this study as a reference to develop the current hydrologic models for Essa presented in this report.

The PCSWMM model was converted from the existing HEC-HMS model. The parameters were calibrated to match the HMS results, using the 100 year 24-hour SCS storm as the basis for matching of flows. The summarized results at the outlet (a downstream confluence point) in both models are shown below in **Table 3-12**. The location of the outlet (RMIN01) is shown in **Figure 3-5.** The detailed model parameters are summarized in **Appendix E**.

Table 3-11 Nottawasaga River Outlet Flow - Matched HMS Catchment

	PCSWMM		VO5 Catchment
Name	Area (ha)	Peak Flow (m^3/s)	Peak Flow (m^3/s)
Outlet (RMIN01)	173,135.2	487.5	487.1

3.4.2 Updated Hydrologic Model

The catchment boundary in Angus was adjusted based on the DEM provided to Greenland by the Township, detailed in **Section 3.3.2**. The development area and the stormwater management pond drainage areas were also delineated based on the as-built drawings. The parameters for the updated catchments, including area, flow length, curve number, slope and imperviousness were based on the available soils data layers and developed areas. **Figure 3-5** presents the updated catchments within the

PCSWMM model. Development-level catchments contributing to SWM ponds have been added to the PCSWMM model as well. **Table 3-13** lists the SWM ponds added to the PCSWMM Model.

Table 3-12 Angus SWM Ponds

SWM Pond Name (Model)	Development/Subdivision
Outlet_Brnley_Sarj	Sarjeant / Brookvalley (Brownley Meadows)
Outlet_Previn	Previn Court
Outlet_Riverview	Riverview
Outlet_Stonemount-E	Stonemount (Nottawasaga Village Ph1)
Outlet_Stonemount-W	Stonemount (Nottawasaga Village Ph3)
Outlet_Terrace-1	Angus Terrace
Outlet_Terrace-2	Angus Terrace
Outlet_Vernon	Vernon
Outlet1_Queensgate	Queensgate

The results at the outlet in the updated model are summarized below in **Table 3-14**. The detailed model parameters for the Angus catchments are summarized in **Appendix E**.

Table 3-13 Updated PCSWMM Model Results

	PCSWMM Original Model		PCSWMM Updated Model	
Name	Area (ha)	Peak Flow (m^3/s)	Area (ha)	Peak Flow (m^3/s)
Outlet (RMIN01)	173,135.2	487.5	173,146.67	505.3

This high-level model will form the basis for more detailed hydraulic and hydrologic assessment of the study area to be completed in the future (outside the scope of this study) and can be used in the interim by the Township as a tool to assess SWM design information provided in development applications.

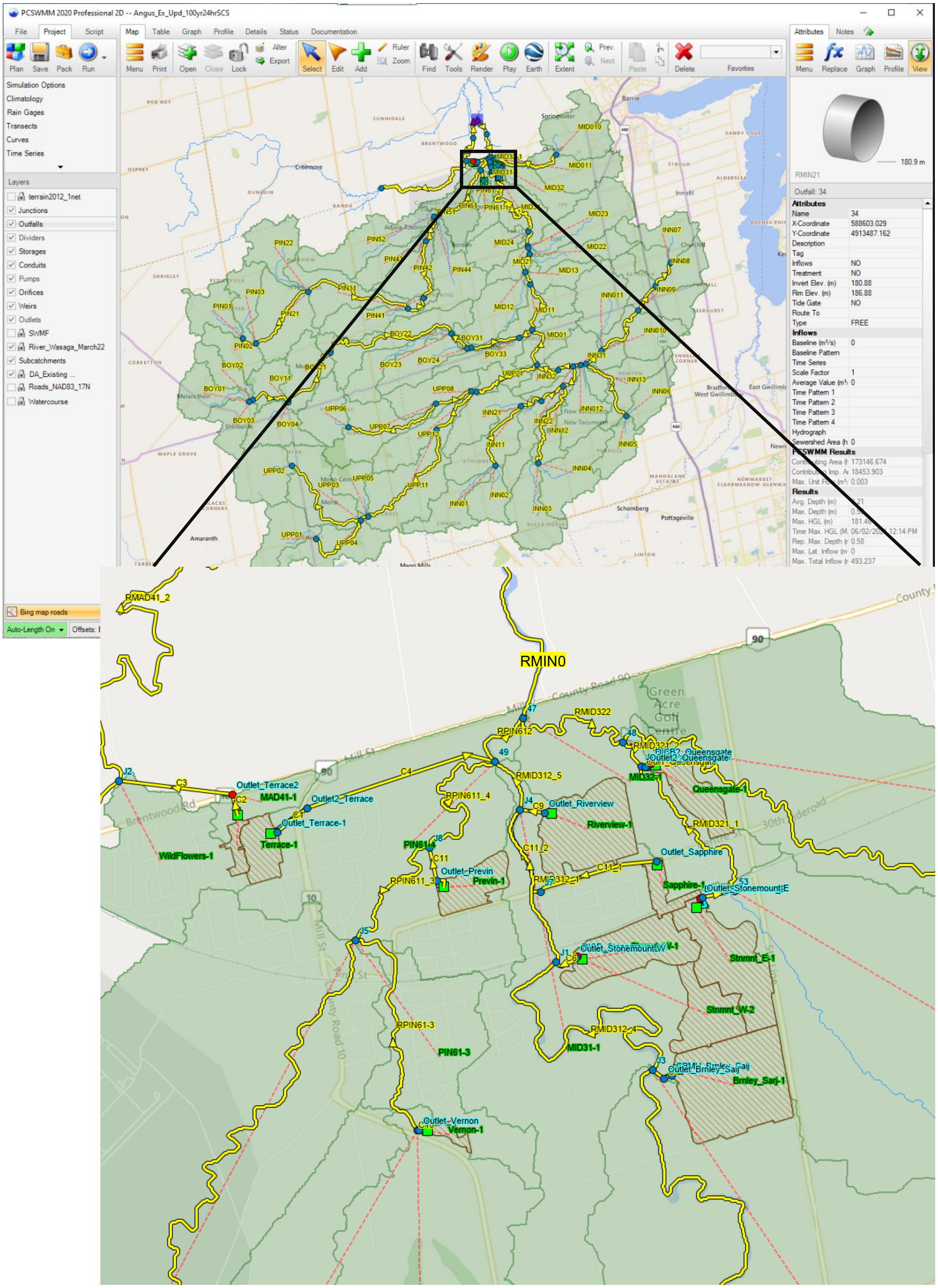

Figure 3-5 PCSWMM Model Schematic

3.5 EXISTING CONDITIONS ROAD NETWORK MODEL DEVELOPMENT

Existing conditions of the road network in Angus were established by StreetScan, through determination of the pavement condition index of all paved roads in Angus. The following subsections summarize how the PCI was determined and modelled.

3.5.1 Field Data Collection

The existing Essa road network shapefile was provided by the Township to determine the study area for StreetScan to perform the field investigation. All paved roads within Angus were included in the assessment.

StreetScan utilizes 3D imaging technology to measure road defects, such as cracking, bumps, surface distortions and surface texture. The 3D imaging cameras provide 8' (2.4m) of lateral road coverage and seamless road coverage in the direction of travel at speeds up to 65 mph (72kph). A 360-degree camera system provides imagery of the road surface and ROW. An Inertial Measurement Unit (IMU) enabled GNSS position system provides position location, even in the event of intermittent GPS satellite coverage.

3.5.2 Data Processing

The collected data was uploaded to the StreetScan server, where automated software processed the raw sensor data. Using advanced processing algorithms, the sensors' raw data was converted into meaningful parameters representing different aspects of pavement condition. Several of the key indicators are fused to determine the pavement condition index (PCI) for each road segment, shown in **Figure 3-6**. StreetScan segmented the pavement evaluation data from intersection to intersection and populated the database allocated to the segment.

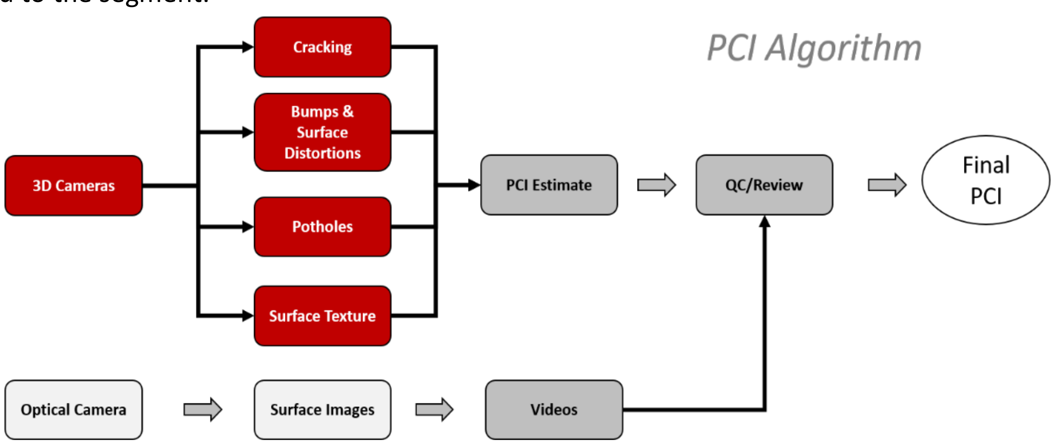

Figure 3-6: StreetScan PCI Algorithm Flow Chart

The results from the evaluation are uploaded to a web-based GIS application, and the Township has been provided access to review the existing condition of the road network, proposed maintenance suggestions. This application also provided the Township the opportunity to edit PCIs as capital road projects are completed.

3.5.3 Road Network PCI

The results from the pavement evaluation are shown below in **Figure 3-7**.

Figure 3-7 Angus Pavement Evaluation (PCI)

In general, the roads within Angus are primarily in good - excellent condition, as shown in **Figure 3-8**. PCI categories have been broken out, per the legend in **Figure 3-7** (failed to excellent condition).

In addition, some of the roads in poor- fair condition are owned by the County of Simcoe (ex. Mill St.), and will therefore be the County's responsibility to maintain or reconstruct.

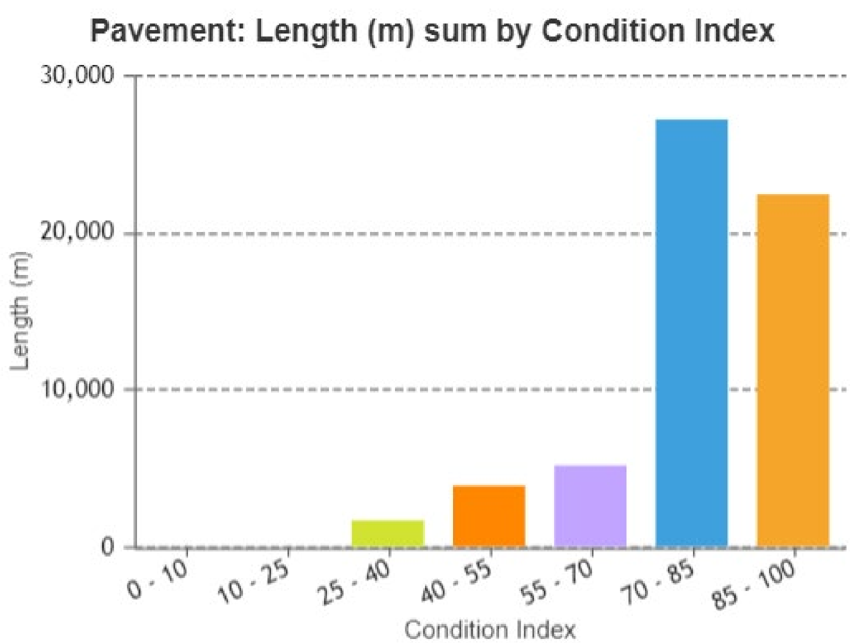

Figure 3-8 Angus PCI Breakdown by Road Length

4.0 ULTIMATE CONDITIONS MODELLING

The ultimate conditions models were developed based on the proposed population in Angus at the end of the 25-year horizon of this study.

4.1 ULTIMATE CONDITIONS WATER MODEL DEVELOPMENT

4.1.1 Drainage Area and Design Criteria

The Ultimate Conditions Model was updated from the Existing Conditions Model. The future watermains, as identified in the 2010 WaterCAD model provided by the Township, were added to the model. Shapefiles with future residential, institutional, industrial and commercial developments as identified by active pre-consultations and development applications with the Township were developed and imported into WaterGEMS. Only pre-consultations and applications within the study area (delineated in **Figure 1-1**), and in keeping with the draft Schedule 'C' depicting land use within Angus, were considered. As internal watermain networks for new development could not be identified at this stage, a new Thiessen Polygon layer was created identifying the junctions in the existing network that would supply water to the new development areas.

For all new development, The Average Day Demand (ADD), Maximum Day Demand (MDD) and the MDD Fire scenarios for the ultimate condition were run using the values identified in the Draft Engineering Standards document and the peaking factor calculated in the existing conditions calibrated model, as summarized in **Table 4-1**.

Table 4-1 Ultimate Conditions Water Model Design Criteria

Single Family:	3	p/unit	(From Model)
Residential ADD:	450	L/p/d	(From Township)
Residential PF (Peak Day):	2.05		(From Model)
Commercial ADD:	28	m^3/ha/d	(From MECP)
Commercial PF (Peak Day):	1.5		(From MECP)
Fire Flow Minimum Pressure:	140	kPa	(From Township)
Fire Flow Needed (Residential):	150	L/s	(From Township)

4.1.2 Model Results

After executing the ultimate conditions model, the pressure and the available water (L/s) during the fire flow scenario for the Ultimate Conditions Model were compared to those generated from the Existing Conditions Model.

The pressure dropped slightly between the Existing Conditions Model and the Ultimate Conditions Model. However, the minimum pressure is still within the limits deemed acceptable in the MECP Design Guidelines for Drinking Water Systems. See **Table 4-2**.

Table 4-2 Water Model Scenario Results Comparison

Scenario	Total System Demand	Minimum Pressure	Maximum Pressure
Present Day ADD	34.96 L/s	452 kPa	630 kPa
Present Day MDD	70.03 L/s	451 kPa	626 kPa
Future ADD	79.72 L/s	450 kPa	627 kPa
Future MDD	161.12 L/s	428 kPa	601 kPa

The MDD Fire Scenario was run using the updated flow and pressure municipal standards. The Fire Flow Needed was set to 150 L/s with a Minimum Pressure of 140 kPa. Under these standards, the Ultimate Conditions Model had 156 of the 315 nodes (junctions) fail to meet the minimum flow and pressure requirements. Mapping of the model results is presented in **Appendix F**.

The supply capacity of the existing water supply system is exceeded in the ultimate conditions MDD scenario, and solutions to address the supply capacity deficit will be discussed in future sections of this report.

4.2 ULTIMATE CONDITIONS SANITARY MODEL DEVELOPMENT

4.2.1 Design Criteria

The Ultimate Conditions sanitary model was updated from the existing conditions model. Shapefiles with future residential, institutional, industrial and commercial developments as identified by active pre-consultations and development applications with the Township were developed and imported into WaterGEMS. Only pre-consultations and applications within the study area (delineated in **Figure 1-1**), and in keeping with the draft Schedule 'C' depicting land use within Angus, were considered. It was assumed that all flow from new development would be connected to existing junctions in the network.

The proposed loading and peaking factors for new development are based on the Township draft engineering design standards and listed below in **Table 4-3**.

Table 4-3 Ultimate Conditions Sanitary Model Design Criteria

Residential ADF:	450	l/p/d	(From Township)
Residential PF (Peak Day):	1.9		(MECP)
Institutional ADF:	90.0	l/p/d	(70 to 140 for MECP)
Institutional PF:	1.5		(MECP)
Commercial ADF:	28.0	m^3/ha/d	
Commercial PF:	1.5		(MECP)

The wet weather infiltration rate is 7,000 litres/hectare/day from the calibrated existing conditions model.

4.2.2 Model Results

The final Ultimate Conditions model schematic is shown, in **Figure 4-1**. The total proposed population is 22,096 persons. The total maximum day wet weather flow is 16,768 m^3/d. The model was executed using peak wet weather flow to identify constraints in the system. The results will be used to identify potential projects needed to support future growth in the Community. The following maps have been developed from the model:

- Flooded Manholes (flow elevation exceeds rim elevation);
- Surcharged Manholes (hydraulic grade-line exceeds pipe elevation);
- Maximum Velocity Sewers; and,
- Low Velocity Sewers.

The mapping of the model results are presented in **Appendix G.**

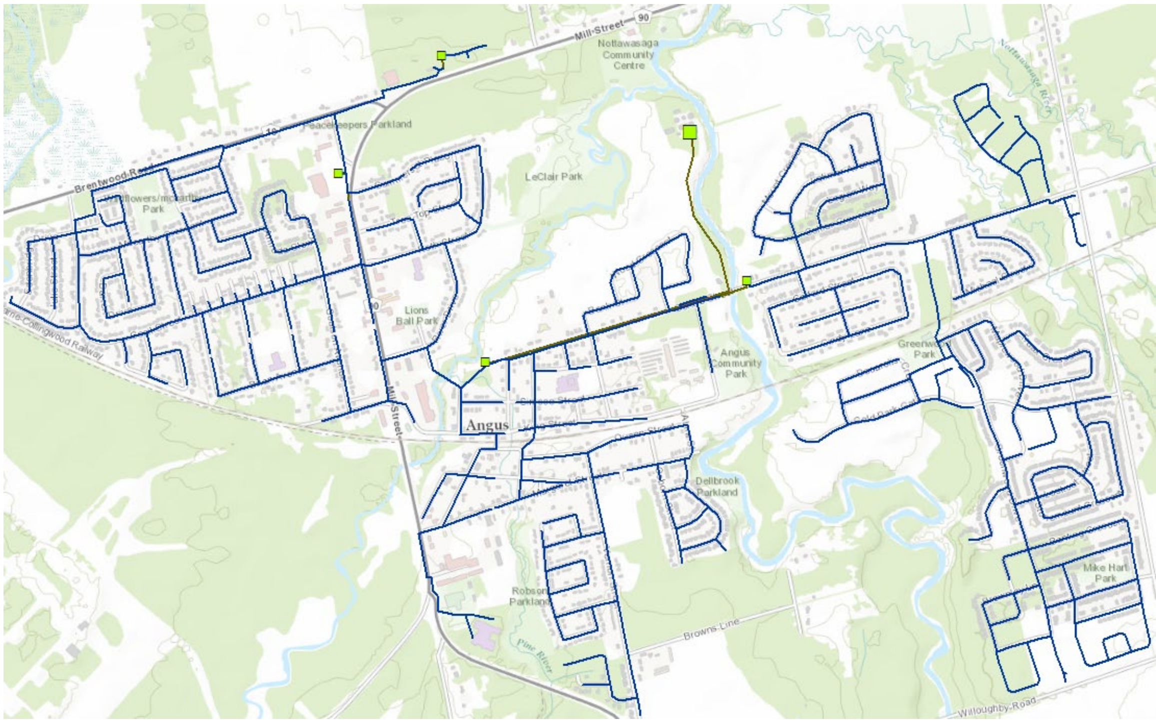

Figure 4-1 SewerGEMS Sanitary Network – Proposed Scenario

4.2.3 Capacity Calculations

The total operating capacity of the major nodes (SPS, WWTP) in the wastewater collection system under ultimate conditions is summarized in **Table 4-4**, below.

Table 4-4 Wastewater System Operating Capacity

Location	Capacity (m^3/d)[1]	Proposed Ultimate Conditions Flow (m^3/d)	Operating Capacity (%)
SPS 1	13,783	16,768	122
SPS 2	7,759	7,319	94
SPS 3	3,197	2,379	66
SPS 305 Mill	311	327	105
WWTP (ADF)	5,511	7,255	132

[1] SPS Capacity was calculated from the maximum existing pumping capacity (L/s) per the design specifications provided by OCWA; WWTP capacity was obtained from the existing ECA

Peak Flow exceeds the design capacity at SPS 1, SPS 305 Mill St. and at the WWTP under ultimate conditions. The SPS at 305 Mill is privately owned, and it will be the responsibility of the developer to ensure that development does not exceed/outpace the capacity of the SPS. Upgrades will be needed at SPS 1 before the proposed ultimate conditions can be met. It will be the responsibility of the Township to review wastewater flows annually to ensure that pump capacity is not being exceeded. Options for future system upgrades are discussed in future sections of the report.

4.3 ULTIMATE CONDITIONS ROAD NETWORK MODELLING

As discussed in **Section 2.11**, there are no proposed changes to the existing road network in Angus, beyond internal road constructed as part of new development, which will be the responsibility of the developer to plan, design and construct in accordance with Township Design Standards. The following subsections discuss the proposed maintenance suggestions to achieve an average excellent condition (PCI ≥85) of the existing road network.

4.3.1 Pavement Management Processing

Once the inventory condition database and GIS web-app were finalized, the work on implementing the pavement management side of the software was initiated. While pavement condition indicators are concerned with the current condition of the network, the management side of the process concerns itself with the analysis of condition, prediction of future condition, generation of maintenance options and pavement management scenarios. At this stage, the Township's preferred repair methods and associated costs were used to customize the road management modules. The results were compiled and reported to the Township in the Streetlogix software (GIS web-app). The decision-trees are highly customizable. The StreetScan Team worked with staff to tailor it to ensure the artificial intelligence (AI) will provide the necessary maintenance and repair suggestions. All decision trees and underlying data are editable by Township staff.

4.3.2 Pavement Maintenance Suggestions

The results from the maintenance / repair recommendation are shown below in **Figure 4-2**.

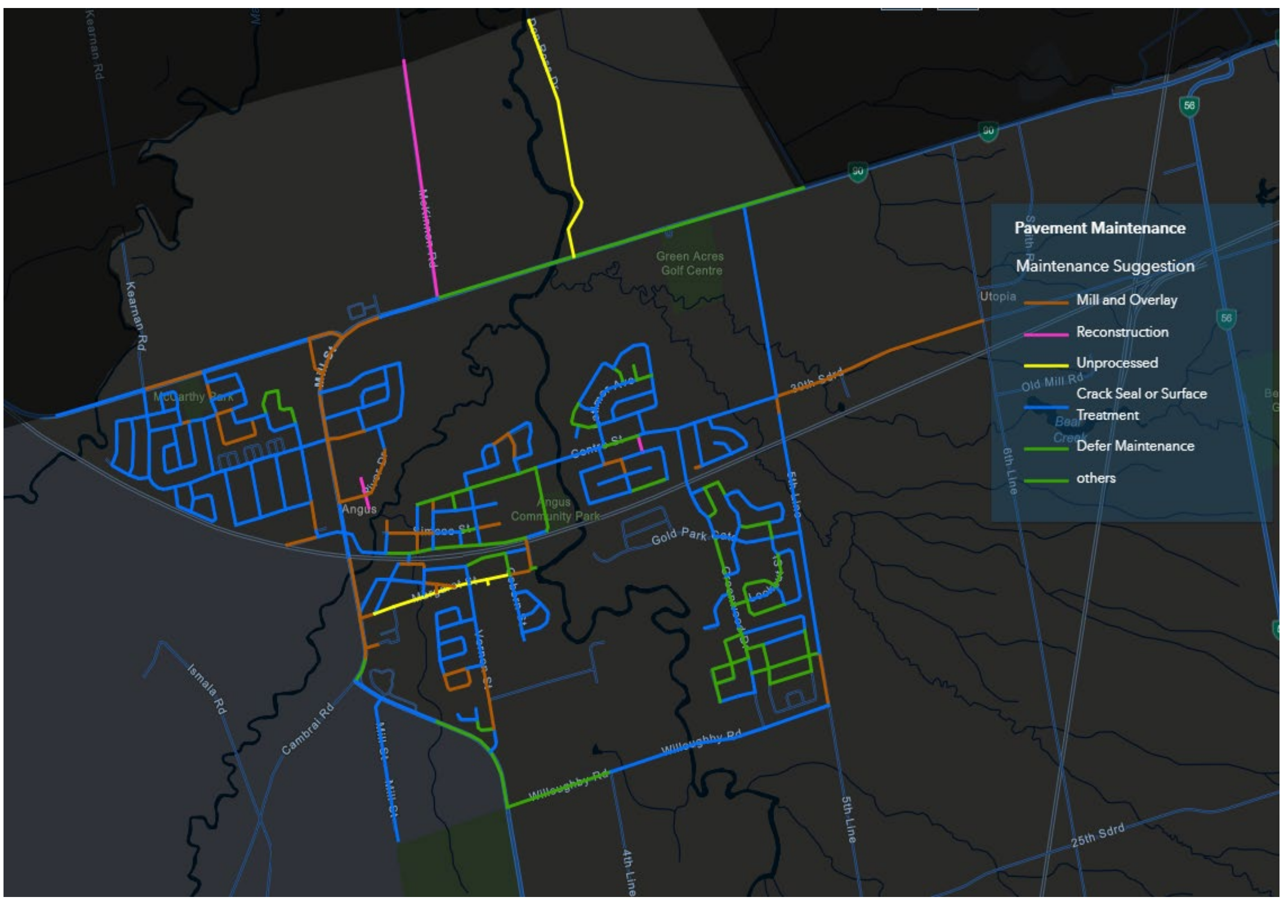

Figure 4-2 Angus Pavement Maintenance Recommendation

The maintenance suggestion can also be summarized in road length of each maintenance suggestion, as shown in **Figure 4-3.**

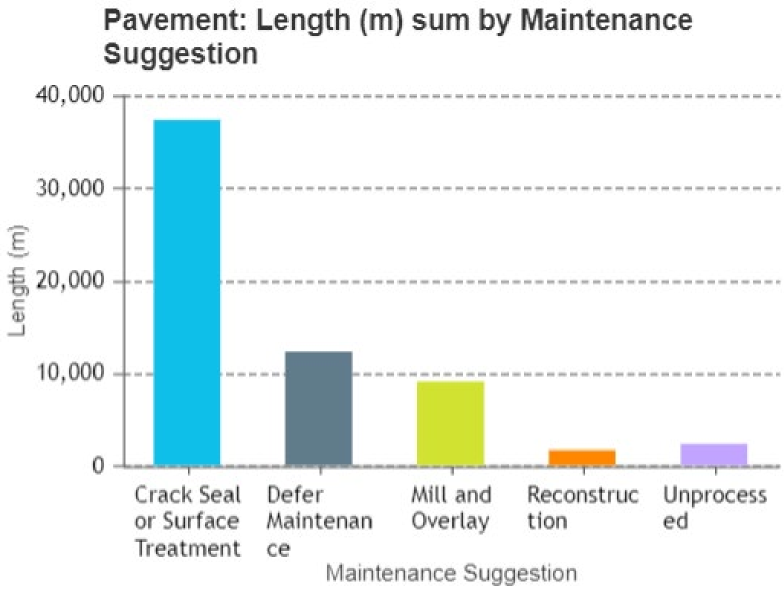

Figure 4-3 Pavement Maintenance Suggestion by Road Length

Maintenance and repair costs will be determined based on the maintenance suggestions summarized above. As the Streetlogix software determines areas of improvement and the maintenance required, this IMP will focus on the implementation of the proposed maintenance suggestions (including capital replacements), rather than determination of potential projects.

5.0 EVALUATION PROCESS

The purpose of this Chapter is to provide details on the methodology that was employed to develop and evaluate alternative servicing solutions for the Study Area. Critical components of the evaluation methodology discussed in this chapter include:

- Development of environmental evaluation criteria;
- Development of a long list of servicing options;
- Screening of servicing options;
- Development of a short-list of servicing options; and,
- Detailed evaluation and selection of the recommended preferred servicing option.

5.1 EVALUATION CRITERIA

In order to evaluate proposed alternative solutions, each of the servicing options were assessed with respect to their strengths and weaknesses in terms of the following general criteria:

- Natural Environment Impacts:
  - Impacts of the option to vegetation, wildlife and the Natural Environment; and
  - Surface and groundwater quality and quantity implications;

- Social / Cultural Environment Impacts:
  - Land Use and Archaeological Considerations;
  - Required agreements (i.e. inter-municipal approvals);
  - Traffic impacts and interruption to residents; and

- Visual landscape and aesthetic impacts of the option.

- Technical / Operational Considerations:
  - Difficulty to construct or implement the solution relative to other alternative solutions;
  - Supply security implications; and,
  - Operation and maintenance efficiency.

- Economic Impacts:
  - Capital construction costs;
  - Long term operation and maintenance cost burden; and
  - Payment structure, cost recovery options for Municipality, phasing and flexibility.

Preliminary screening of servicing options for this IMP included a high-level review of all alternative solutions against these criteria within the context of the background information and calculations presented herein. Any solution which does not satisfy one or more of these criteria (i.e. options which could clearly not be implemented due to prohibitive costs, detrimental environmental effects, or inability to meet the technical criteria such as satisfying the projected servicing demands) were eliminated without further detailed analysis.

Alternative solutions that appeared to be feasible within the context of these criteria were selected as potential "short-listed" alternative solutions and evaluated further in terms of their relative advantages and disadvantages within each evaluation criteria category.

5.2 LONG LIST OF OPTIONS

A long list of servicing options was developed for the water supply, water storage and wastewater systems. Transportation solutions were also assessed at a high level, with limited detailed evaluation due to the scoped approach to these components of the IMP. Road infrastructure solutions are limited to budgeting of the proposed solution, developed in the Streetlogix software.

Stormwater management was limited to an evaluation of the existing infrastructure and development of an associated high-level hydrologic model in PCSWMM, as future Stormwater management facilities will be dependent on the location of individual developments within Angus. A detailed list of the options considered for each municipal infrastructure system is provided in subsequent Chapters of this report.

5.3 SCREENING

The long lists of servicing options were screened against the criteria described below in **Table 5-1.**

Table 5-1: Long List Alternative Screening Matrix

Screening Question	Screening Decision By Answer	
	Pass	Fail
1. Can the proposed solution satisfy the Class EA Problem Statement?	Proceed	Eliminate
2. Does the solution have detrimental environmental, social, technical or economic impacts (i.e. prohibitive costs, agreement or land requirements, or technical difficulty)?	Proceed	Eliminate
3. Can impacts associated with the solution be mitigated?	Proceed	Eliminate

These criteria represent mandatory or "must-have" conditions which must be met in order to be an acceptable servicing solutions. Alternative solutions were reviewed in conjunction with the noted criteria on a pass or fail basis.

5.4 SHORTLIST DEVELOPMENT

The screening exercise described in **Sub-section 5.3** produced a short list of water and wastewater servicing options which were considered viable solutions. Each alternative solution was also evaluated with respect to economic, social and natural impacts as well as technical and operational considerations (details of each are outlined in subsequent chapters of this report for each system). These options then proceeded forward to the detailed evaluation stage.

5.5 DETAILED EVALUATION

Shortlisted alternative solutions to the servicing deficiencies were ranked using a colour coded weighted ranking system for each of the above criteria, where "green" represented the most preferred solution, "yellow" criteria represented less preferred alternatives and "red" represented the least preferred options.

Servicing options which receive the greatest number of "green" and "yellow" rankings (and the least "red" rankings) for each servicing category (i.e. water supply, wastewater treatment) are then considered to be the preferred alternative servicing solutions.

In general, the following steps were completed for the detailed evaluations of water and wastewater servicing solutions:

- Define detailed evaluation criteria (see **sub-section 5.1**);
- Review and define the relative impacts of each short-listed option against each criterion;
- Assign rankings to each short-listed alternative solution with respect to the solution's defined impacts relative to each evaluation criterion;
- Selection of a Preferred Alternative Servicing Solution based on detailed evaluation results; and,
- Development of a comprehensive implementation strategy for the Recommended Preferred Alternative Solution(s).

6.0 WATER SUPPLY AND TREATMENT ASSESSMENT

Angus is currently serviced by a Municipal well system with limited capacity for future expansion. In order to service the 25-year ultimate build-out scenario, approximately 4,635 m^3/d of additional water supply capacity will be required (assuming buildout to 100% capacity). Moreover, additional water storage and distribution infrastructure will be required to provide adequate fire protection as part of any viable alternative solution to service future buildout within the community of Angus. This Chapter summarizes the process of water supply solutions development, shortlisting solutions and evaluation of the options in accordance with the Class EA Process. Storage and Distribution Options and related evaluations are discussed in **Chapter 8**.

6.1 WATER SUPPLY AND TREATMENT ALTERNATIVE SOLUTION LONG LIST

The long list of water supply alternative solutions (Options) considered as part of this IMP is summarized in **Table 6-1**.

Table 6-1: Community of Angus Water Supply Options

Option	Description
Option W-1 – Do Nothing	• Maintain the status quo.
Option W-2 – Increase Current PTTW and Well Capacity to Supply Ultimate Demand	• New Well (Same Location), Expanded Treatment, Booster Pumps, Storage and Fire Protection.
Option W-3 – Use New Tecumseth-Collingwood Trunk Main for All Supply	• Booster Pumps, Storage and Fire Protection, Watermain Network, Connection to New Tecumseth Main.
Option W-4 – Maximize Use of Current Well (Increase PTTW) for Near Term Growth, Connect to New Tecumseth Main for Ultimate Build Out	• New Pumps, Expanded Treatment, Storage and Fire Protection, Watermain Network, Connection to New Tecumseth Main.
Option W-5 – Maximize Use of Current Well (Increase PTTW) for Near Term Growth, Construct New Well in New Location for Ultimate Build Out	• New Well (New Location), Expanded Treatment, Booster Pumps, Storage and Fire Protection, Watermain Network.
Option W-6 – Water Conservation – Construct Reclaimed Water System to Reduce Demand Within the Community	• Reclamation and Disinfection system at WWTP, Booster Pumps, Storage and Fire Protection, Second Watermain Network.

6.1.1 Option W-1 - Do Nothing

This Option represents the status quo with respect to water servicing. As the current system does not offer fire protection, storage capacity, or sufficient water supply to facilitate ultimate build-out, this Option would not satisfy the problem and opportunity statement of this IMP. As such, this Option would not be a viable alternative and was not considered for further evaluation.

6.1.2 Option W-2 – Increase Current PTTW and Well Capacity

Under this scenario, the existing wells and distribution system would be expanded with upgraded pumping and treatment facilities to supply the increase in demand to service projected population growth. The system would also require improvements to the existing reservoirs and booster pumps to provide storage and fire protection to the community (see **Chapter 7**). Hydrogeological investigations (including pump tests), water treatment, and natural habitat assessments are required to confirm that the existing well supply may be expanded through the addition of a well at the current locations or through increased pumping from the existing wells to achieve sufficient capacity to meet future demand without detrimental impacts to surface water. If such investigations prove that this expansion can fulfill the ultimate supply requirements from a capacity perspective, this Option would likely be a very cost effective and technically viable method for providing the required water supply. As such, this Option was short listed for detailed evaluation.

6.1.3 Option W-3 – Use New Tecumseth Trunk Main for All Supply

This Option would connect the existing community and future development to the New Tecumseth (NT) water distribution system which is supplied in part by the drinking water treatment plant (WTP) in the Town of Collingwood. There is currently a connection to the trunk main between Collingwood and Alliston, including a physical connection to the Angus water system, however no water supply has been allocated to Angus. This Option would require preparation of an amendment to the agreement between the municipalities governing this water supply to include the community of Angus.

At a high-level, it has been confirmed the NT system has adequate capacity to provide water supply for the Ultimate Build-Out, however additional booster pumps along the trunk main will be required. Booster pumping and storage facilities would need to be constructed within Angus, while further study is required to confirm whether additional treatment and supply infrastructure would be required on the production side (i.e. beyond planned expansion at the Collingwood WTP). For the purpose of this IMP, it is assumed that water supply costs associated with this option would take the form of a per-unit development charge equivalent to those to connect Angus to the trunk supply. Significant costs associated with expanding the Collingwood WTP and improving infrastructure along the trunk main, as well as the complicated process of negotiating a new Water Supply Agreement are primary deterrents to this Option. This Option would also place supply security into the hands of the NT system operator(s) as opposed to allowing the Township to remain self-sufficient. As such, this Option was not short-listed for further detailed analysis.

6.1.4 Option W-4 – Maximize Use of Current Well (Increase PTTW) for Near Term Growth, Connect to New Tecumseth Main for Ultimate Build Out

This Option is hybrid of **Option W-2** and **Option W-3**. The advantage to this amalgamation of options is that the demands placed on the NT system and associated costs would be greatly reduced by maintaining and maximizing the supply from existing wells. Booster pumping and storage would still likely be required depending on the upset limit of supply from the existing wells versus the amount of water supplied by the NT main; however, the trunk connection will not be required to service the entire 25-year development horizon in this case. This could defer construction costs of the trunk main improvements, although this Option remains cost intensive as development charges associated with the NT solution will still be high.

As the connection to this water supply is already in place, with planned upgrades at the Collingwood WTP, this Option may reduce required upgrades and development charges following maximization of current supply while retaining some degree of self-sufficiency within the system. As such, despite the potential complications in negotiating a new Water Supply Agreement, this Option was selected for further analysis.

6.1.5 Option W-5 – Maximize Use of Current Well (Increase PTTW) for Near Term Growth, Construct New Well in New Location for Ultimate Build Out

Under **Option W-5**, development would continue in Angus until such time as additional water supply capacity is required to meet demands, and existing well capacity would be maximized (subject to the results of hydrogeological investigations as outlined under **Option W-2**). At the time as current well capacity is exceeded, a new well would be brought online to provide the additional capacity to the system. Additional treatment will be required with the new well; however, under this Option the Township maintains control of the municipal water supply and does not require any inter-municipal water supply infrastructure or agreements as suggested in **Options W-3 and W-4**. Additional hydrogeological and natural heritage studies will need to be completed to confirm the applicability of this Option (in addition to those outlined under **Option W-2**), however as the aquifers supplying the existing wells in Angus are currently providing water supply for several municipalities, it has been assumed for the purpose of this IMP that there will be additional capacity in the aquifer for an additional well, and as such this Option has been selected for further evaluation.

6.1.6 Option W-6 – Water Conservation – Construct Reclaimed Water System to Reduce Overall Demand Within the Community

This Option would be complimentary to **Options W-2 through W-5** as it cannot address the problem and opportunity statement of this Class EA on its own merit. This Option proposes that treated effluent from the WWTP would be diverted to a disinfection system for use in a "Purple Pipe", non-potable, water system. Currently there are no MECP standards for water reuse other than the guidelines for toilet and urinal flushing shown in **Table 6-2**. Following the EPA standards effluent would need to be treated to levels shown in **Table 6-3**. Advanced Secondary Treatment with disinfection will be required to reach the objectives for water quality entering the purple pipe system.

Table 6-2: Guidelines for Domestic Reclaimed Water Used in Toilet and Urinal Flushing

Parameter	Units	Water quality parameters	
		Median	Maximum
BOD_5	mg/L	= 10	= 20
TSS	mg/L	≤ 10	≤ 20
Turbidity	NTU	= 2	= 5
Escherichia coli	CFU/100 mL	Not detected	= 200
Thermo-tolerant coliforms	CFU/100 mL	Not detected	= 200
Total chlorine residual	mg/L	≥ 0.5	

Table 6-3: Standards for Quality of Reclaimed Water (US EPA, 2004)

Parameter	Unrestricted Urban Use and Unrestricted Recreational Use	Restricted Urban Reuse	Industrial Reuse	Groundwater Recharge
BOD_5	5-30 mg/L	20-30 mg/L	20 mg/L	5 mg/L
TSS	5-30 mg/L	5-30 mg/L	20 mg/L	5-10 mg/L
Turbidity	0-2 NTU	2-3 NTU	3 NTU	2 NTU
Fecal Coliforms (E.coli)	0-2.2 CFU/100ml	23-200 CFU/100ml	23-200 CFU/100ml	0-2.2 CFU/100ml
Total Nitrogen	≥0.5 mg/L	-	-	12 mg/L
Total Chlorine Residual (Health Canada, 2010)	5-30 mg/L	-	-	-

The US EPA outlines ten (10) main water reuse categories based on the quality of the water required for specific and uses (USEPA 2004). The four (4) categories that pertain to Angus based on land uses within the study area would be Unrestricted Urban and Recreational Reuse, Restricted Urban Reuse, Industrial Reuse; and, Groundwater Recharge.

These uses comprise approximately 20% of all in home water demands, and could reduce the overall ADD from new development by approximately 4,551 m^3/d at the Ultimate Build-Out. This Option enhances opportunities for wastewater treatment and disposal (**Chapter 6**) and has beneficial environmental implications. Depending on the results of well supply testing, this Option may be worth consideration as part of any implementation strategy, however it was not shortlisted for further evaluation as it cannot meet the requirements of the problem statement as a standalone Option. The costs associated with installation of reuse infrastructure (including WWTP trains for reuse) would also likely be significant and could be considered prohibitively expensive as compared to the availability of water from other sources (TBD via hydrogeological testing).

6.2 WATER SUPPLY OPTIONS SHORT LIST

The Water Supply Options shortlisted for detailed evaluation were **Option W-2:** Increase Current PTTW and Well Capacity to Supply Ultimate Demand; **Option W-4:** Maximize Use of Current Well (Increase PTTW) for Near Term Growth, Connect to New Tecumseth Main for Ultimate Build Out; and, **Option W-5**: Maximize Use of Current Well (Increase PTTW) for Near Term Growth, Construct New Well in New Location for Ultimate Build Out.

6.3 EVALUATION OF WATER SUPPLY OPTIONS

Evaluation criteria used to evaluate the shortlisted Water Supply Options were as follows:

- Natural Environment Impacts:
  - Impacts of the option to vegetation, wildlife and the natural environment; and,
  - Surface and groundwater quality and quantity implications.
- Social/Cultural Environment Impacts:
  - Land use and archaeological considerations (including First Nations);
  - Traffic impacts and interruption to residents;
  - Visual landscape and aesthetic impacts; and,
  - Required inter-municipal agreements and infrastructure.

- Technical/Operational Considerations:
    - Difficulty to construct or implement the Option relative to other alternatives; and,
    - Operation and maintenance efficiency.
- Economic Impacts:
    - Capital construction costs;
    - Long term operation and maintenance cost burden; and,
    - Payment structure, cost recovery options for Municipality, phasing and flexibility.

Based on these criteria, the preferred solution was determined to be **Option W-2**. The detailed evaluation process completed to arrive at this preferred solution for Water Supply and Distribution is summarized in **Table 6-4**.

6.4 WATER SUPPLY REQUIREMENTS

As part of the water system upgrades, additional watermains will need to be constructed, as modeled for this IMP. A single model scenario was developed for the new watermains which utilized the most direct connection routes, as identified in the 2010 WaterCAD model. These expansions will be development driven and details determined as development applications are received and reviewed by the Township.

Table 6-4: Angus Water Supply Options Evaluation

Evaluation Criteria	Option W-2 Increase Current PTTW & Well Capacity to Supply Ultimate Demand (Approx 40 L/s)	Option W-4 Maximize Use of Current Well (Increase PTTW) for Near Term Growth, Connect to New Tecumseth Main for Ultimate Build Out	Option W-5 Maximize Use of Current Wells (Increase PTTW) & Construct New Well in New Location for Ultimate Build-out (Approx 40 L/s)
Natural Environment Impacts			
Impacts of the option to vegetation, wildlife and the natural environment	Minimal impacts due to maximizing use of existing systems. No disturbance to new areas.	Similar impacts to Option W-2 as connection to Regional watermain is already available.	Slightly higher impact than W-2 due to disturbance of a new site for new well construction and potential WM work depending on selected location.
Surface and groundwater quality implications	Impacts (and available capacity) will need to be confirmed via Hydro-G study and pump tests.	Similar GW impact to Option W-2, SW impacts limited to increased takings at the Collingwood WTP	Requires same studies as W-2 plus additional location and testing for new site to confirm impacts.
Natural Environment Overall Rating			
Social / Cultural Environment Impacts			
Land use and archaeological considerations (including First Nations)	No known Archaeological issues with proposed servicing alternative due to use of existing sites.	No known Archaeological issues with proposed servicing alternative due to use of existing sites.	Archaeological study will be required for any new well site. Higher land use requirement due to additional well site.
Visual landscape and aesthetic impacts, traffic impacts and interruption to residents	Minimal impacts due to maximizing use of existing systems. No disturbance to new areas.	Minimal impacts due to maximizing use of existing systems. No disturbance to new areas.	Higher impact than W-2 due to use of an additional well site. Site location will determine resident impact.
Required inter-municipal agreements and infrastructure	No Intermunicipal Infrastructure or Agreements Required.	Intermunicipal Water Supply Sharing Agreements & infrastructure Required.	No Intermunicipal Infrastructure or Agreements Required.
Social / Cultural Environment Overall Rating			
Technical/Operational Considerations			
Difficulty to construct or implement the option relative to other alternatives	Least complicated option - Expansion of existing facilities at current locations will be required.	In addition to W-2 requirements this Option will be reliant on Collingwood WTP Upgrades. Most complicated option from technical perspective.	Same technical requirements as Option W-2 in addition to construction of a new well at new location.
Operation and maintenance efficiency	Most efficient from maintenance perspective.	Partial reliance on Collingwood WTP & transmission main will add operational/maintenance complexity.	Same maintenance requirements as W-2 plus maintenance on an additional well system.
Technical/Operational Considerations Rating			
Economic Impacts			
Capital construction costs	Initial study requirements estimated to be approximately $40,000. Estimated capital cost of $2.1 Million, subject to testing results.	Study requirements will be similar to Option W-2, capital requirements will likely be higher due to Town of Collingwood connection charges in addition to well maximization.	Initial study requirements estimated to be approximately $90,000 (incl. W-2 studies). Capital costs estimated to be $3.4 Million, subject to testing results.
Long term operation and maintenance cost burden	Maintenance costs will be scaled up proportionally from existing conditions based on increased flow.	More costly maintenance than Option W-2 due to maintenance of Regional (Collingwood - New Tec) supply system in addition to Angus wells.	More costly maintenance than Option W-2 due to addition of an additional physical well site.
Payment structure, cost recovery options for Municipality, phasing and flexibility	Cost recovery and phasing will likely be development based.	Cost recovery and phasing will be more complicated due to inter-municipal infrastructure. Higher water system costs and lower flexibility.	Cost recovery and phasing will likely be development based.
Economic Ranking			
Overall Ranking:			

7.0 WATER STORAGE

Based on the Ministry of the Environment Design Guidelines (2008) and the forecasted populations for Angus, to address fire storage and storage capacity for Maximum Daily Demand (MDD), Angus will require an additional 4,199 m^3 of storage to service the Ultimate Build-Out.

7.1 WATER STORAGE & FIRE PROTECTION SERVICING STRATEGY LONG LIST

Given the ongoing updates to the Township Standards and in particular the inability of the current system to deliver system wide fire flows of 150 L/s, viability of water storage options was assessed for this IMP from the perspective of overall Servicing Strategies, predominantly via a modeling exercise which attempted to deliver an improved level of service while balancing the need for major infrastructure improvements. Based on initial sensitivity analysis and discussions with Township Engineering staff, the level of fire protection which was used for development of these Options was a fire flow of 100 L/s for existing residential areas and 125 L/s for future residential development areas (200 L/s was used for all commercial and institutional areas). These flow values were chosen as it was determined to not be technically feasible to achieve a 150 L/s standard for all of Angus, as the existing developments were not built to this standard. In addition, as the 150 L/s standard used in the ultimate conditions model was a conservative approach (Township design standard requires 100 L/s for detached dwellings and 150 L/s for townhouses), 125 L/s was determined to be an acceptable flow requirement for future residential development.

In general, this modeling exercise included strategic placement of varying numbers of storage systems within the study area based on shortfalls (failed nodes) identified in the future conditions model described in **Chapter 3.2.7**, and adjusting parameters to determine high level pressure requirements for pumping and/or elevated storage head to arrive at a modeled solution which met all required flows within MECP recommended pressure ranges. The long list of alternative water storage Options considered as part of this IMP is summarized in **Table 7-1**. All storage solutions were assessed under the MDD + fire flow scenario, using the fire flow values discussed above.

Table 7-1: Community of Angus Water Storage Options

Servicing Strategy Alternative	Description
Option WS-1 – Do Nothing	• Maintain the status quo.
Option WS-2 – Storage at Single Location	• Construct a storage system (elevated, in-ground or at grade) at a single site, preferably at (or adjacent to) an existing reservoir location.
Option WS-3 – Storage at Two (2) Locations	• Construct two (2) storage systems (elevated, in-ground or at grade) located at two (2) sites, preferably at (or adjacent to) existing municipal well locations in the Southwest (1) and Northwest (1) areas of Angus.
Option WS-4 – Storage at Three (3) Locations	• Construct three (3) storage systems (elevated, in-ground or at grade) located at three (3) sites, preferably at (or adjacent to) existing municipal well locations in the Southwest (1), Northwest (1) and Northeast (1) areas of Angus.

7.1.1 Option WS-1 - Do Nothing

This Option represents the status quo with respect to water storage. As the current system does not offer enough fire protection or storage capacity for the proposed growth, this Option would not satisfy the problem and opportunity statement of the Angus IMP. As such, this Option would not be a viable alternative solution and was not considered for further evaluation.

7.1.2 Option WS-2 –Storage at Single Location

This Option includes the construction of a single storage system, preferably at the site of (or adjacent to) an existing reservoir location. During the course of this modeling exercise several sites were checked for viability as use of a single storage location has certain obvious benefits from a capital cost perspective as compared to a multi-system approach. However, the required 143m of total dynamic head (TDH) proved to be too much for the existing system and would result in significant requirements for watermain replacements (2.8 km).

Initial consultations with a domestic water pump supplier also suggested that currently available pumps could not provide the required pressure. While a standpipe with booster pumping may be an alternative solution (this variation was not modelled), given the significant distribution system upgrades required and infeasible TDH, this Option appeared to be prohibitively complicated from a technical perspective and as such was not carried forward for further assessment.

7.1.3 Option WS-3 – Storage at Two (2) Locations

This servicing strategy would involve the construction of two (2) new storage facilities, similar to **Option WS-2** (WS-2), but at multiple locations, specifically in the Southwest (1) and Northwest (1) portions of the study area. For the purposes of this high-level evaluation, it has been assumed that the existing pumphouse can be used for the new pump required at the southwest location, with storage onsite or adjacent to the current municipal property. As there are no current wells in the Northwest portion of the study area, land acquisition and a new pumping station may be required for this site. This Option would reduce the required system pressure at a single location to meet fire flow requirements as compared to WS-2, instead relying on two (2) storage facilities to supply necessary pressure. The modeling exercise for this servicing strategy indicated that this would be a viable solution but would still likely require some watermain upgrades (approximately 1.7 km of WM affected) to meet required pressure ranges in all areas. This Option was shortlisted for detailed evaluation.

7.1.4 Option WS-4 – Storage at Three (3) Locations

This servicing strategy would involve the construction of three (3) new storage facilities, similar to **Option WS-3** (WS-3), but including facilities in the Southwest (1), Northwest (1) and Northeast (1) of the study area. This Option would utilize the same assumptions as **Option WS-3** and assumes an additional pump and storage located at the existing well site in Northeast Angus. This Option would further reduce the required system pressure at each single location to meet fire flow requirements as compared to WS-3, instead relying on three (3) storage facilities to supply necessary pressure. The modeling exercise for this Option indicated that this would be a viable solution and by adding a third facility, the watermain upgrades required under WS-3 are eliminated. This Option was shortlisted for detailed evaluation.

7.2 WATER STORAGE OPTIONS SHORT LIST

The water storage options shortlisted for detailed evaluation were:

1) **Option WS-3:** Storage at Two (2) Locations; and,

2) **Option WS-4:** Storage at Three (3) Locations.

7.3 EVALUATION OF WATER STORAGE OPTIONS

Evaluation criteria used to evaluate shortlisted Water Storage Options were as follows:

- Natural Environment Impacts:
  - Impacts of the option to vegetation, wildlife and the natural environment; and,
  - Surface and groundwater quality and quantity implications.
- Social/Cultural Environment Impacts:
  - Land use and archaeological considerations (including First Nations);
  - Visual landscape and aesthetic impacts; and,
  - Traffic impacts and interruption to residents.
- Technical/Operational Considerations:
  - Difficulty to construct or implement the Option relative to other alternatives;
  - Water supply security; and,
  - Operation and Maintenance Efficiency.
- Economic Impacts:
  - Capital construction costs;
  - Long term operation and maintenance cost burden; and,
  - Payment structure, cost recovery options for Municipality, phasing and flexibility.

Based on these criteria, the preferred solution was determined to be **Option WS-4**. The detailed evaluation process completed to arrive at this preferred solution for Water Storage is summarized in .

We note that the modeling assessment completed to derive the storage options did not differentiate between elevated storage tanks vs. at or below grade options. For all options considered, elevated storage would provide consistent pressure and supply security once filled as the pressure provided would be gravity/elevation based rather than pump based like the current subsurface system. This system would be difficult to expand and would have to be sized for the final anticipated level of growth at the outset. In ground or at grade storage could be phased with relative ease to accommodate various stages of development, presuming sufficient land is available for expansion at or adjacent to existing well sites, with supply security provided via backup power systems and pressure requirements met with booster pumping.

The preferred type of storage (elevated, in-ground or at grade) as well as the ideal siting for storage and booster pumps should be verified through a project level Schedule 'B' Class EA Addendum, during subsequent design activities and/or individual project Environmental Assessments (as required).

Table 7-2: Angus Water Storage Options Evaluation		
Evaluation Criteria	**Option WS-3** Storage at Two (2) Locations (SW & NW Angus)	**Option WS-4** Storage at Three (3) Locations (NE, SW, NW Angus)
Natural Environment Impacts		
Impacts of the option to vegetation, wildlife & the Natural Environment	Moderate impacts due to construction at one new site, retrofits at one existing site and 1.7 km of watermain upgrades.	Slightly less impact due to two (2) existing facility retrofits in lieu of watermain upgrades. Storage at one new site still required as well.
Surface/groundwater quality implications	Minimum impact expected except for construction dewatering. Slightly higher impacts due to substantial watermain replacements.	Minimum impact expected except for construction dewatering.
Natural Environment Overall Rating		
Social / Cultural Environment Impacts		
Land Use & Archaeological Considerations (Including First Nations)	New property required for Northeast storage site. Some property impacts for retrofit site.	New property required for Northeast storage site. Some property impacts for two (2) retrofit sites.
Visual landscape/Aesthetic impacts, Traffic impacts & interruption to residents	Significant potential for interruption to residents due to 1.7 km WM replacement requirement. Limited visual impacts, subject to ultimate site selection.	Limited visual or traffic impacts, subject to ultimate site selection.
Social / Cultural Environment Overall Rating		
Technical/Operational Considerations		
Difficulty to construct or implement the Option relative to other alternatives	Higher difficulty due to length of watermain replacement, two (2) storage sites (1 retrofit)	Moderate difficulty due to three (3) storage sites (2 retrofit), no major watermain replacements.
Water Supply Security	Slightly less redundancy due to two larger facilities. No external supply concerns.	Slightly more redundance due to presence of three smaller facilities. No external supply concerns.
Operation & Maintenance Efficiency	Slightly more efficient due to use of only two (2) storage facilities (larger pumps & reservoirs).	Slightly less efficient for maintenance due to three (3) total storage facilities (smaller pumps & reservoirs).
Technical/Operational Considerations Rating		
Economic Impacts		
Capital/construction costs	Storage Costs estimated to be $6-8 Million plus $2.6 Million for Watermain replacements	Storage Costs estimated to be $8-10 Million. No major watermain replacements required.
Long term/operation & maintenance cost burden	Lower life cycle costs due to less facilities.	Slightly higher life cycle cost due to third facility.
Cost Recovery & Phasing Flexibility	Less flexible due to watermain requirements and two (2) potential phases.	Higher flexibility due to three (3) potential phases and limited watermain upgrade requirements.
Economic Ranking		
Overall Ranking:		

8.0 WASTEWATER TREATMENT AND DISPOSAL ASSESSMENT

As discussed in previous Chapters, the Angus WWTP currently has a servicing shortfall of 1,744 m^3/d (based on 100% capacity) with respect to the required capacity to facilitate the proposed ultimate development conditions. Options in this chapter were evaluated on the basis of their capability to achieve this level of servicing, or more specifically, to provide a total ultimate scenario wastewater servicing capacity of 7,255 m^3/d. A total of nine (9) Wastewater Treatment and Disposal long list alternative solutions were considered as part of this IMP. These options are summarized in and discussed in detail throughout this Chapter.

Table 8-1: Community of Angus Wastewater Treatment Options

Option	Description
Option WWT-1 – Do Nothing	• Maintain the status quo.
Option WWT-2 – Expand Existing MBR Wastewater Treatment Plant	• Through upgrades to existing WWTP, expand capacity and continue discharge to Nottawasaga River.
Option WWT-3 – Transport Effluent to Georgian Bay for Treatment, Discharge to Georgian Bay	• Construct a forcemain system between Angus and Collingwood/Wasaga Beach and treat/discharge effluent using existing infrastructure located within that municipality.
Option WWT-4 – Transport Effluent to Alliston for Treatment, Discharge to Nottawasaga River	• Construct a forcemain system between Angus and Alliston and treat/discharge effluent using existing infrastructure located within that municipality.
Option WWT-5 – Development Specific WWTP's	• This option would involve construction of individual WWTP's for each new development Area.
Option WWT-6 – Second Community Conventional WWTP, Surface Disposal	• Construct a new municipal conventional WWTP in Angus with surface water disposal to one of the major watercourses.
Option WWT-7 – Second Community WWTP, Subsurface Disposal	• Construct a new municipal WWTP in Angus, with subsurface disposal.
Option WWT-8 – New Community WWTP (Decommissioning Existing WWTP)	• Construct new municipal WWTP in Angus to treat all flows, decommission the existing WWTP.
Option WWT-9 - Second Community Modular MBR WWTP, Surface Water Discharge	• Construct a new municipal modular MBR WWTP in Angus with surface water disposal to one of the major watercourses.
Option WWT-10 – Transport Effluent to CFB Borden WWTP	• Construct a forcemain system between Angus and CFB Borden and treat/discharge effluent using existing infrastructure located within that community.

8.1 WASTEWATER COLLECTION ASSESSMENT

Wastewater collection system requirements are directly linked to the selected options for wastewater treatment (WWT) and disposal, specifically with respect to location of downstream facilities and infrastructure. For the purposes of the IMP and since the existing wastewater collection system is largely established in Angus already, assessment of wastewater collection requirements was limited to the activities described in the modeling sections of this report (i.e. identifying current deficiencies), with any impacts to the collection system associated with each WWT solution (i.e. new infrastructure or required upgrades to facilitate ultimate conditions sewage conveyance) being considered as part of the evaluation process.

8.2 WASTEWATER TREATMENT AND DISPOSAL ALTERNATIVE SOLUTIONS LONG LIST

8.2.1 Option WWT-1 - Do Nothing

This option represents the status quo with respect to wastewater treatment and disposal and if the alternative solutions were not implemented. As there is insufficient treatment capacity to service the ultimate population of Angus, this option would not satisfy the problem and opportunity statement of the Angus IMP. As such, this option would not be a viable alternative and was not considered further in the evaluation of alternatives solutions.

8.2.2 Option WWT-2 – Expand Existing MBR Wastewater Treatment Plant

The Angus WWTP currently has a rated capacity of 5,511 m^3/d and is operating at approximately 59% capacity under existing conditions. While ultimate conditions will exceed the current capacity of the WWTP, resulting in a shortfall of 1,744 m^3/d, upgrading the existing WWTP to obtain this additional capacity (an increase in total capacity of approximately 32%) appears to be viable from a technical perspective based on preliminary investigations completed as part of this IMP (including site visits and discussions with operations staff, as well as preliminary calculations of effluent parameter loading limits). Collection system upgrades would also be limited for this Option.

Detailed assessment of the technical requirements for such an expansion would need to be determined through a Schedule 'C' Class EA, including an assimilative capacity assessment, however reuse and expansion of existing facilities are generally beneficial for a variety of reasons including potentially reduced capital costs and environmental impacts when compared to the requirements for a new facility. As such, this option was shortlisted for further evaluation.

8.2.3 Option WWT-3 – Transport Effluent to Georgian Bay for Treatment, Discharge to Georgian Bay

This Option relies on co-operation with the neighboring Municipality, and will likely require additional approvals such as a WWTP Expansion Class EA or EA addendum, or agreements related to phasing and accommodation of design flows between the two (2) municipalities. This Option would also require the construction of a centralized pumping station in Angus with approximately 35-37 km of forcemain to transport untreated or partially treated sewage to the Collingwood or Wasaga Beach WWTP.

In addition to the collection and conveyance infrastructure, it is presumed that costs to upgrade the neighbouring WWTP or use its existing capacity would also need to be paid to the receiving community as a condition of approval for this Option.

Despite the shared use of existing facilities having some environmental benefits, due to the significant capital, O&M and upgrade costs or use charges and the challenges associated with inter-municipal agreements and approvals, this Option was not shortlisted for further evaluation.

8.2.4 Option WWT-4 – Transport Effluent to Alliston for Treatment, Discharge to Nottawasaga River

Similar to **Option WWT-3**, this Option relies on co-operation with the neighboring Municipality, and will likely require additional approvals such as a Regional WWTP Expansion Class EA, or agreements related to phasing and accommodation of design flows between the two (2) municipalities. This Option would also require the construction of a centralized pumping station in Angus with approximately 22 km of forcemain to transport untreated or partially treated sewage to the New Tecumseth Regional WWTP.

In addition to the collection and conveyance infrastructure, it is presumed that charges would also need to be paid to the Town of New Tecumseth as a condition of approval for this Option.

As with Option WWT-3, despite the shared use of existing facilities having some environmental benefits, due to the significant capital, O&M and development charge costs and the challenges associated with inter-municipal agreements and approvals, this Option was not shortlisted for further evaluation.

8.2.5 Option WWT-5 – Development Specific/Private WWTP's

This option represents constructing a number of facilities as opposed to developing a more centralized wastewater treatment strategy.

Maintenance for development specific WWTP's would result in a significant operational burden on the Township, once multiple facilities were up and running (both from the perspective of on-going costs and personnel requirements). Communal servicing is also preferred from a provincial policy perspective and allowing multiple development specific facilities (whether publicly or privately owned/operated) would require complicated agreements which would be a burden and potential risk for the municipality. As such, this option is not a sustainable long term wastewater treatment option at this time and was not shortlisted for further evaluation.

8.2.6 Option WWT-6 – Second Community Conventional WWTP, Surface Water Discharge

This Option would require Construction of a new, secondary WWTP in Angus with a capacity of at least 1,744 m^3/d with discharge to a surface water source other than the current WWTP discharge location. This could include discharge to the Pine River, Bear Creek or the Nottawasaga River (at an alternate location). All of these options would require assimilative capacity studies be completed to verify available discharge and treatment requirements, however, assuming these were completed and capacity was available, this option could be a viable solution to achieve the current capacity shortfall. The existing Angus WWTP would continue to operate under this Option. Technical details with respect to the preferred location, treatment and disposal requirements for the new WWTP (subject to available assimilative capacity) would need to be determined as part of a Schedule 'C' Class EA process. Depending on the ultimate location of this WWTP (which would also likely need to be determined relative to the pacing and location of proposed future development in Angus), additional wastewater collection and conveyance solutions would likely need to be assessed as well. This Option was short-listed for further evaluation.

8.2.7 Option WWT-7 – Second Community WWTP, Subsurface Disposal

Similar to **Option WWT-6**, this Option would include the construction of a new, secondary WWTP in Angus, however this facility would utilize subsurface leaching bed disposal for future phases of development. Approximately 1,744 m^3/d of effluent would need to be disposed of in this manner. This would be a very land intensive option, requiring 5-10 ha of land depending on the treatment technologies utilized and the location of the ultimate facility. However, this option could be viable subject to detailed hydrogeological investigations to verify the land requirements for discharge/attenuation and source-water protection implications, both of which would likely impact the siting of the facility. Similar to **Option WWT-6**, the ultimate location of this WWTP would also likely need to be determined relative to the pacing and location of proposed future development in Angus and could result in the need for additional wastewater collection and conveyance solutions to be assessed as well. Due to the extensive land requirements, this solution was not shortlisted for further evaluation.

8.2.8 Option WWT-8 – New Community WWTP (Decommission Existing WWTP)

This Option would include constructing a new community WWTP with either subsurface or surface water effluent discharge, having sufficient capacity to service the entire proposed ultimate build-out of Angus (7,255 m^3/d). While technically feasible, this option would likely be prohibitively expensive as compared to **Options WWT-2, WWT-6 and WWT-7**, while also necessitating complicated implementation strategies when transitioning from the existing facility to the new one. Subsurface discharge for this volume of flow would be prohibitively land intensive and surface water discharge would require assimilative capacity assessments. Either option could require significant changes to the wastewater collection system if the new WWTP were located anywhere other than the site of the current WWTP. As such, this Option was not shortlisted for further evaluation.

8.2.9 Option WWT-9 – Second Community Modular MBR WWTP, Surface Water Discharge

Similar to **Option WWT-6**, this Option would include the construction of a new, secondary WWTP in Angus, however this facility would utilize a modular MBR treatment facility design to reduce the building footprint and design/operational complexity. This would also reduce capital costs compared to a conventional WWTP design and construction process. The existing Angus WWTP would continue operating under this Option. Depending on the ultimate location of this WWTP (which would also likely need to be determined relative to the pacing and location of proposed future development in Angus), additional wastewater collection and conveyance solutions would likely need to be assessed as well. This Option was short-listed for further evaluation.

8.2.10 Option WWT-10 - Transport Effluent to CFB Borden WWTP

Similar to **Option WWT-3** and **WWT-4**, this Option would rely on co-operation with the federal government and will likely require additional approvals such as a WWTP Expansion Class EA or EA addendum, or agreements related to phasing and accommodation of design flows between the Township and CFB Borden.

In addition to the collection and conveyance infrastructure, it is presumed that costs to upgrade the neighbouring WWTP or use its existing capacity would also need to be paid to the receiving community as a condition of approval for this Option.

Despite the shared use of existing facilities having some environmental benefits, due to the significant capital, O&M and development charge costs and the challenges associated with inter-municipal/governmental agreements and approvals, this Option was not shortlisted for further evaluation.

8.3 SUMMARY OF WASTEWATER TREATMENT/DISPOSAL OPTION COSTS

For the purpose of comparison, Greenland has completed a preliminary opinion of probable cost evaluation for comparison of the above referenced Wastewater Treatment and Disposal options which are summarized in .

Table 8-2: Wastewater Treatment and Disposal Option Order of Magnitude Costing

Option Description	Preliminary Opinion of Probable Capital Costs (OPC)	Notes for Further Evaluation
Option WWT-2: Expand Existing MBR WWTP	$8-10 Million	Lowest Capital Cost, moderately complex design and approvals process (requires Schedule 'C' and retrofit design). Minor changes to collection system (for capacity increases only). Requires maintenance of one (1) WWTP.
Option WWT-6: Second Community Conventional WWTP, Surface Water Discharge	$23-28 Million	Moderate-High Capital Cost, complex design and approvals process (requires Schedule 'C' and new WWTP design), Potentially requires major changes to collection system. Requires maintenance of two (2) WWTP's
Option WWT-9: Second Community Modular MBR WWTP, Surface Water Discharge	$14-18 Million	Moderate Capital Cost, complex design and approvals process (requires Schedule 'B,' new WWTP design and significant hydro-G studies), land intensive option. Likely requires major changes to collection system. Requires maintenance of two (2) WWTP's

Note: Supplementary studies (ex. Schedule 'C' EA) have not been included in the OPC estimate.

8.4 WASTEWATER TREATMENT AND DISPOSAL OPTIONS SHORTLIST

As discussed in the previous subsections, the following Wastewater Treatment and Disposal options were shortlisted for detailed evaluation.

1. **Option WWT-2**: Expand Existing WWTP
2. **Option WWT-6**: Second Community Conventional WWTP, Surface Water Discharge
3. **Option WWT-9:** Second Community Modular MBR WWTP, Surface Water Discharge

8.5 EVALUATION OF WASTEWATER TREATMENT AND DISPOSAL OPTIONS

The evaluation criteria used to evaluate Wastewater Treatment and Disposal options were as follows:

- Natural Environment Impacts:
  - Impacts of the option to vegetation, wildlife and the natural environment; and,
  - Surface and groundwater quality and quantity implications.
- Social/Cultural Environment Impacts:
  - Land Use and Archaeological Considerations (Including First Nations);
  - Traffic impacts and interruption to residents;
  - Visual landscape and aesthetic impacts; and,
  - Required inter-municipal agreements and infrastructure.

- Technical/Operational Considerations:
  - Difficulty to construct or implement the option relative to other alternatives; and,
  - Operation and maintenance efficiency.
- Economic Impacts:
  - Capital construction costs;
  - Long term operation and maintenance cost burden; and,
  - Payment structure, cost recovery options for Municipality, phasing and flexibility.

Based on these criteria, the preferred solution was determined to be **Option WWT-2: Expand Existing MBR WWTP**. The detailed evaluation process completed to arrive at this preferred solution for Wastewater Treatment is summarized in . While the current MBR WWTP effluent criteria cannot be applied to the proposed expansion without exceeding loading limits in the existing ECA, based on the preliminary investigation it is technically feasible to reduce current effluent concentration limits to mee current target loading requirements for effluent.

8.6 WASTEWATER COLLECTION REQUIREMENTS

Based on the preferred wastewater treatment and disposal option selected, a high-level future conditions wastewater collection model scenario was developed based on the projected ultimate population and anticipated future development areas. Any deficiencies identified in the model for this scenario were summarized and are broken down in more detail in **Chapters 9 and 10** of this report. In general, the design and construction of collection system upgrades will be the responsibility of developments which impact or cause deficiencies as a result of growth and should be assessed on a case-by-case basis. The assessment of wastewater collection system requirements was limited to the options to address existing issues and the preferred Wastewater Treatment Option for the ultimate conditions scenario.

Table 8-3: Angus Wastewater Treatment and Disposal Options Evaluation

Evaluation Criteria	Option WWT - 2 Expand Existing Wastewater Treatment Plant (Approx 1,750 m3/d)	Option WWT - 6 Second Community WWTP (Conventional), Surface Water Discharge (Approx 1,750 m3/d)	Option WWT - 9 Second Community WWTP (Modular), Surface Water Discharge (Approx 1,750 m3/d)
Natural Environment Impacts			
Impacts of the option to vegetation, wildlife and the natural environment	Minimal impacts due to minimal construction footprint (limited to vicinity of the existing site).	Slightly higher impact than WWT-2 due to increased footprint associated with a second WWTP site.	Slightly higher impact than WWT-2 due to increased footprint associated with a second WWTP site, less impact than WWT-6.
Surface and groundwater quality implications	Limited surface water impact due to use of existing facility and discharge location. Verification of impacts required via Assimilative Capacity Study (ACS). MBR treatment assumed. Minimal GW impact aside from onsite construction.	Slightly higher GW impact during construction than WWT-2 due to larger footprint of a new conventional facility vs. retrofit. Slightly higher surface water impact due to use of a new discharge location, subject to verification via ACS.	Slightly lower GW impact during construction than WWT-6 due to smaller footprint of a modular facility vs. conventional. Slightly higher surface water impact due to use of a new discharge location, subject to verification via ACS.
Natural Environment Overall Rating			
Social / Cultural Environment Impacts			
Land use and archaeological considerations (including First Nations)	No known Archaeological as work limited to existing disturbed site. Minimal additional land requirements.	Archaeological investigation required for any new site selected. Moderate to high land requirements to facilitate new WWTP	Archaeological investigation required for any new site selected. Moderate land requirements to facilitate new WWTP (Less than WWT-6).
Visual landscape and aesthetic impacts, traffic impacts and interruption to residents	Lowest impact to residents due to retrofit work being contained to existing site.	Greater construction Impacts due to lengthier construction of new WWTP at a new site.	Slightly less impact than WWT-6 due to smaller footprint of modular WWTP.
Required inter-municipal agreements and infrastructure	No intermunicipal approvals required.	No intermunicipal approvals required.	No intermunicipal approvals required.
Social / Cultural Environment Overall Rating			
Technical/Operational Considerations			
Difficulty to construct or implement the option relative to other alternatives	Lowest difficulty subject to confirmation via Schedule 'C' Class EA	Higher difficulty due to requirement for siting and construction of a new WWTP.	Higher difficulty due to requirement for siting and construction of a new WWTP. Modular construction slightly less difficult vs. WWT-6
Operation and maintenance efficiency	Maintenance will be similar to existing conditions, scaled up for higher flows.	Higher maintenance burden due to operation of two (2) separate WWTP facilities.	Higher maintenance burden due to operation of two (2) separate WWTP facilities.
Technical/Operational Considerations Rating			
Economic Impacts			
Capital construction costs	Capital Cost of Option is expected to be approximately $8.0-10.5 Million	Capital Cost of Option is expected to be approximately $22-26 Million	Capital Cost of Option is expected to be approximately $13-16 Million
Long term/operation and maintenance cost burden	Moderate ongoing maintenance costs associated with current MBR WWTP.	Highest ongoing maintenance burden due to operation of a second complex MBR WWTP.	Moderate to High ongoing maintenance burden to operation of a second WWTP.
Payment structure, cost recovery options for Municipality, phasing and flexibility	No significant phasing or cost recovery challenges (development driven). Expansion can be completed as needed subject to results of Schedule 'C' EA.	Initial phase will require high capital outlay for a new WWTP. Subsequent phases an option to aid in cost recovery (development driven). Schedule 'C' EA required.	Relatively flexible option due to the nature of modular design vs. conventional design (development driven). Schedule 'C' EA required.
Economic Ranking			
Overall Ranking:			

9.0 SUMMARY OF PREFERRED MASTER SERVICING OPTIONS

Based on the evaluations presented in this report, the recommended preferred master servicing solution for the community of Angus includes implementation of the Servicing Options summarized in **Table 9-1**.

Table 9-1: Summary of Recommended Preferred Master Servicing Options

Option	Description
Option W-2: Increase Current PTTW & Well Capacity to Supply Ultimate Demand	• New Well (Same Location), Expanded Treatment, Booster Pumps, Storage and Fire Protection.
Option WS-4: Storage at Three (3) Locations	• Construct three (3) storage systems (elevated, in-ground or at grade) located at three (3) sites, preferably at (or adjacent to) existing municipal well locations in the Southwest (1), Northwest (1) and Northeast (1) areas of Angus.
Option WWT-2: Expand Existing MBR Wastewater Treatment Plant	• Through upgrades to existing WWTP, expand capacity and continue discharge to Nottawasaga River;
Wastewater Collection Upgrades: Sanitary Network Upgrades in Area 1 & 2	• Upgrade collection system immediately downstream of SPS #2 (Area 1); Upgrade collection system immediately upstream of SPS #1, Increase pump capacity at SPS #1 (Area 2) – Upgrade recommendation based on modeling and subject to implementation of Option WWT-2

The preferred master servicing strategies have been summarized in **Figure 9-1** and **Figure 9-2**.

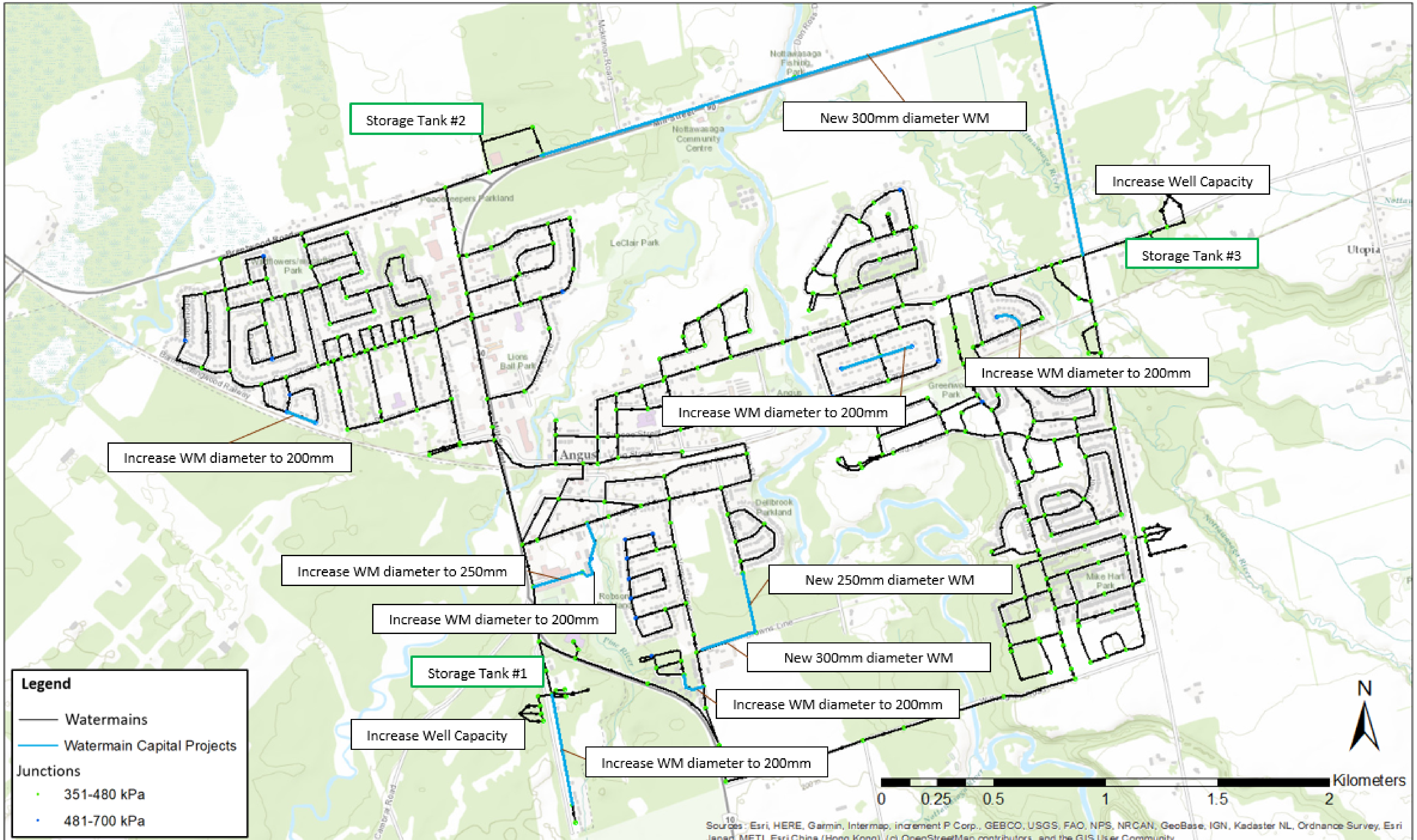

Figure 9-1 Water System Preferred Master Servicing Strategy (Note: Precise storage tank locations to be confirmed at Pre-Design)

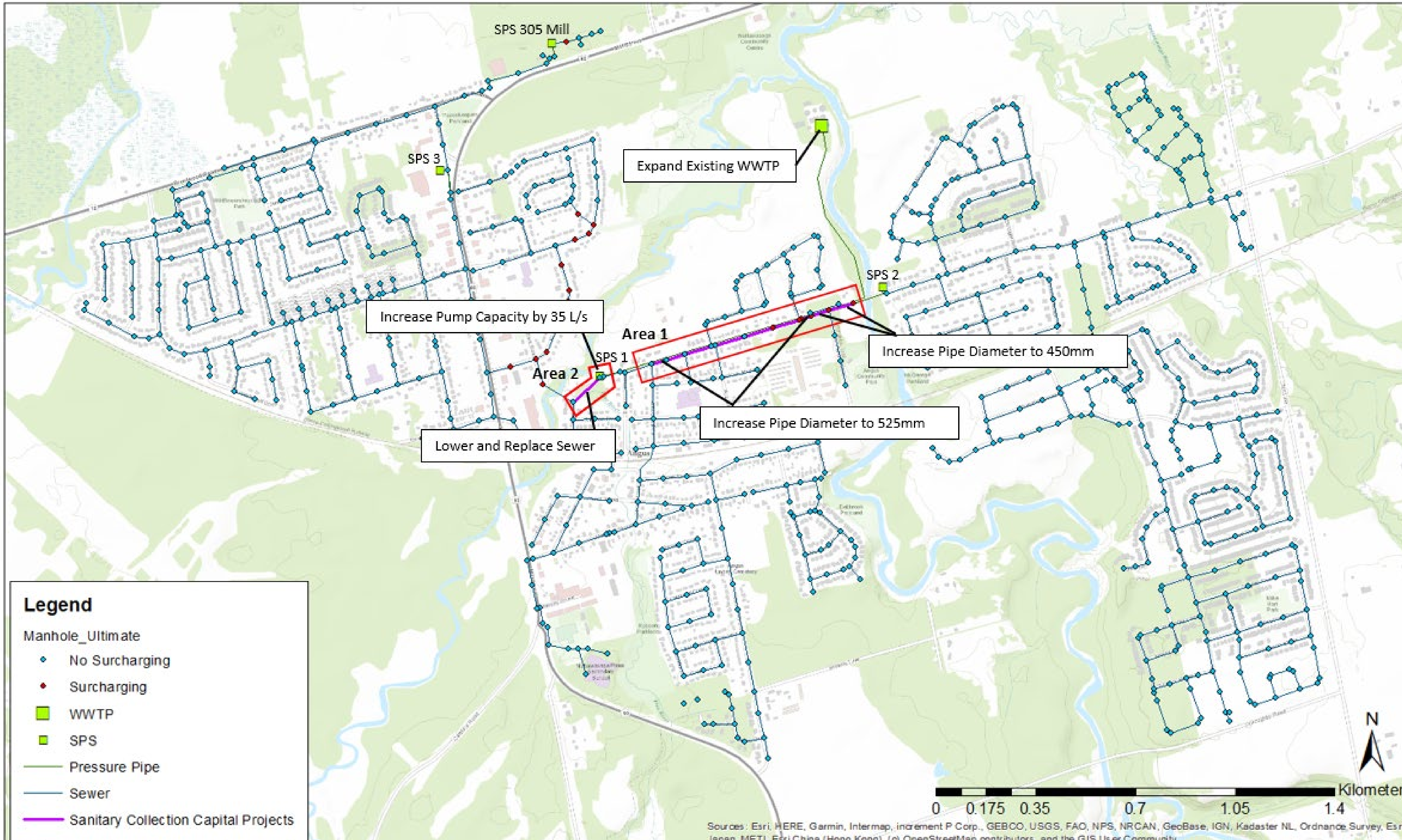

Figure 9-2 Wastewater System Preferred Master Servicing Strategy

10.0 IMPLEMENTATION STRATEGY

Following completion of the relevant stages of the EA process, projects associated with the preferred Master Servicing Solutions for water and wastewater may proceed to the Implementation Stage of the Class EA Process (Phase 5). This Chapter outlines a recommended strategy for implementation of the preferred solutions, including: Required projects and their associated Class EA Schedules, additional study requirements, and necessary infrastructure approvals; Project phasing recommendations; Opinions of probable project capital costs; and, Potential impacts and mitigation and monitoring requirements to facilitate project implementation.

10.1 PREFERRED MASTER SERVICING SOLUTION PROJECTS AND APPROVAL REQUIREMENTS

In addition to meeting the intent of a Schedule 'B' Class EA process (addressed via this report), projects and approval requirements associated with the recommended preferred Master Servicing Options will generally include a number of additional approvals from regulatory agencies such as the Ministry of the Environment, Conservation and Parks (MECP) and the Nottawasaga Conservation Authority (NVCA) as listed within this section.

10.1.1 Water Servicing Project Infrastructure Approvals

The recommended preferred water servicing solutions selected as part of this IMP are generally categorized as Schedule 'B' Projects, and as such may proceed to implementation. Dependent on the results of preliminary studies completed for **Option W-2**, a Schedule 'B' addendum, may be required. Class EA and infrastructure approval requirements for water servicing projects associated with **Option W-2** and **Option WS-4** are summarized in **Table 10-1**.

Table 10-1: Water Project Class EA Schedules and Approval Requirements

Project Description	Class EA Schedule & Study Requirements	Required Agency Approvals
Increase Capacity of Existing Angus Wells at Current Locations	Hydrogeological Investigations Schedule B (Addendum to this IMP, dependent on hydrogeological results)	MECP Permit to Take Water (PTTW) and Environmental Compliance Approval (ECA)
Water Distribution Network Upgrades to Service Development	Schedule A (Addressed via this IMP)	MECP Environmental Compliance Approval (ECA), Planning Act Approvals
Water Storage at Three (3) Locations	Schedule B (Addendum to this IMP, subject to pre-design confirmation of land requirements/availability)	MECP Environmental Compliance Approval (ECA)

10.1.2 Wastewater Project Infrastructure Approvals

It should be noted that any WWTP which utilizes surface water discharge for effluent disposal will require a Schedule 'C' Class EA. Subsequent phased capacity improvements which may occur or may be proposed for the facility will also be subjected to the EA process.

Class EA and infrastructure approval requirements for wastewater projects associated with **Option WWT-2** are summarized in **Table 10-2** .

Table 10-2: Wastewater Project Class EA Schedules and Approval Requirements		
Project Description	Class EA Schedule & Study Requirements	Required Agency Approvals
Expand Existing Wastewater Treatment Plant	Assimilative Capacity Study Schedule C (To Be Completed prior to Implementation)	MECP Environmental Compliance Approval (ECA) NVCA Permit
Sanitary Collection Network Upgrades to Service Development	Schedule A (Addressed via this IMP)	MECP Environmental Compliance Approval (ECA), Planning Act Approvals
Sewage Pumping Station #1 Pump Capacity Increase	Schedule B (To Be Completed prior to Implementation, Subject to results of WWTP EA)	MECP Environmental Compliance Approval (ECA)

10.1.3 Road Infrastructure Project Infrastructure Approvals

The road network maintenance recommendations determined as part of this IMP are generally categorized as a Schedule 'A+' projects, and as such may proceed to implementation. Class EA and infrastructure approval requirements for each type of maintenance recommendation are summarized in **Table 10-3**.

Table 10-3: Road Maintenance Class EA Schedules and Approval Requirements		
Maintenance Suggestion	Class EA Schedule & Study Requirements	Required Agency Approvals
Crack and Seal or Surface Treatment	Schedule A+ (Addressed via this IMP)	None
Mill and Overlay	Schedule A+ (Addressed via this IMP)	None
Reconstruction	Schedule A+ (Addressed via this IMP)	None

10.1.4 SWM Project Infrastructure Approvals

As the scope of this IMP did not include detailed SWM Infrastructure evaluations, it is recommended that the Township consider completing a SWM Master Planning exercise to develop detailed existing conditions hydraulic modeling for major and minor conveyance systems (as opposed to just the hydrologic models developed as part of this IMP) and to identify any potential improvements to the current SWM servicing strategies in the community of Angus as development proceeds (i.e. consolidation of facilities to reduce long-term maintenance burden on the Township). As a minimum, comprehensive SWM modelling would provide beneficial insights for the development review process.

10.2 PROJECT PHASING AND IMPLEMENTATION RECOMMENDATIONS

Although there is currently residual capacity within the Angus Water system's current PTTW for approximately **568 units** of new development, the initial phase of development in Angus will be constrained by the requirement for water servicing. Wastewater servicing will also constrain development prior to Ultimate Build-Out of Angus beyond a threshold of **858 units**.

10.2.1 Wastewater Project Phasing

Expansion of the WWTP as per **Option WWT-2** must occur prior to development of new units beyond the existing capacity (beyond 858 units) within the study area, and will require the completion of a Schedule 'C' Class EA. An assimilative capacity study will also need to be completed as part of this process. It is recommended to initiate the assimilative capacity study and Schedule 'C' Class EA upon completion of this IMP to ensure that expansion of the existing WWTP will be complete once the existing WWTP reaches 80% to ensure there will be no delay or freeze on development within Angus. The need for a Schedule 'B' Class EA for the currently anticipated SPS#1 upgrades and other sewage collection infrastructure upgrades required for the existing community should be confirmed following completion of the Schedule 'C' Class EA. We expect that the SPS upgrades will likely be driven by capacity exceedances associated with upstream development applications.

The WWTP expansion should be designed to provide adequate treatment of the surface water discharge for the full buildout (25 year horizon) of Angus, with detailed technology and phasing recommendations determined through the Schedule 'C' Process. WWTP phasing should also have consideration for the Phasing of water supply expansion (see **Section 10.2.2**) and account for oversizing of certain elements in the initial Phases (i.e. headworks) or consider the use of modular system components to facilitate expansions in later phases.

The existing surface water outfall will also need to be considered through the Schedule 'C' Class EA, i.e. verifying effluent capacity both from a mechanical perspective and environmentally via the required assimilative capacity assessment.

Conveyance requirements were assessed based on the preferred WWTP option and modeling results. On this basis it was determined that the available options were to either upgrade the sewers with insufficient capacity, or do nothing. As the do-nothing option would not meet the requirements of the project problem statement, our recommendation is to proceed with upgrades on an as needed basis, with detailed assessment and design for specific areas being determined by land development requirements. The conveyance requirements are summarized below in **Table 10-4** and **Figure 10-1**.

Table 10-4 Sanitary Collection System Projects

	Project Type	Location	Project	Required Agency Approvals
Area 1	Linear Upgrades	Centre St	155m pipe replacement	Sanitary CLI-ECA[1]
	Linear Upgrades	Centre St	585m pipe replacement	Sanitary CLI-ECA[1]
Area 2	Linear Upgrades	North Water Street	140m lowering pipe + replacement	Sanitary CLI-ECA[1]
	SPS Upgrade	SPS 1	Increase Pump Capacity	Schedule 'B' Class EA required.

[1] A single consolidated linear infrastructure environmental compliance approval (CLI-ECA) is required for all Angus sanitary collection system linear infrastructure projects

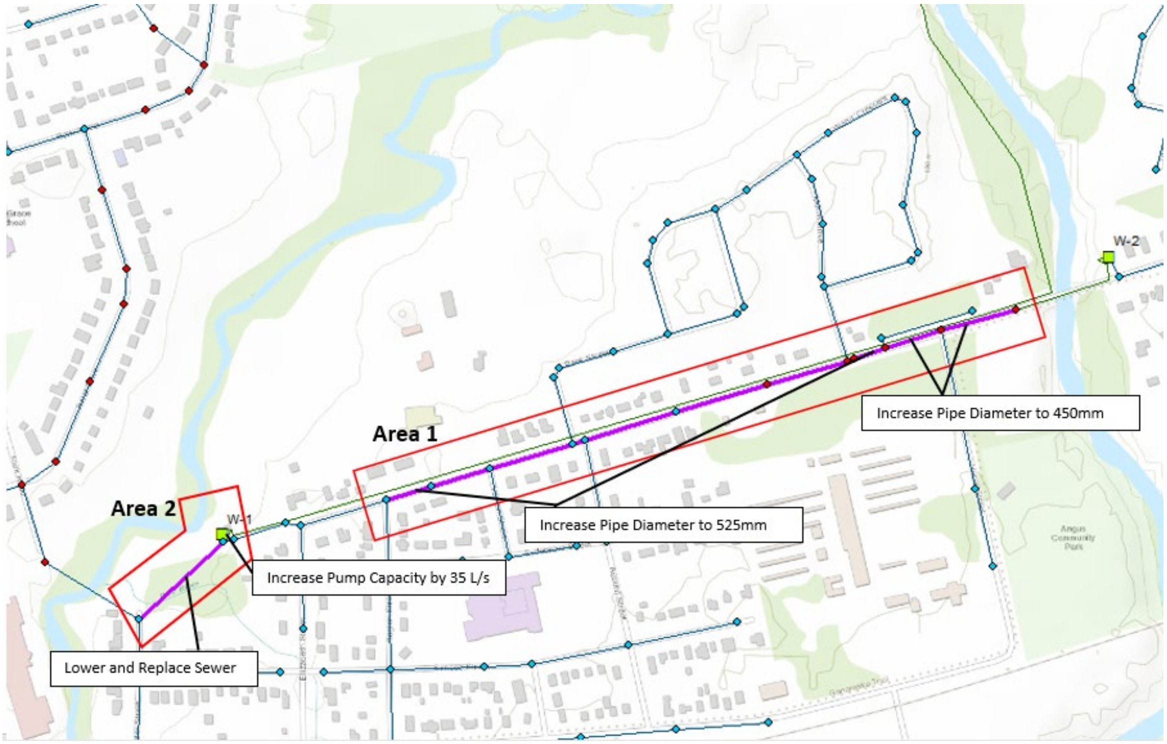

Figure 10-1 Wastewater Collection System Proposed Upgrades

10.2.2 Water Servicing Project Phasing

There is a residual water supply capacity of 1,572 m^3/d in Angus based on the currently approved PTTW. This equates to capacity for approximately **568 units** based on the population density of 3 persons per unit and per capita flow rate of 450 L/c/d for all future development outlined in **Section 4.1.1**.

It is recommended that baseline hydrogeologic study including collection of monitoring data upon completion of this IMP, to confirm ability to increase water-taking to current maximum PTTW capacity of the existing wells in the short-term (a capacity increase of 951 m^3/d). This monitoring data will serve as supporting documentation for an expanded PTTW and the Township may wish to complete this monitoring and near-term increase in advance of the current PTTW expiry date of December 31, 2022. The hydrogeological study should also assess the ability to increase the capacity of the existing wells, per **Option W-2** to service ultimate build-out of Angus (25-year horizon). Based on the results of the hydrogeological study, and addendum to this Schedule 'B' Class EA may be required to confirm the preferred Option and address requirements of the project. Please see **Section 10.4** for additional details on the proposed Mitigation requirements for this Option. In addition, supply capacity expansion was assumed to also include requirements for a correlated level of treatment capacity expansion, the specific requirements of which (i.e. Chlorine contact time) will need to be confirmed at the detailed design stage following successful completion of the hydrogeological studies required to support supply expansion.

Subsurface, at-grade or elevated water storage and fire protection should be constructed in accordance with **Option WS-4**, with phasing considerations (i.e. storage cell expansion, new storage facilities, pump sizing etc.) to be carried out during the detailed design stage. A Class EA addendum to this report which meets Schedule 'B' requirements will be required prior to project implementation and should confirm siting, storage types and other pertinent details for this servicing strategy. Depending on the results of the hydrogeological study, it may be more time and cost-effective to complete the addendum for both water storage and water supply as a single update to this IMP. Completing these exercises in tandem may also result in additional efficiencies for design and construction.

10.2.3 Road Maintenance Project Phasing

The proposed road maintenance program has been determined through StreetScan's Streetlogix software. The maximum forecast horizon in the software is 10 years. Thus a 10-year program to address all road maintenance required to achieve an average PCI of 85 (excellent condition) has been applied for the purposes of this IMP. A baseline value of maintenance beyond this horizon has been estimated for years 11-25 of this IMP growth horizon. The Streetlogix software should be updated annually with the updated road PCIs as maintenance projects are completed to ensure that the budget forecast estimate remains accurate.

10.2.4 Stormwater Management Project Phasing

In order to identify specific stormwater management improvement projects, a comprehensive stormwater management master plan is recommended. This will involve building on the hydrologic modelling completed for this IMP through the completion of detailed hydraulic modelling of the multiple watercourses and road/storm sewer/ditch networks (major and minor systems) in Angus to identify constraints in the systems and areas with flood inundation/flood damage potential. Upon completion of the model development, SWM master servicing solutions should be developed and integrated into the master planning documentation.

10.3 PRELIMINARY PREFERRED SERVICING OPTION PROJECT CAPITAL COSTS

Wastewater projects associated with the preferred sanitary solution **(Option WWT-2)** will generally include the re-construction of trunk sewers along Centre St, downstream of SPS #2 (Area 1, between SPS #2 and Raglan St.) and north of Water Street, upstream of SPS #1 (Area 2). SPS #1 will also require upgrades to the existing pump capacity prior to ultimate build-out of Angus. The preferred wastewater solution will also include the design and construction of an expansion to the existing Wastewater Treatment Plant (WWTP), in accordance with the findings of the Schedule 'C' Class EA process to be completed in support of this solution. **Table 10-5** presents the anticipated Opinion of Probable Capital Costs (OPC) for each project associated with the preliminary preferred master wastewater servicing solution. Preliminary studies required for **Option WWT-2** have been included in the capital cost estimates.

Table 10-5: Opinion of Probable Capital Costs – Wastewater Projects

Project Description	Opinion of Probable Capital Cost
Expand Existing Wastewater Treatment Plant (incl. assimilative capacity study, Schedule 'C' EA)	$9- 12 Million
Area 1 Sanitary Collection Upgrades	$2 Million (Development Driven)
Area 2 Sanitary Collection Upgrades (including SPS pump capacity increase)	$4 Million (Development Driven)

Infrastructure projects associated with the preferred water servicing solution **(Option W-2** and **Option WS-4)** will generally include increasing the capacity of Angus' existing wells and constructing an in-ground, elevated or at-grade storage system (approximate capacity of 4,200 m^3 for 25-year buildout) complete with booster pumping capacity and backup power (as necessary). Fire protection (hydrants) should also be installed throughout the community.

Table 10-6 summarizes the anticipated OPC for each project associated with the preferred master water servicing solution. Preliminary studies (hydrogeological investigation, Class EA) have been included within the proposed capital costs.

Table 10-6: Opinion of Probable Capital Costs – Water Projects

Project Description	Opinion of Probable Capital Cost
Increase Capacity of Existing Angus Wells at Current Locations (incl. hydrogeological studies, pump tests)	$4 Million
Water Storage at Three (3) Locations (Assumes Booster Pumping required to achieve modeled TDH) (incl. Schedule 'B' Addendum)	$9 - 11 Million
Expand Existing Water Distribution Network for New Development Areas	$5 Million (Development Driven)

Table 10-7 summarizes the anticipated OPC for road maintenance projects over the 25-year growth horizon, as determined in the Streetlogix software.

Table 10-7 Opinion of Probable Capital Costs – Road Maintenance

Project Description	Opinion of Probable Capital Cost
Road Maintenance – Years 1-10 (from Streetlogix software)	$ 4 Million
Road Maintenance – Years 11-25 (Assumed cost)	$ 3 Million

Table 10-8 summarizes the anticipated OPC for a comprehensive stormwater management master plan. Capital costs associated with individual stormwater management projects would be determined as part of this Master Plan process.

Table 10-8 Opinion of Probable Costs - Stormwater Management Projects

Project Description	Opinion of Probable Capital Cost
Comprehensive Stormwater Management Master Plan & Detailed Hydraulic Systems Modeling	$200,000

Please Note that Opinions of Probable Capital Cost presented herein include design, approvals (including additional Phases of the Class EA process), additional background studies and/or monitoring programs. However, costs associated with land acquisition (if required) or legal fees are not included.

10.4 ASSET MANAGEMENT COSTS

In addition to the proposed costs for infrastructure upgrades to meet servicing demand of the proposed ultimate conditions population in Angus outlined above, on-going lifecycle costs for existing infrastructure must be budgeted to ensure continued levels of service. Asset management costs (25-year) were recently prepared from asset inventories for water, wastewater and stormwater infrastructure completed by others on behalf of Essa Township. **Table 10-9** summarizes the proposed asset management costs for the next 25-years.

Table 10-9 Asset Management Capital Costs

Replacement Timeline	Sanitary Costs	Water Costs	SWM Costs	Total
Backlog	$ 11,614,619.00	$ 1,283,412.00	$ 1,160,000.00	$ 14,058,031.00
0-5 years	$ 1,589,831.00	$ 1,003,614.00	$ -	$ 2,593,445.00
6-10 years	$ 2,146,881.00	$ 1,375,810.00	$ -	$ 3,522,691.00
11-25 years	$ 13,366,906.00	$ 4,002,423.00	$ 1,427,677.00	$ 18,797,006.00
Total	$ 28,718,237.00	$ 7,665,259.00	$ 2,587,677.00	$ 38,971,173.00

Note: The replacement timeline is based on the estimated useful life (EUL) of infrastructure elements in Angus, and does not represent actual conditions of existing infrastructure. The backlog represents all infrastructure that has exceed its EUL by 2022 and has not yet been replaced.

It is recommended that condition assessments be completed for major infrastructure that is nearing or has exceeded its EUL to confirm the estimated backlog and on-going costs for capital budgeting purposes. These assessments could be completed as a precursor to detailed design and/or additional studies associated with preferred water and wastewater infrastructure solutions outlined in the previous sections (i.e. the WWTP Schedule 'C' process) in order to identify servicing efficiencies.

For example, infrastructure that is nearing the end of its EUL but requires upgrades in order to meet proposed servicing demands may present an opportunity to eliminate the need for existing infrastructure to be replaced (i.e. install new services for future instead of replacements to service existing), therefore reducing asset management financial burdens while also providing required services to facilitate new development.

10.5 PROJECT MITIGATION AND MONITORING

Mitigation of potential impacts and monitoring the effectiveness of mitigation measures during and following implementation is a critical step of any Class EA Process. The following subsections provide recommendations for mitigation strategies pertaining to both near and long-term impacts, as well as associated recommendations for environmental monitoring.

The environmental impacts of the Recommended Preferred Servicing Strategies can be minimized through implementation of a mitigation and monitoring strategy. For example, the water storage should be constructed outside of environmental protection zones, in an area which is currently undeveloped but minimizes removal of existing vegetation. Routine inspections during construction phases of all projects associated with the preferred Master Plan Solution will need to be carried out to ensure adherence to design specifications.

10.5.1 Water Project Impacts, Mitigation and Monitoring

One of the main implementation considerations for water projects is the development and execution of a detailed hydrogeological investigation to allow for proper collection of monitoring data to confirm capacity and support expansion of the Township's current PTTW for Angus in accordance with the recommended preferred water supply solution (**Option W-2**).

A summary of potential impacts and proposed mitigation strategies associated with the preferred water servicing solutions is provided in **Table 10-10**.

Table 10-10: Water Supply, Distribution and Storage Project Impacts and Mitigation

Potential Impact	Mitigation Strategy
Traffic and Interruption to Local Residents	• Affected property owners will be notified in advanced as to construction schedule and duration. • Consultation with MTO, the County of Simcoe, local utilities, local school boards and the Township may be required during construction period. • Proposed solution minimizes impacts by limiting work to existing municipal properties/sites as much as feasible.
Dust, Noise and Vibration	• Construction operations will be restricted to the day time period; in addition, the contractor will be required to meet local noise by-laws. • Dust control will be implemented throughout construction.
Visual Impact	• The locations and types of expanded storage will be finalized in the Schedule 'B' addendum, and will consider minimizing visual impacts.
Sediment and Erosion Control	• Sedimentation and erosion control strategies will be developed for each individual site prior to construction.
Removal of Vegetation	• Recommended solution minimizes vegetation/tree removal by utilizing previously disturbed existing municipal lands as much as possible for the proposed solutions. • Vegetation removal will be considered in the locating of expanded water storage
Aquifer and Aquatic Habitat Monitoring	• Baseline hydrogeological and aquatic ecosystem (as needed) monitoring data should be collected prior to additional development • Monitoring should continue in accordance with recommendations of the initial hydrogeological investigation

10.5.2 Near-Term Impacts and Mitigation Strategies – Wastewater Projects

Potential near term impacts and associated mitigation strategies for the implementation of the preferred wastewater servicing alternative solutions are presented in **Table 10-11**.

Table 10-11: Near Term Impacts and Mitigation Strategies – Wastewater Projects

Potential Impact	Mitigation Strategy
Sediment and Erosion Control	• Sedimentation and erosion control strategies will be developed for each individual project prior to construction. • Erosion and siltation control measures need to be installed along the construction limits of adjacent watercourses/wetlands (including golf course ponds).
Disturbance to Trees and Vegetation	• Recommended Solution minimizes impacts to existing vegetation. • Construction areas to be restored with native species.
Traffic	• Consultation with Ministry of Transportation, County of Simcoe, local utilities and school boards may be required prior to or during construction. • Affected Property Owners will be notified in advance of construction schedule and duration. • Recommended Solution minimizes construction traffic impacts
Infringement on Environmental Protection Areas and Hazard Setbacks	• All gravity sewer and forcemain designs will locate infrastructure within existing municipal ROW's. • Watercourse crossings recommended for completion by trenchless construction method (where applicable)
Temporary Impacts (e.g. dust, noise and vibration)	• Construction activities should be limited to day-light hours to minimize impacts to residents. • Dust and storm water controls to be implemented during construction. • Preferred Servicing Strategies minimize resident disruption by containing majority of works to existing municipal property wherever possible and minimize linear infrastructure upgrade requirements
Implementation and Commissioning	• Tender should allow for adequate warranty and WWTP commissioning • Regular site inspections during construction by qualified environmental and civil engineering site inspectors are recommended. • All work to be completed in accordance with Township Standards

10.5.3 Long-Term Impacts and Mitigation Strategies – Wastewater Projects

Potential long term impacts and associated recommendations for mitigation strategies for the preferred servicing alternative solutions are presented in **Table 10-12**.

Table 10-12: Long Term Impacts and Mitigation Strategies - Wastewater

Potential Impact	Mitigation Strategy
Water Quality and Monitoring of Effluent From WWTP	• Prior to implementation of the Recommended Preferred Option which includes discharge to surface water, a Schedule C Class EA will need to be completed • Proposed WWTP effluent limit is 0.05 mg/L for Phosphorus, limits for other nutrients and potential contaminants should be developed and confirmed as part of the Schedule 'C' Class EA • The ECA for the WWTP will require that effluent quality is monitored and effluent limits and objectives are achieved. An environmental monitoring program should be developed at the detailed design stage
Stormwater Management and Drainage	• If changes to site SWM are determined to be necessary through the Schedule 'C' EA and/or design process, Engineering and Landscape design for WWTP should attempt to match existing drainage patterns and comply with all Township and NVCA Requirements for water quality and quantity control.
Removal of Trees and Vegetation	• Recommended Solution minimizes impacts to existing vegetation. • Restore Construction areas with native species.
Residential Impacts (Noise, Odour and Visual Impacts)	• WWTP Design should complement surrounding community (i.e. design building exteriors to match existing WWTP) • Detailed WWTP Landscape design should include screening (i.e. berms, trees and other plantings). • Detailed WWTP Site Plan design should include adequate buffers and technological solutions for mitigation of noise and odour.
Other Environmental Impacts	• Final design should include a mitigation strategy to protect and enhance the natural heritage system in accordance with the mitigation measures recommended above, and in the Schedule 'C' Class EA

10.5.4 Road Maintenance Projects Impacts, Mitigation and Monitoring

Potential impacts and mitigation strategies for road maintenance projects are summarized below in **Table 10-13**.

Table 10-13 Road Maintenance Project Impacts and Mitigation Strategies

Potential Impact	Mitigation Strategy
Sediment and Erosion Control	• Sedimentation and erosion control strategies will be developed for each individual project prior to construction. • Erosion and siltation control measures need to be installed along the construction limits of adjacent watercourses/wetlands (including golf course ponds).
Disturbance to Trees and Vegetation	• Recommended projects are within existing ROWs, limiting vegetation disturbance. • Construction areas to be restored with native species.
Traffic	• Consultation with Ministry of Transportation, County of Simcoe, local utilities and school boards may be required prior to or during construction. • Public will be notified in advance of construction schedule and duration. • Consideration at design process should be given to required sanitary sewer upgrades and projects combined where possible both to minimize impacts to residents and for potential financial efficiencies.
Stormwater Management and Drainage	• Engineering and Landscape design for reconstruction projects should attempt to match existing drainage patterns and comply with all Township and NVCA Requirements for water quality and quantity control.
Temporary Impacts (e.g. dust, noise and vibration)	• Construction activities should be limited to day-light hours to minimize impacts to residents. • Dust and storm water controls to be implemented during construction.

11.0 CLOSURE

Based on the foregoing information, Greenland recommends that the preferred master wastewater servicing strategy for Angus should be **Option WWT-2: Expand the Existing Wastewater Treatment Plant**.

Furthermore, Greenland recommends that the preferred master water servicing strategy for the Community of Angus should consist of **Option W-2: Increasing the Current PTTW and Well Capacity to Supply Ultimate Demand** and **Option WS-4: Construction of Water Storage at Three (3) Locations**.

These projects should proceed to the next Phases of the Class EA process, including implementation, in accordance with the recommendations presented in this IMP Report and appended supporting documentation.

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