Master Plan Report

Town of Arnprior Water & Wastewater Master Plan Update

November 15, 2024

Prepared for:
Town of Arnprior

Prepared by:
Stantec Consulting Ltd.

Project Number:
163401723

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Prepared by ______________________
(signature)
Christène Razafimaharo, P.Eng.

Reviewed by Telmosse, Marc Digitally signed by Telmosse, Marc Date: 2024.12.16 08:22:01 -05'00'
(signature)

Marc Telmosse, P.Eng.

Prepared by ______________________
(signature)
Chuyi Zheng, EIT

Reviewed by ______________________
(signature)

Jasmin Sidhu, P.Eng.

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Executive Summary

The Town of Arnprior retained Stantec Consulting Ltd (Stantec) to update its Water and Wastewater Master Plan (W&WWMP) (Stantec, 2013), to better understand its existing systems conditions and to assess its ability to service future growth areas. This W&WWMP update involves a comprehensive review and assessment of the Town's sanitary sewer collection and potable water distribution systems. The W&WWMP update also includes a review of the existing municipal drinking water and wastewater treatment facilities with goals of understanding current system capacity constraints and of developing a timeline that identifies future expansion requirements to meet anticipated growth requirements over a 5-year (2027), 10-year (2032) and 20-year (2042) planning horizon.

This Master Plan was conducted in accordance with the requirements of the Environmental Assessment (EA) Act, as outlined in the Ontario Municipal Engineers Association (MEA) Municipal Class Environmental Assessment (MCEA) document (October 2000 as amended in 2007, 2011, 2015 and 2023). Consultation was conducted from the onset of and throughout the Master Planning process, as required by the MCEA. The existing social and economic environment, as well as the potable water system and wastewater collection network are studied. Extensions and upgrades to the existing municipal potable water and wastewater infrastructure systems will be required to service the needs of existing users and future development lands.

Class D opinions of probable costs (OPC) and timelines were developed for projects which will be undertaken by the Town and funded by the Town and/or through development charges. The OPC consist of construction costs, capital costs & risk components (35% of construction costs), and contingency (40% of construction + capital costs & risk components). Project timelines were established, considering the concurrent implementation of water and wastewater infrastructure projects, and aligns them with the Town's other planned capital projects (e.g., road rehabilitation), where feasible. The impact of climate change on the proposed upgrades was also assessed.

Executive Summary Table 1 presents the OPC for the infrastructure projects, based on baseline growth projections, as well as the additional costs to increase resilience to climate change.

Planning and operational measures can be undertaken to address the impacts of climate change, such that the recommended infrastructure upgrades could be deferred, or their sizing reduced. The required sizing should be reviewed in future planning endeavours and as the projects advance through design stages, considering the effectiveness of additional activities undertaken by the Town to address the impacts of climate change.

Executive Summary Table 2 presents the OPC for additional studies, planning and operational activities that the Town could undertake.

Executive Summary Table 1: Summary of Opinion of Probable Cost [1] – Infrastructure Projects, Baseline Growth Projections (2023$)

Project Type	Horizon - Total Site Costs ($)	3-5 Years - Required	3-5 Years - Study Dependent	5-10 Years - Required	5-10 Years - Study Dependent	10-20 Years - Required	10-20 Years - Study Dependent	Additional Total Cost for Increased Climate Change Resilience (2023$)
Wastewater collection system existing gravity sewer upgrades and sewer separations	$17,305,000	$11,340,000	$2,006,000	$3,683,000	$276,000	-	-	+$935,000
Existing sanitary pump stations and forcemain upgrades	$12,096,000	-	-	-	$10,395,000	-	$1,701,000	+$756,000
Existing watermain upgrades and pressure reduction measures	$5,096,000	$151,000	$4,367,000	$578,000	-	-	-	-
Water Filtration Plant (WFP) upgrades	$7,862,000	-	-	$7,862,000	-	-	-	+$3,951,000
Total	**$42,359,000**	**$11,491,000**	**$6,373,000**	**$12,123,000**	**$10,671,000**	**-**	**$1,701,000**	**+$5,642,000**

Notes:

(1) The OPC is inclusive of construction costs, capital costs & risk components (35% of construction costs), and contingency (40% of construction + capital costs & risk components).

Executive Summary Table 2: Summary of Opinion of Probable Cost – Studies & Activities, Opinion of Probable Cost (2023$)

Study/Activity Type	Horizon / Frequency - Total Site Study Costs ($)	Annually	Every 5-10 Years (or as Development Occurs, or per Other Requirements)	3-5 Years	5-10 Years	10-20 Years
Sanitary pump stations monitoring and inflow/infiltration management	$130,000	-	-	$50,000	$80,000	-
Overall wastewater collection network studies & activities	$190,000	$110,000	$80,000	-	-	-
Wastewater Treatment Plant (WWTP) studies and activities	$190,000	$60,000	$30,000	-	$100,000	-
Overall water distribution network studies and activities	$150,000	$100,000	-	-	$50,000	-
WFP studies and activities	$190,000	-	-	-	$190,000	-
Total	**$850,000**	**$270,000**	**$110,000**	**$50,000**	**$420,000**	**-**

This Master Plan also includes the following assessments:

- **Identification of new infrastructure needed to service growth areas**: These constitute local service to development areas, which will be "direct developer responsibility" per the Development Charges Background, hence no OPC was presented for this infrastructure. Nonetheless, preliminary alignments and sizes were identified and documented as part of the overall servicing solution recommended in this Master Plan.
- **Serviceability of outside interests**: The Town has identified two areas outside its municipal boundaries, which could connect to the existing municipal water and wastewater infrastructure. This Master Plan includes a discussion of the systems' capacities to accommodate the demands and flows from these areas. As discussions with outside interests continue and growth within the Town progresses, the capacities in the potable water and wastewater collection infrastructure should be reviewed as part of confirming the serviceability of these new areas, and other new areas identified in the future.

This Master Plan presents a long-term plan for providing potable water and wastewater infrastructure to meet future growth requirements. Nonetheless, growth projections may change over time and aging infrastructure may also affect the systems' performance. Therefore, it is recommended that this Master Plan be reviewed and updated regularly. Per the MCEA document, potential changes which may trigger the need for a review of the Master Plan include:

- Major changes to the assumptions;
- Major changes to the components of the Master Plan;
- Significant new environmental effects; and,
- Major changes in the proposed timing of projects.

1 Introduction

1.1 Background

Stantec Consulting Ltd (Stantec) was retained by the Town of Arnprior (the Town) to update its Water and Wastewater Master Plan (W&WWMP) (Stantec, 2013), to better understand its existing systems conditions and to assess its ability to service future growth areas. This W&WWMP update involves a comprehensive review and assessment of the Town's sanitary sewer collection and potable water distribution systems. The W&WWMP update also includes a review of the existing municipal drinking water and wastewater treatment facilities with goals of understanding current system capacity constraints and of developing a timeline that identifies future expansion requirements to meet anticipated growth requirements over a 5-year, 10-year and 20-year planning horizon.

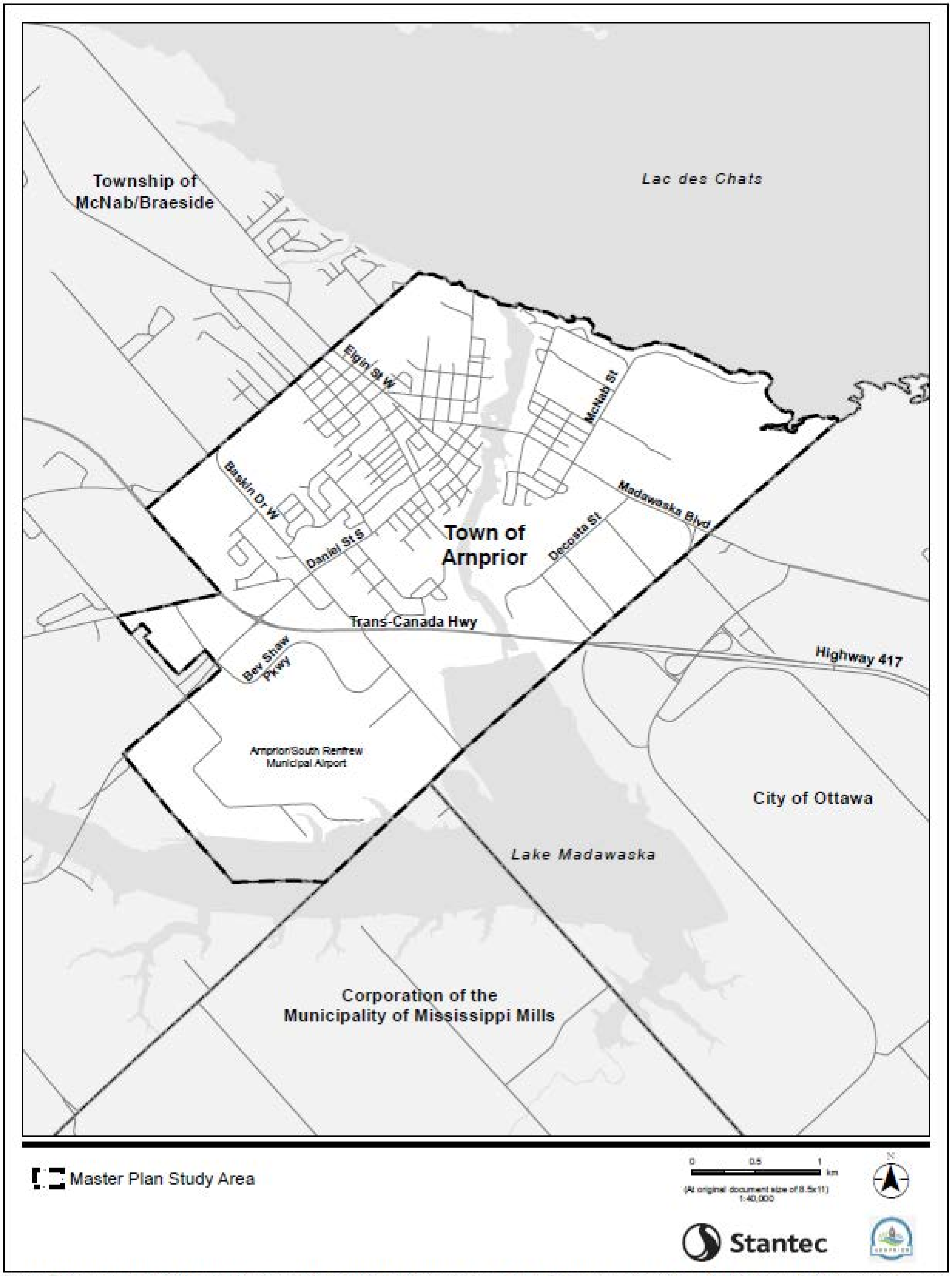
1.2 Study Area

The Town of Arnprior is situated in the Renfrew County, west of the City of Ottawa, accessible via Highway 17. Based on the Statistics Canada 2021 Census (last revised in September 2023), the Town had a population of 9,629 and occupied an area of 13.04 km^2. The Town's population has experienced an increase of 9.5% from the 2021 population.

The Madawaska River runs through the center of the Town and serves as the source of water for the municipal drinking water system, and discharges into the Ottawa River, which is the receiving stream for treated sewage effluent. **Figure 1-1** shows the study area of the Town of Arnprior.

1.3 Problem & Opportunity Statement

Water and wastewater servicing solutions will be required to meet the needs of existing users and future development lands. The first step of the W&WWMP is to gain an understanding of how the existing water and wastewater systems operate, and to determine the opportunities and constraints in the systems under existing and future (growth) conditions.



Disclaimer: This document has been prepared based on information provided by others as cited in the Notes section. Stantec has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result. Stantec assumes no responsibility for data supplied in electronic format, and the recipient accepts full responsibility for verifying the accuracy and completeness of the data.

Figure 1-1: Study Area

2 Environmental Assessment Master Planning Process

The following sections describes the Municipal Class Environmental Assessment, and how the Master Plan process is conducted in accordance with its requirements.

2.1 Overview

All municipalities in Ontario are subject to the provisions of the Environmental Assessment Act (EA Act) and its requirements to prepare an Environmental Assessment (EA) for applicable public works projects. The Ontario Municipal Engineers Association (MEA) Municipal Class Environmental Assessment (MCEA) document (October 2000 as amended in 2007, 2011, 2015 and 2023) provides municipalities with a five-phase planning process approved under the EA Act to plan and undertake all municipal infrastructure projects, including works associated with water supply and storage, in a manner that protects the environment as defined in the Act.

Key components of the EA planning process include:

- Consultation with potentially interested parties early and throughout the process;
- Consideration for a reasonable range of alternative solutions;
- Consideration of effects on the environment and ways to avoid/reduce impacts (mitigation);
- Systematic evaluation of alternatives;
- Clear and transparent documentation; and
- Traceable decision-making.

The MCEA provides a consistent method of identifying and assessing technical and environmental impacts and concerns before improvements or additions to municipal infrastructure are undertaken. Planning in this way provides reassurance that potential impacts from all municipal projects are addressed and mitigated, prior to implementation.

2.1.1 Types of Projects

The MCEA Document provides a framework by which projects are classified as exempt, eligible for screening, Schedule B, or Schedule C. Classification of a project is based on a variety of factors including the general complexity of the project and level of investigation required, and the potential impacts on the environment that may occur. It is the responsibility of the proponent to identify the appropriate schedule for a given project, and to review the applicability of the chosen schedule at various stages throughout the project. Each of the schedules require a different level of documentation and review to satisfy the requirements of the EA, and thus comply with the EA Act as noted below.

Exempt projects (formerly classified as Schedule A and A+ projects) are minor operational and/or maintenance activities, which are limited in scale, have minimal adverse impacts on the environment. These projects are exempt from the requirements of the EA Act and may be implemented without following the procedures outlined in the EA planning process or undertaking public consultation. Examples of Exempt projects include watermain and sewer extensions where all such facilities are located within the municipal road allowance or an existing utility corridor.

Eligible for Screening to Exempt projects may be eligible for exemption, based on the outcome of a screening process to determine whether the project is eligible for exemption from the EA Act. The relevant screening processes to follow are outlined in the MCEA Document Appendix 1. The screening process must be fully and accurately complete for a project to proceed with an exemption. The projects would otherwise be required to undergo the process to meet the requirements of Schedule B or Schedule C projects. Examples of Eligible for Screening to Exempt projects include repairs or replacement of an existing water treatment plant intake in the same location, increases in pumping station capacity in a new building within the existing pumping station site, or constructing new pumping stations or storage facilities where the facilities are not located in or adjacent to an environmentally sensitive natural area, residential or other sensitive land use.

Schedule B projects have the potential for some adverse environmental and social effects. The proponent is required to undertake a screening process involving mandatory contact with potentially affected members of the public, Indigenous communities, and relevant review agencies so that they are aware of the project and that their concerns are addressed. Schedule B projects require that Phases 1 and 2 of the EA planning process be followed, and a Project File be prepared and submitted for a mandatory 30-day review by the public, agencies, and Indigenous communities. If all comments or concerns received within this 30-day review period can be addressed, the proponent may proceed to project implementation (Phase 5). Schedule B projects generally include improvements and minor expansion to existing facilities or smaller new projects.

Schedule C projects have the potential for significant environmental impacts and must follow the full planning and documentation procedures specified in the MCEA document (Phase 1 to 4). An Environmental Study Report (ESR) must be prepared and filed for review by the public, review agencies and Indigenous communities. If concerns are raised that cannot be resolved, then the Part II Order procedure may be invoked. Projects generally include the construction of new facilities and major expansions to existing facilities.

The schedule in which a project applies determines the planning and design phases that must be followed. The five phases are as follows:

- Phase 1: Identification of problem or opportunity;
- Phase 2: Identification of alternative solutions;
- Phase 3: Definition of alternative methods to implement the preferred solution;
- Phase 4: Publication of an Environmental Study Report; and
- Phase 5: Implementation of the solution.

Consultation is a key element of EA planning and is required during different phases to ensure public participation. **Figure 2-1** summarizes the different schedules and phases of the Class EA process, provides details on the activities within each phase of the process.

2.1.2 Scope of Water & Wastewater Master Plan

This study considers the capacity of the existing water distribution and wastewater collection systems and other proposed improvements needed to accommodate the growth projections and associated development outlined in the Official Plan. The Master Plan provides a framework by which future infrastructure requirements can be addressed. The Municipal Class EA process identifies four approaches to the Master Planning process. The document recommends that the proponent adapts and tailors the details of the approach to best suit their needs as long as the approach is in keeping with the requirements and intent of the Class EA process.

As per the framework provided in the Class EA document, the Town of Arnprior Water & Wastewater Master Plan was initiated and conducted in accordance with Approach #1 of the Master Planning Process, involving analyses on a system scale, to enable the Town to identify needs and establish broader infrastructure alternatives and solutions.

This study therefore addresses Phases 1 and 2 of the EA process. Phase 1 of the Class EA process identifies the problems or opportunities in the system. Phase 2 identifies the alternative solutions to address the problems and establish the preferred solution. Specific projects required to achieve the preferred solution described in the Master Plan may be identified, however more detailed investigations at the project-specific level are required to fulfil the MCEA requirements for specific Schedule B and C projects identified within the Master Plan.

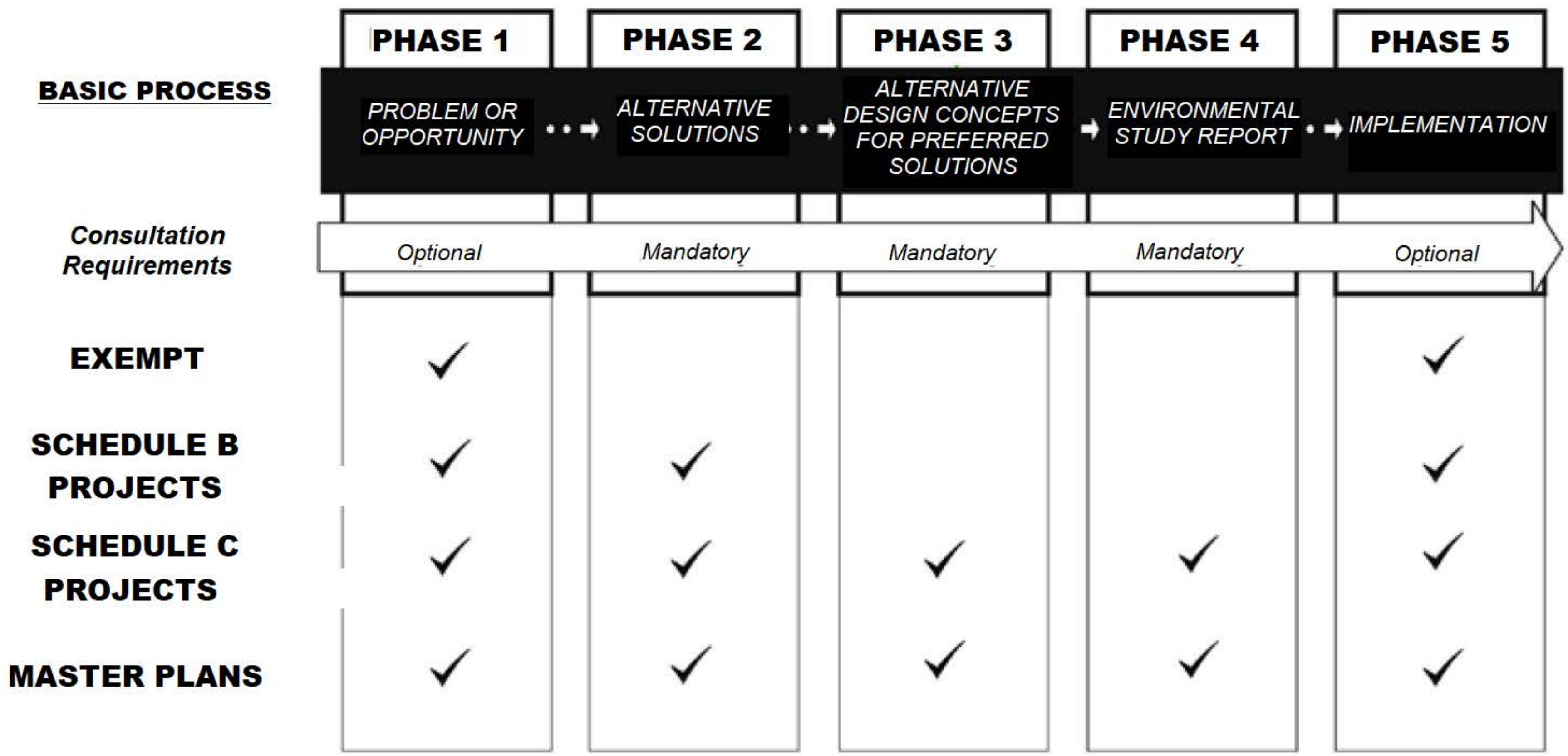


Figure 2-1: Summary of the Municipal Class EA Process
(Source: Adapted from Municipal Engineers Association, 2023)

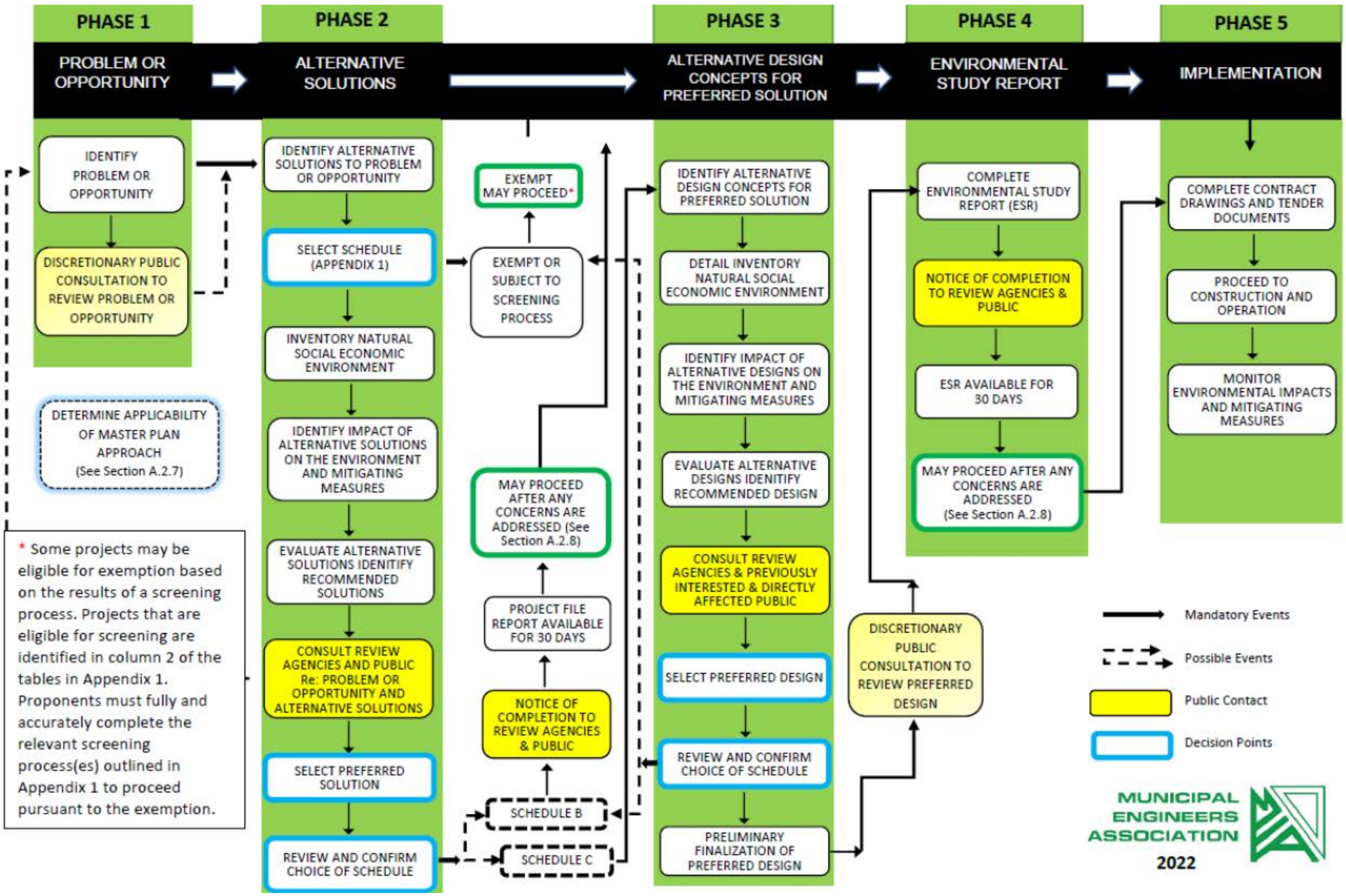


Figure 2-2: Municipal Class EA Planning and Design Process (Source: Municipal Engineers Association, 2023)

2.2 Consultation & Communication

Consultation from the onset of and throughout the process is a key component of the EA planning process. An effective consultation program can foster meaningful dialogue between the project planners and stakeholders, allowing an exchange of ideas and broadening of the information base for better decision-making.

2.2.1 Stakeholder Contact List

A comprehensive study contact list consisting of government agencies, Town staff, utilities, emergency service providers, Indigenous Nations, Indigenous Organizations, local organizations and special interest groups and members of the public who expressed interest in the study was developed at the onset of the study. This list was updated as the study progressed. The latest version of this contact list is provided in **Appendix G.1**.

2.2.2 Town of Arnprior Project Website

The Town of Arnprior Project Website (https://renfrew-county.civilspace.io/en/projects/water-and-wastewater-master-plan) is a central location to provide information on the project and its timeline. Interested members of the public can sign up to receive notifications on project updates. Project material are available for the public to view and provide feedback.

2.2.3 Notice of Study Commencement

The purpose of the Notice of Study Commencement was to inform the public and external agencies about the study and to seek initial input in relation to the study. The notice briefly outlined the objective of the study, the Class EA process, study area location map and contact information for project team representatives.

The Notice of Study Commencement was communicated as follows:

- On the Town's website: https://www.arnprior.ca/en/news/notice-of-study-commencement-water-and-wastewater-master-plan.aspx
- Via email to the contact mailing list.

A copy of this notice is provided in **Appendix G.2** of this document.

2.2.4 Notice of Public Information Centre (PIC)

The purpose of the Notice of Public Information Centre (PIC) was to announce the date and location of the PIC. The notice briefly outlined the objective of the study, the Class EA process, study area location map and contact information for project team representatives. The Notice of PIC for this study was posted on the Town's website on February 9th, 2024 and emailed to all contacts in the Contact List. A copy of this notice is provided in **Appendix G.3** of this document.

2.2.5 PIC

An in-person PIC was held on February 28th, 2024 at the Nick Smith Center (77 James St, Arnprior). Poster boards presenting the objective of the study, the Class EA process and the W&WWMP's servicing alternatives and recommendations were presented. A copy of the boards are provided in **Appendix G.3** of this document.

Attendees were able to provide feedback and ask questions to the Town and Stantec representatives. Further information on the PIC and on the feedback and questions received is presented in the PIC Summary Report provided in **Appendix G.3** of this document.

Approximately 10 people attended the PIC and one (1) written comment was provided. The verbal comments received from attendees and any communication via project email were received up to February 28, 2024 are summarized below.

- Local land developers attended the PIC and asked questions about the Town of Arnprior's W&WW MP capacity to service the proposed developments.
    - Project representatives explained that upgrades identified in the W&WW MP place the Town in good shape to accommodate the 20-year growth projections for the Town. When asked about specific sites, it was explained that no major issues have been found in the development of the W&WW MP that relate to those land development sites specifically.
- Written comment conveyed their thanks for the invitation and indicated it was very informative, easy to follow the different options and they believed the proposed plan 'is a good one'. They appreciated the Project Team's efforts in taking good care of the Town.

2.2.6 Agency Consultation

The following agencies provided comments in response to the Notices of Commencement and PIC.

- Ministry of Environment, Conservation and Parks (Received March 13, 2024):
  - Indicated contact list should include:
    - Algonquins of Ontario (AOO)
    - Algonquins of Pikwàkanagàn First Nation
    - Alderville First Nation
    - Curve Lake First Nation
    - Hiawatha First Nation
    - Mississaugas of Scugog Island First Nation
    - Williams Treaties communities, cc. Karry Sandy McKenzie, William Treaties First Nations Process Co-ordinator at inquiries@williamstreatiesfirstnations.ca
    - Kawartha Nishnawbe
    - Kitigan Zibi Anishnabeg First Nation
    - If archeological studies are undertaken, include: Huron-Wendat
- Ministry of Citizenship and Multiculturalism (Received April 27, 2022):
  - Description of the existing conditions related to cultural heritage resources need to be included in the MP.
  - Existing Conditions subsection of the MP to include a historical summary of the study area's development, identifying all known or potential built heritage resources and cultural heritage landscapes.
    - As projects proceed through the Class EA process, heritage resources and landscapes will be identified.

- o Community and Indigenous input should be sought to identify locally recognized and potential cultural heritage resources.
- o Advise MHSTCI whether any technical cultural heritage studies will be completed for the MP, provided to MHSTCI before issuing the Notice of Completion.
  - No technical studies were completed as part of this study.

2.2.7 Indigenous Consultation

Invitations to consult were sent to Indigenous Nations along with the Notice of Commencement, PIC and Notice of Master Plan.

As a result of the MECP letter being issued after the PIC Notice, a follow up letter was issued to the Indigenous Nations that were not previously contacted to inform them of the Project and invite them to submit any comments.

No responses were received.

2.2.8 Draft Master Plan Report

The Draft Master Plan Report was submitted to the Town staff for comments before a Final Draft is prepared and provided to Town Council.

2.2.9 Notice of Study Completion / Final Master Plan Report

The Notice of Study Completion will be published on the project website when the Master Plan report is made available for public review. The Notice will also be distributed via mail and email to agencies, key stakeholders, Indigenous Nations and the public on the study mailing list. This notice will briefly outline the Recommended Solutions and note the Master Plan will be posted to the project website for a 30-day public review period. Comments received throughout the 30-day review period will be addressed and records from the 30-day review period will be included in the Environmental Study Report (ESR).

Those who wish to review the Master Plan report will be encouraged to do so and submit comments to the project contacts provided by a specified date.

3 Existing Conditions

This section provides an overview of the existing natural, social & economic environments of the Town of Arnprior. The existing water and wastewater infrastructure assessed in this W&WWMP is also introduced.

3.1 Natural Environment

The Town boasts a significant amount of aquatic natural environment features including Lake Madawaska, the Madawaska River, which bisects the Town, and the Ottawa River. The Nopiming Crown Game Preserve, the Nopiming Provincially Significant Wetland occur in the northeast portion of the Town and Significant Woodlands are found in the northwest quadrant of the Town. Several smaller features (e.g., creeks, unevaluated wetlands, floodplains and wooded areas) occur throughout the town in both undeveloped and developed and are also considered as potential constraints to development. The total area of land bounded by the Town is 13.04 square kilometres (km^2).

The Madawaska River is 230 km long and drains an approximate area of 8,740 km^2. At its source, Source Lake in Algonquin Park, to its confluence with the Ottawa River at Arnprior, the Madawaska River drops 224 metres.

As the development of sewage pumping stations are usually proposed in low-lying areas to incorporate the use of gravity-fed sewer systems, the identification of floodplains are important to this Plan. Development within floodplains requires additional environmental surveys, mitigation measures and potentially permitting considerations.

Also of importance is the possibility of high groundwater tables throughout the Town given the proximity to large aquatic features. High groundwater has the potential to impact proposed infrastructure such as gravity-fed sewer systems. The design of future gravity-fed systems must consider the impact of high groundwater and to avoid them, if feasible. Alternative sewer technologies such as pressure of vacuum-based systems might be considered if areas are deemed to be prone to high groundwater conditions.

3.1.1 Desktop Background Review

A background desktop review was conducted by searching the Natural Heritage Information Centre (NHIC; NDMNRF 2022) for species at risk (SAR), wildlife concentration areas, and natural heritage areas. Data records provided by the NHIC are at a 1 x 1 km scale and grid squares that overlap with the Town were searched. The Aquatic Species at Risk map (DFO 2022) was searched for records of aquatic SAR and/or SAR habitat within aquatic features (e.g., Lake Madawaska, Madawaska River, Ottawa River).

As part of the public and government review process, the *Town of Arnprior Water and Wastewater Master Plan* (the Plan) was submitted on June 14, 2013 (Stantec 2013) to the Ministry of Natural Resources (now the Ministry of Natural Resources, and Forestry (MNRF). In response to the Plan, the MNRF provided a list of potential SAR to be considered during the Town's review of the Plan. The SAR identified with potential habitat within the Town are included in this desktop background review. A detailed site investigation is recommended once the Plan is finalized to assess areas with potential SAR habitat (i.e., determine permitting requirements under the ESA/SARA and mitigation measures) and natural heritage features.

At least two Restricted Species were identified during the 2022 desktop review of NHIC records. Restricted Species listed by the NHIC are typically sensitive species that are subject to the illegal trade market (e.g., American Ginseng (*Panax quinquefolius*), Spotted Turtle (*Clemmys guttata*). An information request to the Ministry of Environment, Conservation and Parks (MECP) to provide information on the Restricted Species may be required as part of the planning process.

For this report, SAR are species designated as endangered, threatened, or special concern under the provincial *Endangered Species Act, 2007* (ESA) or federal *Species at Risk Act, 2002* (SARA). **Table 3-1** lists SAR with records within the Town.

Table 3-1: Species at Risk with the Potential to Occur within the Town of Arnprior

Species Type	Common Name	Scientific Name	ESA	SARA, Schedule 1
Herptiles	Blanding's Turtle[1,2]	*Emydoidea blandingii*	Threatened	Endangered
	Midland Painted Turtle[1]	*Chrysemys picta marginata*	Not Listed	Special Concern
	Northern Map Turtle[1,2]	*Graptemys geographica*	Special Concern	Special Concern
	Snapping Turtle[2]	*Chelydra serpentina*	Special Concern	Special Concern
	Eastern Milksnake[1,2]	*Lampropeltis triangulum*	Not Listed	Special Concern
	Western Chorus Frog (Great Lakes – St. Lawrence – Canadian Shield population)[1,2]	*Pseudacris triseriata*	Not Listed	Threatened
Birds	Barn Swallow[2]	*Hirundo rustica*	Threatened	Threatened
	Bobolink[1,2]	*Dolichonyx oryzivorus*	Threatened	Threatened
	Chimney Swift[1,2]	*Chaetura pelagica*	Threatened	Threatened
	Eastern Meadowlark[1,2]	*Sturnella magna*	Threatened	Threatened
	Eastern Wood-pewee[1]	*Contopus virens*	Special Concern	Special Concern
	Loggerhead Shrike[1,2]	*Lanius ludovicianus*	Endangered	Endangered

Species Type	Common Name	Scientific Name	ESA	SARA, Schedule 1
Birds	Peregrine Falcon[1]	*Falco peregrinus*	Special Concern	Special Concern
	Short-eared Owl[1,2]	*Asio flammeus*	Special Concern	Special Concern
	Wood Thrush[1]	*Hylocichla mustelina*	Special Concern	Threatened
Insects	Monarch[2]	*Danaus plexippus*	Special Concern	Special Concern
Aquatic	Hickorynut[3]	*Obovaria olivaria*	Endangered	Endangered
	American Eel[1]	*Anguilla rostrata*	Endangered	Not Listed
	Lake Sturgeon (Great Lakes – Upper St. Lawrence River population)[1]	*Acipenser fulvescens*	Endangered	Under consideration for addition
	River Redhorse[3]	*Moxostoma carinatum*	Special Concern	Special Concern
Mammals	Eastern Small-footed Myotis[4]	*Myotis leibii*	Endangered	Not Listed
	Little Brown Myotis[4]	*Myotis lucifugus*	Endangered	Endangered
	Northern Myotis[4]	*Myotis septentrionalis*	Endangered	Endangered
	Tri-colored Bat[4]	*Perimyotis subflavus*	Endangered	Endangered
Plants	Black Ash[1,5]	*Fraxinus nigra*	Endangered	Under consideration for addition
	Butternut[1,2]	*Juglans cinerea*	Endangered	Endangered

Species Type	Common Name	Scientific Name	ESA	SARA, Schedule 1
Restricted Records	Restricted Species[1]	n/a	Endangered	Endangered
	Restricted Species[1]	n/a	n/a	n/a

Notes:

[1] NHIC desktop review 2022

[2] MNR 2013 correspondence

[3] DFO Aquatic SAR mapping 2022

[4] Atlas of Mammals in Ontario (Dobbyn 1994)

[5] MECP has temporarily suspended ESA authorization requirements for Black Ash while they determine the best approach for protection and recovery of the species.

The following natural heritage features were identified by NHIC within the Town:

- Nopiming Provincially Significant Wetland
- Nopiming Crown Game Preserve
- Gillies Grove
- Arnprior Stand

3.1.2 Official Plan (Natural Heritage Protection)

The Town of Arnprior Official Plan (OP) was approved by the County of Renfrew in November 2017 and went into effect on December 19, 2017. The OP sets out policies and land use designations that are used by the Town to guide development. One of the planning and development goals stated in the OP is "*to protect and enhance significant natural heritage features, areas and function in the Town*".

Section C8.4 of the OP states that "*land designated Parks and Open Space Area shall be planned to both accommodate public use and minimize the impacts of that public use on the environment and adjacent residential areas. The development of … infrastructure should be carried out in a manner that protects and enhances any adjacent natural heritage features and functions*". The following Land Use categories that could provide habitat for SAR or other environmentally sensitive features have been identified in Schedule A within the Town: Parks and Open Space Area, Environmental Protection Area, and Environmental Protection Area – Wetlands.

Section D1.1 of the OP states that "*the diversity and connectivity of natural features in an area, and the long-term ecological function and biodiversity of natural heritage systems, be maintained, restored, or where possible, improved, recognizing linkages between and among natural heritage features and areas, surface water features and groundwater features*." Development and site alteration are not permitted in Significant Wetlands and are only permitted within Significant Woodlands, Significant Valleylands, Significant Wildlife Habitat, and Significant Areas of Natural and Scientific Interest (ANSI) if "*it has been demonstrated that there will be no negative impacts on the natural features or their ecological functions*."

Additionally, development and site alteration are not permitted in fish habitat, habitat of endangered species and threatened species "*except in accordance with provincial and federal requirements*."

The following Natural Heritage Features and Areas were identified within Schedule C of the Town’s OP:

- Significant Wetlands
  - Nopiming Provincially Significant Wetland
- Wooded Area
- Significant Woodlands
  - Gilles Grove
  - Shoreline Natural Corridor
- Fish Spawning Area
  - Mapped between the Ontario Power Generation (OPG) Arnprior Weir and the Ottawa River
- Wintering Area
  - Associated with the Nopiming Crown Game Preserve
- Constraint Area (karst topography)
- Natural Heritage Areas

3.2 Social and Economic Environment

3.2.1 Population

In 2022, the Statistics Canada 2021 Census data reported a population of 9,890 in Arnprior, which has been increasing at an annual rate of approximately +1.5%.The subsequent September 2023 revision of the 2021 Census reported a population of 9,629, which is less than the existing population considered in this Master Plan. This reduction in the reported population may be due to amendments in the 2021 Census, such as revised dwelling counts when considering usual occupancy. The impact of a reduced existing population basis should be considered as part of detailed investigations of the projects identified in this Master Plan.

3.2.2 Households

The September 2023 revision of the 2021 Census reported a total of 4,458 private dwellings, which has been increasing at an annual rate of approximately +1.6%. The average household size is 2.2, which is unchanged from the 2016 Census average household size.

3.2.3 Cultural Heritage

The 2017 Town of Arnprior OP outlines objectives for the conservation of cultural heritage resources. Furthermore, the MCEA requires consideration of cultural environment heritage, including built heritage resources, throughout the EA process. Therefore, as part of project-specific detailed investigations, cultural heritage resources that retain heritage attributes should be identified and avoided where possible. Where avoidance is not possible, potential effects to these attributes should be identified and minimized.

3.2.4 Archaeological Potential

The study area is located within the Ottawa Valley, which has the potential for the recovery of pre- and post-contact Indigenous and Euro-Canadian archaeological resources. Therefore, appropriate archaeological investigations are required for certain infrastructure projects in accordance with the MCEA process. Any projects identified as a Schedule B or C project will require an archaeological assessment to be completed.

3.2.5 Economic Environment

The Town of Arnprior's statement on business and industry (as posted on the Town's website, https://www.arnprior.ca/en/ecdev/why-arnprior.aspx) describes the current and future direction of the economic environment:

Arnprior is open and ready for business. Economic Development is a key priority in the Town's Strategic plan which means your business is our top priority. We have streamlined our processes and enhanced our procedures to help accelerate planning & development applications. Our Economic Development department is readily available to assist you with every aspect of relocating or opening your business in Arnprior. Arnprior is open and ready for business. Economic Development is a key priority in the Town's Strategic plan which means your business is our top priority. We have streamlined our processes and enhanced our procedures to help accelerate planning &

development applications. Our Economic Development department is readily available to assist you with every aspect of relocating or opening your business in Arnprior.

A component of this W&WWMP is to ensure that future commercial and industrial sites supporting the economic development within the Town can be appropriately serviced with municipal water and wastewater services.

3.2.6 Official Plan (Growth)

The 2017 Town of Arnprior OP sets out the policies and land use designations that are to be used by the Town of Arnprior to guide development, and the number of lots required to support the projected growth. The W&WWMP is prepared with consideration given to the long-term objective of *"continued business growth and support."*

3.3 Existing Wastewater and Water Infrastructure

3.3.1 Existing Wastewater Collection Network

The Town's existing wastewater collection network consists of the following:

- Approximately 60 km of sewers, ranging in diameter from 75 mm to 900 mm.
  - The W&WWMP considers the trunk-level infrastructure, which consists of approximately 23 km of sewers with diameters greater than 300 mm or sewers in specific areas of interest to the Town.
- 5 communal pumping stations (PSs), 1 small PS in a municipal building near the beach (Robert Simpson Park), 3 privately owned stations.
  - At the trunk level, 4 of the 5 communal PSs are assessed in the W&WWMP.
- Wastewater in the Town is conveyed to the wastewater treatment plant (WWTP) on Albert St, downstream of the Arnprior Dam, on the left bank of the Madawaska River. The last WWTP expansion was completed in 2011.
- Under extreme events, sanitary flows can overflow to the stormwater collection system or to the Madawaska River at different locations, discussed in **Chapter 1** (**Section 4**).

Further details on the existing wastewater collection system are provided in **Chapter 1** (**Section 4**). The hydraulic model updates and existing infrastructure assessment are presented in **Chapter 2** (**Section 5**). Servicing solutions are developed in **Chapter 3** (**Section 6**), and cost estimates presented in **Chapter 4** (**Section 0**).

3.3.2 Existing Potable Water Distribution System

The Town's existing potable water distribution network consists of the following:

- A Water Filtration Plant (WFP), located on the south side of Havey St, which takes its raw water from the Madawaska River. The WFP was last upgraded in 2010. The WFP provides storage in its clearwells and pumping from high-lift pumps (HLPs).
- An elevated storage tank (EST) on Hartney St, constructed in 1993.
- Approximately 65 km of watermains, ranging in diameter from 50 mm to 600 mm (excluding service lines less than 50 mm in diameters).
- Approximately 315 hydrants.

Further details on the existing potable water distribution system are provided in **Chapter 1** (**Section 4**). The hydraulic model updates and existing infrastructure assessment are presented in **Chapter 2** (**Section 5**). Servicing solutions are developed in **Chapter 3** (**Section 6**), and cost estimates presented in **Chapter 4** (**Section 0**).

4 Chapter 1: Background Review and Data Gap Analysis

The purpose of **Chapter 1** is to review the Town's most recent water and wastewater infrastructure updates, and identify additional information required to update the hydraulic models and complete the system assessments in the next tasks. The methodology for assessing the Town's infrastructure is also reviewed, considering current design and assessment standards. The 2022 flow monitoring program for the wastewater collection system is also presented.

4.1 System Review and Data Gap Analysis

4.1.1 Background Reports

The Town provided various reports, which are used throughout this W&WWMP. The background information available was reviewed and is summarized in this section. The reports pertain to the following topics:

- Growth and land use
- Infrastructure master planning
- Facility planning and design.

4.1.1.1 Growth and Land Use

The following reports were provided as background information for updated growth projections and land use information:

- <u>Town of Arnprior Official Plan (Meridian Planning, 2017)</u>

  The Town's 2017 Official Plan (2017 OP) provides direction on long-term growth management and land use planning to the 2036 horizon. The 2017 OP presents growth projections for population, institutional, commercial and industrial (ICI) areas, and total land areas, for 2036 and intermediate horizons. However, the growth projections are provided as totals over the Town, which are not spatially distributed. The 2017 OP also designates land-use across the Town.

  The 2017 OP's 2036 projections were not used in the current W&WWMP, as they were superseded by revised projections as presented in the Town's *Growth Management Strategy – Draft Report* (Watson & Associates Economists Ltd, 2022), with input from the Town on their distribution. The 2017 OP's existing land-use designation were superseded by information provided in the latest parcel geographic information system (GIS) data provided by the Town (see **Section 4.1.5.1**).

- Growth Management Strategy – Draft Report (Watson & Associates Economists Ltd, 2022)

  As part of the Town's OP review, a growth management strategy (GMS) is being developed to re-assess population and employment growth to the year 2051. Total population and employment forecasts to 2051 are presented. The GMS identifies vacant residential and employment lands and the total available land and unit supply.

  The timeline of development for the development areas is not specified in the GMS. Assumptions are made on the phasing of these developments for each intermediate horizon in this W&WWMP, informed by discussions with the Town, to identify associated water and wastewater infrastructure requirements in **Chapter 2** (**Section 5**).

- Water and Sewage Plant Committed Capacity / Uncommitted Reserve Capacity Spreadsheet Assessment (Town of Arnprior, 2022)

  To estimate committed and remaining capacity at the water filtration plant (WFP) and wastewater treatment plant (WWTP), the Town has provided a list of registered and draft approved lots. This includes an estimate of population for these lots, a calculation of the equivalent total water demands and sewage flow (representing committed hydraulic reserve capacity), and of the remaining uncommitted reserve capacity at both facilities.

  The timeline of the development of the lots was confirmed with the Town and used as part of the growth projections and to identify associated water and wastewater infrastructure requirements in **Chapter 2** (**Section 5**).

4.1.1.2 Infrastructure Master Planning

The following reports were provided as background information on infrastructure master planning:

- <u>Town of Arnprior 2008 Master Traffic Study (CastleGlenn Consultants Inc., 2009)</u>

  The Town's Master Traffic Study identifies infrastructure requirements to accommodate planned growth and improvements to existing traffic and parking conditions, for the planning horizons 2015 and 2025. Recommended infrastructure upgrades identified as part of this W&WWMP can be prioritized based on integration with proposed traffic projects.

  The Town's Transportation Master Plan (TMP) is also being updated in 2022. If available, findings of the updated TMP can be used to prioritize recommended infrastructure upgrades identified as part of this W&WWMP in **Chapter 4** (**Section 0**), based on integration with proposed traffic projects.

- <u>Town of Arnprior Water and Wastewater Master Plan (Stantec Consulting Ltd., 2013)</u>

  The 2013 W&WWMP assessed infrastructure needs for the following horizons: 2011 (as existing conditions), 2016, 2021 and 2031. Projects to meet those future infrastructure needs were identified and are summarized in **Table 4-1** (sanitary) and **Table 4-2** (potable water).

  The status of the projects identified was confirmed with the Town and with the GIS database (for 2016 and 2021 projects). Hydraulic models were updated accordingly in **Chapter 2** (**Section 5**). The current W&WWMP uses updated growth projections to update the infrastructure recommendations and identify new requirements up to the year 2042.

- <u>2015 Sanitary Sewer and Water Model Calibration and Sanitary Sewer System (Stantec Consulting Ltd., 2016)</u>

  As developments in the Town were occurring faster than originally projected in the 2013 W&WWMP, the 2016 horizon was re-assessed based on updated population information. Based on this assessment, capacity restrictions in the sanitary collection system and risks of basement flooding were identified. No combined sewer overflows (CSOs) were observed, however the WWTP and all PS (except PS#2) were noted to be at their capacity under the target design event for existing conditions. The updated populations for 2016 had a negligible impact on pressures and fire flows in the water distribution system.

The current W&WWMP includes an assessment of existing conditions for the year 2022, based on the populations presented in **Section 4.1.5.3** and the criteria outlined in **Section 4.2**.

Table 4-1: Sanitary Servicing Projects from 2013 W&WWMP

Project Location	Project Description	Timing	Status
Area 5 Northwest of Staye Court Dr	575m of 300mm diameter sewer (on privately owned land) to connect into the existing 300mm diameter sewer located along Frieday Street	2016	Not built
Area 8 East of DeCosta St along Madawaska Blvd	150m of 375mm diameter sewer along Madawaska Blvd to existing 600mm diameter existing sewer at the corner of Madawaska Boulevard and DeCosta Street	2016	Built
Area 3 East of Baskin Dr	New 8.3L/s pump station and approximately 100m of 100mm diameter forcemain (both on privately owned land) tied into the existing 400mm diameter trunk sewer located along Baskin Drive East	2021	Not built
Area 1 White Lake Rd/VanDusen Dr	New 10L/s pump station and approximately 670m of 100mm diameter forcemain (270 on privately owned land and 400m on new road alignment or White Lake Rd) tied into the existing 400mm diameter trunk sewer located along Vanjumar Drive	2031	Not built
Area 3 East of Baskin Dr	Increase of the pump station capacity noted above in 2021 from 8 L/s to 15 L/s	2031	Not built

Table 4-2: Water Servicing Projects from 2013 W&WWMP

Project Location	Project Description	Timing	Status
Daniel St 1 (Havey St to Charles St)	564m of 400mm diam. watermain	2016	Built
Havey St (WTP to Daniel St)	456m of 600mm diam. watermain	2016	Built

Daniel St 2 (Charles St to Staye Court Dr)	616m of 400mm diam. watermain	2021	Not built
Staye Court Dr (Daniel St to Hwy 17)	519m of 400mm diam. watermain	2031	Not built
Victoria St (John St to Elgin St)	669m of 300mm diam. watermain	2031	Not built
Elgin St (Victoria St to Norma St)	344m of 300mm diam. watermain	2031	Not built
Norma St (Elgin St to Caruso St)	422m of 300mm diam. watermain	2031	Not built
Caruso St (Norma St to Ida St)	80m of 300mm diam. watermain	2031	Not built
White Lake Rd/Vandusen Dr	1,920m of 300mm diam. watermain	2031	Not built

The Town also provided a list of planned long-term infrastructure projects, which will have an impact on the resulting flows in the system. They were therefore considered when identifying future problem areas and system improvements. These projects are presented in **Sections 5.5.1.2** (wastewater) and **5.5.2.1** (potable water).

4.1.1.3 Facility Planning and Design

The following documents pertaining to water and wastewater facilities' planning and design were provided.

Sanitary Pumping Station Design Briefs

Sanitary pumping station (PS) design briefs for 4 of the Town's 5 PSs were provided. The Town noted that a design brief for PS #4 was not available but provided its Certificate of Authorization (CoA). These reports are used to review and validate how the PSs are modelled. Detailed information and data gaps on the sanitary PSs are further discussed in **Section 4.1.2.3**.

- Draft Design Brief – Sewage Pumping Stations Nos. 2 and 3 – Town of Arnprior (Trow Consulting Engineers Ltd., 2002)

- Design Report for Replacement of Pumping Station No. 1 – Town of Arnprior (Robinson Consultants Inc. Consulting Engineers, 1999)
- Madawaska Village Sanitary Pumping Station Design Brief (Stantec Consulting Ltd., 2007)

Water Filtration Plant Reports

- Town of Arnprior Walter E. Prentice Water Filtration Plant Schedule 'C' Class Environmental Assessment Environmental Study Report (J.L. Richards & Associates Ltd., 2007)

The Town undertook a Class Environmental Assessment (EA) study from 2005 to 2007 for the expansion of the WFP to a 20-year horizon (i.e., the year 2025).

The findings of the study can be compared to updated growth information in the assessment of treatment and storage capacity available in the short- to medium-term horizons, as part of the WFP performance review in **Chapter 2** (**Section 5**).

Detailed information and data gaps on the WFP are further discussed in **Section 4.1.3.3**.

- Arnprior Water Filtration Plant Annual Summary Reports (Corporation of the Town of Arnprior, 2008, 2009, 2010)

Annual summary reports on daily raw and treated water flows from the WFP were provided for 2008 to 2010. Additional data in Excel format was provided for 2016 to 2020, and subsequently for 2006-2015 and 2021.

These reports and data received are used as part of the WFP performance review in **Chapter 2** (**Section 5**), to identify triggers for additional treatment studies and anticipated plant expansion needs.

4.1.2 Sanitary Sewer Network Data

4.1.2.1 Previous Master Plan Hydraulic Model

The Town's sanitary sewer model was developed as part of the 2013 W&WWMP in PCSWMM. The model was originally built based on geographic information system (GIS) data provided by the Town. It is a trunk-level model, consisting of sanitary sewers equal or greater than 300 mm in diameter, and including 4 of the Town's 5 pumping stations. The model was re-calibrated in 2015 using additional (newer) flow monitoring data, and the existing conditions and growth assessments were updated. Additional analyses were completed by Stantec since the latest model update to assess development impacts on the Daniel St sanitary sewers and alternative solutions in the MacDonald/Edey St area to handle additional development inflows. During this work, pipes in the Edey St, MacDonald St, McGonigal St W and John St N areas were added to the model and inverts were updated based on information provided by the Town.

The re-calibrated 2015 model with the infrastructure and invert updates completed for the MacDonald/ Edey St work is used as the basis for the current W&WWMP's model update, with the addition of the Allan Dr sewers, as requested by the Town.

4.1.2.2 Geographic Information System (GIS) Data

The Town provided a geographic information system (GIS) database of geospatial features which is used as part of the current W&WWMP. The sewer asset geodatabase layers form the basis from which to review and update the Town's wastewater hydraulic model network, along with land use, population, parcel data, and elevation data.

These sources of information are also used for mapping. Additional background layers provided include municipal boundaries, parcels, buildings, park space, transportation networks (roads) and watercourses have also been collected (and are documented as base mapping features in **Section 4.1.4**).

Additional shapefiles that may be useful for the W&WWMP and/or hydraulic model development were collected as the need arises. GIS data availability for the sanitary sewer network is summarized in **Table 4-3**. Sanitary collection system infrastructure is illustrated in **Figure 4-1**.

A review of the initial sanitary collection system GIS layers showed that some sewer inverts were missing. Updated GIS layers were provided by the Town, where some previously missing invert information was added. Remaining data gaps may limit the addition of sewers to the model unless the missing information can be obtained from drawings or field measurements. Data gaps are discussed in further details as part of the Engineering Validation (**Section 4.1.2.5**).

Table 4-3: Sanitary Collection System Critical GIS Layers and Data Available

GIS Layer Name and Description	Key Attributes	Missing Information	Use
SAN_MH Sanitary Maintenance Holes (MH)	MHID Ground Elevation Status Installation Year	Depth	Model review and update/build
Sanitary_Manholes Updated GIS Data of Sanitary MH	MHID Ground Elevation Status Installation Year	Depth *(partially provided in updated GIS data of sanitary sewers)*	Model review and update/build
SAN_NODE Miscellaneous Sanitary System Nodes	ID Comment	Ground Elevation Depth	Model review and update/build
SAN_INOUT Pump Station Overflow	ID Status	-	Model review and update/build
SAN_SEWER Sanitary Sewers	Pipe ID Status Type Pipe Size Installation Year	Upstream Invert Downstream Invert Pipe Slope	Model review and update/build
Sanitary_Main Updated GIS Data of Sanitary Sewers	Pipe ID Status Type Pipe Size Installation Year Upstream Invert *(partially available)* Downstream Invert *(partially available)*	Upstream Invert *(partially available)* Downstream Invert *(partially available)* Pipe Slope *(can be inferred from available inverts)*	Model review and update/build
SAN_PS Sanitary Pumping Stations (PSs)	PS Name PS Location Status Installation Year	-	Model review and update/build

Stantec

Legend

- Sanitary Pump Station (PS)
- Wastewater Treatment Plant (WWTP)
- Overflow to Stormwater Sewer System
- Pump Station Overflow (PSO)

Sanitary Sewer Pipes - Diameter

- 75 mm ≤ Diameter ≤ 200 mm
- 200 mm < Diameter ≤ 300 mm
- 300 mm < Diameter ≤ 450 mm
- 450 mm < Diameter ≤ 650 mm
- 650 mm < Diameter ≤ 900 mm
- Unknown Diameter

Combined Sewer Pipes - Diameter

- 75 mm ≤ Diameter ≤ 200 mm
- 200 mm < Diameter ≤ 300 mm
- 300 mm < Diameter ≤ 450 mm
- 450 mm < Diameter ≤ 650 mm
- 650 mm < Diameter ≤ 900 mm
- Forcemains
- Municipal Boundary

N

0 250 500 Meters

(At original document size of 11x17)
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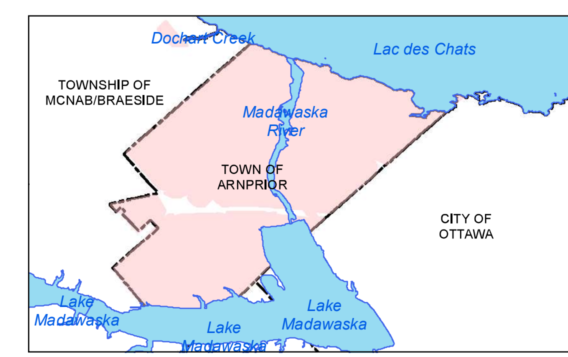
Notes

1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Ontario_Hydro_Network_(OHN)_-_Waterbody.shp*, *Ontario_Hydro_Network_(OHN)_-_Waterbody.shp*, *0837ARNP.sid*, *Parcels.shp*, *Roads_CL.shp*, *SAN_INOUT.shp*, *SAN_PS.shp* and *SAN_SEWER.shp* provided by the Town of Arnprior
3. Background: Contains information licensed under the Open Government Licence – Ontario
4. Abbreviations: PS: Pump Station; CSO: Combined Sewer Overflow; WWTP: Wastewater Treatment Plant



Project Location
Arnprior, ON

Prepared by GB on 2022-07-20
Revised by CR on 2022-10-27

Client/Project
Town of Arnprior
2022 W&WW Master Plan Update

163401723

Figure No.
4-1

Title
Sanitary Sewer Network from GIS

\\Ca0218-ppfss01\01-634\active\1634_01723\planning\drawing\gis\MXDs\tm1_figs\fig2-1_arn_san_study_map_20221027.mxd   Revised: 2022-10-27 By: crazafimaharo

4.1.2.3 Pumping Stations

The Town is currently serviced by a total of nine sanitary pumping station (PS), including five communal pumping stations, one small station in a municipal building near the beach (Robert Simpson Park), and three privately owned stations. The communal PS #4 is outside the model extent, therefore, only four of the five communal PSs are assessed in the W&WWMP. **Table 4-4** provides an overview of each PS and data available. The location of the PSs is shown in the sanitary infrastructure map (**Figure 4-1**).

As part of the existing infrastructure assessment presented in **Chapter 2** (**Section 5**), the Town also provided SCADA and reports to Council from 2017 to 2022, including reports of PS bypass (date of occurrence and volume).

Table 4-4: Overview of Pumping Stations and Data Available

Pumping Station Name	Location	Data Provided	Missing Information	Use
PS #1	Elgin St E / Claude St	Design Report Certificate of Approval Pump Head-Discharge Curves Pump On/Off Levels Facility Drawings	SCADA *[provided by Town in* ***Chapter 2*** *(**Section 5**)]*	Model review and update/build
PS #2	McNab St / Seventh Ave	Design Report Certificate of Approval Pump Head-Discharge Curves Pump On/Off Levels Facility Drawings (obtained from previous W&WWMP files)	SCADA *[provided by Town in* ***Chapter 2*** *(**Section 5**)]*	
PS #3	Madawaska Blvd / Bridge St	Design Report Certificate of Approval	SCADA *[provided by Town in* ***Chapter 2*** *(**Section 5**)]*	Model review and update/build

Pumping Station Name	Location	Data Provided	Missing Information	Use
		Pump Head-Discharge Curves Pump On/Off Levels Facility Drawings (obtained from previous W&WWMP files)		
PS #4	McLean Ave / Riverview Dr	Facility Drawings (obtained from previous W&WWMP files) Certificate of Approval	Design Report *(Town has confirmed that no design report is available)* SCADA *(Town has indicated that no SCADA is available)*	
PS #5	Wolff Cres	Design Report Certificate of Approval Pump Head-Discharge Curves Pump On/Off Levels Facility Drawings	SCADA [*provided by Town in* ***Chapter 2*** *(****Section 5****)]*	

4.1.2.4 Other Special Hydraulic Structures and Boundary Conditions

Special hydraulic structures represent important points in the system where attention to how these are coded in the model is required, given the potential impact on flow distribution and/or resulting water levels. **Figure 4-2** illustrates the location of each of these special hydraulic structures.

Bifurcation nodes (flow splits and high points) were identified as part of the Engineering Validation of the hydraulic model (see **Section 4.1.2.5**). In total, 39 bifurcation locations were identified within the entire system, including 11 locations within the current extent of the hydraulic model. These locations were closely reviewed in preparation for calibration as they may have impacts on the distribution of flow measured in the flow monitoring program. As-built or as-designed drawings were reviewed where available, to ensure that the connectivity is accurately represented in the hydraulic model.

Wastewater in the Town is conveyed to the wastewater treatment plant (WWTP) on Albert St, downstream of the Arnprior Dam, on the left bank of the Madawaska River. The WWTP facility and treatment processes are not modelled in its entirety in the hydraulic model and is instead represented as a simplified outfall. Level boundary conditions were applied to the outfall to represent the WWTP's raw sewage inlet channel capacity. The inlet channel capacity was estimated based on the following data:

- Level sensor data – provided for the period from January 2021 to December 2021
  - Reference elevation from WWTP facility drawings – provided
- Rainfall data – collected as part of the flow monitoring program
- WWTP drawings with elevations – provided
- Typically observed levels – provided

As part of the existing infrastructure assessment presented in **Chapter 2** (**Section 5**), the Town also provided WWTP daily data for 2016 to 2021 and 2023 (partial year, up to April 2023), along with the reports to Council from 2017 to 2022, in addition to SCADA for 2022. This data is used to identify historical trends in the flows to the WWTP and compare them against the WWTP's average day and peak hour flow capacities stated in the facility's certificate of authorization (CoA)

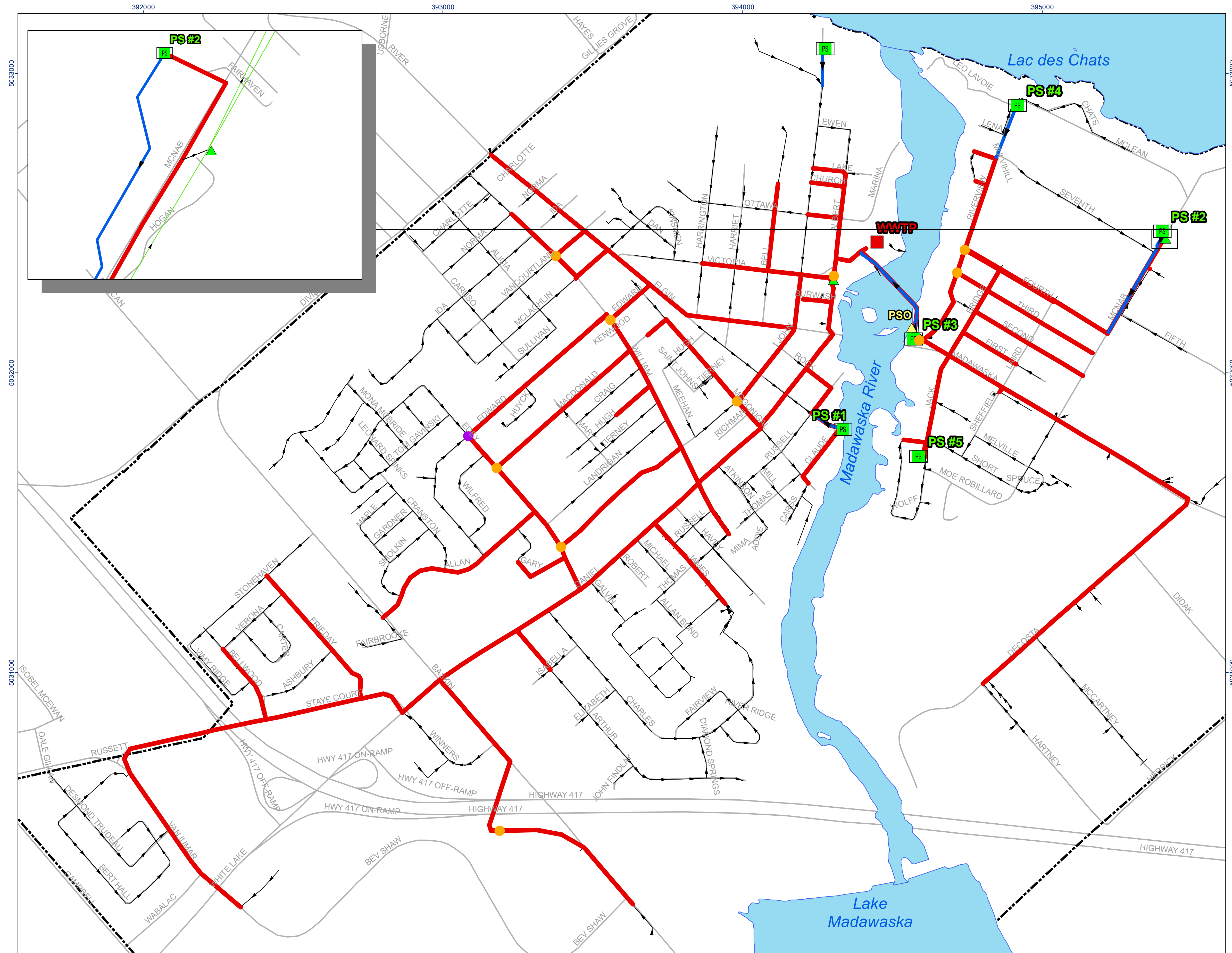
Outfalls into the Madawaska River are also represented as boundary conditions. The Town's two overflows are already in the trunk-level sewer model:

- Albert St Combined Sewer Overflow (CSO)
- PS#3 Overflow

Based on a review of updated GIS data provided, it was identified that the Albert St CSO was reconfigured to bypass into the stormwater sewer system (and discharges into the Madawaska River). A preliminary assumption is that these overflows are free outfalls. The model calibration presented in **Chapter 2** (**Section 5**) did not indicate the need to model these outfalls as submerged for the selected calibration events.

Based on GIS information and previous W&WWMP drawings (as-built), a bypass to the stormwater sewer system on McNab St was identified upstream of PS#2. The Town has provided updated as-built drawings confirming the configuration, dimensions and inverts of the bypass, which were used to add this bypass to the model.

The locations of special hydraulic structures and boundary conditions applied within the study area are presented in **Figure 4-2**.



Legend

- Local Sanitary Collection System (Not Modelled)
- Trunk Sewer (Modelled Pipes)
- Forcemains
- Stormwater Collection System (Not Modelled)
- Wastewater Treatment Plant (WWTP)
- Overflow to Stormwater Sewer
- Sanitary Pump Station (PS)
- Pump Station Overflow (PSO)
- Bifurcation Nodes - High Points
- Bifurcation Nodes - Flow Splits
- Municipal Boundary

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(At original document size of 11x17)
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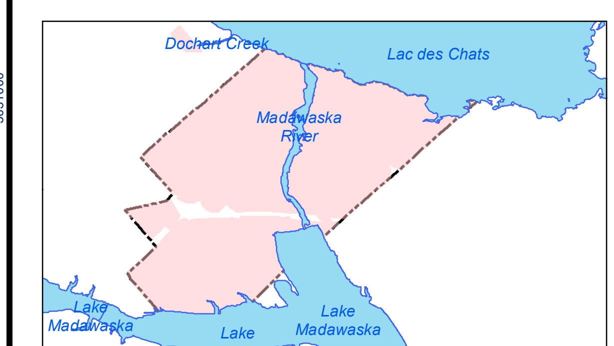
Notes
1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Export_Arnprior_Road_Network_2020.shp*, *SAN_INOUT.shp*, and *SAN_SEWER.shp* provided by the Town of Arnprior
3. Background: Contains information licensed under the Open Government Licence – Ontario
4. Abbreviations: CSO: Combined Sewer Overflow; PSO: Pump Station Overflow; WWTP: Wastewater Treatment Plant



Project Location
Arnprior, ON

Prepared by CR on 2022-09-20
Revised by CR on 2022-10-27

Client/Project
Town of Arnprior
2022 W&WW Master Plan Update

163401723

Figure No.
4-2

Title
Sanitary Sewer Network Special Hydraulic Structures

\\Ca0218-ppfss01\01-634\active\1634_01723\planning\drawing\gis\MXDs\tm1_figs\fig2-2_arn_san_spec_struc_20221027.mxd Revised: 2022-10-27 By: crazafimaharo

4.1.2.5 Engineering Validation

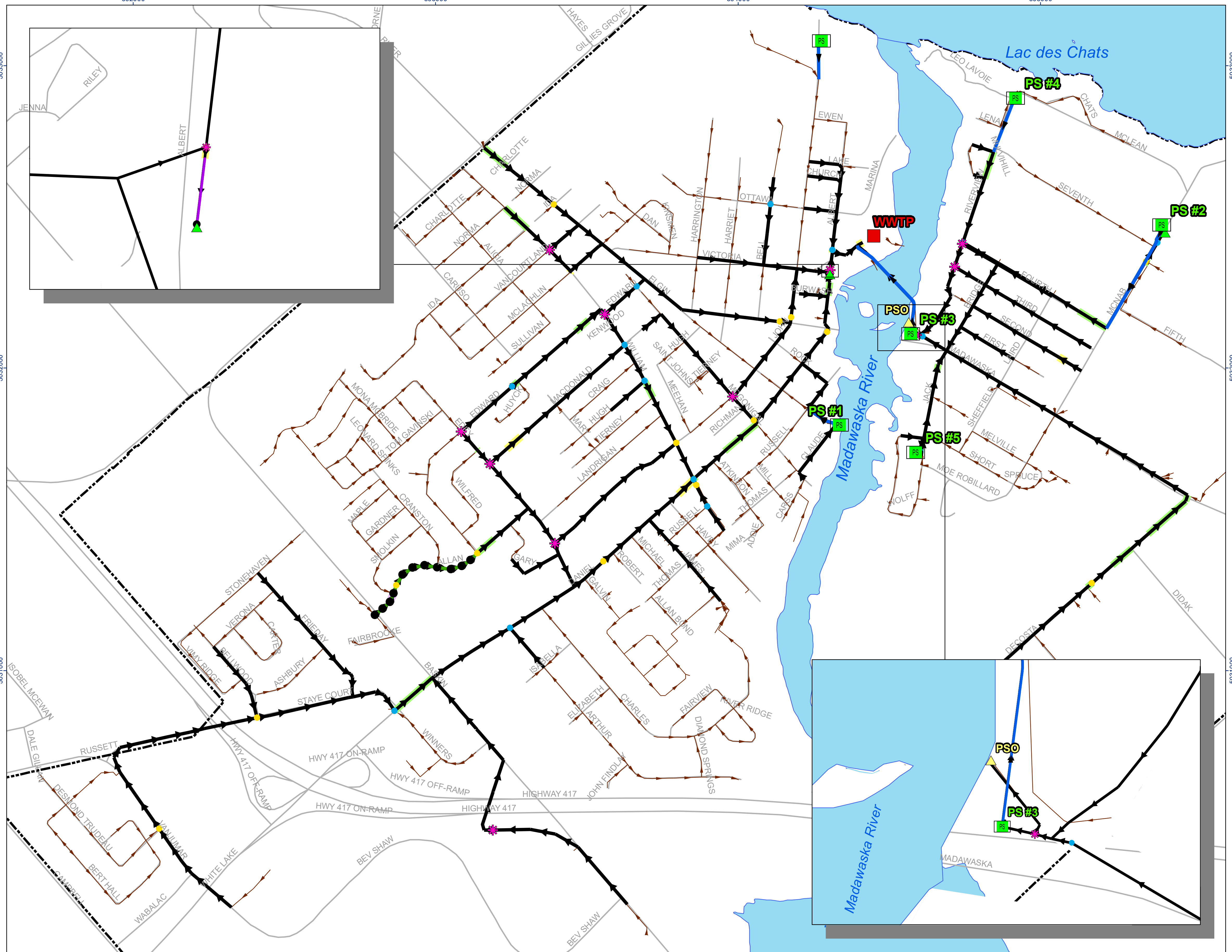
The hydraulic model was updated to include the GIS data most recently provided by the Town, within the existing model extent (i.e., where pipes have been replaced since the last model update). As requested by the Town, the model was expanded along Allan Dr (pipes were added based on GIS data). As part of our routine model review/update process, an engineering validation was completed on the most recent version of the Town's hydraulic model. This evolving engineering validation methodology is performed in InfoWorks ICM, which has robust validation and documentation tools. The validation is completed to identify data gaps, errors and warnings which may require correcting as part of this W&WWMP. Engineering validation errors and warnings are summarized and quantified in **Table 4-5**.

The most predominant issues observed within the study area are Missing Ground Elevation, Pipes Above Ground, Adverse Slopes, Missing Upstream (US) Inverts, and Inconsistent Profile Inverts, each affecting up to 7% of the elements in the study area. Some of these issues were generated when updating the model with GIS data, where ground elevation or pipe invert information was missing. Other issues are warnings, which may have been generated for a valid configuration, and require a review. Finally, the current engineering validation approach raised errors or warnings in locations where the previous model included inferences and simplified configurations. These errors and warnings required a verification of the following model inputs:

- Pipe inverts: these were verified using the following data sources (listed from higher to lower level of certainty):
  - As-built or as-designed drawings – partially available, were requested as needed in specific locations
  - GIS database sewer inverts – provided for most sewers within model extent
  - Inferences based on pipe slopes or obvert matching
  - Assumptions based on standard pipe slopes and required cover
- Ground elevation at MHs: these were verified using the following data sources (listed from higher to lower level of certainty):
  - GIS database MH Elevation data – information is partially available
  - High-resolution LiDAR – available
  - Survey points (20 m x 20 m resolution) – available.

Errors for pump stations are identified based on the availability of PS information as noted in **Section 4.1.2.3**. Upon reviewing facility drawings, design reports and CoAs, the required information for each PS (discharge rates, on/off levels, and wet well inverts and dimensions) was identified, and thus no errors for pump stations were raised.

Figure 4-3 illustrates the distribution of errors within the study area.



Stantec

Legend

- Municipal Boundary
- Local Sanitary Collection System (Not Modelled)
- Trunk Sewers (Modelled)
- Forcemains
- Wastewater Treatment Plant (WWTP)
- Overflow to Stormwater System
- Pump Station Overflow (PSO)

Junction Errors & Warnings

- Inconsistent Profile - Diameter
- Inconsistent Profile - Inverts
- Bifurcation Nodes - High Points & Flow Splits
- Missing Ground Elevation or Added Node

Conduit Errors & Warnings

- Steep Slope
- Flat Pipe (not Missing Upstream & Downstream Invert)
- Adverse Slope
- Pipe Above
- Missing Downstream Invert

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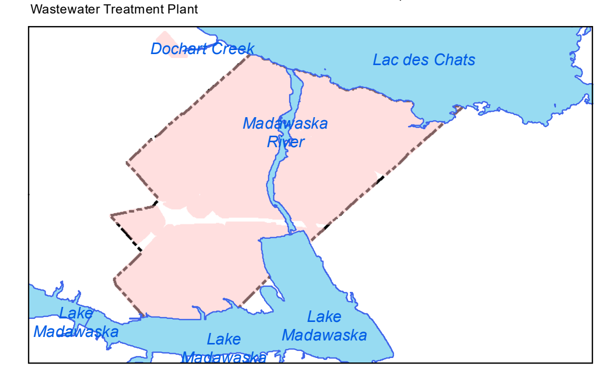
Notes
1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Export_Arnprior_Road_Network_2020.shp*, *SAN_INOUT.shp*, and *SAN_SEWER.shp* provided by the Town of Arnprior
3. Background: Contains information licensed under the Open Government Licence – Ontario
4. Abbreviations: CSO: Combined Sewer Overflow; PSO: Pump Station Overflow; WWTP: Wastewater Treatment Plant



Project Location
Arnprior, ON

Prepared by CR on 2022-09-20
Revised by CR on 2022-10-27

Client/Project
Town of Arnprior
2022 W&WW Master Plan Update

163401723

Figure No.
4-3

Title
Sanitary Sewer Model Engineering Validation Errors & Warnings

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Table 4-5: Engineering Validation Errors and Warnings

Error	Description	Object Type	Error Severity	Error Severity Rationale	Engineering Validation Check Note	Quantity of Errors in Study Area	Number of Records in Study Area	% of Errors in Study Area
Missing Downstream Invert	Downstream invert = 0	Conduit	Error	Pipe inverts must be inputted.	MDSI	1	327	0.3%
Inconsistent Profile based on Inverts	Downstream invert > upstream invert	Junction	Error/warning	Typically, not valid and indicates surrounding invert(s) are incorrect. Can also identify conduit has settled or was constructed this way.	IPI	16	323	5%
Pipe Above Ground	Pipe obvert (and possibly invert) above ground elevation	Conduit	Error	Ground levels and/or pipe inverts are incorrect and must be adjusted.	PAG	12	327	4%
Adverse Slope	Negative sloped pipe	Conduit	Warning	May be valid; however, could be indicative of incorrect inverts or a reversed pipe. Can also identify conduit has settled or was constructed this way.	AS	23	321	7%
Flat Slope	Pipe with 0% slope	Conduit	Warning	May be valid; however, may result in capacity constraints.	FS	1	321	0.3%
Steep Slope	Pipe slope > 5%	Conduit	Warning	May be valid; however, may result in model instabilities.	SS	10	321	3%
Missing Ground Elevation	Ground elevation = 0	Junction	Error	Node ground elevations must be inputted.	MGE	13	323	4%
Bifurcation Node - High Point	System high point with 2+ outgoing pipes	Junction	Warning	Helps to identify where backwater over high points may affect the contributing drainage areas used in calibration.	BNHP	1	323	0.3%
Bifurcation Node - Flow Split	Flow split (incoming pipe(s) and 2+ outgoing pipes)	Junction	Warning	Helps to identify where flow splits may affect the contributing drainage areas used in calibration.	BNFS	10	323	3%
Inconsistent Profile based on Diameter	Downstream diameter < upstream diameter	Junction	Warning	May be valid; however, could indicate that surrounding diameter(s) may be incorrect.	IPD	19	323	6%
Missing Downstream Node	Connectivity issue, no downstream node	Junction	Error	Downstream node must be added	MDSN	1	327	0.3%

4.1.3 Water Distribution Network Data

4.1.3.1 Previous Master Plan Hydraulic Model

The Town's water distribution model was originally developed and calibrated in 2011. It is an all-pipe model in InfoWater Pro, including the Town's water filtration plant (WFP) and elevated storage tank. Minor updates to the model facilities and piping were made as part of the 2013 W&WWMP. The model's demands were updated in 2015. Additional analyses were completed by Stantec since the latest model update to provide boundary conditions in support of development requests. During this work, updates to the model were made to reflect watermain upgrades (on Havey St and Daniel St), new developments (Campbell Farms, Village Creek, Callahan Subdivisions), and to obtain better agreement with field data (by adjusting C-values on some pipes).

The 2015 model with the updates described above is used as the basis for the current W&WWMP's model update. The model is updated to reflect recent watermain replacements and upgrades and is expanded to reflect newer developments in the Town.

4.1.3.2 GIS Data

The Town provided a geographic information system (GIS) database of geospatial features which is used as part of the current W&WWMP. The water distribution asset geodatabase layers form the basis from which to review and update the Town's water distribution hydraulic model network, along with land use, population, parcel data, and elevation data.

These sources of information are also used for mapping. Additional background layers provided include municipal boundaries, parcels, buildings, park space, transportation networks (roads) and watercourses have also been collected (and are documented as base mapping features in **Section 4.1.4**).

GIS data availability for the water distribution network is summarized in **Table 4-6**. Water distribution system infrastructure is illustrated in **Figure 4-4**.

Based on a review of the water distribution system GIS layers, elevation information is partially missing at the nodes and for 253 out of the 425 hydrants in the database. Elevation data gaps were addressed by using the ground elevation data provided by the Town (discussed as a Base Mapping feature in

Section 4.1.4). The hydrant leads do not have diameters or material, however this is not a critical data gap, as the hydrant leads are not included in the hydraulic model.

Table 4-6: Town of Arnprior Critical GIS Layers and Data Available – Watermain Distribution Network

GIS Layer Name	Key Attributes	Missing Information	Use
WATERMAIN Watermains	Pipe ID Diameter Material Installation Year Condition Status/Ownership	-	Model review and update/build
WTR_NODE Water Nodes	ID Node Type	Elevation	
VALVE Valves	Valve ID Elevation Installation Year Condition Status/Ownership Comment/Function	-	
WTR_HYDRANT Hydrants	Hydrant ID Elevation Installation Year Condition Status/Ownership Comment/Status	Elevation (partially)	
WTR_HYDLEAD Hydrant Leads	Pipe ID Status/Ownership Installation Year Condition	Diameter Material	

The Town identified some additional watermain replacements/additions that were not reflected in the previously provided GIS data. The additional watermain replacements/additions were therefore incorporated into the model and are summarized in **Table 4-7**.

Table 4-7: Additional Watermain Replacements/Additions Identified by the Town

Location	Year of Installation	Description of Watermain Replacements/Additions
Alicia St between Division St and McLachlin St S	2021	The 150 mm diameter watermain was replaced with new 200 mm PVC watermain.
Craig St between William St W and Mary St	2022	The 100 mm diameter watermain was replaced with new 150 mm PVC watermain.
Hugh St S between William St W and Edey St	2022	The 100 mm diameter watermain (west Mary St) and 150 mm diameter watermain (east of Mary St) were replaced with new 150 mm PVC watermains.
Baskin Dr W between Stonehaven Way and Allan Dr	2023	New 200 mm diameter watermain is currently under construction to service the future development at 115 Baskin Dr W.

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Legend

Watermains - Diameter (mm)

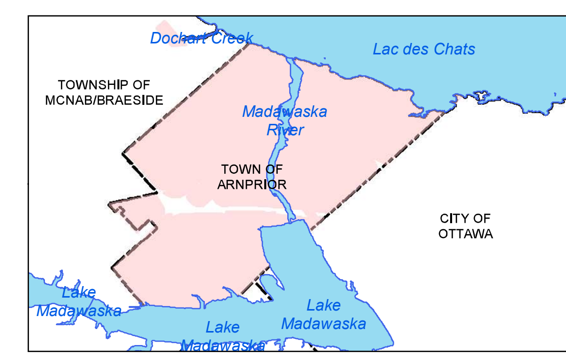
- < 75 mm
- 75 mm - 150 mm
- 150 mm - 225 mm
- 225 mm - 350 mm
- 350 mm - 600 mm
- WTP Water Filtration Plant (WFP)
- Water Tower
- Municipal Boundary

N

0 250 500 Meters
(At original document size of 11x17)
1:16,000

Notes

1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Ontario_Hydro_Network_(OHN)_-_Waterbody.shp*, *Ontario_Hydro_Network_(OHN)_-_Waterbody.shp*, *0837ARNP.sid*, *Parcels.shp*, *Roads_CL.shp*, *WTR_NODE.shp* and *WTRMAIN.shp* provided by the Town of Arnprior
3. Background: Contains information licensed under the Open Government Licence – Ontario
4. Abbreviations: WFP: Water Filtration Plant



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Town of Arnprior
2022 W&WW Master Plan Update

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Figure No.
4-4

Title
Water Distribution Network from GIS

4.1.3.3 Water Distribution Facilities

The Town takes its raw water from the Madawaska River, which is treated at the Arnprior Water Filtration Plant (WFP), located on the south side of Havey St. Per the 2009 Certificate of Approval, the WFP has a treatment capacity of 10,340 m^3/d (120 L/s). Treated water storage is provided at the WFP by two concrete clearwells with a total capacity of 3,971 m^3 (volumes of clearwell 1 and 2 are 2,167 m^3 and 1,804 m^3 respectively as per the Town's DWWP dated March 31, 2021) and is discharged into the distribution network by high-lift pumps (HLPs). The WFP is equipped with 3 HLPs, each with a rated capacity of 125 L/s at a total dynamic head (TDH) of 70 m. The treatment, clearwell and pumping capacities were confirmed using the Drinking Water Works Permit (DWWP) and Municipal Drinking Water License (MDWL) provided, to verify that they are still valid for the hydraulic model update and WFP performance review.

The WFP facility and treatment processes are not modelled in their entirety in the hydraulic model, and are instead represented by the 3 HLPs, drawing water from a fixed head reservoir. Based on a preliminary review of SCADA provided, the HLPs are operated to maintain the elevated storage tank (EST) on Hartney St between 60% and 80% full. This was confirmed with the Town. Pump curves and duty setpoints were provided by Town in **Chapter 2** (**Section 5**) and are used to update and validate the controls in the hydraulic model.

Within the distribution network, the EST located at 433 Hartney St provides balancing, fire flow and emergency storage. The EST has a rated capacity of 2,365 m^3 (624,800 liquid gallons) as per the Gallonage Chart of the EST provided by the Town. EST drawings were provided by the Town and are used to confirm volume and typical operational elevations, to update and validate the hydraulic model inputs and results.

Table 4-8 provides an overview of the major water distribution facilities and data available.

Table 4-8: Overview of Water Distribution Facilities and Data Available

Facility Name	Location	Data Provided	Missing Information	Use
WFP (including HLPs)	Havey St / Madawaska River	DWWP, MDWL WFP Expansion Environmental Study Report Annual Summary Reports (2008-2010) Certificate of Approval As-Built Drawings SCADA Daily WFP Data (2006-2021)	Pump Controls/Operation Information Pump Curves *[provided by Town in **Chapter 2** (**Section 5**)]*	Model review and update/build Performance review
EST	Hartney St	SCADA Drawings DWWP	-	Model review and update/build

4.1.3.4 Hydrant Data

The Town has equipped one hydrant on Alicia St with a remote pressure and temperature sensor. Readings of temperature and pressure data can be accessed from an online platform. The pressure readings can be used to validate the modelled pressures in the vicinity of the hydrant.

As part of the water distribution model calibration and validation presented in **Chapter 2** (**Section 5**), the Town also provided hydrant flow test data from 2018, including 324 tests performed at 320 hydrants located across the Town.

4.1.4 Base Mapping

The GIS database of geospatial features provided by the Town includes municipal boundaries, parcels, buildings, park space, transportation networks (roads) and watercourses. Geospatial features pertaining to linear infrastructure are described in **Section 4.1.2.2** (sanitary sewer) and **Section 4.1.3.2** (water distribution).

Ground elevation data from LiDAR imagery was provided. Ground elevation data is used in sanitary modelling to address maintenance hole rim elevation data gaps and to assess the risk of basement or surface flooding, as well as in potable water modelling to address surface elevation data gaps to assess the adequacy of system pressures.

Parcels were also provided as a GIS shapefile, which includes land use attributes for each parcel. The type of potable water and sanitary servicing received by each parcel is also indicated, which can be used to estimate the number of properties connected to the existing water distribution and sanitary collection systems. Residential population and employment data per parcel is not specified. This information is required to obtain a distribution of current water demands and sanitary flows across the Town, used as inputs into the hydraulic models. As described in **Section 4.1.5**, this data gap is addressed by using a similar approach to the 2013 W&WWMP, where total population for the Town of Arnprior was distributed based on residential parcel areas.

Table 4-9 lists the available GIS data for base mapping.

Table 4-9: Town of Arnprior Critical GIS Layers and Data Available – Base Mapping

GIS Layer Name and Description	Key Attributes	Missing Information	Use
0837ARNP Aerial Image	-	-	Graphics, flow monitoring characterization, infrastructure solutions
Export_Arnprior_Road_Network_2020, Arnprior_Roads_20220324 Road Network(1)	Road Name Classification/Ownership Date Added	-	Graphics
OBOUNDARY Official Town Boundary	-	-	Graphics
dtm_1m_utm18_w_10_103_North **dtm_1m_utm18_w_10_103_South** LIDAR data at a 1 m x 1 m Resolution	Ground Elevation	-	Model update
WATER_BODY Waterbodies	Name	-	Graphics
PARKLAND Parklands	Name Area Ownership Park Type	-	Graphics, flow monitoring characterization, infrastructure solutions

GIS Layer Name and Description	Key Attributes	Missing Information	Use
Arnprior_PropertyParcels_ wAssessment_20220324 Town Property Parcels	Land Use Area Water Servicing Type Sanitary Servicing Type	Population per Parcel Employment per Parcel	Graphics, model update, flow monitoring characterization, model calibration, existing population distribution, future population projections
Res_Parcels_Dec2021 Residential Sites under Active Development Applications and Vacant Residential Land(2)	Status Area Number of Units(3)	-	Future population projections
Employment_Parcels_Dec2021 Vacant Employment Lands(2)	Status Gross Area(3) Net Area(3)	-	Future employment projections

Notes

(1) Multiple road network layers were provided. *Export_Arnprior_Road_Network_2020* is mainly used for mapping, as it includes roads outside the Town's municipal boundaries as of 2020. *Arnprior_Roads_20220324* includes streets in newer subdivisions, built after 2020.

(2) Parcels identified for residential and employment supply in the Town's GMS (2022).

(3) Residential supply (number of units) and employment land supply (gross and net area) are provided in separate spreadsheets.

4.1.5 Population and Land Use

4.1.5.1 Land Use

Figure 4-5 illustrates the generalized land use classifications within the study boundary while the land use types are summarized in **Table 4-10**. This classification is based on the Town's Parcels shapefile, which includes a land use attribute. Land use classification is used in the modelling stages to evaluate the water demand and sanitary sewage flow generation. It is also used in conjunction with other data sets to provide context for flow monitoring data interpretation.

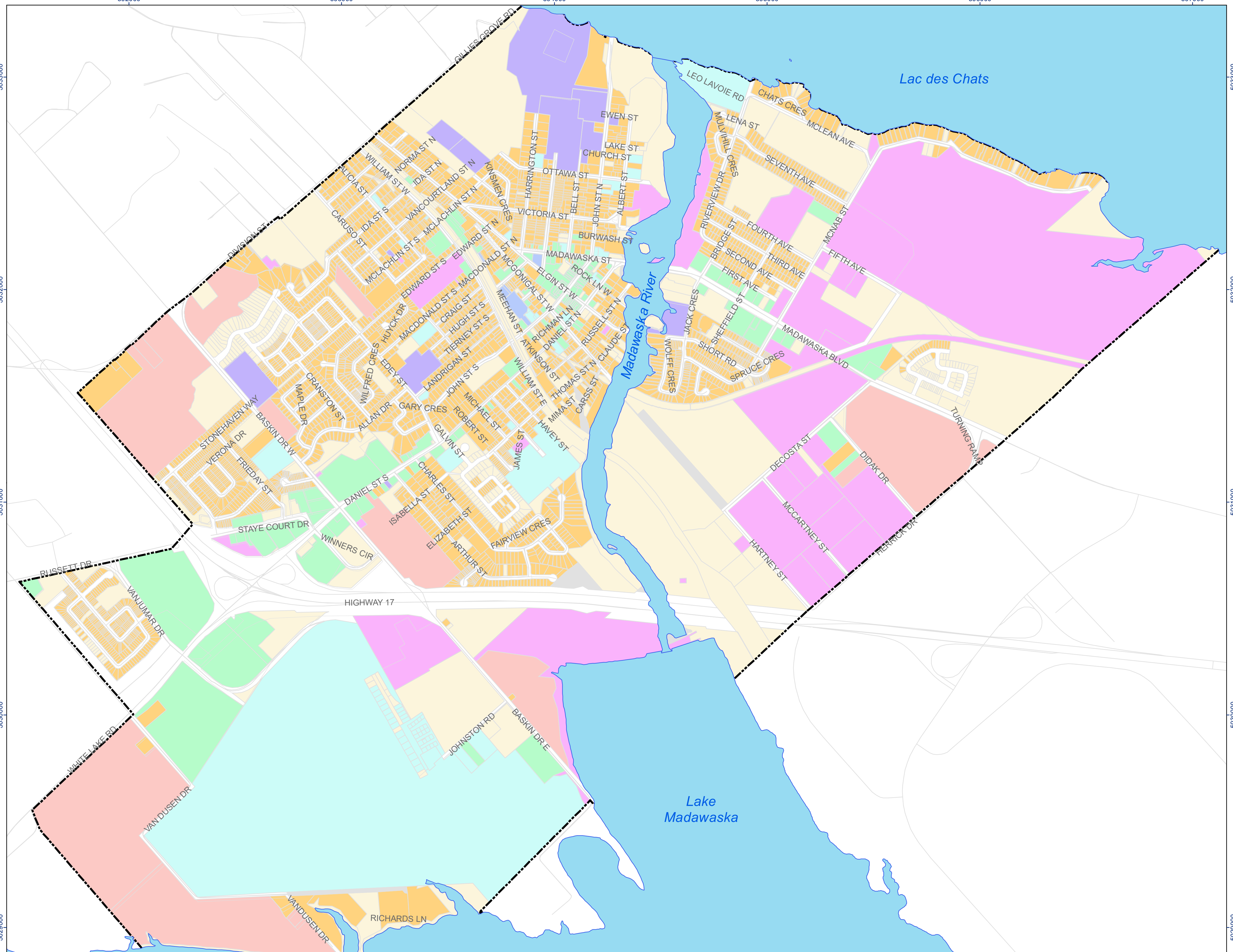
Table 4-10: Land Use Classification

Land Use Classification Type	Land Use Classification	Land Use Area (ha)	Percentage of Total (%)
Residential	Residential	301.2	23.3%
Industrial/ Commercial/ Institutional (ICI)	Government	1.4	0.1%
	Commercial	75.4	5.8%
	Industrial	237.5	18.3%
	Institutional	32.3	2.5%
Other	Vacant	307.3	23.7%
	Special Purpose(1)	170.6	13.2%
	Farm	130.3	10.1%
	Unassessed	38.2	3.0%
	Total	1,294.2	100.0%

Note

(1) "Special Purpose": comprises a variety of land uses, including (but not limited to) religious buildings, curling club, marina, and airport buildings. For modelling purposes, no population (and hence, no water demand or sanitary flow) is allocated to these parcels.

Overall, the Town has diverse land use features, with no one land use type occupying more than a half of the total area. Residential areas occupy ~23% of the land uses, and ICI areas ~27%. The remaining areas (other land uses; 50%) are predominantly composed of vacant areas (~24% of total land use in the Town), which show potential for development and growth in the Town. Other land uses include parcels tagged as “Special Purpose”, which comprise a variety of land uses, including (but not limited to) religious buildings, curling club, marina, and airport buildings. For modelling purposes, no population (and hence, no water demand or sanitary flow) is allocated to these parcels.



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Legend

Land Use

- Commercial
- Farm
- Government
- Industrial
- Institutional
- Residential
- Special Purpose
- Unassessed
- Vacant
- Municipal Boundary

N

0 250 500 Meters
(At original document size of 11x17)
1:18,500

Notes

1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Export_Output_Roads.shp*, and *Arnprior_PropertyParcels_wAssessment_20220324.shp*, *OBOUNDARY* provided by the Town of Arnprior
3. Background: Contains information licensed under the Open Government Licence – Ontario

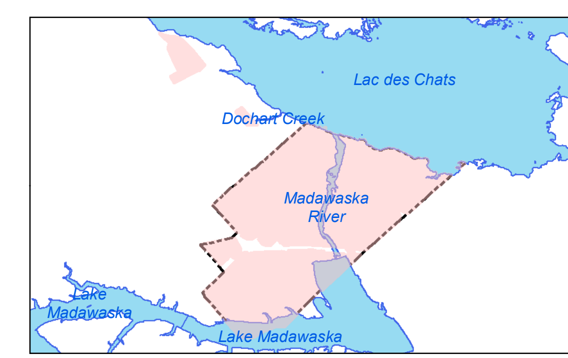

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Figure No.
4-5

Title
Land Use Classification

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Disclaimer: This document has been prepared based on information provided by others as cited in the Notes section. Stantec has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result. Stantec assumes no responsibility for data supplied in electronic format, and the recipient accepts full responsibility for verifying the accuracy and completeness of the data.

4.1.5.2 Water Consumption/ Billing Records

As land use varies across the Town, water consumption records can be used to derive per capita water usage and wastewater generation rates. For sanitary modelling, the per capita water usage is an indicator of population-derived sewage generation, and therefore is used to cross-reference the sewage rates calculated by flow monitoring data.

For water distribution modelling, water consumption records are used to identify top water consumers and allocate their demands to specific junctions in the model. The remaining water demand in the distribution system is obtained by subtracting the top users' demands from the bulk WFP treated flow and distributed across the remaining model junctions.

Water consumption records for top water users and approximately 2,000 residential and ICI users were available for the 2013 W&WWMP; updated water consumption records were provided by the Town and are considered in subsequent hydraulic modelling update steps.

4.1.5.3 Current Population

Population data for existing conditions is provided in the Town's 2022 GMS Report and is derived from the Statistics Canada 2021 Census data. The 2021 population was 9,890 and has been increasing at an annual rate of approximately +1.5%. Using this annual growth rate, a 2022 baseline population of 10,038 people can be assumed for the W&WWMP. The distribution of population across the Town is estimated based on residential parcel information. This data is initially used to estimate per capita sanitary sewage output (L/c/d) from the flow monitoring data and forms the input in the base sanitary hydraulic models for generating dry weather sewage flow.

Following the completion of the sanitary model calibration presented in **Chapter 2** (**Section 5**), the subsequent September 2023 revision of the 2021 Census reported a population of 9,629, which is less than the original 2021 population considered in this Master Plan. This reduction in the reported population may be due to amendments in the 2021 Census, such as revised dwelling counts when considering usual occupancy. While this population reduction would result in an increase in the dry weather flow per capita sanitary parameters (L/c/d), the impact on the wet weather flow calibration and results is minor. The peak wet weather flows remain the main driver of the Master Plan-level capacity assessment and infrastructure recommendations.

Growth projections are presented and assessed as part of modelling growth interests in **Chapter 2** (**Section 5**).

4.2 Design/Assessment Standards Review and Selection

4.2.1 Sanitary Sewer Network

4.2.1.1 Collection System Assessment Criteria

Following the hydraulic model update and calibration, the existing sanitary sewer network was assessed, to identify existing capacity constraints and flooding risks in the Town. Existing flows were generated based on current population and land use (**Section 4.1.5**) and parameters derived from the analysis of flow monitoring data as part of the calibration [**Chapter 2** (**Section 5**)]. The assessment uses a 25-year SCS II 6-hour rainfall distribution event.

For the existing conditions assessment, the collection system performance is evaluated based on hydraulic grade lines (HGLs). The resultant HGLs are assessed to identify if basement or surface flooding risks are generated, whereby:

- The risk of basement flooding is evaluated based on a depth of 1.8 m from crown, which was selected as a representative distance between the underside of footing (USF) and ground surface. The MH cover elevation is assumed representative of the crown of the road, as most MHs are located along the centerline of the roadway.
- Surface flooding occurs when the HGL is at or above surface. HGL issues are defined by locations that do not meet the freeboard criteria (i.e., freeboard is < 1.8 m).

Pipe surcharge state can help define the issues within the system but is not considered in the criteria. Pipe surcharge state is identified using a combination of the flow capacity utilization within the pipe (q/Q) and the depth ratio (d/D). Pipes can either be bottlenecked (undersized and flowing above the pipe's capacity), experiencing backwater conditions due to downstream bottlenecks, or free flowing.

The approach described above is consistent with that of the 2013 Master Plan.

4.2.1.2 Pumping Stations (PS) Assessment Criteria

The capacities of the PSs are assessed by identifying the incoming flow and comparing it to the PS's firm capacity (largest pump offline). To do so, PSs are modelled as ideal (flow in = flow out) for the existing conditions assessments. Their current operational configurations are represented in the model for calibration to replicate the hydraulic conditions within the network as best as possible. The assessment presents results from a 25-year SCS II 6-hour rainfall distribution event, consistent with the event used in the 2013 Master Plan. Results from a 10-year design event are also presented, to align with the Ministry of the Environment, Conservation and Parks (MECP) level of service recommendations for PS design. PS bypass history is also used to supplement the PS capacity assessment.

4.2.1.3 Wastewater Treatment Plant (WWTP) Assessment Criteria

The capacity of the WWTP is assessed by identifying the peak hour flow (PHF) and comparing it to the WWTP's PHF capacity stated in the facility's certificate of authorization (CoA). The occurrence and volume of bypass at the Albert St CSO is also reported. The assessment presents results from a 25-year SCS II 6-hour rainfall distribution event, consistent with the event used in the 2013 Master Plan.

Historical data is also used to identify historical trends in the flows to the WWTP and compare them against the WWTP's average day and peak hour flow capacities stated in the facility's CoA. This approach supplements the model findings, with greater consideration for the various design flows for WWTPs as defined by the MECP. This approach is also consistent with that applied in other nearby municipalities.

4.2.2 Water Distribution Network

Following the hydraulic model update, the existing water distribution network was assessed, to identify existing capacity constraints in the Town in terms of pressures and fire flows. Existing water demands were generated based on current population, land use (**Section 4.1.5**), WFP SCADA and billing records. Storage capacity was also assessed, to ensure that there is sufficient balancing, fire flow and emergency storage in the system.

4.2.2.1 System Pressure Objectives

As per the MECP *Design Guidelines for Drinking-Water Systems*, normal operating pressures in a distribution system range from 350 to 480 kPa (50 to 70 psi) and should not be less than 275 kPa (40 psi). Minimum pressures should not decrease below 140 kPa (20 psi) at any point in the system and should not exceed 700 kPa (100 psi). Pressure reducing measures are required to service areas where pressures greater than 560 kPa (80 psi) are anticipated. These operating pressures are in line with typical industry standards, the 2013 W&WWMP, and more recent assessments conducted in the Town.

Table 4-11 provides a summary of the pressure scenarios and the corresponding recommended pressures.

Table 4-11: Recommended Operating Pressures

Pressure Scenario	Pressure - kPa	Pressure - psi
Minimum Maximum Day + Fire Flow (MXDY+FF)	140	20
Minimum peak hour (PKHR)	275	40
Minimum recommended	350	50
Maximum recommended	480	70
Maximum Average Day (AVDY) recommended	560	80
Maximum all conditions	700	100

4.2.2.2 Fire Flow Objectives

For the assessment of balancing, fire flow and emergency storage, the Ministry of the Environment, Conservation and Parks (MECP) Design Guidelines for Drinking-Water Systems (2019) provide fire flow requirements for sizing water storage in a table (Table 8-1), which outlines required fire flow and duration, based on equivalent populations. For a 2022 population of 10,038 people in the Town of Arnprior, this corresponds to a fire flow rate of 189 L/s (11,000 L/min) for a duration of 3 hours, which are used in the MECP formula for calculating storage requirements:

Total Treated Water Storage Requirement = A + B + C

Where:

- A = Fire storage (m^3)
- B = Equalization storage (25% of MXDY demand); and
- C = Emergency storage [25% of (A+B)].

The MECP guidelines also refer communities to the FUS method [presented in *Water Supply for Public Fire Protection* (2020)] for fire flow calculations for fire protection requirements provided by a centralized distribution system. For the assessment of fire flow in the water distribution system and for the sizing of watermains in new developments, it is recommended that the required fire flow be determined using the latest version of the FUS guidelines, based on the type and size of buildings within the development.

In existing areas where the FUS cannot be met, other municipalities (e.g., City of Ottawa) also refer to the Ontario Office of the Fire Marshal (OFM) guidelines (1999), which support the Ontario Building Code (OBC) Part 3 on *Fire Protection, Occupant Safety and Accessibility*. The maximum fire flow required using the OFM method is 150 L/s (9,000 L/min). It is recommended that the FUS guidelines first be used for the assessment of fire flow in the water distribution system in existing areas. Should there be deficiencies in fire flows, the OFM guidelines could be used as a secondary assessment.

It should be noted that these fire flows are used for system-wide assessments, however the actual fire flow available at hydrants can vary depending on various factors, including the number of hydrants, hydrant lead piping restrictions, local watermain and feedermain capacity, and (partially) closed valves. Therefore, hydraulic modelling and hydrant testing should be considered prior to the development of land to confirm actual fire flow availability.

The approach described above is consistent with that of the 2013 Master Plan.

4.3 2022 Flow Monitoring Program

Flowmetrix was engaged to collect data for the 2022 flow monitoring program. This consisted of 6 flow meters installed across the Town in early-April of 2022 and remained operational through to late-July 2022. The flow monitoring data is available on Flowmetrix's portal online, and a detailed flow monitoring report was prepared by Flowmetrix and is provided in **Appendix A.2**. Details on the selected flow monitoring sites and data collected are presented in **Chapter 2** (**Section 5**). Data from the 6 flow meters (FMs) are used in **Chapter 2** (**Section 5**) for the sanitary model calibration, in conjunction with the relevant rain gauge data.

4.4 Chapter 1 Conclusions

Chapter 1 presents the background review and data gap analysis for the Town of Arnprior W&WWMP Update, including the following discussions:

- Review of background reports (**Section 4.1.1**);
- Review of sanitary sewer network data (**Section 4.1.2**);
- Review of water distribution network data (**Section 4.1.3**);
- Review of base mapping features (**Section 4.1.4**);
- Review of existing population and land use information (**Section 4.1.5**);
- Review and selection of design assessment and standards (**Section 4.2**); and the
- Documentation of the 2022 flow monitoring program. (**Section 4.3**).

The information provided is used to update the hydraulic models and assess the existing systems in **Chapter 2** (**Section 5**).

5 Chapter 2: Existing Infrastructure Assessment

The purpose of **Chapter 2** is to present the updates to the wastewater collection system and water distribution system hydraulic models. The existing systems' performance is then assessed using the updated models. This chapter also presents growth projections and the resulting wastewater flows generated and water demands. The existing infrastructure's performance is then assessed under these growth conditions.

5.1 Hydraulic Model Updates

The Town's previous Master Plan wastewater collection and potable water distribution system hydraulic models were updated to reflect existing conditions in each system. These updates consisted of infrastructure and flow (wastewater flows and water demand) updates and are detailed in the following sub-sections. The models were calibrated and validated to available measurements, as discussed in **Section 5.1.1.6** (wastewater model) and **Section 5.1.2.3** (potable water model).

5.1.1 Wastewater Collection System Model

The wastewater collection system model is a trunk-level model in PCSWMM, consisting of sanitary sewers equal or greater than 300 mm in diameter, and including 4 of the Town's 5 pumping stations (PSs). As discussed in **Chapter 1** (**Section 4**), the Town's re-calibrated 2015 model (2015 W&WWMP Update), last updated in 2018 for the MacDonald/Edey St assessment, was used as the basis for the current W&WWMP's model update. Throughout these model updates, sewers with diameters less than 300 mm have also been added to the model upon request, depending on the assessment needs. The 2018 model update involved adding the bifurcation at Edey St/MacDonald St, to redirect flows from Edey St to MacDonald St. The model's infrastructure and wastewater flows were updated, and the model re-calibrated, to represent existing conditions during the flow monitoring period (April 2022 to July 2022).

As requested by the Town, the model extent was expanded to include the Allan Dr sewers. In general, the model's trunk-level infrastructure was updated using geographic information system (GIS) data, PS data, and additional information provided for special hydraulic structures and boundary conditions. **Chapter 1** (**Section 4**) provides details on the data available, the hydraulic model updates and its engineering validation. The following sub-sections document additional updates made to the model after the **Chapter 1** (**Section 4**) submission.

5.1.1.1 Infrastructure

5.1.1.1.1 Ground Elevation Updates

Maintenance hole (MH) top of grate (TOG) elevations were partially available in the Town's geographic information system (GIS) database. These elevations were primarily used to confirm or update the model's elevations. Elevations at major facilities (e.g., pumping stations, WWTP) were updated based on drawings, where available.

As discussed in **Chapter 1** (**Section 4**), locations with missing ground elevations within the sewer network were identified. These data gaps were addressed using high-resolution LiDAR data. Elevations at select locations were further updated using LiDAR data as part of sewer invert profile modifications, which are discussed in **Section 5.1.1.1.2**.

5.1.1.1.2 Sewer Invert Profile

Sewer invert elevations or MH TOG elevation and sewer invert depths provided were used to verify and update inverts in the hydraulic model. If issues in the updated sewer profiles which could affect the calibration were identified [see Engineering Validation in **Chapter 1** (**Section 4**)], adjustments (fixes) were made and documented within the hydraulic model file. Notably, the following profiles were updated during calibration, to improve the fits between modelled and monitored data (see **Section 5.1.1.6** for a discussion of model calibration and results):

- Updated MH TOG elevation using LiDAR data and the resulting sewer invert elevations (based on provided depth) along Daniel St, from Atkinson St to Elgin St (upstream and downstream of flow monitor (FM) 2 [refer to **Section 5.1.1.3** for details on the flow monitoring program and sites)];
- Updated MH TOG elevation using LiDAR data and the resulting sewer invert elevations (based on provided depth) along De Costa St, from approximately 200 m south of Didak St to Madawaska Blvd (upstream and downstream of FM 6 [refer to **Section 5.1.1.3** for details on the flow monitoring program and sites)];
- Updated inverts at the intersection of Albert St and Victoria St based on as-built drawings.

The profiles before and after the adjustments are illustrated in **Appendix A.1**, along with additional profile updates. It is recommended that the Town confirm the inverts and resulting profiles along these sections, as well as in areas where engineering validation issues were identified in **Chapter 1** (**Section 4**), which can be integrated in the next W&WWMP update.

5.1.1.1.3 Pumping Stations

As discussed in **Chapter 1** (**Section 4**), the Town is currently serviced by a total of seven sanitary pumping stations (PSs), including five communal pumping stations, one small station in a municipal building near the beach (Robert Simpson Park), and one privately-owned pump station. The five communal PSs are assessed in the W&WWMP. **Table 5-1** summarizes how each PS was represented in the model. Boundary conditions applied at the overflows are discussed in **Section 5.1.1.6.1**.

Table 5-1: Sanitary Model Updates – Pumping Stations

Pumping Station Name	Location	Number of Pumps	PS Operations	Overflow/ Bypass
PS #1	Elgin St E / Claude St	2	Head-discharge curve from design report Pump on/off levels from design report and/or drawings	Wet well overflow to Madawaska River – added based on drawings
PS #2	McNab St / Seventh Ave	2		Upstream bypass to stormwater collection system – added based on drawings
PS #3	Madawaska Blvd / Bridge St	3		Upstream overflow to Madawaska River – reviewed based on drawings
PS #4	McLean Ave / Riverview Dr	Outside of modelled extent	Outside of modelled extent	Outside of modelled extent

Pumping Station Name	Location	Number of Pumps	PS Operations	Overflow/ Bypass
PS #5	Wolff Cres	2	Head-discharge curve from design report Pump on/off levels from design report and/or drawings	None

5.1.1.1.4 Albert St Weir and Overflow

As discussed in **Chapter 1** (**Section 4**), the reconfigured Albert St CSO was updated in the hydraulic model. The weir at MH-NW-MN-1706 was added to the model. The weir elevation of 78.74 m was added based on a DEM ground elevation of 80.04 m and a depth of 1.3 m (as provided in the Town's GIS database). Flows from the weir discharge into a 750 mm diameter sanitary sewer, which discharges into a 1,200 mm diameter stormwater sewer and into the Madawaska River. The discharge into the stormwater sewer is represented as a model boundary condition, as discussed in **Section 5.1.1.6.1**.

5.1.1.2 Population and Areas

The population and areas contributing to wastewater flow generation were updated to reflect existing (2022) conditions, and capture growth which has occurred in the Town since the 2013 W&WWMP update. As described in **Chapter 1** (**Section 4**), a 2022 baseline population of 10,038 people was assumed for the W&WWMP. The distribution of population across the Town was estimated based on residential parcel GIS data. Based on a review of residential parcel GIS data against the wastewater collection system network layout, it is estimated that 8,984 people and 160 ha of ICI properties are serviced by the Town's sewer network. Remaining residential and ICI area are presumably serviced by decentralized systems which do not discharge directly into the Town's sewer network (e.g., septic tanks).

For Inflow and Infiltration (I/I) generation purposes, effective areas consisting of a 100 m buffer around all sanitary sewers were generated (50 m in each direction). This resulted in a total effective area of 448 ha.

5.1.1.3 Flow Monitoring

As presented in **Chapter 1** (**Section 4**), Flowmetrix was engaged to collect data for the 2022 flow monitoring program. This consisted of 6 flow meters (FMs) installed across the Town in early-April of 2022 and remaining operational through to late-July. The flow monitoring data is available on Flowmetrix's portal online, and a detailed flow monitoring report was prepared by Flowmetrix and is provided in **Appendix A.2**. Data from the 6 FMs is used for the wastewater collection system model calibration, in conjunction with the relevant rain gauge (RG) data.

5.1.1.3.1 Flow Meter Sites

The 6 FMs were installed in trunk sewers, providing coverage for the main branches of the wastewater collection system and thus capturing growth across different areas of the Town. A temporary rain gauge was installed at 73 James St (Water Filtration Plant and Public Works Garage yard) for the duration of the flow monitoring program. **Table 5-2** summarizes the flow meter locations, pipe characteristics, and contributing area (metershed) characteristics. The metershed characteristics include the metershed areas (based on the parcels allocated to the metershed), the residential (RES) population, and the industrial, commercial, and institutional (ICI) areas.

The hydraulic model was used to trace the contributing metersheds and create a schematic illustrating the flow meters and their connectivity, as shown in **Figure 5-1**. **Figure 5-2** illustrates the location of the flow meters and the rain gauge, as well as the metersheds and the sewer age (installation year).

Table 5-2: Flow Metershed Characteristics

FM ID	FM Name and Location	MH ID	Meter Location (Upstream or Downstream Pipe)	Pipe Size (mm)	Rain Gauge ID	Total(1) Parcel-Based(2) Contributing Area (ha)	Incremental(3) Parcel-Based Contributing Area (ha)	Total(1) RES(4) Population	Incremental(3) RES(3) Population	Total(1) RES(4) Area (ha)	Incremental(3) RES(3) Area (ha)	Total(1) ICI(4) Area (ha)	Incremental(3) ICI(3) Area (ha)	Total(1) % RES(4) Area	Land Use Classification(5)	General Metershed Sewer Installation Year	General Metershed Type
FM 1	ARN-1 Staye Court Dr	MH-SW-MN-1092	Upstream	600		58	58	889	889	21.2	21.2	18	18	54.4%	Mixed Use	> 2000	Separated
FM 2	ARN-2* Daniel St/CN Recreation Trail	MH-NW-MN-236	Upstream	600		252	193	4,424[6]	3,536[(6)]	103.3	82.1	50	32	67.5%	Mixed Use	Mixed	Mixed (Separated and Combined)
FM 3	ARN-3 Elgin St W/Madawaska St	MH-NW-MN-448	Upstream	600	Arnprior-RG	49	49	1,253	1,253	28.9	28.9	4	4	86.7%	RES	Mixed	Mixed (Separated and Combined)
FM 4	ARN-4 Riverview Dr	MH-NE-MN-1314	Upstream	400		38	38	554	554	13.2	13.2	16	16	45.1%	ICI	< 2000	Separated
FM 5	ARN-5* Madawaska Blvd	MH-NE-MN-1328	Downstream	750[(7)]		113	67	1,007	1,007	22.3	22.3	61	19	26.8%	ICI	Mixed	Separated
FM 6	ARN-6 Decosta St	MH-NE-MN-1508	Upstream	400		46	46	-	-	0.0	0.0	42	42	0.0%	ICI	< 2000	Separated

Notes:

(1) Total contributing areas, populations and ICI areas include areas/populations draining to upstream FMs (FM in series).
(2) Parcel-based area refers to the area of all parcels draining to each meter; includes non-effective areas like parking lots, parks, etc.
(3) Incremental areas and populations refer to only the areas/populations between the upstream FM and the FM of focus.
(4) Percent (%) RES area is based on total area of RES and ICI parcels [RES area / (RES + ICI area)].
(5) Land Use Classification is generalized based on % RES;
   a. < 50% is considered ICI,
   b. Between 50% and 75% is considered Mixed, and,
   c. > 50% is considered RES.
(6) The sum of the incremental values does not equal the total value due to rounding.
(7) FM 5 pipe diameter measured by FlowMetrix and confirmed with as-built drawings of PS #3 (drawing reference: *C-102-3*; Trow Consulting Engineers Ltd., 2004); previous model diameter input of 600 mm was updated accordingly.

FM is downstream of one or more other FMs (FM in series)

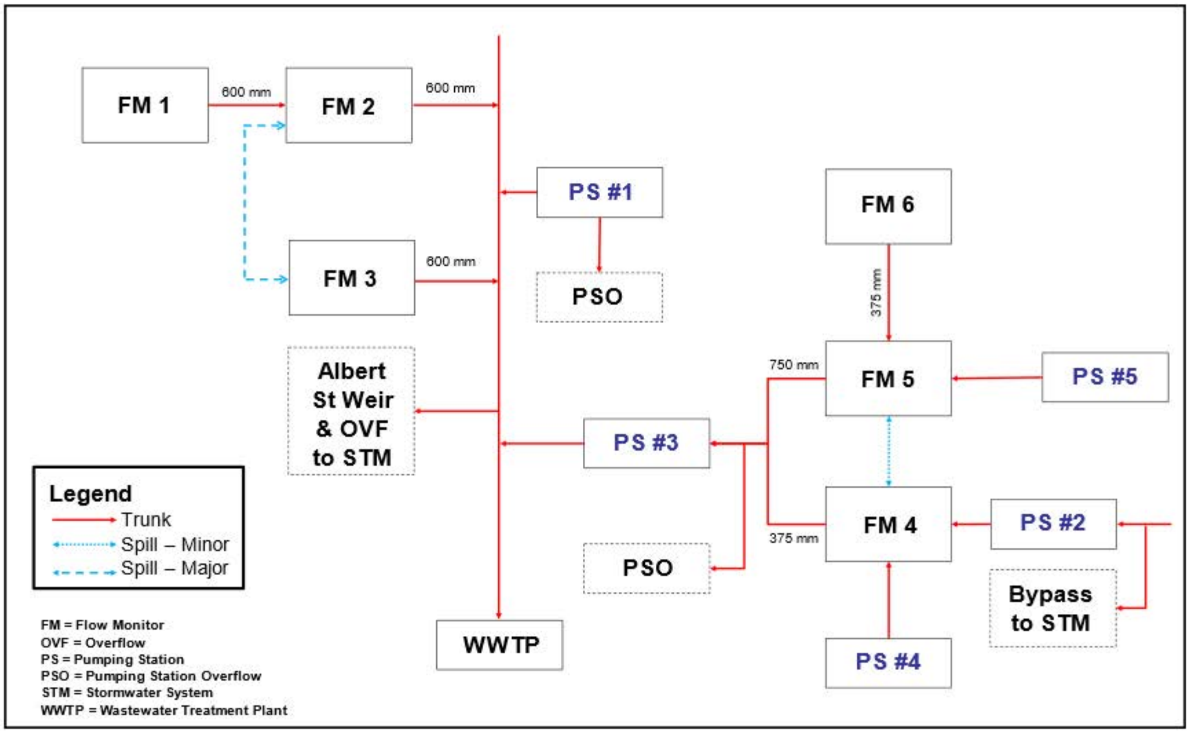
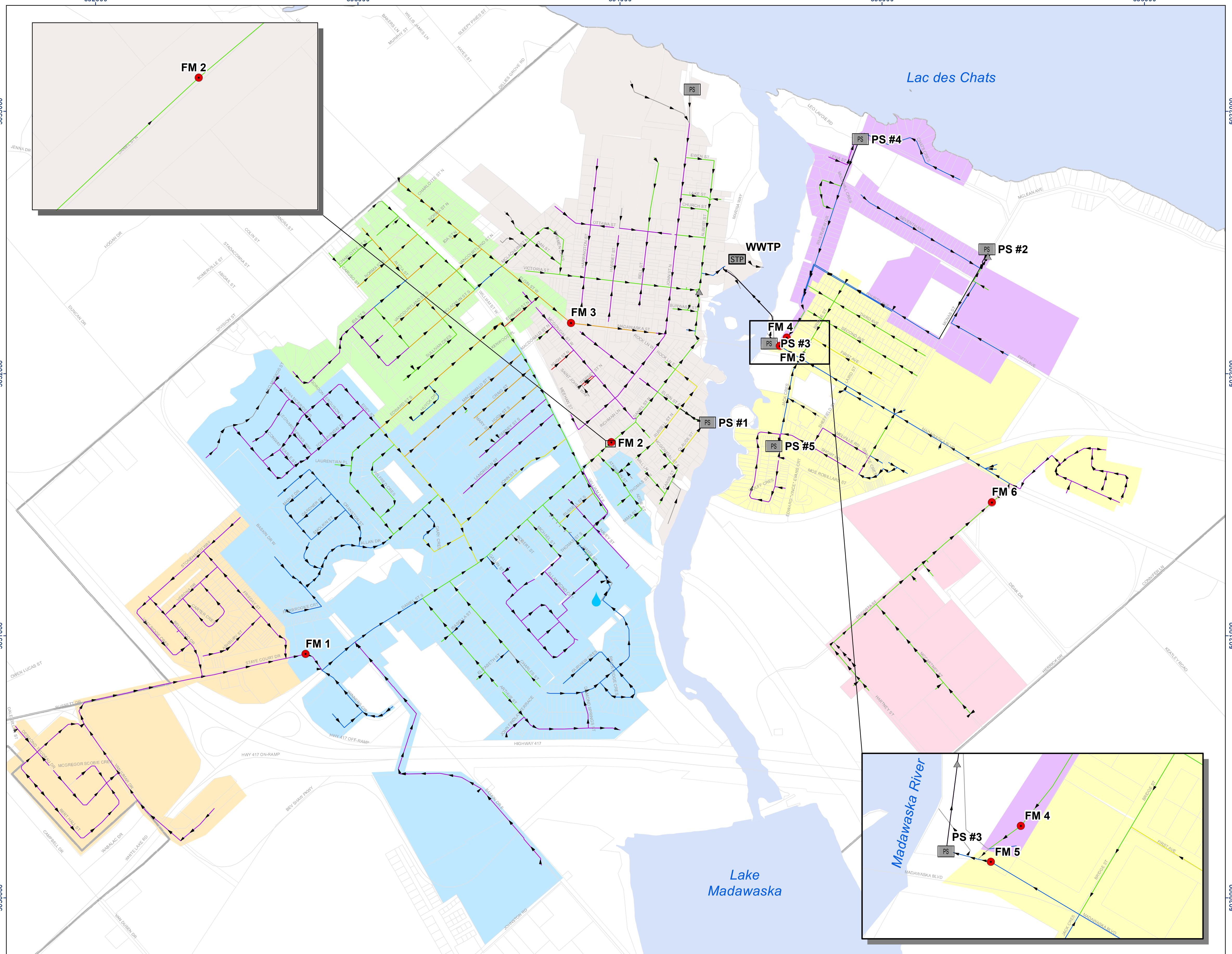


Figure 5-1: 2022 Flow Meter Schematic

As shown in **Figure 5-1**, FM 2 is located downstream of FM 1 and drains through the Daniel St N trunk to the WWTP. FM 5 is located downstream of FM 6 and drains through the Madawaska Blvd trunk to PS #3. FM 5 is also downstream of PS #5. PS #2 is upstream of FM 4, which, like FM 5, also drains to PS #3. FM 3 drains through Elgin St W to the WWTP.

A weir is located at Albert St and Victoria St, where wastewater can overflow into a storm sewer, which discharges into the Madawaska River. PS #1 and PS #3 have overflows (PSOs), which also discharge into the river. There is also a bypass upstream of PS #2, which discharges into the stormwater collection system.

Bifurcation manholes (more than 1 outgoing pipe) that define flow splits (FSs) or high points (HPs) within the system were previously identified as special hydraulic structures [see **Chapter 1** (**Section 4**)]. If located along a metershed boundary, these bifurcations can result in hydraulic connectivity between sub-systems depending on the chamber and pipe orientation, and the flow conditions observed. The flow schematic indicates the presence of major spill points between the FM 2 and FM 3 metersheds, where the upstream inverts of the outgoing pipes from the FS or HP are similar in elevation, thus resulting in frequent or consistent hydraulic connectivity, potentially even during low flow conditions. The flow schematic also indicates the presence of minor spill points between the FM 4 and FM 5 metersheds, where a larger offset is observed between the upstream inverts of the outgoing pipes, and hydraulic connectivity with the system of higher elevation likely occurs less frequently and potentially only during higher flow conditions. With spill points identified between metersheds, calibration can prove challenging due to the contributing upstream area varying with fluctuating flow conditions.



Stantec

Legend

- Sanitary Pump Station (PS)
- Overflow
- Wastewater Treatment Plant (WWTP)

Sanitary Sewer Installation Date

- Not Stated
- 1910 - 1919
- 1920 - 1939
- 1940 - 1959
- 1960 - 1979
- 1980 - 1999
- 2000 - 2020
- Forcemains
- Rain Gauge
- Flow Meter

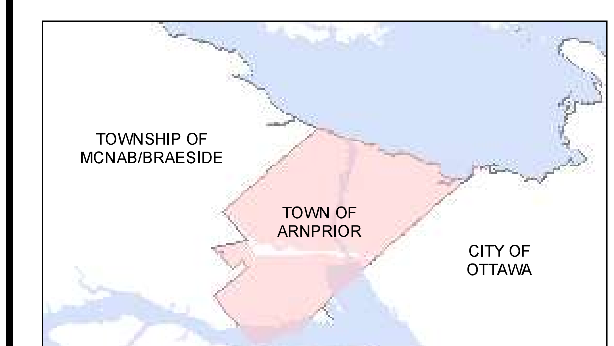
Flow Metershed

- FM 1
- FM 2
- FM 3
- FM 4
- FM 5
- FM 6
- Unmonitored

N

0 250 500 Meters
(At original document size of 11x17)
1:15,000

Notes
1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Export_Output_Parcel_Fabric.shp*, *Export_Output_Roads.shp*, *Export_Output_San_MH.shp* and *Export_Output_SAN_SEWER.shp* provided by the Town of Arnprior
3. Background: Contains information licensed under the Open Government Licence – Ontario
4. Abbreviations: FM: Flow Monitor; MH: Maintenance Hole; PS: Pump Station; WWTP: Wastewater Treatment Plant



Project Location Prepared by CR on 2023-02-14
Arnprior, ON

Client/Project 163401723
Town of Arnprior
2022 W&WW Master Plan Update

Figure No.
5-2

Title
2022 Flow Monitoring Program Meter & Rain Gauge Locations

C:\Users\crazafimaharo.CORP\Documents\Local_Work_Tmp\Local-163401723-ArnpriorMP\gis_local\MXDs\fm2_figs\fig2-2_am_san_fm_map_wFMsheds_wPPEage_20230214.mxd Revised: 2023-02-14 By: crazafimaharo

5.1.1.3.2 Flow Meter Data Availability

Flow monitoring data is available at each monitor between April 6th and July 19th, 2022. Although velocity and depths were continuously monitored throughout the duration of the program, there are periods of variable data, including data drift, velocity dropouts, and the effects of silt and debris. Data variability and quality is discussed in **Section 5.1.1.3.3**.

5.1.1.3.3 Flow Meter Data Quality Review

The meter data for all flow meters between April 2022 and July 2022 was reviewed on a macro-level to identify periods of missing data, questionable readings (depth/velocity), backwater and surcharge. This review is the first step in identifying appropriate periods of data for the selection of the dry weather flow (DWF) periods and wet weather flow (WWF) events. This flow meter data quality assessment is illustrated in **Appendix A.3**. Key observations from this macro data review are listed below, which are considered in the selection of calibration periods and the evaluation of subsequent calibration results:

- **Velocities at all FMs generally decrease throughout the flow monitoring period** – Higher velocities (and flows) are observed in April and May, where the wastewater flows experience latent snowmelt. This drift is particularly pronounced in FM 6. This drift could be due to a reduction in groundwater contributions, as the weather becomes warmer and groundwater levels decrease. Observed velocities throughout the flow monitoring program at all FMs are shown in **Figure 5-3** (figure exported from FlowWorks website). Observed flows and depths are illustrated in the flow monitoring report by FlowMetrix, provided in **Appendix A.2**

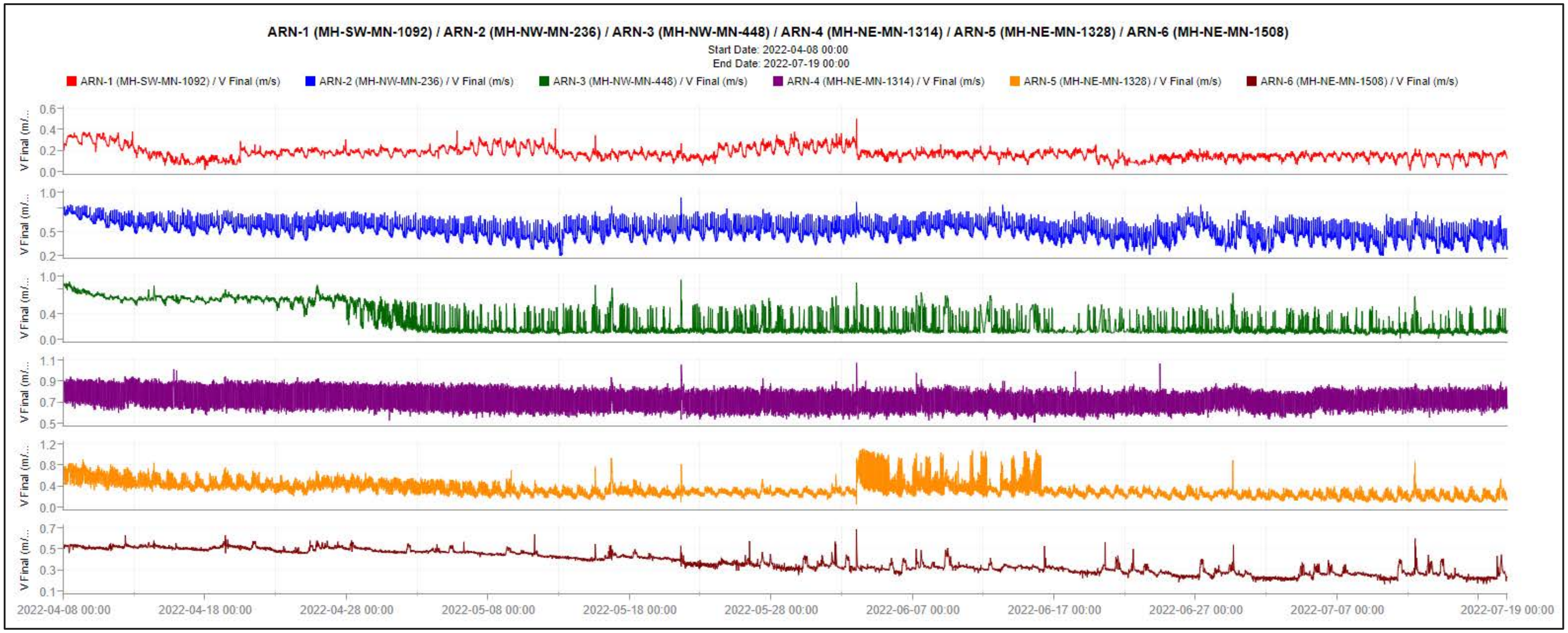
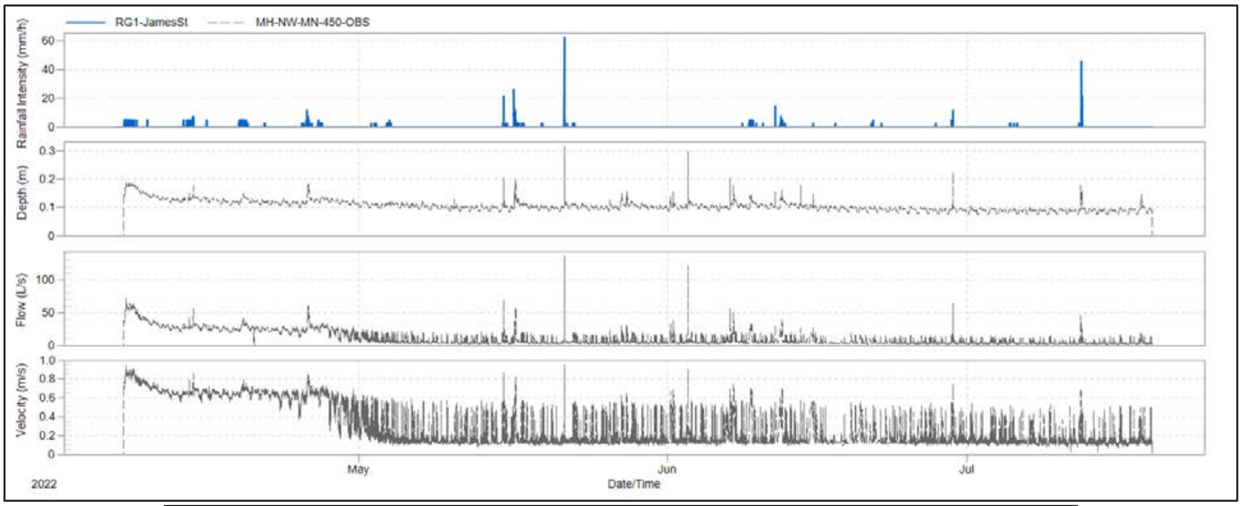


Figure 5-3: 2022 Flow Monitoring Program Velocity Data at all FMs (Entire Period) – Figure Exported from FlowWorks Website

- **FM 3 had a prolonged period of questionable data quality** – Starting on April 28th, 2022, velocity readings at FM 3 decrease on average, while a significant amount of noise is observed in the data. A response to wet weather events can still be observed. Flowmetrix observed whirlpooling flow during site visits. The velocity decrease is possibly due to upstream blockage. This may pose challenges during calibration (especially DWF calibration), as the cause of this velocity decrease is unclear and can therefore be difficult to represent in the model. Flow monitoring data at FM 3 for the entire period is shown in **Figure 5-4**.



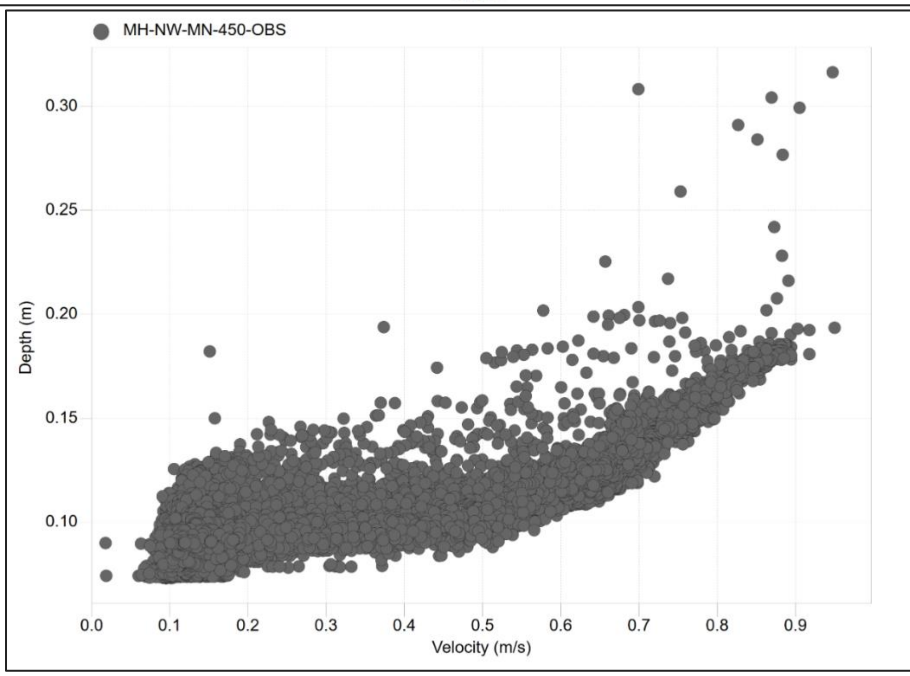
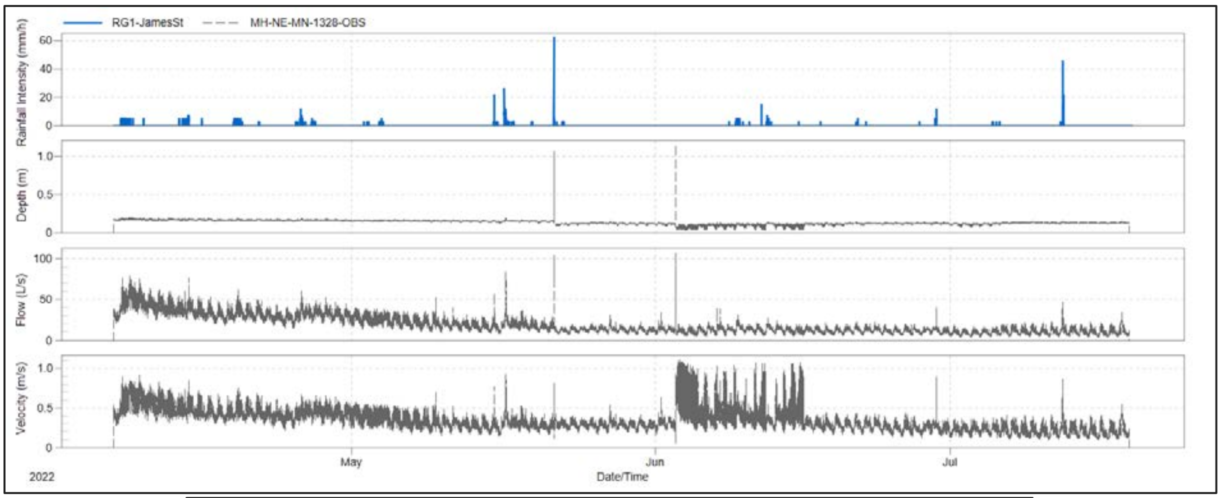


Figure 5-4: 2022 Flow Monitoring Program Data at FM 3 (Entire Period)

- **FM 5 had a significant period of questionable data quality** – On June 3rd, 2022, the pipe at FM 5 experiences backwater and is surcharged. The cause of this backwater is unknown, and cannot be compared to rainfall data, which is missing from May 24th, 2022 to June 8th, 2022 (see discussion of rainfall data quality in **Section 5.1.1.4.1**). Following this, from June 4th, 2022 to June 16th, 2022, velocity and depth readings at FM 5 show fluctuations, with an increase in noise, as shown in **Figure 5-5**. Due to these data quality issues, this period is not used during calibration. The cause of these data quality issues could not be confirmed by Flowmetrix, but could be due to a blockage.



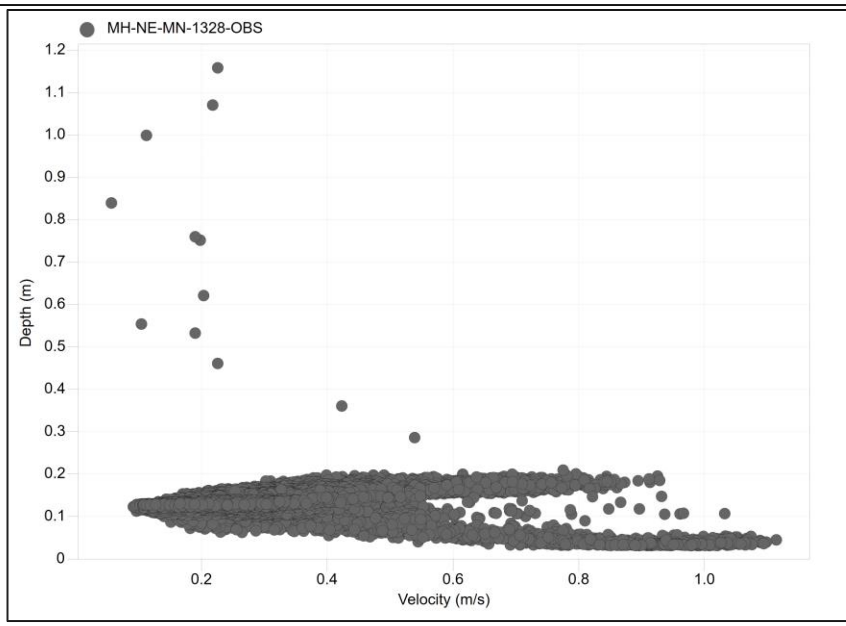


Figure 5-5: 2022 Flow Monitoring Program Data at FM 5 (May 31st, 2022 to June 18th, 2022)

- **Pump station influence** – FM 2, FM 4, and FM 5 experience notable fluctuations in flow patterns consistent with the presence of nearby pumps, as identified in **Section 5.1.1.3.1**. Pump station influence can present challenges in calibration, as operational changes occurring in pump stations can be difficult to represent in the model. Additionally, information on private pump stations is unknown. Flow monitoring data during a sample dry period is shown in **Figure 5-6** (FM 2), **Figure 5-7** (FM 4), and **Figure 5-8** (FM 5).

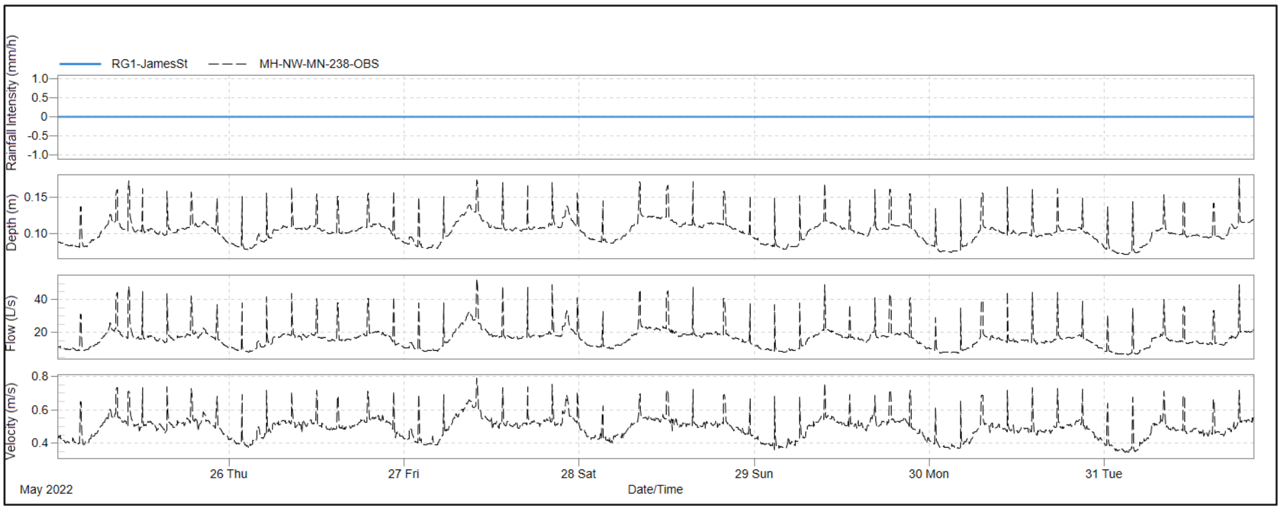


Figure 5-6: 2022 Flow Monitoring Data at FM 2 (Sample Dry Period from May 25th to May 31st, 2022)

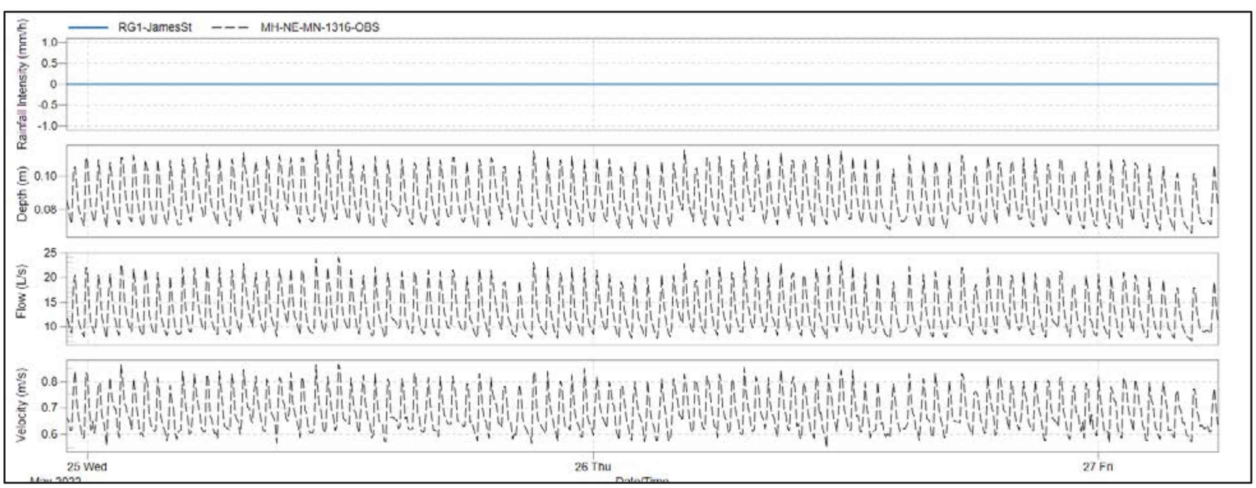


Figure 5-7: 2022 Flow Monitoring Data at FM 4 (Sample Dry Period from May 25th to May 27th, 2022)

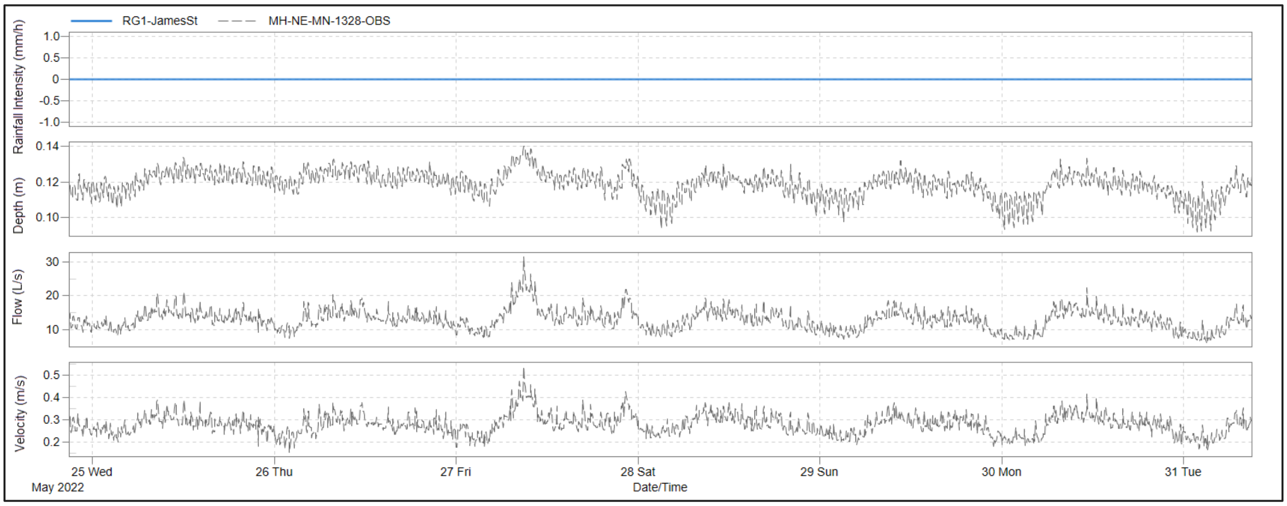


Figure 5-8: 2022 Flow Monitoring Data at FM 5 (Sample Dry Period from May 25th to May 31st, 2022)

- **Two meters experience backwater conditions and surcharge** – FM 4 and FM 5 both experience backwater conditions (sudden decrease in velocity) and are surcharged (measured depth exceeds pipe diameter) during the May 21st, 2022 rainfall event and on June 3rd, 2022. No rainfall was recorded on June 3rd, 2022 due to rain gauge data dropout from May 24th, 2022 to June 8th, 2022 (see **Section 5.1.1.4.1**). A review of Environment and Climate Change Canada (ECCC; Environment Canada) historical weather data from the nearest station (daily total precipitation at Appleton) indicates that there may have been a rainfall in this area on that day. Backwater conditions can present challenges during model calibration as the hydraulic conditions within a surcharged pipe can fluctuate and be difficult to replicate.
- Three-day weekends (Friday to Sunday) with significant pattern variations are observed at FM 6 – Almost no flow is observed in FM 6 on weekends, including Fridays, as shown in Figure 5-9 for a sample week. This suggests that activity in the ICI areas upstream of FM 6 generally stops from Friday to Sunday. Differences can be observed in calibration, as flow generation on Fridays are assigned the weekday pattern.

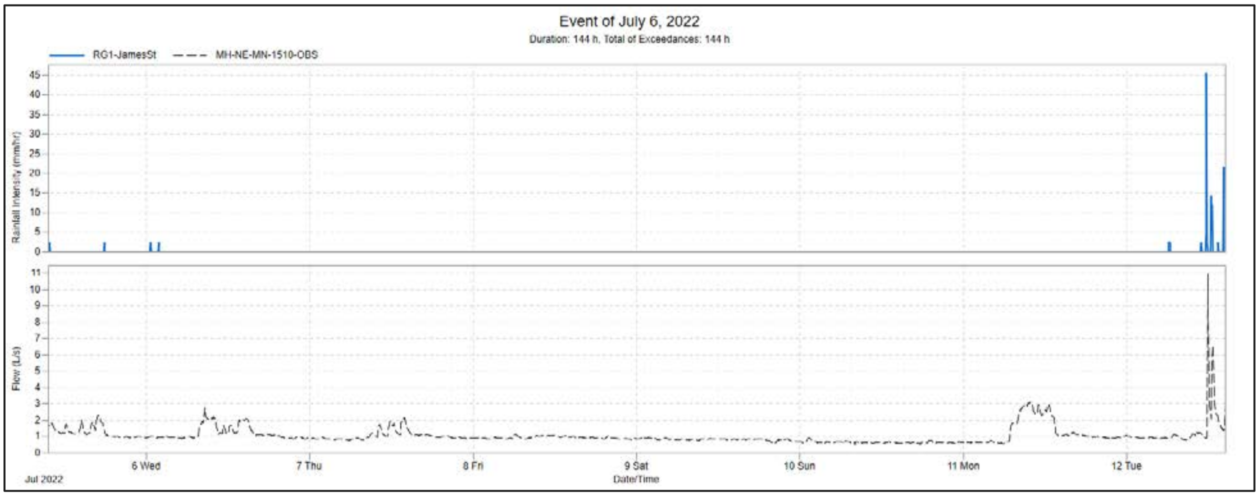


Figure 5-9: 2022 Flow Monitoring Data at FM 6 (Sample Week from July 5th to July 12th, 2022)

- **The flow meter data quality is acceptable for calibration** – The majority of the flow meters showed reasonable response to the WWF events and presented generally consistent data (diurnal patterns) for DWF calibration.

5.1.1.4 Rainfall Data

Along with the 6 FMs, a temporary rain gauge (RG) was installed at 73 James St (Water Filtration Plant and Public Works Garage yard) throughout the duration of the flow monitoring program from early-April to late-July 2022. The rainfall data collected was assessed in conjunction with the flow monitoring data and used to select the DWF periods and WWF events used for calibration. The following sections detail the assessment findings and selected periods.

5.1.1.4.1 Data Quality and Quantity Review

Figure 5-10 presents the cumulative rainfall measured at the James St RG during the flow monitoring program period from April 7th, 2022 to July 16th, 2022. Throughout this period, the rain gauge collected 170 mm in cumulative rainfall. Flowmetrix reported a rain gauge data collection failure from May 24th, 2022 to June 8th, 2022, where rainfall data was unavailable. This data availability issue was considered when selecting DWF periods and WWF events. Rainfall data was otherwise generally good and acceptable for calibration.

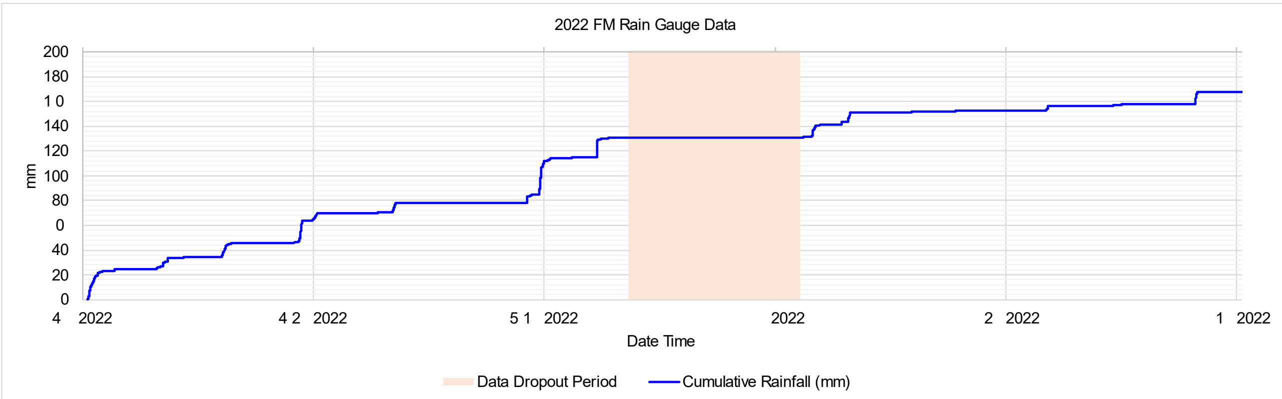


Figure 5-10: Cumulative Rainfall Volume at the James St Rain Gauge

5.1.1.4.2 Dry Weather Flow Calibration Periods

Periods of DWF were defined by no more than 1 mm of rain in the previous 7 days. Periods of 6 consecutive days of dry weather were targeted for calibration. A total of 21 DWF days were identified between early-April 2022 and late-July 2022. Most of these DWF days fall within 4 separate periods. The periods were selected to straddle the flow monitoring program period, and to include a variety of weekday and weekend days, for a more representative calibration. The selected DWF periods are as follows:

- DWF Period 1: May 6th, 2022 (00:00) to May 12th, 2022 (00:00); and,
- DWF Period 2: July 6th, 2022 (00:00) to July 12th, 2022 (00:00).

5.1.1.4.3 Storm Events Summary

The rain gauge data was processed to identify storm events. Storm event volume, duration and peak intensities were considered when identifying potential events for use in calibration. **Table 5-3** summarizes the 7 most significant rainfall events identified.

The selected WWF events were plotted against the Intensity-Duration-Frequency (IDF) curves for the nearest Environment Canada rain gauge in Shawville, Québec, as shown in **Figure 5-11**. All the identified events correspond to an event with a 1:2-year return period or less. While the May 21st, 2022 WWF event generated the most significant response in the system, it is still classified as a 1:2-year storm. Therefore, only smaller events were captured during the monitoring period from which to base the WWF calibration. The observed events are considered acceptable for use in calibration, however, using smaller events for this purpose can in some cases results in unrealistic extrapolated responses when more extreme events are simulated [i.e., the design event(s)].

Table 5-3: Storm Event Characteristics

Event Rank(1)	Start Time	End Time	Duration (hr)	Total Volume (mm)	Average 5 Minute Peak Intensity (mm/hr)	Event Return Period(2)
1	5/21/22 14:35	5/21/22 15:39	1.08	15.0	62.4	≤ 1:2-year
2	7/12/22 6:10	7/12/22 14:14	8.08	10.2	45.6	< 1:2-year
3	5/16/22 13:30	5/17/22 0:30	11.00	27.6	26.4	< 1:2-year
4	5/15/22 10:25	5/15/22 21:50	11.42	6.4	21.6	< 1:2-year
5	6/11/22 19:00	6/11/22 19:15	0.25	2.4	14.4	< 1:2-year
6	6/29/22 12:00	6/29/22 15:45	3.75	3.8	12.0	< 1:2-year
7	4/25/22 7:55	4/26/22 0:55	17.00	17.8	12.0	< 1:2-year

Notes:

Events ranked based on average 5-minute peak intensity.

Return frequency based on IDF curves at the ECCC Shawville, Québec station.

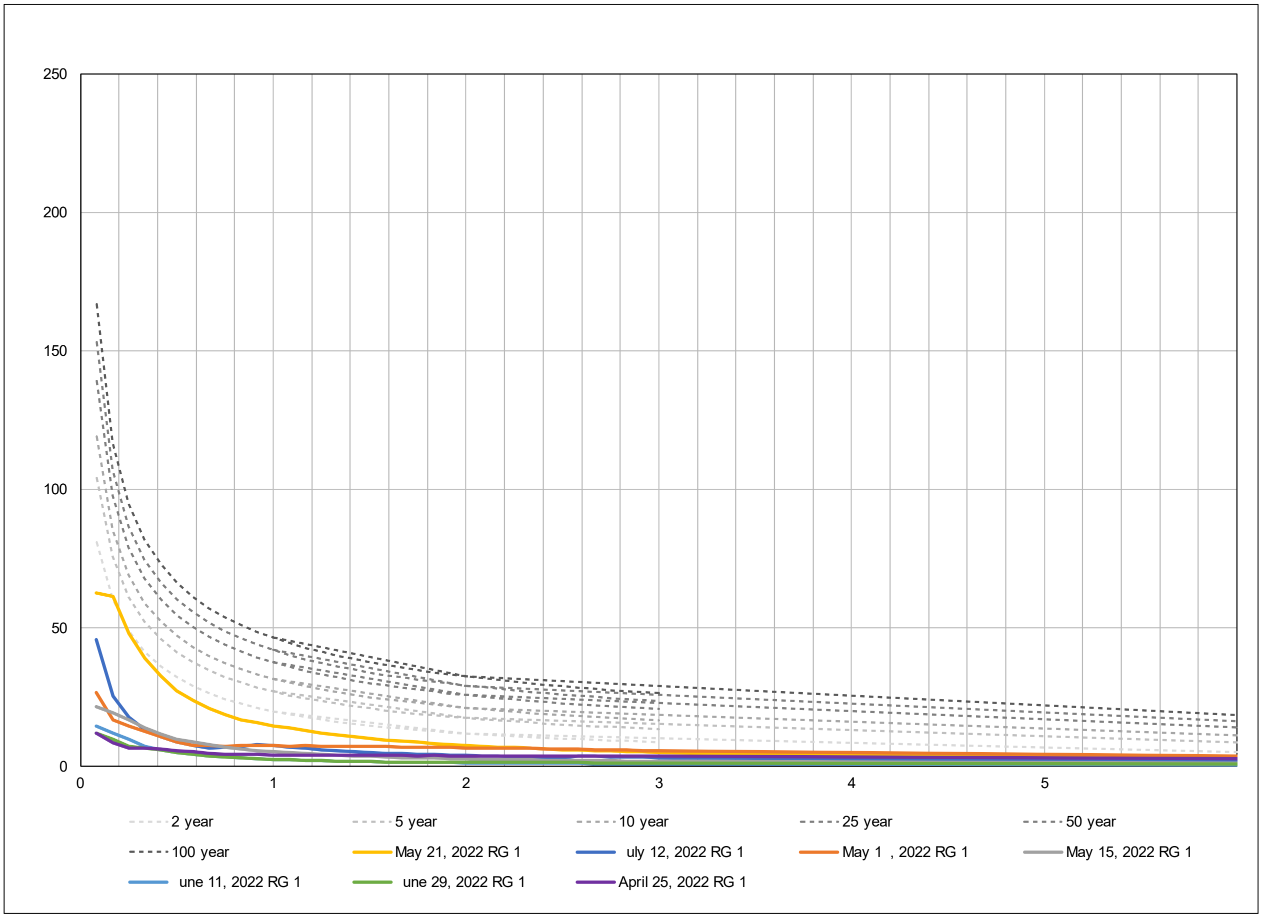


Figure 5-11: Comparison of 2022 FM Rainfall Events to IDF Curves

5.1.1.4.4 Selection of Wet Weather Flow Calibration Events

The intent of the rainfall event review was to define and use 2 WWF events. Although short in duration, the May 21st event was selected, as it produced the highest peak intensity and good responses at the FMs. Likewise, the July 12th event produced the second highest peak intensity and good responses in most FMs. Refer to **Table 5-3** for event details.

The wet weather events selected for calibration are therefore as follows:

- WWF Event 1: May 21st, 2022 (12:00) to May 22nd, 2022 (0:00), referred to as the May 21st, 2022 event; and,
- WWF Event 2: July 12th, 2022 (3:00) to July 12th, 2022 (21:00).

5.1.1.5 Other Wastewater Collection System Data

Along with the FM and rainfall data collected as part of the 2022 flow monitoring program, Supervisory Control and Data Acquisition (SCADA) data at the WWTP and PS facilities and records of CSO volumes for 2022 were provided. While this information is not used for a direct calibration of the model parameters, it is used to validate the modelled results at these different facilities and provide context on the system's performance.

5.1.1.5.1 SCADA Data Review

Along with the FM and rainfall data collected as part of the 2022 flow monitoring program, SCADA data at the WWTP and PS facilities was provided for 2021 and 2022. Since data for 2022 was provided for the entire year, it overlaps with the flow monitoring period, and is used to validate the calibrated model's results. The following sub-sections provide a review of the SCADA data requested and provided by location.

PS SCADA Data

SCADA data was provided for all PSs and is used to validate the modelled PS performance. **Table 5-4** presents the SCADA data availability for the PSs, and the following sub-sections provide details on each location.

In general, as noted in **Section 5.1.1.1.3**, control setpoints (on/off levels) for the PSs were applied in the model based on design briefs. However, the PSs' current operations may differ from design operations, such that the level cycles observed in the data can differ from the modelled cycles. Pump curves were also used when provided in design briefs, which can also differ from the current pump operation. This can create discrepancies when comparing observed and modelled wet well level ranges and cycles. Differences are thus also expected in the pump running statuses. Provided pump running statuses were not used to adjust the PS operation in validation, as the calibration fits at downstream meters are considered adequate for W&WWMP purposes (see **Section 5.1.1.6**) and because operational set points can fluctuate regularly.

Table 5-4: PS SCADA Data Availability

Facility	Location	SCADA Data Available	Timeframe and Temporal Resolution
PS #1	Elgin St E / Claude St	Wet well levels (mm) Individual pump running status (on/off)	January 2022 to December 2022 (1-minute timestep)
PS #2	McNab St / Seventh Ave	Wet well levels (mm) Individual pump running status (on/off)	
PS #3	Madawaska Blvd / Bridge St	Wet well levels (mm) Individual pump speed (rpm)	
PS #4	McLean Ave / Riverview Dr	Wet well levels (mm) Individual pump running status (on/off)	
PS #5	Wolff Cres	Wet well levels (m) Individual pump flow (L/s)	

PS #1

The following SCADA data was provided for PS #1:

- **Wet well levels** (in mm) from January 2022 to December 2022 at a 1-minute timestep: this data is compared against the modelled wet well levels.
- **Individual pump running status** (on/off) from January 2022 to December 2022 at a 1-minute timestep: this data is not used, as pump running status depends on current PS operations and can therefore deviate from PS design setpoints (as inputted into the model). Since the calibration results downstream of this PS for the selected periods and events were acceptable (see **Section 5.1.1.6**), adjustments to align to the observed individual pump running status were not considered necessary.

PS #2

The following SCADA data was provided for PS #2:

- **Wet well levels** (in mm) from January 2022 to December 2022 at a 1-minute timestep: data is missing for prolonged durations; it is therefore not used.

- **Individual pump running status** (on/off) from January 2022 to December 2022 at a 1-minute timestep: this data is not used, as pump running status depends on current PS operations and can therefore deviate from PS setpoints (as input into the model). Since the calibration results downstream of this PS for the selected periods and events were acceptable (see **Section 5.1.1.6**), adjustments to align to the observed individual pump running status were not considered necessary.

PS #3

The following SCADA data was provided for PS #3:

- **Wet well levels** (in mm) in each of the two connected chambers from January 2022 to December 2022 at a 1-minute timestep: the wet well levels between the two connected chambers should be similar; however, due to sensor calibration issues, the levels are inconsistent, until this discrepancy is corrected in mid-November 2022. This data is therefore not used.
- **Individual pump speed** (rpm) from January 2022 to December 2022 at a 1-minute timestep: this data is not used, as measured pump speed is not directly comparable with a modelled output.

PS #4

The following SCADA data was provided for PS #4:

- **Wet well levels** (in mm) from January 2022 to December 2022 at a 1-minute timestep: this data is not used.
- **Individual pump running status** (on/off) from January 2022 to December 2022 at a 1-minute timestep: this data is not used.

PS #4 resides outside the extent of the hydraulic model; thus, this data is not used.

PS #5

The following SCADA data was provided for PS #5:

- **Wet well levels** (in m) from January 2022 to December 2022 at a 1-minute timestep: this data is compared against the modelled wet well levels.
- **Individual pump flow** (L/s) from January 2022 to December 2022 at a 1-minute timestep: this data is compared against the modelled flow through the pumps.

WWTP SCADA Data

Inlet channel level SCADA data from 2021 was provided for the WWTP. This data is used to establish the boundary conditions applied in the hydraulic model (see **Section 5.1.1.6.1**).

Influent and effluent channel 2022 flow measurements were provided for the WWTP. Based on a review of drawings, it was identified that the two datasets of influent flows were measured in the channels downstream of the grit tanks. For this analysis, it was assumed that these flows could be added to represent the total incoming flow to the WWTP, for a comparison with the modelled flows into the WWTP (upstream of the grit tanks). There may however be discrepancies due to hydraulic losses through the grit tanks, such that the measured flows within the influent channels may be less than incoming flows to the WWTP. **Table 5-5** presents the SCADA data availability for the WWTP.

Table 5-5: WWTP SCADA Data Availability

Facility	Location	SCADA Data Available	Timeframe and Temporal Resolution
WWTP	233 Albert St	Inlet channel level data (mm)	January 2021 to December 2021 (1-minute timestep)
WWTP	233 Albert St	Influent channel(1) flow (L/s) Effluent channel flow (L/s)	January 2022 to December 2022 (1-minute timestep)

Note:

(1) Two sets of flow measurements were provided for each influent channel, downstream of the grit tanks at the WWTP. For this analysis, it was assumed that these flows could be added to represent the total incoming flow to the WWTP.

5.1.1.5.2 CSO Records

The level in the Albert CSO is monitored using a level logger that is maintained by Capital Controls. The flows are then estimated based on these levels. The data from this logger is connected to the Town's SCADA system through the WWTP and an alarm is triggered during any bypasses. The data is read and reset following each event. **Table 5-6** lists CSO occurrences in 2022, as reported by the Town as of December 1st, 2022.

Of the 3 CSO occurrences that were recorded in 2022, only 2 of them (on May 21st and on June 3rd) align with the flow monitoring program period. As noted in **Section 5.1.1.4.1**, rainfall data was unavailable from May 24th, 2022 to June 8th, 2022. A review of Environment Canada historical weather data from the nearest active station (daily total precipitation at Appleton) indicates that there may have been a rainfall in this area on that day. However, this data is only available at a daily resolution and thus, the model cannot be validated to the June 3rd CSO occurrence.

A wet weather flow calibration event was selected for May 21st, 2022, which aligns with a CSO occurrence. However, the CSO volume reported on that day is an estimation, as the Town noted that the flow meter lost power due to a widespread outage. In general, accurate measurements of CSO volumes can be difficult to obtain. Therefore, the calibration does not focus on reproducing this CSO volume, but only validating the occurrence of the CSO.

Table 5-6: CSO Occurrences in 2022

CSO Occurrence	Date	CSO Volume (m^3)
1	May 21st, 2022	Estimated 500 m^3(1)
2	June 3rd, 2022	56 m^3
3	August 26th, 2022	5.5 m^3

Note:

(1) Town noted that the flow meter lost power due to a widespread outage

5.1.1.6 Model Calibration and Validation

The selected 2022 flow monitoring periods and events are used to establish the DWF and WWF parameters, including the residential and ICI sewage generation rates, diurnal patterns, groundwater infiltration (GWI) rates, resulting baseflows, and rainfall derived infiltration and inflow (RDII). Areas without monitor coverage are allocated average parameters from the monitored areas based on the unmonitored area's characteristics. A total of 2 DWF and 2 WWF events have been selected for calibration.

The process of adjusting model parameters to better correlate results with observed data is referred to as model calibration. This calibration process was achieved using an iterative approach until an acceptable fit to the observed flow was obtained. Dry and wet weather targets have been adopted in accordance with the *Chartered Institution of Water and Environmental Management (CIWEM) Urban Drainage Group (UDG) Code of Practice for the Hydraulic Modelling of Urban Drainage Systems,"* ver. 01, dated November 2017*.* The target guidelines are outlined in **Section 5.1.1.6.2** (DWF) and **Section 5.1.1.6.3** (WWF).

The initial calibration parameters for each metershed were extracted from the flow monitoring data, using the US Environmental Protection Agency (EPA) flow monitoring data analysis software Sanitary Sewer Overflow Analysis and Planning (SSOAP) toolbox. The parameters were then applied to the updated existing areas and populations within each metershed, representative of 2022 conditions (see **Section 5.1.1.2**).

5.1.1.6.1 Boundary Conditions

Boundary condition locations originally identified in **Chapter 1** (**Section 4**) were reviewed during model calibration. **Table 5-7** presents the boundary conditions applied in the model, which are presented in detail in the following sub-sections.

Table 5-7: Boundary Conditions for Calibration

Location Description	MH/ Modelled Node ID	Boundary Condition Type	FM Metershed	Value Applied
Private PS (WFP Sludge Discharge) Inflows	MH-NW-MN-328	Inflow	FM 2	DWF Calibration: Inflows based on FM data WWF Calibration: +26.6 L/s every 3 hours(1)
PS #1 Overflow to Madawaska River	D9435231822	Level	Unmonitored	Free Flowing
PS #2 Overflow to Stormwater System	D9541132448	Level	Unmonitored	Free Flowing
PS #3 Overflow to Madawaska River	OT-NE-MN-1700	Level	Unmonitored	Free Flowing
Albert St Overflow to Stormwater System	D9430232311	Level	Unmonitored	Free Flowing
WWTP Inlet Channel	WWTP	Level	Unmonitored	78.31 m(2)

Notes:

(1) Average inflow pattern extracted from flow monitoring data.

Based on typical WWTP inlet channel elevation range of 400-430 mm under dry weather conditions (per operations staff); higher end selected based on review of 2021 SCADA. Boundary condition applied under both dry and wet weather conditions, based on review of resulting overflows at the Albert St weir.

Private PS Inflows (WFP Sludge Discharge, Upstream of FM 2)

As identified from the flow monitoring data (**Section 5.1.1.3.3**), flows in FM 2 are influenced by inflows from an upstream private PS. These inflows may be attributed to the WFP sludge discharge pumps, based on a review of GIS data and the WFP CoA. The corresponding inflows were extracted from the flow monitoring data and imported into the model as an incoming 'inflow' hydrograph directly upstream of FM 2. For DWF calibration, the observed inflows from the flow monitoring data during each DWF calibration period were used. For WWF calibration and system assessment, an average inflow pattern of +26.6 L/s approximately every 3 hours was used.

PS #1 Overflow to Madawaska River

PS #1 has an overflow pipe that allows the relief of excess flows from the pumping station wet well to the Madawaska River. It is initially assumed that the downstream river levels do not impact the overflow and is thus modelled as a free outfall (no boundary condition applied). The validity of this assumption was assessed during calibration and did not suggest any required adjustments and therefore, the initial assumption was maintained.

PS #2 Overflow to Stormwater System

A bypass is located upstream of PS #2, which discharges into the stormwater collection system and eventually into the Madawaska River when triggered. The bypass pipe is included in the model and drains to a free outfall (i.e., the stormwater sewer is not modelled). The validity of this assumption was assessed during calibration and was maintained.

PS #3 Overflow to Madawaska River

An overflow pipe is located upstream of the PS #3 wet well, discharging into the Madawaska River. The overflow pipe is modelled with a free outfall, which was reviewed in calibration and maintained.

Albert St Overflow to Stormwater System

Overflows at the Albert St weir are first conveyed into a 12 m long 750 mm diameter sanitary sewer, which discharges into a 1200 mm diameter stormwater sewer pipe and eventually drains into the Madawaska River. The Albert St weir and sanitary sewer are included in the model with a free outfall (i.e., the stormwater sewer is not modelled).

Since these overflows are meant to relieve the system when surcharged, it can be initially assumed that the downstream water levels do not impact the overflows. The validity of this assumption was reviewed during calibration and did not suggest any required adjustments.

WWTP Inlet Channel

The WWTP is not modelled. Rather, a dummy pipe is used to represent the WWTP inlet channel, which drains directly into an outfall node. The boundary condition applied at the WWTP inlet channel was based on information provided by Town operations staff, a review of 2021 inlet channel SCADA levels and resulting overflows at the Albert St weir, and drawings of the WWTP.

The WWTP drawings showed an inlet channel invert elevation of 77.88 m. Town operations staff provided the following ranges of inlet channel level for different conditions:

- Dry weather levels: 400-430 mm
- Light rain: 500 mm
- Maximum level (triggering a plant bypass): 900 mm.

Based on a review of 2021 SCADA data, the reported upper range of the dry weather levels (430 mm) is representative of the typical levels observed in the inlet channel under dry weather conditions. An inlet channel level of 78.31 m was therefore applied as a fixed head on the outfall node under dry weather conditions.

The 2021 SCADA data showed a peak inlet channel depth of 880 mm. This value is close to the maximum level of 900 mm reported by Town operations staff. However, an inlet depth of 880 mm results in a water level boundary condition of 78.76 m, which is higher than the Albert St weir elevation in the model (78.74 m), and results in a continuous CSO.

The Albert St weir elevation is set in the model using the provided measured depth and the DEM rim elevation. The modelled overflows are triggered based on flow, the weir elevation, and the boundary condition at the WWTP. For the Albert St weir elevation provided, different wet weather boundary conditions at the WWTP were trialled:

- Applying the peak inlet channel depth of 880 mm throughout the entire simulation (including during dry periods) resulted in unrealistic results, generating sanitary sewer overflows (SSOs) before and after the wet weather event;

- Applying the peak inlet channel depth of 880 mm only for the duration of the rainfall event was also tested during calibration, however it did not yield the expected overflows at the Albert St weir (see discussion in **Section 5.1.1.6.4**).

The 2021 SCADA data otherwise shows an inlet channel depth range of 500-600 mm under wet weather conditions, which aligns with the levels reported by operations staff. This range could be appropriate for the majority of rainfall events. At this stage however, these levels cannot be directly correlated to specific rainfall events.

5.1.1.6.2 Dry Weather Calibration

Approach

The DWF parameters (sewage rate, GWI, and average diurnal pattern) were determined for each sanitary flow meter using the US EPA flow monitoring data analysis software SSOAP. As previously done in the 2013 W&WWMP, the GWI was derived using the Stevens-Schutzbach formula based on average and minimum flows and was subtracted from the average dry weather flow observed to determine the average sewage flow per meter. This represents the dry weather infiltration into the sewer and is applied as a constant base flow. The Stevens-Schutzbach formula to calculate the GWI component (in million gallons/day, MGD) is as follows:

$$GWI = \frac{0.4 \times MDF}{1 - \left(0.6 \times \left(\frac{MDF}{ADF}\right)\right)^{ADF^{0.7}})}$$

Where MDF is the minimum dry weather flow (in MGD) and ADF is the average dry weather flow (in MGD). The resulting GWI (in MGD) is then converted into L/s.

Parameters extracted from the flow monitoring data analysis are initially applied to the residential population and ICI areas for wastewater generation, and to the effective areas for the constant GWI. The flow hydrograph produced by the model at each meter site is compared to the monitored or observed flow. The parameters (GWI rates, wastewater generation rates, and diurnal patterns) are then adjusted within a reasonable range until an acceptable fit to the observed flow is obtained. This is completed for the two separate periods, both consisting of 6 full dry weather days (144 hrs). In addition to matching the overall general response, the flow hydrographs should meet the following CIWEM criteria for goodness-of-fit:

- The alignment of the peaks and valleys of the time series should be within 1 hour;
- The peak flows should be within ± 10% of each other; and,
- The volume should be within ± 10%. Care should be taken to exclude periods of missing or inaccurate data.

Calibration is intended to establish a representative model of the system, but often does not perfectly reflect real-life conditions. Slight differences can be observed for various reasons, including varying system hydraulics, as well as inconsistent field conditions (e.g., sediment depth, minor defects and obstructions, and/or differences between the actual pipe condition, size, or slope and the available data applied in the model). As discussed in **Section 5.1.1.6.1**, boundary condition assumptions may also result in variations observed between modelled and monitored data, as does variable facility operation (i.e., pump stations) and ongoing maintenance activities such as flushing.

Calibration Challenges and Assumptions

The following notes outline challenges and assumptions encountered during DWF calibration:

- In dry weather flow, the magnitude of the flows tends to be small. With smaller flows, under- or overestimating the peak flows in the model by even a few L/s can result in percent fits that fall outside of the targeted range. The magnitudes should be considered to provide context for the suitability of the DWF calibration fits presented;

- The available design briefs and drawings for all PSs incorporated in the model were reviewed and where necessary, the model was updated. The design information represented the most up-to-date source of information for each PS at the time of calibration. However, current PS operations may differ from the original design, due to pump impeller wear, or changes in on/off levels, etc. Nonetheless, where a FM is influenced by an upstream PS, the FM data can be used to validate that the pump station operation in the model is reasonable. Additionally, the SCADA data provided post-calibration and presented in **Section 5.1.1.5.1** can be used to validate the calibrated results, as discussed further in **Section 5.1.1.6.4**. Validation of PS response may not lead to adjustments in PS operation within the model due to the uncertainties involved with the stations. Since the intent of calibration is to produce a model that can be used to assess the existing and future conditions of the system, tweaks made to match the current operation of the PS may not be appropriate for the model’s future use;
- GWI rates can vary substantially depending on the soil condition, climate, location, and season. It is important to consider the DWF period over which the calibration is being completed. GWI rates are anticipated to be higher in the May calibration period than in July, due to the effect of spring melt. Typical GWI design rates can range anywhere from 0.02 to 0.12 L/s/ha (approx. 1,000 L/ha/d to 11,000 L/ha/d). Higher or lower rates are also possible; and,
- The ICI wastewater flow rate can vary considerably depending on the type of commerce, industry, or institution present. Typical ICI flow rates can vary from as low as 1,500 L/ha/d to as high as 75,000 L/ha/d. Water consumption records were used as a reference to validate wastewater flows. These water consumption rates are reported in **Table 5-8**.

Results

Table 5-8 presents the final DWF parameters derived through model calibration for each metershed. The calibrated diurnal patterns are presented in **Appendix B.3**. Table 5-9 and **Table 5-10** present the resulting calibration fits between the modelled and observed data for DWF period 1 (May 6th – 12th, 2022) and DWF period 2 (July 6th – 12th, 2022), respectively. The peak flow and volume percent fits are colour-coded based on the following:

- Peak flow:
  - **Green**: if it falls within the targeted range of -10% to +10%;
  - Yellow: if it falls within -10% to -15% or +10% to +15%; and,
  - **Red**: if it is less than -15% or greater than +15%.
- Volume:
  - **Green**: if it falls within the targeted range of -10% to +10%;
  - Yellow: if it falls within -10% to -15% or +10% to +15%; and,
  - **Red**: if it is less than -15% or greater than +15%.

The corresponding DWF calibration graphs are shown in **Figure 5-12** (peak flow) and **Figure 5-13** (volume). Hydrographs for each event and each FM (observed vs modelled) are provided in **Appendix B.1**.

Table 5-8: Final Dry Weather Flow Parameters

Metershed Characteristics

Flow Monitor	Total(1) Area-Based(2) Tributary Area (ha)	Total(1) Existing Residential Population	Total Existing ICI Area (ha)	Water Consumption Rates(3) Residential Parcels (L/s)	Water Consumption Rates(3) Residential Parcels (L/c/d)	Water Consumption Rates(3) ICI Parcels (L/s)	Water Consumption Rates(3) ICI Parcels (L/ha/d)
FM 1 ARN-1 Staye Court Dr	54	889	18	2.5	242	0.2	810
FM 2 ARN-2* Daniel St/CN Recreation Trail	217	4,424[6]	32	8.7	170	1.2	2,072
FM 3 ARN-3 Elgin St W/Madawaska St	49	1,253	4	2.3	156	0.1	1,142
FM 4 ARN-4 Riverview Dr	29	554	16	0.7	107	7.8	41,602
FM 5 ARN-5* Madawaska Blvd	74	1,007	19	2.1	181	3.2	4,571
FM 6 ARN-6 Decosta St	19	-	42	-	-	1.9	3,940
Average (Monitored Areas)	-	-	-	-	***171***	-	***9,023***
Total (Monitored Areas)	***368***	***7,238***	***131***	***31.6***	-	***14.3***	-
Unmonitored Areas	*80*	*1,746*	*29*	*5.2*	*164*	*1.8*	*5,263*

Calibrated Parameters

Flow Monitor	Average Dry Weather Flow (L/s)	Groundwater Infiltration (L/s)	Groundwater Infiltration (L/s/ha)	Average Sewage Flow Total (L/s)	Average Sewage Flow Residential (L/c/d)	Average Sewage Flow ICI (L/ha/d)
FM 1 ARN-1 Staye Court Dr	4.5	1.0	0.018	3.5	235	5,501
FM 2 ARN-2* Daniel St/CN Recreation Trail	8.9	2.2	0.010	6.7	120	1,000
FM 3 ARN-3 Elgin St W/Madawaska St	4.3	0.5	0.010	3.8	235	8,600
FM 4ARN-4 Riverview Dr	13.0	1.4	0.050	11.6	235	54,000
FM 5ARN-5* Madawaska Blvd	20.5	3.7	0.050	16.8	235	20,000
FM 6 ARN-6 Decosta St	1.5	1.0	0.050	0.5	-	1,131
Average (Monitored Areas)	-	-	***0.031***	-	***216***	***15,039***
Total (Monitored Areas)	***52.8***	***9.7***	-	***43.1***	-	-
Unmonitored Areas	*12.1*	*2.5*	*0.031*	*9.6*	*216*	*15,039*

Notes:

(1) Total Area-Based Tributary Area, Total Existing Residential Population and Total Existing ICI Area includes all areas/populations draining to upstream FMs (FM in series).

(2) Area-Based Tributary area refers to the area draining to each meter, based on the contributing effective areas only. Effective areas are defined by a 100 m buffer around all pipes and are meant to represent the effective area contributing groundwater and rainfall derived I/I to each sewer segment.

(3) The Water Consumption Rates presented are based on 100% of the average water consumption rates from August 2021 to August 2022.

* FM is downstream of one or more other FMs (FM in series)

Table 5-9: 2022 Dry Weather Calibration Results for Period 1 – Peak Flow and Volume (May 6th – May 12th, 2022)

Flow Monitor	Data Quality Notes	Monitored Peak Flow (L/s)	Modelled Peak Flow (L/s)	Peak Flow Percent Fit	Monitored Volume (m^3)	Modelled Volume (m^3)	Volume Percent Fit
FM 1 ARN-1 Staye Court Dr	-	8.9	6.0	-32.7%	2,528	2,333	-7.7%
FM 2 ARN-2* Daniel St/CN Recreation Trail	Upstream private PS (WFP sludge discharge) influence is observed	42.6	42.1	-1.2%	6,402	6,396	-0.1%
FM 3 ARN-3 Elgin St W/Madawaska St	Data quality issues observed after April 2022	22.6	5.7	-74.8%	2,571	2,249	-12.5%
FM 4 ARN-4 Riverview Dr	Upstream PS influence is observed	25.1	23.4	-7.1%	7,217	6,750	-6.5%
FM 5 ARN-5* Madawaska Blvd	Upstream PS influence is observed	52.6	19.0	-63.8%	10,690	5,849	-45.3%
ARN-6 Decosta St	Overall drift throughout FM period; flow generation patterns and peaks are inconsistent, and Fridays appear to be part of the weekend	9.2	1.7	-81.0%	1,489	788	-47.1%

Notes:

* * FM is downstream of one or more other FMs (FM in series)

Table 5-10: 2022 Dry Weather Calibration Results for Period 2 – Peak Flow and Volume (July 6th – July 12th, 2022)

Flow Monitor	Data Quality Notes	Monitored Peak Flow (L/s)	Modelled Peak Flow (L/s)	Peak Flow Percent Fit	Monitored Volume (m^3)	Modelled Volume (m^3)	Volume Percent Fit
FM 1 ARN-1 Staye Court Dr	-	6.3	6.0	-4.3%	1,964	2,333	18.8%
FM 2 ARN-2* Daniel St/CN Recreation Trail	Upstream private PS (WFP sludge discharge) influence is observed	42.3	37.6	-11.1%	5,516	6,392	15.9%
FM 3 ARN-3 Elgin St W/Madawaska St	Data quality issues observed after April 2022	14.5	5.7	-60.7%	1,754	2,249	28.2%
FM 4 ARN-4 Riverview Dr	Upstream PS influence is observed	24.4	23.3	-4.8%	7,439	6,755	-9.2%
FM 5 ARN-5* Madawaska Blvd	Upstream PS influence is observed	22.7	19.0	-16.1%	5,518	5,850	6.0%
FM 6 ARN-6 Decosta St	Overall drift throughout FM period; flow generation patterns and peaks are inconsistent, and Fridays appear to be part of the weekend	3.1	1.7	-44.2%	515	788	53.0%

Notes:

* * FM is downstream of one or more other FMs (FM in series)

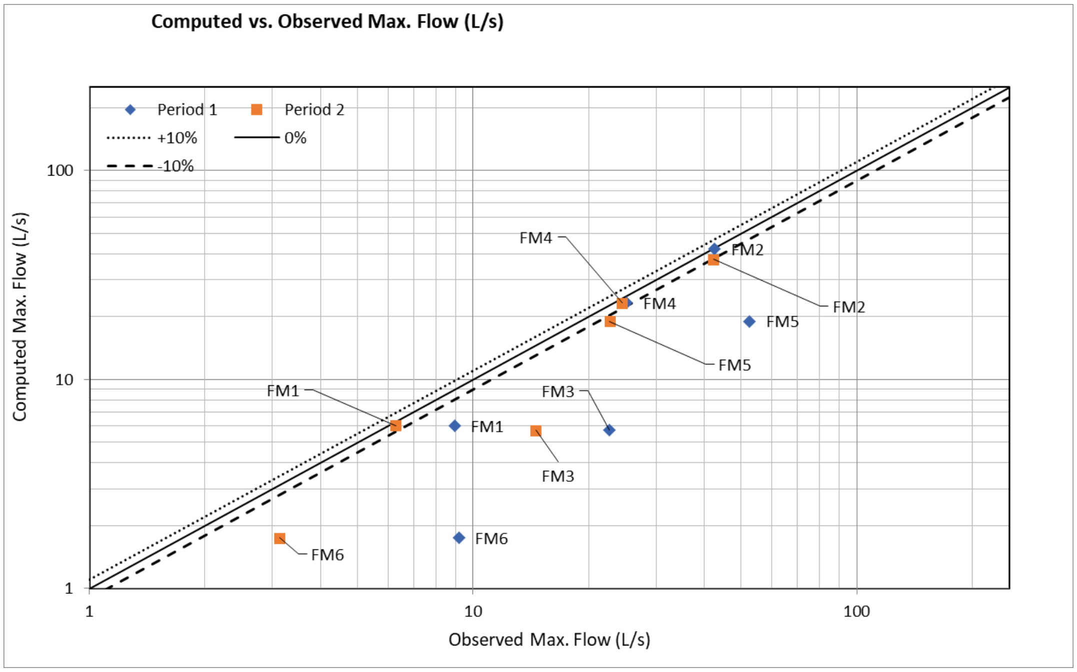


Figure 5-12: 2022 Dry Weather Calibration Results – Peak Flow

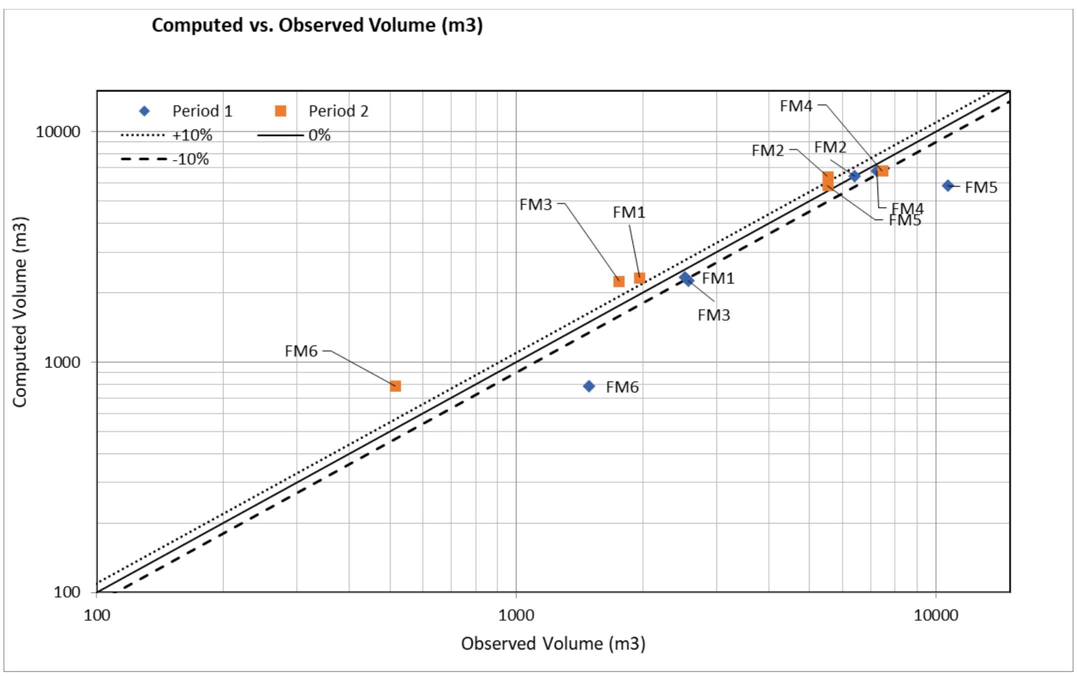


Figure 5-13: 2022 Dry Weather Calibration Results – Volume

The following sub-sections present overarching results and considerations for all the FMs, as well as individual calibration results per FM.

Overall DWF Calibration Results and Considerations (All FMs)

The following are considerations which are applicable to multiple FMs when interpreting the calibration results:

- In order to generate the diurnal patterns for calibration (presented in **Appendix B.3**), the hourly flows are averaged, smoothing out the flow pattern and reducing the noise generated in the modelled response. This can yield differences on days where the observed diurnal pattern deviates from the averaged pattern, yielding discrepancies in the peak flows.
- As noted in the DWF **Calibration Challenges and Assumptions**, the magnitude of DWF flows should be considered when evaluating the resulting calibration fits. This is especially the case for FM 1 and FM 6, where the magnitude of the absolute differences (in L/s) is small.
- Seasonal differences will lead to lower observed volumes in DWF Period 2 (July) compared to DWF Period 1 (May). Therefore, while the calibration can yield a good volume fit to DWF Period 1 (May), the modelled volume in DWF Period 2 (July) may be higher than observed. This nonetheless means that the resulting parameters are conservative for drier periods of the year.
  - Seasonal differences may also lead to underestimated volumes in DWF Period 1 (May), and overestimated volumes in DWF Period 2 (July), as seen for most FMs. The calibration results therefore straddled both events, such that any further adjustments in one event could negatively affect the resulting fits in the other event.
- While the water consumption rates are provided in **Table 5-8** for reference and are used as a guide during calibration, they do not necessarily equate to sewage generated (i.e., lawn watering or industrial process water use). Thus, some metersheds see considerable differences between water consumption and sewage generation ranges, such as at FM 1, FM 3, FM 4, and FM 5. These differences can be explained by the following:
  - To maintain consistency with the 2013 MP, a standard residential sewage generation rate of 235 L/c/d was applied to most metersheds. The ICI water consumption rate was then adjusted in calibration to match the observed total

sewage flow generation, thus resulting in differing ICI and residential sewage generation distributions than seen in the water consumption rates.

- Total sewage flows can differ from total water consumed in a metershed for reasons such as uncertainties in the water consumption records, such as missing water consumption records or 0 values reported, or water consumption practices that do not generate equivalent sewage flows. Water consumption records are presented and discussed in **Section 5.1.2.2**.
- A better understanding of sewage flows from large ICI facilities is needed to confirm the higher ICI sewage flow generation rates within the FM 4 and FM 5 metersheds.

FM 1 (Staye Court)

The DWF calibration at FM 1 yields a good calibration fit in terms of volume but a low peak flow fit during the DWF Period 1 (May). Conversely, the peak flow fit is good, but the volumes are overestimated during the DWF Period 2 (July). As noted in the **Overall DWF Calibration Results and Considerations (All FMs)**, calibration results are straddling both events due to seasonal differences, and any further adjustments in one event could negatively affect the resulting fits in the other event. Discrepancies due to smoothed out modelled diurnal flow patterns also contribute to deviations in peak flow. Finally, the magnitude of DWF flows should be considered. The peak observed and modelled FM 1 flows are less than 10 L/s, such that the magnitude of the absolute difference (in L/s) is small.

The GWI rate for FM 1 is 0.018 L/s, which is on the lower end of the range of GWI rates applied (0.01 L/s/ha to 0.05 L/s/ha) and is representative of the newer residential sanitary systems (from the 2000’s or newer) within this metershed.

The residential sewage generation rate was maintained at 235 L/c/d, as applied in the 2013 W&WWMP, which is similar to the water consumption rate. The ICI water consumption rate was adjusted in calibration to match the observed total sewage flow generation. The resulting ICI sewage flow generate rate is higher than the water consumption rate. Differences between water consumption rates and sewage flow generation rates are discussed in the **Overall DWF Calibration Results and Considerations (All FMs)**.

FM 2 (Daniel St/CN Recreation Trail)

The DWF calibration at FM 2 yields a good calibration fit in terms of peak flows and volumes during the DWF Period 1 (May). The calibration fits are lower during the DWF Period 2 (July). Since the volume fits are straddling both events due to seasonal differences, any further adjustments in one event could negatively affect the resulting fits in the other event. As initially identified in **Section 5.1.1.3.3**, FM 2 flows are influenced by an upstream private PS (WFP sludge discharge) , which was modelled as an inflow directly upstream of FM 2 (see **Section 5.1.1.6.1**). While minor discrepancies can still be observed in the calibration, this approach yields a good estimate of peak flows in FM 2 for the purposes of assessing the system performance and long-term infrastructure planning.

The GWI rate for FM 2 is 0.01 L/s/ha, which is on the lower end of the range of GWI rates applied (0.01 L/s/ha to 0.05 L/s/ha) and is representative of the predominantly newer residential sanitary systems within this metershed.

The residential sewage generation rate at FM 2 was reduced to 120 L/c/d. This may be explained by the higher residential population within this metershed, as reported in **Table 5-2**, along with newer developments where more efficient connections and appliances are likely used. The ICI flow generation rate is 1,000 L/ha/d, which is likely due to the sizes of the ICI parcels being larger than within the denser core of the Town. The ICI areas were determined based on the provided GIS parcel data, which is often larger than the actual ICI building area, such that areas which do not generate wastewater were not systematically discounted from the ICI areas.

FM 3 (Elgin St W/Madawaska St)

The DWF calibration at FM 3 yields low calibration fits in terms of peak flows and volumes during both DWF periods (May and July). As initially identified in **Section 5.1.1.3.3**, there are data quality issues at FM 3 after the end of April, thus affecting both DWF Periods in May and July. The source of these issues is unknown and high sporadic peaks are observed in the data, which cannot be replicated in the model. This results in peak flow discrepancies at FM 3. These peaks resemble the effect of an upstream PS or of sump pumps. No private PS was identified upstream of FM 3 in the Town's GIS data. Due to the data quality issues, no attempt was made at replicating the observed peaks as inflows. Since the volume fits are straddling both events due to seasonal differences, any further adjustments in one event could negatively affect the resulting fits in the other event.

The GWI rate for FM 3 is 0.01 L/s/ha, which is on the lower end of the range of GWI rates applied (0.01 L/s/ha to 0.05 L/s/ha).

The residential sewage generation rate was maintained at 235 L/c/d, as applied in the 2013 W&WWMP, which is higher than the water consumption rate. The ICI water consumption rate was adjusted in calibration to match the observed total sewage flow generation. Differences between water consumption rates and sewage flow generation rates are discussed in the **Overall DWF Calibration Results and Considerations (All FMs)**.

FM 4 (Riverview Dr)

The DWF calibration at FM 4 yields good calibration fits in terms of peak flows and volumes during both DWF periods (May and July).

The GWI rate for FM 4 is 0.05 L/s/ha, which is on the higher end of the range of GWI rates applied (0.01 L/s/ha to 0.05 L/s/ha). This higher rate may be due to most pipes being located in proximity to the Madawaska River, while also coinciding with areas where the sanitary pipes are older (1960 – 1999). Sewer age is illustrated in **Figure 5-2**, and land use classifications per metershed are reported in **Table 5-2**. This relatively higher GWI rate, however, is within typical ranges of design GWI parameters.

As identified in **Section 5.1.1.3.3**, FM 4 is highly influenced by upstream PSs (PS #2, PS #4), and the observed DWF hydrograph does not exhibit typical wastewater generation diurnal patterns because of this. The residential sewage generation rate at FM 4 was maintained at 235 L/c/d. The ICI flow generation rate is 54,000 L/ha/d. This area is downstream of the Nylene Canada ULC facility (Nylene facility), which is one of the largest water users within the Town (based on a review of water consumption data, with an average daily consumption of 666 m^3/d, as reported in **Section 5.1.2.2**). The ICI rate applied for this metershed is also considered on the higher end of the typical rates. While the Town has indicated that flows from the Nylene facility have generally decreased, its exact contributions to sewage flows are not well understood and are not quantified, and therefore are potentially compensated for in the residential per capita rate as well. It is therefore recommended that the Nylene sewage generation rates be confirmed to improve this understanding.

FM 5 (Madawaska Blvd)

The DWF calibration at FM 5 yields low calibration fits in terms of peak flows and volumes during the DWF Period 1 (May), and a low calibration fit in terms of peak flows but a good volume fit during the DWF Period 2 (July). As identified in **Section 5.1.1.3.3**, there is noise in the monitored data during DWF conditions, which can be due to nearby pumping station influence. This noise results in several instantaneous elevated readings, which generates peaks which are not easily reproduced in the model, leading to the peak flow discrepancies observed. Furthermore, since the volume fits are straddling both events due to seasonal differences, any further adjustments in one event could negatively affect the resulting fits in the other event.

The GWI rate for FM 5 is 0.05 L/s/ha, which is on the higher end of the range of GWI rates applied (0.01 L/s/ha to 0.05 L/s/ha), as most of the pipes are located in proximity to the Madawaska River, while also coinciding with areas where the sanitary pipes are older (1950 – 1979). Sewer age is illustrated in **Figure 5-2**, and land use classifications per metershed are reported in **Table 5-2**. This relatively higher GWI rate, however, is within typical ranges of design GWI parameters.

The residential sewage generation rate at FM 5 was maintained at 235 L/c/d, as applied in the 2013 W&WWMP, which is higher than the water consumption rate. The ICI water consumption rate was adjusted in calibration to match the observed total sewage flow generation. The resulting ICI sewage flow generate rate of 20,000 L/ha/d is higher than the water consumption rate and is on the higher end of the ICI rates throughout the Town. Differences between water consumption rates and sewage flow generation rates are discussed in the **Overall DWF Calibration Results and Considerations (All FMs)**. FM 5 is located downstream of large ICI facilities. A better understanding of sewage flows from large ICI facilities is recommended to confirm the higher ICI sewage flow generation rates within the FM 5 metershed.

FM 6 (De Costa St)

The DWF calibration at FM 6 yields poor peak flow and volume calibration fits for both DWF periods (May and July). Since the volume fits are straddling both events due to seasonal differences, any further adjustments in one event could negatively affect the resulting fits in the other event. Furthermore, there is noise observed in the monitored data during DWF conditions, which can often be attributed to the lower magnitude flows observed and corresponding measurement inaccuracies that can occur in these conditions. Outlier flow measurements are observed during the DWF Period 1 (May), due to irregular observed sewage flow generation. Discrepancies due to smoothed out modelled diurnal flow patterns also contribute to deviations in peak flow. However, the magnitude of DWF flows should be considered. When considering the actual values (< 10 L/s), the discrepancy is minimal.

The GWI rate for FM 6 is 0.05 L/s/ha, which is on the higher end of the range of GWI rates applied (0.01 L/s/ha to 0.05L/s/ha), as most of the pipes are located in proximity to the Madawaska River, while also coinciding with areas where the sanitary pipes are older (1960 – 1979). Sewer age is illustrated in **Figure 5-2**, and land use classifications per metershed are reported in **Table 5-2**. This relatively higher GWI rate, however, is within typical ranges of design GWI parameters.

The FM 6 metershed is exclusively composed of ICI properties. The ICI flow generation rate is 1,131 L/ha/d, which is on the lower end of the ICI rates applied throughout the Town. The sizes of the ICI parcels within this metershed are larger than within the denser core of the Town. The ICI areas were determined based on the provided GIS parcel data, which is often larger than the actual ICI building area, such that areas which do not generate wastewater were not systematically discounted from the ICI areas.

5.1.1.6.3 Wet Weather Calibration

Approach

The WWF event-based calibration was carried out for the 2 selected events discussed in **Section 5.1.1.4.4**. The modelled flow rates, volumes, and depths are compared to the observed values from the corresponding rainfall event to determine the calibration fits. The hydrographs should closely follow each other both in shape and in magnitude, until the flow has substantially returned to DWF conditions. In addition to the shape, the observed and modelled hydrographs are targeted to meet the following criteria:

- The timing of the peaks and valleys should be similar for the duration of the event;
- The peak flow rates at each significant peak should be in the range of -15% to +25%;
- The volume of flow should be within -10% to +20%;
- The surcharge depths should be in the range of -0.1 m to +0.5 m; and,

- Where data of high confidence is available, the non-surcharged depths at key points should be within the range ±0.1 m.

The RDII in a sanitary system is often estimated using the RTK method, where the “R” is the percentage of rainfall in a given metershed that is observed in the sewer, the “T” is the time it takes to see the peak flow response to a rainfall occurrence (Time to Peak), and the “K” is the ratio of the Time to Peak to the recession time. **Figure 5-14** shows how these parameters work together to create three distinct unit hydrograph responses, representing the fast initial inflow response (R1, T1, K1), moderate infiltration response (R2, T2, K2) and slow infiltration response (R3, T3, K3). The fast response is attributed to cross-connections such as roof downspouts or catchbasins; the moderate response is associated with foundation drains or low-lying MHs; and the slow response is via migrating surface water through the ground into cracks and pipe/MH deficiencies.

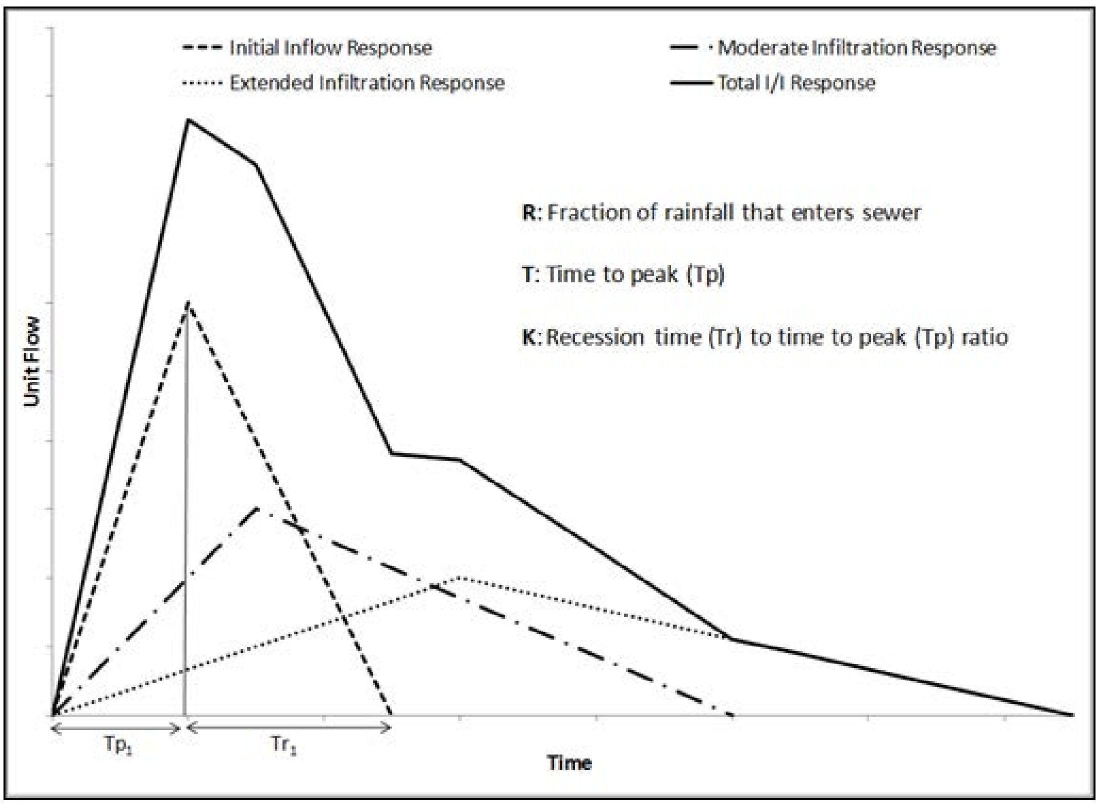


Figure 5-14: Definition of RTK Parameters

RTK parameters are derived from monitoring data and applied on a metershed basis to the contributing effective areas. Through hydrograph separation, the wet weather hydrograph is isolated per rain event. The volume under the curve represents the wet weather volume, which is compared to the total rainfall depth over the effective tributary area to the FM (i.e., total rainfall volume) to generate the total R, or volumetric runoff coefficient. The value becomes the target for distributing the R1, R2 and R3 parameters per unit hydrograph. The combination of RTKs is adjusted within a range per characteristic response to generate the overall RDII response. Generally, the “R” values are adjusted to match the shape volumes of the WWF events, and the “T” and “K” values adjusted to improve peaks timing.

Calibration Challenges and Assumptions

Beyond the targets mentioned in the WWF Calibration **Approach**, several other factors should be considered during the WWF calibration process:

- The presence of surcharging makes calibration more difficult. It is crucial that the correct diameters, slopes, and materials are being applied in the model to be able to replicate the same backflow conditions at the same time as the monitored data. This is not unique to the pipe where the flow monitor is located, but also the pipes upstream and downstream which may be contributing to the surcharged conditions. FM 4 and FM 5 experience surcharging during this calibration period, which are further discussed in the WWF Calibration **Results**;
- WWF Event 1 (May 21st) was selected as the primary event due to its peak intensity. When there is a large response difference between WWF Event 1 (May 21st) and WWF Event 2 (July 12th), the calibration focuses on matching WWF Event 1 (May 21st) to produce a more conservative model;
- The calibration focuses on matching peak flow. When an event has a long duration, such as WWF Event 2 (July 12th), it can consist of multiple rainfall peaks. This presents an opportunity for volume discrepancies due to attempting to meet the largest peak flow values and over or under-estimating smaller peaks observed earlier or later in the event; and,
- Geospatial variations in rainfall across the Town during an event can lead to different timing and unattainable response matches in the model due to using rainfall measured at the single rain gauge located at 73 James St. This can produce differences in the timing of the peaks and valleys, as well as magnitude and response patterns.

- Based on validating the PS #5 performance under a 10-year event and 25-year event using historical PS bypass data (see **Section 5.2.1.3**), the RTK parameters for the FM 1 metershed were applied to areas upstream of PS #5. Otherwise, the RTK parameters for FM 5 were developed considering a large metershed including ICI areas with potential cross-connections, which are not representative of the subcatchments upstream of PS #5. The pipes in the FM 1 metershed and the pipes upstream of PS #5 have the same age (see **Figure 5-2**), hence there is more confidence in applying the FM 1 parameters to the subcatchment upstream of PS #5.

Results

The final RTK parameters for the WWF calibration are presented in **Table 5-11** and the final total R distribution is shown per metershed in **Figure 5-15**.

Table 5-11: Final Wet Weather RTK Calibration Parameters

Flow Monitor	Area Type	Total R	R1	T1	K1	R2	T2	K2	R3	T3	K3
FM 1(1) ARN-1 Staye Court Dr	Separated	0.31%	0.3%	0.5	0.1	0.01%	0.55	0.2	-	-	-
FM 2 ARN-2* Daniel St/CN Recreation Trail	Separated	0.90%	0.5%	0.1	2	0.3%	0.5	3	0.1%	2	6
	Combined	9.00%	5.0%	0.001	2	3.0%	0.005	3	1.0%	1	4
FM 3 ARN-3 Elgin St W/Madawaska St	Separated	1.00%	0.5%	0.01	1	0.3%	0.2	2	0.2%	0.01	4
	Combined	5.00%	2.2%	0.005	1	1.8%	0.2	2	1.0%	0.8	4
FM 4 ARN-4 Riverview Dr	Separated	3.80%	1.8%	0.005	3	1.5%	0.3	4	0.5%	0.5	5
FM 5 ARN-5* Madawaska Blvd	Separated	2.50%	1.4%	0.01	1	1.0%	0.5	2	0.1%	1	3
FM 6 ARN-6 Decosta St	Separated	1.40%	0.6%	0.01	0.5	0.5%	0.01	3	0.3%	0.5	5
Average (Monitored Areas) Applied to Unmonitored Areas	***Separated***	1.65%	0.9%	0.106	1.3	0.6%	0.343	2.4	0.2%	0.633	3.5
	Combined	7.00%	3.1%	0.003	1.5	2.4%	0.103	2.5	1.0%	0.405	4

Notes:

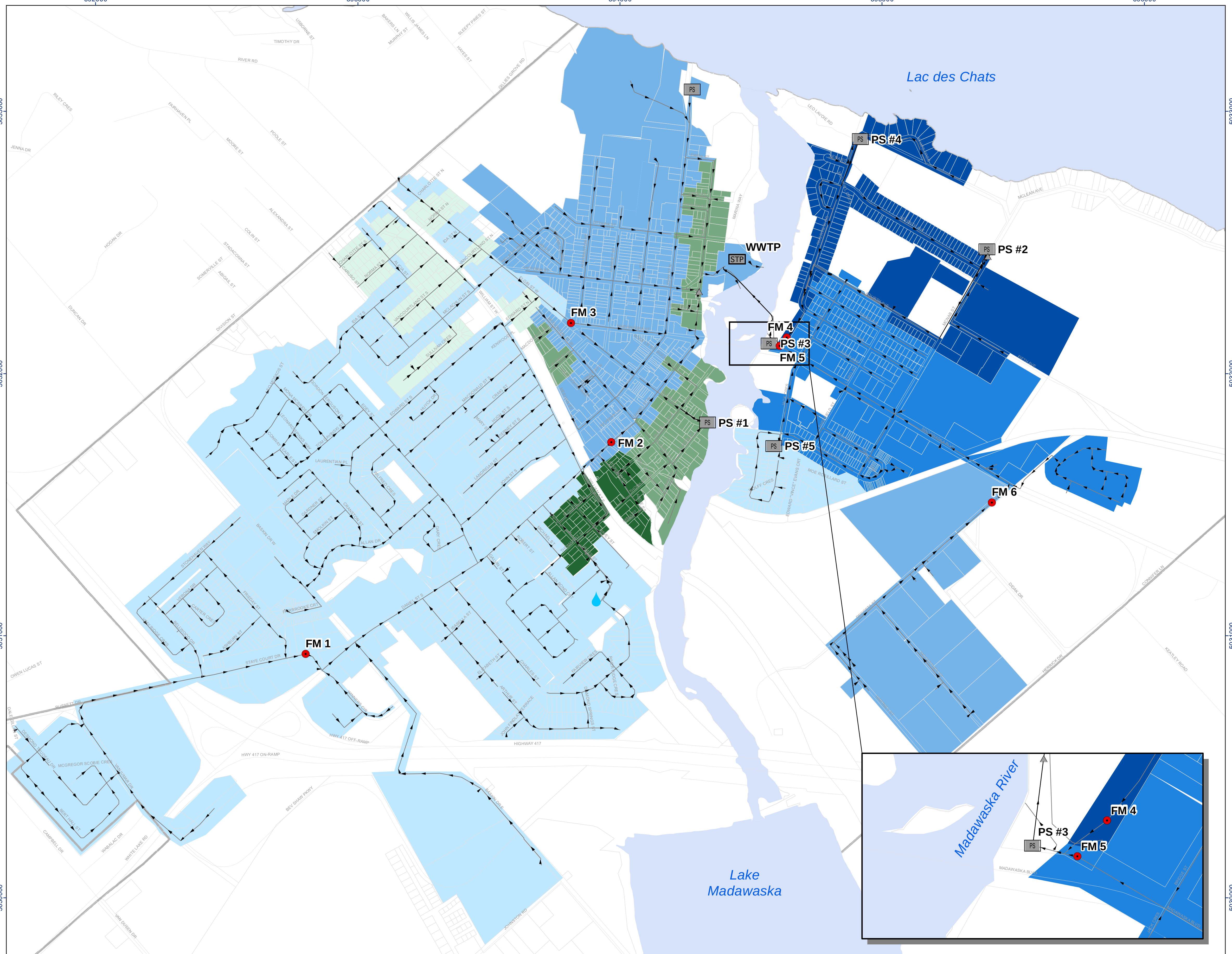
* FM is downstream of one or more other FMs (FM in series)

(1) The RTK parameters for FM 1 were also applied to the subcatchments upstream of PS #5, which is located upstream of FM 5.

Table 5-12 and **Table 5-13** show the resulting calibration fits between the modelled and monitored data for WWF Event 1 (May 21st) and WWF Event 2 (July 12th), respectively. These calibration fits are colour-coded based on the following:

- Peak flow:
  - **Green**: if it falls within the targeted range of -15% to +25%;
  - **Yellow**: if it falls within -25% to -15% or +25% to +35%; and,
  - **Red**: if it is less than -25% or greater than +35%.
- Depths:
  - **Green**: if it is in the targeted depth range of ±0.1 m;
  - **Yellow**: if it is within -0.2 m to -0.1 m or +0.1 m to +0.6 m; and,
  - **Red**: if it is less than -0.2 m and greater than 0.6 m.
- Volume:
  - **Green**: if it falls within the targeted range of -10% to +20%;
  - **Yellow**: if it falls within -20% to -10% or +20% and +30%; and,
  - **Red**: when it is less than -20% and greater than 30%.

Hydrographs for each event and each FM (observed vs modelled) are provided in **Appendix B.2**.



Stantec

Legend

- Sanitary Pump Station (PS)
- Overflow
- Wastewater Treatment Plant (WWTP)
- Sanitary Sewer
- Forcemains
- Rain Gauge
- Flow Meter

Total R by Flow Metershed - Separated Areas

- ≤ 1.00 %
- 1.01 - 2.00%
- 2.01 - 3.00%
- 3.01 - 4.00%

Total R by Flow Metershed - Combined Areas

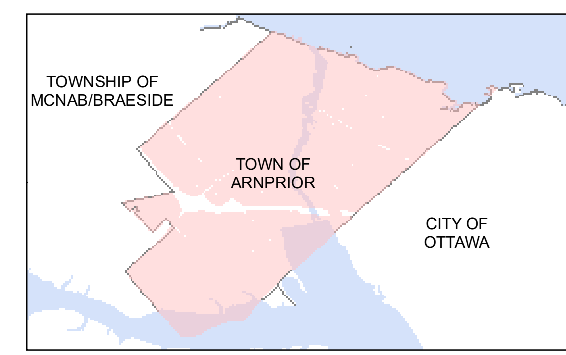
- ≤ 5.00%
- 5.01 - 7.00%
- 7.01% - 9.00%

N

0 250 500 Meters
(At original document size of 11x17)
1:15,000

Notes

1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Export_Output_Parcel_Fabric.shp*, *Export_Output_Roads.shp*, *Export_Output_San_MH.shp* and *Export_Output_SAN_SEWER.shp* provided by the Town of Arnprior
3. Background: Contains information licensed under the Open Government Licence – Ontario
4. Abbreviations: FM: Flow Monitor; MH: Maintenance Hole; PS: Pump Station; WWTP: Wastewater Treatment Plant



Project Location
Arnprior, ON

Prepared by CR on 2024-01-04
Revised by CR on 2024-02-01

Client/Project
Town of Arnprior
2022 W&WW Master Plan Update

163401723

Figure No.
5-15

Title
Total R per Metershed

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Table 5-12: 2022 Wet Weather Calibration Results for Event 1 (May 21st, 2022) – Peak Flow, Volume and Maximum Depth

Flow Monitor	Data Quality and Calibration Period Notes	Monitored Peak Flow (L/s)	Modelled Peak Flow (L/s)	Peak Flow Percent Fit	Monitored Volume (m^3)	Modelled Volume (m^3)	Volume Percent Fit	Monitored Maximum Depth (m)	Modelled Maximum Depth (m)	Maximum Depth Fit (m)
FM 1(1) ARN-1 Staye Court Dr	Observed dry weather wastewater flow generation is lower than average pattern following the storm event	14.9	14.7	-1.0%	198	244	22.7%	0.16	0.12	-0.04
FM 2 ARN-2* Daniel St/CN Recreation Trail	Upstream private PS (WFP sludge discharge) influence is observed; average pattern is applied (see description in **Section 5.1.1.6.1**)	135.4	137.3	1.4%	1,113	909	-18.3%	0.31	0.29	-0.01
FM 3 ARN-3 Elgin St W/Madawaska St	Data quality issues observed after April 2022	135.9	132.8	-2.3%	507	479	-5.6%	0.32	0.21	-0.11
FM 4 ARN-4 Riverview Dr	Upstream PS influence is observed	60.3	63.1	4.8%	751	734	-2.3%	0.74	0.19	-0.55
FM 5 ARN-5* Madawaska Blvd	Upstream PS(1) influence is observed	104.1	97.2	-6.6%	761	733	-3.7%	1.07	0.19	-0.88
FM 6 ARN-6 Decosta St	Overall drift throughout FM period; flow generation patterns and peaks are inconsistent, and Fridays appear to be part of the weekend	24.1	22.3	-7.6%	112	106	-5.2%	0.19	0.13	-0.06

Notes:

- * FM is downstream of one or more other FMs (FM in series)
- (1) The RTK parameters for FM 1 were also applied to the subcatchments upstream of PS #5, which is located upstream of FM 5.

Table 5-13: 2022 Wet Weather Calibration Results for Event 2 (July 12th, 2022) – Peak Flow, Volume and Maximum Depth

Flow Monitor	Data Quality and Calibration Period Notes	Monitored Peak Flow (L/s)	Modelled Peak Flow (L/s)	Peak Flow Percent Fit	Monitored Volume (m^3)	Modelled Volume (m^3)	Volume Percent Fit	Monitored Maximum Depth (m)	Modelled Maximum Depth (m)	Maximum Depth Fit (m)
FM 1(1) ARN-1 Staye Court Dr	Observed dry weather wastewater flow generation is lower in July than in May (see DWF calibration in **Section 5.1.1.6.2**)	8.0	7.5	-5.4%	269	325	20.7%	0.12	0.09	-0.03
FM 2 ARN-2* Daniel St/CN Recreation Trail	Upstream private PS (WFP sludge discharge) influence is observed; average pattern is applied (see description in **Section 5.1.1.6.1**) Peaks in FM data observed before peaks in RG data (due to geospatial variation in rainfall across the Town)	54.2	71.0	30.9%	1,101	1,055	-4.2%	0.19	0.20	0.01
FM 3 ARN-3 Elgin St W/Madawaska St	Data quality issues observed after April 2022 Peaks in FM data observed before peaks in RG data (due to geospatial variation in rainfall across the Town)	45.3	53.2	17.4%	432	483	11.8%	0.18	0.13	-0.05
FM 4 ARN-4 Riverview Dr	Upstream PS influence is observed	25.6	40.0	56.3%	1,000	960	-4.1%	0.12	0.15	0.03
FM 5 ARN-5* Madawaska Blvd	Upstream PS(1) influence is observed Peaks in FM data observed before peaks in RG data (due to geospatial variation in rainfall across the Town)	47.1	51.1	8.6%	874	933	6.8%	0.15	0.14	-0.01
FM 6 ARN-6 Decosta St	Overall drift throughout FM period; flow generation patterns and peaks are inconsistent, and Fridays appear to be part of the weekend	11.0	7.6	-31.1%	90	128	43.0%	0.10	0.07	-0.03

Note:
- * FM is downstream of one or more other FMs (FM in series)
- (1) The RTK parameters for FM 1 were also applied to the subcatchments upstream of PS #5, which is located upstream of FM 5.

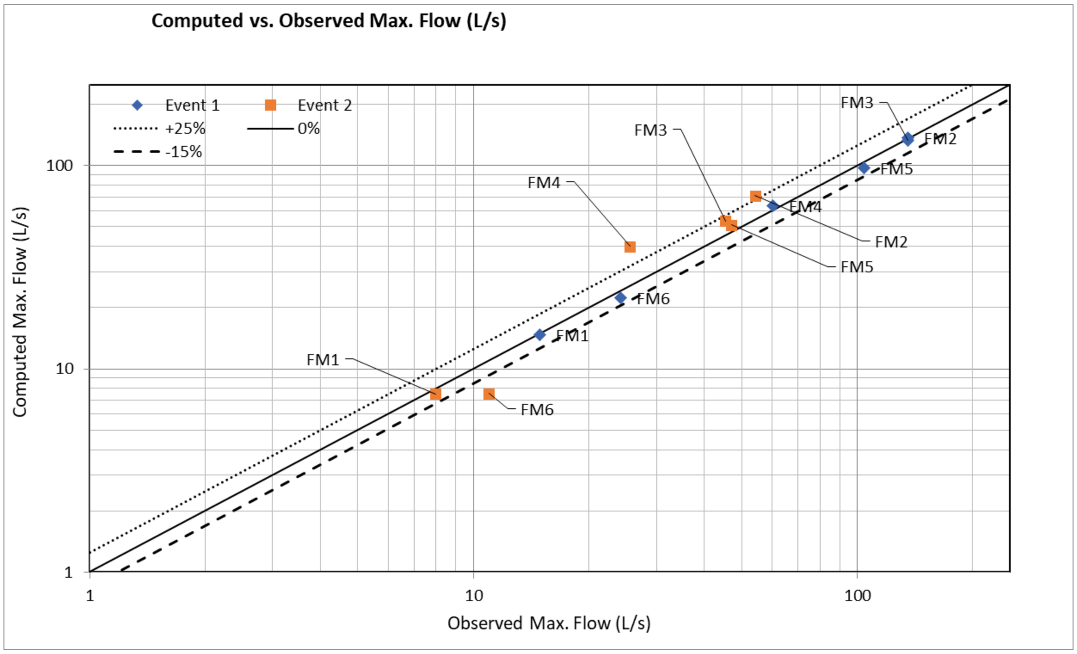

Figure 5-16: 2022 Wet Weather Calibration Results – Peak Flow

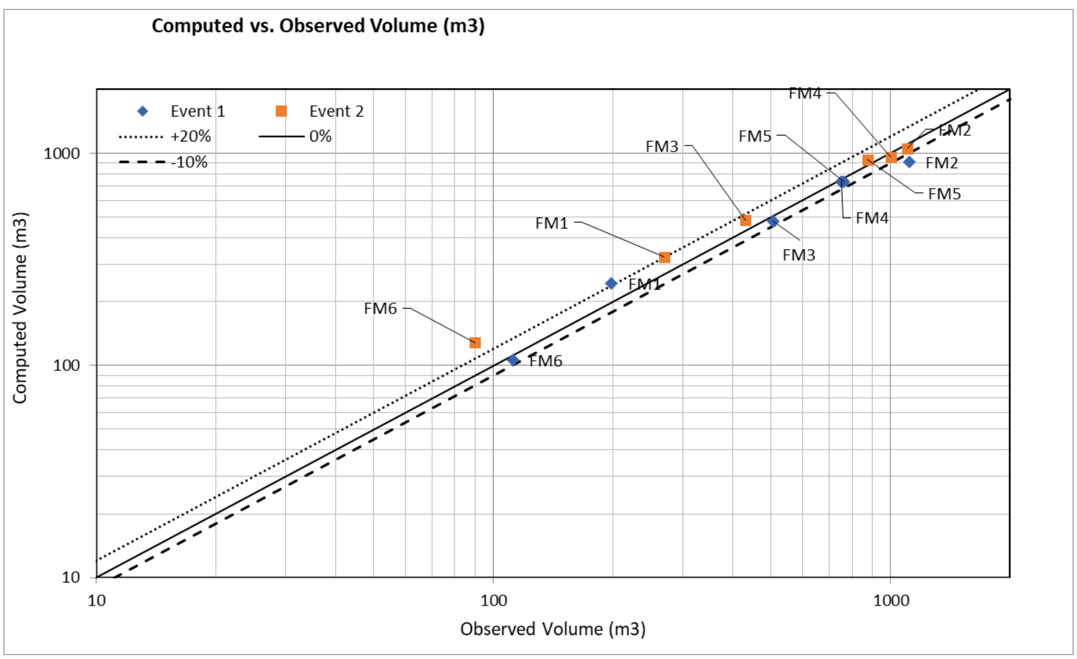

Figure 5-17: 2022 Wet Weather Calibration Results – Volume

The following sub-sections present overarching results and considerations for all the FMs, as well as individual calibration results per FM.

Overall WWF Calibration Results and Considerations (All FMs)

In general, the calibration targets were achieved. The following items should also be considered when assessing the calibration results:

- Generally, the WWF Event 1 (May 21st) calibration fits are better than the WWF Event 2 (July 12th) calibration fits. This is due to WWF Event 1 being the primary focus for calibration, due to its peak intensity. This results in a more conservative calibration.
- Overall drift throughout the flow monitoring period (as identified in **Section 5.1.1.3.3**) results in lower observed volumes in DWF Period 2 (July) compared to DWF Period 1 (May). This can translate into discrepancies observed in the WWF calibration.
- The response to WWF Event 2 in the flow monitors FM 2, FM 3 and FM 5 is observed before the peak rainfall at the rain gauge. This is potentially due to geospatial variations across the Town during this event, depending on the travel direction of rainfall, which would not have been captured by a single rain gauge.
- Combined systems tend to see higher total R values than separated sanitary systems due to the additional connections from catchbasins, roofs and/or foundation drains. Generally, the lower total R values are established in metersheds with newer developments that employ more modern design guidelines which prevent roof and foundation drain connections to sanitary sewers. Newer systems are also often tighter, yielding less rainfall-derived infiltration to the piping network.
- Differences in the actual and modelled parameters related to pipe hydraulics can have an impact on the depth fits, such as the pipe roughness (pipe condition), pipe slope (pipe inverts), pipe diameter, and silt and debris conditions. These can differ within the pipe at an FM location, but also within the overall metershed, leading to discrepancies in depths.

FM 1 (Staye Court)

The WWF calibration at FM 1 yields a good peak flow and maximum depth fit under both WWF Events 1 (May 21st) and 2 (July 12th). The volume fit at FM 1 during WWF Event 1 (May 21st) is lower but improves from 22.7% to 7.9% when excluding the dry weather hours which directly follow the rainfall (after 16:00). The observed data shows that the dry weather flow pattern immediately after this storm event is less than the typical observed diurnal pattern. The volume fit at FM 1 during WWF Event 2 (July 12th) improves from 20.7% to 5.6% when excluding the dry weather hours preceding the event (before 10:00). As noted in the DWF calibration (**Section 5.1.1.6.2**), dry weather flow volumes in July are overestimated due to seasonal differences leading to lower observed volumes in DWF Period 2 (July) compared to DWF Period 1 (May), and overall drift throughout the flow monitoring period (as identified in **Section 5.1.1.3.3**) also leading to lower observed volumes in DWF Period 2 (July) compared to DWF Period 1 (May).

The total R value for FM 1 is 0.31%, which is on the lower end of the values applied throughout the Town, as the FM 1 metershed is composed of separated sanitary areas which see less RDII, and where newer developments employ more modern design guidelines which prevent roof and foundation drain connections to sanitary sewers. Newer systems are also often tighter, yielding less rainfall-derived infiltration to the piping network. Sewer age is illustrated in **Figure 5-2**, and sewer type is illustrated in **Chapter 1** (**Section 4**).

FM 2 (Daniel St/CN Recreation Trail)

The WWF calibration at FM 2 yields a good peak flow and maximum depth fit during the WWF Event 1 (May 21st). The volume fit at FM 2 during WWF Event 1 (May 21st) improves from -18.3% to -3.0% when excluding the dry weather hours before and after the rainfall (i.e., before 13:00 and after 17:00). As noted in the DWF calibration (**Section 5.1.1.6.2**), dry weather flow volumes in May are underestimated due to seasonal differences. The WWF calibration at FM 2 yields a good volume and maximum depth fit during WWF Event 2 (July 12th); the peak flow is overestimated during this event; however, a conservative calibration is maintained. Also, as noted in the **Overall WWF Calibration Results and Considerations (All FMs)**, WWF Event 1 was the primary focus of the calibration, rather than WWF Event 2. The response to WWF Event 2 (July 12th) in FM 2 is observed before the peak rainfall at the rain gauge, due to potential geospatial variations across the Town during this event.

The total R values within the FM 2 metershed are 0.90% in separated sanitary areas and 9.00% in combined areas. The lower total R value of 0.90% is representative of systems that see less RDII. Differences in R values between combined and separated areas are discussed in the **Overall WWF Calibration Results and Considerations (All FMs)**. Sewer age is illustrated in **Figure 5-2**, and sewer type in **Chapter 1** (**Section 4**).

FM 3 (Elgin St W/Madawaska St)

The WWF calibration at FM 3 yields a good peak flow and volume fit during the WWF Event 1 (May 21st). The maximum depth does not closely match the measured depth, which can also be due to blockages. In general, depth fit targets can be challenging to achieve due to potential differences in pipe and metershed hydraulics (pipe roughness, slope) and variable sediment, silt, and debris conditions in the field. The calibration at FM 3 yields good fits during the WWF Event 2 (July 12th). The response to WWF Event 2 is observed before the peak rainfall at the rain gauge, due to potential geospatial variations across the Town during this event (see discussion in **Overall WWF Calibration Results and Considerations (All FMs)**.

The total R values within the FM 3 metershed are 1.00% in separated sanitary areas and 5.00% in combined areas. Differences in R values between combined and separated areas are discussed in the **Overall WWF Calibration Results and Considerations (All FMs)**. Sewer age is illustrated in **Figure 5-2**, and sewer type in **Chapter 1** (**Section 4**).

FM 4 (Riverview Dr)

The WWF calibration at FM 4 yields a good peak flow and volume fit during the WWF Event 1 (May 21st). The maximum depth does not closely match the measured depth. Since FM 4 experiences surcharging during WWF Event 1, matching the observed maximum depth can be challenging due to discrepancies related to pipe hydraulics, as discussed in the **Overall WWF Calibration Results and Considerations (All FMs)**. Furthermore, FM 4 is located downstream of PS #2 and PS #4, as well as directly upstream of PS #3, as initially identified in **Section 5.1.1.3.3**. The observed surcharging could have therefore been caused by downstream constraints at PS #3 or by other downstream blockages, which are not replicated in the model.

The WWF calibration at FM 4 yields a good volume and maximum depth fit during the WWF Event 2 (July 12th). FM 4 is influenced by upstream PSs. The modelled peak flow is higher than observed in WWF Event 2 due to the PS discharge occurring simultaneously with the initial short-term inflow response in the metershed. As noted previously, current PS operations can differ from the original design, therefore there can be uncertainty in the timing of the PS discharge. Nonetheless, this yields conservative results for system performance assessment and long-term infrastructure planning using peak flows.

The total R value for FM 4 is 3.80%, which is on the upper end of the values applied throughout the Town for separated sanitary areas but is still considered reasonable.

FM 5 (Madawaska Blvd)

The WWF calibration at FM 5 yields a good peak flow and volume fit during the WWF Event 1 (May 21st). The maximum depth does not closely match the measured depth. Since FM 5 experiences surcharging during WWF Event 1, matching the observed maximum depth can be challenging due to discrepancies related to pipe hydraulics, as discussed in the **Overall WWF Calibration Results and Considerations (All FMs)**. Furthermore, FM 5 is located downstream of PS #5, as well as directly upstream of PS #3. The observed surcharging could have therefore been caused by downstream constraints at PS #3 or by other downstream blockages, which are not replicated in the model.

The WWF calibration at FM 5 yields good fits during the WWF Event 2 (July 12th). The response to WWF Event 2 (July 12th) in FM 5 is observed before the peak rainfall at the rain gauge due to potential geospatial variations across the Town during this event (see discussion in **Overall WWF Calibration Results and Considerations (All FMs)**.

The total R value for FM 5 is 2.50%, which is on the upper end of the values applied throughout the Town for separated sanitary areas but is still considered reasonable.

FM 6 (De Costa St)

The WWF calibration at FM 6 yields good fits during the WWF Event 1 (May 21st). The peak flow and volume fits during the WWF Event 2 (July 12th) are lower. The volume fit at FM 6 during WWF Event 2 (July 12th) improves from 43.0% to 27.1% when excluding the dry weather hours before and after the rainfall (i.e., before 11:00 and after 18:00). As noted in the DWF calibration (**Section 5.1.1.6.2**), dry weather flow volumes in July are overestimated due the following:

- Seasonal differences leading to lower observed volumes in DWF Period 2 (July) compared to DWF Period 1 (May).
- Overall drift throughout the flow monitoring period (as identified in **Section 5.1.1.3.3**) also leading to lower observed volumes in DWF Period 2 (July) compared to DWF Period 1 (May).
    - Therefore, while the calibration can yield a good volume fit to DWF Period 1 (May), the modelled volume in DWF Period 2 (July) may be higher than observed.
- As identified during the FM data quality review (**Section 5.1.1.3.3**), FM 6 experiences significant drift in velocity throughout the flow monitoring period and observed flows in July are lower than in May. This results in an overestimated DWF volume in July (**Section 5.1.1.6.2**), which is reflected in the WWF Event 2 (July 12th) calibration results.

The total R value for FM 6 is 1.40%, which is around the average value throughout the Town for separated sanitary areas.

5.1.1.6.4 Pumping Station and Wastewater Treatment Plant Validation

As described in **Section 5.1.1.5**, additional data (SCADA and CSO volumes) were obtained post-calibration. While this information is not used for a direct calibration of the model parameters, it can be used to validate the modelled results at the PSs and WWTP and provide context on the system’s performance.

Pumping Station Validation

With the exception of PS #5, flow measurements through the PSs were unavailable, and therefore modelled flows through the PSs cannot be validated. Wet well level data was provided for all PSs. However, data quality issues in the SCADA data limit the ability to validate the results (missing data at PS #2 and inconsistent wet well levels at PS #3). Overall, it is recommended that operational setpoints and pump/system curves at each PS be confirmed. Updated PS wet well level and flow data corresponding to these setpoints should be collected and used as part of the calibration. Additionally, current pump performance should be evaluated (pump tests), to identify the impact of current pump condition on performance (i.e., changes in pump and system curves, efficiency, head losses).

The following are findings from the model validation for each PS.

PS #1

The modelled wet well levels at PS #1 during the DWF Period 1 (May) and the WWF Event 1 (May 21st) are generally lower than observed in the SCADA, and the modelled levels cycle less frequently than observed. As previously noted, this is due to differences between the PS design information (used in the model) and current PS operation and performance.

Comparisons to wet well levels during DWF Period 2 (July) and WWF Event 2 (July 12th) is not feasible due to data quality issues.

Flows through PS #1 are small in magnitude, and therefore, variations from SCADA at this PS likely have minimal impacts on the calibration.

The Town reported PS overflows of 0.28 m^3 at PS #1 during the WWF Event 1 (May 21st). This PS overflow is not replicated in the model. This discrepancy, while minor, may be due to differences between how the PS is modelled and current operations.

PS #2

No validation was performed at PS #2, as no flow data was available and wet well level data was missing during the selected events.

PS #3

No validation was performed at PS #3, as no flow data was available and wet well level data was inconsistent during the selected events.

The Town reported a PS overflow of 16 m^3 at PS #3 during the WWF Event 1 (May 21st). This PS overflow is not replicated in the model. This discrepancy, while minor, may be due to differences between how the PS is modelled and current operations.

PS #4

No validation was performed at PS #4, which is not included within the model extent.

PS #5

The modelled wet well levels at PS #5 during all DWF periods and WWF events are generally higher than observed in the SCADA, and the modelled levels cycle more frequently than observed. As previously noted, this may be due to differences between the PS design information (used in the model) and current PS operation and performance. This may also be due to the downstream calibration at FM 5, which can lead to higher flows in some areas. While PS #5 receives flows from a newer residential subdivision (Madawaska Village) and therefore lower flows are generally expected, this residential subdivision is included in the larger metershed of the downstream FM 5, which also includes areas with higher I/I. Therefore, the RTK parameters for the FM 1 metershed were applied to areas upstream of PS #5. Otherwise, the RTK parameters for FM 5 were developed considering a large metershed including ICI areas with potential cross-connections, which are not representative of the subcatchments upstream of PS #5. The pipes in the FM 1 metershed and the pipes upstream of PS #5 have the same age (see **Figure 5-2**), hence there is more confidence in applying the FM 1 parameters to the subcatchment upstream of PS #5. It is recommended that flows downstream of the subdivision flowing into the PS be monitored to confirm the flows to the PS, and better understand the wet well storage cycles.

The modelled pump flows at PS #5 during all DWF periods and WWF events are generally higher than observed in the SCADA, and the modelled pump cycles are more frequent than observed (as noted from the wet well level validation). The differences in the modelled and observed pump flows are generally small, due to the small order of magnitude of the flows through PS #5 (flows are less than 10 L/s). These differences therefore have minimal influence on the downstream calibration of FM 5.

As observed in the DWF calibration (see **Section 5.1.1.6.2**), volumes in July tend to be overestimated due to seasonal differences, which contributes to the higher flows and more frequent cycling in the model.

Wastewater Treatment Plant and CSO Validation

Incoming flows to the WWTP can be compared to the influent channel flow measurements at the WWTP, downstream of the grit tanks. Along with this dataset, the reported CSO volumes can also be used as part of the WWTP validation. The following are findings from the model validation using the available data:

- On average, the modelled flows to the WWTP under DWF conditions are generally lower than the measured flows. The measured average DWF during DWF Period 1 (May) was 70 L/s, and was 61 L/s during the DWF Period 2 (July), whereas the modelled average DWF during both DWF periods was 54 L/s.
  - Flows to the WWTP are influenced by flows from unmonitored areas. While average parameters based on monitored areas have been applied to unmonitored areas, there remain differences which may be attributed to differences in metershed characteristics;
  - Flows to the WWTP are also influenced by the PS #3 forcemain (river crossing), and hence by the operations of PS #3 (see discussion of discrepancies at PS in **Pumping Station Validation**).
- The observed peak influent flow at the WWTP during WWF Event 1 (May 21st) is 510 L/s, whereas the modelled peak incoming flow is 499 L/s (-2.2% peak flow fit), providing a good fit, and therefore a good representation of the hydraulics of the system downstream of the monitored areas in WWF conditions.
- The Town has reported an estimated overflow volume of 500 m3 at the Albert St CSO on May 21st, 2022, and also noted that the flow meter lost power due to a widespread outage. An overflow volume of 113.5 m3 is modelled for this event, which is less than the estimated reported volume. Differences in the CSO volume can be due to the following:
  - Uncertainties in the elevation of the Albert St weir, or in the invert measurements at this location, which will influence the volume of sewage which will overflow during a CSO;

- The dynamic hydraulics between the Albert St weir elevation and the incoming flows to the WWTP, whereby an increase in modelled flows can increase the modelled CSO volume, but also lead to an overestimation of flows to the WWTP;
- The dynamic hydraulics between the Albert St weir elevation and the inlet channel level boundary condition at the WWTP (see **Section 5.1.1.6.1**). Testing a higher boundary condition level of 880 mm at the WWTP for the duration of the rainfall event yields a larger modelled CSO volume of 174 m^3, which is still not equivalent to the observed CSO volume; and,
- In general, accurate measurements of CSO volumes can be difficult to obtain. Therefore, while the CSO volume is not reproduced by the model, the occurrence of the CSO is represented.

5.1.1.6.5 Model Limitations

Notwithstanding the calibration challenges and assumptions discussed in the **Section 5.1.1.6.2** (dry weather calibration) and in **Section 5.1.1.6.3** (wet weather calibration), the model development is within the normal application of large-scale planning studies and therefore all subsequent results should be interpreted according to this level of detail currently available. The following describes limitations within the model in reference to the calibration:

- Uncertainty in the boundary conditions can impact the calibration. Where feasible, inflows due to private PSs were represented, to produce a conservative assessment of peak flows within the system. The impact and source of these inflows should be considered if pipe capacity issues arise during system assessment;
- Though the model was updated with the most recently available GIS data, adjustments in pipe inverts and sizes were needed to resolve Engineering Validation errors deemed critical for calibration. These adjustments were based on available record drawings and LiDAR elevation data. Nonetheless, there are remaining unresolved Engineering Validation issues, such that the real site conditions in some locations might not be accurately captured. Following this master plan, the model adjustments and the remaining issues should be investigated, to further improve the representativeness of the model for future model update and calibration efforts.

- The effects of the DWF calibration are carried forward into WWF calibration. Though the magnitude is minimal in comparison to heavy rainfall events, when the DWF calibration did not fall within the targeted fit, it is possible that poor fits carry over or influence the results of WWF calibration;
- Relatively small storm events were observed in the flow monitoring period of April to July 2022, with return periods of 1:2-years or less in general. Linear extrapolation to larger events may not be fully reflective of the actual response to such events. Future flow monitoring, model updates and recalibration are recommended to account for the magnitude of events observed during calibration;
- Sediment may be present in the pipes, which is not represented in the model. This can result in discrepancies between the modelled and observed depths but is often temporary in nature due to flushing programs and large WWF events potentially dislodging debris and build-up. Providing frequent sewer flushing programs for Town's sewers can help to reduce sediment and its impact to flow conditions.

5.1.2 Potable Water Distribution System Model

The water distribution model is an all-pipe model in Innovyze's InfoWater Pro software, including the Town's water filtration plant (WFP) and elevated storage tank (EST). As discussed in **Chapter 1** (**Section 4**), the 2015 model with the updates to support development requests (i.e., watermain upgrades on Havey St and Daniel St, new developments at Campbell Farms, Village Creek, Callahan Subdivisions, and roughness coefficient adjustments based on field data) was used as the basis for the current W&WWMP's model update. The hydraulic model was modified to reflect the updated infrastructure in the water distribution system, reflect current system operations, and reflect recent growth and water consumption in the Town. With the updated infrastructure and demands, the model's performance was validated against available SCADA (July 1 – 5 and July 7 - 8, 2022), hydrant pressure data (June 12 – July 11, 2022), and 2018 hydrant flow test data.

5.1.2.1 Infrastructure

The modelled water distribution system network was compared to the Town's current GIS watermain database to identify any recent upgrades and reflect existing conditions. The updates included:

- Adding new pipes for new service areas;
- Abandoning older pipes which are no longer in service; and,
- Adding replacement pipes.

Also, updates regarding pipe alignment and size were made to the model where discrepancies were found between the two sets of data. The updated water distribution system network is shown in **Figure 5-18**.

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Legend

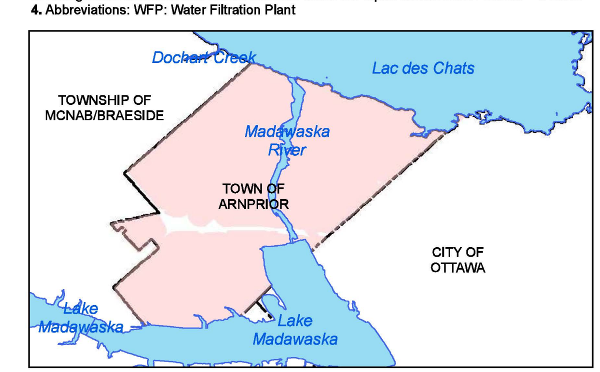
Modelled Watermains - Diameter (mm)

- < 75 mm
- 75 mm - 150 mm
- 150 mm - 225 mm
- 225 mm - 350 mm
- 350 mm - 600 mm
- Modelled Junctions
- WTP Water Treatment Plant (WTP)
- Elevated Storage Tank (EST)
- Municipal Boundary

N

0 250 500 Meters
(At original document size of 11x17)
1:16,000

Notes
1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Ontario_Hydro_Network_(OHN)_-_Waterbody.shp*, *Ontario_Hydro_Network_(OHN)_-_Waterbody (2).shp*, *Municipal_Boundary_-_Lower_and_Single_Tier.shp*, and *0837ARNP.sid*, *Arnprior_PropertyParcels_wAssessment_20220324.shp*, *Arnprior_Roads_20220324.shp* and *WTR_NODE.shp* provided by the Town of Arnprior
3. Background: Contains information licensed under the Open Government Licence – Ontario
4. Abbreviations: WFP: Water Filtration Plant



Project Location Prepared by CZ on 2023-01-31
Arnprior, ON

Client/Project 163401723
Town of Arnprior
2022 W&WW Master Plan Update

Figure No.
5-18

Title
Updated Water Distribution Network (Existing Conditions)

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No changes were made to the roughness coefficients of all pipes that were in the base model (i.e., the 2015 hydraulic model with the updates described above). For updated or added pipes, roughness coefficients were applied based on the assignment rules as outlined in **Table 5-14** below.

Table 5-14: Assignment Rules for Roughness Coefficients of Updated or Added Watermains

Scenario	Pipe Material	Assignment of Roughness Coefficient
There is pipe in the base model that has the same pipe size, material, and age near the updated/added pipe.	N/A	The same roughness coefficient as the pipe in the base model is applied.
There is no pipe in the base model that has the same pipe size, material, and age near the updated/added pipe.	PVC / HDPE	Roughness coefficient is assigned according to Table 4.4 in the City of Ottawa Water Distribution Design Guidelines (i.e., roughness coefficient based on pipe size).
	CU (Copper)	A roughness coefficient of 130 is applied for all copper pipes, as the roughness coefficients of all other copper pipes in the base model are 130 in despite of pipe size and age.
	DI / CI	The same roughness coefficient as the pipe in the base model that have the same pipe size, material, and same or close age is assigned.

In general, surface elevations of model junctions were kept as per the base model. For junctions added to the model, ground elevations were assigned based primarily on the provided LiDAR data at a 1 m x 1 m resolution, as well as the survey points (20 m x 20 m resolution).

Upon reviewing the provided data for water distribution facilities (e.g., SCADA, as-built / as-design drawings, Municipal Drinking Water Licence [MDWL], Drinking Water Works Permit [DWWP], and environment study reports), the hydraulic parameters of the elevated storage tank (EST) and WFP were verified, and the following modifications were made to the model for existing conditions:

- Initial level of the EST was set to 7.77 m which is the average level in the EST based on 2022 SCADA data. The initial EST water level of 7.77 m is equivalent to approximately 70% of the overall volume and is within the observed operating range of 58 to 83% full.
- Reservoir head at the WFP was updated to 91.62 m which is the average water level in in both Clearwell #1 and Clearwell #2 according to 2022 SCADA data. The head of 91.62 m is equivalent to about 84% full of the reservoir based on the top water level (TWL) of 92.20 m and bottom of clearwell elevation of 88.54 m shown on the hydraulic profile as part of the 2011 Arnprior Water Filtration Plant Expansion as-built drawings.
- As confirmed by 2022 SCADA data, only one high lift pump (HLP) at the WFP would be called into service at a time, and the HLP was set to open when water in the EST is less than 60% of the overall volume (i.e., level in the EST drops below 6.79 m) and closed when water in the EST achieves 80% of the overall volume (i.e., level in the EST reaches 8.74 m).
- The Town provided a test pump curve (dated July 13, 2021) for the WFP's HLPs. By comparing the test pump curve with the design pump curve that was used in the base model (see **Figure 5-19**), differences between the two curves were considered marginal with the rated test-based curve operating slightly above the design curve. Therefore, the design pump curve was maintained and used in the analysis of this network.

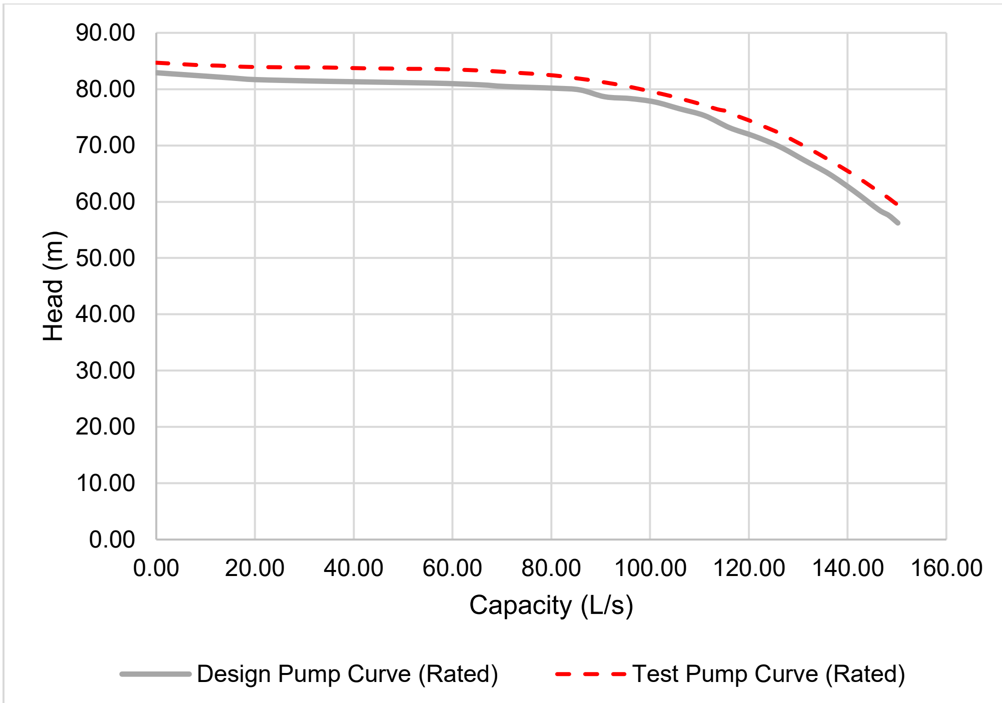


Figure 5-19: Design and Test Pump Curves for HLPs at the WFP

5.1.2.2 Existing Water Demands

Water demands in the model were updated to reflect changes in demand and growth that has occurred in the Town since the last model update in 2015, and to integrate recent consumption records.

Annual WFP treated water flow data was provided by the Town. Six years of data, from January 2016 to December 2021, was used to calculate the total existing system average day (AVDY) demand of 4,146 m^3/d (average from 2016 to 2021). The average of annual maximum daily treated flow from 2016 to 2021 (i.e., 5,933 m^3/d) was assumed as the total maximum day (MXDY) demand which resulted in a MXDY peaking factor of 1.43. It is noted that all outlier flows (e.g., high flows due to watermain breaks, refilling of the EST, and reported clearwell issue) based on the *Water & Sewage Plant Committed Capacity / Uncommitted Reserve Capacity Spreadsheet Assessment* (Town of Arnprior, 2022) were excluded from the calculation of total MXDY demand.

The Town also provided water consumption records (monthly / bimonthly metered data) for the existing metered services area from July 2021 to August 2022. The average daily consumption for each user was calculated. For the hydraulic model update, the water consumption data of each metered site was joined with property parcels by either matching the property number or geocoding based on address.

Figure 5-21 illustrates the distribution of water consumption based on available metered data. To allow for a more reflective distribution of system demands within the model, the top water consumers (i.e., users with high water consumption) were identified based on the calculated average daily water consumption rates and a threshold of 5 m^3/d which is the 99^{th} percentile (refer to **Figure 5-20**). This yielded 38 high water users which account for an average water consumption of 1,232 m^3/d, which represents approximately 30% of the Town's overall AVDY demand. Water consumptions associated with top water consumers were then assigned to the nearest model junctions as AVDY demands, and the peaking factor of 1.43 was applied to establish MXDY demands.

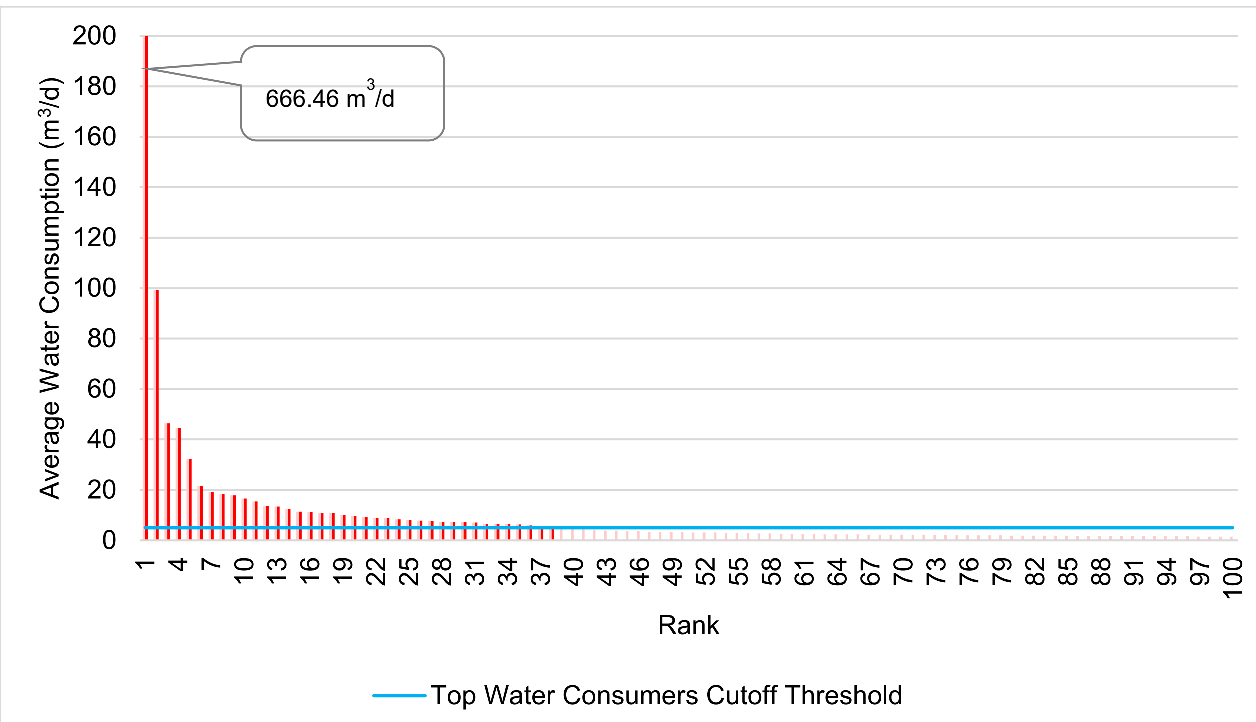
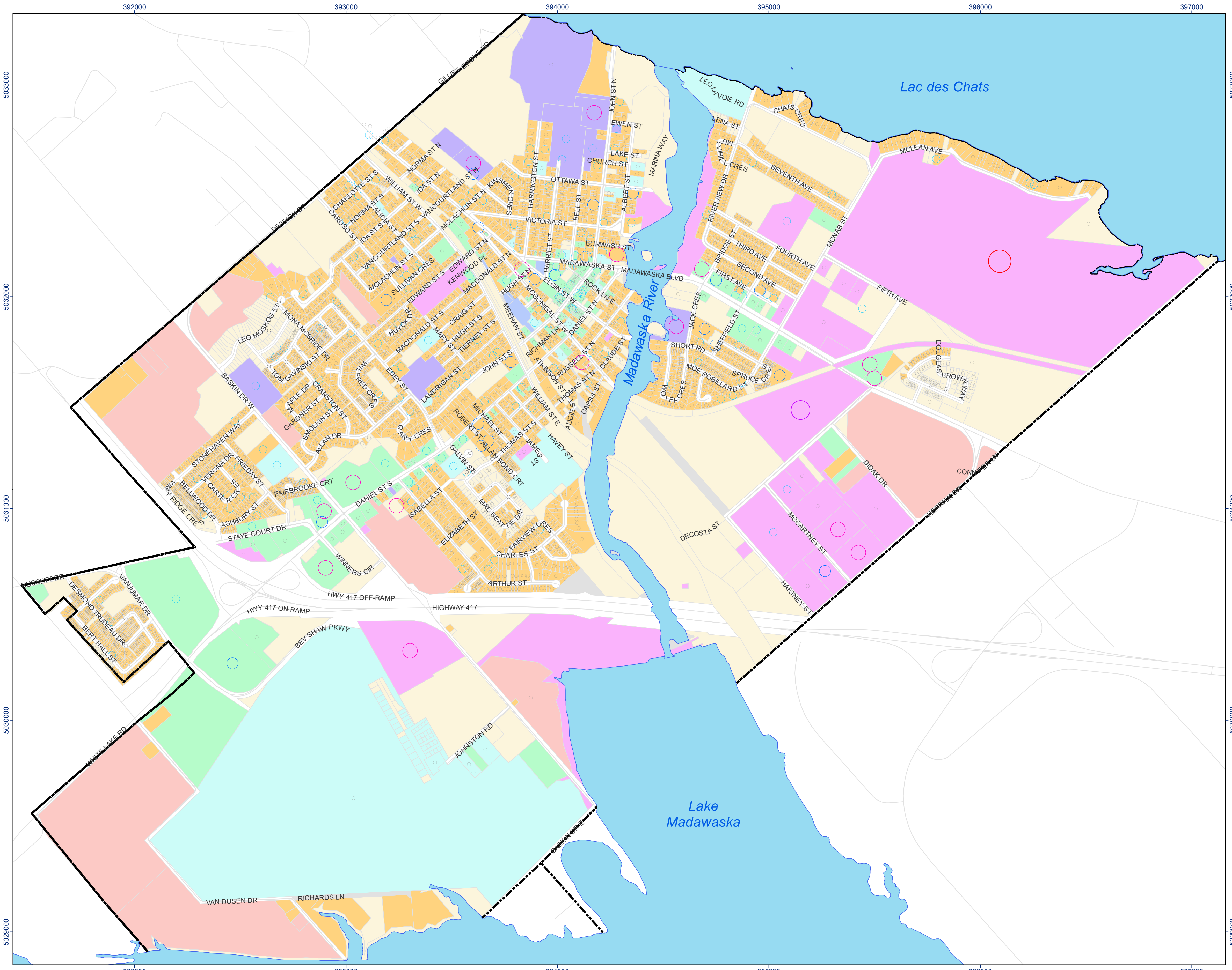


Figure 5-20: Top 100 Average Water Consumption



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Legend

Water Consumption (July 2021 - August 2022 Average)

- < 1 m3/d
- 1 m3/d - 5 m3/d
- 5 m3/d - 10 m3/d
- 10 m3/d - 50 m3/d
- 50 m3/d - 100 m3/d
- 100 m3/d - 666 m3/d

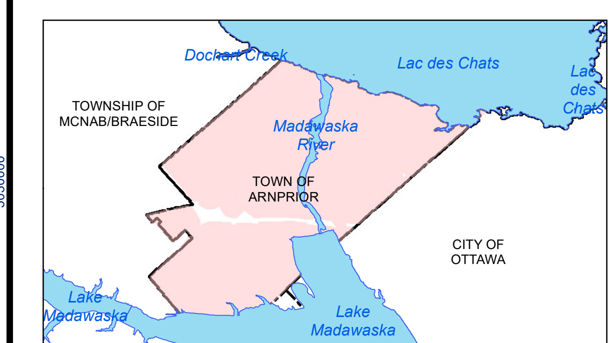
Land Use

- Commercial
- Farm
- Government
- Industrial
- Institutional
- Residential
- Special Purpose
- Unassessed
- Vacant
- Municipal Boundary

N

0 250 500 Meters
(At original document size of 11x17)
1:18,500

Notes
1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Ontario_Hydro_Network_(OHN)_-_Waterbody.shp, Ontario_Hydro_Network_(OHN)_-_Waterbody (2).shp, Municipal_Boundary_-_Lower_and_Single_Tier.shp*, and *Arnprior_Roads_20220324* and *Arnprior_PropertyParcels_wAssessment_20220324.shp* provided by the Town of Arnprior.
3. Background: Contains information licensed under the Open Government Licence – Ontario



Project Location Prepared by CZ on 2023-01-31

Arnprior, ON

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Town of Arnprior
2022 W&WW Master Plan Update

Figure No.
5-21

Title
Water Consumption Based on Metered Data

C:\Users\chzheng\Documents\My Documents\temp\163401723 Arnprior Water Master Plan\figures\Ch2\mxd\fig2-25_arn_wtr_billing_data_map_20230131.mxd Revised: 2023-02-07 By: chzheng

It should be noted that the total average daily water consumption of all metered sites is about 2,806 m^3/d, which is about 32% lower than the total average daily treated flow of 4,146 m^3/d at the WFP. The difference between the WFP output and the total metered water consumption could be considered as non-revenue water (NRW), which typically includes authorized unbilled consumption (e.g., potential non-metered properties, water for flushing and firefighting) and various water losses (e.g., leaks and overflows and inaccuracies in metering).

By subtracting the total water consumption of top water users from the total AVDY and MXDY demands, the remaining demands were then proportionally distributed to non-hydrant model junctions based on the number of metered properties with non-zero water consumption that are spatially allocated to the junction (i.e., total remaining demand x [number of metered properties with non-zero water consumption that are spatially allocated to the junction / total number of metered properties that have non-zero water consumption]). **Table 5-15** summarizes the water demand parameters used in the hydraulic model update, as described previously.

Table 5-15: Existing Conditions Estimated Water Demands

Parameter	Units	AVDY	MXDY
Total WFP Treated Flow(1)	m^3/d	4,146	5,933
Maximum Day Peaking Factor(2)	-	1.43	1.43
Total Water Consumption by Top Water Consumers(3)	m^3/d	1,232	1,763
Remaining Demand	m^3/d	2,914	4,170

Notes:

(1) Based on annual WFP treated water flow data, the total AVDY demand is the overall average from 2016 to 2021. The total MXDY demand is taken as the average of annual maximum daily treated flow from 2016 to 2021.

(2) Maximum day peaking factor was calculated by dividing the total MXDY demand by total AVDY demand.

(3) Top water consumers are identified as the water users with average daily consumption greater than 5 m^3/d.

To model the water distribution network over an extended period of time, the same 72-hr patterns as the base model were applied, which are typical mixed-use diurnal patterns for both AVDY and MXDY demand conditions.

5.1.2.3 Model Calibration and Validation

Preliminary results generated by the updated model were validated against recorded data provided by the Town, including system responses observed at the WFP and EST (i.e., SCADA data), pressure readings at the hydrant near 263 Alicia St (i.e., iHydrant data), and hydrant flow data from 2018 for 324 tests performed at 320 hydrants located across the Town. Of the 324 hydrant flow tests, 316 either had an associated hydrant in the GIS database or complete data results with pressure drop greater than 10% during the test (the drop between the static and residual pressures should be at least 10% to obtain satisfactory results). Therefore, the model was only validated against these 316 hydrant test results.

Table 5-16 presents the comparison of the model output to the SCADA and iHydrant data. In general, the model results are within the range of recorded values for discharge pressures at the WFP, levels in the EST (percent full), and pressure at the iHydrant location. The modelled discharge flow from the WFP was higher than that observed which may be due to pump curves not reflecting actual pump performance during the SCADA period, or the variation in the actual duty setpoints of the HLPs with respect to levels in the EST (i.e., the actual start and stop setpoints fluctuated around 60% and 80% full of the EST).

Table 5-16: Model Calibration/Validation Results (SCADA and iHydrant Data vs. Model Output)

Source	WTP Discharge Pressure (psi)	WTP Discharge Flow (L/s)	Elevated Storage Tank Level (%)	iHydrant Location (263 Alicia St) Pressure (psi)
Typical Range of Measured Values	73 - 95	120.0 - 135.0	57.7 - 83.0	70 - 90
Ranged of Simulated Values - under AVDY demand conditions	80 - 88	141.0 - 145.0	60.2 - 79.9	75 - 83
Ranged of Simulated Values - under MXDY demand conditions	80 - 87	141.6 - 146.0	60.4 - 79.6	75 - 82

As the hydrant flow test data used for model validation were completed over the course of 2018 under varying system operating conditions (or boundary conditions), hydrant test results were first categorized into groups based on their corresponding combination of SCADA discharge flow at the WFP and level in the EST for the associated timestep. These groupings of boundary conditions were then applied in a series of validation runs (MXDY + fire flow steady-state simulation), and the model result (i.e., available fire flow at a residual pressure of 20 psi) at the junction closest to the test hydrant was compared to corresponding hydrant fire flow data under the specific group of boundary conditions. **Table 5-17** presents the comparison of the model output to the hydrant test data. About 43% of the modelled available fire flows were within 25% of recorded values, and around 67% of the modelled flows were within 50% of recorded data. Locations with high differences are mainly in areas where watermains have been upgraded or additional looping has been added since 2018 (e.g., watermain along William St upgraded in 2018 leads to differences between modelled and tested flows at Charlotte St and Norma St, new looping near Mac Beattie Dr added in 2020 results in differences between modelled and tested flows in area near Fairview Cres). Given that the tests were completed in 2018 (and prior to network and demand changes due to recent development), overall, the fit of dataset to the output of the updated model was considered reasonable for master planning purposes. However, it is recommended that future calibration efforts are considered to further improve the reporting of the available fire flows in the network.

Table 5-17: Model Calibration/Validation Results (Hydrant Flow Test Data vs. Model Output)

% Difference, Abs [(Modelled Flow - Tested Flow) / Tested Flow]	Comparison of Available Fire Flow at 20 psi Count	Comparison of Available Fire Flow at 20 psi % of Total
≤ 0%	65	21%
10% - 25%	71	22%
25% - 50%	77	24%
50% - 75%	50	16%
75% - 100%	29	9%
> 100%	24	8%
Total	316	100%

5.2 Existing Hydraulic Conditions Assessment

Following the updates presented in **Section 5.1**, the wastewater collection and water distribution system hydraulic models were used to assess the existing infrastructure under existing flow and demand conditions.

5.2.1 Wastewater Collection System

As presented in **Section 5.1.1**, the trunk-level wastewater collection system model's infrastructure and wastewater flows were updated, and the model re-calibrated, to represent existing conditions during the flow monitoring period (April 2022 to July 2022). The calibrated model is then used to assess the performance of the existing system's sewers, pump stations and WWTP under a design event.

5.2.1.1 Boundary Conditions

The boundary conditions applied in the model for the existing conditions assessment are consistent with those applied for the WWF events during calibration, as presented in **Table 5-7** of **Section 5.1.1.6.1**. Notably, the DWF inlet channel level is applied as a boundary condition at the WWTP, and the inflows from the private PS (WFP sludge discharge) upstream of FM 2 are modelled using the same pattern developed for the WWF calibration.

5.2.1.2 Collection System

As described in **Chapter 1** (**Section 4**), the existing sanitary sewer network is assessed to identify existing capacity constraints and flooding risks in the Town.

For the existing conditions assessment, the collection system performance is evaluated based on hydraulic grade lines (HGLs). The resultant HGLs are assessed to identify if basement or surface flooding risks are generated, as described in **Chapter 1** (**Section 4**). Pipe surcharge state can help define the issues within the system but is not considered in the criteria. Pipe surcharge state is identified using a combination of the flow capacity utilization within the pipe (q/Q) and the depth ratio (d/D). Pipes can either be bottlenecked (undersized and flowing above the pipe's capacity), experiencing backwater conditions due to downstream bottlenecks, or free flowing.

Under DWF conditions, all pipes are free-flowing and do not experience surcharge. HGLs are within 1.8 m of ground surface in some locations with shallow sewers, which are illustrated in **Figure 5-22**.

In line with the 2013 W&WWMP's approach, the WWF assessment uses a 25-year SCS II 6-hour rainfall distribution event based on records from the nearby Environment Canada station in Shawville, Québec. As noted in the model limitations (**Section 5.1.1.6.5**), the model was calibrated to small events (equivalent to a 2-year event or less). When extrapolating the flows to a more extreme event, this can result in a conservative system response.

Figure 5-22 shows the results of the existing collection system assessment under the 25-year design event. MHs and sewers are rendered as follows:

- MH HGL (freeboard):
    - **Black**: HGL is more than 1.8 m below ground surface (i.e., low risk of basement flooding);
    - **Yellow**: HGL is within 1.8 m of ground surface (i.e., potential for basement flooding); and,
    - **Red**: HGL is above ground surface (i.e., potential for basement and surface flooding).
- Pipe surcharge state:
    - **Black**: free-flow within sewer;
    - **Yellow**: sewer surcharged, peak flow within free-flow capacity of the sewer (i.e., under backwater conditions);
    - **Red**: sewer surcharged, peak flow greater than free-flow capacity of the sewer (i.e., sewer is under capacity and causing bottleneck); and,
    - **Purple** halo: shallow sewers with less than 1.8 m between the sewer obvert and the ground surface.

Yellow nodes located on shallow (purple) sewers indicate that the HGL is within 1.8 m of ground surface, as commonly observed with shallow sewers. These locations are not discussed further when evaluating the system's performance. Sewer invert and ground elevations in these areas should be confirmed to ensure that the data used is accurate.

Pump Station (PS) Representation: The collection system assessment assumes ideal pumps (flow in = flow out), such that the design flows are conveyed downstream of the pump stations and potential downstream constraints can be identified. The incoming flows to each PS are also assessed against the firm capacity.

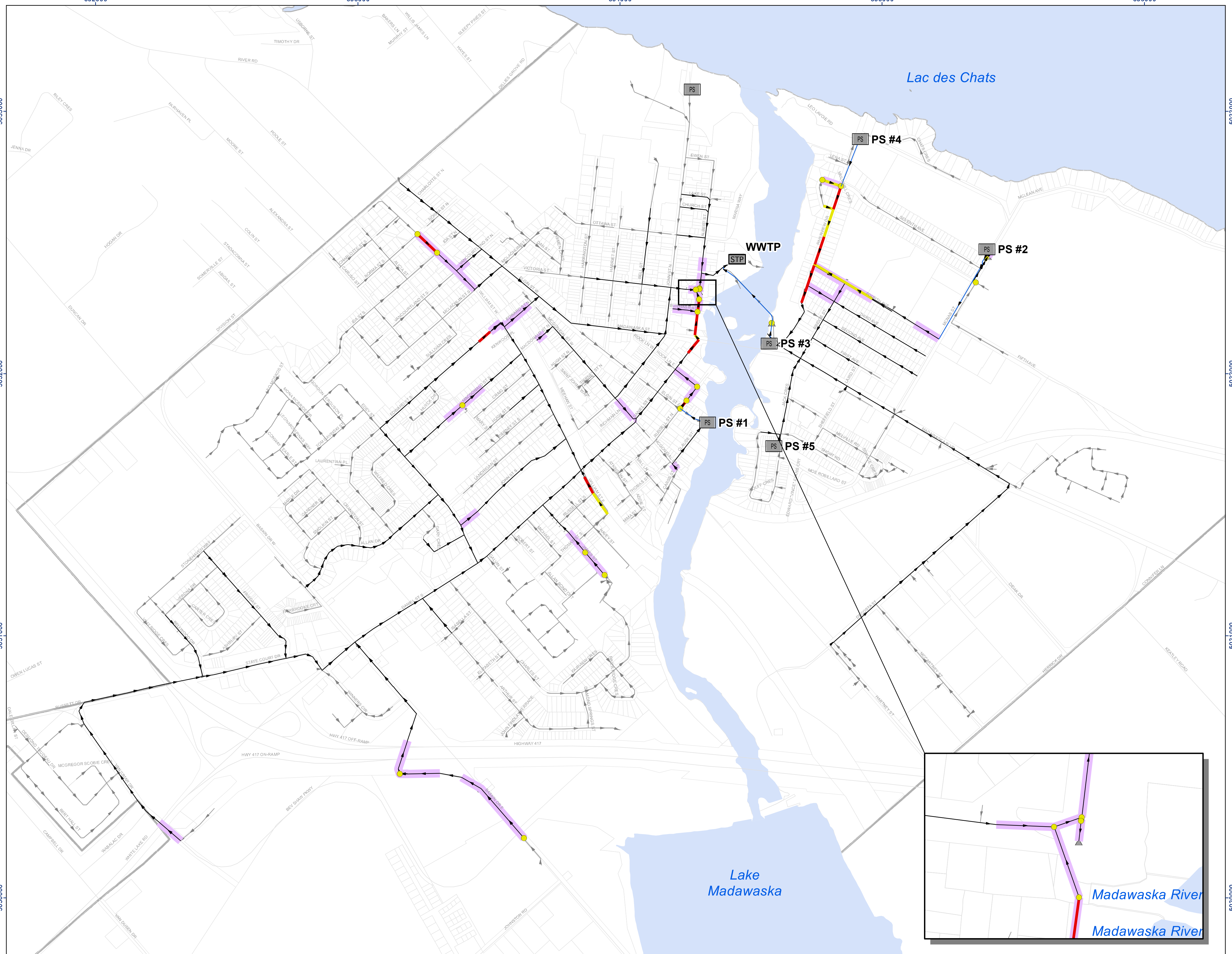
The problem areas are as follows:

- **Problem Area PA-1 – Riverview Dr/Fourth Ave/Mulvihill Cr**: Risks of basement flooding are observed along Riverview Dr and Mulvihill Cr, due to sewer capacity issues along Riverview Dr, which propagate upstream. The 450 mm diameter sewers on Riverview Dr, north of Fourth Ave, are undersized for the flows observed in the 25-year design event. The sewer along Riverview Dr, however, does have an adverse (and almost flat) slope, based on the invert information received. It is therefore recommended that the inverts along these sewers be confirmed, prior to implementing the solutions developed in **Chapter 3** (**Section 6**). No future projects are planned that will impact flows to this problem area.
- **Problem Area PA-2 –Daniel St**: Risks of basement flooding are observed along the shallow sewers on Albert St just upstream of the CSO location, and on Daniel St, upstream of Madawaska Blvd. While these sewers are shallow, some upstream sewers also experience capacity constraints in the 25-year event, thus indicating that the 600 mm diameter sewers are also undersized. These sewers receive flows from upstream combined sewer areas within the FM 2 and FM 3 metersheds; however, they do themselves fall within the unmonitored area. The planned sewer separations presented in **Table 5-27** are expected to alleviate the flows to the Daniel St trunk sewer, and reduce the extent of the pipe capacity constraints under future conditions (see results in **Section 5.5.1.3**). No HGL issues due to pipe constraints are observed. The sewers experiencing bottlenecked conditions, however, consist of some inferred inverts applied to eliminate the adverse slopes produced when using provided inverts. It is therefore recommended that the inverts along these sewers be confirmed, prior to implementing the solutions developed in **Section 6.5**.
- **Problem Area PA-3 – Edward St**: While no HGL issues are observed along Edward St, the existing 200 mm diameter sewer south of William St is bottlenecked. Flows from the Callahan Developments are partially diverted from Edey St to Edward St at the bifurcation between the two streets. Sewer separation along Edward St is planned downstream, north of William St (project SEW-FUT-16 in **Table 5-27**), but does not impact flows to this problem area.

Under existing conditions, issues are also identified in the following areas:

- **William St W (Northwest of Daniel St)**: Risks of basement flooding are observed along William St W, indicating that the 450 mm diameter sewer is undersized for the 25-year design event. This sewer receives flows from combined areas. These HGL issues and surcharging may however be due to the most upstream sewer having an adverse slope, based on the invert information received. It is therefore recommended that the inverts along these sewers be confirmed, prior to implementing any solutions that may be developed in **Chapter 3** (**Section 6**). Sewer separations along Charlotte St S and Ida St are planned in 2036 (project SEW-FUT-11 in **Table 5-27**), which will eliminate these HGL issues in the future (see **Section 5.5.1.3**), hence this area is not further assessed as a problem area.
- **Russell St, downstream of PS #1**: Risks of basement flooding are observed along the sewers on Russell St, directly downstream of the PS #1's forcemain. These sewers and PS #1 receive flows from upstream combined sewer areas which fall within the unmonitored area. The sewer directly downstream of the forcemain experiences bottlenecked conditions. Sewer separations along Claude St are planned in 2030 (project SEW-FUT-8 in **Table 5-27**), as well as along Russell St in 2031 (project SEW-FUT-9 in **Table 5-27**), which eliminate these HGL issues in the future (see **Section 5.5.1.3**), hence this area is not further assessed as a problem area.
- **William St E (Southeast of Daniel St)**: While no HGL issues are observed along William St E, the 375 mm diameter sewer is undersized for the 25-year design event. This sewer receives flows from separated and combined subcatchments. Sewer separations along James St are planned in 2033 (project SEW-FUT-10 in **Table 5-27**), which will eliminate these HGL issues in the future (see **Section 5.5.1.3**), hence this area is not further assessed as a problem area.

Other HGL issues (risks of basement flooding) are observed throughout the system, however these are due to shallow sewers rather than pipe capacity issues and are not further addressed in this chapter. Nonetheless, these results should be compared to reported basement flooding occurrences and the installation of backwater valves considered where necessary.



Stantec

Legend

- Sanitary Pump Station (PS)
- Overflow
- Wastewater Treatment Plant (WWTP)
- Sanitary Sewer (Not Modelled)
- Forcemains

HGL Freeboard

- At or Above Surface
- Within Basement Level (Within 1.8 m of Surface)

Pipe Surcharge State

- Bottleneck (Undersized Sewer)
- Backwater Conditions
- Free-Flowing Conditions
- Shallow Pipes (Obvert Within 1.8 m of Surface)

N

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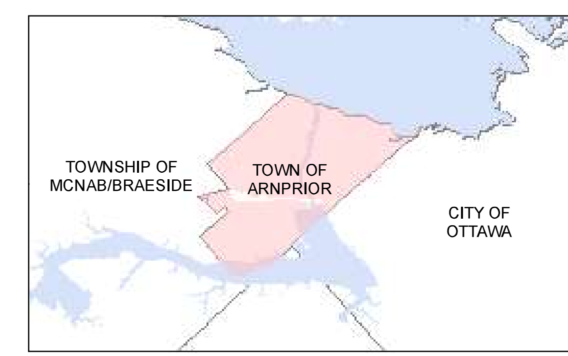
Notes

1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Export_Output_Parcel_Fabric.shp*, *Export_Output_Roads.shp*, *Export_Output_San_MH.shp* and *Export_Output_SAN_SEWER.shp* provided by the Town of Arnprior
3. Background: Contains information licensed under the Open Government Licence – Ontario
4. Abbreviations: FM: Flow Monitor; MH: Maintenance Hole; PS: Pump Station; WWTP: Wastewater Treatment Plant



Project Location Prepared by CR on 2023-01-06
Arnprior, ON

Client/Project 163401723
Town of Arnprior
2022 W&WW Master Plan Update

Figure No.
5-22

Title
Existing Conditions - 25-Year SCS II 6 Hour Event

C:\Users\crazafimaharo.CORP\Documents\Local_Work_Tmp\Local-163401723-ArnpriorMP\gis_local\MXDs\tm3_figs\appA3-1_arn_san_results_excondn_rev_20231109.mxd Revised: 2023-11-09 By: crazafimaharo

An intense rainstorm occurred in the evening of September 7th, 2023, during which several sewer service line backups and basement flooding occurrences were reported at the following locations:

- Arnprior Public Library (21 Madawaska St),
- Sullivan Cr (4 reports),
- 59 Madawaska St, and
- 191 John St N.

Furthermore, overflows were observed at the Albert St weir and combined sewer overflow (CSO), at PS #1, and PS #3.

The Town reported a rainfall depth of 33.8 mm to 43 mm during approximately 30 minutes, which, based on the intensity-duration-frequency (IDF) curves for the Environment and Climate Change Canada (ECCC) Appleton Station (see Chapter 2 (Section 5) and Figure 5-23), is equivalent to a 100-year event (i.e., with a 1% chance of annual occurrence).

With the exception of PS #3, all the locations listed above are downstream of combined areas. As shown in the future conditions assessment (Section 5.5.1.3), the planned sewer separations are expected to alleviate sewers, notably the Daniel St trunk sewer. It is recommended that the Town continue its efforts towards sewer separations and monitor the resulting flows to confirm their impacts. PS #3 is located downstream of industrial, commercial, and institutional (ICI) areas which may have roof drain connections to the sanitary sewers, or other potential cross-connections. The capacity of PS #3 is further discussed in the following PS capacity assessment.

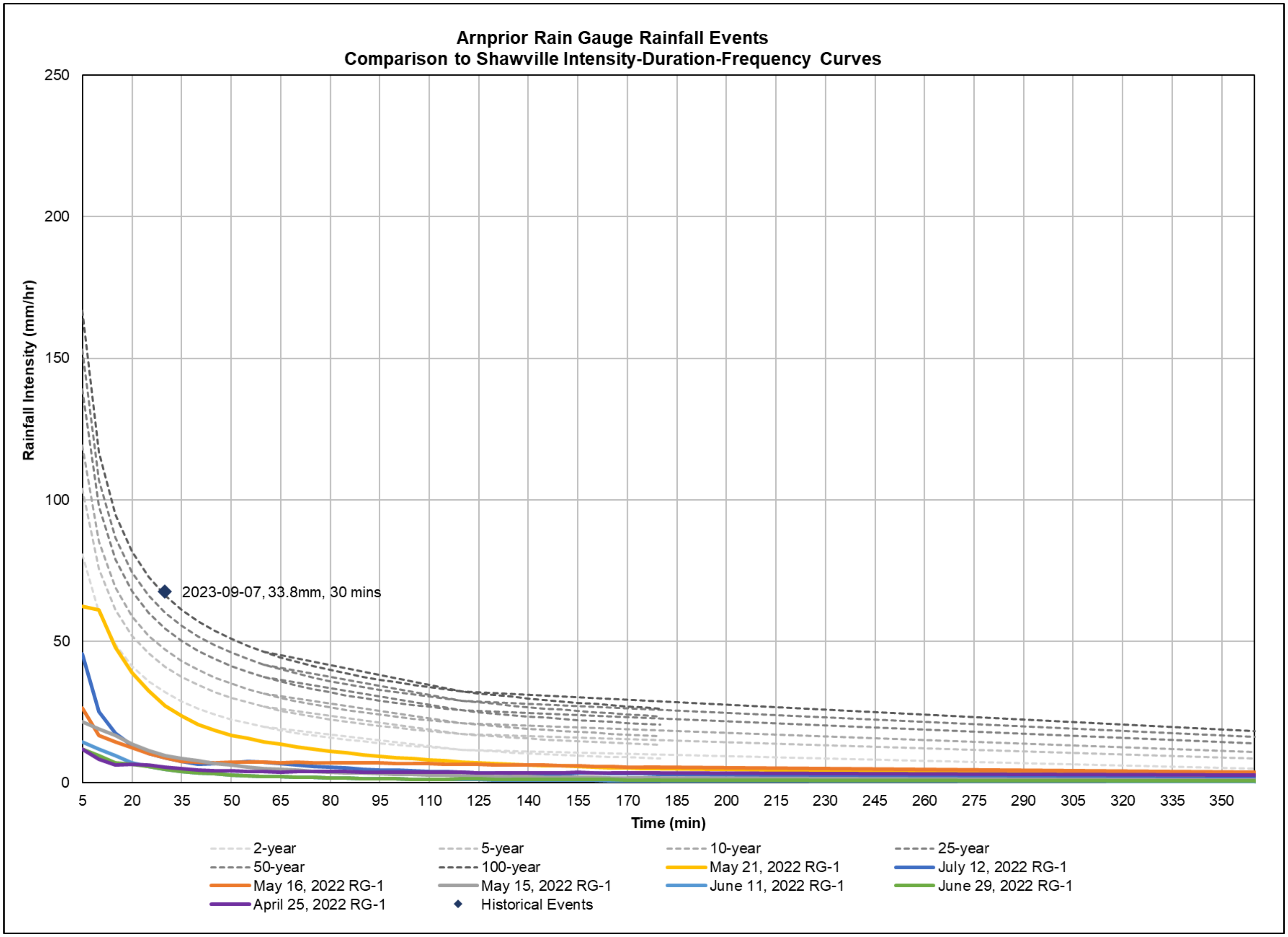


Figure 5-23: 2022 Flow Monitoring and 2023 Historical Events Comparison with IDF Curves

5.2.1.3 Pumping Stations

As described in **Chapter 1** (**Section 4**), the capacities of the PSs are assessed by identifying the incoming flow and comparing it to the PS's firm capacity (largest pump offline). The existing PSs capacities are compared to the revised peak modelled incoming flows under DWF conditions, the 10-year design event, and the 25-year design event, for each growth horizon, with and without the future (planned) projects presented in **Table 5-27**. Per the MECP guidelines, PSs should be designed for a firm capacity at least capable of handling the 10-year design event. Additionally, the PSs bypass history from 2017 to 2022 was also reviewed at each PS. The results are summarized in **Table 5-18**. The PSs were modelled as ideal (flow in = flow out) for the existing conditions assessments. PS #4 was not explicitly modelled; therefore, its capacity is not assessed.

Table 5-18 shows the comparison of the PS's firm capacity (i.e., largest pump out of service) against the modelled incoming flows under DWF conditions, the 10-year design event, and the 25-year design event. As noted in the model limitations (**Section 5.1.1.6.5**), the model was calibrated to an event equivalent to a 2-year event, i.e., with a 50% probability of occurring every year. Extrapolating the flows to a less frequent event such as the 25-year event (i.e., with a 4% probability of occurring every year) can result in conservative peak flows throughout the system, including those incoming to the PSs.

No PS capacity concerns are observed under DWF conditions. In the 10-year and 25-year design events however, PS #1, PS #2 and PS #3 are already at capacity in existing conditions, such that backwater and HGL issues upstream of the PSs may occur. Nonetheless, where multiple pumps are present at a PS, flows exceeding the PS's firm capacity could still be conveyed when all pumps operate simultaneously (if possible). These findings should therefore be validated against historical (anecdotal) evidence of PS performance under large events, to confirm whether any operational or PS backup issues have been experienced, and if any impacts on the sanitary collection system were observed under these conditions.

For example, the Town's 2022 Annual Report includes reports of PS bypass at PS #1 and PS #3. Considering the review of the PSs bypass history, PS #2 and PS #5 have not experienced bypasses between 2017 and 2022, however PS #1 was bypassed twice between 2020 and 2022, and PS #3 has experienced yearly bypasses between 2020 and 2022, for a total of 5 bypasses. Both PS #1 and PS #3 also experienced overflows during the intense rainstorm reported by the Town on September 7th, 2023.

PS #1 is located downstream of combined areas. It is expected that the Town's planned sewer separations on McGonigal St and Claude St (project SEW-FUT-8 in **Table 5-27**) will help reduce the flows to PS #1 once implemented by the 10-year horizon. Once sewer separation is completed, monitoring is recommended to confirm the efficacy of the sewer separation and the resulting impact on inflow and infiltration (I/I) to PS #1. Other PSs are not impacted by the other planned projects.

PS #3 is located downstream of ICI areas which may have roof drain connections to the sanitary sewers, or other potential cross-connections. These may contribute to the peak flows exceeding the PS firm capacity observed under WWF conditions. Under existing conditions, addressing potential sources of upstream I/I could decrease the peak flows within the PS's firm capacity and defer potential upgrades. However, the efficacy of I I reduction measures would need to be confirmed with updated monitoring, also considering the impact of upstream growth on flows.

No bypass at PS #2 due to heavy precipitation were observed. Applying parameters which were calibrated over large metersheds can also lead to higher flows in some areas. Therefore, flows upstream of PS #2 should be monitored and confirmed prior to undertaking PS upgrades.

PS #5 receives flows from a newer residential subdivision (Madawaska Village). As part of the model calibration (see **Section 5.1.1.6.3**), the RTK parameters for the FM 1 metershed were applied to areas upstream of PS #5. Otherwise, the RTK parameters for FM 5 were developed considering a large metershed including ICI areas with potential cross-connections, which are not representative of the subcatchments upstream of PS #5. The pipes in the FM 1 metershed and the pipes upstream of PS #5 have the same age (see Figure 5 2), hence there is more confidence in applying the FM 1 parameters to the subcatchment upstream of PS #5. As a result, the peak flows are within the PS's firm capacity. This is supported by the Town's reports, where no bypasses have historically been observed at PS #5. Nonetheless, it is recommended that flows downstream of the subdivision flowing into the PS be monitored to confirm that PS #5 does not experience capacity issues.

Table 5-18: Existing Conditions PS Capacity Assessment

Name	Location	Number of Pumps at PS	Firm Capacity (Largest Pump Out of Service) (L/s)	Peak Modelled Incoming Flows (L/s) DWF	Peak Modelled Incoming Flows (L/s) 10-Year Design Event	Peak Modelled Incoming Flows (L/s) 25-Year Design Event	Number of Bypasses (3) per Year 2017	Number of Bypasses (3) per Year 2018	Number of Bypasses (3) per Year 2019	Number of Bypasses (3) per Year 2020	Number of Bypasses (3) per Year 2021	Number of Bypasses (3) per Year 2022
PS #1	Elgin St E at Claude St	2	25	0.7	81	96	-	-	-	1	-	1
PS #2	McNab St at Seventh Ave	2	59	8.5	71	84	-	-	-	-	-	-
PS #3	Madawaska Blvd, west of Bridge St	3(1)	275	28	278	323	-	-	-	1	1	3
PS #5	Wolff Cres	2	7	1.6	5.4	6.1	-	-	-	-	-	-

Note:

(1) The pumps at PS #3 are equipped with variable frequency drives (VFDs).

(2) Bypasses due to heavy precipitation or snowmelt (not due to equipment failure), as reported in the Town's reports to Council from 2017 to 2022.

5.2.1.4 Wastewater Treatment Plant

Similarly to the PSs, the WWTP's capacity is assessed based on comparing the incoming flow to the plant's capacity. Based on the *Certificate of Approval* (issued February 17th, 2010), the WWTP has a peak hour flow (PHF) capacity of 685 L/s (59,200 m^3/d). The modelled incoming PHF under DWF is 64 L/s (5,530 m^3/d), which is within the WWTP's PHF capacity. The modelled incoming PHF under the 25-year design event is 676 L/s (58,392 m^3/d), nearing the WWTP's PHF capacity. As a result of the level boundary condition applied at the WWTP (maximum depth of 600 mm), a CSO is triggered at the Albert St/Victoria St weir, at a peak flow rate of 387 L/s and a volume of 862 m^3. Applying the WWTP's PHF capacity of 85 L/s (59,200 m^3/d) as a flow limit into the WWTP, the resulting CSO at the Albert St/Victoria St weir increases to a peak flow rate of 710 L/s and a volume of 1,156 m^3. While HGLs from Albert St/Victoria St to the WWTP increase, no new HGL issues (new locations of basement flooding or surface flooding risk) are observed in the sanitary collection system.

As noted in the model limitations (**Section 5.1.1.6.5**), the model was calibrated to an event equivalent to a 2-year event, i.e., with a 50% probability of occurring every year. Extrapolating the flows to a less frequent event such as the 25-year event (i.e., with a 4% probability of occurring every year) can result in conservative incoming flows to the WWTP.

These findings should be validated against historical (anecdotal) evidence of WWTP performance under large events, to confirm plant bypasses (CSOs at Albert St) have occurred, and if any impacts on the sanitary collection system were observed under these conditions. While the model provides peak instantaneous flow and overflow results, the WWTP capacity assessment considers historical average daily flows and peak hour flows, which are compared against the corresponding CoA design flows. **Table 5-19** presents the modelled incoming flows to the WWTP, and the modelled overflows at the Albert St weir and combined sewer overflow (CSO) under existing conditions, as well as WWTP bypass history for 2016-2022. In general, it is expected that the Town's planned sewer separations will help reduce the peak flows to the WWTP and the bypass volumes at the Albert St CSO. Nonetheless, flows should be monitored as sewer separation projects are completed, to confirm the resulting reduction in flows.

Table 5-19: Updated Modelled Incoming Flows to WWTP, Albert St CSO Volumes and WWTP Bypass (CSO) History

Location	Modelled Parameter	Existing (2022) Modelled Incoming Flows (L/s) With Existing Infrastructure Only	Existing (2022) Modelled Incoming Flows (L/s) With Existing Infrastructure Only	Number of Bypasses (1,2) per Year						
		DWF	**25-Year Design Event**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
WWTP PHF	Peak Instantaneous Flow	74	1,014							
Capacity = 685 L/s	Peak Hourly Flow	64	676	2	3	2	1	1	2	3
Albert St CSO(1)	Overflow Volume	0	862							

Notes:

(1) Per the WWTP's Certificate of Authorization (CoA), the Albert St weir and overflow constitutes the WWTP bypass. Town operations staff have noted that bypasses (and hence, overflows at Albert St) are triggered when the levels in the WWTP inlet channel reach 900 mm.

(2) Bypasses as reported in the reports to Council and daily WWTP data provided from 2016 to 2022.

The Town's reports to Council and available SCADA data were analyzed to compare the measured flows against the WWTP's CoA average day and peak hour design flows. The historical (2016-2023) data is provided in **Figure 5-24**.

The 2017-2023 average daily flows were within the WWTP's average daily design flow, suggesting that the WWTP does not experience capacity issues. Our review of this data shows there is a decreasing trend in average flows to the WWTP. The Town has attributed this decreased water consumption to the Nylene facility (based on meter readings from 2011 to 2021), as well as to the elimination of dead-end watermain flushers which would continuously discharge into the sanitary sewers (replaced with bi-weekly hydrant flushing program and looping of dead-end watermains). This decreasing trend is expected to stabilize with growth.

The peak hour flows in 2018-2022 were within the WWTP's peak hour design flow, which also supports that the WWTP did not experience capacity issues during this time period. This aligns with the conclusions based on the average daily flows. Overall, the WWTP is expected to have capacity to service future growth within the MP's 20-year planning horizons.

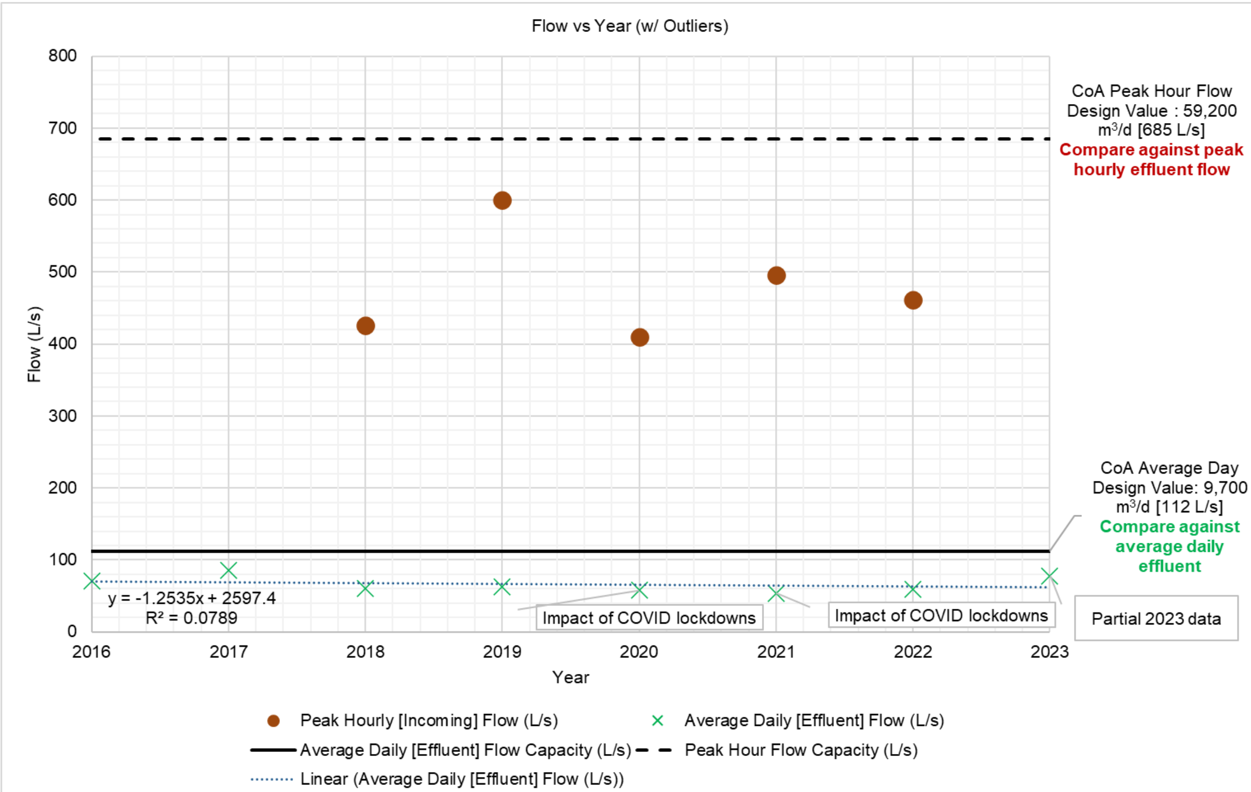


Figure 5-24: Historical (2016-2023) WWTP Flows

5.2.1.4.1 Effects of COVID-19 Pandemic

The onset of the COVID-19 pandemic in early 2020 has led to changes in daily habits with the implementation of work-from-home (WFH) policies. While the effects today may be reduced compared to those in 2020, deviations may be seen in residential and ICI diurnal flow generation, with potential increase in residential flow generation and decrease in ICI activity and flow generation. These changes in diurnal habits do not impact extreme WWF conditions, which are used for the assessment of the wastewater collection system. Nonetheless, should this be of interest to the Town beyond this MP, multi-year diurnal flows to the WWTP should be assessed to quantify potential changes due to changes in daily habits. Diurnal flows to other key locations within the system (e.g., downstream of ICI areas) could also be monitored, to understand the changes as they also relate to land use.

5.2.1.4.2 Climate Change Considerations

Climate change can lead to more intense extreme events, with higher intensity events gaining in frequency, increasing the risk of issues within the sanitary collection system. It therefore needs to be considered in planning for future solutions.

The impact of climate change is analyzed as part of developing a servicing strategy for growth, which is presented in **Chapter 3** (**Section 6**). The climate change analysis consists of a sensitivity analysis of the proposed solutions under a higher rainfall intensity scenario. For a selected shared socioeconomic pathway (SSP) climate change scenario, the online IDF_CC Tool from the Institute for Catastrophic Loss Reduction (ICLR) was used to predict the design event's rainfall under this SSP scenario. This rainfall was input in the hydraulic model, and the performance of the system with the infrastructure solutions was assessed for sensitivity. Recommendations for monitoring the system were made, and opportunities to size the solutions based on this sensitivity analysis were identified.

5.2.2 Potable Water System

As described in **Section 5.1.2**, the hydraulic model was updated to reflect the existing water distribution system and current system operations and validated against available recorded data. The validated model was then further updated to incorporate the additional watermain replacements/additions identified by the Town (refer to **Table 4-7**), and used to assess the performance of the WFP and existing water distribution system under different demand conditions.

5.2.2.1 Water Treatment Plant

The WFP was upgraded in 2010 and has a MXDY flow capacity of 10,340 m^3/d with respect to treatment as per the Town's MDWL dated March 31, 2021.

Table 5-20 provides the historical AVDY and MXDY treated water flows of the WFP. For MXDY treated water flows, all outlier flows (e.g., high flows due to watermain breaks, refilling of the EST, and reported clearwell issue) identified in *Water & Sewage Plant Committed Capacity / Uncommitted Reserve Capacity Spreadsheet Assessment* (Town of Arnprior, 2022) were excluded. The highest MXDY flow observed from 2016 to 2021 is 6,490 m^3/d which occurred in 2020. This maximum flow rate corresponds to 63% of the current WFP's rated treatment capacity. If a design value of 280 L c d is considered as per the City of Ottawa Water Distribution Design Guidelines as well as a MXDY demand peaking factor of 1.43, the remaining treatment capacity available at the WFP is equivalent to approximately 9,600 persons or approximately 3,000 single family home (SFH) equivalents (at 3.2 persons per SFH).

Table 5-20: Historical System Demands

Year	, Treatment Capacity (m^3/d)	AVDY Treated Water Flow at WFP (m^3/d)	MXDY Treated Water Flow at WFP (1)			Residual Treatment Capacity (Rated Capacity – MXDY)	Residual Treatment Capacity (Rated Capacity – MXDY)
			Flow in m^3/d	% of Rated Treatment Capacity	Month when the Flow Occurred	Flow in m^3/d	% of Rated Treatment Capacity
2016	10,340	4,580	6,154	60%	August	4,186	40%
2017	10,340	4,473	6,471	63%	July	3,869	37%
2018	10,340	4,000	5,852	57%	July	4,488	43%
2019	10,340	3,819	5,397	52%	July	4,943	48%
2020	10,340	3,997	6,490	63%	August	3,850	37%
2021	10,340	4,007	5,235	51%	June	5,105	49%

Note:

(1) This table excludes all anomalies in WFP maximum daily treated flow data (e.g., high flows due to watermain breaks, refilling of the EST, and reported clearwell issue) based on *Water & Sewage Plant Committed Capacity / Uncommitted Reserve Capacity Spreadsheet Assessment* (Town of Arnprior, 2022).

5.2.2.1.1 Effects of COVID-19 Pandemic

As with the observations and effects noted on the wastewater treatment plant, changes to daily habits due to work-from-home policies in 2020 had impacts on residential and ICI diurnal demands. While the effects today may be reduced compared to those in 2020, deviations may be seen in residential and ICI diurnal demand, with potential increase in residential demands and decrease in those associated with ICI activity.

At a macro level, the effect of the pandemic is less discernible when looking at historical annual treated water flows at the WFP from 2016 to 2021, as illustrated in **Figure 5-25**. In general, the annual average daily treated flow decreased from 2016 to 2019. As noted by the Town, several dead-end bleeder/flusher valves were successfully eliminated since 2017, which correlates to the decrease in annual average daily flow from 2017 to 2019. In 2020 and 2021, the average daily treated flow increased slightly; however, there is no obvious trend in water consumption/production before and during the COVID pandemic. In terms of maximum daily treated water flows, the maximum daily flow increased markedly in 2020, but no continuing trend was observed from 2016 to 2021.

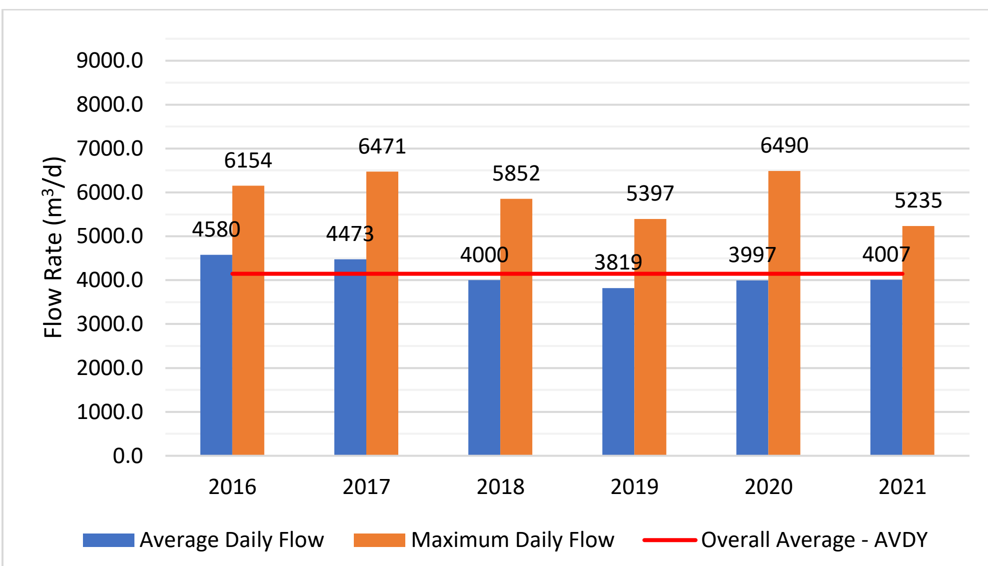


Figure 5-25: 2016 - 2021 WFP Treated Water Flows (Annual Average and Maximum Daily Flows)

Although no obvious trends were discovered on annual water consumption pre and during COVID pandemic, changes in monthly water consumption pattern were observed in 2020. As shown in **Figure 5-26**, the highest monthly average daily flows in 2020 occurred in March and April which is inconsistent with the typical monthly water use trend as in all the other years (i.e., highest water consumption typically occurred during summer months). The relatively high-water consumption in March and April 2020 may be partially the result of COVID pandemic (e.g., WFH policies) considering the lockdowns in Ontario started in March 2020, as well as due to the watermain break at the Madawaska River crossing in April 2020. Since these changes in monthly average daily flow were observed only in 2020 but not in 2021, the effects on monthly water consumption today may be reduced and thus would likely not impact the existing conditions. Nonetheless, should this be of interest to the Town beyond this MP, multi-year diurnal flows from the WFP may be assessed to quantify potential changes due to changes in daily habits.

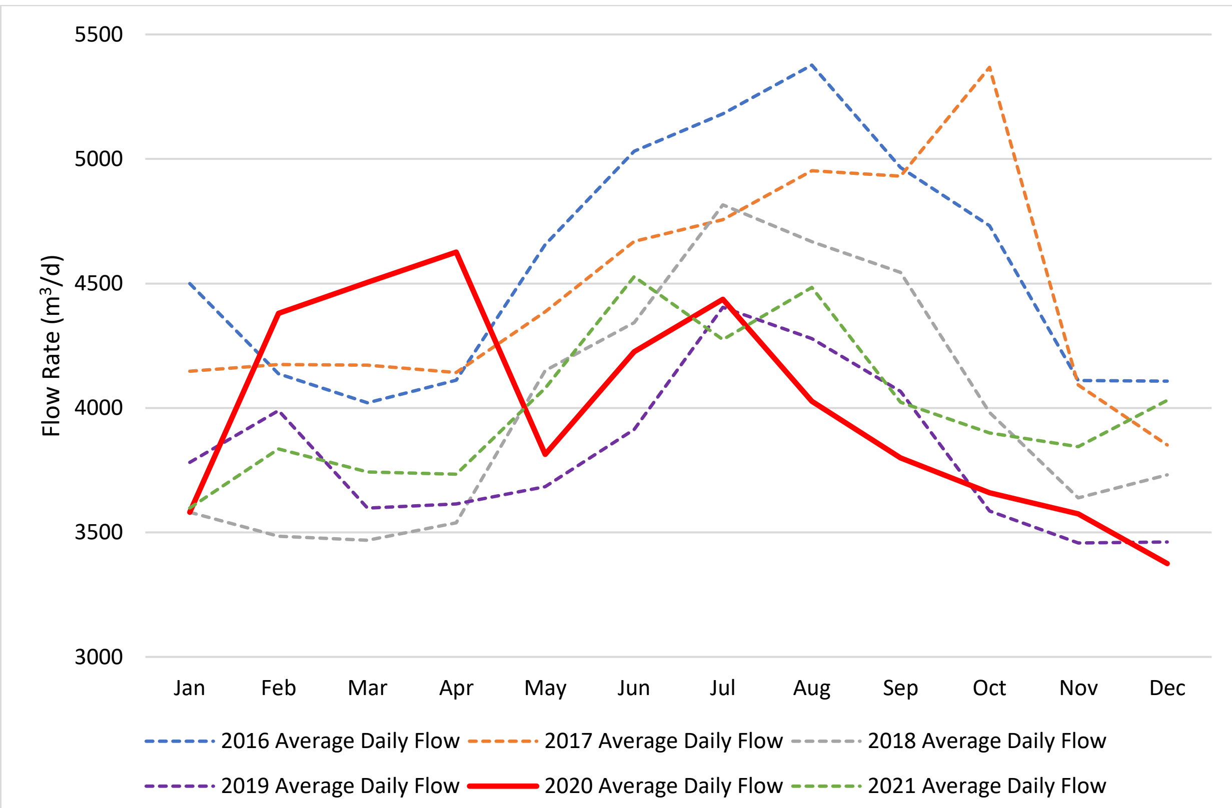


Figure 5-26: 2016 - 2021 WFP Treated Water Flows (Monthly Average Daily Flow)

5.2.2.1.2 Climate Change Considerations

Climate change will likely lead to higher climate variability with more extreme weather events, which increase the risk to potable water infrastructure. Examples of potential risks or impacts on potable water infrastructure include higher outdoor water demand (OWD) resulting from increased temperatures or decreased precipitation; greater risk of watermain breaks caused by increased freeze-thaw cycles, cold extremes, warm extremes, or drought; and/or facility (e.g., WFP, EST) failure resulting from flooding or extreme and shock weather events.

The impact of climate change was evaluated as part of the servicing alternatives development and is discussed in **Chapter 3** (**Section 6**). For the preferred servicing strategy, a sensitivity analysis was performed on the 2042 scenarios to further explore the impacts of increased OWD on MXDY water consumption, as well as the proposed infrastructure upgrades' response in terms of level of service. The MXDY increase was determined during the sensitivity analysis.

Moreover, certain climate parameters may be correlated to the occurrence of emergency scenarios (e.g., pipe breaks). Certain emergency scenarios (e.g., failure of key feedermains, WFP) may also be simulated, to identify potential opportunities with respect to system redundancy/reliability.

5.2.2.2 Storage

The EST located at 433 Hartney St has a rated capacity of 2,365 m^3 (624,800 liquid gallons) as per the Gallonage Chart of the EST provided by the Town. This tank has minimum and maximum operating elevations of 141.8 m and 152.5 m, respectively. Treated water storage is also provided at the WFP by two concrete clearwells with a total capacity of 3,971 m^3 (volumes of clearwell 1 and 2 are 2,167 m^3 and 1,804 m^3 respectively as per the Town's DWWP dated March 31, 2021). Water in the EST is fed from the two clearwells by the HLPs that are operated based on the water level in the EST. According to SCADA data, the EST typically operates between 60% (148.59 m) to 80% (150.54 m) of the overall volume. The pumps would start when percent full in the EST drops below 60% and stop when it reaches 80%.

Based on the MECP formula as discussed in **Chapter 1** (**Section 4**), the total treated water storage requirement for a 2022 population of 10,038 people in the Town is 4,406 m^3, as presented in **Table 5-21** below. This calculated treated water storage requirement is less than the total available system storage of 6,336 m^3. Thus, the total capacity of the EST and clearwells at the WFP is sufficient to meet the storage needs for existing conditions.

Table 5-21: Treated Water Storage Requirement for the System Providing Fire Protection

MXDY Demand	Fire Flow Requirement	Fire Flow Requirement	Fire Storage (A)	Equalization Storage (B = 25% of MXDY Demand)	Emergency Storage [C = 25% of (A + B)]	Total Treated Water Storage Requirement (A + B + C)
m^3/d	L/s	hrs	m^3	m^3	m^3	m^3
5,933	189	3	2,041	1,483	881	4,406

5.2.2.3 Pumping

The WFP currently operates three identical HLPs, each of which has a design flow of 125 L/s (10,800 m^3/d) and total dynamic head (TDH) of 70 m at the duty point. As confirmed by SCADA data, the three HLPs alternate duties. Under existing conditions, the duty pump is controlled to operate based on the water level in the EST, as described in **Section 5.2.2.2**.

With the largest pump out of service, the firm capacity of the HLPs is 250 L/s (21,600 m^3 d). Assuming that 50% of the EST's operating volume (i.e., 1,182.5 m^3) would be available for fire flow conditions, the volume is equivalent to a flow rate of 109 L/s (9,460 m^3/d) over a 3-hour fire duration. By summing the firm capacity of the HLPs and the available fire flow from the EST, the total capacity becomes 359 L/s (31,060 m^3/d).

The current MXDY demand of 69 L/s (5,933 m^3/d) plus the MECP fire flow of 189 L/s (16,330 m^3/d) is equal to 258 L/s (22,263 m^3/d), which is less than the total available capacity of 359 L/s (31,060 m^3/d). Therefore, the total capacity considering the firm capacity of the HLPs and the available fire flow from the EST is sufficient to meet the existing system needs.

5.2.2.4 Distribution Pipe Network

Model results for existing AVDY, MXDY, and MXDY + fire flow demand scenarios are presented in the following subsections. AVDY and MXDY scenarios were run over an extended period of time (72-hr) assuming one HLP to be called into service and controlled by the water level in the EST as described in **Section 5.1.2.1**. For MXDY +

fire flow scenario, a steady-state simulation was run with two HLPs in service (i.e., assuming the largest pump is offline).

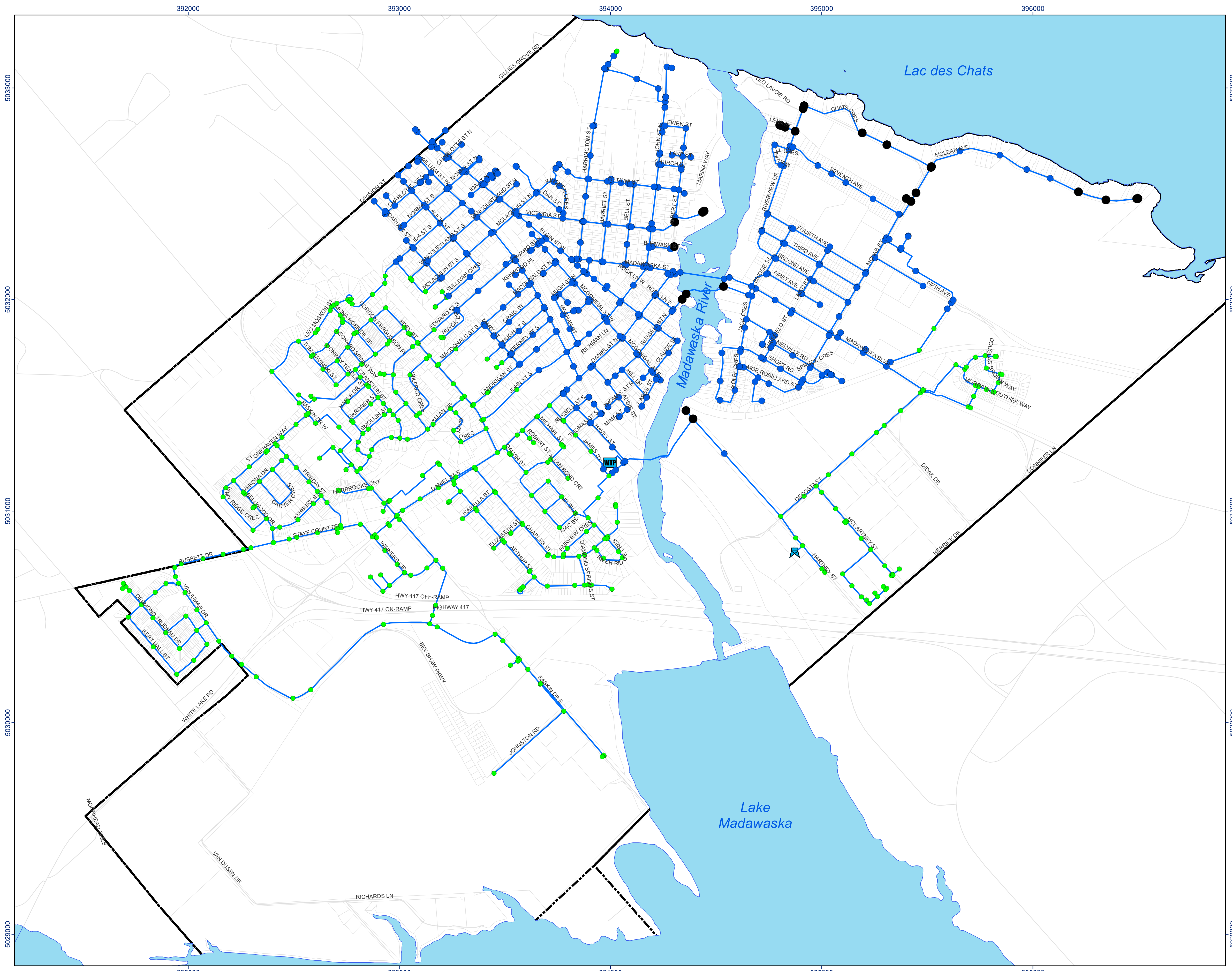
5.2.2.4.1 System Head / Pressures

Figure 5-27 shows model results for maximum pressures under AVDY demands throughout the existing water distribution system. Hydraulic modelling shows maximum pressures ranging from 61 to 108 psi, with the EST operating between 60 to 80% full. Maximum pressures are mostly above the MECP's recommended maximum operating pressure of 70 psi, areas with maximum pressures above 80 psi but below 100 psi are anticipated in lower elevation areas, northeast of Caruso St, Mary St, and Havey St, and north of the Canadian National Railway corridor. There are a few areas with maximum pressures greater than 100 psi in low-lying areas along the shorelines of the Ottawa and Madawaska Rivers.

Figure 5-28 presents model results for minimum pressures under MXDY demands (at peak hour [PKHR]) throughout the existing water distribution system. Hydraulic modelling shows the EST operates between 60 to 80% full, and minimum pressures ranging from 53 to 101 psi which are above the MECP's recommended minimum operating pressure of 50 psi. No minimum pressures less than 40 psi are anticipated.

5.2.2.4.2 Fire Flows

Figure 5-29 shows model results for available fire flows at a residual pressure of 20 psi under MXDY plus fire flow demands throughout the existing water distribution system. Available fire flows in the system are generally greater than 33.33 L/s (2,000 L/min) which meets the minimum fire flow requirement of 2,000 L/min as per the FUS guidelines. Available fire flows less than 33.33 L/s are observed in a few areas throughout the Town. These areas are generally serviced by a local watermain with a diameter less than 150 mm and/or are located along a dead-end watermain, which limit fire flow availability.



Stantec

Legend

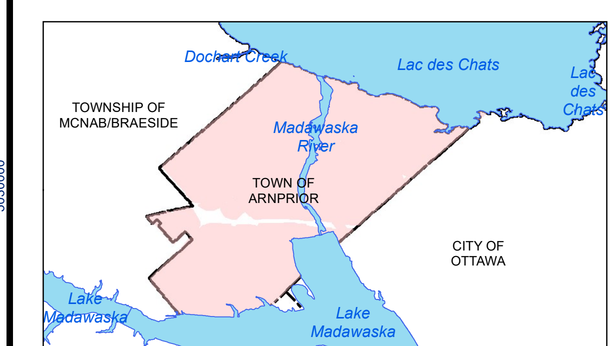
Maximum Pressure

- Max. Pressure ≤ 40 psi
- 40 psi < Max. Pressure ≤ 60 psi
- 60 psi < Max. Pressure ≤ 80 psi
- 80 psi < Max. Pressure ≤ 100 psi
- Max. Pressure > 100 psi
- Watermains
- Water Treatment Plant (WTP)
- Elevated Storage Tank (EST)
- Municipal Boundary

N

0 250 500 Meters
(At original document size of 11x17)
1:18,500

Notes
1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Ontario_Hydro_Network_(OHN)_-_Waterbody.shp, Ontario_Hydro_Network_(OHN)_-_Waterbody (2).shp, Municipal_Boundary_-_Lower_and_Single_Tier.shp,* and *Arnprior_Roads_20220324* and *Arnprior_PropertyParcels_wAssessment_20220324.shp* provided by the Town of Arnprior.
3. Background: Contains information licensed under the Open Government Licence – Ontario

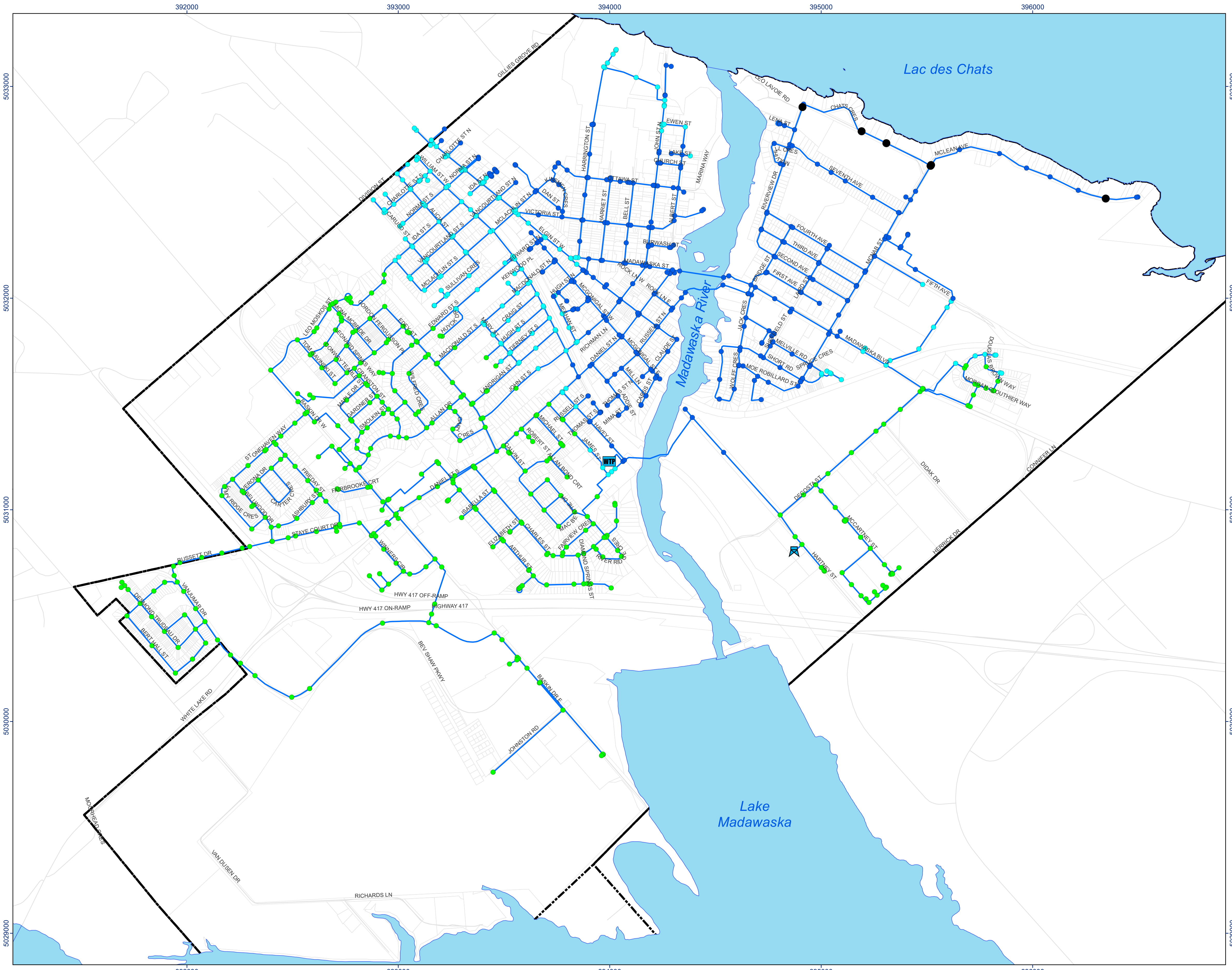


Project Location Prepared by CZ on 2023-11-08
Arnprior, ON

Client/Project 163401723
Town of Arnprior
2022 W&WW Master Plan Update

Figure No.
5-27

Title
Model Results: Existing Conditions (2022) – AVDY Maximum Pressures



Stantec

Legend

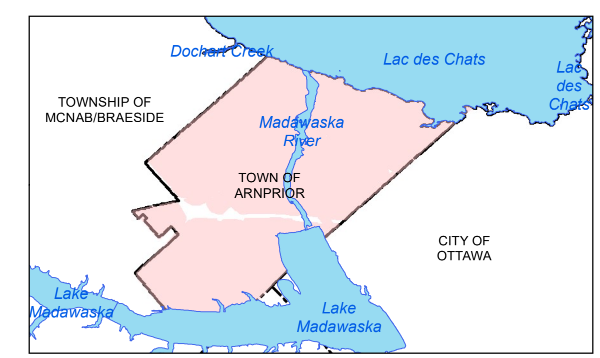
Minimum Pressure

- Min. Pressure ≤ 20 psi
- 20 psi < Min. Pressure ≤ 40 psi
- 40 psi < Min. Pressure ≤ 50 psi
- 50 psi < Min. Pressure ≤ 70 psi
- 70 psi < Min. Pressure ≤ 80 psi
- 80 psi < Min. Pressure ≤ 100 psi
- Min. Pressure > 100 psi
- Watermains
- Water Treatment Plant (WTP)
- Elevated Storage Tank (EST)
- Municipal Boundary

N

0 250 500 Meters
(At original document size of 11x17)
1:18,500

Notes
1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Ontario_Hydro_Network_(OHN)_-_Waterbody.shp, Ontario_Hydro_Network_(OHN)_-_Waterbody (2).shp, Municipal_Boundary_-_Lower_and_Single_Tier.shp*, and *Arnprior_Roads_20220324* and *Arnprior_PropertyParcels_wAssessment_20220324.shp* provided by the Town of Arnprior.
3. Background: Contains information licensed under the Open Government Licence – Ontario



Project Location
Prepared by CZ on 2023-11-08

Arnprior, ON

Client/Project
163401723

Town of Arnprior
2022 W&WW Master Plan Update

Figure No.

5-28

Title

Model Results: Existing Conditions (2022) – MXDY Minimum Pressures

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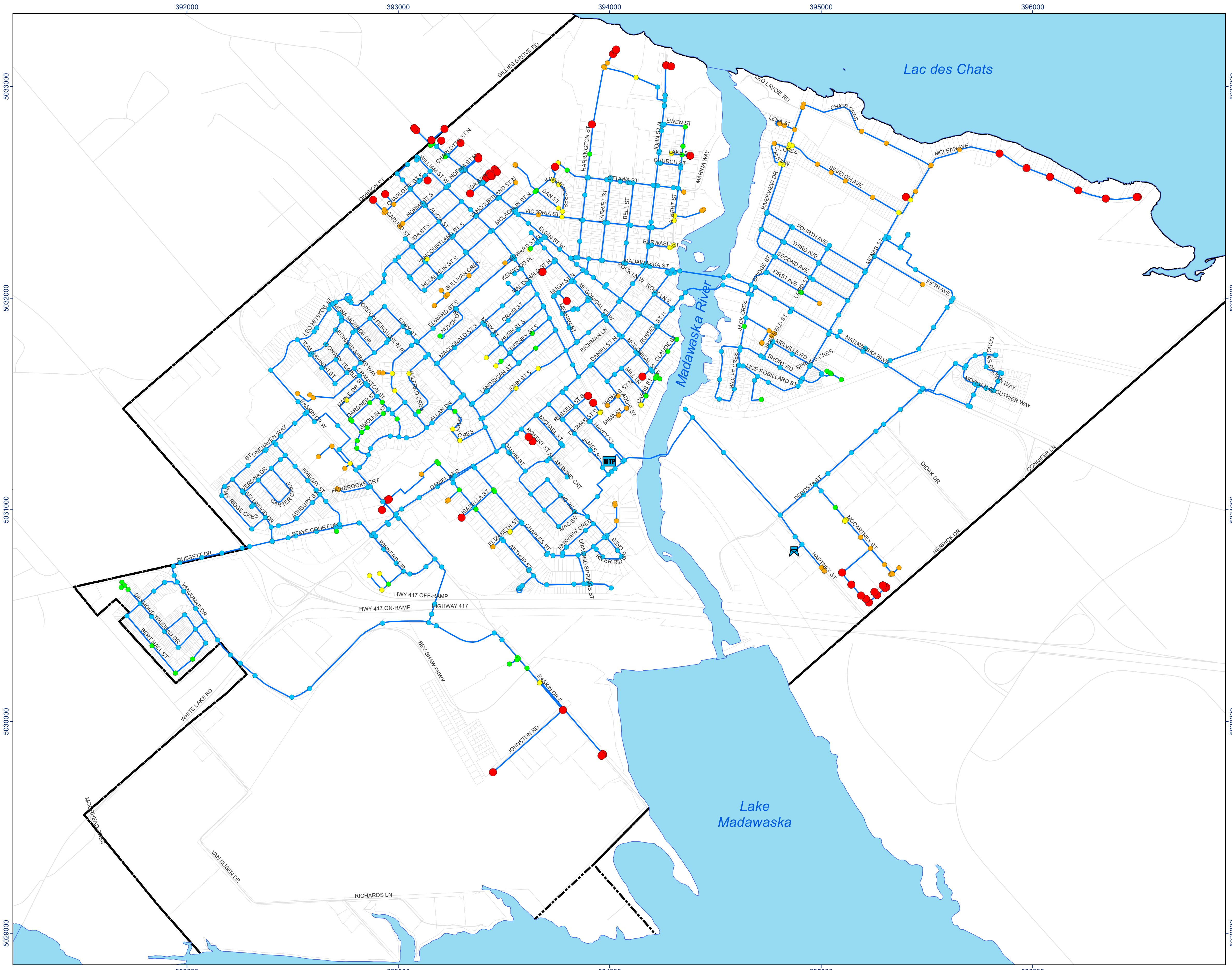


Stantec

Legend

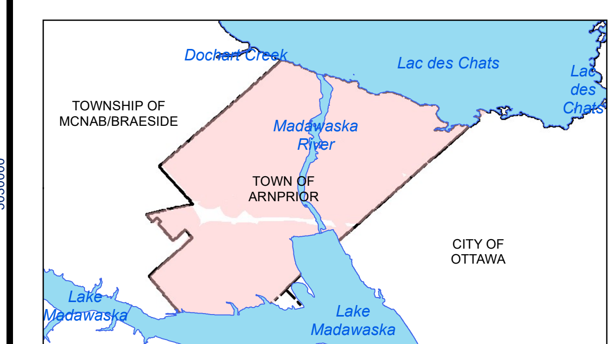
Available Fire Flow at 20 psi (AFF)

- AFF < 33.33 L/s
- 33.33 L/s ≤ AFF ≤ 75 L/s
- 75 L/s < AFF ≤ 100 L/s
- 100 L/s < AFF ≤ 125 L/s
- AFF > 125 L/s
- Watermains
- Water Treatment Plant (WTP)
- Elevated Storage Tank (EST)
- Municipal Boundary

N

0 250 500 Meters
(At original document size of 11x17)
1:18,500

Notes
1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Ontario_Hydro_Network_(OHN)_-_Waterbody.shp*, *Ontario_Hydro_Network_(OHN)_-_Waterbody (2).shp*, *Municipal_Boundary_-_Lower_and_Single_Tier.shp*, and *Arnprior_Roads_20220324* and *Arnprior_PropertyParcels_wAssessment_20220324.shp* provided by the Town of Arnprior.
3. Background: Contains information licensed under the Open Government Licence – Ontario



Project Location Prepared by CZ on 2023-11-08
Arnprior, ON

Client/Project 163401723
Town of Arnprior
2022 W&WW Master Plan Update

Figure No.
5-29

Title
Model Results: Existing Conditions (2022) – MXDY Available Fire Flow at 20 psi

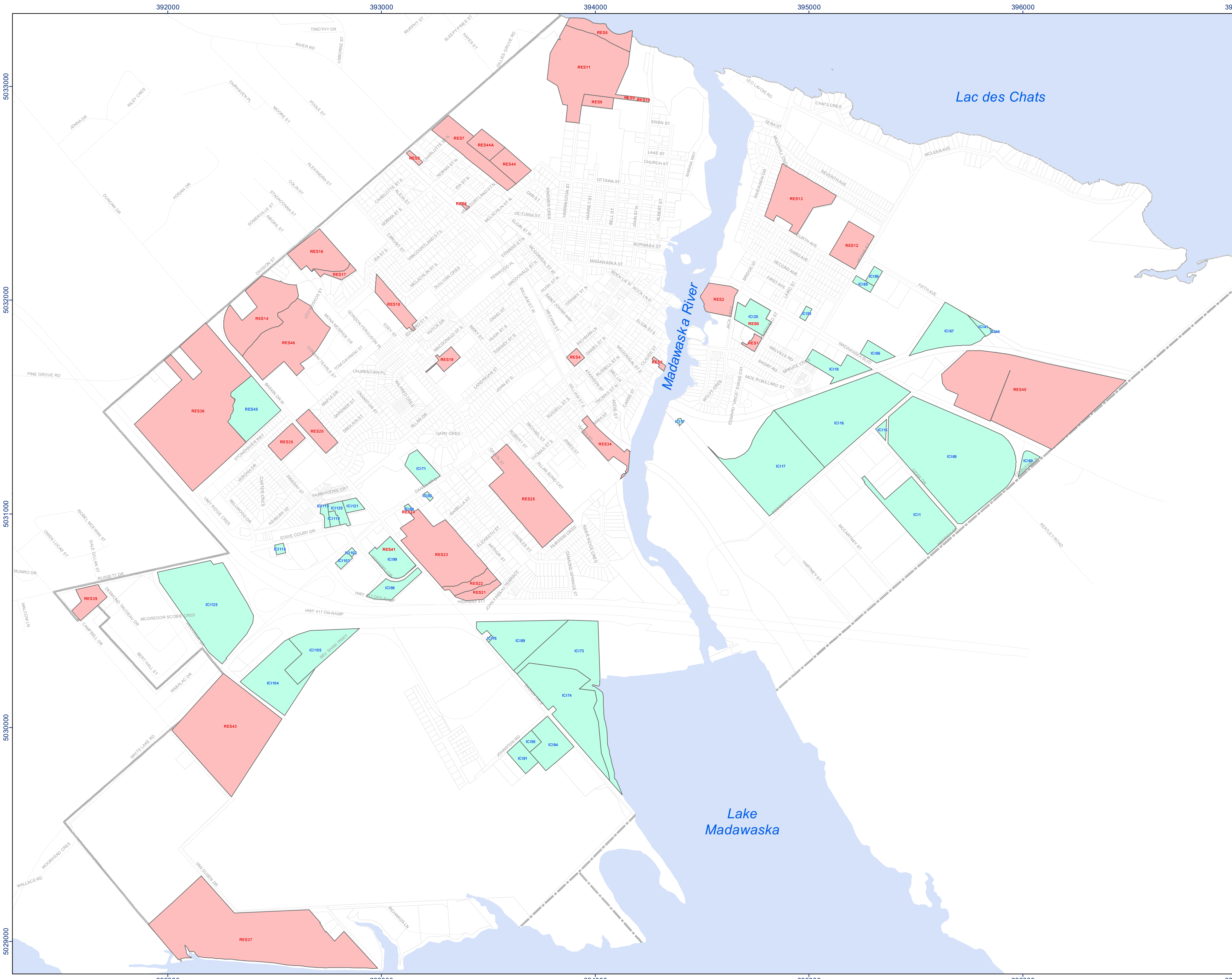
5.3 Growth Projections

This Master Plan aims to identify infrastructure needs to service growth in the Town. This section therefore presents growth projections for the established 5-year (2027), 10-year (2032), and 20-year (2042) horizons.

5.3.1 Growth Areas Inside Town Boundaries

Growth projections were established with input from the Town and using the information from the background studies described in **Chapter 1** (**Section 4**) pertaining to growth and land use. Potential residential and ICI growth areas were initially identified based on the information presented in the *Growth Management Strategy – Draft Report* (Watson & Associates Economists Ltd., 2022; 2022 GMS), with additional information from the *Water & Sewage Plant Committed Capacity / Uncommitted Reserve Capacity Spreadsheet Assessment* (Town of Arnprior, 2022). This information was reviewed with the Town, to confirm the anticipated buildout population/area and timeline (horizon) of each development. The growth areas identified in these background studies and for which information was provided are all within the Town's existing boundaries.

Residential and ICI growth areas are shown in **Figure 5-30**. Detailed growth projection information for each area is provided in **Appendix C.1**.



![Stantec]

Stantec

Legend

Potential Residential Growth Areas

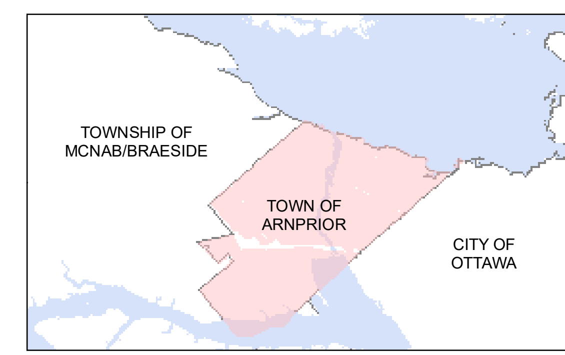
Potential ICI Growth Areas

N

0 250 500 Meters

(At original document size of 11x17)
1:18,500

Notes
1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Arnprior_PropertyParcels_wAssessment_20220324.shp, Employment_Parcels_Dec2021.shp,Res_Parcels_Dec2021.shp, Export_Arnprior_Road_Network_2020.shp, OBOUNDARY* provided by the Town of Arnprior
3. Background: Contains information licensed under the Open Government Licence – Ontario
4. Abbreviations: ICI = Industrial, Commercial, Institutional



Project Location Prepared by CR on 2023-02-13

Arnprior, ON

Client/Project 163401723

Town of Arnprior
2022 W&WW Master Plan Update

Figure No.

5-30

Title

Growth Areas

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5.3.2 Growth Areas Outside Town Boundaries

The population projections presented herein currently only pertain to growth areas identified within the Town's existing boundaries. However, it is understood that the Town has interest in understanding the ability of its infrastructure to accommodate additional growth outside of its current boundary. This potential was explored as part of **Chapter 3** (**Section 6**). Refer to **Section 6.6** for details about outside interests.

5.3.3 Population Projections

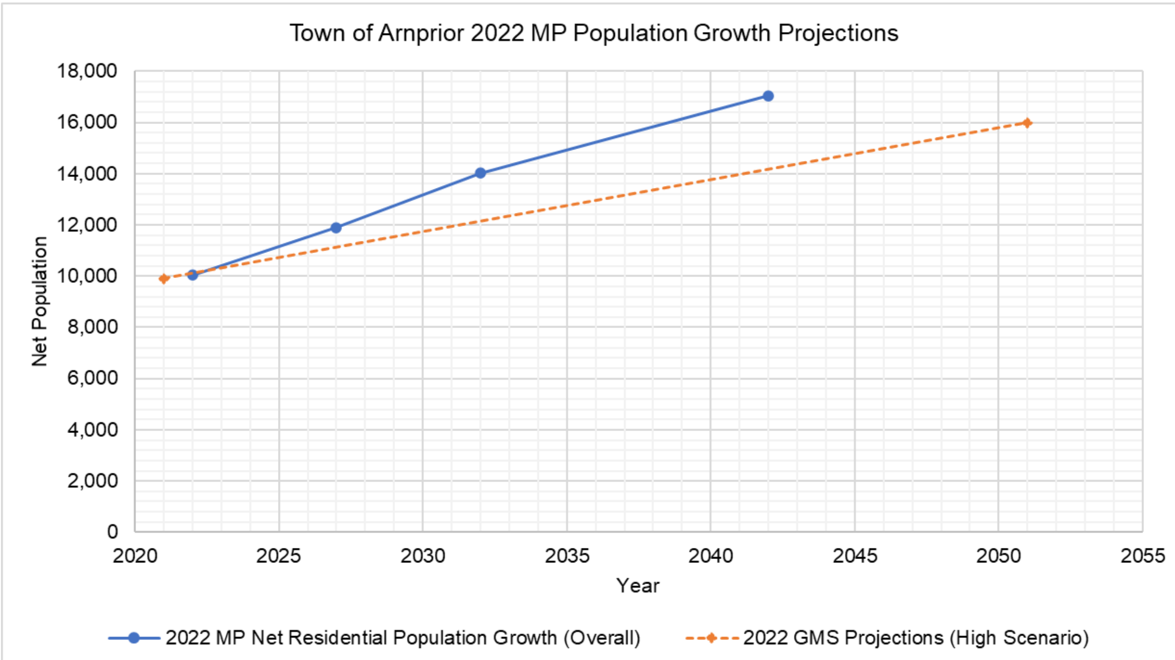
Table 5-22 shows the projected total population and ICI area within each horizon. Note that the ICI area is typically based on total parcel area and does not reflect only developed portions of each parcel. **Table 5-22** also shows the existing population or ICI area, which is subtracted within each horizon, to account for existing site redevelopments. **Figure 5-31** illustrates projected residential populations, showing a comparison between the 2022 W&WWMP projections and the 2022 GMS growth projections. The 2022 W&WWMP projections are generally more aggressive than the 2022 GMS growth projections. A similar comparison with comparable conclusions is presented in the 2013 MP.

Figure 5-32 illustrates projected ICI areas. Total ICI areas are projected to generally increase within the 20-year horizon. ICI areas will experience small decreases due to the conversion of ICI areas into residential areas. The 2022 GMS does not present ICI area projections; therefore, no comparison is presented in **Figure 5-32**.

Population projections, as they specifically apply to each system, are discussed in **Section 5.4.1** (wastewater flow generation) and **Section 5.4.2** (water demand calculations).

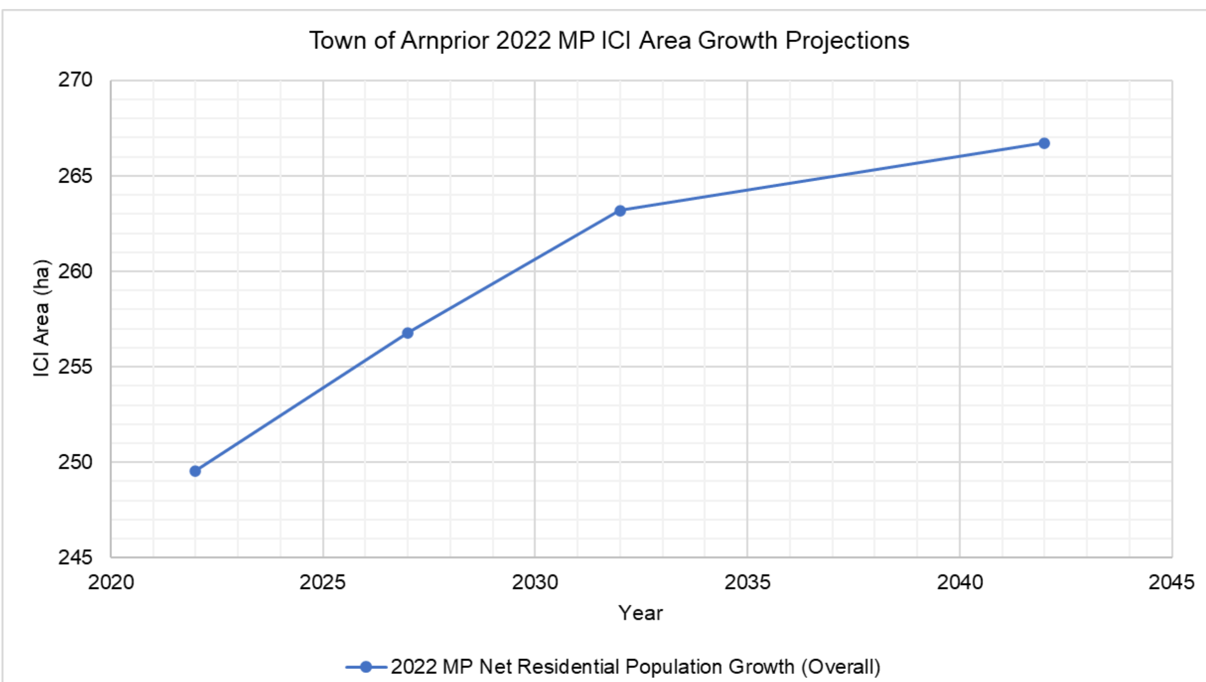
Table 5-22: Summary of Growth Projections – 2022 W&WWMP Town of Arnprior Growth Projections

Horizon	Category	Population	ICI Area (ha)
Existing (2022)	**Total**	**10,038**	**250**
5-Year Horizon (2027)	Redeveloped (Removed)	-	-2.7
	Added	+1,860	+9.9
	Net Growth	+1,860	+7.2
	Total	**11,898**	**257**
10-Year Horizon (2032)	Redeveloped (Removed)	-48	-1.6
	Added	+2,166	+8.0
	Net Growth	+2,118	+6.4
	Total	**14,016**	**263**
20-Year Horizon (2042)	Redeveloped (Removed)	-	-
	Added	+3,035	+3.5
	Net Growth	+3,035	+3.5
	Total	**17,051**	**267**



***Note**: refer to **Appendix C** for detailed projections.*

Figure 5-31: Town of Arnprior 2022 W&WWMP Population Projections



***Note**: refer to **Appendix C** for detailed projections.*

Figure 5-32: Town of Arnprior 2022 W&WWMP ICI Area Projections

5.4 Future Wastewater Generation and Water Demands

This section presents the parameters which, along with the growth projections presented in **Section 5.3**, are used to generate future wastewater flows and water demands.

5.4.1 Wastewater Flows

Future wastewater flows are generated considering the growth information provided by the Town for redevelopments and new developments. It should be noted that the future population serviced by the wastewater collection system only considers the current areas serviced by the existing collection system, i.e., 8,984 people and 160 ha of ICI properties, as presented in **Section 5.1.1.2**. The growth projections presented in **Section 5.3** are added onto the existing serviced population and ICI areas. Properties currently not serviced by the wastewater collection system under existing conditions are assumed to remain so under future conditions unless the property is being redeveloped and considered as part of the growth projections.

5.4.1.1 Future Wastewater Generation Parameters

Future wastewater generation parameters were determined based on the hydraulic model calibration (see **Section 5.1.1.6**) and on the City of Ottawa Design Guidelines. The parameters consist of GWI and sewage generation rates, diurnal patterns and RTK hydrographs.

For infill developments or vacant property development within existing subcatchment areas, it is assumed that the existing sewers within the right-of-way (ROW) remain. As such, the existing calibrated metershed GWI and I/I parameters (GWI rates, RTK hydrographs and effective areas) are maintained for these areas (i.e., total GWI flow and I/I generated remain unchanged). Design parameters for sewage generation within the infill developments are applied. Diurnal sewage generation is assumed to follow the calibrated pattern for the existing metershed. To account for the replacement of existing development by infill developments, the average sewage flows from the existing developments are subtracted when appropriate.

For new developments in new areas (e.g., new subdivisions), which are not within the existing sanitary subcatchments, it is assumed that new separated sewers will be installed. Therefore, calibrated parameters for representative metersheds were applied. The calibrated GWI rate and RTK hydrograph for FM 1 were applied, as FM 1 comprises newer developments and new sewers in the Town, where infiltration is low (see sewer age in **Figure 5-2**). Since the layout of the new sewers within these new developments is unknown, the effective area was conservatively assumed to correspond to the total development area per horizon. Design parameters for sewage generation within the new developments was also applied. Diurnal sewage generation was assumed to follow the calibrated patterns for representative metersheds based on land use. Thus, the FM 1 diurnal pattern was applied to new residential developments, and the FM 6 diurnal pattern was applied to new ICI developments.

Table 5-23 summarizes the future wastewater generation parameters used in this assessment.

Table 5-23: Future Wastewater Generation Parameters

Parameter	Redevelopments or Development (Occupancy) of Vacant Properties within Existing Subcatchments	New Developments (New Subcatchments)
GWI Rate	Calibrated Metershed GWI Rate (see **Table 5-8**)	0.05 L/s/ha(2)
Residential Sewage Generation Rate	280 L/c/d(2)	280 L/c/d(2)
Light Industrial Sewage Generation Rate	35,000 L/ha/d(2)	35,000 L/ha/d(2)
Commercial and Institutional Sewage Generation Rate	28,000 L/ha/d(2)	28,000 L/ha/d(2)
Residential Diurnal Pattern	Calibrated Metershed Diurnal Pattern (see **Appendix B.3)**	FM 1 Diurnal Pattern(3)
ICI Diurnal Pattern		FM 6 Diurnal Pattern(4)
RTKs (RDII Response)	Calibrated Metershed RTKs (see **Table 5-11**)	FM 1 RTKs(5)

Notes:
(1) Assumed representative of a typical GWI rate for a new separated system.
(2) Design parameter from the City of Ottawa Design Guidelines.
(3) Assumed representative of a typical pattern for a new residential development.
(4) Assumed representative of a typical pattern for a new ICI development.
(5) Assumed representative of a RDII response for a new separated system.

5.4.1.2 Future Wastewater Flows

The parameters presented in **Section 5.4.1.1** are applied to the growth projections presented in **Section 5.3** for the serviced area to generate future flows added to the wastewater collection system.

Table 5-24 summarizes the future wastewater flow generation for redevelopments and new areas. For each horizon, the total flows added to the existing conditions flows are presented. Future wastewater flow generation for redevelopments are added to the existing sanitary subcatchments, whereas new subcatchments are created for new growth areas. Total peak DWF increases due to the increase in population (or the development of ICI areas) upon redevelopment. It should be noted that only the sewage flow component of the DWF increases, as the total GWI generated by the existing subcatchments is not affected by the redevelopment, as explained in **Section 5.4.1.1**. Total peak WWF, however, does not change (increase) from existing peak WWF, as the total RDII generated by the existing subcatchments is not affected by the redevelopment, as explained in **Section 5.4.1.1**.

The existing subcatchments that were updated and the new subcatchments that were added are illustrated in **Figure 5-33**. Detailed future wastewater flows generated by growth areas per subcatchment are presented in **Appendix C**.

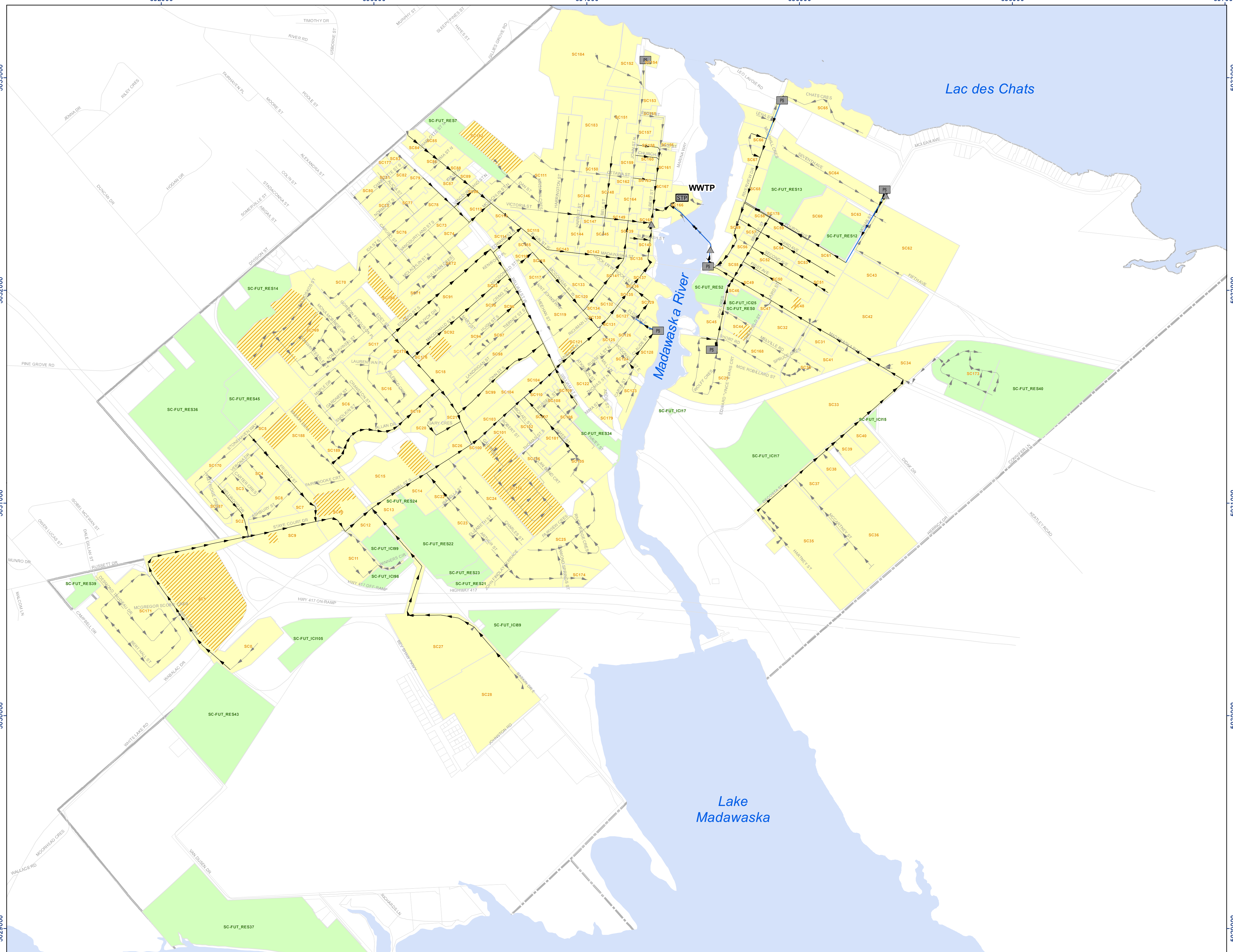
Table 5-24: Summary of Future Wastewater Flow Generation (Flow Added to Existing Conditions)

Parameter	Redevelopments/ Development (Occupancy) of Vacant Properties			New Developments			Total (Redevelopments + New Developments)		
	5-Year Horizon (2027)	10-Year Horizon (2032)	20-Year Horizon (2042)	5-Year Horizon (2027)	10-Year Horizon (2032)	20-Year Horizon (2042)	5-Year Horizon (2027)	10-Year Horizon (2032)	20-Year Horizon (2042)
Additional Peak DWF (L/s) *In addition to existing flows*	+4.6(1)	+5.8(1)	+9.6(1)	+8.2	+22.2	+39.0	+12.8	+28.0	+48.6
Additional Peak WWF (L/s) *In addition to existing flows*	-(2)	-(2)	-(2)	+12.6	+38.5	+69.6	+12.6	+38.5	+69.6
Total Additional Flow (DWF + WWF) (L/s) *In addition to existing flows*	+4.6	+5.8	+9.6	+20.8	+60.8	+108.8	+25.4	+66.5	+118.2

Notes:

(1) DWF = GWI + sewage; total peak DWF increases due to the increase in population (or the development of ICI areas) upon redevelopment. It should be noted that only the sewage flow component of the DWF increases, as the total GWI generated by the existing subcatchments is not affected by the redevelopment, as explained in **Section 5.4.1.1**.

(2) Total peak WWF in redevelopments does not change (increase) from existing peak WWF, as the total RDII generated by the existing subcatchments is not affected by the redevelopment, as explained in **Section 5.4.1.1**.



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Legend

- Existing Subcatchment (Unchanged)
- Existing Subcatchment (with Redevelopments or Development/Occupancy of Vacant Properties)
- New Subcatchment
- Overflow
- Wastewater Treatment Plant (WWTP)
- Sanitary Pump Station (PS)
- Forcemains
- Trunk Sanitary Sewer (Modelled)
- Local Sanitary Sewer (Not Modelled)

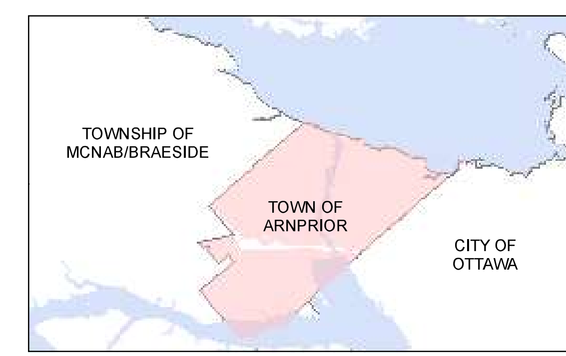
N

0 250 500 Meters

(At original document size of 11x17)
1:18,500

Notes

1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Arnprior_PropertyParcels_wAssessment_20220324.shp*, *Employment_Parcels_Dec2021.shp*, *Res_Parcels_Dec2021.shp*, *Export_Arnprior_Road_Network_2020.shp*, OBOUNDARY provided by the Town of Arnprior
3. Background: Contains information licensed under the Open Government Licence – Ontario
4. Abbreviations: ICI = Industrial, Commercial, Institutional



Project Location Prepared by CR on 2023-02-13

Arnprior, ON

Client/Project 163401723

Town of Arnprior
2022 W&WW Master Plan Update

Figure No.

5-33

Title

Sanitary Subcatchments (Future Conditions)

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5.4.2 Potable Water Demands

Future potable water flows are populated according to the growth information provided by the Town for redevelopments and new developments. By using the growth projections described in **Section 5.3**, future potable water demands for each planning horizon (i.e., 5-, 10-, and 20-year horizon) were calculated and applied to the existing water distribution system in the model.

5.4.2.1 Future Potable Water Demand Parameters

Table 5-25 summarizes the parameters used to calculate the future water demand for each growth area. The listed future water demand parameters were established based on primarily the City of Ottawa Water Distribution Design Guidelines as well as the MECP Design Guidelines for Drinking-Water Systems.

Table 5-25: Future Potable Water Demand Parameters

Parameter	Value Used	Unit
Average Day Demand, Residential (1)	280	L/c/d
Average Day Demand, Light Industrial (1)	35,000	L/gross ha/d
Average Day Demand, Commercial and Institutional (1)	28,000	L/gross ha/d
Maximum Day Peaking Factor, Residential (PF x AVDY) (2)	1.9	-
Maximum Day Peaking Factor, Light Industrial (PF x AVDY) (3)	1.5	-
Maximum Day Peaking Factor, Commercial and Institutional (PF x AVDY) (3)	1.5	-

Notes:

(1) Design parameter from the City of Ottawa Water Distribution Design Guidelines.

(2) Design parameter from the MECP Design Guidelines for Drinking-Water Systems.

(3) Design parameter from the City of Ottawa Water Distribution Design Guidelines and is consistent with value used in the 2013 W&WWMP update.

5.4.2.2 Future Potable Water Demands

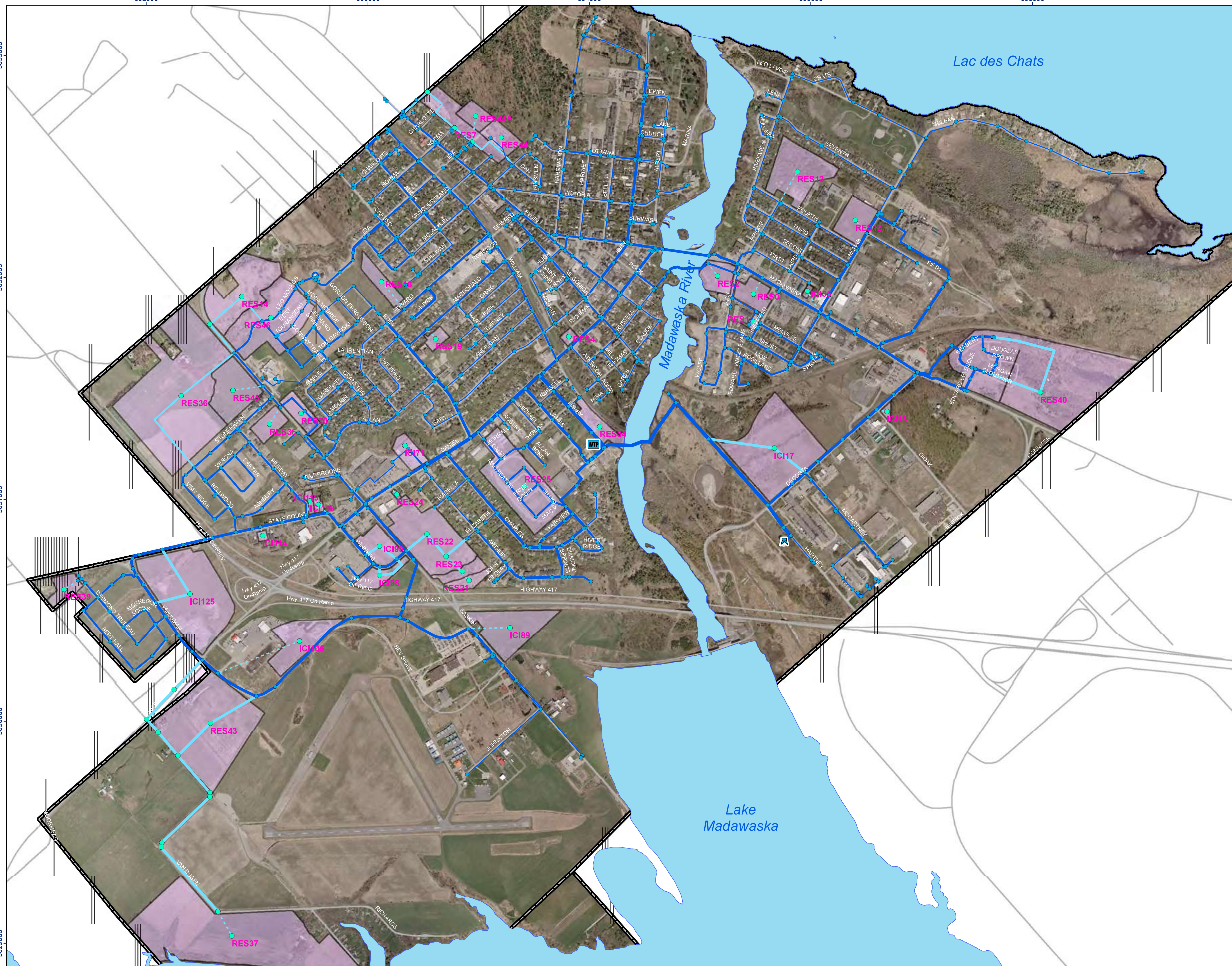
The parameters listed in **Table 5-25** were applied to the growth projections presented in **Section 5.3** for growth areas to generate future water demands for each planning horizon. **Table 5-26** summarizes the future water AVDY and MXDY demands generated by growth areas for each horizon. Detailed future water demands for each growth area are included in **Appendix C.3**. For redevelopments, the water consumption based on provided billing records for the existing properties is relatively small compared to the future demands. Considering that water demands were proportionally allocated to the distribution system under existing conditions, future water demands accounting for the entire redeveloped area were used as a conservative approach without subtracting existing water consumption.

Table 5-26: Summary of Future Potable Water Demands

Future Water Demands	Existing (2022)	5-Year Horizon (2027)	10-Year Horizon (2032)	20-Year Horizon (2042)
Addition of AVDY Demand (L/s)	-	9.27	10.08	13.40
Total AVDY Demand (L/s)	47.99	57.26	67.34	80.74
Total AVDY Demand (m^3/d)	4,146	4,947	5,818	6,976
Addition of MXDY Demand (L/s)	-	16.32	17.94	24.04
Total MXDY Demand (L/s)	68.67	84.99	102.93	126.98
Total MXDY Demand (m^3/d)	5,933	7,343	8,894	10,971

To apply future water demands, a new node was added for each growth area in the model. A dummy pipe was created for each infill development to connect the added node to the existing water distribution system, whereas looped distribution mains were added for new subdivisions. For the added distribution mains, a diameter the same as the connected existing watermain was initially proposed, and the roughness coefficient was assigned based on the City of Ottawa Water Distribution Design Guidelines. The nodes, dummy pipes, and distribution mains that were added for future growth areas are illustrated in **Figure 5-34**. All added distribution mains were assumed based on the configuration of distribution system and location of new subdivisions. The Town has also indicated that the future water demands originally associated with growth area ICI105 could be re-allocated to the proposed car wash at adjacent site (i.e., Antrim Truck Stop at 580 White Lake Rd), as area ICI105 is proposed to be storage units with no anticipated water demands except for fire protection. Therefore, these future water demands (i.e., average day (AVDY) demand of 1.31 L/s and maximum day (MXDY) demand of 1.96 L/s under 2027 conditions) were re-assigned to the node near to the entrance of Antrim Truck Stop at Bev Shaw Pkwy.

It should be noted that growth area RES37 at Van Dusen Dr (Tartan Homes) with approximately 285 residential units is currently not serviced by the water distribution system. To service the RES37 area, a new watermain was initially proposed within the ROW extending from the existing distribution network at Bev Shaw Pkwy and along White Lake Rd and Van Dusen Dr. The City of Ottawa Water Distribution Design Guidelines define residential areas serving 50 or more dwellings and connecting to a single feedermain as vulnerable service areas, which may pose issues of reliability in the event of a watermain break. Details of the second watermain required to feed the RES37 area were investigated as part of the development of solutions in **Chapter 3** (**Section 6**).



Stantec

Legend

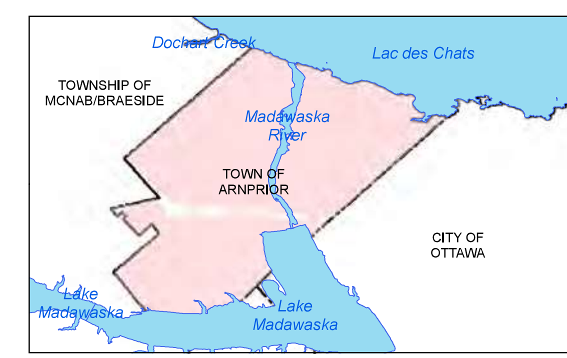
- Nodes Added for Growth Areas
- Dummy Pipes Added for Growth Areas
- Distribution Mains Added for Growth Areas
  - 150 mm - 225 mm
  - 225 mm - 350 mm
- Growth Areas with Future Water Demands
- Modelled Watermains - Diameter (mm)
  - < 75 mm
  - 75 mm - 150 mm
  - 150 mm - 225 mm
  - 225 mm - 350 mm
  - 350 mm - 600 mm
- Modelled Junctions
- WTP Water Treatment Plant (WTP)
- Elevated Storage Tank (EST)
- Municipal Boundary

N

0 200 400 600 Meters

(At original document size of 11x17)
1:18,000

Notes
1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Ontario_Hydro_Network_(OHN)_-_Waterbody.shp*, *Ontario_Hydro_Network_(OHN)_-_Waterbody (2).shp*, *Municipal_Boundary_-_Lower_and_Single_Tier.shp*, and *0837ARNP.sid*, *Arnprior_PropertyParcels_wAssessment_20220324.shp*, *Arnprior_Roads_20220324.shp* and *WTR_NODE.shp* provided by the Town of Arnprior
3. Background: Contains information licensed under the Open Government Licence – Ontario
4. Abbreviations: WFP: Water Filtration Plant



Project Location
Arnprior, ON

Prepared by CZ on 2023-02-16
Revised by CZ on 2024-01-16

Client/Project
Town of Arnprior
2022 W&WW Master Plan Update

163401723

Figure No.
5-34

Title
Water Distribution Network (Future Conditions Without Solutions)

C:\Users\chzheng\Documents\My Documents\temp\163401723 Arnprior Water Master Plan\figures\MP_Report\mxd\fig5-34_arn_wtr_fu_cond_no_soln_dist_network_20240116.mxd Revised: 2024-01-16 By: chzheng

5.5 Do Nothing Alternative Assessment

The existing wastewater collection and potable water distribution systems were assessed under future conditions by applying the future flows and water demands developed in **Section 5.4**. This is equivalent to an assessment of the “do nothing” alternative as part of the Municipal Class Environmental Assessment (EA) process.

5.5.1 Wastewater Collection System

Similarly to the existing conditions assessment presented in **Section 5.2.1**, the existing wastewater collection system’s performance is assessed under future (growth) conditions, by adding the flows generated in **Section 5.4.1** to the hydraulic model.

5.5.1.1 Boundary Conditions

The boundary conditions applied to the model for the future (growth) conditions system assessment remain unchanged from the boundary conditions applied under existing conditions and are presented in **Section 5.2.1.1**.

5.5.1.2 Planned Future Projects

The Town provided a list of planned long-term infrastructure projects, which will have an impact on the resulting flows in the system. They were therefore considered when identifying future problem areas and system improvements. The planned future wastewater collection system projects are summarized in **Table 5-27** and illustrated in **Figure 5-35**. The planned future projects notably consisted of:

- **Sewer separations**: sewer separations were modelled by updating the RTK hydrographs applied at the loading nodes along the sewers being separated. The RTK hydrographs were updated by decreasing the R1 (short-term R) parameter, which represents disconnecting catchbasin leads. The R1 value was reduced to 0.9%, which was determined through calibration for unmonitored areas. Once sewer separation is completed, flows should be monitored to confirm the efficacy of separation and the resulting parameters.

- **Edey St redirection (projects SEW-FUT-2 and SEW-FUT-3 in Table 5-27)**: the Town is currently undertaking a project to redirect flows along Edey St. Existing flows from Edey St and Allan Dr are eastbound to Daniel St, and the future redirection will divert Allan Dr and Edey St flows west, and then northbound to MacDonald St. Based on conceptual design drawings, a new sewer will be installed on MacDonald St, connecting William St and McGonigal St. Detailed design information (inverts, new sewer diameters) are unavailable, therefore updated inverts along Edey St were assumed to redirect the flows as intended. The existing 250 mm and 300 mm diameter sewers along MacDonald St were upsized to 450 mm diameter, as they will be receiving flows from the existing 450 mm diameter sewers on Edey St. These assumptions should be confirmed once detailed design information is available and updated in the model.

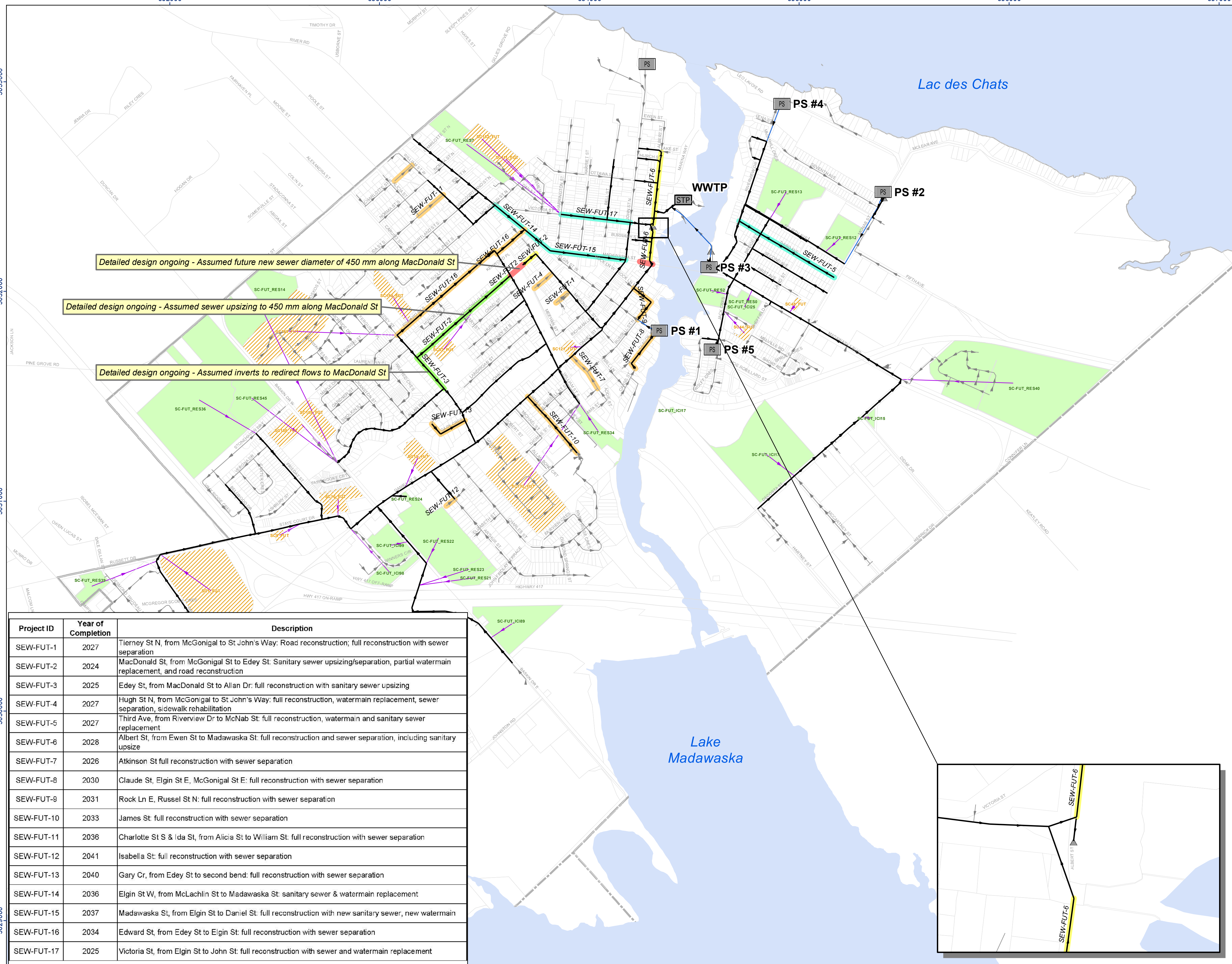
Table 5-27: Planned Wastewater Collection Infrastructure Projects

Project ID	Year of Completion(1)	Description
SEW-FUT-1	2027	Tierney St N, from McGonigal to St John's Way: Road reconstruction; full reconstruction with sewer separation
SEW-FUT-2	2024	MacDonald St, from McGonigal St to Edey St: Sanitary sewer upsizing/separation, partial watermain replacement, and road reconstruction
SEW-FUT-3	2025	Edey St, from MacDonald St to Allan Dr: full reconstruction with sanitary sewer upsizing
SEW-FUT-4	2027	Hugh St N, from McGonigal to St John's Way: full reconstruction, watermain replacement, sewer separation, sidewalk rehabilitation
SEW-FUT-5	2027	Third Ave, from Riverview Dr to McNab St: full reconstruction, watermain and sanitary sewer replacement
SEW-FUT-6	2028	Albert St, from Ewen St to Madawaska St: full reconstruction and sewer separation, including sanitary upsize
SEW-FUT-7	2026	Atkinson St full reconstruction with sewer separation
SEW-FUT-8	2030	Claude St, Elgin St E, McGonigal St E: full reconstruction with sewer separation
SEW-FUT-9	2031	Rock Ln E, Russell St N: full reconstruction with sewer separation
SEW-FUT-10	2033	James St: full reconstruction with sewer separation
SEW-FUT-11	2036	Charlotte St S and Ida St, from Alicia St to William St: full reconstruction with sewer separation
SEW-FUT-12	2041	Isabella St: full reconstruction with sewer separation

Project ID	Year of Completion[1]	Description
SEW-FUT-13	2040	Gary Cr, from Edey St to second bend: full reconstruction with sewer separation
SEW-FUT-14	2036	Elgin St W, from McLachlin St to Madawaska St: sanitary sewer and watermain replacement
SEW-FUT-15	2037	Madawaska St, from Elgin St to Daniel St: full reconstruction with new sanitary sewer, new watermain
SEW-FUT-16	2034	Edward St, from Edey St to Elgin St: full reconstruction with sewer separation
SEW-FUT-17	2025	Victoria St, from Elgin St to John St: full reconstruction with sewer and watermain replacement

Note:

(1) Year of completion inferred from long-range capital forecasts (final year of planned capital investment).



Project ID	Year of Completion	Description
SEW-FUT-1	2027	Tierney St N, from McGonigal to St John's Way: Road reconstruction; full reconstruction with sewer separation
SEW-FUT-2	2024	MacDonald St, from McGonigal St to Edey St: Sanitary sewer upsizing/separation, partial watermain replacement, and road reconstruction
SEW-FUT-3	2025	Edey St, from MacDonald St to Allan Dr: full reconstruction with sanitary sewer upsizing
SEW-FUT-4	2027	Hugh St N, from McGonigal to St John's Way: full reconstruction, watermain replacement, sewer separation, sidewalk rehabilitation
SEW-FUT-5	2027	Third Ave, from Riverview Dr to McNab St: full reconstruction, watermain and sanitary sewer replacement
SEW-FUT-6	2028	Albert St, from Ewen St to Madawaska St: full reconstruction and sewer separation, including sanitary upsize
SEW-FUT-7	2026	Atkinson St full reconstruction with sewer separation
SEW-FUT-8	2030	Claude St, Elgin St E, McGonigal St E: full reconstruction with sewer separation
SEW-FUT-9	2031	Rock Ln E, Russel St N: full reconstruction with sewer separation
SEW-FUT-10	2033	James St: full reconstruction with sewer separation
SEW-FUT-11	2036	Charlotte St S & Ida St, from Alicia St to William St: full reconstruction with sewer separation
SEW-FUT-12	2041	Isabella St: full reconstruction with sewer separation
SEW-FUT-13	2040	Gary Cr, from Edey St to second bend: full reconstruction with sewer separation
SEW-FUT-14	2036	Elgin St W, from McLachlin St to Madawaska St: sanitary sewer & watermain replacement
SEW-FUT-15	2037	Madawaska St, from Elgin St to Daniel St: full reconstruction with new sanitary sewer, new watermain
SEW-FUT-16	2034	Edward St, from Edey St to Elgin St: full reconstruction with sewer separation
SEW-FUT-17	2025	Victoria St, from Elgin St to John St: full reconstruction with sewer and watermain replacement

Stantec

Legend

- Sanitary Pump Station (PS)
- Overflow
- Wastewater Treatment Plant (WWTP)
- Trunk Sanitary Sewer (Modelled)
- Local Sanitary Sewer (Not Modelled)
- Forcemains

Future Sewer Projects

- New Sewers
- Sewer Redirection (with Upsizing)
- Sewer Replacement (no Upsizing)
- Sewer Separation
- Sewer Separation (with Upsizing)

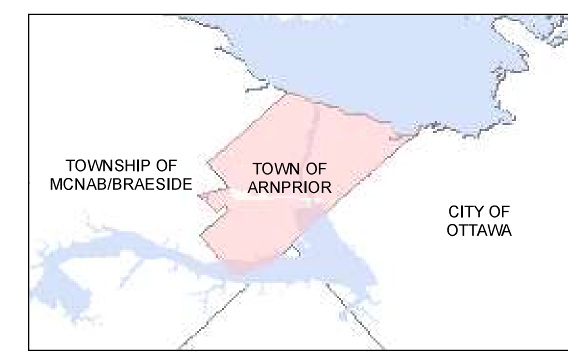
Growth Areas

- Growth Area
- Existing Subcatchment (with Redevelopments or Development/Occupancy of Vacant Properties)
- New Subcatchment

N

0 250 500 Meters
(At original document size of 11x17)
1:19,000

Notes
1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Export_Output_Parcel_Fabric.shp*, *Export_Output_Roads.shp*, *Export_Output_San_MH.shp* and *Export_Output_SAN_SEWER.shp* provided by the Town of Arnprior
3. Background: Contains information licensed under the Open Government Licence – Ontario
4. Abbreviations: FM: Flow Monitor; MH: Maintenance Hole; PS: Pump Station; WWTP: Wastewater Treatment Plant



Project Location Prepared by CR on 2023-11-06
Arnprior, ON
Client/Project 163401723
Town of Arnprior
2022 W&WW Master Plan Update
Figure No.
5-35
Title
Planned Wastewater Collection Infrastructure Projects

C:\Users\crazafimaharo.CORP\Documents\Local_Work_Tmp\Local-163401723-ArnpriorMP\gis_local\MXDs\tm3_figs\fig2-1_arn_san_fuProj_20231110.mxd Revised: 2023-11-10 By: crazafimaharo

5.5.1.3 Collection System

The existing sanitary collection network, including the planned projects listed in **Table 5-27**, is assessed to identify if additional capacity constraints and HGL and surcharge issues arise under future (growth) conditions. The assessment is based on the same HGL criteria outlined in **Section 5.2.1.1** and the same scenarios (DWF and WWF under a 25-year SCS II 6-hour rainfall distribution event). The results are illustrated in **Figure 5-36** (2027), **Figure 5-37** (2032) and **Figure 5-38** (2042). The planned projects listed in **Table 5-27** were included in the future conditions, based on their projected year of completion. **Figure 5-38** (2042) also shows the location of problem areas for which servicing solutions were developed.

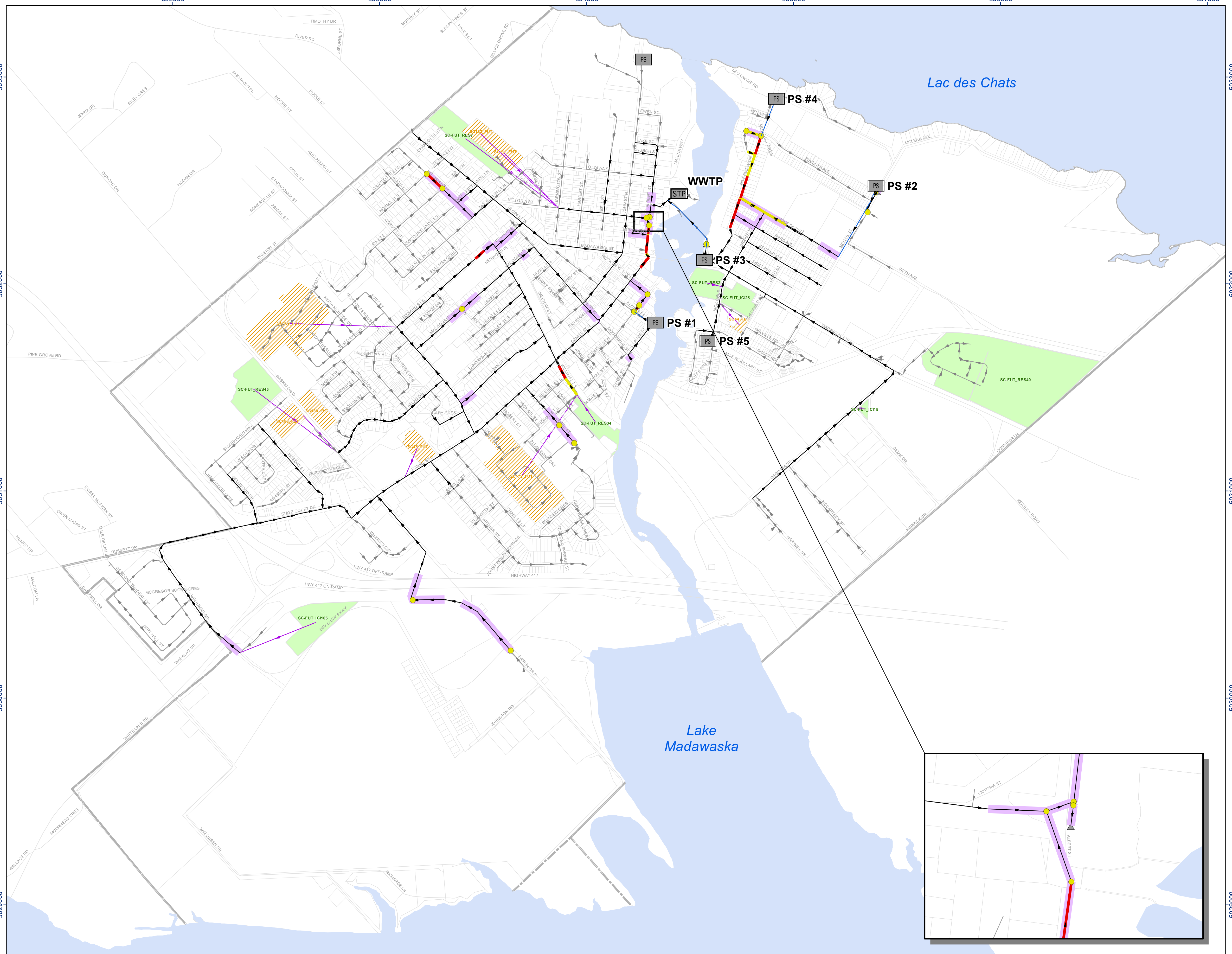
The pipes under DWF are all free-flowing and no HGL issues associated to pipe surcharge are identified. The WWF assessment shows 3 key locations of potential constraints, for which solutions are developed as part of the servicing strategy.

The problem areas are as follows:

- **Problem Area PA-1 – Riverview Dr/Fourth Ave/Mulvihill Cr**: Risks of basement flooding are observed along Riverview Dr and Mulvihill Cr, due to sewer capacity issues along Riverview Dr, which propagate upstream. The 450 mm diameter sewers on Riverview Dr, north of Fourth Ave, are undersized for the flows observed in the 25-year design event, under existing and future conditions. The sewer along Riverview Dr, however, does have an adverse (and almost flat) slope, based on the invert information received. It is therefore recommended that the inverts along these sewers be confirmed, prior to implementing the solutions developed in **Section 6.5**. No future projects are planned that will impact flows to this problem area.
- **Problem Area PA-2 –Daniel St**: In the future and considering the planned sewer separations listed in **Table 5-27**, a short section of 600 mm diameter sewers along Daniel St, south of Madawaska St, remains bottlenecked. However, no HGL issues due to pipe constraints are observed. The sewers experiencing bottlenecked conditions, however, consist of some inferred inverts applied to eliminate the adverse slopes produced when using provided inverts. It is therefore recommended that the inverts along these sewers be confirmed, prior to implementing the solutions developed in **Section 6.5**.

- **Problem Area PA-3 – Edward St**: While no HGL issues are observed along Edward St, the existing 200 mm diameter sewer south of William St is bottlenecked. Flows from the Callahan Developments are partially diverted from Edey St to Edward St at the bifurcation between the two streets. Sewer separation along Edward St is planned downstream, north of William St (project SEW-FUT-16 in **Table 5-27**, but does not impact flows to this problem area.

Other HGL issues (risks of basement flooding) are observed throughout the system, however these are due to shallow sewers rather than pipe capacity issues and are not further addressed in this chapter. Nonetheless, these results should be compared to reported basement flooding occurrences and the installation of backwater valves considered where necessary.



Stantec

Legend

- Sanitary Pump Station (PS)
- Overflow
- Wastewater Treatment Plant (WWTP)
- Sanitary Sewer (Not Modelled)
- Forcemains

HGL Freeboard

- At or Above Surface
- Within Basement Level (Within 1.8 m of Surface)

Pipe Surcharge State

- Bottleneck (Undersized Sewer)
- Backwater Conditions
- Free-Flowing Conditions
- Shallow Pipes (Obvert Within 1.8 m of Surface)

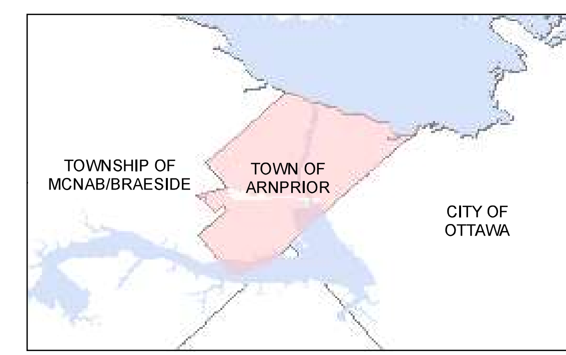
Growth Areas

- Growth Area
- Existing Subcatchment (with Redevelopments or Development/Occupancy of Vacant Properties)
- New Subcatchment

N

0 250 500 Meters
(At original document size of 11x17)
1:19,000

Notes
1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Export_Output_Parcel_Fabric.shp*, *Export_Output_Roads.shp*, *Export_Output_San_MH.shp* and *Export_Output_SAN_SEWER.shp* provided by the Town of Arnprior
3. Background: Contains information licensed under the Open Government Licence – Ontario
4. Abbreviations: FM: Flow Monitor; MH: Maintenance Hole; PS: Pump Station; WWTP: Wastewater Treatment Plant



Project Location Prepared by CR on 2023-01-06
Arnprior, ON

Client/Project 163401723
Town of Arnprior
2022 W&WW Master Plan Update

Figure No.
5-36

Title
2027 Growth Conditions with Projects Planned by 2027 - 25-Year SCS II 6 Hour

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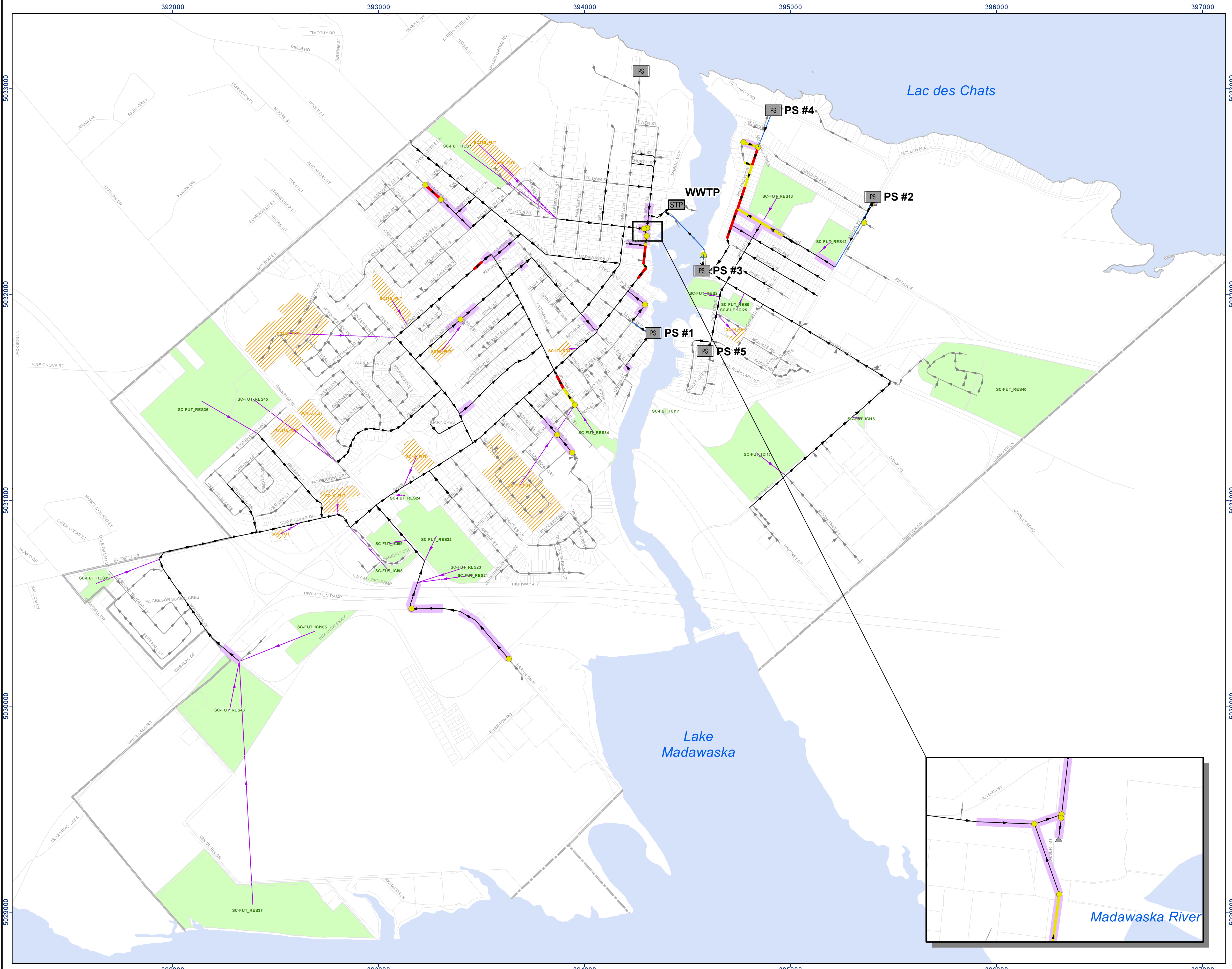


Stantec

Legend

- Sanitary Pump Station (PS)
- Overflow
- Wastewater Treatment Plant
- Sanitary Sewer (Not Modelled)
- Forcemains

HGL Freeboard

- At or Above
- Within Basement Level (Within 1.8 m of Surface)

Pipe Surcharge State

- Bottleneck (Undersized Sewer)
- Backwater Conditions
- Free-Flowing Conditions
- Shallow Pipes (Obvert Within 1.8 m of Surface)

Growth Areas

- Growth Area
- Existing Subcatchment (with Redevelopments or Development/Occupancy of Vacant Properties)
- New Subcatchment

N

0 250 500 Meters

(At original document size of 11x17) 1:19,000

Notes

1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Export_Output_Parcel_Fabric.shp*, *Export_Output_Roads.shp*, *Export_Output_San_MH.shp* and *Export_Output_SAN_SEWER.shp* provided by the Town of Arnprior
3. Background: Contains information licensed under the Open Government Licence – Ontario
4. Abbreviations: FM: Flow Monitor; MH: Maintenance Hole; PS: Pump Station; WWTP: Wastewater Treatment Plant

TOWNSHIP OF MCNAB/BRAESIDE
TOWN OF ARNPRIOR
CITY OF OTTAWA

Project Location Prepared by CR on 2023-01-06

Arnprior, ON

Client/Project 163401723

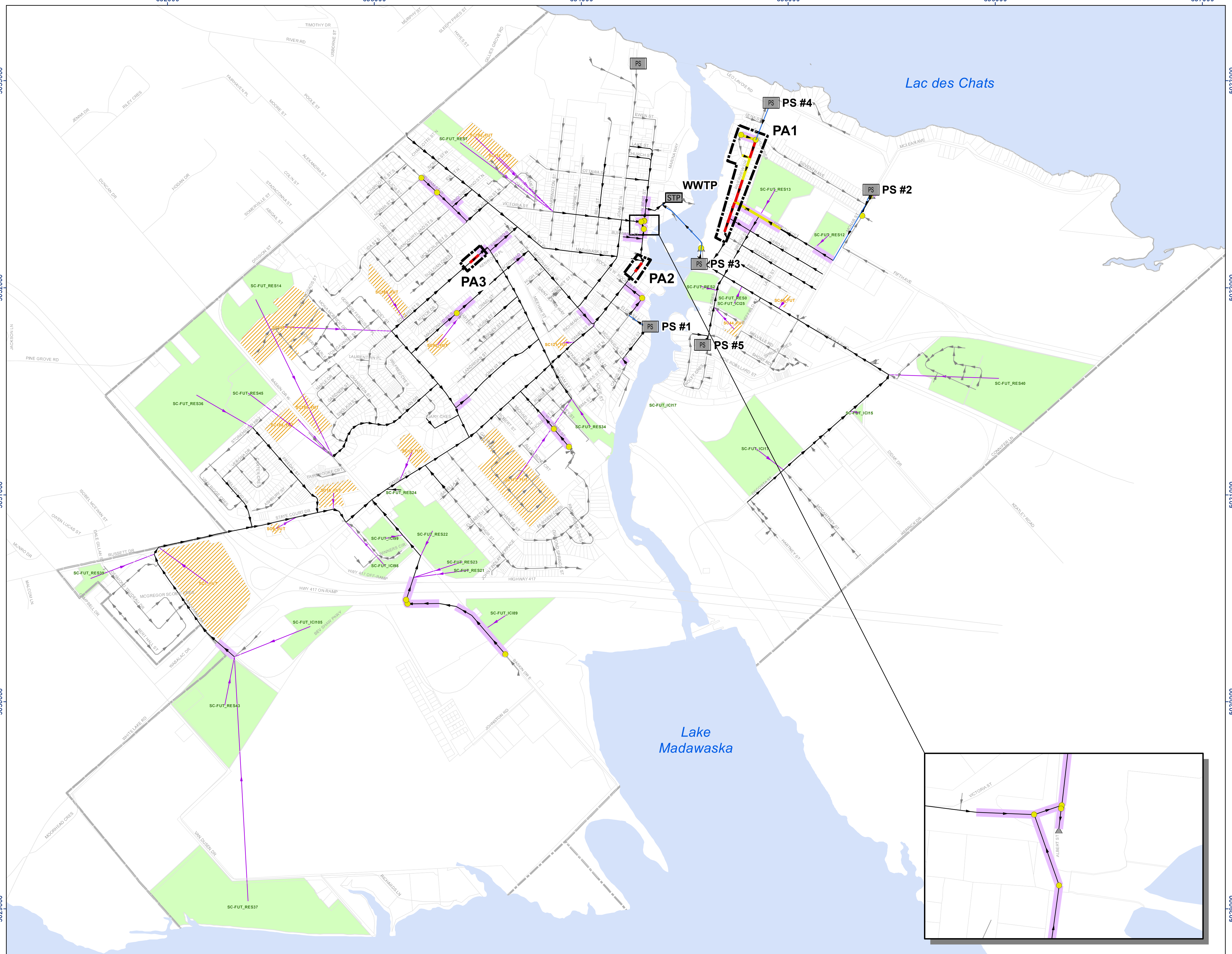
Town of Arnprior
2022 W&WW Master Plan Update

Figure No.

5-37

Title

2032 Growth Conditions with Projects Planned by 2032 - 25-Year SCS II 6 Hour



Stantec

Legend

- Sanitary Pump Station (PS)
- Overflow
- Wastewater Treatment Plant (WWTP)
- Sanitary Sewer (Not Modelled)
- Forcemains

HGL Freeboard

- At or Above Surface
- Within Basement Level (Within 1.8 m of Surface)

Pipe Surcharge State

- Bottleneck (Undersized Sewer)
- Backwater Conditions
- Free-Flowing Conditions
- Shallow Pipes (Obvert Within 1.8 m of Surface)
- Problem Areas

Growth Areas

- Growth Area
- Existing Subcatchment (with Redevelopments or Development/Occupancy of Vacant Properties)
- New Subcatchment

N

0 250 500 Meters

(At original document size of 11x17)
1:19,000

Notes

1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Export_Output_Parcel_Fabric.shp*, *Export_Output_Roads.shp*, *Export_Output_San_MH.shp* and *Export_Output_SAN_SEWER.shp* provided by the Town of Arnprior
3. Background: Contains information licensed under the Open Government Licence – Ontario
4. Abbreviations: FM: Flow Monitor; MH: Maintenance Hole; PS: Pump Station; WWTP: Wastewater Treatment Plant

Project Location
Arnprior, ON

Prepared by CR on 2023-11-07

Client/Project
Town of Arnprior
2022 W&WW Master Plan Update

163401723

Figure No.
5-38

Title
2042 Growth Conditions with Project Planned by 2042 – 25-Year SCS II 6 Hour Event and Problem Areas

5.5.1.4 Pumping Stations

The existing PSs capacities are compared to the revised peak modelled incoming flows under DWF conditions, the 10-year design event, and the 25-year design event, for each growth horizon, with and without the future (planned) projects presented in **Table 5-27**. Per the MECP guidelines, PSs should be designed for a firm capacity at least capable of handling the 10-year design event. Additionally, the PSs bypass history from 2017 to 2022 was also reviewed at each PS. The results are summarized in **Table 5-28.**

No PS capacity concerns are observed under DWF conditions. In the 10-year and 25-year design event however, PS #1, PS #2 and PS #3 are already at capacity in existing conditions (see **Section 5.2.1.3**), which is exacerbated by growth at PS #3. The peak incoming flows to PS #5 are within the PS's firm capacity under existing conditions. The peak incoming flows to PS #1, PS #2 and PS #5 under the 10-year and 25-year design event do not increase (i.e., no growth is expected upstream of these PSs).

PS #1 is located downstream of combined areas. It is expected that the Town's planned sewer separations on McGonigal St and Claude St (project SEW-FUT-8 in **Table 5-27**) will help reduce the flows to PS #1 once implemented by the 10-year horizon. Once sewer separation is completed, monitoring is recommended to confirm the efficacy of the sewer separation and the resulting impact on inflow and infiltration (I/I) to PS #1. Other PSs are not impacted by the other planned projects.

The peak incoming flows to PS #3 under the 10-year design event will increase by +28 L/s to 306 L/s in the 20-year horizon, and under the 25-year design event will increase by +15 L/s to 338 L/s, as overall growth is expected east of the Madawaska River. PS #3 is also located downstream of ICI areas which may have roof drain connections to the sanitary sewers, or other potential cross-connections. These may contribute to the high peak flows observed under WWF conditions.

Also, as noted in the model limitations (**Section 5.1.1.6.5**) and under existing conditions (**Section 5.2.1.3**), the model was calibrated to an event equivalent to a 2-year event, i.e., with a 50% probability of occurring every year. Extrapolating the flows to a less frequent event such as the 25-year event (i.e., with a 4% probability of occurring every year) can result in conservative peak flows throughout the system, including those incoming to the PSs.

Section 5.2.1.3 (existing conditions) includes a discussion of the PSs' bypass history, which corroborate the constraints identified at PS #1 and PS #3. Servicing solutions and recommendations to address the PS constraints and accommodate future growth are developed in **Section 6.5**.

Table 5-28: Updated Modelled Incoming Flows to PSs and Bypass History

Name	PS #1	PS #2	PS #3	PS #5
Location	**Elgin St E at Claude St**	**McNab St at Seventh Ave**	**Madawaska Blvd, west of Bridge St**	**Wolff Cres**
Number of Pumps at PS	2	2	3(2)	2
Firm Capacity (Largest Pump Out of Service) (L/s)	25	59	275	7
DWF Peak Modelled Incoming Flow (L/s) with Existing Infrastructure Only *with Planned Projects*(1)				
Existing	0.7	8.5	28	1.6
5-Year Horizon (2027)	0.7, *0.7*	8.5, *8.5*	29, *29*	1.5, *1.5*
10-Year Horizon (2032)	0.7, *0.7*	8.5, *8.5*	34, *34*	1.5, *1.5*
20-Year Horizon (2042)	0.7, *0.7*	8.5, *8.5*	43, *43*	1.5, *1.5*
10-Year Design Event Peak Modelled Incoming Flow (L/s) with Existing Infrastructure Only *with Planned Projects*(1)				
Existing	81	71	278	5.4
5-Year Horizon (2027)	81, *81*	71, *71*	280, *280*	5.4, *5.4*
10-Year Horizon (2032)	81, *81*	71, *71*	297, *297*	5.4, *5.4*
20-Year Horizon (2042)	81, *81*	71, *71*	306, *306*	5.4, *5.4*
25-Year Design Event Peak Modelled Incoming Flow (L/s) with Existing Infrastructure Only *with Planned Projects*(1)				
Existing	96	84	323	6.1
5-Year Horizon (2027)	96, *96*	84, *84*	324, *324*	6.1, *6.1*
10-Year Horizon (2032)	96, *96*	84, *84*	329, *329*	6.1, *6.1*

Name	**PS #1**	**PS #2**	**PS #3**	**PS #5**
Location	**Elgin St E at Claude St**	**McNab St at Seventh Ave**	**Madawaska Blvd, west of Bridge St**	**Wolff Cres**
20-Year Horizon (2042)	96, *96*	84, *84*	338, *338*	6.1, *6.1*
Number of Bypasses(3) per Year				
2017				
2018				
2019				
2020	1		1	
2021			1	
2022	1		3	

Notes:

(1) Future (planned) projects presented in **Table 5-27.**

(2) The pumps at PS #3 are equipped with variable frequency drives (VFDs).

(3) Bypasses due to heavy precipitation or snowmelt (not due to equipment failure), as reported in the Town's reports to Council from 2017 to 2022.

5.5.1.5 Wastewater Treatment Plant

The WWTP's PHF capacity (8 5 L/s [59,200 m^3/d]) is compared against the projected DWF and 25-year design event incoming flows, with and without the future (planned) projects presented in **Table 5-27**. This table also presents the expected overflow volume at Albert St under each horizon, and the WWTP's bypass history. Town operations staff have noted that bypasses (and hence, overflows at Albert St) are triggered when the levels in the WWTP inlet channel reach 900 mm.

The modelled incoming flows under DWF conditions are within the WWTP's PHF capacity and does not result in overflows at the Albert St CSO. The 25-year design event results in existing conditions (**Section 5.2.1.4**) shows the modelled PHF's within (but nearing) the WWTP's PHF capacity, with a CSO being triggered at the Albert St/Victoria St weir. Under growth conditions without the future (planned) projects, the peak modelled incoming flows and CSO volumes further increase and are projected to exceed the WWTP's PHF capacity by the 10-year horizon. In general, it is expected that the Town's planned sewer separations will help reduce the peak flows to the WWTP and the bypass volumes at the Albert St CSO. Nonetheless, flows should be monitored as sewer separation projects are completed, to confirm the resulting reduction in flows.

These findings are subject to the same limitations described in **Section 5.2.1.4**. The model was calibrated to an event equivalent to a 2-year event, i.e., with a 50% probability of occurring every year. Extrapolating the flows to a less frequent event such as the 25-year event (i.e., with a 4% probability of occurring every year) can result in conservative peak incoming flows to the WWTP.

While the model provides incoming flow and overflow results, the WWTP capacity assessment considers historical average daily flows and peak hour flows, which are compared against the corresponding CoA design flows. The Town's reports to Council and available SCADA data were analyzed to compare the measured flows against the WWTP's CoA average day and peak hour design flows. The historical (201 -2023) data is provided in **Figure 5-24.**

The peak hour flows in 2018-2022 were within the WWTP's peak hour design flow, which also supports that the WWTP did not experience capacity issues during this time period. This aligns with the conclusions based on the average daily flows. Overall, the WWTP is expected to have capacity to service future growth within the MP's 20-year planning horizons. However, this should be confirmed by updating the WWTP's capacity assessment regularly (e.g., every 5 years), as growth occurs, and planned sewer separation projects are completed. Flows should be monitored as sewer separation projects are completed, to confirm the resulting reduction in peak wet weather flows, and as growth occurs, to quantify the changes in average flows.

Furthermore, it is recommended that further monitoring and calibration be conducted to capture less frequent events (such as 5-year, 10-year events). This would help confirm the modelled incoming flows to the WWTP under large events, and the resulting overflows under these conditions.

Table 5-29: Modelled Incoming Flows to WWTP (Existing and Future), Albert St CSO Volumes and WWTP Bypass (CSO) History

Location	WWTP PHF Capacity = 685 L/s	WWTP PHF Capacity = 685 L/s	Albert St CSO
Modelled Parameter	**Peak Instantaneous Flow**	**Peak Hourly Flow**	**Overflow Volume**
DWF Peak Modelled Incoming Flow (L/s) with Existing Infrastructure Only *with Planned Projects*[(1)]			
Existing	74	64	0
5-Year Horizon (2027)	*84,* 83	73, *73*	0
10-Year Horizon (2032)	99, *98*	86, *86*	0
20-Year Horizon (2042)	126, *125*	111, *110*	0
25-Year Design Event Peak Modelled Incoming Flow (L/s) with Existing Infrastructure Only *with Planned Projects*[(1)]			
Existing	1,014	676	862
5-Year Horizon (2027)	1,017, *992*	684, *667*	904, *843*
10-Year Horizon (2032)	1,020, *963*	694, *651*	958, *837*
20-Year Horizon (2042)	1,040, *914*	716, *645*	1,056, *823*
Number of Bypasses[(2, 3)] per Year			
2016	2	2	2
2017	3	3	3
2018	2	2	2

Location	**WWTP PHF Capacity = 685 L/s**	**WWTP PHF Capacity = 685 L/s**	**Albert St CSO**
Modelled Parameter	**Peak Instantaneous Flow**	**Peak Hourly Flow**	**Overflow Volume**
2019	1	1	1
2020	1	1	1
2021	2	2	2
2022	3	3	3

Notes:

(1) Future (planned) projects presented in **Table 5-27.**

(2) Per the WWTP's Certificate of Authorization (CoA), the Albert St weir and overflow constitutes the WWTP bypass. Town operations staff have noted that bypasses (and hence, overflows at Albert St) are triggered when the levels in the WWTP inlet channel reach 900 mm.

(3) Bypasses as reported in the reports to Council and daily WWTP data provided from 2016 to 2022.

5.5.2 Potable Water System

By applying the future demands as described in Section **5.4.2.2**, the performance of the WFP and existing water distribution system is evaluated under future (growth) conditions.

5.5.2.1 Planned Future Projects

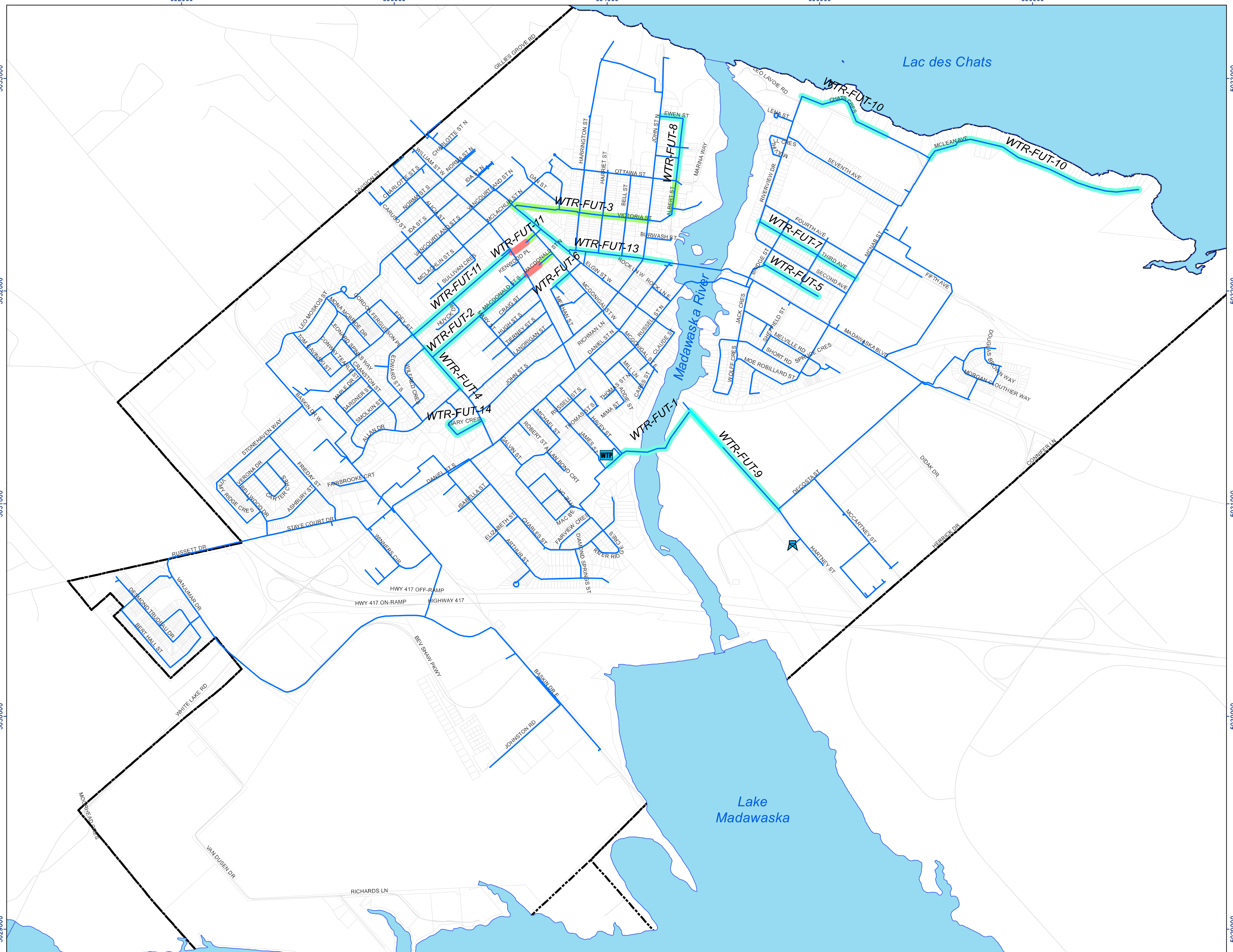
The Town provided a list of planned long-term infrastructure projects, which includes additional planned waterwork projects as summarized in **Table 5-30** and illustrated in **Figure 5-39**. All planned waterworks with anticipated year of completion prior to 2042 were therefore incorporated into the model. It is noted that the planned watermain upsizing projects at Daniel St, Staye Court Dr, Elgin St, Norma St, and Caruso St are based on the recommendations from the 2013 W&WWMP. These projects will be deferred past 2042 due to the additional conveyance capacity and looping provided by the new/upgraded watermains post-2011 (refer to **Section 6.5.2.2** for detailed discussion).

Table 5-30: Planned Waterwork Projects

Count	Project Name	Project ID	Year of Completion(1)	Planning Horizon	Planned Waterworks	Notes
1	River Crossing Phase I - 400mm Watermain Replacement	WTR-FUT-1	2024	2027	Replace the existing 400mm river crossing (CI watermain installed in 1957) near the WFP between James St and Hartney St.	It is noted that the configuration of the new watermain river crossing will be changed, and the stub of 300mm watermain near the river will be eliminated altogether.
2	MacDonald St from McGonigal St to Edey St - sanitary sewer upsizing/separation, partial watermain, and road reconstruction	WTR-FUT-2	2024	2027	Replace the existing 200mm DI watermain (installed in 1990) on MacDonald St from Edey St to William St. Upsize the existing 100mm CI watermain (installed in 1910) on MacDonald St (between McGonigal St and William St) to 200mm and extend the 200mm watermain to William St (connecting to the replaced pipe at William St).	
3	Victoria (John to Elgin) - Full reconstruction and Upsize Watermain 300mm	WTR-FUT-3	2025	2027	Upsize the existing 100mm and 150mm DI watermains (installed in 1966) on Victoria St from John St to Elgin St to 300mm.	
4	Edey St from MacDonald St to Allan Dr - full reconstruction with ss upsizing	WTR-FUT-4	2025	2027	Replace the existing 250mm CI watermain (installed in 1966) on Edey St from Wilfred Cres to Allan Dr.	
5	First Avenue Full Reconstruction - Bridge St. to End	WTR-FUT-5	2026	2027	Replace the existing 150mm DI/PVC watermains (installed in 1955) on First Ave.	
6	Hugh St. N. from McGonigal to Saint Johns Way; Full reconstruction, WM, sewer separation, sidewalk one side only	WTR-FUT-6	2027	2027	Replace the existing 150mm CI watermain (installed in 1910) on Hugh St N from McGonigal St to Saint Johns Way.	
7	Third Avenue from Riverview Dr. to McNab St. Full Recons; narrow road from 10m to 8.5.m wide, sidewalk on one side only, wm and ss replacement	WTR-FUT-7	2027	2027	Replace the existing 150mm DI watermain (installed in 1960) on Third Ave from Riverview Dr to McNab St.	
8	Albert St. and Ewen St - Full Reconstruction and Sewer Separation, incl sanitary upsize to Madawaska	WTR-FUT-8	2028	2032	Upsize the existing 100mm CI watermain (installed in 1914) on Albert St near Marina Way to 150mm. Replace the existing 150mm CI watermains (installed in 1920 and 1966) on Albert St and Ewen St (from Victoria St to John St).	
9	River Crossing Phase II - WM replacement to Decosta	WTR-FUT-9	2029	2032	Replace the existing 400mm CI watermain (installed in 1957) on Hartney St from the connection point of river crossing to Decosta St.	
10	McLean Ave and Chats Cr - Watermain and Road Grade Raise (Flooding mitigation)	WTR-FUT-10	2031	2032	Replace the existing 150mm DI watermain (installed in 1986) on both McLean Ave and Chats Cres.	The existing 150mm PVC watermain (installed in 2008) on McLean Ave is to remain.
11	Full Reconstruction w/ Sewer Sep Edward Street from Edey to Elgin Street	WTR-FUT-11	2034	2042	Replace the existing 200mm DI watermains (installed in 1914 and 1970) on Edward St from Edey St to William St. Upsize the existing 150mm watermain (installed in 1910) on Edward St (between McGonigal St and William St) to 200mm and extend the 200mm	

Count	Project Name	Project ID	Year of Completion(1)	Planning Horizon	Planned Waterworks	Notes
					watermain to William St (connecting to the replaced pipe at William St).	
12	Elgin Street West Sanitary Sewer and Watermain - McLachlin St to Madawaska Street	WTR-FUT-12	2036	2042	Upsize the existing 150mm PVC watermain (installed in 1992) on Elgin St W near McLachlin St to 200mm. Replace the existing 200mm PVC watermains (installed in 1992) on Elgin St W from McLachlin St to Madawaska St.	
13	Madawaska Street (Elgin to Daniel) Full Reconstruction (new ss, new wm, streetscaping/ landscaping, lighting)	WTR-FUT-13	2037	2042	Replace the existing 200mm DI watermains (installed in 1970 and 1995) and 300mm DI watermain (installed in 1957) on Madawaska St from Elgin St to Daniel St.	
14	Gary Cr Full Recon. /Sew/Sep - Edey St. to Second Bend	WTR-FUT-14	2040	2042	Replace the existing 150mm CI watermain (installed in 1957) on Gary Cres from Edey St to the second bend.	
15	Full Reconstruction: Arthur Street from Daniel to John Findlay	WTR-FUT-15	2044	Post-2042	Replace the existing 150mm DI watermain (installed in 1966) and 200mm PVC watermain (installed in 1966) on Arthur St from Daniel St to John Findlay Terrace.	
16	Daniel Street WM Replacement (Pt 2) - Charles St. to Staye Court Dr. (400mm)	WTR-FUT-16	N/A	Post-2042	Upsize the existing 250mm DI watermain (installed in 1987) on Daniel St from Charles St to Staye Court Dr to 400mm.	Based on the analysis with the current growth projections, the additional conveyance capacity and looping provided by the new/upgraded watermains post-2011 helps defer the need for the Daniel St, Staye Court Dr, Elgin St, Norma St, and Caruso St watermain upsizing projects that were previously proposed in the 2013 W&WWMP to past 2042.
17	Staye Court (Daniel to Hwy 17) - Upsize Watermain 400mm / Staye Court - Urbanization and Watermain	WTR-FUT-17	N/A	Post-2042	Upsize the existing 250mm DI watermain (installed in 1987) on Staye Court Dr from Daniel St to Bellwood Dr to 400mm.	
18	Elgin (Victoria to Norma) - Upsize Watermain 300mm	WTR-FUT-18	N/A	Post-2042	Upsize the existing 150mm and 200mm PVC watermains (installed in 1992/1993) on Elgin St from Victoria St to Norma St to 300mm.	
19	Norma (Elgin to Caruso) - Upsize Watermain 300mm	WTR-FUT-19	N/A	Post-2042	Upsize the existing 150mm CI watermain (installed in 1920 and 1960) on Norma St from Elgin St to Caruso St to 300mm.	
20	Caruso (Division to Ida) Watermain Loop, Norma (Alicia to Caruso), Charlotte (Alicia to Caruso)	WTR-FUT-20	N/A	Post-2042	Upsize the existing 150mm PVC watermain (installed in 1969) on Caruso St (between Ida St and Norma St) to 300mm and extend the 300mm watermain to Norma St to provide looping.	

Note:
(1) Year of completion inferred from long-range capital forecasts (final year of planned capital investment).



Stantec

Legend

- Watermains
- Water Treatment Plant (WTP)
- Elevated Storage Tank (EST)
- Municipal Boundary

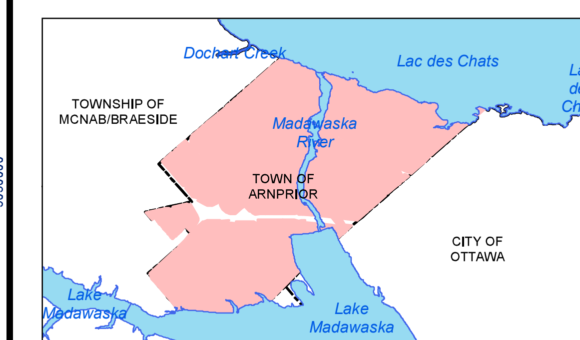
Planned Potable Water Infrastructure Projects

- New Watermain
- Watermain Replacement (no Upsizing)
- Watermain Upgrade (with Upsizing)

N

0 250 500 Meters
(At original document size of 11x17)
1:18,500

Notes
1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Ontario_Hydro_Network_(OHN)_-_Waterbody.shp*, *Ontario_Hydro_Network_(OHN)_-_Waterbody (2).shp*, *Municipal_Boundary_-_Lower_and_Single_Tier.shp*, and *Arnprior_Roads_20220324* and *Arnprior_PropertyParcels_wAssessment_20220324.shp* provided by the Town of Arnprior.
3. Background: Contains information licensed under the Open Government Licence – Ontario



Project Location Prepared by CZ on 2023-11-08

Arnprior, ON

Client/Project 163401723

Town of Arnprior
2022 W&WW Master Plan Update

Figure No.

5-39

Title

Planned Potable Water Infrastructure Projects

5.5.2.2 Water Filtration Plant

With the established future water demands, the treatment capacity of the WFP was assessed for future conditions, as shown in **Table 5-31** and **Figure 5-40**. Based on the analysis, using the average of historical maximum demand from 2016 to 2021, the WFP's rated treatment capacity of 10,340 m^3/d would be capable of supplying the projected population's MXDY demand until the end of 2038, or when the Town's reaches a population of approximately 16,130 people.

The growth projections currently suggest that an additional treatment capacity of about 631 m^3/d would be required in the 20-year planning horizon to accommodate population growth in the Town, considering the MXDY demand of 5,933 m^3/d applied for existing conditions.

Table 5-31: Future (Growth) Conditions WFP Treatment Capacity Assessment

	Existing (2022)	5-Year Horizon (2027)	10-Year Horizon (2032)	20-Year Horizon (2042)
Population Projections (ppl)	10,038	11,899	14,016	17,050
Total MXDY Demand (L/s)	68.67	84.99	102.93	126.98
Total MXDY Demand (m^3/d)	5,933	7,343	8,894	10,971
WFP's Rated Treatment Capacity (m^3/d)	10,340	10,340	10,340	10,340
Residual Treatment Capacity (m^3/d)	4,407	2,997	1,446	-
Residual Treatment Capacity (% of Rated Capacity)	43%	29%	14%	-
Additional Treatment Capacity Required (m^3/d)	-	-	-	631
Additional Treatment Capacity Required (% of Rated Capacity)	-	-	-	6%

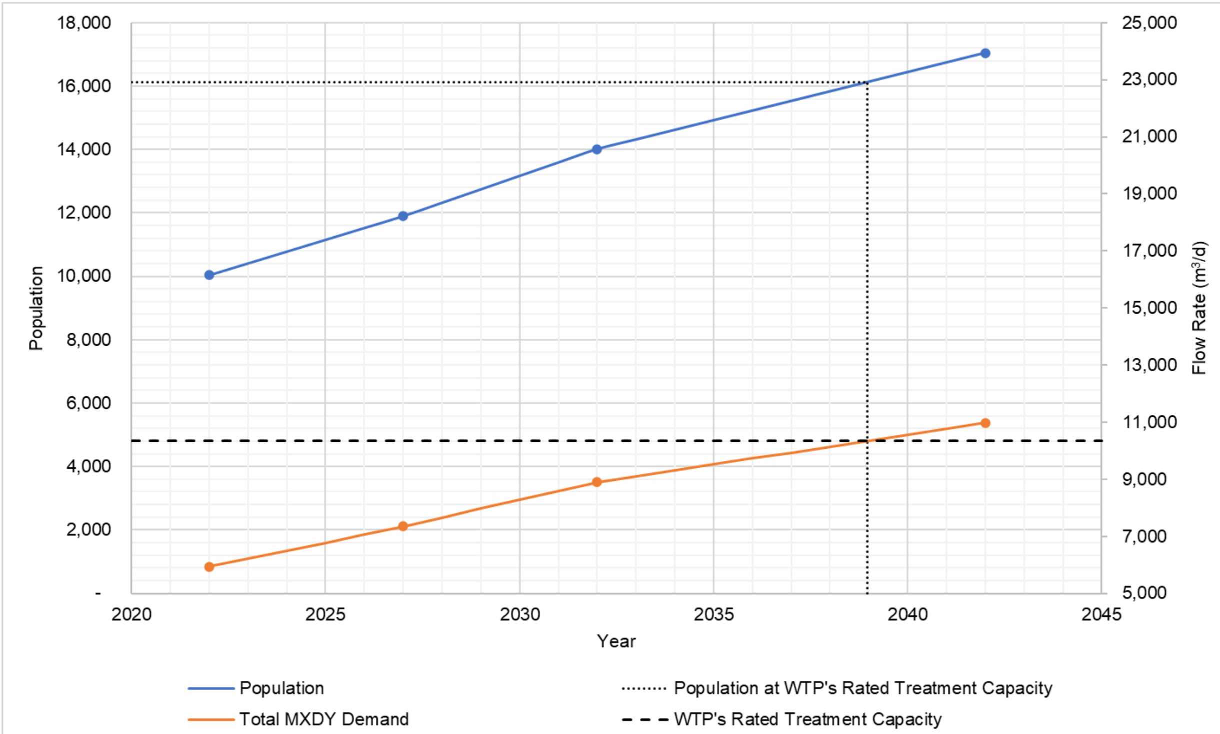


Figure 5-40: Potable Water Treatment Requirements

5.5.2.3 Storage

The system's future storage capacity was evaluated using the MECP formula and recommended fire flow requirements, based on the projected population and future water demands, as presented in **Table 5-32** and **Figure 5-41**. Considering both the storage provided by the EST and clearwells at the WFP, the total available storage volume of 6,336 m^3 would meet projected MXDY demand and corresponding fire flow requirements until the middle of the year 2033, or at a projected population of approximately 14,430 people. In the 20-year planning horizon, it is anticipated that an additional storage volume of 1,592 m^3 would be required to service the projected growth in the Town.

It should be noted that the fire flows and durations used to calculate the total required storage volume were interpolated from the MECP fire flow requirements based on projected population. It is recommended that the fire flow requirements for future conditions to be reviewed with the Town to minimize the possibility of storage oversizing.

Table 5-32: Future (Growth) Conditions Potable Water Storage Capacity Assessment

	Existing (2022)	**5-Year Horizon (2027)**	**10-Year Horizon (2032)**	**20-Year Horizon (2042)**
Population Projections (ppl)	10,038	11,899	14,016	17,050
Total MXDY Demand (L/s)	68.67	84.99	102.93	126.98
Total MXDY Demand (m^3/d)	5,933	7,343	8,894	10,971
Fire Flow Required (Interpolated) (L/s)	189.00	209.67	227.50	250.00
Duration (Interpolated) (hrs)	3.00	3.00	3.25	4.00
Fire Storage Required: A (m^3)	2,041	2,264	2,662	3,600
Equalization Storage: B = 25% of MXDY (m^3)	1,483	1,836	2,223	2,743
Emergency Storage: C = 25% of [A+B] (m^3)	881	1,025	1,221	1,586
Total Storage Volume Required: A + B + C (m^3)	4,406	5,125	6,106	7,928
Existing Storage Available - WFP Clearwells (m^3)	3,971	3,971	3,971	3,971
Existing Storage Available - EST (m^3)	2,365	2,365	2,365	2,365
Total Storage Volume Available (m^3)	6,336	6,336	6,336	6,336
Additional Storage Volume Required (m^3)	-	-	-	1,592

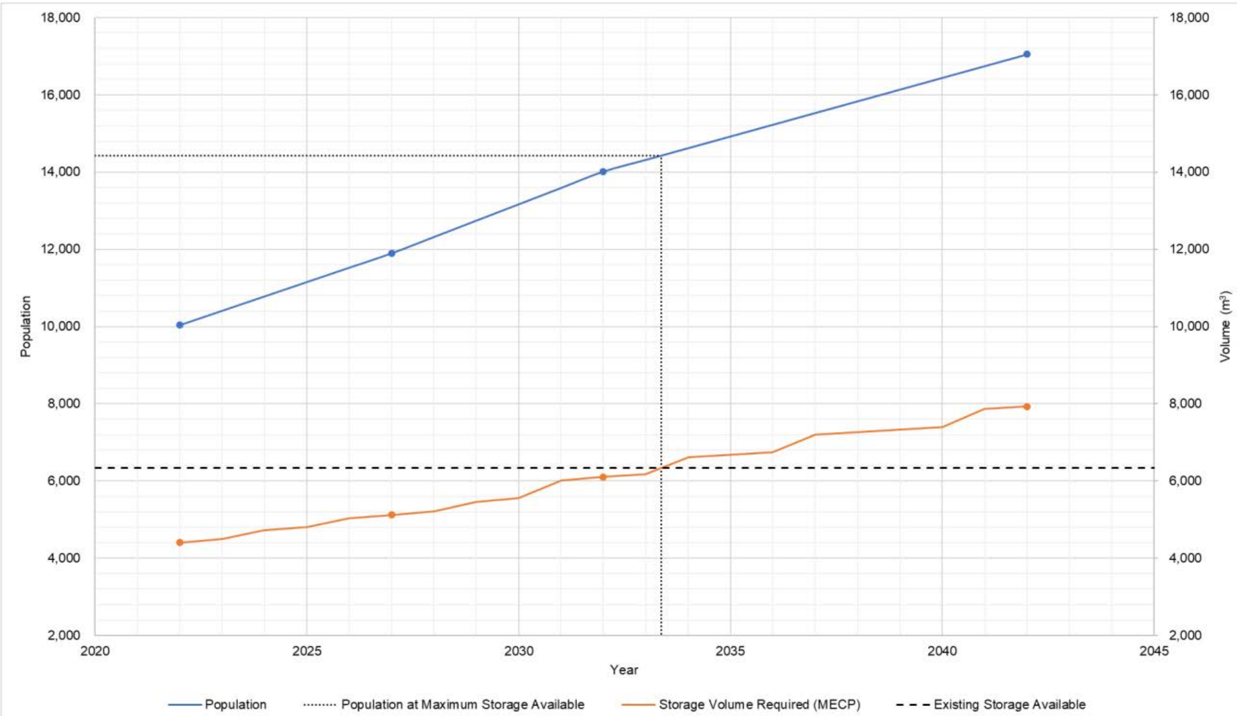


Figure 5-41: Potable Water Storage Requirements

5.5.2.4 Pumping

Assessment of the system's future pumping capacity is presented in **Table 5-33** and **Figure 5-42**. By assuming that 50% of the EST's operating volume would be available for fire flow conditions as described in **Section 5.2.2.3**, the existing high lift firm pumping capacity in conjunction with elevated storage is sufficient to supply total MXDY demand and fire flows that meet the MECP requirements until the end of 2034, or to a population of approximately 14,620 people. After 2034, an expansion of the HLPs' capacity will be required to accommodate future growth. By the end of 2042 (20-year planning horizon), the additional pumping capacity that will be needed is about 45 L/s.

Table 5-33: Future (Growth) Conditions Potable Water HLP Capacity Assessment

	Existing (2022)	5-Year Horizon (2027)	10-Year Horizon (2032)	20-Year Horizon (2042)
Population Projections (ppl)	10,038	11,899	14,016	17,050
Total MXDY Demand (L/s)	68.67	84.99	102.93	126.98

	Existing (2022)	5-Year Horizon (2027)	10-Year Horizon (2032)	20-Year Horizon (2042)
Fire Flow Required (Interpolated) (L/s)	189.00	209.67	227.50	250.00
Duration (Interpolated) (hrs)	3.00	3.00	3.25	4.00
Total MXDY Demand + MECP Fire Flow (L/s)	257.67	294.66	330.43	376.98
Pump Rated Capacity at WFP - Pump 1 (L/s)	125	125	125	125
Pump Rated Capacity at WFP - Pump 2 (L/s)	125	125	125	125
Pump Rated Capacity at WFP - Pump 3 (L/s)	125	125	125	125
Firm Pumping Capacity at WFP (L/s)	250	250	250	250
Existing Storage Available at EST (m^3)	2,365	2,365	2,365	2,365
% ’ operating volume that would be available for fire flow conditions	50%	50%	50%	50%
Available Fire Flow Supplied by EST (L/s)	109.49	109.49	101.07	82.12
Total Capacity: Fire Pumping Capacity at WFP + Available Fire Flow Supplied by EST (L/s)	359.49	359.49	351.07	332.12
Total Additional Pumping Capacity Required (L/s)	-	-	-	44.86

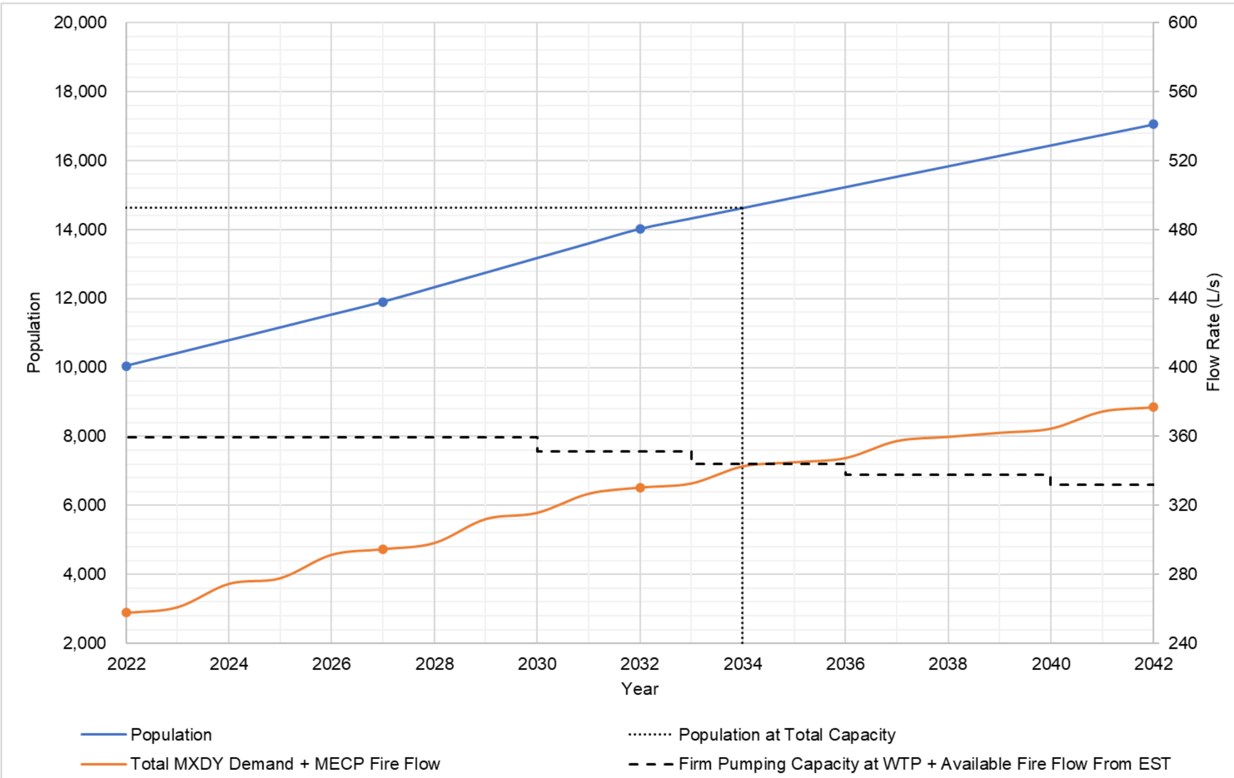


Figure 5-42: Potable Water HLP Requirements

5.5.2.5 Distribution Pipe Network

The existing water distribution network is assessed for the 5-year (2027), 10-year (2032), and 20-year (2042) planning horizons by applying future water demands for growth areas as described in **Section 5.4.2**. For future conditions, all hydraulic parameters of the EST and the reservoir and HLPs at the WFP remain unchanged as per **Section 5.1.2.1**.

Hydraulic model results for AVDY, MXDY, and MXDY + fire flow demand scenarios under future conditions are presented in **Appendix C.4**. AVDY and MXDY scenarios were simulated over an extended period of time (72-hr), while MXDY + fire flow scenarios were run in the steady-state assuming two HLPs are in service.

5.5.2.5.1 System Head / Pressures

Model results of maximum pressures throughout the water distribution system under AVDY demands are shown in **Figure C4-1** (2027), **Figure C4-4** (2032), and **Figure C4-7** (2042) in **Appendix C**. The results under future conditions show no new pressure issues with the additional demands from growth areas. The overall pressure range and pressure distribution in each planning horizon remain the same as per the existing conditions.

Model results of minimum pressures throughout the water distribution system under MXDY demands (at PKHR) are shown in **Figure C4-2** (2027), **Figure C4-5** (2032), and **Figure C4-8** (2042) in **Appendix C**. Hydraulic modelling shows minimum pressures ranging from 50 to 98 psi in the 5-year horizon (2027), 49 to 97 psi in the 10-year horizon (2032), and 49 to 98 psi in the 20-year horizon (2042), which are similar to the minimum pressure range under the existing conditions. For both the 2027 and 2032 conditions, the results show the EST operates between the typical operation range of about 60 to 80%. However, the EST operates between 54 to 80% full in 2042 conditions. Considering the lower water level in the EST under 2042 conditions, servicing strategies that are presented in **Chapter 3** (**Section 6**) include recommendations to add the operation of a second HLP. In terms of the overall pressure distribution, no minimum pressures less than 40 psi are observed. When compared to the existing conditions with no areas having minimum pressure below 50 psi, additional areas with minimum pressure slightly lower than 50 psi but greater than 40 psi are anticipated mainly near Vanjumar Dr / Russett Dr in both the 10-year and 20-year horizons.

5.5.2.5.2 Fire Flows

Model results of available fire flows at a residual pressure of 20 psi throughout the water distribution system under MXDY plus fire flow demands are shown in **Figure C4-3** (2027), **Figure C4-6** (2032), and **Figure C4-9** (2042) in **Appendix C**. No further issues with respect to available fire flows are identified under future conditions with the additional demands from growth areas. Locations having available fire flows less than 33.33 L/s in each planning horizon remain the same as those in the existing conditions.

5.6 Chapter 2 Conclusions

Chapter 2 presents the assessment of the Town's existing wastewater collection system and potable water distribution system under existing and future (growth) conditions, including the following discussions:

- Hydraulic model updates (Section 5.1);
- Assessment of existing hydraulic conditions (Section 5.2);
- Growth projections (Section 5.3);
- Future wastewater flows and water demands (Section 5.4); and,
- Assessment of existing infrastructure under future flows and demand conditions ("do nothing" alternative; **Section 5.5**).

The following are findings from the calibration and existing and future conditions wastewater collection system assessment, for consideration for servicing alternatives in **Chapter 3** (**Section 6**):

- Overall, the calibration resulted in acceptable DWF and WWF calibration to the periods and events evaluated. The calibrated parameters were therefore used for the existing and growth conditions assessments within this MP.
- HGL issues under the 25-year design event were identified along William St E (southeast of Daniel St), William St W (northwest of Daniel St), Russell St, Albert St, and Riverview Dr/Fourth Ave and Mulvihill Cr.
  - These HGL issues are indicative of potential sewer capacity constraints, however, most occur in locations with adverse or flat pipes, or pipes with inferred inverts. It is recommended that these inverts be confirmed prior to proceeding with the implementation of any solutions.
  - The issues along William St W, Russell St and William St E are expected to be eliminated by planned sewer separation projects and are therefore not further assessed as problem areas.
  - Other HGL issues (risks of basement flooding) are observed throughout the system, however these are due to shallow sewers rather than pipe capacity issues.

  - The results under future (growth) conditions do not show any new HGL issues due to the additional flows generated in the growth areas. The HGL issues identified under existing conditions remain.

- The PSs firm capacities (largest pump offline at each PS) were compared to the modelled incoming flow under DWF conditions and in the 10-year and 25-year design events.
  - Peak incoming DWF flows can be conveyed at all of the PSs under existing and growth conditions.
  - It was found that PS #1, PS #2 and PS #3 are at capacity under the 10-year and 25-year design event, such that backwater upstream of the PSs may occur, which could generate HGL issues within the sanitary collection system. The peak incoming flows to PS #1, PS #2, and PS #5 do not increase (i.e., no growth is expected upstream of these PSs), however the peak incoming flows to PS #3 under the 10-year and 25-year design events will increase in the 20-year horizon, as overall growth is expected east of the Madawaska River.
- The WWTP's peak hour flow (PHF) capacity was compared against the modelled incoming flow under DWF conditions and in the 25-year design event.
  - The modelled incoming flow under DWF conditions is within the WWTP's PHF capacity under existing and growth conditions.
  - The modelled incoming flow under the 25-year design event near the WWTP's PHF capacity, and a CSO is triggered at the Albert St/Victoria St weir. Under growth conditions, the peak modelled incoming flows to the WWTP and CSO volumes at the Albert St weir will further increase.
  - In general, it is expected that the Town's planned sewer separations will help reduce the peak flows to the WWTP and the bypass volumes at the Albert St CSO. Nonetheless, flows should be monitored as sewer separation projects are completed, to confirm the resulting reduction in flows.
  - While the model provides incoming flow and overflow results, the WWTP capacity assessment considers historical average daily flows and peak hour flows, which are compared against the corresponding CoA design flows. The peak hour flows in 2018-2022 were within the WWTP's peak hour design flow, which also supports that the WWTP did not experience capacity issues during this time period. This aligns with the conclusions based on the average

daily flows. Overall, the WWTP is expected to have capacity to service future growth within the MP's 20-year planning horizons. However, this should be confirmed by updating the WWTP's capacity assessment regularly (e.g., every 5 years), as growth occurs, and planned sewer separation projects are completed.

The following recommendations also arose from the wastewater collection system assessment, for consideration for solutions development and the next Master Plan update.

- Reviewing and confirming sewer invert profiles, such as in the sewer sections identified in the Chapter 1 Engineering Validation, in **Section 5.1.1.1.2** and **Section 5.2.1.2**;
- Confirming actual PS operations and conditions (on/off setpoints, current pump performance, pump and system curves, pump efficiency and head losses);
- Monitoring water consumption and wastewater flows downstream of high-water users to understand their sewage generation rates, such as the Nylene facility;
- Monitoring wastewater flows downstream of the Madawaska Village subdivision, upstream of PS #5, to confirm flows to PS #5;
- Continuously collecting PS wet well level and flow data;
- Providing frequent sewer flushing to reduce sediment and its impact on flow conditions;
- Validating the modelled existing conditions assessment findings against historical (anecdotal) evidence of WWTP and PS performance under large events, to confirm bypasses and overflows, and if any impacts on the sanitary collection system were observed under these conditions; and,
- Assessing multi-year diurnal flows to the WWTP and at other key locations within the system to understand the impact of changes in diurnal habits as they relate to land use.

The following are findings from the existing and future conditions potable water distribution system assessment, for consideration for servicing alternatives in **Chapter 3** (**Section 6**):

- When using the average of historical maximum demand from 2016 to 2021 while excluding all outlier flows due to watermain breaks, refilling of the EST, and reported clearwell issue, the WFP's rated treatment capacity of 10,340 m^3/d can supply the existing MXDY demand as well as future MXDY demand until the end of the year 2038 or when the projected population increases to about 16,130 people. To accommodate the projected population growth in the Town, additional treatment capacity would be required at the WFP prior to the 20-year planning horizon.
- The total capacity of 6,336 m^3 provided by the EST and clearwells at the WFP meets the storage need for the existing population and the projected population up to approximately 14,430 people or at the middle of the year 2033. Additional storage volume should be considered prior to the 20-year planning horizon.
- The existing high lift firm pumping capacity along with elevated storage (assuming 50% of the EST's operating volume available for fire flow conditions) is capable to supply total MXDY demand and fire flows that meet the MECP requirements for a population up to approximately 14,620 people or until the end of 2034. Thus, an expansion of the HLPs' capacity will be needed to accommodate future growth prior to the 20-year planning horizon.
- Issues related to pressures and fire flows were identified based on hydraulic modelling results.
  - Maximum pressures under AVDY demands in both the existing and future conditions:
    - Maximum pressures greater than 100 psi are observed in low-lying areas along the shorelines of the Ottawa River and Madawaska River.
    - Maximum pressures above 80 psi but below 100 psi are identified in lower elevation areas, northeast of Caruso St, Mary St, and Havey St, and north of the Canadian National Railway corridor.
  - Minimum pressures under MXDY demands (at PKHR):
    - Based on model results, the EST is shown to operate between 54 to 80% full, the lower end of which is just below the typical range of 60 to 80% (the EST typically operates between 60% to 80% full under existing conditions according to SCADA data).

  - Available fire flows at a residual pressure of 20 psi under MXDY plus fire flow demands in both the existing and future conditions:
    - Available fire flows less than 33.33 L/s are observed in areas generally serviced by a local watermain with size less than 150 mm in diameter and having only one connection to the water distribution system (i.e., no looping).
- Considering that the growth area RES37 at Van Dusen Dr (Tartan Homes) will serve more than 50 dwellings, a second feedermain should be provided to enhance reliability of water service to this area. Details of the second watermain required to feed the RES37 area should be investigated as part of solutions development.

The following recommendations also arose from the potable water distribution system assessment, for consideration for solutions development and the next Master Plan update.

- Conducting further calibration and validation for model fire flow using data from new hydrant tests to further improve the reporting of the available fire flows in the network, considering that the hydrant flow data currently used are from tests completed in 2018 which happened prior to network and demand changes due to recent development.
- Reviewing details of climate change analysis, as discussed in **Section 5.2.2.1.2**, to determine the scenarios of interest that will be assessed during solutions development.
- Reviewing and confirming the future conditions fire flow requirements for storage and pumping capacity assessment.
- Adding a second HLP to the system in the 2042 MXDY demand scenario to ensure the EST operating within the typical range of 60 to 80% full.

Following the findings presented herein, servicing alternatives are identified and assessed in **Chapter 3** (**Section 6**).

6 Chapter 3: Servicing Strategy

The purpose of **Chapter 3** is to present and evaluate strategies to address existing constraints and service projected growth. This report also assesses the serviceability of areas outside the Town's current boundaries.

6.1 Summary of Servicing Constraints

6.1.1 Wastewater Collection System Servicing Constraints

In this chapter, servicing alternatives are assessed based on problems identified in the 20-year horizon as summarized below:

- Collection system HGL issues and pipe capacity constraints in the following problem areas:
  - Problem Area PA-1 – Riverview Dr/Fourth Ave/Mulvihill Cr
  - Problem Area PA-2 –Daniel St
  - Problem Area PA-3 – Edward St
- PS capacity constraints at the following PSs:
  - PS #1
  - PS #2
  - PS #3

Additionally, this chapter addresses servicing of growth areas.

6.1.2 Potable Water Distribution System Servicing Constraints

In this chapter, servicing alternatives are assessed based on problems identified in the 20-year horizon as summarized below.

- Maximum pressures under AVDY demands:
  - Maximum pressures above 100 psi are identified in low-lying areas along the shorelines of the Ottawa River and Madawaska River.

  - Maximum pressures greater than 80 psi but less than 100 psi are observed in lower elevation areas, northeast of Caruso St, Mary St, and Havey St, and north of the Canadian National Railway corridor.

- Minimum pressures under MXDY demands [at peak hour (PKHR)]:

  - Based on model results, the EST is shown to operate between 54 to 80% full, the lower end of which is just below the typical range of 60 to 80% (the EST typically operates between 60% to 80% full under existing conditions according to SCADA data).

- Available fire flows at a residual pressure of 20 psi under MXDY plus fire flow demands:

  - Available fire flows below 33.33 L/s are observed in areas generally serviced by a local watermain less than 150 mm diameter in size with only one connection to the water distribution system (i.e., no looping).

Additionally, as discussed in **Chapter 2** (**Section 5**), details of the second watermain required to feed the growth area RES37 at Van Dusen Dr (Tartan Homes) would be investigated as part of solutions development in this chapter, in order to improve reliability of water service to this residential subdivision with more than 50 dwellings.

6.2 Evaluation Criteria

The proposed servicing alternatives for the wastewater collection and water distribution systems were assessed based on the criteria presented in **Table 6-1**.

Each alternative is qualitatively assessed against each criteria using a reasoned argument approach, according to the following 5-point scale:

- Very well aligned with criteria;
- Well aligned with criteria;
- Somewhat aligned with criteria;
- Not well aligned with criteria; and
- Low alignment with criteria.

Table 6-1: Evaluation Criteria

Criteria Category	Criteria	Criteria Indicators
1. Environmental	a. Protects Environmental Features	• Protect sensitive natural features and regulated areas. • Minimize the potential impact from construction and operation to existing terrestrial and aquatic habitats/features, species at risk, vegetation, wetlands, woodlots, and steep slopes. • Allow for scheduling and roll-out of construction activities in a way and at a time of year that would limit the negative impacts on the vegetation of the site and surrounding area.
	b. Protects Groundwater, Streams and Rivers	• Protect groundwater / surface water and meet *Clean Water Act* requirements. • Minimize sewage discharge to the environment during design conditions and mitigate spills during extreme rainfall. • Minimize impacts within Madawaska River and Ottawa River regulated areas.
	c. Minimizes Impact on Climate Change	• Minimize greenhouse gas (GHG) emissions and negative impacts on the landscape which may alter the ecosystems' ability to remove carbon dioxide from the atmosphere (e.g., changes vicinity plant cover). • Prioritize energy and water conservation and efficiency measures and/or adaptive re-use of buildings or structures to reduce new energy or material demands. • Evaluate contributions to or investments in natural spaces that offset or mitigate the alternative's climate change impacts.
2. Social/Cultural	a. Minimizes Long-Term Impacts to the Community Related to Noise, Odour, Traffic and Aesthetics	• Minimize noise, odour, and traffic affecting the community during system operation and maintenance. • Maintain access to, and aesthetics of, public spaces. • Minimize negative impacts that may result due to changes to the neighbourhood characteristics (e.g., recreational features, green space, property values).
	b. Minimizes Impacts to Businesses and Major Transportation Corridors	• Maintain access for businesses during construction and system operation. • Minimize potential negative effects on short-term and long-term business vitality, and community growth and development. • Minimize potential negative impacts on major transportation corridors and bus routes.
	c. Manages and Minimizes Short-Term Construction Impacts	• Minimize noise, odour, road closures, and truck traffic affecting the community during construction.
	d. Protects Health and Safety	• Minimize the potential risk to public health and safety, particularly on downstream users (including for recreation and tourism). • Minimize the potential risk to operator and maintenance staff health and safety.
	e. Protects Cultural Heritage Resources	• Minimize potential impact to cultural heritage resources.
3. Economic	a. Provides Low Lifecycle Costs	• Minimize capital, operation and maintenance (life cycle) costs over a 50-year period.
4. Technical	a. Meets Existing and Future Needs	• Addresses the existing system capacity constraints. • Mitigate the impact on level-of-service performance of existing infrastructure. • Meets the long-term capacity requirements to service the projected population growth to 2042.

Criteria Category	Criteria	Criteria Indicators
	b. Provides Ease of Maintenance	• Provide operational improvements to allow for safe and efficient maintenance activities. • Minimize increases in operational and/or maintenance complexity of the system.
	c. Aligns with Existing and Planned Infrastructure	• Optimize existing infrastructure investment. • Minimize requirement for upgrades/expansion to recent infrastructure. • Align with other planned infrastructure initiatives (Transportation, Stormwater Master Plans, Capital projects). • Ability to implement in a phased manner over time.
	d. Aligns with Existing and Future Land Use	• Evaluate need to acquire land for new/expanded utility corridors or facilities (pumping stations, storage tanks) including ownership requirements.
	e. Aligns with Efficient Approval and Permitting Process	• Minimize the complexity and time spent to obtain approvals from various regulatory agencies.
	f. Manages and Minimizes Construction Risks	• Minimize complexity of construction and maximize ability to maintain adequate water/wastewater servicing during construction.
	g. Ability to Adapt to Climate Change	• Promote resiliency to extreme weather events. • Prioritize climate change adaptation to minimize risk associated with variation in climate parameters (temperature, precipitation, wind gusts, or other) and natural hazards (flooding, high river levels, or other). • Prioritize the surrounding area's ability to be resilient and maintain its adaptive capacity to climate change.

6.3 Alternatives Development

Per the Municipal Class Environmental Assessment (MCEA) requirements, alternative solutions must be considered and evaluated. The following section presents the high-level servicing strategies. These strategies are evaluated in **Section 6.4** (against the criteria presented in **Section 6.2**), and the preferred alternative is further refined in **Section 6.5**.

6.3.1 Do Nothing

The *Do Nothing* alternative maintains the existing wastewater collection and water distribution system "as is". This alternative does not address system constraints [as identified in **Chapter 2** (**Section 5**)], however, it is included as a benchmark against which all other alternatives may be considered. A decision to *Do Nothing* may be made if the financial and environmental costs of all other alternatives outweigh the benefits. However, a *Do Nothing* approach does not allow for growth to occur beyond the existing potable water and wastewater system's capabilities, as it does not provide the infrastructure needed to meet future growth requirements projected in the Town's Official Plan.

6.3.2 I/I Reduction, Water Conservation and Re-Use

This alternative consists of implementing water conservation measures to reduce water consumption rates. Examples of water conservation measures include implementing a bylaw to control outdoor water use during the spring and summer months and establishing water re-use program to optimize the overall water use. The primary objective of water conservation measures is to reduce per capita water consumption from both the existing and future users; however, the efficiency of the measures would have to be verified with WFP data. In general, it is unlikely that water conservation measures will be sufficient to meet future demand needs without upgrading the existing potable water system.

The resulting reduced water usage is expected to reduce the volume of sanitary flows produced. However, the Town cannot rely on water efficiency measures alone to offset the larger contributing factor of wet weather infiltration and inflow (I/I). I/I remains a contributor to elevated flows during wet weather and during spring melt conditions, and PS bypasses and overflows at the Albert St CSO which have been reported. I/I reduction alone cannot resolve existing conveyance deficiencies nor offset future growth demands. Nonetheless, I/I reduction and mitigation is a prudent measure of collection system management that complements conveyance system upgrades, building in resiliency to uncertain implications of climate change.

6.3.3 Communal Potable Water and Wastewater Systems

Communal Systems are smaller systems that may be considered as an alternative to a larger municipal system, when certain constraints are identified where connections to an existing municipal system could be too costly to implement and operate.

6.3.3.1 Communal Wastewater Collection System

Communal wastewater collection systems consist of small diameter gravity sewers, pressure sewers and vacuum sewers. These alternative wastewater collection technologies are viable options where conventional sewers may be too costly to construct, operate and maintain. Typical conditions which could be beneficial for communal sewers include unserviced areas with very rocky, hilly terrain, and/or high ground water tables. However, these conditions are not applicable to the Town's municipal sewer system, which is centrally located and provides access to all development areas within the Town's municipal boundary. The Town's geological, hydrogeological and topographical conditions are appropriate for conventional sewers.

In terms of wastewater treatment, as reported in **Chapter 2** (**Section 5**), the Town's WWTP is expected to have capacity to service the growth projected in the current MP's planning horizons. The Town's WWTP is located centrally, and sewage flows can be conveyed by the wastewater collection network from all development areas within the Town's municipal boundary.

6.3.3.2 Communal Potable Water System

Communal potable water systems that utilize groundwater wells are typically considered in rural areas where the construction and operation of a municipal water system is not feasible due to specific constraints, such as cost and contaminated water source. In some cases, communal potable water systems might not supply the fire flow (i.e., fire protection would be provided by tanker and pumper truck), and therefore reduce the required pipe size and associated pumping and storage infrastructure. Considering the population density and the existing municipal water distribution system in the Town with good water source from the river, communal potable water systems that would require additional and unnecessary operations and maintenance are not deemed beneficial.

6.3.4 Partial Services Private/Communal and Municipal

Partial Services consist of a combination of municipal services, and private and/or communal services in different areas of the Town. Partial services have been considered in communities where implementing full municipal services is cost-prohibitive, and implementing full municipal services is not feasible within the foreseeable development horizon. However, where full municipal services are readily established and can be easily expanded to new developments, the implementation of partial services is not preferred.

6.3.5 Improvement and Expansion of the Municipal Potable Water Distribution and Wastewater Collection Systems

This servicing alternative consists of improving and expanding the existing municipal wastewater collection and potable water distribution, and treatment systems. Given the Town's size, projected growth, and outside interests, improving and expanding its existing systems are a reasonable alternative to meet future needs.

6.3.5.1 Improvement and Expansion of the Municipal Wastewater Collection System

Improving and expanding the existing wastewater collection system allows for an optimized use of existing infrastructure and provides a centrally located treatment process. This alternative includes considerations for upgrading and expanding the wastewater collection network, PSs and WWTP, to meet future growth needs.

6.3.5.2 Improvement and Expansion of the Municipal Potable Water Distribution System

The alternative of improving and expanding the existing potable water system would be a cost-efficient option which optimizes the use of existing infrastructure, including the water distribution network, the EST, and the centrally located WFP. Based on potable water system assessment results presented in **Chapter 2** (**Section 5**), upgrades and expansion of the existing municipal potable water system would be required to meet future growth requirements.

6.3.6 Other Alternatives

The following alternatives were also considered, but not further evaluated.

6.3.6.1 Limit Future Growth

The *Limit Future Growth* alternative essentially reduces or eliminates future wastewater and water servicing requirements by limiting collection system flow generation and water demands. This would involve limiting future residential, industrial, commercial and institutional growth and does not conform with the Town’s Official Plan long-term objective, “including continued business growth and support” needed as part of implementing the Province of Ontario’s Provincial Policy Statement (2014, replaced in 2020). Additionally, this alternative does not address system limitations under existing conditions. Therefore, this alternative was not further evaluated.

6.3.6.2 Private Well and Septic Servicing

The *Private Well and Septic Servicing* alternative consists of servicing future growth areas with private well and septic systems for each property. Private services can limit the potential to develop the surrounding land, as a wellhead protection area would need to be established, and the areas around a septic tank should remain clear. While private services would reduce the volume of sanitary flows, they would not address existing constraints due to I I. The Town’s current bylaws do no permit private well and septic servicing as a servicing strategy for new developments, with exceptions considered in specific instances. Private systems could be considered when a distant property wishes to develop prior to municipal services being readily available. Therefore, while private systems are not allowed from a master planning perspective (and are therefore not further evaluated), they could be considered on a case-by-case basis by the Town, as part of the alternative to provide *Partial Services Private/Communal and Municipal* (see **Section 6.3.4**).

6.4 Alternatives Evaluation

The alternatives identified in **Section 6.3** are evaluated against the criteria outlined in **Section 6.2**, for each of the wastewater collection and water distribution systems.

6.4.1 Wastewater Collection System Alternatives Evaluation

The following sub-sections summarizes the assessment of each criterion outlined in **Section 6.2**, for the wastewater collection system. A detailed evaluation table for the wastewater collection system is presented in **Appendix D.1**.

6.4.1.1 Wastewater Collection System Alternatives Evaluation - Environmental

The *Communal Systems*, *Partial Services* and *Improvement and Expansion of Existing Municipal Systems* alternatives are expected to have the largest impact on environmental features and lead to an increase in GHG emissions due to construction requirements. Furthermore, these alternatives could also require the removal of trees, which could be replanted to renew the resources. The *Do Nothing* alternative is expected to have no impact on environmental features compared to existing conditions. The *I/I Reduction, Water Conservation and Re-Use* alternative has the potential to reduce the flows into the Town's systems. Limiting future growth is expected to have a minor impact on environmental features due to reduced development.

6.4.1.2 Wastewater Collection System Alternatives Evaluation - Social/Cultural

The *Do Nothing* alternative has high potential for negative effects on long-term business vitality, community growth and development as existing infrastructure does not have sufficient capacity to accommodate future demands and flows.

I/I Reduction, Water Conservation and Re-Use measures have the potential to lessen the servicing needs and extend the lifecycle of existing infrastructure. Since the Town's wastewater collection system is partially separated, it is expected that activities such as sewer separation could contribute to I/I reduction, however this would have to be confirmed with further monitoring. Implementing private or communal servicing, and improvements to the existing infrastructure are expected to have the highest social/cultural impact related to construction projects. These construction projects would be short-term in duration; however, it is expected that new facilities would result in an increased operational and maintenance activity requirements.

6.4.1.3 Wastewater Collection System Alternatives Evaluation - Economic

The *Do Nothing* alternative does not involve any capital costs, however there is potential for increased lifecycle costs due to system aging and replacement/emergency needs.

I/I Reduction would conceptually require limited cost (when compared to infrastructure needs for the *Communal Systems, Partial Servicing, and Improvement and Expansion of the Existing Municipal Systems* alternatives). The potential gain from this alternative is not expected to be significant by comparison but is part of an overall strategic approach to improved system management that may help to defer capital projects should significant public I/I sources be found with a direct mitigation measure of smaller scale.

Improvement and expansion of the existing system is expected to have major capital costs. Along with *Communal Systems* and *Partial Servicing,* these alternatives have the potential for cost sharing with developers. Furthermore, higher long-term costs are expected if new PSs are built, operated, and maintained.

6.4.1.4 Wastewater Collection System Alternatives Evaluation - Technical

The *Do Nothing* and *I/I Reduction* alternatives are all the easiest to implement. They all however significantly do not meet the technical requirements and are therefore not satisfactory within the context of satisfying the Town's long-term servicing needs.

6.4.1.5 Wastewater Collection System Alternatives Evaluation - Servicing Evaluation Summary

Of the alternatives assessed, *improving and expanding the existing system* is the only one that can meet the future requirements for the system while meeting the Town's Official Plan objective of "continued business growth and support". Therefore, this was carried forward to be further refined in **Section 6.5**.

I/I reduction and mitigation measures are proposed to complement the recommended solution in areas where they could be beneficial, however, their impact would need to be confirmed through further monitoring. The full evaluation of the wastewater servicing alternatives is provided in **Appendix D.1**.

6.4.2 Potable Water Distribution System Alternatives Evaluation

The assessment of the potable water distribution system alternatives based on criteria listed in **Section 6.2** is summarized in sub-sections below. Refer to **Appendix D.2** for a detailed evaluation table for the potable water distribution system.

6.4.2.1 Potable Water Distribution System Alternatives Evaluation – Environmental

The *Do Nothing* alternative is expected to have no impact on the existing environment as no new construction/upgrades to the potable water system are proposed. The *Water Conservation and Re-Use* alternative is expected to have minor impacts on fish and fish habitats considering potentially reduced water taking, as well as impacts on GHG emissions due to water conservation and re-use measure.

The *Communal System*, *Partial Servicing*, and *Improvement and Expansion of Existing Municipal System* alternatives are considered to have greater impacts on environment as construction/upgrades are required. Some negative impacts on environmental features due to these four alternatives could be minimized by various means, such as replanting of removed trees.

6.4.2.2 Potable Water Distribution System Alternatives Evaluation – Social/Cultural

The *Do Nothing* alternative is anticipated to have high negative impacts on long-term business vitality, community growth and development since the existing potable water system is unable to accommodate future growth needs under 2042 conditions based on the assessment presented in **Chapter 2** (**Section 5**).

The remaining five alternatives all involve new construction which lead to short-term impacts on the residents and communities. While the *Water Conservation and Re-Use* alternative has low potential to meet community growth and development, the *Communal System*, *Partial Servicing*, and *Improvement and Expansion of Existing Municipal System* options are expected to have greater ability to accommodate future growth with new or upgraded infrastructure. However, it should be noted that the ability to meet future demand needs for the *Communal System*, and *Partial Servicing* alternatives is limited depending on groundwater supply regarding quantity and quality. Furthermore, aquifers that service the groundwater wells would have to be protected which restricts the types of development that could be built.

6.4.2.3 Potable Water Distribution System Alternatives Evaluation – Economic

The *Do Nothing* alternative is expected to have the lowest costs as it involves only operation and maintenance costs but no capital cost. The *Water Conservation and Re-Use* alternative would require relatively low capital costs to initiate water conservation program, along with operation and maintenance costs for the existing potable water system. It is anticipated that the operation and maintenance costs for these three options would increase over time due to system aging and emergency needs.

The other four alternatives involving new construction would have higher capital costs. Operation and maintenance costs are also required for these alternatives. When comparing to the *Improvement and Expansion of Existing Municipal System* alternative, the *Communal System* and *Partial Servicing* options are expected to have greater long-term costs to operate and maintain the new facilities.

6.4.2.4 Potable Water Distribution System Alternatives Evaluation – Technical

The *Do Nothing* and *Water Conservation and Re-Use* alternatives are all simple options involving little to no construction. However, they are unable to address existing constraints or meet long-term capacity requirements to service the projected population growth. The *Communal System* and *Partial Servicing* options that utilize groundwater as the source, have the potential capability to accommodate future growth needs, but would depend on the quantity and quality of groundwater supply. Additionally, water taking from aquifers could increase vulnerability to drought which reduces the ability to adapt to climate change. As for the *Improvement and Expansion of Existing Municipal System* alternative, it has the ability to address existing constraints and meet future demand needs while aligning with planned infrastructure initiatives.

6.4.2.5 Potable Water Distribution System Alternatives Evaluation – Servicing Evaluation Summary

According to the evaluation table for potable water servicing alternatives presented in **Appendix D.2**, the *Improvement and Expansion of Existing Municipal System* alternative is the most aligned with criteria. Therefore, it was carried forward for further evaluation.

6.5 Refined Alternatives

The following section presents the refined alternatives for the wastewater collection and water distribution system servicing strategies, with the intent of developing the implementation plan which is presented in **Chapter 4** (**Section 0**).

6.5.1 Refined Alternative – Improvement and Expansion of the Wastewater Collection System

Improvements to the wastewater collection system consist of upgrades to existing infrastructure (sewers, PSs) to accommodate projected flows. Expanding the system consists of identifying new trunk sewers and PSs to service areas which cannot be directly serviced by the existing system.

6.5.1.1 Refined Alternatives – Improvements to Existing Sewers

The *Improvement of the Municipal Wastewater Infrastructure* for the sewer collection system involves the implementation of capital projects such as upgraded sewers, twinned sewers, inline/offline storage, and/or modifications to existing infrastructure to both address existing constraints and meet the needs to future growth. In most cases, the approach identifies a gravity solution (i.e., a new or upgraded new sewer) as preferred to one requiring a new pumping station and accompanying forcemains. This is due to a range of benefits (overall) from environmental, social/cultural, economic, technical, and financial perspectives.

In general, improvements to the Town's existing wastewater collection system by replacing/upgrading sewers is the preferred approach for local system deficiencies. Nonetheless, the conceptual replacement/upgrade strategy presented herein should be confirmed during detailed design, during which the following should be further investigated:

- Confirm feasible and preferred alignments;
- Confirm that design guideline requirements with respect to depth of cover, velocities, and other criteria are met;
- Identify whether twinning, or inline/offline storage should be implemented; and
- Identify potential conflicts with other utilities.

6.5.1.1.1 Problem Area PA-1 – Riverview Dr/Fourth Ave/Mulvihill Cr Upgrades

PA-1 consists of 300 mm to 450 mm diameter sewers along Mulvihill Cr, Riverview Dr, and Fourth Ave. The peak HGL profile under 2042 25-year design event conditions is shown in **Figure 6-1**. No projects from **Table 5-27** are planned upstream of PA-1, which will have an impact on the future flows.

Under the refined alternative (Existing system improvements), the following is recommended to increase sewer capacity and eliminate HGL issues, as shown in **Figure 6-2:**

- **SEW-PA1-A)** Confirm the inverts along Riverview Dr with a topographical survey;
- **SEW-PA1-B)** Increase slopes to address existing adverse and flat sewer inverts along 316 m of 450 mm diameter sewers along Riverview Dr;
- **SEW-PA1-C)** Upgrade 356 m of 300 mm and 375 mm diameter sewers to 525 mm along Riverview Dr;
  - While not surcharged, the 204 m of 300 mm diameter sewers along Riverview Dr from Second St to Madawaska Blvd should be upsized to provide continuity in the diameters, and avoid new downstream capacity issues as the upstream sewers’ capacity is increased.

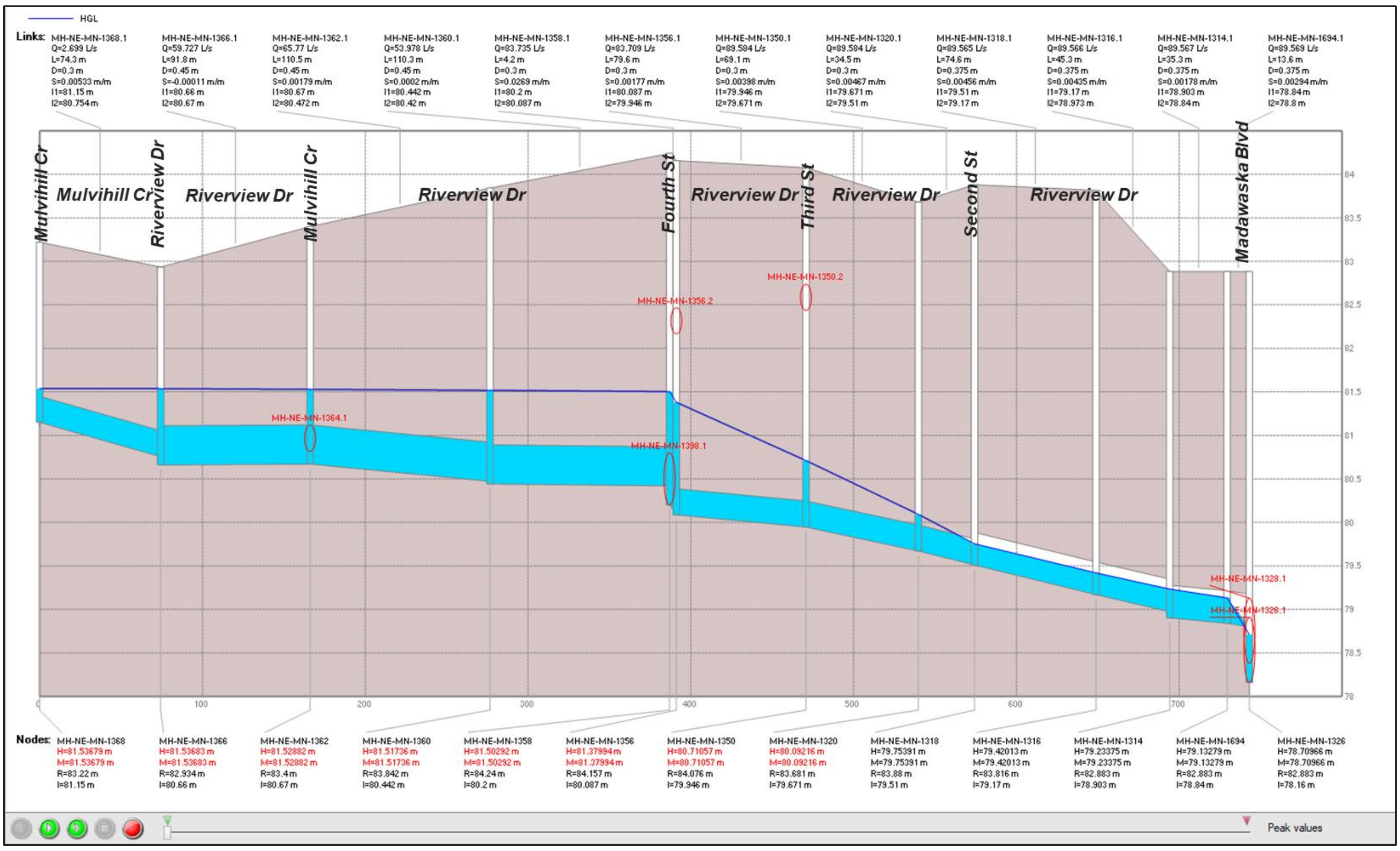


Figure 6-1: Problem Area PA-1 - 2042 Conditions 25-Year Event Peak HGL Profile (Existing Infrastructure, with Planned Sewer Separations and Edey St Redirection)

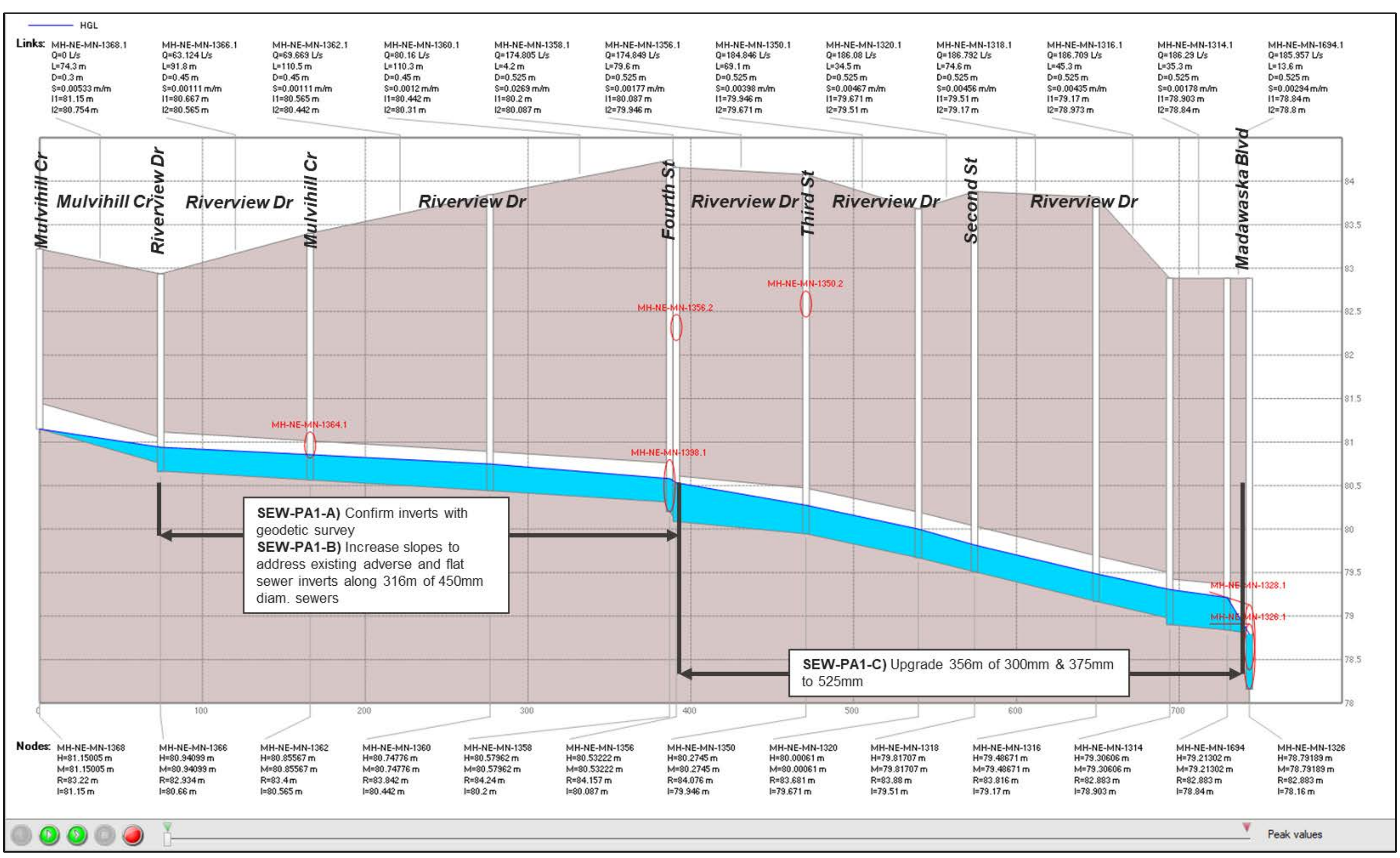


Figure 6-2: Problem Area PA-1 - 2042 Conditions 25-Year Event Peak HGL Profile (Post-Upgrade)

6.5.1.1.2 Problem Area PA-2 - Daniel St/Albert St Upgrades

PA-2 consists of 600 mm diameter sewers along Daniel St and Albert St. The peak HGL profile under 2042 25-year design event conditions with future (planned) projects (sewer separations, Edey St redirection) is shown in **Figure 6-3**.

Under the refined alternative (Existing system improvements), the following is recommended to increase sewer capacity and eliminate HGL issues, as shown in **Figure 6-4**:

- **SEW-PA2-A)** Upgrade the sewers along Daniel St and Albert St as follows:
  - SEW-PA2-A1: Upgrade 66 m of 600 mm diameter sewers to 675 mm along Daniel St from south of Madawaska St to Madawaska St., and
  - SEW-PA2-A2: Upgrade 198 m of 600 mm diameter sewers to 675 mm along Daniel St/Albert St from Madawaska St to Victoria St.
    - This section overlaps with the Town’s planned project to upgrade the Albert St sewers from McEwen St to Madawaska St (project SEW-FUT-6 in Table 5-27). The sizing proposed herein can be used to inform the next stages of planning and design of this project.

Additionally, PA-2 is also identified as a problem area under climate change conditions in **Section 6.7.1.1.1**. Recommended sewer upsizing to consider climate change are therefore presented.

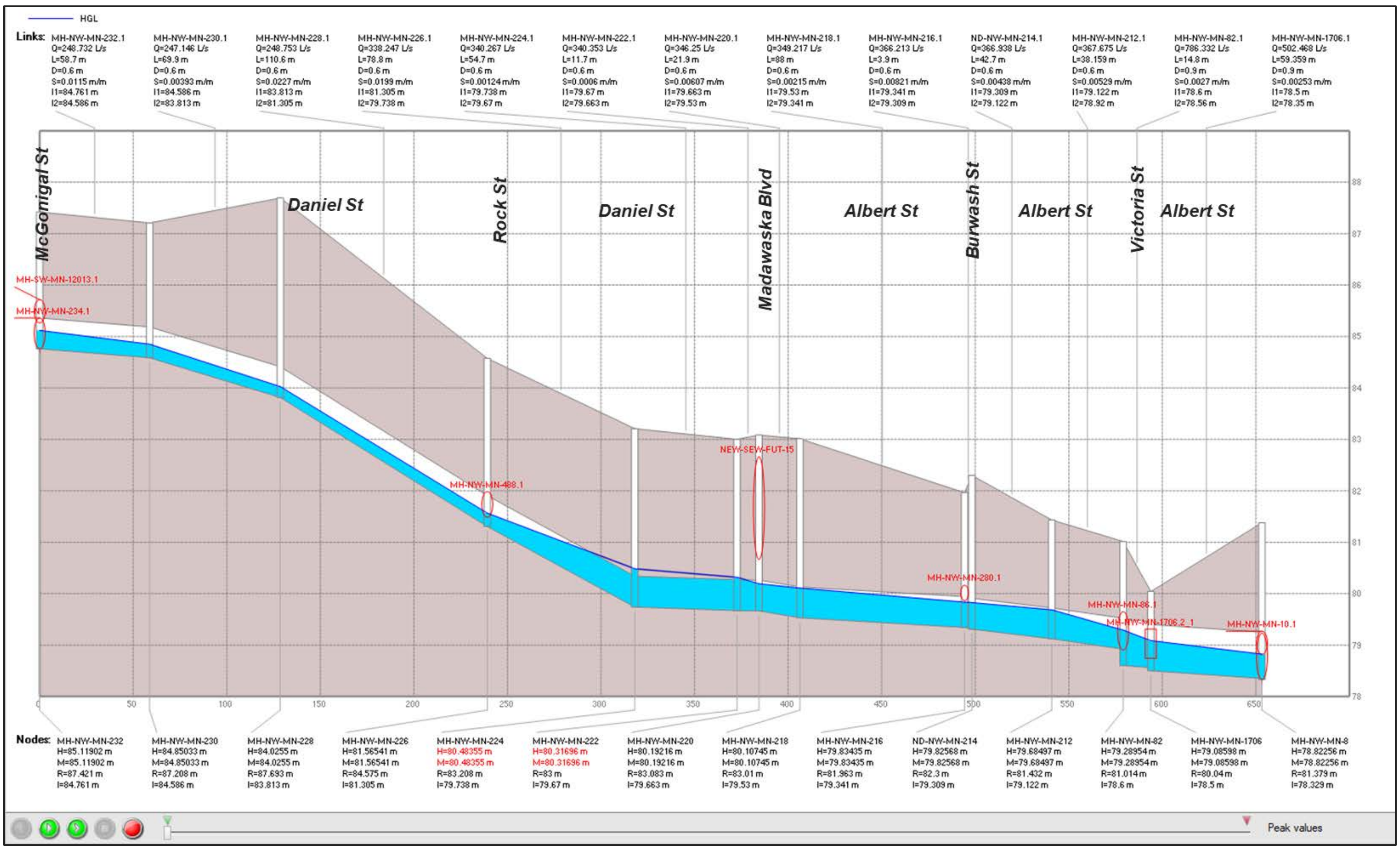


Figure 6-3: Problem Area PA-2 - 2042 Conditions 25-Year Event Peak HGL Profile (Existing Infrastructure, with Planned Sewer Separations and Edey St Redirection)

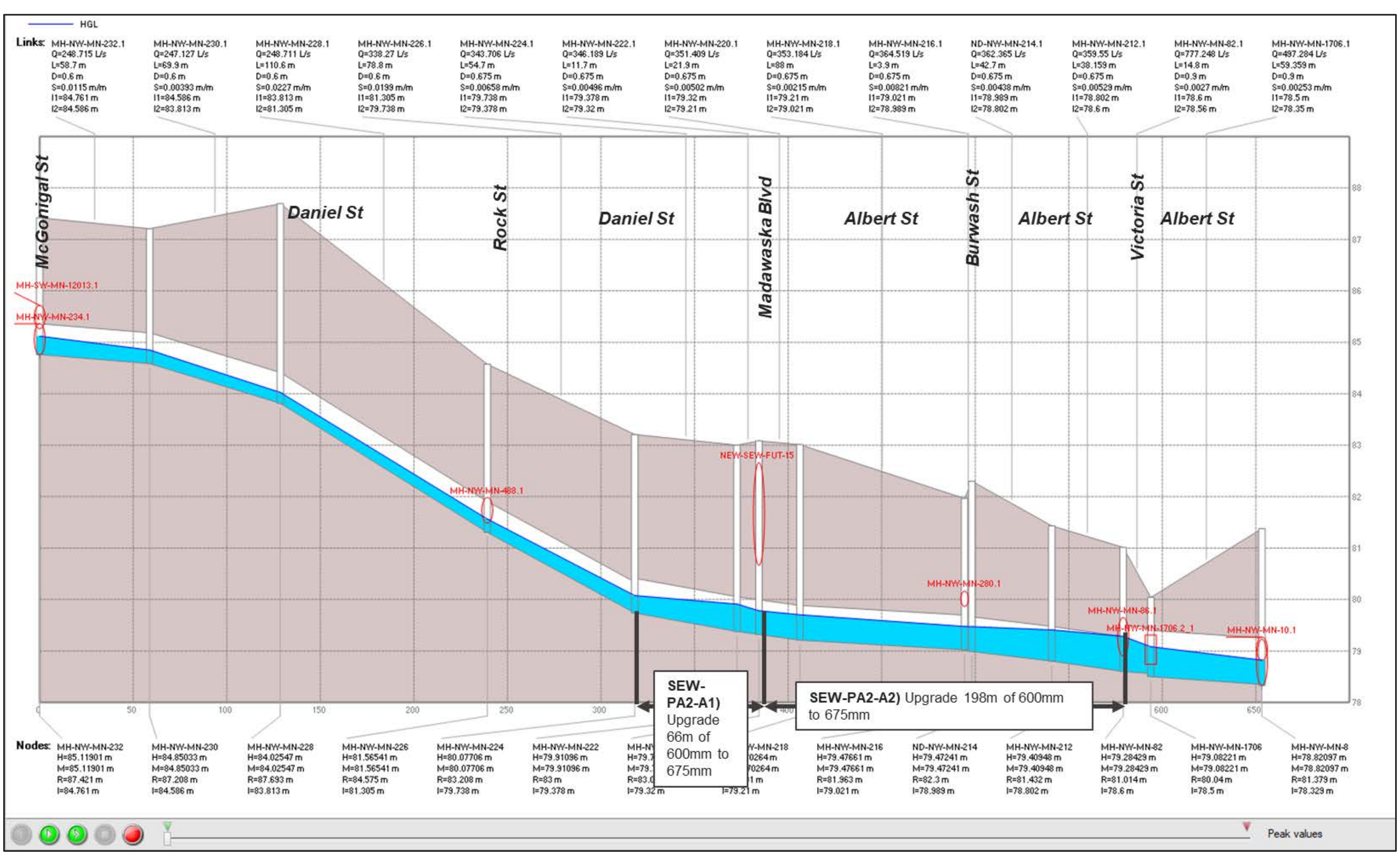


Figure 6-4: Problem Area PA-2 - 2042 Conditions 25-Year Event Peak HGL Profile (Post-Upgrade)

6.5.1.1.3 Problem Area PA-3 - Edward St

PA-3 consists of 200 mm diameter sewers along Edward St. The peak HGL profile under 2042 25-year design event conditions with future (planned) projects (sewer separations, Edey St redirection) is shown in **Figure 6-5**.

Under the refined alternative (Existing system improvements), the following is recommended to increase sewer capacity and eliminate HGL issues, as shown in **Figure 6-6:**

- **SEW-PA3-A)** Confirm the inverts along Edward St with a topographical survey;
- **SEW-PA3-B)** Upgrade 112 m of 200 mm diameter sewers to 250 mm along Edward St.

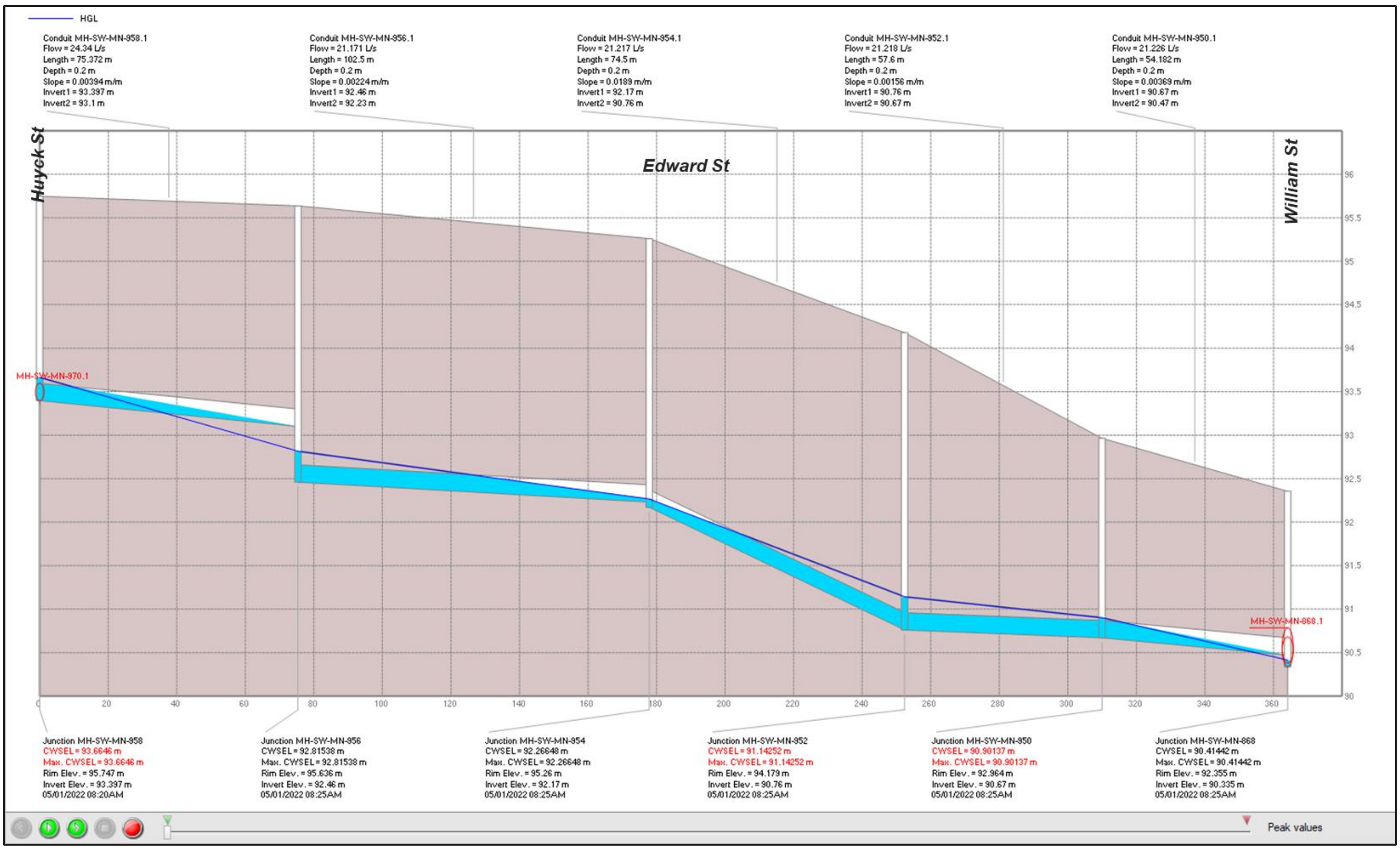


Figure 6-5: Problem Area PA-3 - 2042 Conditions 25-Year Event Peak HGL Profile (Existing Infrastructure, with Planned Sewer Separations and Edey St Redirection)

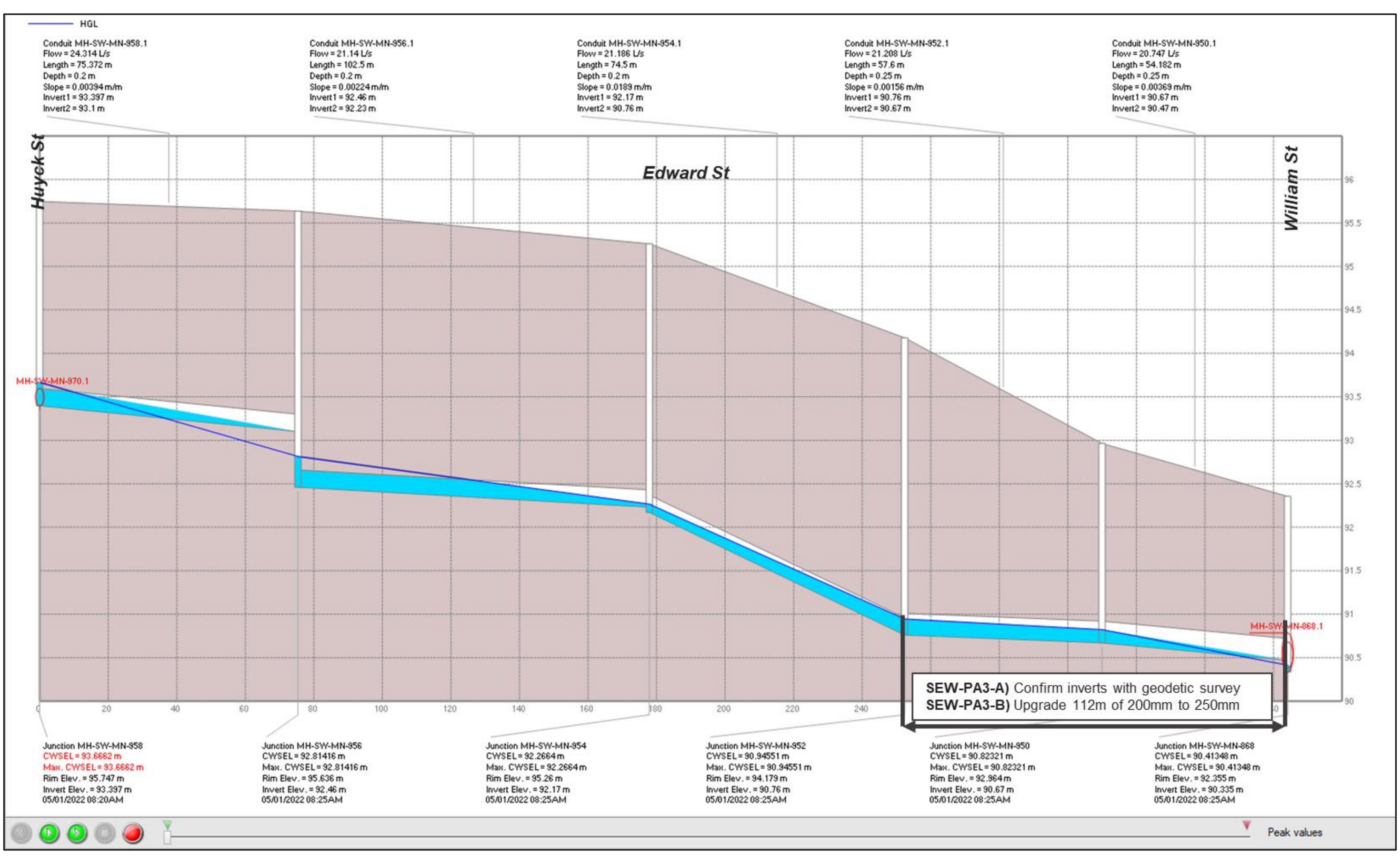


Figure 6-6: Problem Area PA-3 - 2042 Conditions 25-Year Event Peak HGL Profile (Post-Upgrade)

6.5.1.2 Refined Alternatives – Improvements to Existing Pumping Stations

The *Improvement of the Municipal Wastewater Infrastructure* for the PSs involves the upgrades to existing PS facilities to both address existing constraints and meet the needs to future growth.

6.5.1.2.1 Post-Upgrade Flows to Pumping Stations

Following the sewer upgrades presented in **Section 6.5.1.1**, more flow can be conveyed downstream. This will result in an increase in the flows modelled at the PSs. For the improvements to the existing PSs, the flows considering the upstream sewer upgrades are used to size the required upgrade. The modelled peak incoming flows are presented in

Table 6-2. The results with the proposed sewer upgrades are also inclusive of the Town's planned sewer separation and Edey St redirection projects presented in **Table 5-27**. For PS #1, the flows with and without the upstream sewer separations are reported, as their efficacy in reducing peak flows should first be confirmed with monitoring once sewer separation is completed.

The main impact of the sewer upgrade recommendations is on the peak incoming flows to PS #3, which are projected to increase once the proposed upgrades along PA-1 on Riverview Dr are implemented (see **Section 6.5.1.1.1**) and more flows are conveyed downstream.

The recommended design event per the MECP guidelines is the 10-year design event.

Table 6-2: 2042 Peak Incoming Flows to PSs (Pre- and Post-Upgrades)

Name	**PS #1**	**PS #2**	**PS #3**	**PS #5**
Location	**Elgin St E at Claude St**	**McNab St at Seventh Ave**	**Madawaska Blvd, west of Bridge St**	**Wolff Cres**
Number of Pumps at PS	2	2	3(1)	2
Firm Capacity (Largest Pump Out of Service) (L/s)	25	59	275	7
20-Year Horizon (2042) Peak Modelled Incoming Flow (L/s) with Existing Infrastructure Only *with Planned Projects*(1)				
10-Year Design Event: Original (No Upgrades)	81, *44*	71, *71*	306, *306*	5.4, *5.4*
10-Year Design Event: With Proposed Sewer Upgrades(2)	81(3), *44*	*71*	*371*	*5.4*
25-Year Design Event: Original (No Upgrades)	96, *53*	84, *84*	338, *338*	6.1, *6.1*
25-Year Design Event: With Proposed Sewer Upgrades(2)	96(3), *53*	*84*	*436*	*6.1*

Notes:

(1) Future (planned) projects presented in **Table 5-27**.
(2) Proposed sewer upgrades presented in **Section 6.5.1.1**.
(3) Without upstream sewer separation (project SEW-FUT-8 in **Table 5-27**).

6.5.1.2.2 PS #1

The modelled flows to PS #1 exceed the PS's firm capacity under existing and future 10-year and 25-year design event conditions. Furthermore, the PS has bypassed twice between 2017 and 2022 due to heavy precipitation, as well as during the high-intensity rainstorm of September 7th, 2023. The following is therefore recommended, to address the PS capacity constraints identified:

- **PS1-A)** Undertake combined sewer separation activities planned upstream of PS #1 (see project SEW-FUT-8 in **Table 5-27**) and in the areas draining to Russell St and Elgin St (east of Daniel St; see project SEW-FUT-9 in **Table 5-27**)
- **PS1-B)** Monitor flows upstream and downstream of PS #1 and update the Town's model to reflect.
- **PS1-C)** Should the projected flows still exceed the PS #1 capacity, an upgrade to PS #1 should be undertaken.
  - Under a scenario without the combined sewer separation planned in PS1-A, PS #1 should be upgraded to accommodate peak incoming flows of 81 L/s under the 10-year design event for a 20-year planning horizon, per the MECP guidelines.
  - With the combined sewer separation planned in PS1-A, PS #1 should be upgraded to accommodate peak incoming flows of 44 L/s under the 10-year design event.
  - The PS #1 upgrades were costed in **Chapter 4** (**Section 0**), assuming that a PS capacity expansion within the existing PS footprint is feasible. However, a study will be required to determine the required extent of the PS expansion, and whether the expansion will be an exempt project, or a Schedule B or C project.

6.5.1.2.3 PS #2

The modelled flows to PS #2 exceed the PS's firm capacity under existing and future 10-year and 25-year design event conditions. However, there were no bypasses here during the events that caused these elsewhere between 2017 to 2022.

The bypass history therefore does not support a PS upgrade recommendation in the short-term. Furthermore, the PS is located downstream of the Nylene facility, for which a peak DWF contribution of 5.8 L/s was modelled [which is comparable to the average water consumption of 7.1 L/s (666 m^3/d) reported in **Chapter 2** (**Section 5**)]. The Town has noted that water consumption for the Nylene facility has been decreasing, which could also be reflected in the sewage flows. Therefore, the following is recommended to further characterize the flows from the Nylene facility and to PS #2:

- **PS2-A)** Monitor upstream flows and review the PS #2 capacity based on updated flow monitoring data. Update the Town's model as warranted.
- **PS2-B)** Should the updated projected flows still exceed the PS #2 capacity, an upgrade to PS #2 should be undertaken.
  - Under the current flow projections, PS #2 should be upgraded to accommodate peak incoming flows of 71 L/s under the 10-year design event for a 20-year planning horizon, per the MECP guidelines.
  - The PS #2 upgrades were costed in **Chapter 4** (**Section 0**), assuming that a PS capacity expansion within the existing PS footprint is feasible. However, a study will be required to determine the required extent of the PS expansion, and whether the expansion will be an exempt project or a Schedule B or C project.

6.5.1.2.4 PS #3

The modelled flows to PS #3 exceed the PS's firm capacity under existing and future 10-year and 25-year design event conditions. Furthermore, the PS #3 bypass history reports annual bypasses between 2020 and 2022 due to heavy precipitation/snowmelt, including a total of 3 bypasses in 2022, as well as during the high-intensity rainstorm of September 7th, 2023. Unlike PS #1, PS #3 is located downstream of separated areas, therefore the increase in I/I during wet weather events may be due to roof drains from the upstream ICI areas, or other potential cross-connections. Additionally, the WWF calibration was completed using flow monitoring data collected upstream of PS #3 during an event with a return frequency of approximately 1:2 year, which may lead to high flows when extrapolated to a 10-year event. Recommendations are therefore made to prioritize establishing confidence in the design basis of PS #3. Finally, the Town has noted the lack of reliability of the single sewage forcemain from PS #3 to the WWTP.

The following is therefore recommended, to address the PS capacity constraints identified:

- **PS3-A)** Investigate and address sources of I/I upstream of PS #3.
  - Examples of I/I investigation measures include: Micromonitoring, CCTV inspections, smoke testing, MH inspections.
  - Proceed with mitigation of I/I sources to remove these from the flows received at PS #3.
- **PS3-B)** Continue flow monitoring upstream of PS #3 to assess the efficacy of I/I reduction measures and capture the response under a variety of larger WWF events.
- **PS3-C)** Upgrade PS #3 to accommodate peak incoming flows of 371 L/s under the 10-year design event for a 20-year planning horizon, per the MECP guidelines.
  - The PS #3 upgrades were costed in **Chapter 4** (**Section 0**), assuming that a PS capacity expansion within the existing PS footprint is feasible. However, a study will be required to determine the required extent of the PS expansion, and whether the expansion will be an exempt project or a Schedule B or C project.
  - The requirement and extent of the upgraded needed will depend on the following:
    - Upstream I/I investigation (**PS3-A**) and reduction measures (**PS3-B**): It is possible that the removal of the I/I from the upstream system would be adequate to negate the need for a PS upgrade.
    - Sewer upgrades along Riverview Dr (**SEW-PA-1C**): Undertaking those sewer upgrades would allow flows to be conveyed downstream, possibly increasing peak flows to PS #3.
- **PS3-D)** Twin the existing sewage forcemain from PS #3 to the WWTP with a new 260 m long 350 mm diameter forcemain.

Since the PS #3 forcemain also discharges directly upstream of the WWTP, an increase in the PS #3 capacity will lead to an increase in the flows conveyed to the WWTP. As discussed in **Chapter 2** (**Section 5**), the WWTP capacity is assessed on the basis of historical average day and peak hour flows, rather than on modelled instantaneous flows. It is therefore recommended that, as PS #3 upgrades are implemented, the flows to the WWTP be reviewed against its capacity (see recommendation WWTP-5 in **Section 6.5.1.3**).

6.5.1.2.5 PS #5

The modelled flows to PS #5 are within the PS's firm capacity under existing and future 25-year design event conditions. PS #5 has not bypassed based on the records provided. As discussed in **Chapter 2** (**Section 5**), it was found that the FM 5 WWF parameters were not applicable to the areas upstream of PS #5, since these parameters were averaged over a large metershed comprising ICI areas with potential cross-connections, generating a high WWF response. Instead, the FM 1 parameters were applied to the areas upstream of PS #5. While no PS upgrades are recommended for PS #5, the following is recommended to further characterize the flows to PS #5:

- **PS5-A)** Monitor upstream flows and review the PS #5 capacity based on updated flow monitoring data and modelling results.

6.5.1.3 Refined Alternatives – WWTP

Capacity constraints at the WWTP were not identified under existing nor future growth conditions [see **Chapter 2** (**Section 5**)]. A historical downward trend in average flows to the WWTP has been observed, due to decreased water consumption at the Nylene facility and the elimination of watermain dead-end flushers continuously discharging into the sanitary sewers (replaced with bi-weekly hydrant flushing and looping of dead-end watermains). This trend is expected to stabilize with growth, as population increases while water consumption decreases.

As presented in **Table 5-6**, overflows at the Albert St weir and CSO have been observed yearly between 2016 and 2022 due to heavy precipitation events and snowmelt. An overflow was also observed during the high-intensity rainstorm of September 7th, 2023. Per the WWTP CoA and Town operations, these overflows constitute WWTP bypasses, which are triggered when levels in the WWTP inlet channel exceed 900 mm. While the occurrence of these overflows is not used as a measure for the WWTP capacity, and it is understood that these are reported to the MECP, the Town could consider further assessment to ensure the MECP's F-5-5 guidelines for the *Determination of treatment requirements for municipal and private combined sewage systems* are met.

Therefore, from an overall WWTP capacity perspective, the following is recommended:

- **WWTP-1)** Maintain activities to reduce I/I into the sanitary collection system;
- **WWTP-2)** Develop criteria to monitor and further assess the Albert St CSO, e.g., using the MECP's F-5-5, which notably includes (but is not limited to) the following criteria:
  - Maximizing flows to the WWTP when capacity is available; and,
  - Establishing a volumetric control criterion, composed of capturing and treating the average DWF + 90% of the WWF volume, during the period from April to October.
- **WWTP-3)** Continuously update the WWTP committed capacity assessment, as new development interests are identified; and,
- **WWTP-4)** Monitor the impact of upstream infrastructure upgrades on incoming flows to the WWTP.

From a treatment process perspective, the 2020 Stantec study on the Town's total nitrogen issues recommended the following:

- **WWTP-5)** Plan for the addition of an anoxic zone to improve pH control and support nitrification in the shoulder seasons.
- **WWTP-6)** Undertake a study of the organic and solids loading to the WWTP versus loading capacity.
  - Measured loads based on 2019 data used for the 2020 Total Nitrogen study suggest that the WWTP may be near its loading capacity. It is common to find that loads to WWTPs increase faster than the flows to the WWTP with the implementation of water-saving fixtures and appliances. However, the reported sludge production rate does not support this finding. This discrepancy should be resolved to confirm the remaining load capacity of the WWTP.

6.5.1.4 Refined Alternatives – Expansion of Existing Wastewater Collection System

The *Expansion of the Existing Wastewater Collection System* alternative consists of new trunk sewers, PSs and forcemains which will connect to the existing network, to service new growth areas. The following sub-sections identify the new infrastructure needed to expand the existing wastewater collection system.

6.5.1.4.1 Direct Servicing of Growth Areas

Based on a review of the projected growth areas' proximity to the existing sewer collection network, most growth areas can be directly serviced from the adjacent local or trunk sewers, such that the existing wastewater collection system would not require expansion to service these areas. **Table 6-3** lists the feasible direct wastewater servicing connections for each growth area, with additional considerations and alternative servicing options which could be explored at a detailed design stage. Where available, information provided by the Town on planned servicing from ongoing development applications was also considered.

The trunk sewer residual capacities are illustrated in **Figure 6-11** for the 2042 growth conditions with the planned projects (sewer separations, Edey St redirection) presented in **Table 5-27** and the solutions presented in **Section 6.5.1.1**. The growth areas were already considered as part of the growth assessment and refined alternatives to improve the wastewater collection system. However, local (non-modelled) residual sewer capacities were not confirmed as part of this Master Plan. It is recommended that local and trunk sewer capacities be reviewed as the servicing strategy for each growth area is established, and development proceeds as required.

Table 6-3: Direct Wastewater Servicing of Growth Areas

Growth Area ID	20-Year Horizon (2042) Modelled(1) Peak WWF (L/s)	Proposed Direct Wastewater Servicing Solution	Additional Considerations and Alternative Servicing Options
SC1_FUT	2.8 L/s	Direct connection to existing 600 mm diam. trunk sewer on Vanjumar Dr	
SC10_FUT	0.4 L/s	Direct connection to existing 600 mm diam. trunk sewer on Staye Ct Dr	
SC111_FUT	0.4 L/s	Direct connection to existing 250 mm diam. local sewer on Dan St, draining to existing 600 mm diam. trunk sewer on Victoria St	Local sewer on Dan St was not modelled, capacity was not confirmed
SC121_FUT	5.6 L/s	Direct connection to existing 600 mm diam. trunk sewer on Daniel St	
SC15_FUT	0.6 L/s	Direct connection to existing 600 mm diam. trunk sewer on Daniel St	
SC169_FUT	1.3 L/s	Direct connection to existing internal subdivision network, draining to existing 450 mm diam. trunk sewer on Edey St	Flows could be diverted from Edey St to Edward St and to MacDonald St (both 250 mm diameter)
SC172_FUT	1.2 L/s	Direct connection to existing internal subdivision network, draining to existing 375 mm diam. trunk sewer on William St E	
SC180_FUT	0.4 L/s	Direct connection to existing 250 mm diam. trunk sewer on Edward St	
SC182_FUT	0.1 L/s	Direct connection to existing 200 mm diam. local sewer on Dan St, draining to existing 600 mm diam. trunk sewer on Victoria St	
SC44_FUT	0.7 L/s	Direct connection to existing 200 mm diam. local sewer on Private St from Sheffield St to Jack Cr, draining to existing 450 mm diam. trunk sewer on Jack Cr	Alternative: direct connection to existing 250 mm diam. local sewer on Sheffield St, draining to existing 450 mm diam. trunk sewer on Jack Cr
SC48_FUT	0.1 L/s	Direct connection to existing 600 mm diam. trunk sewer on Madawaska Blvd	
SC9_FUT	0.1 L/s	Direct connection to existing 600 mm diam. trunk sewer on Staye Ct Dr	
SC92_FUT	0.5 L/s	Direct connection to existing 250 mm diam. trunk sewer on MacDonald St	
SC-FUT_ICI105	4.4 L/s	Direct connection to existing 450 mm diam. trunk sewer on Beth Shaw Pkwy	
SC-FUT_ICI15	0.6 L/s	Direct connection to existing 375 mm diam. trunk sewer on DeCosta St	
SC-FUT_ICI17	6.8 L/s	Direct connection to existing 300 mm diam. trunk sewer on DeCosta St	
SC-FUT_ICI98	1.2 L/s	Direct connection to existing 250 mm diam. local sewer on Winners Circle, draining to existing 600 mm diam. trunk sewer on Daniel St	Alternative: direct connection to existing 450 mm diam. trunk on Baskin Dr E
SC-FUT_ICI99	2.5 L/s	Direct connection to existing 450 mm diam. trunk sewer on Baskin Dr	Alternative: direct connection to existing 250 mm diam. local sewer on Winners Circle, draining to existing 600 mm diam. trunk on Daniel St
SC-FUT_RES0	3.0 L/s	Direct connection to existing 450 mm diam. trunk sewer on Jack Cr	
SC-FUT_RES12	2.1 L/s	Direct connection to existing 600 mm diam. trunk sewer on Fourth Ave	
SC-FUT_RES13	2.7 L/s	Direct connection to existing 600 mm diam. trunk sewer on Fourth Ave	
SC-FUT_RES2	2.9 L/s	Direct connection to existing 450 mm diam. trunk sewer on Jack Cr	
SC-FUT_RES22	9.5 L/s	Direct connection to existing 450 mm diam. trunk sewer on Baskin Dr	

Growth Area ID	20-Year Horizon (2042) Modelled[1] Peak WWF (L/s)	Proposed Direct Wastewater Servicing Solution	Additional Considerations and Alternative Servicing Options
SC-FUT_RES24	0.2 L/s	Direct connection to existing 600 mm diam. trunk sewer on Daniel St	
SC-FUT_RES34	2.7 L/s	Direct connection to existing 375 mm diam. trunk sewer on William St E	
SC-FUT_RES39	1.4 L/s	Direct connection to existing internal subdivision network, draining to existing 600 mm diam. trunk sewer on Vanjumar Dr	
SC-FUT_RES40	14.4 L/s	Direct connection to existing internal subdivision network, draining to existing 600 mm diam. trunk sewer on Madawaska Blvd	
SC-FUT_RES7	3.1 L/s	Direct connection to existing 200 mm diam. local sewer on Dan St, draining to existing 600 mm diam. trunk sewer on Victoria St	

Note:

(1) Refer to **Chapter 2** (**Section 5**) for flow generation parameters applied to growth areas in hydraulic model.

6.5.1.4.2 New Gravity Trunk Sewers

Growth areas which are not adjacent to the existing wastewater collection network will require new infrastructure to connect to the existing system. New gravity trunk sewers were identified as presented in **Table 6-4** and illustrated in **Figure 6-28**. Where applicable, previous projects recommended in the 2013 W&WWMP were further carried over, and sizing reviewed based on updated flow projections. The recommended minimum sizing and length should be reviewed and confirmed at a further design stage. The following is noted:

- **SC-FUT_RES14**: This area is directly adjacent to Phase 3 of the Callahan Development (growth area SC169_FUT). While a direct connection to the Callahan Development (further draining to Edey St and Edward St) is an alternative for servicing this growth area, the Town has noted potential constraints in the sewers within the existing phases of the Callahan Development which could limit servicing of additional growth areas. For the current MP, an alternative servicing solution is presented, which consists of extending the local sewer along Baskin Dr W westwards, which will also service the growth areas SC188_FUT and SC-FUT_RES45, and further drain to the Allan Dr trunk sewer.
- **SC-FUT_RES36**: The 2013 W&WWMP recommended 575 m of 300 mm diameter sewer. The sewer length was revised based on updated development servicing information provided by the Town. The sewer diameter was revised based on updated peak flows and aligns with the proposed development servicing connection. The downstream trunk sewer connection to Frieday St remains unchanged from the 2013 W&WWMP. Based on updated development servicing information, flows can also drain to the trunk sewer on Bellwood Dr.
- **SC-FUT_RES43**: Based on topography, the current W&WWMP identified the need for a PS to service this area. This area is currently undergoing the development application process, and a common PS within SC-FUT_RES37 and dual forcemains were proposed by the consultant. These are carried forward for the purposes of master planning and presented in **Section 6.5.1.4.3**; however, the recommendation may be subject to change and alternative options selected as the proposed strategy is reviewed by the Town. Under this servicing strategy, a new gravity trunk sewer from SC-FUT_RES43 to SC-FUT_RES37 would be needed. The consultant has noted that the diameter of the gravity sewer would be 250 mm or 300 mm. For master planning purposes, the larger diameter

(300 mm) is carried forward into the implementation plan and opinion of probable cost.

Table 6-4: New Gravity Trunk Sewers to Service Growth Areas

Growth Area ID	**SC188_FUT**	**SC-FUT_RES14**	**SC-FUT_RES45**	**SC-FUT_RES21**	**SC-FUT_RES23**	**SC-FUT_RES36(1)**	**SC-FUT_RES43**
20-Year Horizon (2042) Peak WWF (L/s)	6.6 L/s	6.6 L/s	6.6 L/s	2.4 L/s	2.4 L/s	21 L/s	7.2 L/s
Proposed New Gravity Trunk Sewer: ID	**SEW-GRW1**	**SEW-GRW1**	**SEW-GRW1**	**SEW-GRW2**	**SEW-GRW2**	**SEW-GRW3**	**SEW-GRW5**
Proposed New Gravity Trunk Sewer: Diameter (mm)	200	200	200	200	200	250	300
Proposed New Gravity Trunk Sewer: Length (m)	620	620	620	300	300	310	490
Downstream Modelled Trunk Sewer Connection	250 mm diameter trunk on Allan Dr W	250 mm diameter trunk on Allan Dr W	250 mm diameter trunk on Allan Dr W	450 mm diameter trunk on Baskin Dr E	450 mm diameter trunk on Baskin Dr E	300 mm diameter trunk on Frieday St 300 mm diameter trunk on Bellwood Dr	Drains to SC-FUT_RES37 (see **Table 6-5**), with forcemain discharging into 450 mm diameter trunk on Bev Shaw Pkwy
Additional Considerations & Alternative Servicing Options	Connect to existing 250 mm diameter sewer on Baskin Dr W (not modelled), which drains into Allan Dr trunk sewer.	Connect to existing 250 mm diameter sewer on Baskin Dr W (not modelled), which drains into Allan Dr trunk sewer.	Connect to existing 250 mm diameter sewer on Baskin Dr W (not modelled), which drains into Allan Dr trunk sewer.	Areas could be directly serviced from adjacent growth area SC-FUT_RES22's internal network, if SC-FUT_RES22 is developed first.	Areas could be directly serviced from adjacent growth area SC-FUT_RES22's internal network, if SC-FUT_RES22 is developed first.	Planned connection into Campbellbrook Phase 4 250 mm diameter sewer bifurcation on Stonehaven Way.	Combined servicing strategy with SC-FUT_RES37. Consultant identified need for either 250 mm or 300 mm diameter gravity sewer.

Note:

(1) Extension of planned Campbellbrook Phase 4 development, for which servicing drawings were provided by the Town.

6.5.1.4.3 New PSs & Forcemains

Growth areas which are not adjacent to the existing wastewater collection network will require new infrastructure to connect to the existing system. Where the topography restricts the implementation of new gravity trunk sewers, new PSs and forcemains were identified as presented in **Table 6-5** and illustrated in **Figure 6-28**. Where applicable, previous projects recommended in the 2013 W&WWMP were further carried over. The following should be noted:

- **SC-FUT_ICI89**: The 2013 W&WWMP recommended a PS and 100 m of 100 mm diameter forcemain to service a larger area comprising SC-FUT_ICI89 and adjacent growth east, towards Lake Madawaska. Based on updated growth projections, the adjacent growth is not foreseen within the current MP's planning horizon. Nonetheless, the PS and forcemain are still needed to service SC-FUT_ICI89 and will also benefit future adjacent growth. The forcemain should be twinned for redundancy and resiliency.
- **SC-FUT_RES37 & SC-FUT_RES43**: Based on topography, the current W&WWMP identified the need for PSs to service each of those areas. These areas are currently undergoing the development application process, and the recommended common PS and dual forcemains were proposed by the consultant. These are carried forward for the purposes of master planning, however, the recommendation may be subject to change and alternative options selected as the proposed strategy is reviewed by the Town.

Table 6-5: New PSs and Forcemains to Service Growth Areas

Growth Area ID	SC-FUT_ICI89	SC-FUT_RES37	SC-FUT_RES43
20-Year Horizon (2042) Peak WWF (L/s)	2.8 L/s	19 L/s	19 L/s
Proposed New PS and Forcemain: ID	**PS-GRW4**	**PS-GRW5**	**PS-GRW5**
Proposed New PS and Forcemain: New PS Location	Within SC-FUT_ICI89, between Baskin Dr E and Hwy 417	Within SC-FUT_RES37	Within SC-FUT_RES37
Proposed New PS and Forcemain: Forcemain Diameter (mm)	Dual 100 mm forcemains	Dual 200 mm forcemains	Dual 200 mm forcemains
Downstream Modelled Trunk Sewer Connection: Forcemain Length (m)	100	2,200	2,200
Downstream Modelled Trunk Sewer Connection: Trunk Diameter	450 mm diameter trunk on Baskin Dr E	450 mm diameter trunk on Beth Shaw Pkwy	450 mm diameter trunk on Beth Shaw Pkwy
Additional Considerations & Alternative Servicing Options	Forcemain length and diameter previously recommended in 2013 W&WWMP.	Servicing option proposed by consultant; to be reviewed.	Servicing option proposed by consultant; to be reviewed.

6.5.1.5 Refined Alternatives – Overall Wastewater Collection System

As part of expanding & improving the existing Municipal Wastewater Infrastructure, the following overarching strategies are recommended:

- **SAN-1)** Continue flow monitoring in key areas of interest. Potential future monitoring sites include:
  - Downstream of the Nylene facility (upstream of PS #2);
  - Upstream of PS #5;
  - Upstream and downstream of PS #1 (following the planned sewer separation activities, see PS1-A in **Section 6.5.1.2.2**);
  - Downstream of infrastructure upgrades recommended in **Section 6.5.1.1** and **6.5.1.2**; and,
  - Downstream of areas newly developed and other areas of operational and growth interests.
- **SAN-2)** Continue sewer separation activities and monitor resulting flows to understand the achieved benefits.
- **SAN-3)** Implement measures to reduce sewage generation rates, including:
  - Water conservation measures;
  - Promoting the use of efficient fixtures.
- **SAN-4)** Continue implementing measures to reduce I/I into the system
- **SAN-5)** Continue expanding the hydraulic model to local areas of interest, with the long-term goal of building an all-pipe model.

6.5.2 Refined Alternative – Improvement & Expansion of the Potable Water System

The refined alternative for potable water system includes upgrades to existing treatment, storage, and pumping facilities, as well as expansion of distribution pipe network to supply water to growth areas that cannot be serviced directly by the existing system.

6.5.2.1 Refined Alternatives – Treatment, Storage, and High Lift Pumping

As discussed in **Chapter 2** (**Section 5**), additional treatment, storage, and pumping needs are required to satisfy future capacity requirements in the 20-year planning horizon. **Table 6-6** summarizes the results of the growth capacity assessment, which includes hydraulic trigger years in which the demand requirements reach the available capacity, and additional capacity needed to meet future (2042) demands.

Table 6-6: Summary of Growth Capacity Treatment, Storage, and High Lift Pumping Requirements

Infrastructure	Hydraulic Trigger Year	Projected Population at Hydraulic Trigger Year	Additional Capacity Required by 2042
Treatment	2038	16,130	631 m^3/d
Storage	2033	14,430	1,592 m^3
High Lift Pumping	2034	14,620	45 L/s

The growth capacity assessment is based on the projected growth as presented in **Chapter 2** (**Section 5**) of this report. Details of upgrades on treatment, storage, and pumping capacities should be explored based on the actual growth rate of the community during detailed design. It is recommended that actual system treatment/consumption (e.g., SCADA) and growth rate in the Town (e.g., master plan updates, official plans, etc.) be monitored on a regular basis to confirm the actual time when system upgrades are required. Additional measures, such as water conservation program, water leakage management, water restrictions for industrial properties, and process optimization, could be used to optimize water use and therefore decelerate demand growth.

6.5.2.2 Refined Alternatives – Improvements and Expansion of Existing Potable Water Distribution System

According to the updated hydraulic model results as presented in **Chapter 2** (**Section 5**), the existing potable water distribution system is able to meet the minimum operating pressure requirements under the future growth conditions, without incorporating the outstanding watermain upgrades at Daniel St, Staye Court Dr, Elgin St, Norma St, and Caruso St that were previously recommended in the 2013 W&WWMP (refer to **Appendix F.2**).

Based on a review of the Town's watermain GIS data, a number of new watermains have been installed/replaced post 2011 (where 2011 network information would have been used to represent existing conditions in the 2013 W&WWMP), as presented in **Appendix F.3**. New watermains were constructed in 2018/2020 for the Fairgrounds subdivision (near Mac Beattie Dr) and the Callagan Phase 2 subdivision (near Leo Moskos St) which provide additional looping to Daniel St and Staye Court Dr. The new/upsized 200 mm dia. Watermains along William St, McGonigal St, and Elgin St (installed in 2017/2018) and the upgraded 300 mm dia. Madawaska River crossing near Russell St (installed in 2020) also provide additional conveyance capacity and looping to the area. Per the updated analysis with the current growth projections, the additional conveyance capacity and looping provided by these new/upgraded watermains helps defer the need for the Daniel St, Staye Court Dr, Elgin St, Norma St, and Caruso St watermain upsizing projects that were previously proposed in the 2013 W&WWMP to past 2042.

Although the modeling results are no longer showing the requirement for these 2013 W&WWMP projects before 2042, some watermain replacements will provide some added hydraulic capacity and reliability to the distribution system by further extending the backbone watermains to the west along Daniel St / Staye Court Dr and north along Elgin St. From a hydraulics standpoint, the improvements observed under 2042 buildout conditions (without incorporating the additional watermain replacements/additions in existing conditions and planned waterwork projects, as noted in **Section 5.5.2.1**) include the following:

- Upgrading the Daniel St / Staye Court Dr watermains provides a slight improvement in PKHR minimum pressures in this area of up to +1.6 psi. Upgrades would also provide an increase of approximately +17 L/s in available fire flow under MXDY+FF conditions on average in this area.
- Upgrading the Victoria St / Elgin St / Norma St / and Caruso St watermains provides a marginal improvement in PKHR minimum pressures in this area of up to +0.1 psi. Upgrades would also provide a small increase of approximately +2 L/s in available fire flow under MXDY+FF conditions on average in this area.

The hydraulic improvements of the projects noted above are not significant enough to warrant continuing with these upgrades based on hydraulics alone. Although there are no proposed wastewater servicing solutions in these areas, these projects (particularly along Daniel St / Staye Court Dr) may however still be considered as part of future planned road renewal works in these areas. Additionally, although the hydraulic benefit is marginal for the Victoria St / Elgin St / Norma St / and Caruso St projects, renewal of some of these aging watermains (particularly the +100 year-old CI pipes along Norma St) may be considered as part of lifecycle renewal plans.

Considering the model results and the review of watermain upgrades previously proposed in the 2013 W&WWMP (as discussed above), no upgrades to existing pipes are required, except for expansion of the existing distribution pipe network to growth areas that are not currently serviced directly by the existing system (e.g., development by Tartan Homes at Van Dusen Dr) and extension/upsizing of watermains specifically for future growth areas (i.e., upsize the existing 150 mm dia. watermains on Elizabeth St to 250 mm and extend the new 250 mm dia. watermain to provide connection between growth areas RES21/22/23 and the existing 250 mm dia. pipe on Charles St).

Additional refinements that were made in the model under 2042 conditions are summarized as follows:

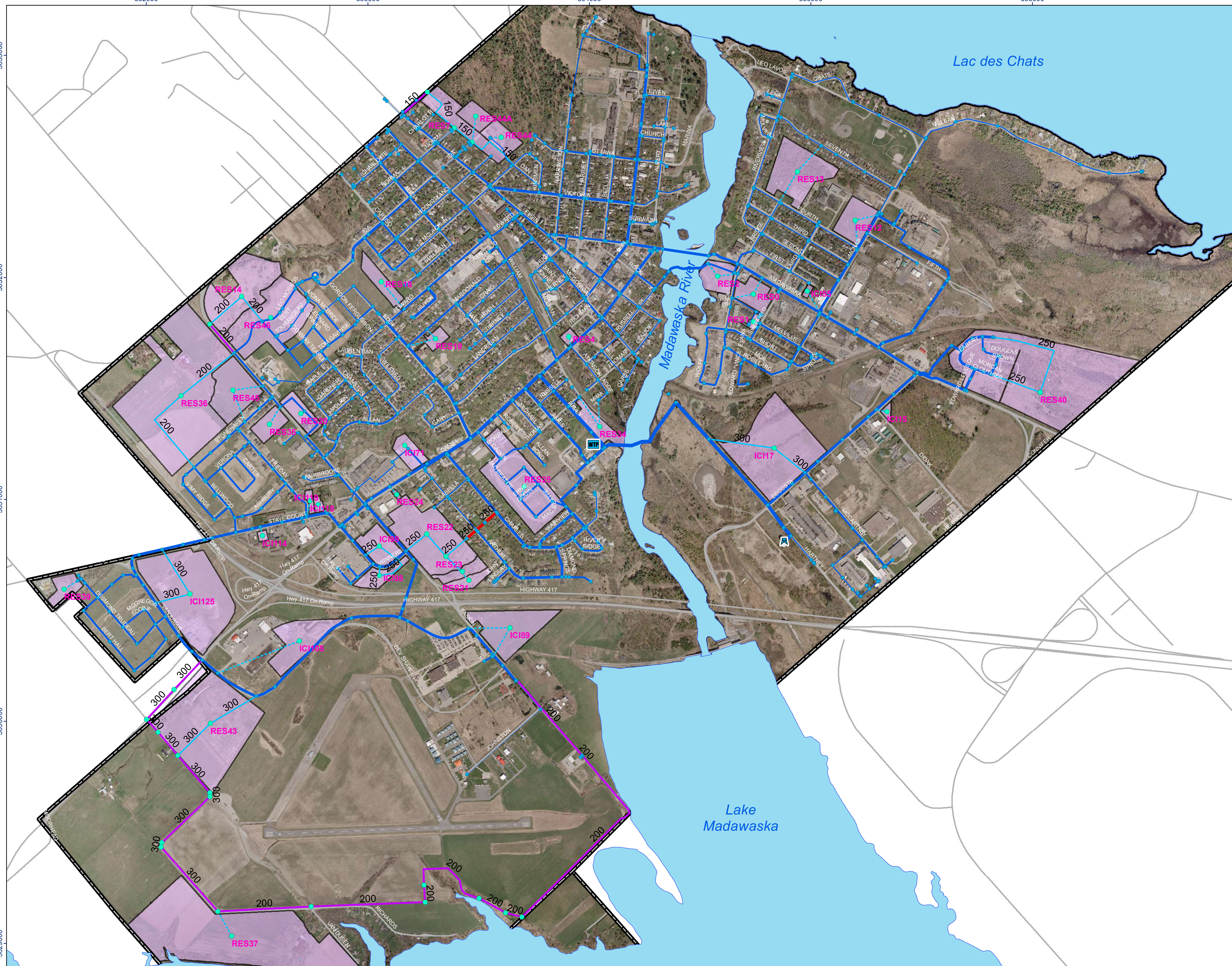
- Locations of water service connection were adjusted for growth areas RES13 at 124 Fourth Ave and RES34 at 18 Thomas St based on developers' servicing plans provided by the Town. An additional connection to the existing 150 mm dia. watermain on Seventh Ave was added for area RES13 to provide a looped system for the proposed development. As for growth area RES34, watermain connection points were adjusted from single feed from Havey St to looped connections fed from Thomas St and Mima St, respectively.
- All residential growth areas with 50 or more dwellings and ICI growth areas with AVDY demands greater than 50 m^3/d were provided with a second feed to avoid the creation of vulnerable areas, as per the City of Ottawa Water Distribution Design Guidelines. In particular, the existing 100 mm dia. watermain on Baskin Dr E upsizing to 200 mm dia. and a new 200 mm dia. watermain connecting the upsized 200 mm dia. pipe to the new 300 mm dia. watermain at VanDusen Dr were proposed to provide a looped connection for growth area RES37 (i.e., subdivision by Tartan Homes). It is noted that this proposed watermain routing would require an easement through or acquisition of airport land as well as a water crossing east of Richards Ln. An alternative pipe alignment is to have two parallel pipes along VanDusen Dr which is the easiest with respect to constructability; however, this alternative is typically not considered as the preferred solution as a watermain break in one line would likely affect the other pipe in the event of a washout.
- A second HLP at the WFP was proposed to be called into service under MXDY demand conditions to ensure that the EST operates within its typical range of 60

to 80% full, which in turn requires re-programming of the SCADA to allow for the second pump to kick in. In the model, a second HLP is assumed to open when the EST is less than 58% full (i.e., level in the EST drops below 6.59 m), which is the lowest EST level observed from the provided SCADA data, and close when the water in the EST reaches 80% of the overall volume (i.e., level in the EST goes above
8.74 m).

Figure 6-7 presents the updated water distribution network in the ultimate 2042 conditions. The staging of these upgrades are discussed further in **Chapter 4** (**Section 0**).

Figure 6-8 to **Figure 6-10** show hydraulic model results for AVDY, MXDY, and MXDY + fire flow demand scenarios under 2042 conditions based on the refined model as described above. In general, the model results are similar to that presented in **Chapter 2** (**Section 5**). High pressures greater than 100 psi under AVDY demand conditions are observed in low-lying areas along the shorelines of the Ottawa River and Madawaska River. Pressure reduction measures to critical areas (e.g., installation of pressure reducing valves) are encouraged to prevent excessive pressures in the system. In terms of available fire flows, low flows less than 33.33 L/s (2,000 L/min) are anticipated in local watermains with dead ends. Considerations should be given to provide looping where possible (e.g., watermain on McLean Ave) to ensure adequate fire protection for identified problem areas.

Additionally, peak watermain velocity and head loss per km length of watermain were also examined under MXDY demand conditions, to identify vulnerable areas with high velocities and/or head losses (see **Figure F1-1** and **Figure F1-2** in **Appendix F.1**). Watermains with maximum velocities exceeding 2.0 m/s and/or high head loss rates are typically considered to be more susceptible to failure. It is therefore recommended that watermains with higher modelled velocities and head losses (e.g., 400 mm Madawaska River crossing near the WFP) be monitored for the potential occurrence of watermain breaks.



Stantec

Legend

- Nodes Added for Growth Areas / Solutions
- Dummy Pipes Added for Growth Areas
- Assumed Future Local Distribution Looping (Internal to Development Area)
- Proposed Upgrade of Existing Watermain
- Proposed New Watermain / Watermain Upgrade (Developer-Driven)
- Growth Areas with Future Water Demands

Existing Watermains - Diameter (mm)

- < 75 mm
- 75 mm - 152 mm
- 152 mm - 225 mm
- 225 mm - 350 mm
- 350 mm - 610 mm
- Modelled Junctions
- Water Treatment Plant (WTP)
- Elevated Storage Tank (EST)
- Municipal Boundary

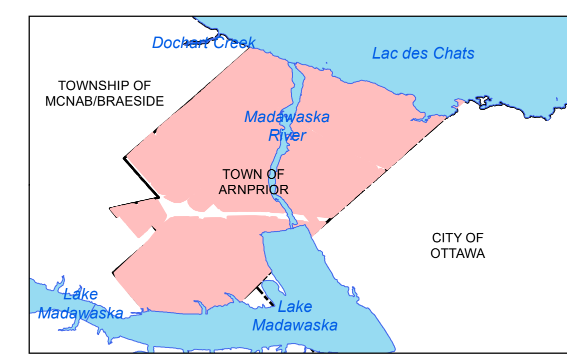
N

0 200 400 600 Meters

(At original document size of 11x17)
1:18,000

Notes

1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Ontario_Hydro_Network_(OHN)_-_Waterbody.shp*, *Ontario_Hydro_Network_(OHN)_-_Waterbody (2).shp*, *Municipal_Boundary_-_Lower_and_Single_Tier.shp*, and *0837ARNP.sid* , *Arnprior_PropertyParcels_wAssessment_20220324.shp*, *Arnprior_Roads_20220324.shp* and *WTR_NODE.shp* provided by the Town of Arnprior
3. Background: Contains information licensed under the Open Government Licence – Ontario



Project Location
Arnprior, ON

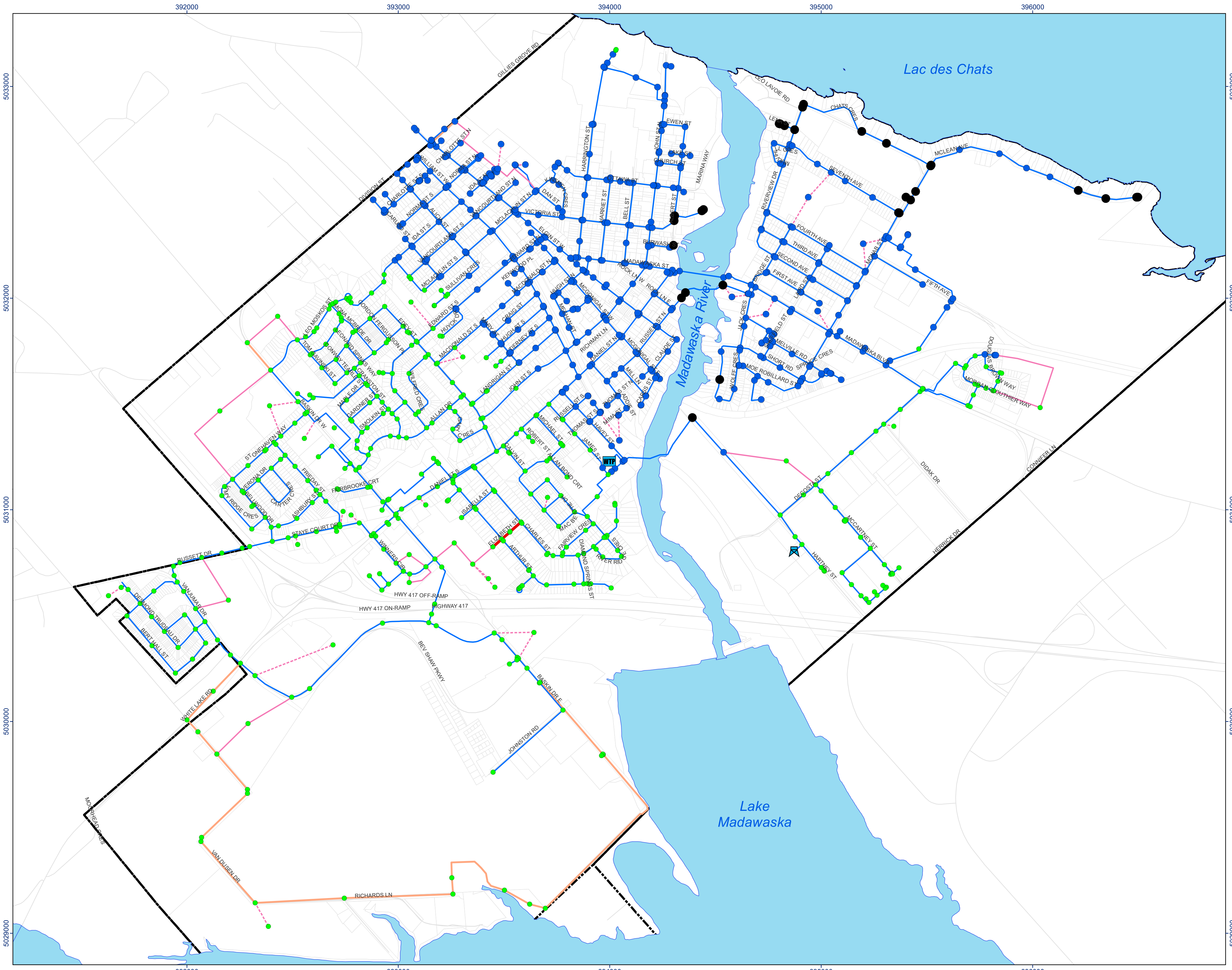
Prepared by CZ on 2023-08-04
Revised by CZ on 2024-01-30

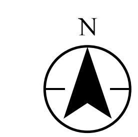
Client/Project
163401723
Town of Arnprior
2022 W&WW Master Plan Update

Figure No.
6-7

Title
Water Distribution Network (2042 Conditions with Solutions)

Revised: 2024-01-30 By: chzheng





Legend

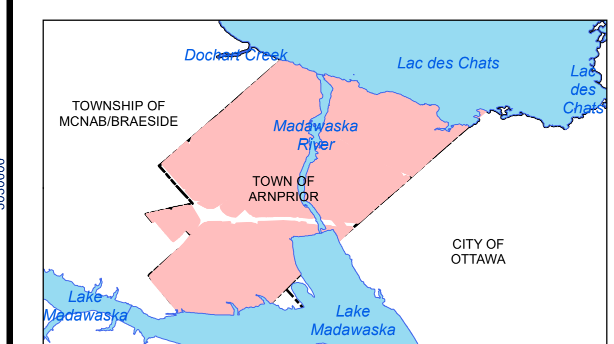
Maximum Pressure

- Max. Pressure ≤ 40 psi
- 40 psi < Max. Pressure ≤ 60 psi
- 60 psi < Max. Pressure ≤ 80 psi
- 80 psi < Max. Pressure ≤ 100 psi
- Max. Pressure > 100 psi
- Existing Watermains
- Dummy Pipes Added for Growth Areas
- Assumed Future Local Distribution Looping (Internal to Development Area)
- Proposed Upgrade of Existing Watermain
- Proposed New Watermain / Watermain Upgrade (Developer-Driven)
- WTP Water Treatment Plant (WTP)
- Elevated Storage Tank (EST)
- Municipal Boundary

N

0 250 500 Meters
(At original document size of 11x17)
1:18,500

Notes
1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Ontario_Hydro_Network_(OHN)_-_Waterbody.shp, Ontario_Hydro_Network_(OHN)_-_Waterbody (2).shp, Municipal_Boundary_-_Lower_and_Single_Tier.shp*, and *Arnprior_Roads_20220324* and *Arnprior_PropertyParcels_wAssessment_20220324.shp* provided by the Town of Arnprior.
3. Background: Contains information licensed under the Open Government Licence – Ontario



Project Location
Arnprior, ON

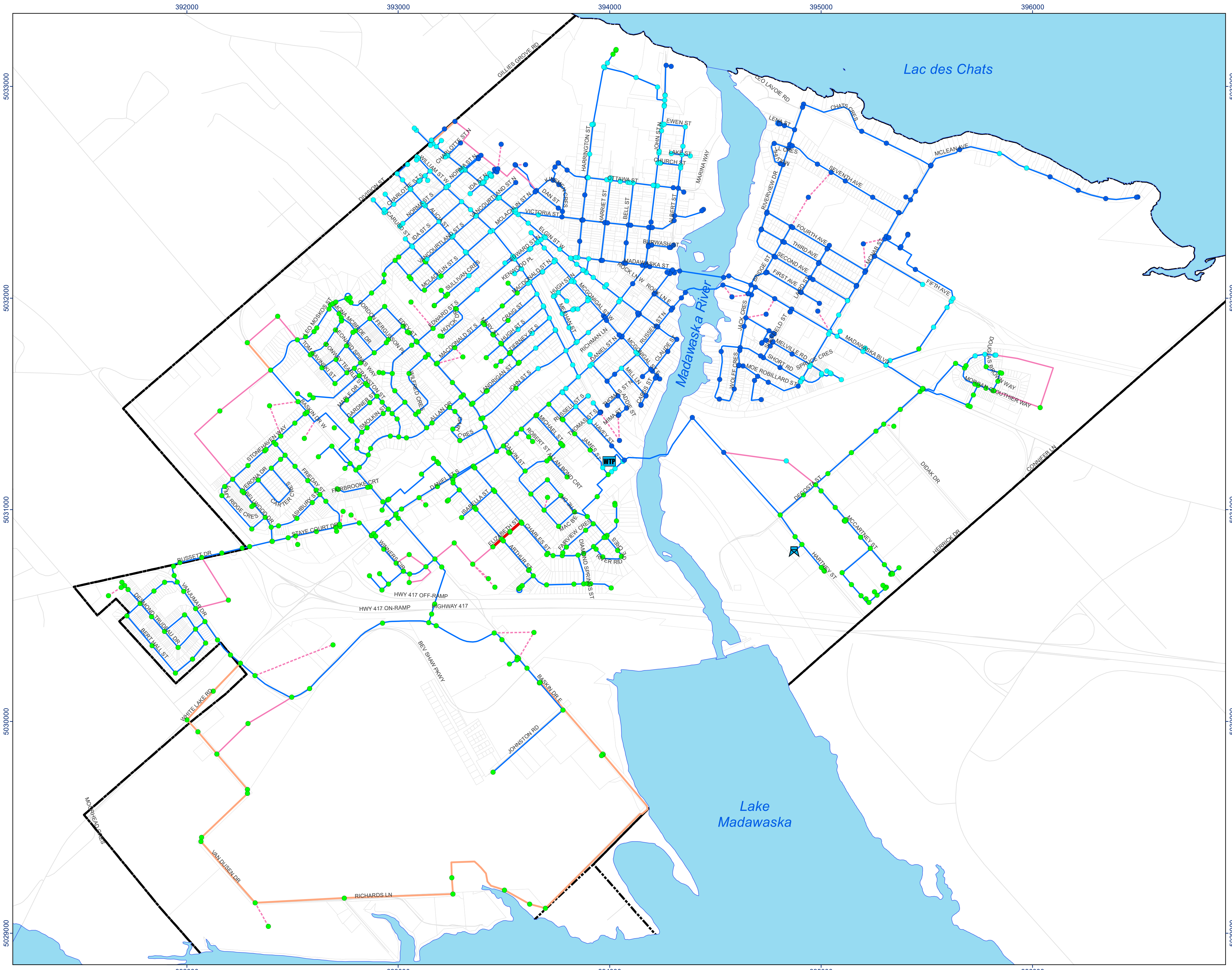
Prepared by CZ on 2023-08-04
Revised by CZ on 2024-01-25

Client/Project
Town of Arnprior
2022 W&WW Master Plan Update
163401723

Figure No.
6-8

Title
Model Results: 2042 Conditions with Solutions – AVDY Maximum Pressures

W:\active\1634_01723\planning\drawing\gis\MXDs\tm3_figs\fig6-8to10_arn_wtr_2042_w_solns_model_results_20231117.mxd Revised: 2024-01-25 By: chzheng



Stantec

Legend

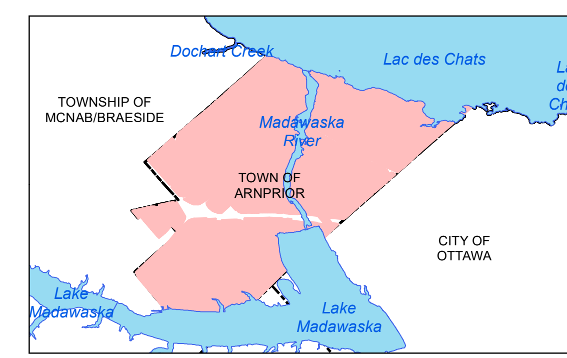
Minimum Pressure

- Min. Pressure ≤ 20 psi
- 20 psi < Min. Pressure ≤ 40 psi
- 40 psi < Min. Pressure ≤ 50 psi
- 50 psi < Min. Pressure ≤ 70 psi
- 70 psi < Min. Pressure ≤ 80 psi
- 80 psi < Min. Pressure ≤ 100 psi
- Min. Pressure > 100 psi
- Existing Watermains
- Dummy Pipes Added for Growth Areas
- Assumed Future Local Distribution Looping (Internal to Development Area)
- Proposed Upgrade of Existing Watermain
- Proposed New Watermain / Watermain Upgrade (Developer-Driven)
- Water Treatment Plant (WTP)
- Elevated Storage Tank (EST)
- Municipal Boundary

N

0 250 500 Meters
(At original document size of 11x17)
1:18,500

Notes
1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Ontario_Hydro_Network_(OHN)_-_Waterbody.shp*, *Ontario_Hydro_Network_(OHN)_-_Waterbody (2).shp*, *Municipal_Boundary_-_Lower_and_Single_Tier.shp*, and *Arnprior_Roads_20220324* and *Arnprior_PropertyParcels_wAssessment_20220324.shp* provided by the Town of Arnprior.
3. Background: Contains information licensed under the Open Government Licence – Ontario



Project Location
Arnprior, ON

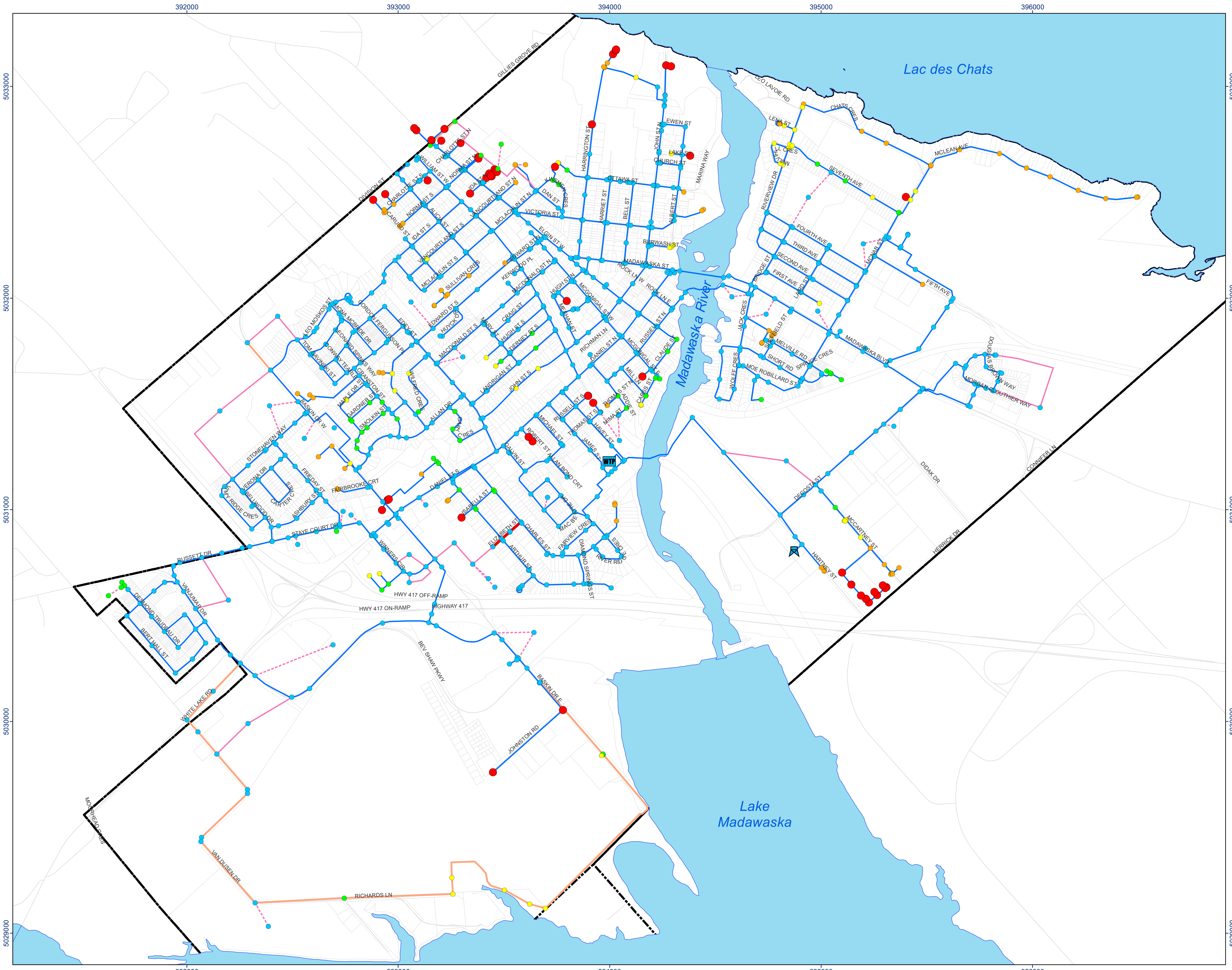
Prepared by CZ on 2023-08-04
Revised by CZ on 2024-01-25

Client/Project
163401723
Town of Arnprior
2022 W&WW Master Plan Update

Figure No.
6-9

Title
Model Results: 2042 Conditions with Solutions – MXDY Minimum Pressures

W:\active\1634_01723\planning\drawing\gis\MXDs\tm3_figs\fig6-8to10_arn_wtr_2042_w_solns_model_results_20231117.mxd Revised: 2024-01-25 By: chzheng



Stantec

Legend

Available Fire Flow at 20 psi (AFF)

- AFF < 33.33 L/s
- 33.33 L/s ≤ AFF ≤ 75 L/s
- 75 L/s < AFF ≤ 100 L/s
- 100 L/s < AFF ≤ 125 L/s
- AFF > 125 L/s
- Existing Watermains
- Dummy Pipes Added for Growth Areas
- Assumed Future Local Distribution Looping (Internal to Development Area)
- Proposed Upgrade of Existing Watermain
- Proposed New Watermain / Watermain Upgrade (Developer-Driven)
- Water Treatment Plant (WTP)
- Elevated Storage Tank (EST)
- Municipal Boundary

N

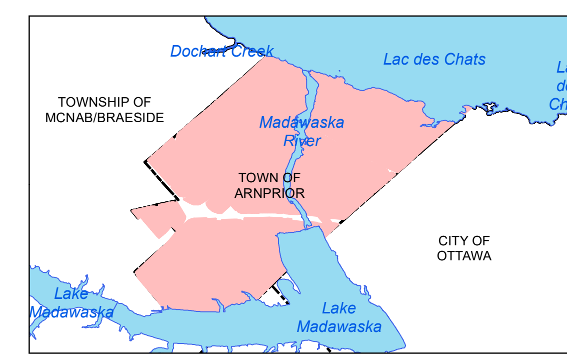
0 250 500 Meters
(At original document size of 11x17)
1:18,500

Notes

1. Coordinate System: NAD 1983 UTM Zone 18N

2. Data Sources: *Ontario_Hydro_Network_(OHN)_-_Waterbody.shp*, *Ontario_Hydro_Network_(OHN)_-_Waterbody (2).shp*, *Municipal_Boundary_-_Lower_and_Single_Tier.shp*, and *Arnprior_Roads_20220324* and *Arnprior_PropertyParcels_wAssessment_20220324.shp* provided by the Town of Arnprior.

3. Background: Contains information licensed under the Open Government Licence – Ontario



Project Location
Arnprior, ON

Prepared by CZ on 2023-08-04
Revised by CZ on 2024-01-25

Client/Project 163401723
Town of Arnprior
2022 W&WW Master Plan Update

Figure No.
6-10

Title
Model Results: 2042 Conditions with Solutions – MXDY Available Fire Flow at 20psi

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6.6 Outside Interests

The following section addresses the potential to service development interests outside the current municipal boundary.

6.6.1 Overview of Outside Interests

The Town has identified two areas which could connect to the existing municipal water and wastewater infrastructure. Those areas are summarized in **Table 6-7**, with the populations estimated based on the City of Ottawa design guidelines’ criteria for population density.

Table 6-7: ’ x Systems

Area #	Area Name	Area (ha)	Population Density (persons/ha)	Population (ppl)
1	McNab & Braeside	60	60(1)	3,600
2	City of Ottawa	35		2,100

Note:

(1) Rate recommended in the City of Ottawa Sewer Design Guidelines.

6.6.2 Wastewater Collection System Servicing of Outside Interests

To identify potential connection points from outside development interests to the Town’s wastewater collection network, the available residual capacity within the modelled sewers was reviewed against the expected peak wet weather flow (PWWF) from the outside growth areas, summarized in **Table 6-8**. The available residual capacities in the trunk sewers under 2042 growth conditions with the proposed sewer upgrades are illustrated in **Figure 6-11**. The residual capacities under existing conditions (with and without solutions and planned projects) and 2042 growth conditions without solutions and planned projects are illustrated in the figures in **Appendix E.1**.

The PWWF of 36.1 L/s for Area 1 – McNab & Braeside exceeds the residual capacity of the existing 250 mm to 300 mm diameter sewers along Allan Dr. The currently proposed 2042 upgrades do not include upgrades to the Allan Dr sewers; however, these may be considered as growth within the Town progresses, and serviceability solutions for Area 1 are developed. Alternatively, this area may be serviced from a new sewer along

Division St and connecting to the existing 300 mm to 600 mm diameter trunk sewers on Elgin St W, which mostly have residual capacity to accommodate Area 1's PWWF. Short sections of sewers (< 100 m long) might pose constraints on the additional PWWF, however this should be reviewed as the serviceability of Area 1 is further assessed.

The PWWF of 21.1 L/s for Area 2 – City of Ottawa is within the residual capacity of the existing 600 mm to 750 mm diameter sewers along Madawaska Blvd. This area would also drain into the PS #3 and may need to be considered in the proposed PS #3 upgrades' design and as serviceability solutions for Area 2 are developed.

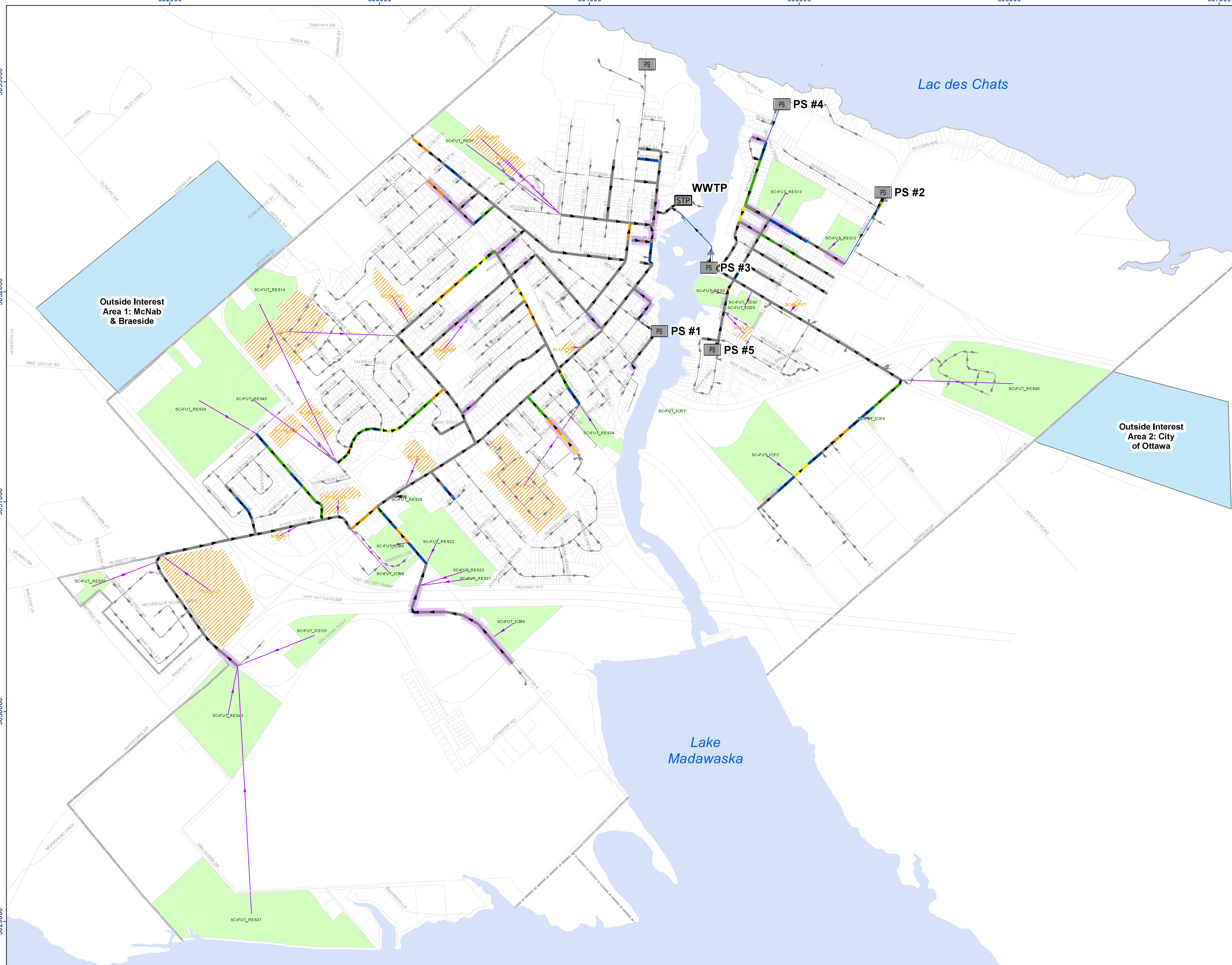
As discussions with outside interests continue and growth within the Town progresses, the residual capacities in the sewers should be reviewed as part of confirming the serviceability of these new areas, and other new areas identified in the future. Potential impacts on existing PSs capacity should be reviewed as applicable. The Town should also continue updating its WWTP reserve capacity assessment.

Table 6-8: Sanitary Flow Generation for Outside Interests

Area #	Area Name	Area (ha)	Population Density (persons/ha)	Population (ppl)	Average Sewage Flow[1] (L/s)	Peak Sewage Flow[2] (L/s)	GWI[3] (L/s)	PDWF (L/s)	Wet Weather Extraneous Flows[4] (L/s)	PWWF (L/s)
1	McNab & Braeside	60	60[1]	3,600	11.7	16.3	3.0	19.3	16.8	36.1
2	City of Ottawa	35		2,100	6.8	9.5	1.8	11.3	9.8	21.1

Notes:

(1) Residential sewage generation rate of 280 L/c/d from the City of Ottawa Design Guidelines.
(2) Peaking factor of 1.4 from the flow monitoring FM 1 diurnal pattern.
(3) GWI rate of 0.05 L/s/ha from the City of Ottawa Design Guidelines.
(4) Wet weather extraneous flow contribution of 0.28 L/s/ha from the City of Ottawa Design Guidelines.



Stantec

Legend

- Sanitary Pump Station (PS)
- Overflow
- Wastewater Treatment Plant (WWTP)
- Sanitary Sewer (Not Modelled)
- Forcemains

Sewer WWF Residual Capacity

- No Capacity (0 L/s; Sewer is Surcharged)
- Limited Capacity (0 L/s; Sewer is not Surcharged)
- <= 5 L/s
- 5 - 25 L/s
- 25 - 50 L/s
- > 50 L/s

Growth Areas

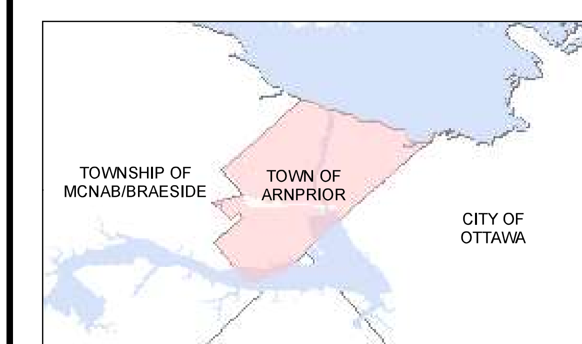
- Growth Area
- Existing Subcatchment (with Redevelopments or Development/Occupancy of Vacant Properties)
- New Subcatchment
- Outside Interest

N

0 250 500 Meters
(At original document size of 11x17)
1:19,000

Notes

1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Export_Output_Parcel_Fabric.shp*, *Export_Output_Roads.shp*, *Export_Output_San_MH.shp* and *Export_Output_SAN_SEWER.shp* provided by the Town of Arnprior
3. Background: Contains information licensed under the Open Government Licence – Ontario
4. Abbreviations: FM: Flow Monitor; MH: Maintenance Hole; PS: Pump Station; WWTP: Wastewater Treatment Plant



Project Location
Arnprior, ON

Prepared by CR on 2023-11-08
Revised by CR on 2024-02-02

Client/Project 163401723
Town of Arnprior
2022 W&WW Master Plan Update

Figure No.
6-11

Title
Sewer Residual Capacity – 2042 Growth Conditions with Planned Projects & Proposed Upgrades

6.6.3 Potable Water System Servicing of Outside Interests

For the potable water system, an analysis was conducted based on flow capacity and HGL pressure in the system, to identify possible connection points from the Town's potable water distribution network to service the areas with development interests outside the current municipal boundary.

It should be noted that this potable water system analysis for servicing of outside interests is based on the currently identified demands and growth projection. The residual capacities in watermains and HGL at the potential connection points should be further reviewed incorporating any changes in water demands and growth within the Town to confirm the serviceability of these outside interest areas and other new areas proposed in the future.

6.6.3.1 Flow Capacity Analysis

The available residual capacities for all watermains were calculated by subtracting the modelled 2022 and 2042 average flows under MXDY demand conditions from the watermain flow capacity at a maximum velocity of 1.5 m/s (as per the City of Ottawa Water Distribution Design Guidelines). The results are illustrated in **Figure 6-12** (existing conditions with existing infrastructure) and **Figure 6-13** (2042 growth conditions with proposed watermain upgrades). The residual capacities within the watermains were the compared against the projected demands for the outside interest areas, as summarized in **Table 6-9**.

Table 6-9: Potable Water Demand Projection for Outside Interests

Area #	Area Name	Area (ha)	Population Density (1) (persons/ha)	Population (ppl)	AVDY Demand (2) (L/s)	MXDY Demand (3) (L/s)
1	McNab & Braeside	60	60	3,600	11.7	22.2
2	City of Ottawa	35		2,100	6.8	12.9

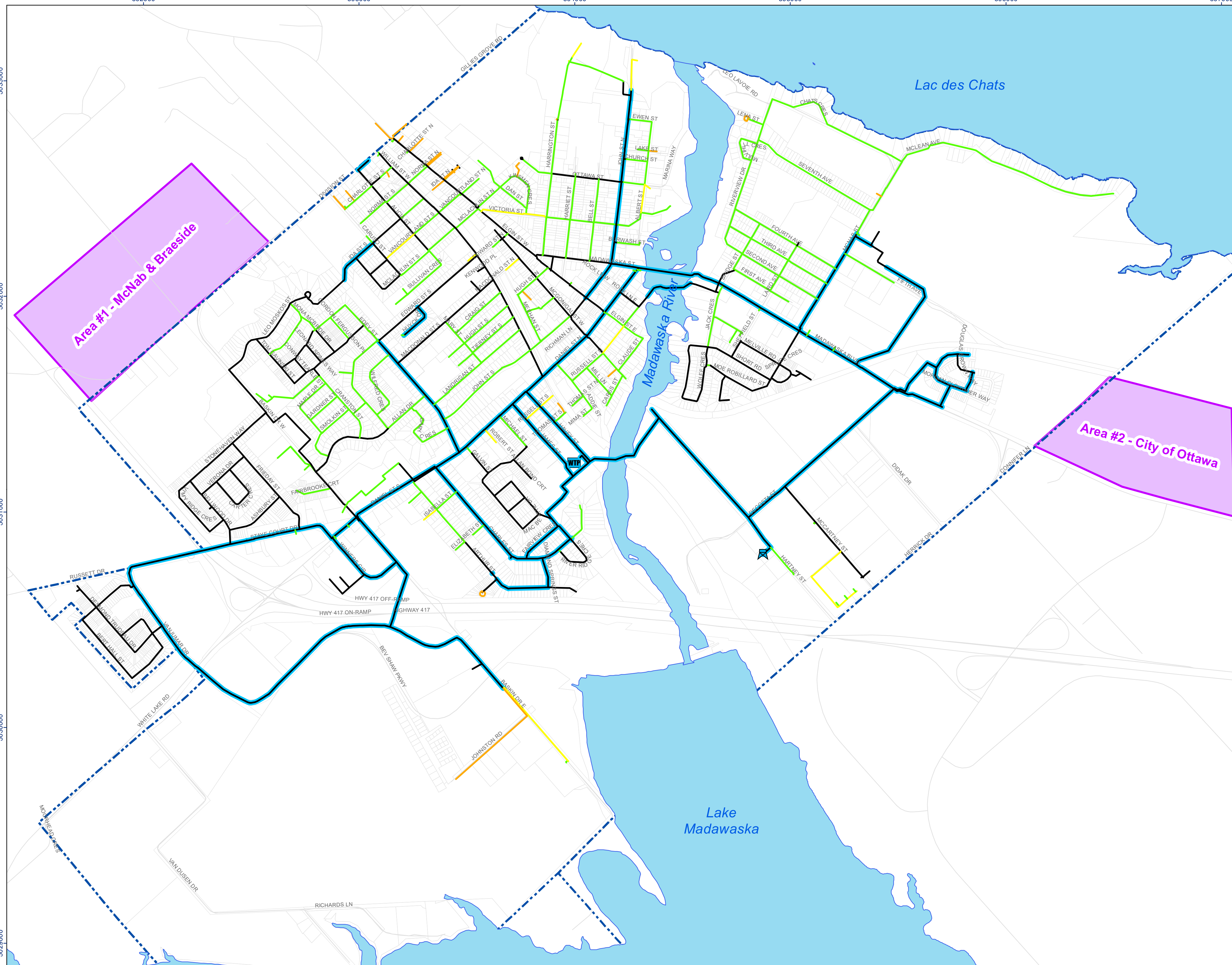
Notes:

(1) Population density rate of 60 ppl/ha recommended in the City of Ottawa Sewer Design Guidelines.

(2) Residential average daily consumption rate of 280 L/c/d from the City of Ottawa Water Distribution Design Guidelines.

(3) Peaking factor of 1.9 from the MECP Design Guidelines for Drinking-Water Systems (based on population of the entire town).

Based on the velocity criteria (maximum velocity of 1.5 m/s) under MXDY demands, there are no constraints in servicing the two outside interest areas with respect to watermain flow capacity in both the existing conditions and 2042 conditions with proposed solutions. Area 1 (McNab & Braeside) with a projected MXDY demand of 22.2 L/s could be potentially serviced from the 200 mm diameter watermain along Baskin Dr near Division St, the 200 mm diameter watermain on Elgin St or William St near Division St, or the 300 mm diameter watermain on Staye Court Dr near Highway 417. For Area 2 (City of Ottawa) with a MXDY demand of 12.9 L/s, possible connection points could include the 300 mm diameter watermain on Madawaska Blvd at Decosta St, the 400 mm diameter watermain along Hartney St near the EST, and the 200 mm diameter watermain on McCartney St near Herrick Dr. Watermain at any of these potential connection points has adequate flow capacity (e.g., residual capacity greater than 30 L/s) to service each outside interest area; however, a minimum of two connections are required for reliability as per the City of Ottawa Water Distribution Design Guidelines, since each of these areas would likely have more than 50 residential dwellings or ICI AVDY demand greater than 50 m^3/d.



Stantec

Legend

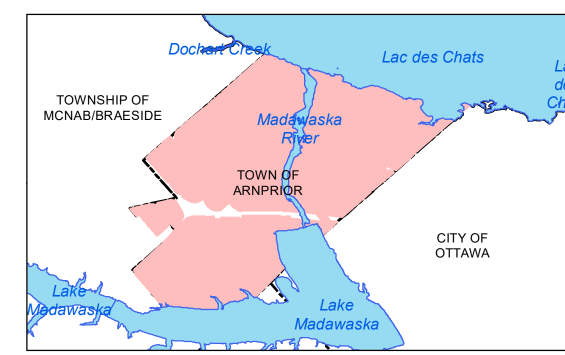
Watermain Residual Capacity at a Maximum Velocity = 1.5 m/s

- No Capacity
- 0 L/s < Capacity ≤ 10 L/s
- 10 L/s < Capacity ≤ 20 L/s
- 20 L/s < Capacity ≤ 30 L/s
- Capacity > 30 L/s
- Backbone / Feeder Main (Diameter ≥ 250mm)
- Outside Interest Areas
- Water Treatment Plant (WTP)
- Elevated Storage Tank (EST)
- Municipal Boundary

N

0 250 500 Meters
(At original document size of 11x17)
1:18,500

Notes
1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Ontario_Hydro_Network_(OHN)_-_Waterbody.shp*, *Ontario_Hydro_Network_(OHN)_-_Waterbody (2).shp*, *Municipal_Boundary_-_Lower_and_Single_Tier.shp*, and *Arnprior_Roads_20220324* and *Arnprior_PropertyParcels_wAssessment_20220324.shp* provided by the Town of Arnprior.
3. Background: Contains information licensed under the Open Government Licence – Ontario

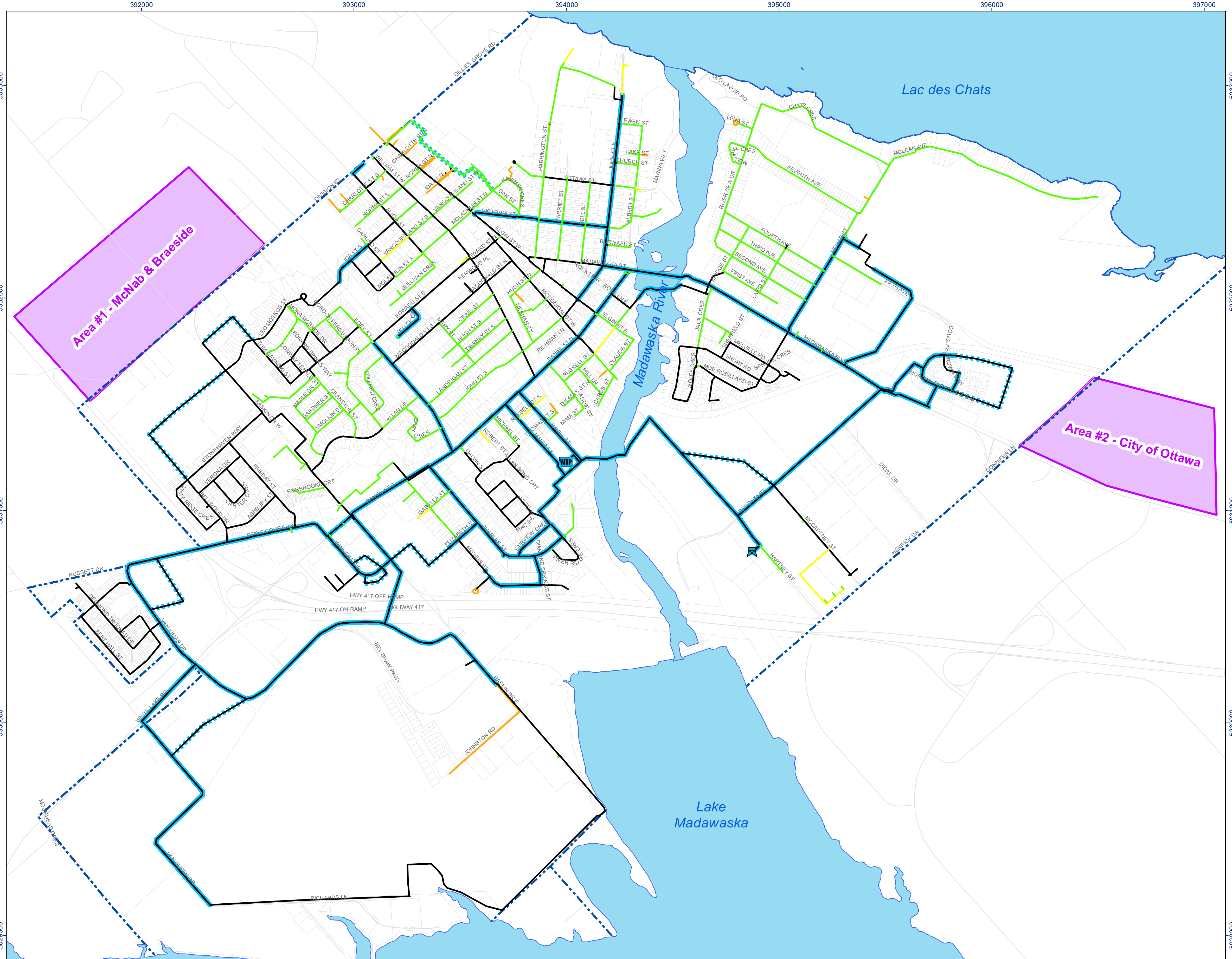


Project Location Prepared by CZ on 2023-10-19
Arnprior, ON

Client/Project 163401723
Town of Arnprior
2022 W&WW Master Plan Update

Figure No.
6-12

Title
Watermain Residual Capacity - Existing Conditions (2022) with Existing Infrastructure (MXDY Scenario)



Stantec

Legend

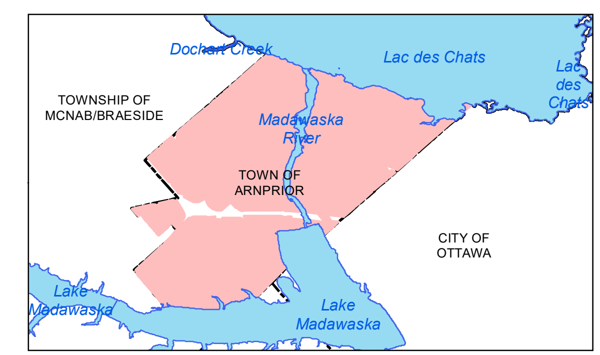
Watermain Residual Capacity at a Maximum Velocity = 1.5 m/s

- No Capacity
- 0 L/s < Capacity ≤ 10 L/s
- 10 L/s < Capacity ≤ 20 L/s
- 20 L/s < Capacity ≤ 30 L/s
- Capacity > 30 L/s
- Backbone / Feeder Main (Diameter ≥ 250mm)
- Assumed Future Local Distribution Looping
- Outside Interest Areas
- Water Treatment Plant (WTP)
- Elevated Storage Tank (EST)
- Municipal Boundary

N

0 250 500 Meters
(At original document size of 11x17)
1:18,500

Notes
1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Ontario_Hydro_Network_(OHN)_-_Waterbody.shp, Ontario_Hydro_Network_(OHN)_-_Waterbody (2).shp, Municipal_Boundary_-_Lower_and_Single_Tier.shp,* and *Arnprior_Roads_20220324* and *Arnprior_PropertyParcels_wAssessment_20220324.shp* provided by the Town of Arnprior.
3. Background: Contains information licensed under the Open Government Licence – Ontario



Project Location Prepared by CZ on 2023-10-19

Arnprior, ON

Client/Project 163401723

Town of Arnprior
2022 W&WW Master Plan Update

Figure No.

6-13

Title

Watermain Residual Capacity - 2042 Growth Conditions with Proposed Upgrades (MXDY Scenario)

Revised: 2023-11-17 By: jsidhu

6.6.3.2 HGL / Pressure Analysis

In addition to flow capacity analysis, the modelled minimum HGL (under MXDY demands) at the possible connection points identified in **Section 6.6.3.1** were further reviewed against the corresponding HGL required to satisfy a minimum pressure requirement of 40 psi ([.e., maximum ground elevation + 28.1 m (i.e., head equivalent to 40 psi)]. The HGL requirements and minimum HGL at potential connection points for each outside interest area are summarized in **Table 6-10**, **Table 6-11**, and **Table 6-12** below. Based on the model results, minimum HGL at all potential connection points are higher than the 40 psi equivalent HGL for the outside interest areas under both the existing conditions and 2042 conditions with proposed watermain upgrades. Therefore, no additional boosting would be required to service these two areas from the identified possible connection points.

Table 6-10: HGL Requirements for Outside Interest Areas

Area #	Area Name	Maximum Ground Elevation (1) (m)	40 psi Equivalent HGL at Maximum Ground Elevation (m)
1	McNab & Braeside	115	143.1
2	City of Ottawa	106	134.1

Note:
(1) Ground elevations based on LiDAR data.

Table 6-11: Minimum HGL under MXDY Demands at Possible Connection Points for Area 1 – McNab & Braeside

Scenario	Baskin Dr near Division St	Elgin St / Division St	William St / Division	Staye Court Dr / Hwy 417
Existing Conditions (2022) with Existing Infrastructure	147.1	147.1	147.1	147.1
2042 Growth Conditions with Proposed Upgrades	144.7	145.0	145.0	144.7

Table 6-12: Minimum HGL under MXDY Demands at Possible Connection Points for Area 2 – City of Ottawa

Scenario	Madawaska Blvd / Decosta St	Hartney St near EST	McCartney St near Herrick Dr
Existing Conditions (2022) with Existing Infrastructure	147.4	148.6	148.1
2042 Growth Conditions with Proposed Upgrades	145.5	148.4	147.1

6.7 Climate Change Considerations

The following section presents the assessment of the proposed refined wastewater and potable water system alternatives presented in **Section 6.5** with respect to climate change. Additional constraints associated with climate change are identified, and alternatives to address these constraints are presented.

Appropriate interpretation of these climate change considerations remains important. Whereas our analysis identifies enhancements or new recommendations to accommodate the currently projected climate change conditions, this does not equate to a need to implement these. The climate change analysis is meant to be a stress-test of the improvements that are being recommended. Within this context, upgrades that are identified may be further developed incorporating resiliency to be able to accommodate the climate change condition. In certain instances, this may not be feasible. In those instances, we recommend the Town consider the impacts of not accommodating the climate change condition. Other mitigative measures may be available and we recommend these be considered.

6.7.1 Climate Change Considerations for Wastewater Collection System Alternatives

The following subsection presents the assessment of the proposed wastewater collection system upgrades under a climate change scenario. Projects triggered by the climate change considerations are presented. The assessment of the upgraded wastewater collection system under climate change conditions consists of generating an updated design event, which is then used to evaluate the capacity of the upgraded sewers and PSs.

6.7.1.1 Updated Design Event under Climate Change

The online IDF_CC Tool[1] from the Institute for Catastrophic Loss Reduction (ICLR) was used to derive intensity-duration-frequency (IDF) parameters under a climate change scenario for the Environment Canada Shawville Station. This scenario is based on the shared socioeconomic pathway (SSP) 8.5, which generally represents the higher end of future greenhouse gas (GHG) emissions pathways. The climate change projections to 2100 were selected, as this horizon encompasses the lifespan of the infrastructure.

Updated 10-year and 25-year 6-hour design events were derived using the IDF parameters adjusted for climate change. **Figure 6-14** (10-year design event) and **Figure 6-15** (25-year design event) compare the rainfall hyetographs under historical (using the Environment Canada Shawville Station data) and climate change (exported from the IDF_CC tool) conditions. Under climate change conditions for the selected scenario, total rainfall volume and intensity increase by ~22-24%. As a result, the 10-year design event under climate change conditions is approximately equivalent to the historical 25-year design event, and the 25-year design event under climate change conditions is approximately equivalent to the historical 50-year design event. The 2042 growth conditions scenario with the sewer upgrades proposed in **Section 6.5** was simulated with the updated design events.

[1] Simonovic, S.P., A. Schardong, R. Srivastav, and D. Sandink (2015), IDF_CC Web-based Tool for Updating Intensity-Duration-Frequency Curves to Changing Climate – ver 7.0, Western University Facility for Intelligent Decision Support and Institute for Catastrophic Loss Reduction, open access https://www.idf-cc-uwo.ca.

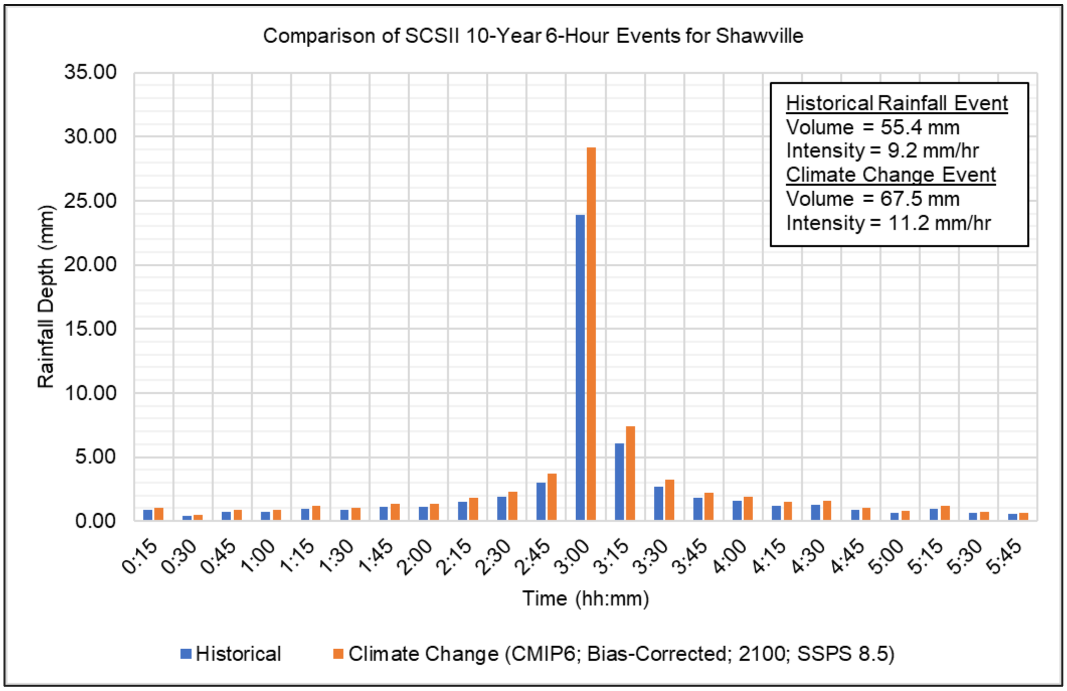


Figure 6-14: Comparison of 10-Year 6-Hour Design Event at the Shawville Station under Historical and Climate Change Conditions

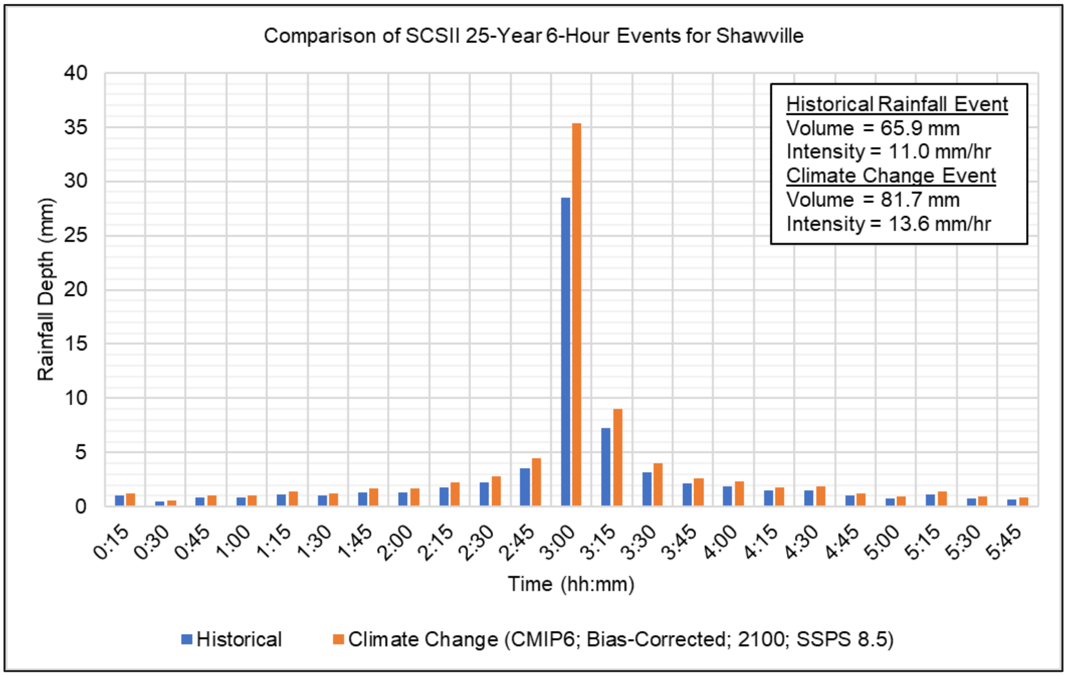


Figure 6-15: Comparison of 25-Year 6-Hour Design Event at the Shawville Station under Historical and Climate Change Conditions

6.7.1.1.1 Sewer System Performance under Climate Change

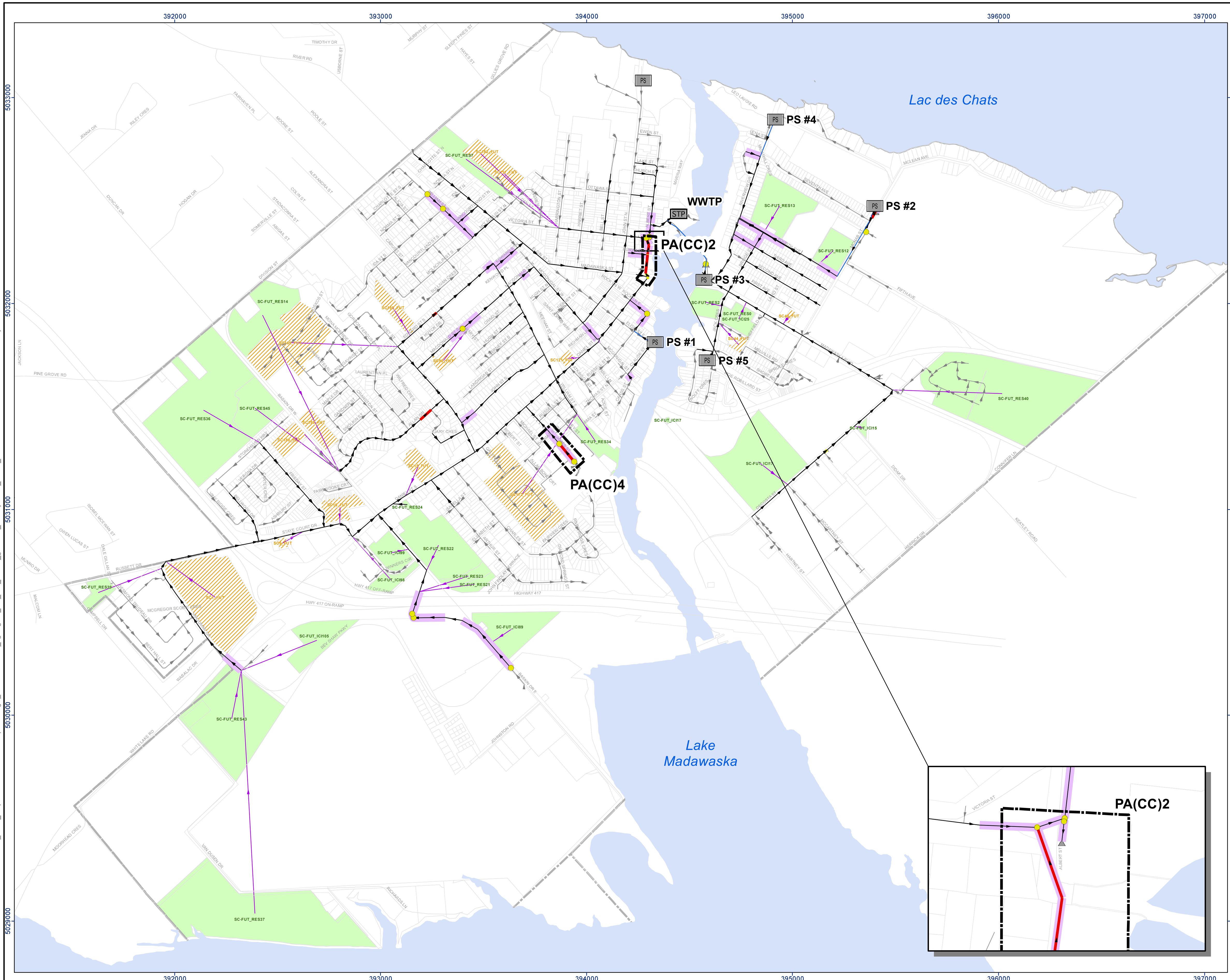
The wastewater collection system hydraulic model was used to assess the system under 2042 growth conditions with the planned projects (sewer separations, Edey St redirection) presented in **Table 5-27** and the sewer upgrades proposed in **Section 6.5.1.1** to address growth needs, and using the WWF design event adjusted for climate change. The same freeboard and pipe surcharge criteria were used to identify problem areas triggered by climate change. **Figure 6-16** shows the results of the system assessment and the location of problem areas for which servicing solutions to consider climate change were developed.

This assessment also assumes ideal pumps (flow in = flow out), such that conservative flows are conveyed downstream of the pump stations. Overall, the assessment shows 2 key locations of potential constraints related to climate change, for which solutions were developed:

- **Problem Area PA-2(CC) –Daniel St/Albert St**: Risks of basement flooding are observed along the shallow sewers on Albert St just upstream of the CSO location. While these sewers are shallow and upgrades for growth were previously recommended in **Section 6.5.1.1.2**, capacity constraints under the

25-year event under climate change conditions are observed. This indicates a need to further upsize the sewers to accommodate the higher peak flows observed when considering climate change.

- **Problem Area PA-4(CC) – James St**: Risks of basement flooding are observed along the shallow sewers on James St, from the WFP to Russell St. HGL issues (risk of basement flooding) were originally identified in **Chapter 2** (**Section 5**) (see **Figure 5-22**). However, those issues were associated with the sewers' shallow depth (pipe obvert < 1.8 m) rather than pipe capacity constraints, and therefore did not trigger the need for pipe upgrades to accommodate growth to 2042. Nonetheless, under climate change conditions, the pipes along James St experience capacity constraints, indicating a need to upgrade the sewers to accommodate the higher peak flows observed when considering climate change.



C:\Users\crazafimaharo.CORP\Documents\Local_Work_Tmp\Local-163401723-ArnpriorMP\gis_local\MXDs\tm3_figs\fig8-3_arn_san_results_grw2042_FuProj-Sdns_CCPA_20231108.mxd Revised: 2023-11-13 By: crazafimaharo

Stantec

Legend

- Sanitary Pump Station (PS)
- Overflow
- Wastewater Treatment Plant
- Sanitary Sewer (Not Modelled)
- Forcemains

HGL Freeboard

- At or Above
- Within Basement Level (Within 1.8 m of Surface)

Pipe Surcharge State

- Bottleneck (Undersized Sewer)
- Backwater Conditions
- Free-Flowing Conditions
- Shallow Pipes (Obvert Within 1.8 m of Surface)
- Problem

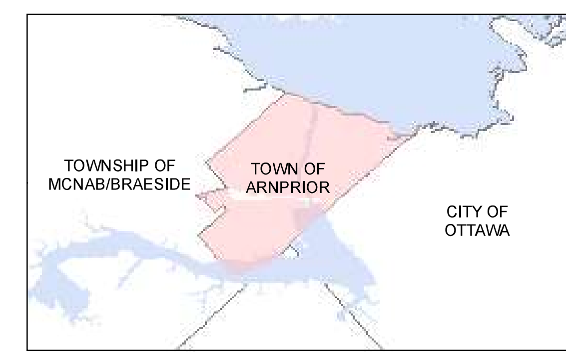
Growth Areas

- Growth Area
- Existing Subcatchment (with Redevelopments or Development/Occupancy of Vacant Properties)
- New Subcatchment

N

0 250 500 Meters
(At original document size of 11x17)
1:19,000

Notes
1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Export_Output_Parcel_Fabric.shp*, *Export_Output_Roads.shp*, *Export_Output_San_MH.shp* and *Export_Output_SAN_SEWER.shp* provided by the Town of Arnprior
3. Background: Contains information licensed under the Open Government Licence – Ontario
4. Abbreviations: FM: Flow Monitor; MH: Maintenance Hole; PS: Pump Station; WWTP: Wastewater Treatment Plant



Project Location Prepared by CR on 2023-07-17
Arnprior, ON
Client/Project 163401723
Town of Arnprior
2022 W&WW Master Plan Update
Figure No.
6-16
Title
2042 Growth Conditions with Planned Projects & Proposed Infrastructure - 25-Year SCS II 6 Hour Event (Climate Change)

6.7.1.1.2 Pumping Stations Performance under Climate Change

The PS capacities were also compared to the peak modelled incoming flows under the 10-year and 25-year design event with and without climate change, for the 2042 horizon. The results are summarized in **Table 6-13.**

This assessment assumes ideal pumps (flow in = flow out), to identify the peak incoming flows that the PS should convey under this scenario. PS upgrades were previously recommended to accommodate the flows under the 10-year 2042 growth conditions (see **Section 6.5.1.2**). The PS upgrades should therefore consider the potential increased peak incoming flows under climate change conditions.

Table 6-13: 2042 Peak Modelled Incoming Flows to Pumping Station (Original Results & Climate Change Considerations)

Name	**PS #1**	**PS #2**	**PS #3**	**PS #5**
Location	**Elgin St E at Claude St**	**McNab St at Seventh Ave**	**Madawaska Blvd, west of Bridge St**	**Wolff Cres**
Number of Pumps at PS	2	2	3(1)	2
Firm Capacity (Largest Pump Out of Service) (L/s)	25	59	275	7
20-Year Horizon (2042) Peak Modelled Incoming Flow (L/s) *with Planned Projects*(1) and with Proposed Infrastructure Upgrades(2)				
10-Year Design Event: Original	81(3), *44*	*71*	*371*	*5.4*
10-Year Design Event: Climate Change	98(3), *54*	*84*	*445*	*6.2*
25-Year Design Event: Original	96(3), *53*	*84*	*436*	*6.1*
25-Year Design Event: Climate Change	119(3), *65*	*100*	*534*	*7.2*

Notes:
(1) Future (planned) projects presented in **Table 5-27**.
(2) Proposed sewer upgrades presented in **Section 6.5.1.1**.
(3) Without upstream sewer separation (project SEW-FUT-8 in **Table 5-27**).

6.7.1.1.3 WWTP Performance under Climate Change

The WWTP performance assessment [**Chapter 2** (**Section 5**)] did not identify the need for WWTP capacity upgrades, based on recent historical trends in average daily flows. Historical multi-year trends in peak hour and peak daily flows were not evaluated against rainfall events due to limitations in the availability of sub-daily rainfall data. Nonetheless, it is generally expected that climate change will impact the occurrence of extremes. That is to say, the peak and minimum flow conditions. As a result, climate change should be considered in terms of how wet and drought conditions may impact the WWTP's processes and capacities.

6.7.1.2 Improvements to Sewers with Climate Change Considerations

The following improvements to the sewer collection system are recommended to consider climate change.

6.7.1.2.1 Problem Area PA-2(CC) – Daniel St Upgrades with Considerations for Climate Change

PA-2(CC) consists of 600 mm diameter sewers along Daniel St and Albert St. Upgrades to the 600 mm diameter sewers to accommodate growth to 2042 were previously identified in **Section 6.5.1.1.2**. The peak HGL profile in the upgraded sewers under 2042 25-year design event conditions, adjusted for climate change, is shown in **Figure 6-17**.

The following is recommended to increase sewer capacity and eliminate HGL issues under climate change conditions, as shown in **Figure 6-18**:

- **SEW-PA2(CC)-A)** Upgrade the sewers along Daniel St and Albert St, as follows:
  - SEW-PA2(CC)-A1: Upgrade 66 m of 600 mm diameter sewers to 675 mm along Daniel St from south of Madawaska St to Madawaska St,
  - SEW-PA2(CC)-A2: Upgrade 160 m of 600 mm diameter sewers to 675 mm along Daniel St/Albert St from Madawaska St to Victoria St, and
  - SEW-PA2(CC)-A3: Upgrade 38 m of 600 mm diameter sewers to 825 mm along Albert St from Madawaska St to Victoria St.

- Sections SEW-PA2(CC)-A2 overlaps with the Town’s planned project to upgrade the Albert St sewers from McEwen St to Madawaska St (project SEW-FUT-6 in **Table 5-27**). The sizing proposed herein can be used to inform the next stages of planning and design of this project.

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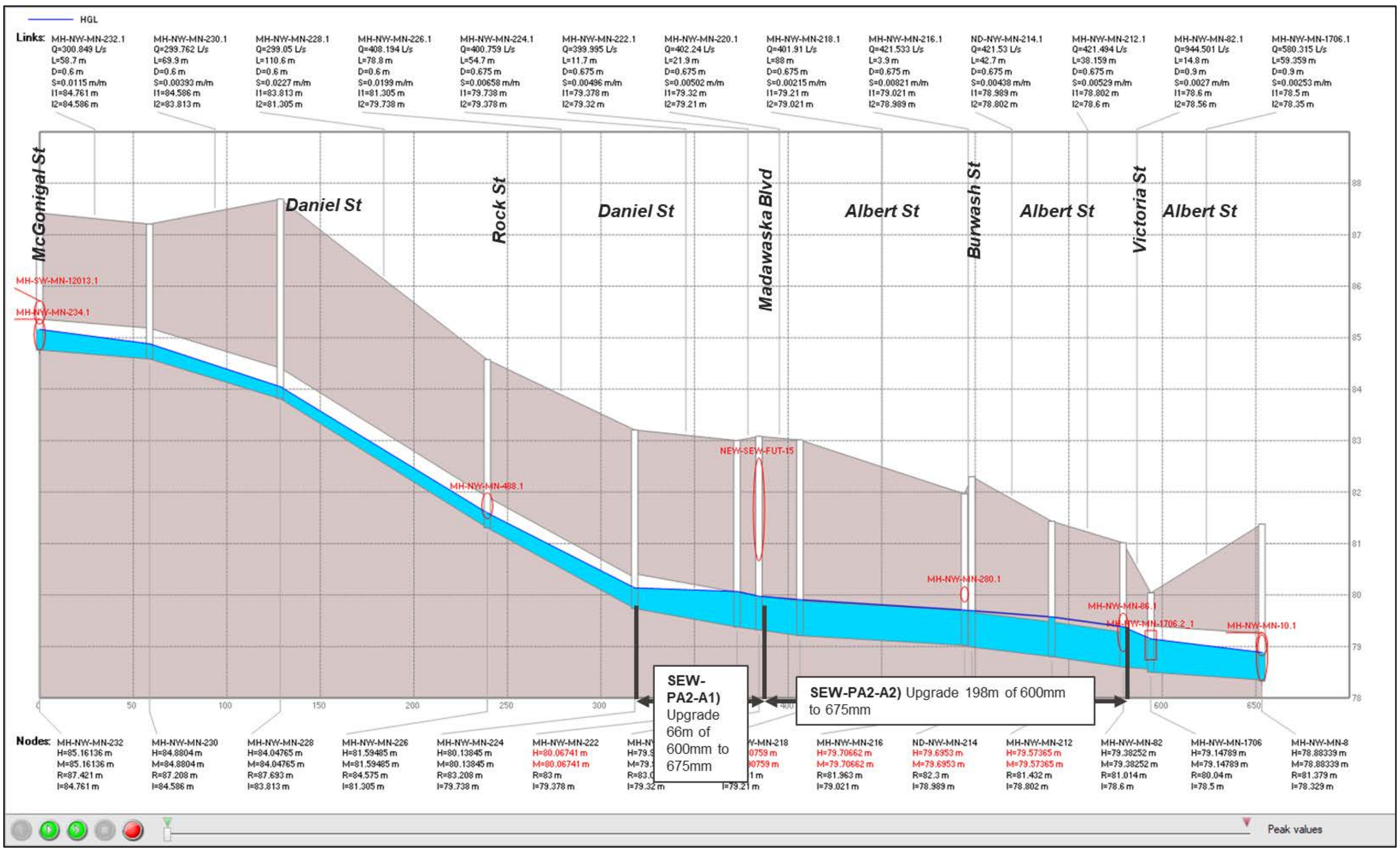


Figure 6-17: Problem Area PA-2(CC) - 2042 Conditions 25-Year Event (with Climate Change) Peak HGL Profile (Post-Upgrade)

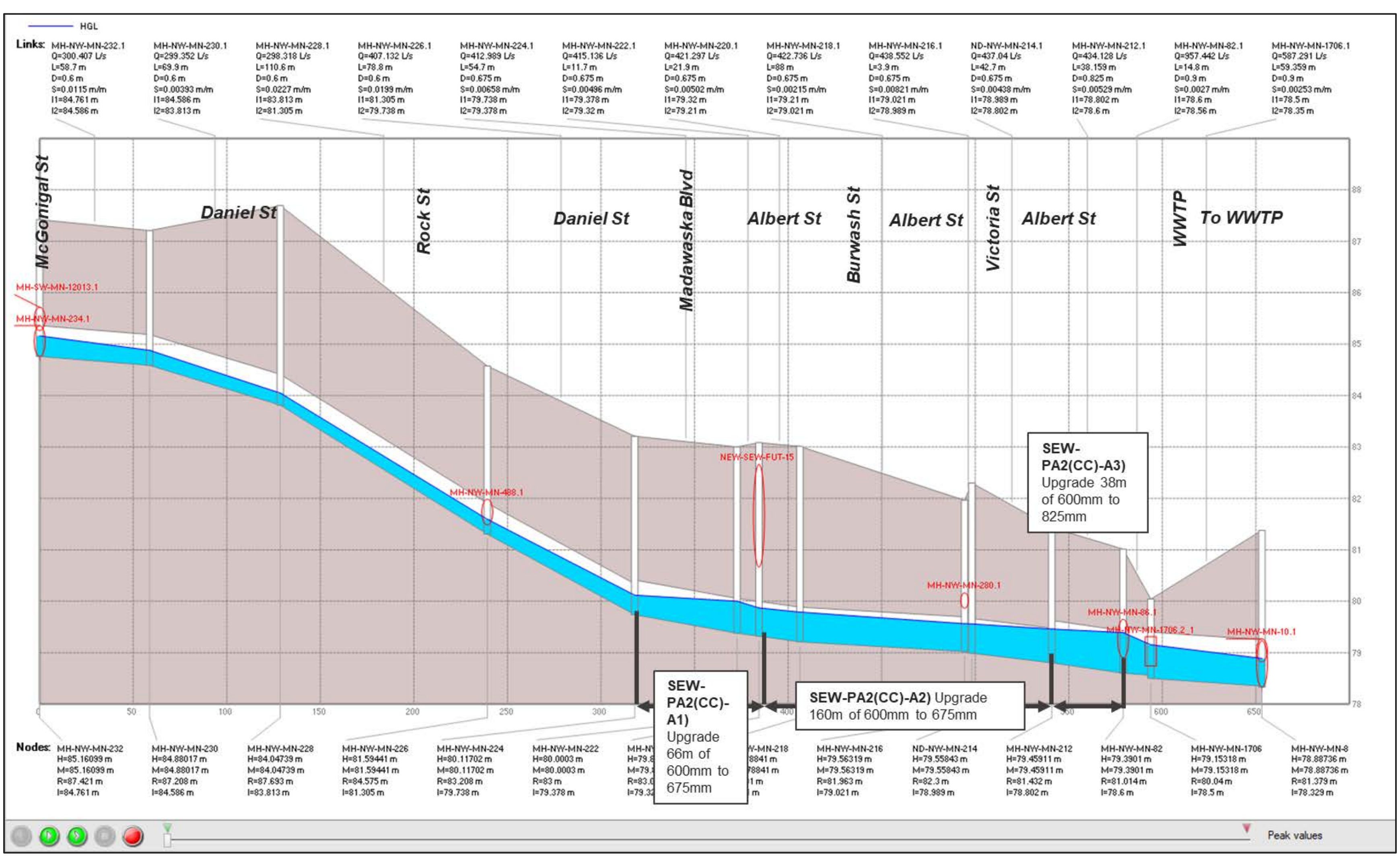


Figure 6-18: Problem Area PA-2(CC) - 2042 Conditions 25-Year Event (with Climate Change) Peak HGL Profile (Post-Upgrade, with Additional Climate Change Considerations)

6.7.1.2.2 Problem Area PA-4(CC) – James St Upgrades with Considerations for Climate Change

PA-4(CC) consists of 250 mm and 300 mm diameter sewers along James St, from the Water Filtration Plant to Daniel St. This area includes combined sewers, which are planned for separation, as presented in **Table 5-27** (project SEW-FUT-10). Following sewer separation, HGL issues (risk of basement flooding) were originally identified in **Chapter 2** (see **Figure 5-22**). However, those issues were associated with the sewers' shallow depth (pipe obvert < 1.8 m) rather than pipe capacity constraints, and therefore did not trigger the need for pipe upgrades to accommodate growth to 2042. Nonetheless, under climate change conditions, the pipes along James St experience capacity constraints. The peak HGL profile under 2042 25-year design event conditions, adjusted for climate change, is shown in **Figure 6-19**.

The following is recommended to increase sewer capacity and eliminate HGL issues under climate change conditions, as shown in **Figure 6-20**:

- **SEW-PA4(CC)-A)** Confirm inverts and ground elevations along James St with a topographical survey
- **SEW-PA4(CC)-B)** Upgrade 215 m of 250 mm diameter sewers to 300 mm along James St, from the WFP to east of Russell St:
  - The existing combined sewers along James St are currently planned for separation (project SEW-FUT-10 in **Table 5-27**). The proposed sewer upgrade could be implemented as part of the planned sewer separation.
- **SEW-PA4(CC)-C)** Lower the upgraded sewers along James St, from the WFP to Daniel St.
  - Upgrading the sewers increases their conveyance capacity, however, HGL issues (risk of basement flooding) still arise if the sewers remain shallow. Laying the sewers deeper along James St to match the lowest elevation at the intersection with Daniel St and reducing the slope of the most upstream sewer partially eliminate the HGL issues. However, the depth of cover is still low at the most upstream end, where risks of basement flooding are still observed. Confirming the ground elevations along James St should be prioritized to further validate those risks of HGL issues, and additional solutions to increase the depth of cover should be explored at a detailed design stage.

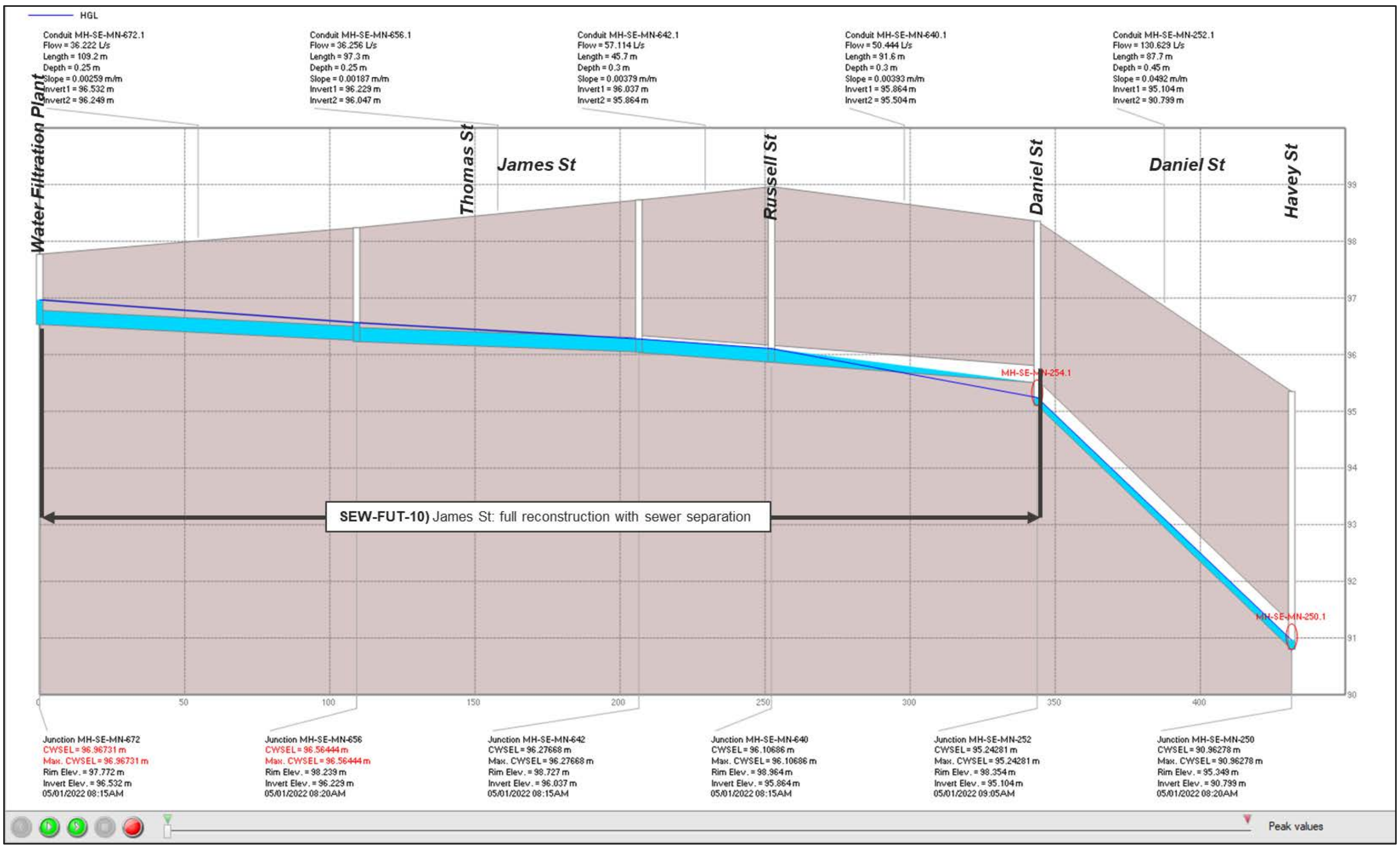


Figure 6-19: Problem Area PA-4(CC) - 2042 Conditions 25-Year Event (with Climate Change) Peak HGL Profile (Existing Infrastructure, with Planned Sewer Separations & Edey St Redirection)

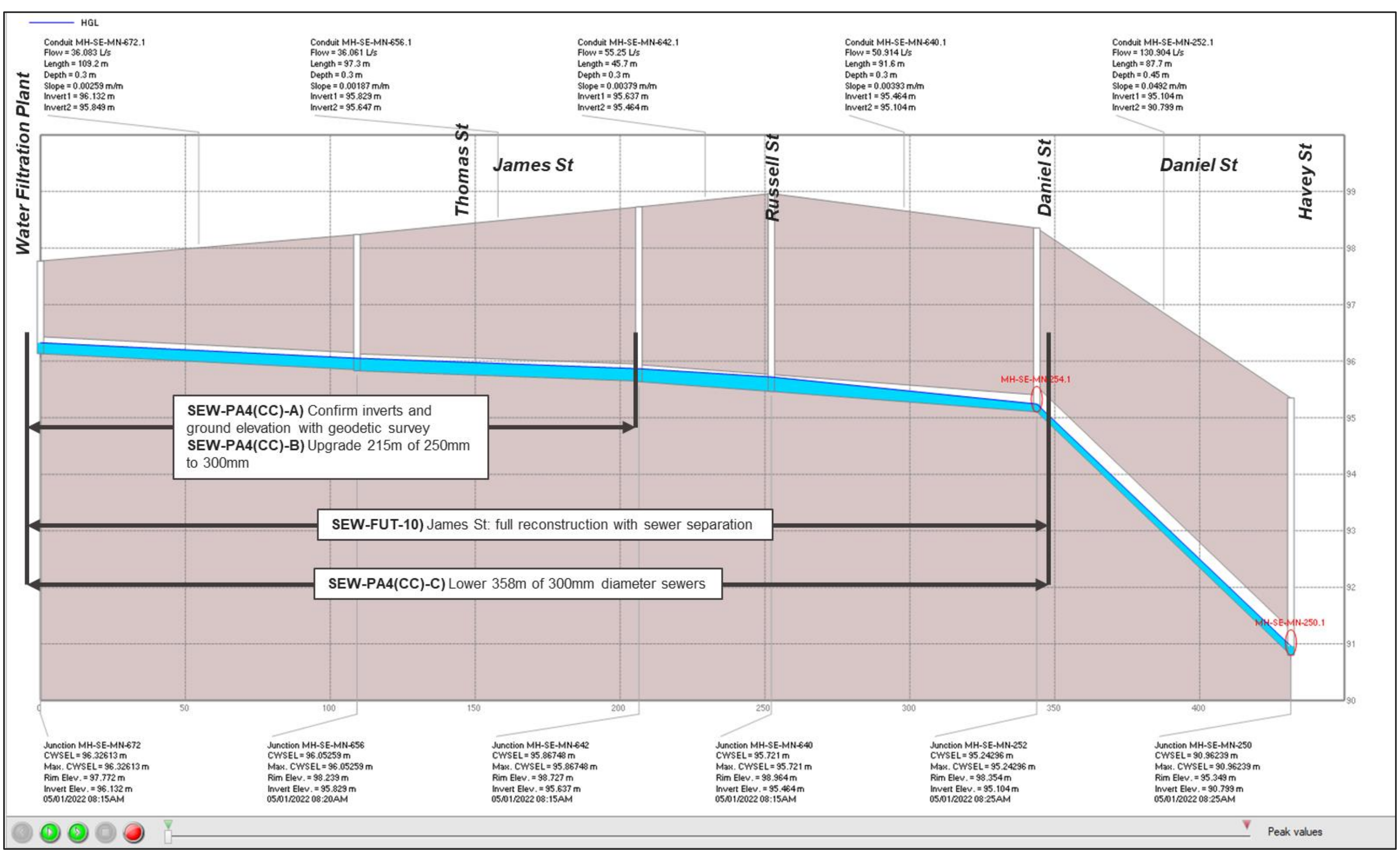


Figure 6-20: Problem Area PA-4(CC) - 2042 Conditions 25-Year Event (with Climate Change) Peak HGL Profile (Post-Upgrade)

6.7.1.3 Improvements to Pumping Stations with Climate Change Considerations

As shown in **Table 6-13**, peak modelled incoming flows to the PSs are expected to increase under climate change conditions. The PS upgrades identified in **Section 6.5.1.2** should therefore consider the potential higher peak flows in the PS sizing, as presented in **Table 6-14**.

Table 6-14: Climate Change Considerations for the Sizing of PSs

Name	Location	PS Upgrade Project for Growth	PS Upgrade Project for Growth with Climate Change Considerations
PS #1	Elgin St E at Claude St	**PS1-C)** Upgrade PS #1 to accommodate peak incoming flows of **81 L/s** under the 10-year design event for a 20-year planning horizon. May be reduced with upstream sewer separation.	**PS1(CC)-C)** Upgrade PS #1 to accommodate peak incoming flows of **98 L/s** under the 10-year design event for a 20-year planning horizon. May be reduced with upstream sewer separation.
PS #2	McNab St at Seventh Ave	**PS2-B)** Upgrade PS #2 to accommodate peak incoming flows of **71 L/s** under the 10-year design event for a 20-year planning horizon.	**PS2(CC)-B)** Upgrade PS #2 to accommodate peak incoming flows of **84 L/s** under the 10-year design event for a 20-year planning horizon.
PS #3	Madawaska Blvd, west of Bridge St	**PS3-A)** Upgrade PS #3 to accommodate peak incoming flows of **371 L/s** under the 10-year design event for a 20-year planning horizon.	**PS3(CC)-A)** Upgrade PS #3 to accommodate peak incoming flows of **445 L/s** under the 10-year design event for a 20-year planning horizon.
PS #5	Wolff Cres	No upgrade required	No upgrade required

6.7.1.4 WWTP Climate Change Considerations

Overall, climate change should be considered throughout the different recommendations presented in **Section 6.5.1.3.** The following is further recommended to consider climate change impacts on the WWTP:

- **WWTP(CC)-7)** Undertake climate change resiliency studies, to identify the main risks to the WWTP related to climate change and potential adaptation measures. Examples of climate change impacts which could be considered in a resiliency study are presented in **Table 6-15**.

Table 6-15: Examples of Potential Climate Change Impacts and Adaptation Measures for the WWTP

Climate Parameter	Impact	Potential Adaptation Measures
More intense precipitation events	Increased peak incoming flows to the WWTP	Design processes to accommodate potential upgrades of equipment without major infrastructure upgrades if peak flows increase. Consider upgrades within the sanitary collection system to reduce peak inflows to the WWTP.
More severe storms		
More intense spring melt (due to higher temperatures combined with greater snow loads)		
More intense precipitation events	Flooding	Build new process structures and buildings above the floodplain limit, with a buffer to accommodate future floods. Relocating equipment away from flood-prone areas. Verify and update emergency measures for flooding.
Decreased precipitation	Lower river flows and reduced assimilative capacity	Design processes to adjust treatment, considering potential reduced assimilation capacity.
Prolonged droughts		
Temperature increase	Odour generation	Consider higher oxygen demand and lower oxygen transfer capacity in design of aeration facilities.

Climate Parameter	Impact	Potential Adaptation Measures
Severe storms	Interruption of deliveries, power outages	Design storing capacity to provide additional reserve and minimize impacts of delayed deliveries on plant operation. Size backup power generators for critical plant processes. Co-generation of energy.

6.7.2 Climate Change Considerations for Potable Water System Alternatives

The following subsections present the assessment of the proposed potable water distribution system upgrades under climate change conditions. Moreover, assessment of the system under certain emergency scenarios (i.e., failures of key feedermains, HLPs, and EST) are also presented.

6.7.2.1 Potable Water System Assessment under Climate Change

As described in **Chapter 2** (**Section 5**), this assessment is representative of climate change impacts, where demands would increase with temperatures and extreme weather events. For this assessment, a sensitivity analysis was performed by increasing the MXDY demand projections by a factor of 10%. Both the impacts on growth capacity triggers and distribution system level of service (LOS) were assessed.

6.7.2.1.1 Treatment, Storage, and High Lifting Pumping

Table 6-16 summarizes the capacity triggers comparison between the baseline demand projections as presented in **Section 5.5.2** and the increased demand projections. Details of capacity requirements are illustrated in **Figure 6-21**, **Figure 6-22**, and **Figure 6-23**.

Based on the analysis, increasing demand projections by 10% would accelerate the need for WFP treatment upgrades by 4 years to 2034. Additional storage would be required 2 years earlier in 2031, while the pumping upgrades at the WFP would be required 1 year earlier, by 2033.

Table 6-16: Sensitivity of Capacity Triggers to Increased Demands

Infrastructure	Capacity Triggers Baseline Demand Projections	Capacity Triggers +10% Increase in Demand Projections	Capacity Triggers Difference in Triggers	Additional Capacity Required by 2042 Baseline Demand Projections	Additional Capacity Required by 2042+10% Increase in Demand Projections
Treatment	2038	2034	4 years earlier	631 m^3/d	1,728 m^3/d
Storage	2033	2031	2 years earlier	1,592 m^3	1,935 m^3
High Lift Pumping	2034	2033	1 year earlier	45 L/s	58 L/s

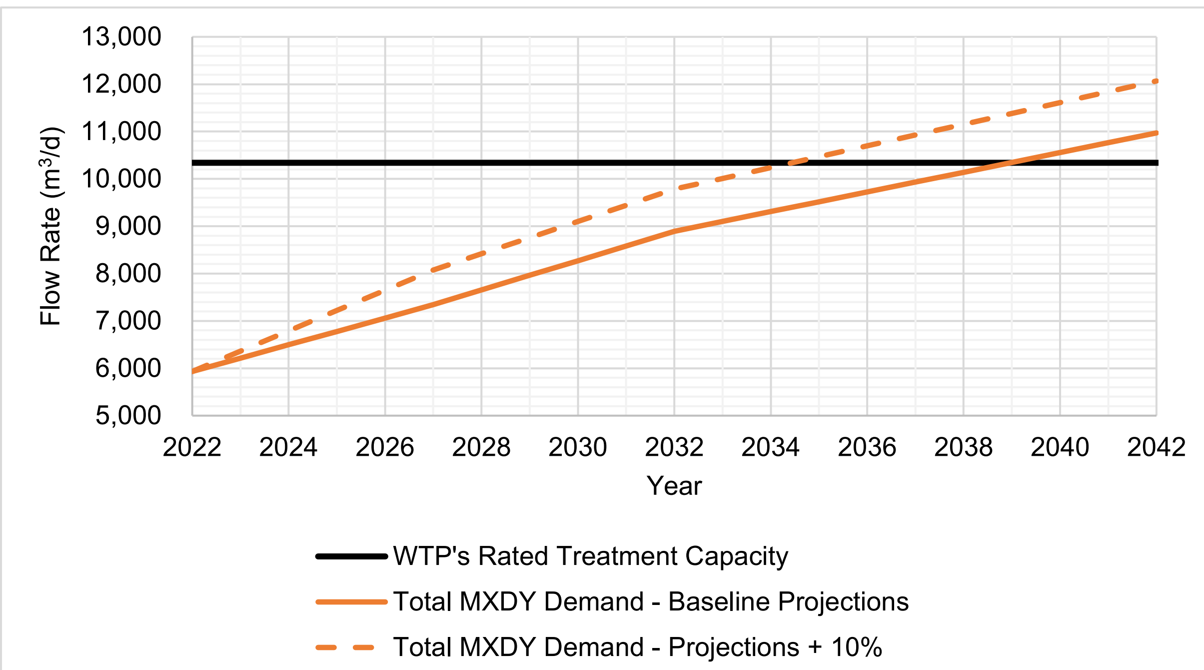


Figure 6-21: Treatment Capacity Requirements – Sensitivity Analysis

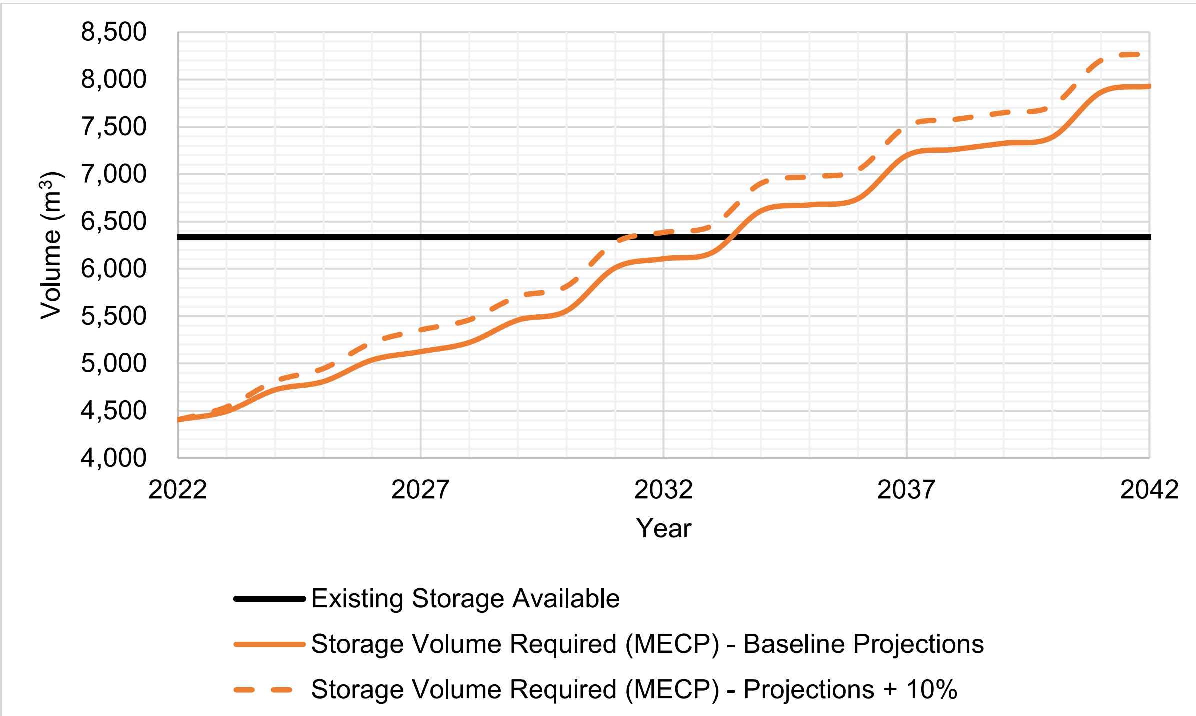


Figure 6-22: Storage Capacity Requirements – Sensitivity Analysis

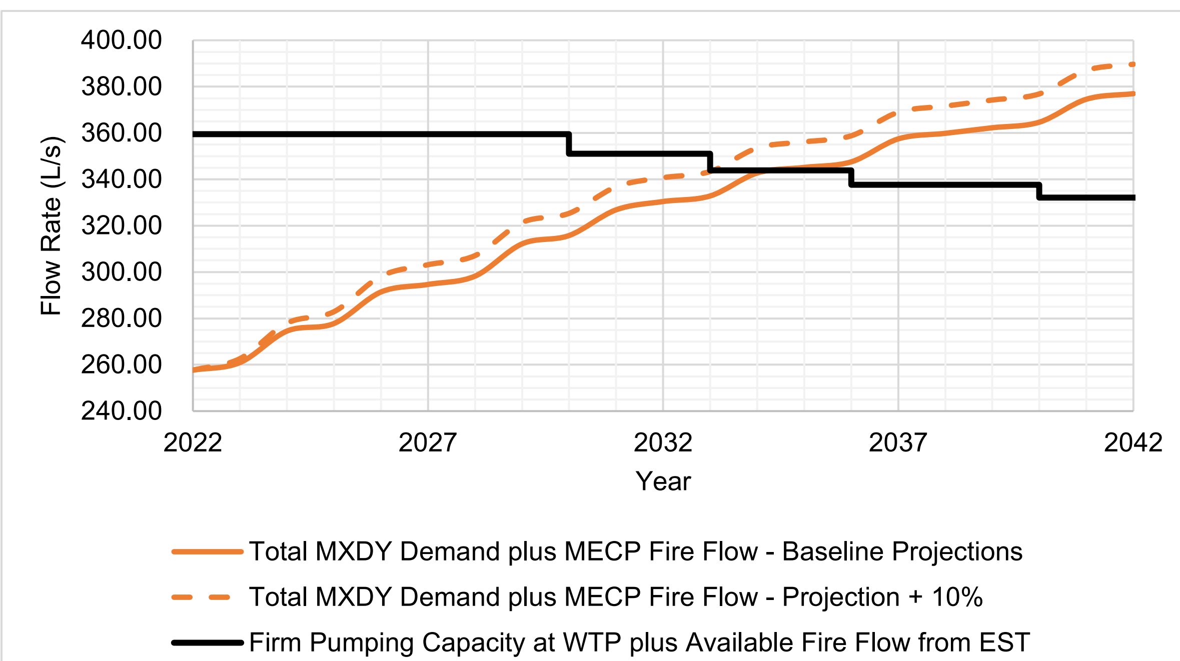
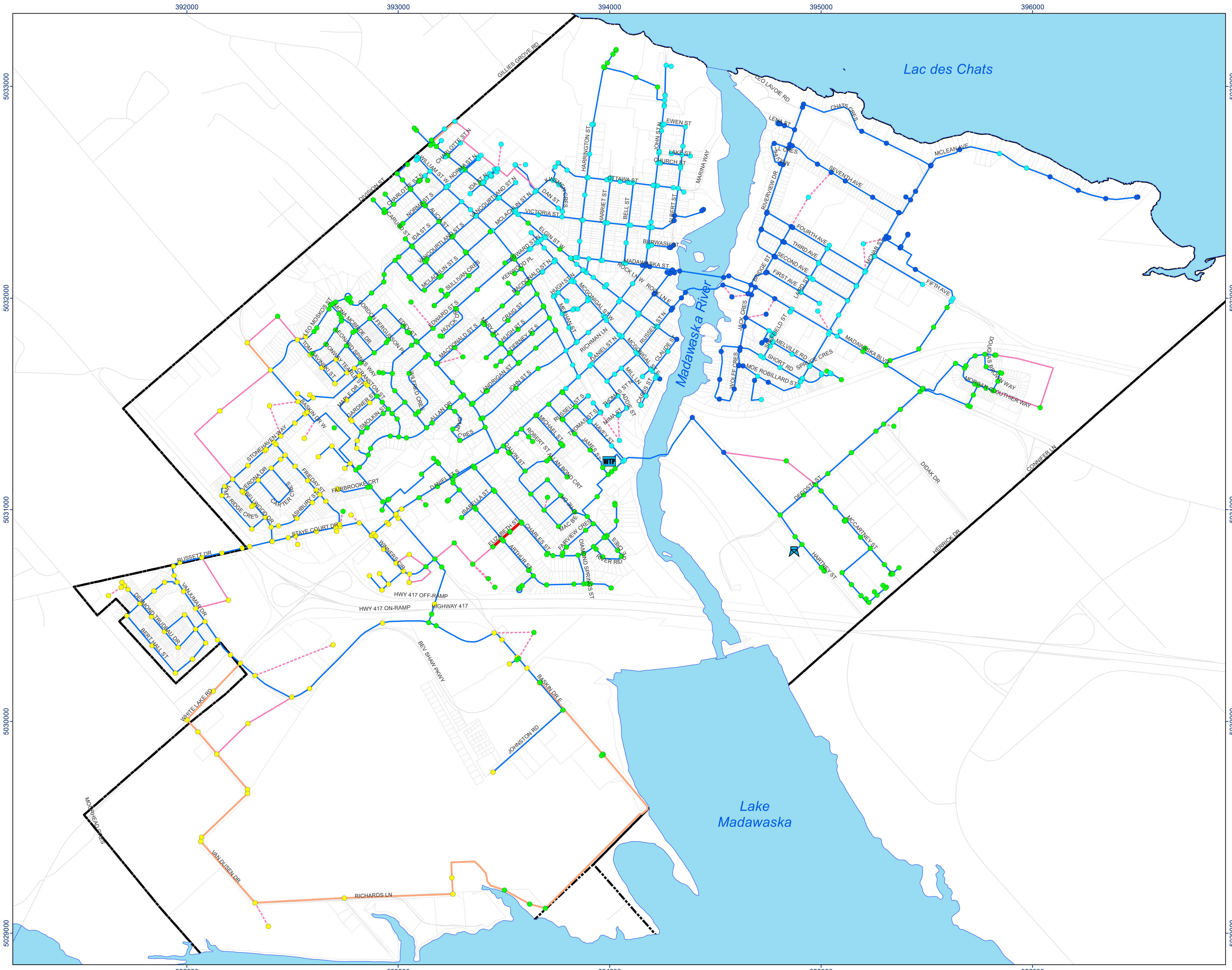


Figure 6-23: Pumping Capacity Requirements – Sensitivity Analysis

6.7.2.1.2 Distribution Pipe Network

The 2042 model scenario including the proposed potable water distribution system upgrades and 10% increase in demands was run under MXDY demand conditions, with all boundary conditions remained unchanged as presented in **Section 6.5.2.2**. The minimum pressure results are illustrated in **Figure 6-24**. Hydraulic modelling shows minimum pressures ranging from 44 to 92 psi with the EST operating between 59 to 80% full. No minimum pressures less than 40 psi are anticipated. Therefore, no further water distribution system upgrades are needed given the climate change considerations.



Stantec

Legend

Minimum Pressure

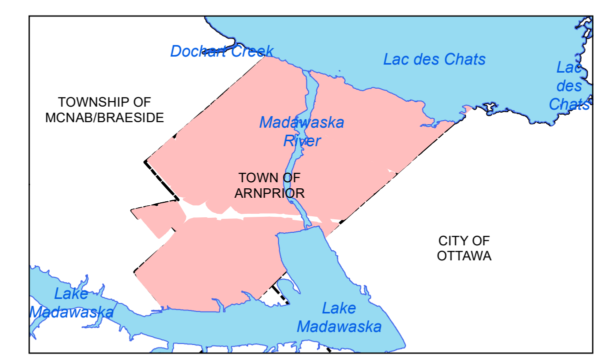
- Min. Pressure ≤ 20 psi
- 20 psi < Min. Pressure ≤ 40 psi
- 40 psi < Min. Pressure ≤ 50 psi
- 50 psi < Min. Pressure ≤ 70 psi
- 70 psi < Min. Pressure ≤ 80 psi
- 80 psi < Min. Pressure ≤ 100 psi
- Min. Pressure > 100 psi
- Existing Watermains
- Dummy Pipes Added for Growth Areas
- Assumed Future Local Distribution Looping (Internal to Development Area)
- Proposed Upgrade of Existing Watermain
- Proposed New Watermain / Watermain Upgrade (Developer-Driven)
- Water Treatment Plant (WTP)
- Elevated Storage Tank (EST)
- Municipal Boundary

N

0 250 500 Meters
(At original document size of 11x17)
1:18,500

Notes

1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Ontario_Hydro_Network_(OHN)_-_Waterbody.shp, Ontario_Hydro_Network_(OHN)_-_Waterbody (2).shp, Municipal_Boundary_-_Lower_and_Single_Tier.shp*, and *Arnprior_Roads_20220324* and *Arnprior_PropertyParcels_wAssessment_20220324.shp* provided by the Town of Arnprior.
3. Background: Contains information licensed under the Open Government Licence – Ontario



Project Location
Arnprior, ON

Prepared by CZ on 2023-08-09
Revised by CZ on 2024-01-25

Client/Project
163401723
Town of Arnprior
2022 W&WW Master Plan Update

Figure No.
6-24

Title
Model Results: 2042 Conditions with Solutions and 10% Increase in Demand Projections – MXDY Minimum Pressures

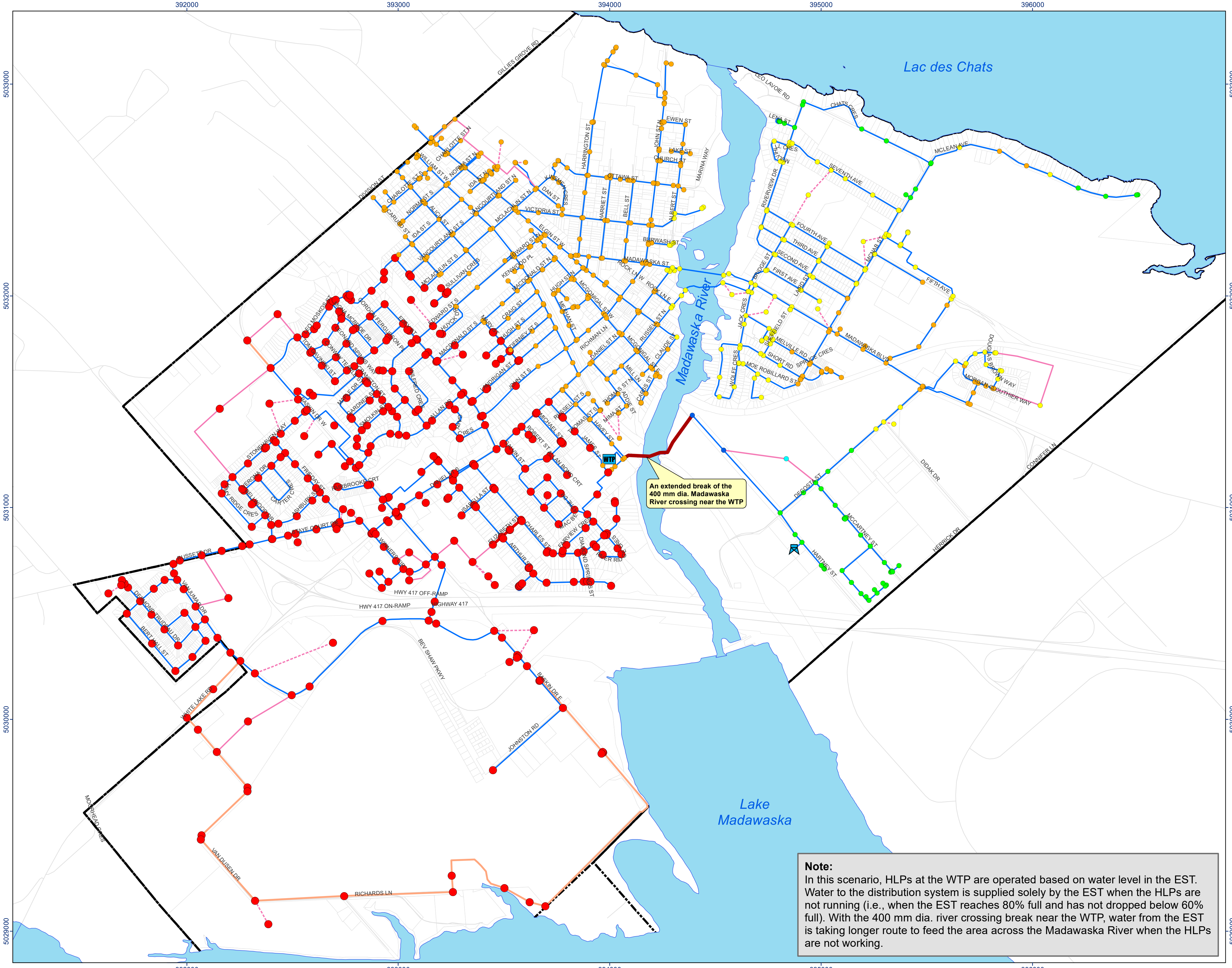
6.7.2.2 Potable Water System Assessment under Emergency Scenarios

In addition to the sensitivity analysis, a reliability analysis was conducted to assess the performance of the system under future (2042) emergency/failure scenarios. Five emergency scenarios with major infrastructure failure including key feedermain breaks, HLP failure, and EST out of service were modelled for 72-hr under 2042 AVDY demand conditions. Details of each emergency scenario simulated for the reliability assessment are summarized as follows:

- Feedermain break #1: This scenario assumes an extended break of the 400 mm dia. Madawaska River crossing near the WFP. This 400 mm dia. river crossing is the direct feed from the WFP to the EST. During this watermain break, water to the EST could be fed alternatively via a less direct route through the two 300 mm dia. river crossings near Madawaska Blvd.
- Feedermain break #2: This scenario assumes an extended break of the 300 mm dia. Madawaska River crossing along Madawaska Blvd. In comparison to the other 300 mm dia. river crossing near Russell St, the watermain on Madawaska Blvd was selected due to its greater simulated flow and older pipe age.
- Feedermain break #3: This scenario assumes an extended break of the 610 mm dia. watermain immediately downstream of the WFP on Havey St. A secondary feed to the areas serviced primarily by the 610 mm dia. pipe could be provided by the 250 mm dia. watermain along James St.
- HLP failure: This scenario assumes extended outage of the three HLPs in the WFP. For this scenario, the system operates in “level mode” with all pumps at the WFP were turned off and the initial level in the EST was set to its maximum level (i.e., 10.7 m).
- EST out of service: This scenario assumes that the EST is taken out of service (e.g., during maintenance of the tank). Under this scenario with the modelled tank offline, the system would operate in “pressure mode” with one pump on at the WFP and set to operate such that a maximum discharge pressure of 92 psi is not exceeded.

Figure 6-25 to **Figure 6-27** show the results of the reliability analysis for three feedermain breaks scenarios under 2042 conditions, with proposed infrastructure upgrades. According to the hydraulic modelling results, the potable water distribution system with proposed upgrades can provide AVDY demands while maintaining a pressure of 40 psi during the 300 mm dia. river crossing break on Madawaska Blvd (break #2) and 610 mm dia. watermain break on Havey St (break #3). However, the minimum required LOS (i.e., 40 psi) cannot be maintained in the event of a watermain break in the 400 mm dia. river crossing near the WFP (break #1), especially in the southwestern area of the Town. In this scenario, HLPs at the WFP are operated under normal system operating conditions (i.e., one HLP operating at a time based on water level in the EST); water to the distribution system would be supplied solely by the EST when the HLP is not running (i.e., when the EST reaches 80% full and has not dropped below 60% full). During the 400 mm dia. river crossing break (break #1), water from the EST would take longer route to feed the area across the Madawaska River when the HLP is not working, which results in lower pressure (less than 40 psi) in the southwestern area. This scenario demonstrates the critical nature of this 400 mm dia. watermain that acts as the most direct feedermain between the WFP/southwestern area and the EST, and which in turn sees relatively high head losses as presented in **Figure F1-2** in **Appendix F.1**. Therefore, in the event of a failure of this feedermain, it is recommended that the system be operated similar to that under pressure mode conditions (i.e., HLP operating within a required pressure range to feed the distribution system, especially the southwestern area, at all times during the feedermain break) such that the minimum required pressure of 40 psi can be maintained throughout the system until repairs can be completed. An additional alternative feed across the river with a similar direct route to the EST may also be considered.

In terms of pumping reliability analysis, deficits were identified based on hydraulic modelling results. The hydraulic analysis shows that the full EST is able to supply AVDY demands for 10-hr without additional water fed from the WFP, while maintaining the minimum pressure requirement of 40 psi. The Town is encouraged to establish an emergency plan to ensure that the pumping capacity can be restored within 10-hr. Additional standby capacity assessments and facility upgrades (if needed) are also recommended to provide sufficient standby pumping capacity and backup power at the WFP. As for storage reliability, the hydraulic analysis indicates that minimum pressures greater than 40 psi throughout the water distribution system can be sustained solely by water pumping from the WFP. As noted by the Town, the system was operated with the EST taken out of service for re-painting for a month in 2021, which confirmed that the HLPs are capable to operate within a required range of pressure without over-pressurizing the system.



Note:
In this scenario, HLPs at the WTP are operated based on water level in the EST. Water to the distribution system is supplied solely by the EST when the HLPs are not running (i.e., when the EST reaches 80% full and has not dropped below 60% full). With the 400 mm dia. river crossing break near the WTP, water from the EST is taking longer route to feed the area across the Madawaska River when the HLPs are not working.

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Legend

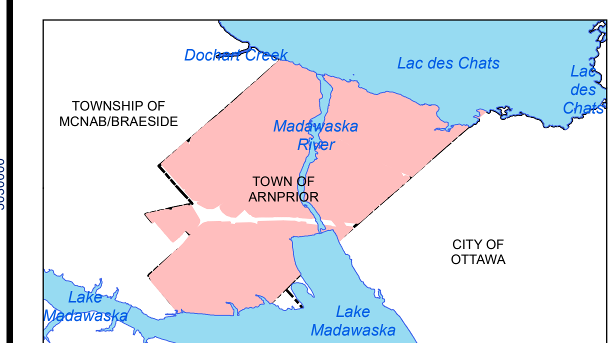
Minimum Pressure

- Min. Pressure ≤ 20 psi
- 20 psi < Min. Pressure ≤ 40 psi
- 40 psi < Min. Pressure ≤ 50 psi
- 50 psi < Min. Pressure ≤ 70 psi
- 70 psi < Min. Pressure ≤ 80 psi
- 80 psi < Min. Pressure ≤ 100 psi
- Min. Pressure > 100 psi
- Reliability Analysis Failure Location - Watermain Break #1
- Existing Watermains
- Dummy Pipes Added for Growth Areas
- Assumed Future Local Distribution Looping (Internal to Development Area)
- Proposed Upgrade of Existing Watermain
- Proposed New Watermain / Watermain Upgrade (Developer-Driven)
- Water Treatment Plant (WTP)
- Elevated Storage Tank (EST)
- Municipal Boundary

N

0 250 500 Meters
(At original document size of 11x17)
1:18,500

Notes
1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Ontario_Hydro_Network_(OHN)_-_Waterbody.shp*, *Ontario_Hydro_Network_(OHN)_-_Waterbody (2).shp*, *Municipal_Boundary_-_Lower_and_Single_Tier.shp*, and *Arnprior_Roads_20220324* and *Arnprior_PropertyParcels_wAssessment_20220324.shp* provided by the Town of Arnprior.
3. Background: Contains information licensed under the Open Government Licence – Ontario



Project Location
Arnprior, ON

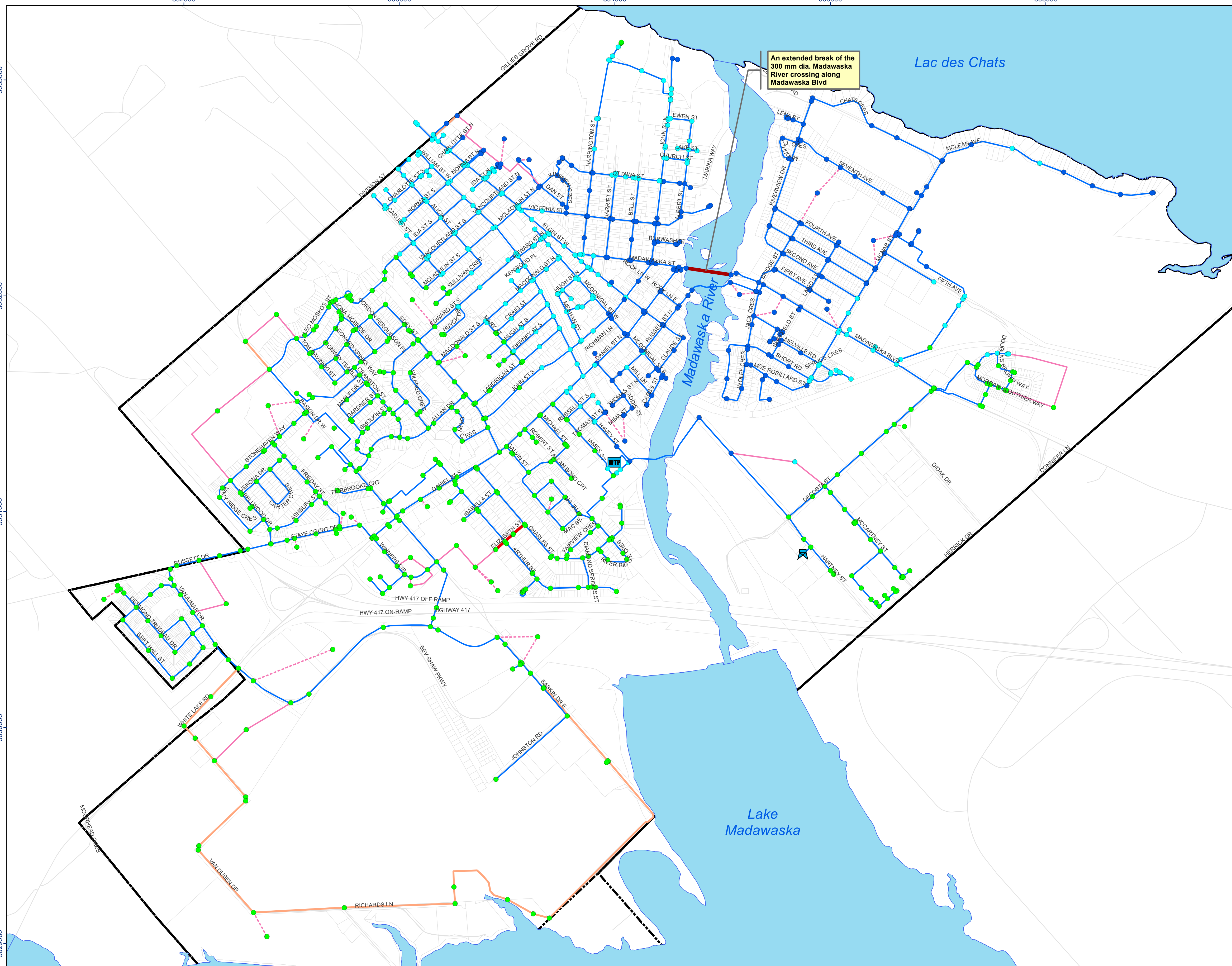
Prepared by CZ on 2023-08-09
Revised by CZ on 2024-01-25

Client/Project
163401723
Town of Arnprior
2022 W&WW Master Plan Update

Figure No.
6-25

Title
Model Results: 2042 Conditions with Solutions and Watermain Break #1 – AVDY Minimum Pressures

C:\Users\chzheng\Documents\My Documents\temp\163401723 Arnprior Water Master Plan\figures\MP_Report\mxd\fig6-25_am_wt_2042_w_solns_wm_break1_model_results_20240125.mxd Revised: 2024-01-25 By: chzheng



Stantec

Legend

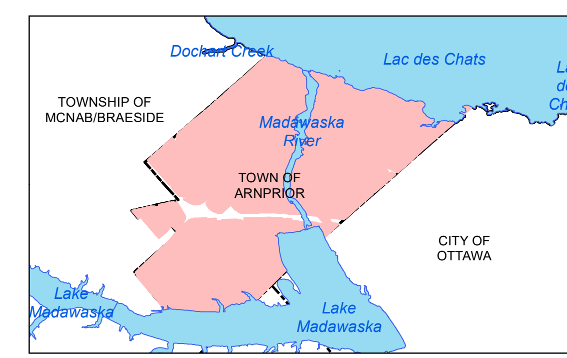
Minimum Pressure

- Min. Pressure ≤ 20 psi
- 20 psi < Min. Pressure ≤ 40 psi
- 40 psi < Min. Pressure ≤ 50 psi
- 50 psi < Min. Pressure ≤ 70 psi
- 70 psi < Min. Pressure ≤ 80 psi
- 80 psi < Min. Pressure ≤ 100 psi
- Min. Pressure > 100 psi
- Reliability Analysis Failure Location - Watermain Break #2
- Existing Watermains
- Dummy Pipes Added for Growth Areas
- Assumed Future Local Distribution Looping (Internal to Development Area)
- Proposed Upgrade of Existing Watermain
- Proposed New Watermain / Watermain Upgrade (Developer-Driven)
- WTP Water Treatment Plant (WTP)
- Elevated Storage Tank (EST)
- Municipal Boundary

N

0 250 500 Meters
(At original document size of 11x17)
1:18,500

Notes
1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Ontario_Hydro_Network_(OHN)_-_Waterbody.shp, Ontario_Hydro_Network_(OHN)_-_Waterbody (2).shp, Municipal_Boundary_-_Lower_and_Single_Tier.shp*, and *Arnprior_Roads_20220324* and *Arnprior_PropertyParcels_wAssessment_20220324.shp* provided by the Town of Arnprior.
3. Background: Contains information licensed under the Open Government Licence – Ontario



Project Location
Arnprior, ON

Prepared by CZ on 2023-08-09
Revised by CZ on 2024-01-30

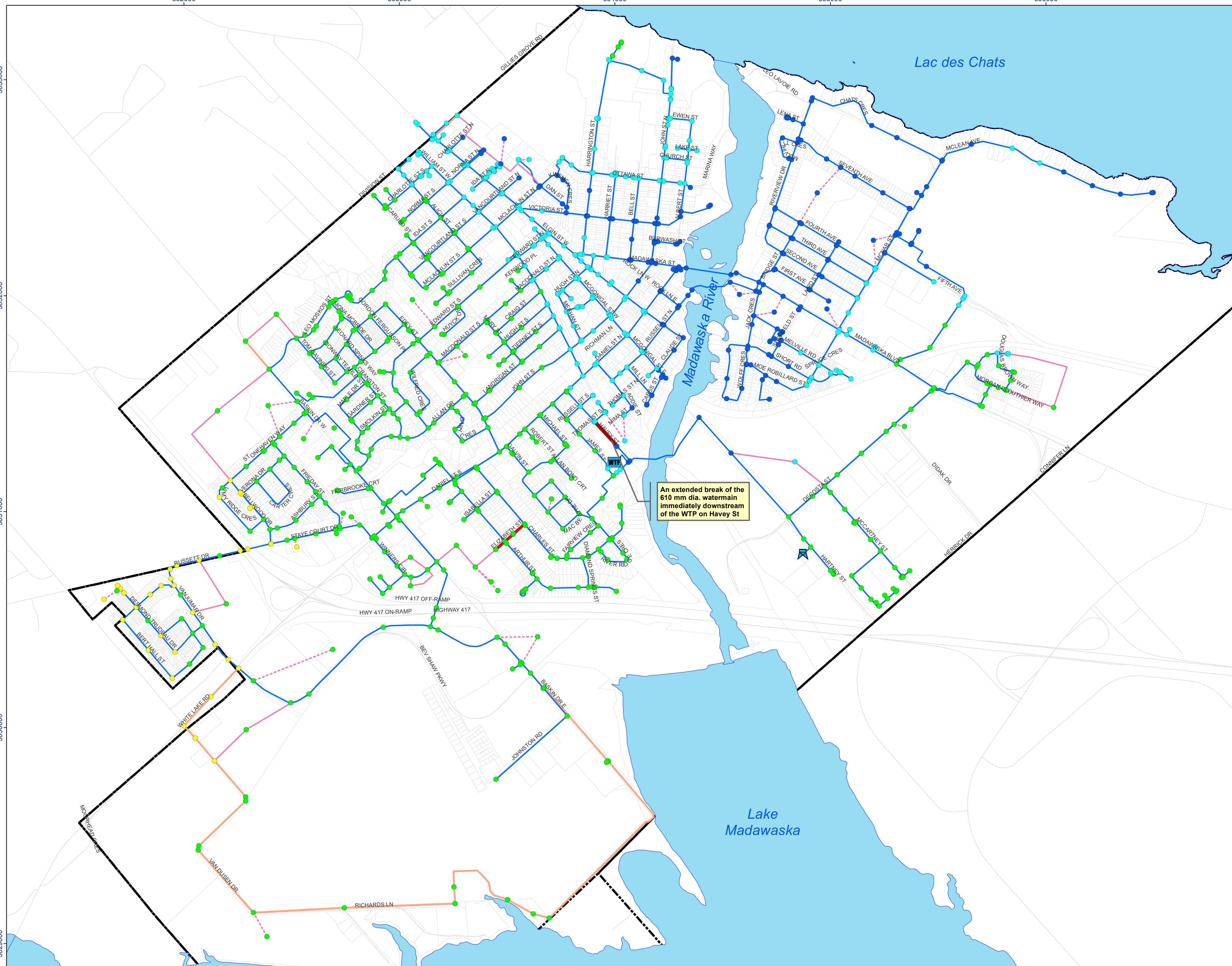
Client/Project
Town of Arnprior
2022 W&WW Master Plan Update

163401723

Figure No.
6-26

Title
Model Results: 2042 Conditions with Solutions and Watermain Break #2 – AVDY Minimum Pressures

C:\Users\chzheng\Documents\My Documents\temp\163401723 Arnprior Water Master Plan\figures\MP_Report\mxd\fig6-26_arn_wtr_2042_w_solns_wm_break2_model_results_20240130.mxd Revised: 2024-01-30 By: chzheng



Stantec

Legend

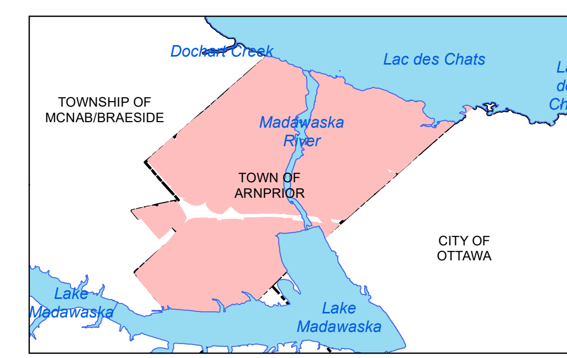
Minimum Pressure

- Min. Pressure ≤ 20 psi
- 20 psi < Min. Pressure ≤ 40 psi
- 40 psi < Min. Pressure ≤ 50 psi
- 50 psi < Min. Pressure ≤ 70 psi
- 70 psi < Min. Pressure ≤ 80 psi
- 80 psi < Min. Pressure ≤ 100 psi
- Min. Pressure > 100 psi
- Reliability Analysis Failure Location - Watermain Break #3
- Existing Watermains
- Dummy Pipes Added for Growth Areas
- Assumed Future Local Distribution Looping (Internal to Development Area)
- Proposed Upgrade of Existing Watermain
- Proposed New Watermain / Watermain Upgrade (Developer-Driven)
- Water Treatment Plant (WTP)
- Elevated Storage Tank (EST)
- Municipal Boundary

N

0 250 500 Meters
(At original document size of 11x17)
1:18,500

Notes
1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Ontario_Hydro_Network_(OHN)_-_Waterbody.shp, Ontario_Hydro_Network_(OHN)_-_Waterbody (2).shp, Municipal_Boundary_-_Lower_and_Single_Tier.shp*, and *Arnprior_Roads_20220324* and *Arnprior_PropertyParcels_wAssessment_20220324.shp* provided by the Town of Arnprior.
3. Background: Contains information licensed under the Open Government Licence – Ontario



Project Location
Arnprior, ON

Prepared by CZ on 2023-08-09
Revised by CZ on 2024-01-30

Client/Project
Town of Arnprior
2022 W&WW Master Plan Update

163401723

Figure No.
6-27

Title
Model Results: 2042 Conditions with Solutions and Watermain Break #3 – AVDY Minimum Pressures

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6.8 Servicing Summary

The following summarizes the wastewater collection system and potable water system servicing strategies, outlining and illustrating the projects identified.

6.8.1 Wastewater Servicing Summary

Ongoing and planned wastewater collection system projects identified by the Town are listed in **Table 5-27** (and were previously illustrated in **Figure 5-35**), and mainly consist of sewer separation projects and the Edey St sewer redirection. Additional wastewater servicing recommendations identified in the current W&WWMP to address existing system constraints and service growth are summarized in **Table 6-18** and illustrated in **Figure 6-28**. The recommendations are based on the refined alternatives presented in **Section 6.5.1**, with the additional considerations for climate change discussed in **Section 6.7.1**.

The recommendations' sizing and alignments are subject to change, as each project will undergo additional studies as needed, and detailed design. For master planning purposes, an implementation plan for these recommendations were developed in **Chapter 4** (**Section 0**), considering prioritization, phasing and costing of the projects.

Table 6-17: Planned Wastewater Collection Infrastructure Projects

Project ID	Year of Completion(1)	Description
SEW-FUT-1	2027	Tierney St N, from McGonigal to St John's Way: Road reconstruction; full reconstruction with sewer separation
SEW-FUT-2	2024	MacDonald St, from McGonigal St to Edey St: Sanitary sewer upsizing/separation, partial watermain replacement, and road reconstruction
SEW-FUT-3	2025	Edey St, from MacDonald St to Allan Dr: full reconstruction with sanitary sewer upsizing
SEW-FUT-4	2027	Hugh St N, from McGonigal to St John's Way: full reconstruction, watermain replacement, sewer separation, sidewalk rehabilitation
SEW-FUT-5	2027	Third Ave, from Riverview Dr to McNab St: full reconstruction, watermain and sanitary sewer replacement

Project ID	Year of Completion(1)	Description
SEW-FUT-6	2028	Albert St, from Ewen St to Madawaska St: full reconstruction and sewer separation, including sanitary upsize
SEW-FUT-7	2026	Atkinson St full reconstruction with sewer separation
SEW-FUT-8	2030	Claude St, Elgin St E, McGonigal St E: full reconstruction with sewer separation
SEW-FUT-9	2031	Rock Ln E, Russel St N: full reconstruction with sewer separation
SEW-FUT-10	2033	James St: full reconstruction with sewer separation
SEW-FUT-11	2036	Charlotte St S & Ida St, from Alicia St to William St: full reconstruction with sewer separation
SEW-FUT-12	2041	Isabella St: full reconstruction with sewer separation
SEW-FUT-13	2040	Gary Cr, from Edey St to second bend: full reconstruction with sewer separation
SEW-FUT-14	2036	Elgin St W, from McLachlin St to Madawaska St: sanitary sewer & watermain replacement
SEW-FUT-15	2037	Madawaska St, from Elgin St to Daniel St: full reconstruction with new sanitary sewer, new watermain
SEW-FUT-16	2034	Edward St, from Edey St to Elgin St: full reconstruction with sewer separation
SEW-FUT-17	2025	Victoria St, from Elgin St to John St: full reconstruction with sewer and watermain replacement

Note:

(1) Year of completion inferred from long-range capital forecasts (final year of planned capital investment).

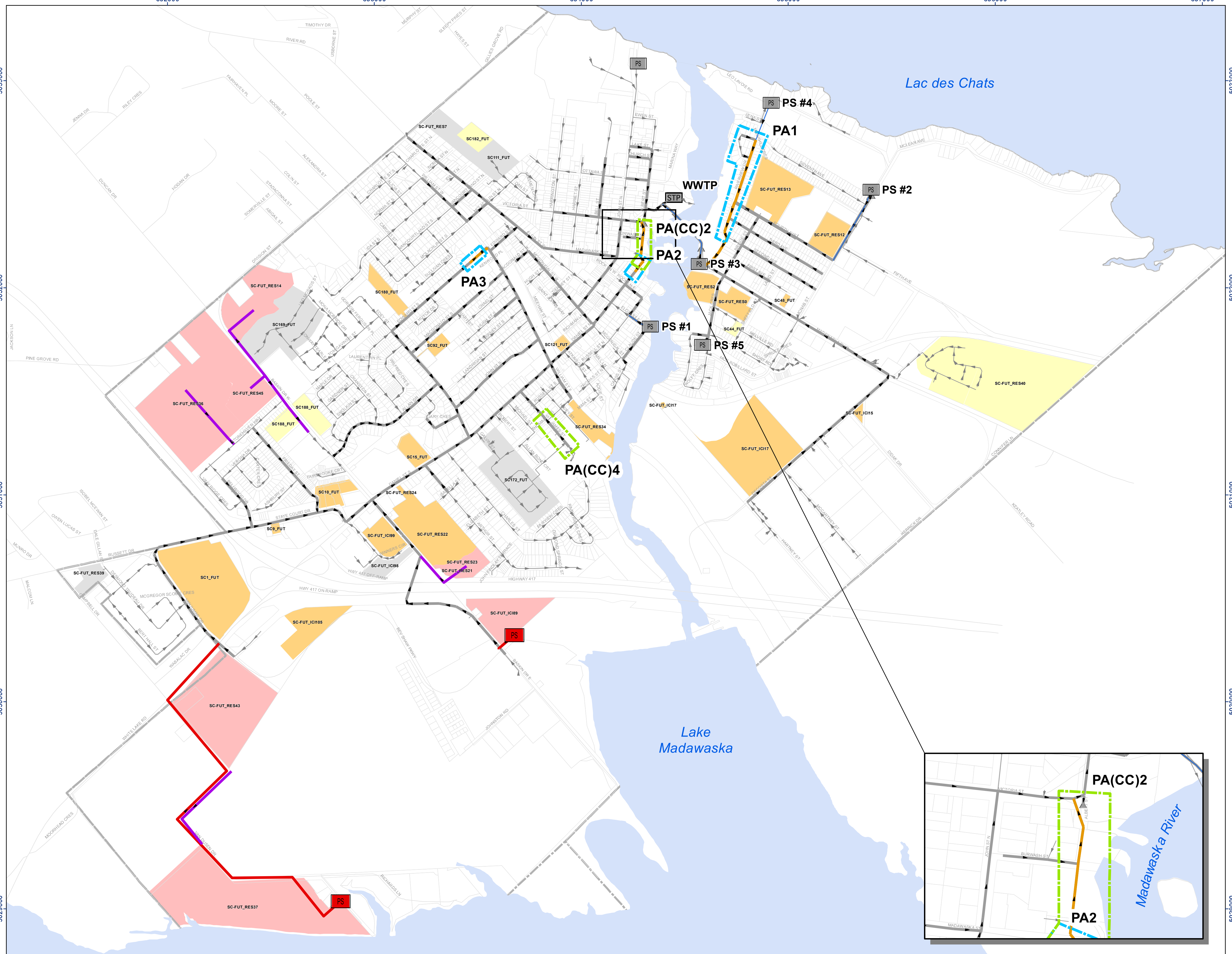
Table 6-18: Summary of Wastewater Servicing Recommendations

Project ID	Description
Improvements to Existing Sewers & PSs	
SEW-PA1-A	Confirm inverts along Riverview Dr with a topographical survey
SEW-PA1-B	Increase slopes to address existing adverse and flat sewer inverts along 316m of 450mm diameter sewers along Riverview Dr
SEW-PA1-C	Upgrade 356m of 300mm & 375mm to 525mm along Riverview Dr
SEW-PA2-A	SEW-PA2-A1: Upgrade 66 m of 600 mm diameter sewers to 675 mm along Daniel St from south of Madawaska St to Madawaska St SEW-PA2-A2: Upgrade 160 m of 600 mm diameter sewers to 675 mm along Daniel St/Albert St from Madawaska St to Victoria St SEW-PA2-A3: Upgrade 38 m of 600 mm diameter sewers to 675 mm along Albert St from Madawaska St to Victoria St
SEW-PA2(CC)-A(1)	SEW-PA2(CC)-A1: Upgrade 66 m of 600 mm diameter sewers to 675 mm along Daniel St from south of Madawaska St to Madawaska St SEW-PA2(CC)-A2: Upgrade 160 m of 600 mm diameter sewers to 675 mm along Daniel St/Albert St from Madawaska St to Victoria St SEW-PA2(CC)-A3: Upgrade 38 m of 600 mm diameter sewers to 825 mm along Albert St from Madawaska St to Victoria St
SEW-PA3-A	Confirm inverts along Edward St with a topographical survey
SEW-PA3-B	Upgrade 112 m of 200 mm diameter sewers to 250 mm along Edward St
SEW-PA4(CC)-A	Confirm inverts and ground elevations along James St with a topographical survey
SEW-PA4(CC)-B	Upgrade 215 m of 250 mm diameter sewers to 300 mm along James St, from the WFP to east of Russell St (in conjunction with planned sewer separations)
SEW-PA4(CC)-C	Lower the upgraded sewers along James St, from the WFP to Daniel St
PS1-A	Undertake combined sewer separation activities planned upstream of PS #1 and in the areas draining to Russell St and Elgin St (east of Daniel St)
PS1-B	Monitor flows to upstream and downstream of PS #1
PS1-C	Upgrade PS #1 to accommodate peak incoming flows of 81 L/s under the 10-year design event for a 20-year planning horizon.
PS1(CC)-C(1)	Upgrade PS #1 to accommodate peak incoming flows of 98 L/s under the 10-year design event for a 20-year planning horizon.
PS2-A	Monitor upstream flows
PS2-B	Upgrade PS #2 to accommodate peak incoming flows of 71 L/s under the 10-year design event for a 20-year planning horizon.
PS2(CC)-B(1)	Upgrade PS #2 to accommodate peak incoming flows of 84 L/s under the 10-year design event for a 20-year planning horizon.
PS3-A	Investigate and address sources of I/I upstream of PS #3.
PS3-B	Continue flow monitoring upstream of PS #3 to assess the efficacy of I/I reduction measures and capture the response under a variety of larger WWF events.
PS3-C	Upgrade PS #3 to accommodate peak incoming flows of 371 L/s under the 10-year design event for a 20-year planning horizon.
PS3(CC)-C(1)	Upgrade PS #3 to accommodate peak incoming flows of 445 L/s under the 10-year design event for a 20-year planning horizon.
PS3-D	Twin the existing sewage forcemain from PS #3 to the WWTP with a new 260 m long 350 mm diameter forcemain.
PS5-A	Monitor upstream flows
Improvements to WWTP	
WWTP-1	Maintain activities to reduce I/I into the sanitary collection system
WWTP-2	Develop criteria to monitor and assess Albert St CSO, e.g., using the MECP's F-5-5, which notably includes (but is not limited to) the following criteria:
WWTP-3	Continuously update the WWTP committed capacity assessment, as new development interests are identified
WWTP-4	Monitor the impact of upstream infrastructure upgrades on incoming flows to the WWTP
WWTP-5	Plan for the addition of an anoxic zone to improve pH control and support nitrification in the shoulder seasons.
WWTP-6	Undertake a study of the organic and solids loading to the WWTP versus loading capacity.
New Infrastructure to Service Growth Areas	
SEW-GRW1	New 620 m long 200 mm diameter gravity sewer along Baskin Dr W to service growth areas SC188_FUT, SC-FUT_RES14 and SC-FUT_RES45.
SEW-GRW2	New 300 m long 200 mm diameter gravity sewer along Baskin Dr E to service growth areas SC-FUT_RES21 and SC-FUT_RES23

Project ID	Description
SEW-GRW3	New 310 m long 250 mm diameter gravity sewer within future SC-FUT_RES36 growth area.
SEW-GRW5	New 490 m long 300 mm diameter gravity sewer from the growth area SC-FUT_RES43 to SC-FUT_RES37.
PS-GRW4	New PS within growth area SC-FUT_ICI89 with 100 m of new dual 100 mm diameter forcemains connected to existing 450 mm diameter trunk sewer on Baskin Dr.
PS-GRW5	New PS within growth area SC-FUT_RES37, to service both SC-FUT_RES37 and SC-FUT_RES43, with 2,200 m of new dual 200 mm diameter forcemains connected to existing 450 mm diameter trunk sewer on Beth Shaw Pkwy.
Overall Wastewater Collection System Recommendations	
SAN-1	Continue flow monitoring in key areas of interest
SAN-2	Continue sewer separation activities and monitor resulting flows.
SAN-3	Implement measures to reduce sewage generation rates
SAN-4	Continue implementing measures to reduce I/I into the system
SAN-5	Continue expanding the hydraulic model to local areas of interest, with the long-term goal of building an all-pipe model.

Note:

(1) Recommendation includes considerations for climate change, as described in **Section 6.7.1**.



Legend

- Sanitary Pump Station (PS)
- Overflow
- Wastewater Treatment Plant (WWTP)
- Sanitary Trunk Sewer (Modelled; No Upgrades)
- Sanitary Sewer (Not Modelled)
- Forcemains

Servicing Solutions

- Problem Areas (Growth-Related)
- Pipe Upgrades (for Growth)
- Problem Areas (Growth, with Climate Change Considerations)
- Pipe Upgrades (for Growth, with Climate Change Considerations)
- New Gravity Sewer
- New PS (Growth Area Servicing)
- New Forcemain

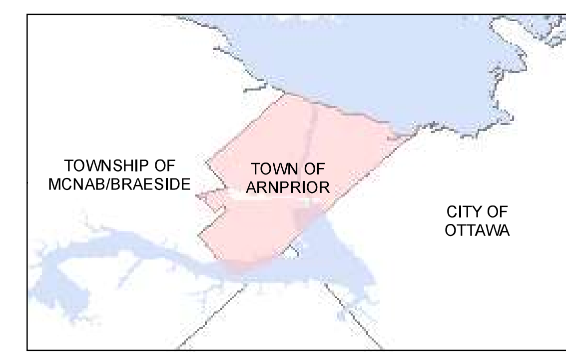
Growth Areas Servicing Approach

- Direct Servicing from Adjacent Local (Non-Modelled) Sewers
- Direct Servicing from Adjacent Trunk Sewer
- Direct Servicing by Extending Local (Non-Modelled) Sewers
- Servicing from New Trunk Sewer Infrastructure

N

0 250 500 Meters
(At original document size of 11x17)
1:19,000

Notes
1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Export_Output_Parcel_Fabric.shp*, *Export_Output_Roads.shp*, *Export_Output_San_MH.shp* and *Export_Output_SAN_SEWER.shp* provided by the Town of Arnprior
3. Background: Contains information licensed under the Open Government Licence – Ontario
4. Abbreviations: FM: Flow Monitor; MH: Maintenance Hole; PS: Pump Station; WWTP: Wastewater Treatment Plant



Project Location Prepared by CR on 2023-11-08
Arnprior, ON

Client/Project 163401723
Town of Arnprior
2022 W&WW Master Plan Update

Figure No.
6-28

Title
Proposed Wastewater Servicing Solutions

Disclaimer: This document has been prepared based on information provided by others as cited in the Notes section. Stantec has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result. Stantec assumes no responsibility for data supplied in electronic format, and the recipient accepts full responsibility for verifying the accuracy and completeness of the data.

6.8.2 Potable Water Servicing Summary

The potable water servicing recommendations to address existing system constraints and service growth are summarized in **Table 6-19**. This table includes the refined alternatives as presented in **Section 6.5.2**, as well as the recommendations based on sensitivity and reliability analysis as discussed in **Section 6.7.2**. Locations of the proposed watermain upgrade/expansion are presented in **Figure 6-29**. It should be noted that all figures in **Section 6.5.2**, **Section 6.6.3**, and **Section 6.7.2** indicate a new 150 m long 150 mm diameter watermain along Division St N. It is the pipe proposed in the hydraulic model to service growth area RES7 (Mackie Homes subdivision). However, it was advised by the Town that the developer is currently proposing a different routing to avoid installing the new watermain on Division St which is the boundary between the Town of Arnprior and the Township of McNab Braeside. Therefore, the 150 mm diameter watermain servicing growth area RES7 on Division St N is not included as part of the potable water servicing recommendations.

An implementation plan was developed in **Chapter 4** (**Section 0**), including prioritization, phasing, and costing for these recommendations. It shall be noted that all recommended upgrades and pipe sizing and alignments are subject to change. They will need to be reviewed and confirmed by additional assessments during detailed design stage.

Table 6-19: Summary of Potable Water Servicing Recommendations

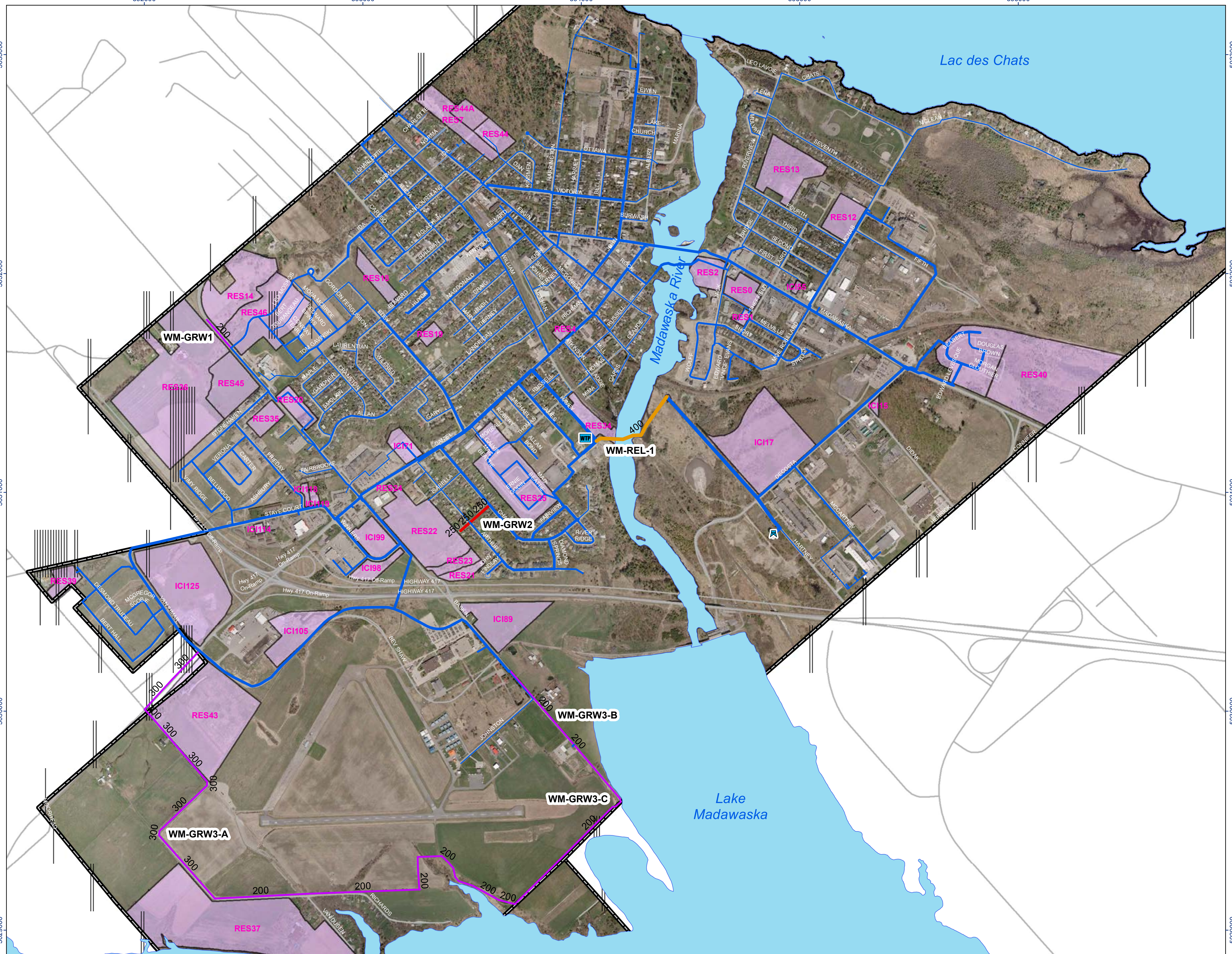
Project ID	**Description**
Improvements to WFP	
WTP-TRT-1	Upgrade treatment capacity by 2038 to provide an additional treatment capacity of about 631 m^3/d for a 20-year planning horizon.
WTP-STR-1	Upgrade storage capacity by 2033 to provide an additional storage volume of about 1,592 m^3 for a 20-year planning horizon.
WTP-PMP-1	Upgrade high lift pumping capacity by 2034 to provide an additional pumping capacity of about 45 L/s for a 20-year planning horizon.
WTP-PMP-2	Adjust the operating philosophy of HLPs to have two HLPs called into service under high demand conditions in the 20-year planning horizon. SCADA programming would need to be adjusted to allow for the second HLP to kick in.
WTP-TRT-1-CC (2)	Upgrade treatment capacity by 2034 to provide an additional treatment capacity of about 1,728 m^3/d for a 20-year planning horizon.
WTP-STR-1-CC (2)	Upgrade storage capacity by 2031 to provide an additional storage volume of about 1,935 m^3 for a 20-year planning horizon.
WTP-PMP-1-CC (2)	Upgrade high lift pumping capacity by 2033 to provide an additional pumping capacity of about 58 L/s for a 20-year planning horizon.
WTP-REL-1 (3)	Plan for potential occurrence of HLP failure to ensure that the pumping capacity can be restored within 10 hours.
WTP-REL-2 (3)	Perform additional standby capacity assessments and upgrade the facility as needed based on study results.
WTP-REL-3 (3)	Operate the system in pressure mode (i.e., HLP operating within a required pressure range to feed the distribution system) when the EST is out of service and/or in the event of the failure of the 400 mm dia. Madawaska River crossing near the WFP.
Improvements & Expansion of Distribution Pipe Network (1)	
WM-GRW1	New 170 m long 200 mm diameter watermain along Baskin Dr W to service growth area RES14.
WM-GRW2	Upsize the existing 130 m long 150 mm diameter watermains on Elizabeth St to 250 mm and extend the new 250 mm diameter watermain to provide connection between growth areas RES21/22/23 and the existing 250 mm diameter pipe on Charles St.
WM-GRW3-A	New 1,530 m long 300 mm diameter watermain along White Lake Rd and VanDusen Dr to service growth area RES37.
WM-GRW3-B	Upsize the existing 460 m long 100 mm diameter watermain on Baskin Dr E to 200 mm diameter watermain.
WM-GRW3-C	New 2,630 m long 200 mm diameter watermain connecting the upsized 200 mm diameter pipe on Baskin Dr E to new 300 mm diameter watermain at VanDusen Dr to provide a secondary feed for growth area RES37.
WM-REL-1 (3)	Provide a secondary direct feed from the WFP to the EST near the existing 400 mm diameter river crossing.
Overall Potable Water Distribution System Recommendations	
WAT-1	Implement pressure reduction measures (e.g., installation of PRVs) in areas where high pressures are anticipated.
WAT-2	Provide watermain looping (where possible) for areas with low available fire flows.
WAT-3	Monitor high-risk watermains (i.e., watermains with high head loss) for the potential occurrence of watermain breaks.

Notes:

(1) This table does not include distribution mains within growth areas assumed in the hydraulic model. Sizing and alignments of these distribution mains are subject to change and will be designed by developers.

(2) Recommendation based on sensitivity analysis (climate change), as described in **Section 6.7.2.1**.

(3) Recommendation based on reliability analysis, as discussed in **Section 6.7.2.2**.



Stantec

Legend

- Proposed Upgrade of Existing Watermain
- Proposed New Watermain / Watermain Upgrade (Developer-Driven)
- Critical Watermain where a Secondary Feed is Recommended
- Growth Areas with Future Water Demands

Existing Watermains - Diameter (mm)

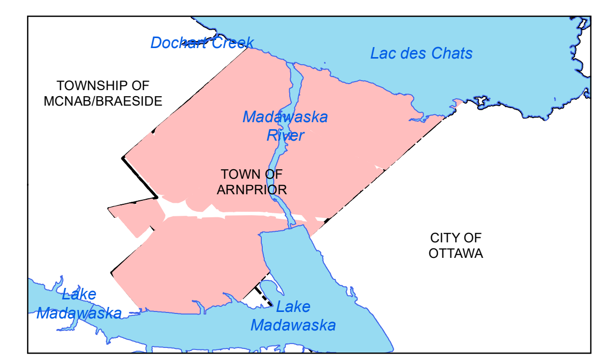
- < 75 mm
- 75 mm - 150 mm
- 150 mm - 225 mm
- 225 mm - 350 mm
- 350 mm - 600 mm
- Water Treatment Plant (WTP)
- Elevated Storage Tank (EST)
- Municipal Boundary

N

0 200 400 600 Meters

(At original document size of 11x17)
1:18,000

Notes
1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Ontario_Hydro_Network_(OHN)_-_Waterbody.shp*, *Ontario_Hydro_Network_(OHN)_-_Waterbody (2).shp*, *Municipal_Boundary_-_Lower_and_Single_Tier.shp*, and *0837ARNP.sid* , *Arnprior_PropertyParcels_wAssessment_20220324.shp*, *Arnprior_Roads_20220324.shp* and *WTR_NODE.shp* provided by the Town of Arnprior
3. Background: Contains information licensed under the Open Government Licence – Ontario



Project Location
Arnprior, ON

Prepared by CZ on 2023-08-09
Revised by CZ on 2024-03-05

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Town of Arnprior
2022 W&WW Master Plan Update

163401723

Figure No.
6-29

Title
Proposed Watermain Upgrades / Expansion

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6.9 Chapter 3 Conclusions

Chapter 3 proposes servicing solutions to address the Town's existing wastewater collection system and potable water distribution system's existing constraints, and to service future (growth), and includes the following discussions:

- Review of existing system constraints (**Section 6.1**);
- Presentation of the alternatives evaluation criteria (**Section 6.2**);
- Development of the servicing alternatives (**Section 6.3**);
- Evaluation of the servicing alternatives (**Section 6.4**);
- Presentation of a refined alternative (**Section 6.5**);
- Assessment of the systems' capacity to service outside interests (**Section 6.6**);
- Assessment of the upgraded systems' capacity under climate change conditions (**Section 6.7**).

The following recommendations arose from the wastewater collection system assessment and servicing strategy development:

- The servicing alternative which is most aligned to the evaluation criteria is to improve and expand the existing municipal wastewater collection system;
- As part of the refined servicing strategy, projects were identified to:
  - Improve the existing collection system with sewer upgrades (**Section 6.5.1.1**);
  - Improve existing PSs' capacity (**Section 6.5.1.2**);
  - Improve the WWTP's treatment processes (**Section 6.5.1.3**);
  - Expand the existing infrastructure to service new growth areas (**Section 6.5.1.4**).
- Overall recommendations to continue improving the wastewater collection system were also presented (**Section 0**);
- The potential to service outside interests was reviewed (**Section 6.6.2**);

- The proposed upgrades were also sized to consider the impact of climate change. New projects triggered under climate change conditions were also identified (**Section 6.7.1**).

Recommendations arose from the potable water distribution system assessment and servicing strategy development are as follows:

- The servicing alternative which is most aligned to the evaluation criteria is to improve and expand the existing municipal potable water distribution system;
- The following upgrades and recommendations were identified as part of the refined servicing strategy:
  - Upgrade the existing infrastructure with respect to treatment, storage, and high lift pumping capacities (**Section 6.5.2.1**);
  - Improve and expand the existing infrastructure to service new growth areas (**Section 6.5.2.2**).
- The potential to service outside interests was reviewed (**Section 6.6.3**);
- The potable water distribution system with proposed upgrades were assessed under climate change conditions and emergency scenarios.
  - The impacts on growth capacity triggers and distribution system LOS were identified (**Section 6.7.2.1**);
  - Additional recommendations based on reliability analysis results were proposed (**Section 6.7.2.2**).

Following the servicing strategies presented herein, opinions of probable cost and implementation plans were developed in **Chapter 4** (**Section 4**).

7 Chapter 4: Implementation Plan and Cost Estimates

The purpose of **Chapter 4** is to present the implementation plan for the recommended wastewater and potable water servicing strategies, by identifying critical timelines for required projects to service long-term growth interests. The implementation plan also includes Class D cost estimates for the recommended infrastructure upgrades.

7.1 Implementation Plan and Capital Project Costs

Water and wastewater infrastructure projects and additional studies and operational activities were identified in **Chapter 3** (**Section 6**)**.** Subsequently, Class D opinions of probable costs (OPC) and timelines were developed for the following recommendations:

- Projects which will be undertaken by the Town and funded by the Town and/or through development charges, per the Town's Development Charges Background Study (Watson & Associates Economists Ltd., 2023).
- Additional studies, planning and operational activities that the Town could undertake.

OPCs are not presented for infrastructure which constitute local service to development areas. This infrastructure will be *"direct developer responsibility"* per the Development Charges Background Study. The infrastructure projects' OPC presented include the following components:

- Construction costs (in 2023$);
- Capital cost components & risk factors (engineering, project management, utilities, permitting, geotechnical issues), equivalent to 35% of the construction costs; and
- Class D contingency of 40% applied to the subtotal of construction costs + capital costs & risk components.

The construction costs presented are based on the required ultimate sizing for a 20-year planning horizon based on growth needs using acceptable design standards and guidelines as established in **Chapter 1** (**Section 4**), and do not include additional costing for sizing or designing to address potential risks associated with severe weather events attributed to climate change. Additional infrastructure needs or sizing to accommodate severe weather events attributed to climate change are presented in **Chapter 3** (**Section 6**) and are further discussed in **Section 7.2**.

The recommended timelines consider the concurrent implementation of water and wastewater infrastructure projects and aligns them with the Town's other planned capital projects (e.g., road rehabilitation), where feasible. In some cases, based on the assessment presented in **Chapter 3** (**Section 6**), the recommended projects are needed earlier than the currently planned road renewal timeline.

Table 7-1 summarizes the implementation plan and costs for the recommended water and wastewater infrastructure projects, additional studies and operational activities. Infrastructure projects are divided between projects that are *Required*, based on identified system constraints and needs, and projects that are *Study Dependent*, and could be reviewed or deferred based on the outcome of other infrastructure projects, studies or activities. Monitoring is recommended as changes are undertaken in the systems, to confirm the impact on the identified projects.

Costs by service area are further outlined in **Table 7-2** (infrastructure projects) and **Table 7-3** (studies & activities).

Table 7-1: Master Plan Recommendations Implementation Plan and Costs

Master Plan Infrastructure Recommendations Implementation Plan and Costs – *Refer to* ***Table 7-2*** *for breakdown by site*							
Project Type	**Horizon**	**3-5 Years**		**5-10 Years**		**10-20 Years**	
	Total Site Costs ($)	**Required**	**Study Dependent**	**Required**	**Study Dependent**	**Required**	**Study Dependent**
Existing Sanitary Sewer Upgrades & Sewer Separation	$17,305,000	$11,340,000	$2,006,000	$3,683,000	$276,000	-	-
Existing Sanitary PS & Forcemain Upgrades	$12,096,000	-	-	-	$10,395,000	-	$1,701,000
Existing Watermain Upgrades & Pressure Reduction Measures	$5,096,000	$151,000	$4,367,000	$578,000	-	-	-
WFP Upgrades	$7,862,000	-	-	$7,862,000	-	-	-
Total – Infrastructure Recommendations	**$42,359,000**	**$11,491,000**	**$6,373,000**	**$12,123,000**	**$10,671,000**	**-**	**$1,701,000**

Master Plan Studies & Activities Recommendations Implementation Plan and Costs – *Refer to* ***Table 7-3*** *for breakdown by site*						
Study/Activity Type	**Horizon / Frequency** **Total Site Study Costs ($)**	**Annually**	**Every 5-10 Years (or as Development Occurs, or per Other Requirements)**	**3-5 Years**	**5-10 Years**	**10-20 Years**
Studies/Activities for Sanitary PS	$130,000	-	-	$50,000	$80,000	-
Studies/Activities for Overall Wastewater Collection Network	$190,000	$110,000	$80,000	-	-	-
Studies/Activities for WWTP	$190,000	$60,000	$30,000	-	$100,000	-
Studies/Activities for Overall Water Distribution Network	$150,000	$100,000	-	-	$50,000	-
Studies/Activities for WFP	$190,000	-	-	-	$190,000	-
Total – Studies & Activities	**$850,000**	**$270,000**	**$110,000**	**$50,000**	**$420,000**	**-**

Table 7-2: Master Plan Infrastructure Recommendations Implementation Plan and Costs (Based on Acceptable Current Design Standards and Guidelines)

Site	Upgrade Type	Upgrade	Timeline	2023 Construction Cost (Nearest $1,000)	Capital Cost Components & Risk Factors (35% of Construction Cost) (Nearest $1,000)	Construction + Capital Costs ($)	Contingency (40% of Construction + Capital Costs) ($)	Total (Construction + Capital) + Contingency ($)	Total Site Costs ($)	Comments
Riverview Dr / McNab St	Confirm the inverts along Riverview Dr with a topographical survey	Confirm the inverts along Riverview Dr with a topographical survey	Within 3-5 years	*Costs included in preliminary design (considered in sewer upgrade capital cost components)*	*Costs included in preliminary design (considered in sewer upgrade capital cost components)*	*Costs included in preliminary design (considered in sewer upgrade capital cost components)*	*Costs included in preliminary design (considered in sewer upgrade capital cost components)*	*Costs included in preliminary design (considered in sewer upgrade capital cost components)*	*Costs included in preliminary design (considered in sewer upgrade capital cost components)*	Invert confirmation needed to review sewer capacity.
	Existing Sanitary Sewer Upgrade	316 m @ 450 mm		$474,000	$166,000	$640,000	$256,000	$896,000	$2,006,000	Road renewal planned post-2042. Sewer upgrades are needed earlier to address existing constraints under the 25-year design event [see **Chapter 3** (**Section 6**)].
		356 m @ 525 mm		$587,000	$206,000	$793,000	$317,000	$1,110,000		
	Water distribution pressure reduction measures	Water distribution pressure reduction measures		$80,000	$28,000	$108,000	$43,000	$151,000	$151,000	Installation of pressure reduction valves on Riverview Dr and McNab St to mitigate high pressures along McLean Ave [see **Chapter 3** (**Section 6**)].
Daniel St / Albert St	Existing Sanitary Sewer Upgrade	66 m @ 675 mm	Within 5-10 years	$112,000	$39,000	$151,000	$60,000	$211,000	$848,000	Daniel St reconstruction from William St to Madawaska St planned in 2039-2040. Sewer upgrades are needed earlier to address 2032 sewer surcharge under the 25-year design event [see **Chapter 3** (**Section 6**)]. Sewers have also experienced surcharge in 2023 (see discussion of September 7th, 2023, event in **Section 5.2.1.2**).
		160 m @ 675 mm		$272,000	$95,000	$367,000	$147,000	$514,000		
		38 m @ 675 mm		$65,000	$23,000	$88,000	$35,000	$123,000		

Site	Upgrade Type	Upgrade	Timeline	2023 Construction Cost (Nearest $1,000)	Capital Cost Components & Risk Factors (35% of Construction Cost) (Nearest $1,000)	Construction + Capital Costs ($)	Contingency (40% of Construction + Capital Costs) ($)	Total (Construction + Capital) + Contingency ($)	Total Site Costs ($)	Comments
Edward St	Confirm the inverts along Edward St with a topographical survey	Confirm the inverts along Edward St with a topographical survey	Within 5-10 years	*Costs included in preliminary design (considered in sewer upgrade capital cost components)*	*Costs included in preliminary design (considered in sewer upgrade capital cost components)*	*Costs included in preliminary design (considered in sewer upgrade capital cost components)*	*Costs included in preliminary design (considered in sewer upgrade capital cost components)*	*Costs included in preliminary design (considered in sewer upgrade capital cost components)*	*Costs included in preliminary design (considered in sewer upgrade capital cost components)*	
	Existing Sanitary Sewer Upgrade	112 m @ 250 mm		$146,000	$51,000	$197,000	$79,000	$276,000	$276,000	Edward St reconstruction and sewer separation planned in 2034.
Elizabeth St	Existing Watermain Upgrades	180 m @ 250 mm	Within 5-10 years	$306,000	$107,000	$413,000	$165,000	$578,000	$578,000	
WFP/River Crossing	Twin of Existing Watermain River Crossing	420 m @ 400 mm	Within 3-5 years	$2,310,000	$809,000	$3,119,000	$1,248,000	$4,367,000	$4,367,000	Twinning of river crossing recommended for reliability. Existing pipe will be replaced in 2024 (project WTR-FUT-1 in **Table 5-30**), which could reduce the likelihood of failure and defer the need for twinning.
Sanitary PS#1	Monitor flows to upstream and downstream of PS #1	Monitor flows to upstream and downstream of PS #1	Within 5-10 years	*Refer to **Table 7-3** for site study cost*	*Refer to **Table 7-3** for site study cost*	*Refer to **Table 7-3** for site study cost*	*Refer to **Table 7-3** for site study cost*	*Refer to **Table 7-3** for site study cost*	*Refer to **Table 7-3** for site study cost*	Flow monitoring needed to confirm peak flows to PS #1, impact of sewer separations and required PS upgrade.
	Sewer Separation Measures	Sewer Separation Measures		$1,500,000	$525,000	$2,025,000	$810,000	$2,835,000	$5,670,000	Planned sewer separations upstream and downstream of PS#1 [see **Chapter 3** (**Section 6**)]; OPC derived from Town LRCF.
	Existing Sanitary PS & Forcemain Upgrade	+56 L/s	Within 5-10 years	$1,500,000	$525,000	$2,025,000	$810,000	$2,835,000		PS upgrade sizing assuming no reduction in peak flows following sewer separation measures and updated flow monitoring. PS upgrade with existing forcemain replacement.

Site	Upgrade Type	Upgrade	Timeline	2023 Construction Cost (Nearest $1,000)	Capital Cost Components & Risk Factors (35% of Construction Cost) (Nearest $1,000)	Construction + Capital Costs ($)	Contingency (40% of Construction + Capital Costs) ($)	Total (Construction + Capital) + Contingency ($)	Total Site Costs ($)	Comments
Sanitary PS#2	Monitor upstream flows	Monitor upstream flows	Within 5-10 years	*Refer to **Table 7-3** for site study cost*	*Refer to **Table 7-3** for site study cost*	*Refer to **Table 7-3** for site study cost*	*Refer to **Table 7-3** for site study cost*	*Refer to **Table 7-3** for site study cost*	*Refer to **Table 7-3** for site study cost*	Study needed to confirm peak flows to PS #2 and required PS upgrade.
	Existing Sanitary PS Upgrade	+12 L/s	Within 10-20 years	$900,000	$315,000	$1,215,000	$486,000	$1,701,000	$1,701,000	PS upgrade sizing assuming no reduction in peak flows following updated flow monitoring. PS upgrade only (existing forcemain can accommodate future peak flows).
Sanitary PS#3	Investigate and address sources of I/I upstream of PS #3	Investigate and address sources of I/I upstream of PS #3	Within 3-5 years	*Refer to **Table 7-3** for site study cost*	*Refer to **Table 7-3** for site study cost*	*Refer to **Table 7-3** for site study cost*	*Refer to **Table 7-3** for site study cost*	*Refer to **Table 7-3** for site study cost*	*Refer to **Table 7-3** for site study cost*	Study needed to reduce peak flows to PS #3 and required PS upgrade.
	Continue flow monitoring upstream of PS #3 to assess the efficacy of I/I reduction measures	Continue flow monitoring upstream of PS #3 to assess the efficacy of I/I reduction measures	Within 5-10 years	*Refer to **Table 7-3** for site study cost*	*Refer to **Table 7-3** for site study cost*	*Refer to **Table 7-3** for site study cost*	*Refer to **Table 7-3** for site study cost*	*Refer to **Table 7-3** for site study cost*	*Refer to **Table 7-3** for site study cost*	Flow monitoring needed to confirm reduction in peak flows to PS #3 and required PS upgrade.

Site	Upgrade Type	Upgrade	Timeline	2023 Construction Cost (Nearest $1,000)	Capital Cost Components & Risk Factors (35% of Construction Cost) (Nearest $1,000)	Construction + Capital Costs ($)	Contingency (40% of Construction + Capital Costs) ($)	Total (Construction + Capital) + Contingency ($)	Total Site Costs ($)	Comments
	Existing Sanitary PS & Forcemain Upgrade	+96 L/s	Within 5-10 years	$4,000,000	$1,400,000	$5,400,000	$2,160,000	$7,560,000	$7,560,000	PS upgrade sizing assuming no reduction in peak flows following I/I investigation and updated flow monitoring. PS upgrade sizing assuming increase in peak flows following Riverview Dr sewer upgrades. PS upgrade with existing forcemain replacement (upsizing) & twinning. Without PS upgrade: OPC for existing forcemain twinning only (keep existing forcemain): $1,229,000 OPC for existing forcemain replacement (upsizing) & twinning: $2,646,000
Water Filtration Plant (WFP)	WFP Upgrade (Treatment Capacity)	+631 m^3/d	Within 5-10 years	$1,500,000	$525,000	$2,025,000	$810,000	$2,835,000	$7,862,000	
	WFP Upgrade (Clearwell Expansion)	+1,592 m^3		$2,000,000	$700,000	$2,700,000	$1,080,000	$3,780,000		
	WFP Upgrade (High-Lift Pumping Upgrade)	+45 L/s		$660,000	$231,000	$891,000	$356,000	$1,247,000		
Overall Wastewater Collection Network	Sewer Separation Measures	Sewer Separation Measures	Annually, or based on sewer separation projects' timelines	$6,000,000	$2,100,000	$8,100,000	$3,240,000	$11,340,000	$11,340,000	Planned sewer separations by 2042 across the wastewater collection network (except directly upstream/downstream of PS#1); OPC derived from Town LRCF.

Table 7-3: Master Plan Study & Activities Recommendations Implementation Plan and Costs

Site	Description	Timeline	2023 Study Cost ($)	Total Site Study Costs ($)	Comments
Sanitary PS#1	Monitor flows to upstream and downstream of PS #1	Within 5-10 years	$20,000	$20,000	
Sanitary PS#2	Monitor upstream flows	Within 5-10 years	$20,000	$20,000	
Sanitary PS#3	Investigate and address sources of I/I upstream of PS #3	Within 3-5 years	$50,000	$70,000	Investigate upstream metershed, with a total parcel area of 151 ha.
	Continue flow monitoring upstream of PS #3 to assess the efficacy of I/I reduction measures and capture the response under a variety of larger WWF events	Within 5-10 years	$20,000		
Sanitary PS#5	Monitor upstream flows	Within 5-10 years	$20,000	$20,000	
Overall Wastewater Collection Network	Continue flow monitoring in key areas of interest	Every 5 years, or as development occurs	$50,000	$190,000	
	Implement measures to reduce sewage generation rates	Annually	$10,000		Assumed Town-led initiative to encourage water conservation measures and use of efficient fixtures.
	Continue implementing measures to reduce I/I into the system	Annually	$100,000		
	Continue expanding the hydraulic model to local areas of interest, with the long-term goal of building an all-pipe model.	Every 5-10 years	$30,000		
Overall Potable Water Distribution Network	Provide watermain looping (where possible) for areas with low available fire flows.	Within 5-10 years	$50,000	$150,000	Costing study to identify locations of looping
	Monitor high-risk watermains (i.e., watermains with high head loss) for the potential occurrence of watermain breaks.	Annually	$100,000		OPC for monitoring key watermains through e.g., wire-tracing, hydrant pressure monitoring, watermain inspections, acoustic detection.
Water Filtration Plant (WFP)	Operate the system in pressure mode (i.e., high-lift-pump (HLP) operating within a required pressure range to feed the distribution system) when the EST is out of service and/or in the event of the failure of the 400 mm dia. Madawaska River crossing near the WFP.	Within 5-10 years	$30,000	$190,000	

Site	Description	Timeline	2023 Study Cost ($)	Total Site Study Costs ($)	Comments
	Adjust the operating philosophy of HLPs to have two HLPs called into service under high demand conditions in the 20-year planning horizon. SCADA programming would need to be adjusted to allow for the second HLP to kick in.	Within 5-10 years	$100,000		
	Plan for potential occurrence of HLP failure to ensure that the pumping capacity can be restored within 10 hours.	Within 5-10 years	$30,000		
	Perform additional standby capacity assessments and upgrade the facility as needed based on study results.	Within 5-10 years	$30,000		OPC for standby capacity assessment only, which may include a review of existing available backup power onsite (for HLP); identifying backup power level of service requirements; and identifying any deficits/need for additional standby (backup power) capacity.
Wastewater Treatment Plant (WWTP)	Develop criteria to monitor and assess Albert St CSO, e.g., using the MECP's F-5-5	Frequency based on Ministry of the Environment, Conservation & Parks (MECP) requirements	$30,000	$190,000	
	Continuously update the WWTP committed capacity assessment, as new development interests are identified	Annually, or as development occurs	$10,000		Assumed assessment completed internally by Town.
	Monitor the impact of upstream infrastructure upgrades on incoming flows to the WWTP	Annually, or based on sewer separation projects' timelines	$50,000		
	Plan for the addition of an anoxic zone to improve pH control and support nitrification in the shoulder seasons.	Within 5-10 years	$50,000		
	Undertake a study of the organic and solids loading to the WWTP versus loading capacity.	Within 5-10 years	$50,000		

7.2 Climate Change Considerations

The potential impacts of climate change are considered as they relate to the effectiveness of the baseline recommendations provided. Many climate models exist, which consider the effectiveness of encouraged and legislated societal behavioural change, and the results of these are yet to be realized. As a result, there is a degree of uncertainty in the long-term projections of climate conditions and its impacts. Nonetheless, it is recommended to consider providing resilience against the potential impacts of climate change.

It is generally recommended that adaptability for future expansions to satisfy the climate change condition be incorporated in the design of the upgrades. Additional infrastructure needs or sizing to accommodate climate change were identified in **Chapter 3** (**Section 6**). The resulting additional costs are presented in **Table 7-4**, and consist of:

- Additional costs to upsize sewers (+$21,000);
- New sewer upgrades (+$914,000);
- Additional costs to upsize sanitary PSs and forcemains (+$756,000); and
- Additional costs to upsize the WFP treatment capacity, clearwell and high-lift pumping capacity (+$3,951,000).

Furthermore, the Town can undertake planning and operational measures to address the impacts of climate change, such that the recommended infrastructure upgrades could be deferred, or their sizing reduced. The required sizing should be reviewed in future planning endeavours and as the projects advance through design stages, considering the effectiveness of additional activities undertaken by the Town to address the impacts of climate change.

Table 7-4: Climate Change Impacts on Infrastructure Recommendation and Costs

Site	Upgrade Type	Upgrade (Baseline Level of Service)	Total Site Costs (Baseline Level of Service) ($)	Upgrade (With Climate Change Considerations)	Timeline	Opinion of Probable Cost (with Climate Change Considerations) 2023 Construction Cost (Nearest $1,000)	Opinion of Probable Cost (with Climate Change Considerations) Capital Cost Components & Risk Factors (35% of Construction Cost) (Nearest $1,000)	Opinion of Probable Cost (with Climate Change Considerations) Construction + Capital Costs ($)	Opinion of Probable Cost (with Climate Change Considerations) Contingency (40% of Construction + Capital Costs) ($)	Opinion of Probable Cost (with Climate Change Considerations) Total (Construction + Capital) + Contingency ($)	Opinion of Probable Cost (with Climate Change Considerations) Total Site Costs ($)	Difference (Total Site Costs with Climate Change Considerations – Baseline Level of Service)	Climate Change Consideration
Daniel St / Albert St	Existing Sanitary Sewer Upgrade	66 m @ 675 mm	$848,000	66 m @ 675 mm	2032	$112,000	$39,000	$151,000	$60,000	$211,000	$869,000	+$21,000	
		160 m @ 675 mm		160 m @ 675 mm		$272,000	$95,000	$367,000	$147,000	$514,000			
		38 m @ 675 mm		38 m @ 825 mm		$76,000	$27,000	$103,000	$41,000	$144,000			Pipe upsizing needed for climate change consideration.
James St	Existing Sanitary Sewer Upgrade	No Upgrade	-	215 m @ 300 mm	2032	$290,000	$102,000	$392,000	$157,000	$549,000	$914,000	+$914,000	James St reconstruction and sewer separation planned in 2033. Existing sewer diameter upsizing & lowering recommended as a climate change consideration [see **Chapter 3** (**Section 6**)].
				143 m @ 300 mm		$193,000	$68,000	$261,000	$104,000	$365,000			
Sanitary PS#1	Sewer Separation Measures	Sewer Separation Measures	$5,670,000	Sewer Separation Measures	2032	$1,500,000	$525,000	$2,025,000	$810,000	$2,835,000	$5,859,000	+$189,000	
	Existing Sanitary PS &	+56 L/s		+73 L/s		$1,600,000	$560,000	$2,160,000	$864,000	$3,024,000			Larger pumps needed for climate change consideration.

Site	Upgrade Type	Upgrade (Baseline Level of Service)	Total Site Costs (Baseline Level of Service) ($)	Upgrade (With Climate Change Considerations)	Timeline	Opinion of Probable Cost (with Climate Change Considerations) 2023 Construction Cost (Nearest $1,000)	Opinion of Probable Cost (with Climate Change Considerations) Capital Cost Components & Risk Factors (35% of Construction Cost) (Nearest $1,000)	Opinion of Probable Cost (with Climate Change Considerations) Construction + Capital Costs ($)	Opinion of Probable Cost (with Climate Change Considerations) Contingency (40% of Construction + Capital Costs) ($)	Opinion of Probable Cost (with Climate Change Considerations) Total (Construction + Capital) + Contingency ($)	Opinion of Probable Cost (with Climate Change Considerations) Total Site Costs ($)	Difference (Total Site Costs with Climate Change Considerations – Baseline Level of Service)	Climate Change Consideration
	Forcemain Upgrade												
Sanitary PS#2	Existing Sanitary PS Upgrade	+12 L/s	$1,701,000	+25 L/s	2042	$1,000,000	$350,000	$1,350,000	$540,000	$1,890,000	$1,890,000	+$189,000	PS upgrade sizing assuming no reduction in peak flows following updated flow monitoring. Larger pumps needed for climate change consideration.
Sanitary PS#3	Existing Sanitary PS & Forcemain Upgrade	+96 L/s	$7,560,000	+170 L/s	2032	$4,200,000	$1,470,000	$5,670,000	$2,268,000	$7,938,000	$7,938,000	+$378,000	Larger pumps, faster motors, larger new twin forcemains needed for climate change consideration.
WFP	WFP Upgrade (Treatment Capacity)	+631 m³/d	$7,862,000	+1,728 m³/d	2032	$3,000,000	$1,050,000	$4,050,000	$1,620,000	$5,670,000	$11,813,000	+$3,951,000	Larger volume (and storage footprint) needed for climate change consideration.
	WFP Upgrade (Clearwell Expansion)	+1,592 m³		+1,935 m³		$2,400,000	$840,000	$3,240,000	$1,296,000	$4,536,000			Larger volume (and storage footprint) needed for climate change consideration.
	WFP Upgrade (High-Lift	+45 L/s		+58 L/s		$850,000	$298,000	$1,148,000	$459,000	$1,607,000			Larger pumps needed for climate

Site	Upgrade Type	Upgrade (Baseline Level of Service)	Total Site Costs (Baseline Level of Service) ($)	Upgrade (With Climate Change Considerations)	Timeline	Opinion of Probable Cost (with Climate Change Considerations) 2023 Construction Cost (Nearest $1,000)	Opinion of Probable Cost (with Climate Change Considerations) Capital Cost Components & Risk Factors (35% of Construction Cost) (Nearest $1,000)	Opinion of Probable Cost (with Climate Change Considerations) Construction + Capital Costs ($)	Opinion of Probable Cost (with Climate Change Considerations) Contingency (40% of Construction + Capital Costs) ($)	Opinion of Probable Cost (with Climate Change Considerations) Total (Construction + Capital) + Contingency ($)	Opinion of Probable Cost (with Climate Change Considerations) Total Site Costs ($)	Difference (Total Site Costs with Climate Change Considerations – Baseline Level of Service)	Climate Change Consideration
	Pumping Upgrade)												change consideration.

Total Difference (Additional Costs to Provide Resilience to Climate Change)	**$5,642,000**
Total Difference – Existing Sanitary Sewer Upgrades & Sewer Separation	$935,000
Total Difference – Existing Sanitary PS & Forcemain upgrades	$756,000
Total Difference – WFP Upgrades	$3,951,000

Orange Shading = New upgrade or upgrade sizing updated for climate change considerations

7.3 Chapter 4 Conclusions

Chapter 4 presents the implementation plan and opinion of probable costs for the servicing solutions identified to address the Town's existing wastewater collection system and potable water distribution system's existing constraints, and to service future (growth), and includes the following discussions:

- Presentation of the proposed implementation plan & capital project costs (**Section 7.1**); and,
- Impact of climate change on the proposed infrastructure recommendations & costs (**Section 7.2**).

The following conclusions and recommendations arose from the proposed implementation plan & capital project costs:

- Class D opinions of probable costs (OPC) and timelines were developed for projects which will be undertaken by the Town and funded by the Town and/or through development charges, and additional studies, planning and operational activities that the Town could undertake.
- The OPC consist of construction costs, capital costs & risk components (35% of construction costs), and contingency (40% of construction + capital costs & risk components).
- Project timelines were established, considering the concurrent implementation of water and wastewater infrastructure projects, and aligns them with the Town's other planned capital projects (e.g., road rehabilitation), where feasible.
- The total infrastructure project OPC is $42,359,000, of which:
  - $17,305,000 will fund wastewater collection system existing gravity sewer upgrades and sewer separations;
  - $12,096,000 will fund existing sanitary pump station and forcemain upgrades;
  - $5,096,000 will fund existing watermain upgrades and pressure reduction measures; and,
  - $7,882,000 will fund WFP upgrades.
- The total study & activities OPC is $850,000, of which:

  - $130,000 will fund studies & activities for sanitary pump stations monitoring & I/I management;
  - $190,000 will fund studies & activities for the overall wastewater collection network;
  - $190,000 will fund studies & activities for the WWTP;
  - $150,000 will fund studies & activities for the overall water distribution network; and,
  - $190,000 will fund studies & activities for the WFP.
- The impact of climate change on the proposed upgrades was also assessed. Infrastructure needs and sizing to increase resilience to climate change amount to an additional +$5,642,000, of which:
  - +$21,000 are needed to provide resilience to climate change by further upsizing sewers;
  - +$914,000 are needed to provide resilience to climate change with additional sewer upgrades;
  - +$756,000 are needed to provide resilience to climate change by further upsizing sanitary PSs and forcemains; and,
  - +$3,951,000 are needed to provide resilience to climate change by further upsizing the WFP treatment capacity, clearwell and high-lift pumping capacity.
- Furthermore, the Town can also undertake planning and operational measures to address the impacts of climate change, such that the recommended infrastructure upgrades could be deferred, or their sizing reduced. The required sizing should be reviewed in future planning endeavours and as the projects advance through design stages, considering the effectiveness of additional activities undertaken by the Town to address the impacts of climate change.

8 Class EA Areas of Interest

The following section describes how the current Master Plan and identified projects fulfil the MECP's interests with regards to the Class EA process, or how these will be addressed as part of future project-specific investigations for the projects identified in **Chapter 3** (**Section 6**) and **Chapter 4** (**Section 0**).

8.1 Planning and Policy

As described in **Section 3.2**, this Master Plan is prepared with consideration given to the Town of Arnprior's 201   Official Plan policies and objectives, needed as part of implementing the Province of Ontario's Provincial Policy Statement (2014, replaced in 2020). These policies were considered in the assessment of the high-level servicing alternatives presented in **Chapter 3** (**Section 6**).

For the projects identified in this Master Plan, other applicable plans and policies should be reviewed on an individual project basis, as part of the next planning and design phases. Potentially relevant policies for the projects identified include:

- The Safe Drinking Water Act (2002, last amended in 2021)
- The Sustainable Water and Sewage Systems Act (2002)
- The Ontario Water Resources Act (last amended in 2021)
- The Ontario environmental Protection Act (1990, last emended in 2021)

Other potentially relevant policies should be identified, and their requirements addressed in the next planning and design phases.

8.2 Source Water Protection

The following project is located near the Town's WFP raw water intake:

- WFP/River crossing (crossing the Madawaska River).

For this project, as well as for other projects identified in this Master Plan, the proximity to sources of drinking water (municipal or other) and any delineated vulnerable areas should be assessed in the next project-specific planning and design stages. Potential impacts to source protection areas due to construction or operational activities should be identified and mitigated.

8.3 Climate Change

Climate change mitigation and adaptation were considered in the overall assessment of the high-level servicing alternatives presented in **Chapter 3** (**Section 6**). As the projects identified in this Master Plan proceed with further investigations and design stages, climate change mitigation and adaptation should be further considered in the assessment of alternative solutions and alternative designs.

8.3.1 Climate Change Mitigation

The following projects have the potential to produce GHG emissions and have impacts on carbon sinks:

- Sanitary PS #1 upgrade (pump upgrades, backup generator)
- Sanitary PS #2 upgrade (pump upgrades, backup generator)
- Sanitary PS #3 upgrade (pump upgrades, backup generator)
- WFP high-lift pumping upgrade (pump upgrades, backup power)

In general, GHG emissions and impacts on carbon sinks would occur throughout the lifecycle of any project. Therefore, for the projects listed above, as well as for other projects identified in this Master Plan, climate change mitigation should be considered during each project's individual planning and design phases, when assessing alternative solutions and designs.

8.3.2 Climate Change Adaptation

The impacts of climate change on the servicing solutions identified in this Master Plan were assessed and presented in **Chapter 3** (**Section 6**). Additional resilience measures through design were identified and considered in the implementation plan and cost estimates presented in **Chapter 4** (**Section 0**). Climate change adaptation should be further considered during each project's individual planning and design phases, when assessing alternative solutions and design.

Furthermore, the Town can undertake planning and operational measures to address the impacts of climate change. The required sizing should be reviewed in future planning endeavours and as the projects advance through design stages, considering the effectiveness of additional activities undertaken by the Town to address the impacts of climate change.

8.4 Air Quality, Dust and Noise

As the projects identified in this Master Plan proceed with further investigations and design stages, sensitive receptors within each study area should be identified, and an assessment of air quality/odour impact may be needed to determine the impacts and appropriate mitigation measures. Dust and noise control measures should be included in the construction plans and include requirements per the Town's Noise Control By-law (number 6764-17).

8.5 Ecosystem Protection and Restoration

Natural heritage and hydrologic features were identified and documented in **Section 3.1**. As each project identified in this Master Plan proceeds with further planning and design studies, these should include further reviews of potential impacts to natural heritage and to the local ecosystem within the specific study areas, and the development of appropriate mitigation measures, to align with the MECP's requirements as well as the Town's Official Plan policies on the protection of natural heritage.

8.6 Species at Risk

Species at Risk (SARs) with potential habitat within the Town of Arnprior were identified in a desktop background review as documented in **Section 3.1**. This review can inform project-specific preliminary screening and detailed site investigations for SARs once the projects identified in this Master Plan undergo separate planning and design studies.

8.7 Surface Water

The following projects are located near watercourses, cross watercourses, or have the potential to impact watercourses:

- WFP/River crossing (crossing the Madawaska River);
- Sanitary PS #1 upgrade (near the Madawaska River, with overflow discharging to the river);
- Sanitary PS #3 upgrade (near the Madawaska River, with overflow discharging to the river);
- Sanitary PS #3 forcemain upgrade (forcemain crosses the Madawaska River);
- WFP Upgrades (increased water-taking from the Madawaska River).

For these projects, as well as for other projects identified in this Master Plan, potential impacts to watercourses due to construction or operational activities should be identified and mitigated. This should be addressed in each project's individual planning and design process.

8.8 Groundwater

Potential impacts to any well water supplies should be identified and addressed in the next planning and design steps for each individual project identified in this Master Plan. The current recommended potable water servicing strategy (*Improvement & Expansion of the Potable Water System*) does not involve any groundwater taking. The Town's current bylaws do no permit private well servicing as a servicing strategy for new developments, with exceptions considered in specific instances.

Groundwater should be protected from the potential for spills, dewatering and wood pole preservative during construction. A plan should be in place for preventing and dealing with spills. All spills that could potentially cause damage to the environment should be reported to the Spills Action Centre of the Ministry of the Environment, Conservation and Parks at 1-800-268-6060.

8.9 Excess Materials Management

During the design and construction of each project identified in this Master Plan, activities involving the management of excess soil should be conducted in accordance with the Environmental Protection Act regulation titled *On-Site and Excess Soil Management* (O. Reg. 40   19) and with the MECP's current guidance *Management of Excess Soil – A Guide for Best Management Practices* (2014). All waste generated during construction should be disposed of in accordance with the MECP's requirements.

8.10 Contaminated Sites

At a Master Plan level, no current or historical waste disposal sites or contaminated sites were identified for the study area of the Town of Arnprior. Nonetheless, as each project identified in this Master Plan proceeds with further investigations and design stages, the presence of contaminated sites within each specific study area should be confirmed, and appropriate testing and soil removal undertaken.

8.11 Servicing, Utilities and Facilities

As the projects identified in this Master Plan proceed with further investigations and design stages, any above or underground utilities and servicing infrastructure within each study area should be identified. The owners should be consulted to discuss impacts to this infrastructure, including potential spills.

At a high-level, this Master Plan already considers the potential for projects within the same study area or right-of-way in the development of the implementation plan and cost estimates presented in **Chapter 4** (**Section 0**).

8.12 Mitigation and Monitoring

The projects identified in this Master Plan will proceed with separate Class EA studies (applicable to potential Schedule B or Schedule C projects), design and construction. For each project, these next steps shall include the identification, documentation and implementation of measures to mitigate impacts to the environment, and to rehabilitate or enhance any impacted areas. Construction and post-construction effects monitoring strategies and programs should be documented.

8.13 Consultation

Consultation efforts undertaken as part of this Master Plan are documented in **Section 2.2**. Potential Schedule B or Schedule C projects may require that additional consultation be conducted as part of project-specific Class EA studies.

8.14 Class EA Process

As described in **Section 2.1**, this Master Plan was initiated and conducted in accordance with Approach #1 of the Master Planning Process, involving analyses on a system scale, to enable the Town to identify needs and establish broader infrastructure alternatives and solutions. Specific projects required to achieve the preferred solution described in the Master Plan were identified, however more detailed investigations at the project-specific level are required to fulfil the MCEA requirements for specific Schedule B and C projects identified within the Master Plan.

Table 8-1 lists the Master Plan projects identified in **Chapter 4** (**Section 0**), and includes the potential project type, based on the 2023 MCEA classification. Most watermain and sewer replacement projects are expected to occur within the municipal road allowance or existing utility corridors, such that they are *Exempt* from the requirements of the EAA. Sanitary PS upgrades and WFP upgrades are *Eligible for Screening to Exempt* and require further investigation to confirm whether they are *Exempt* from the requirements of the EAA or will need to meet the requirements of Schedule B or Schedule C projects. Projects which require water crossings have the potential for some adverse environmental and social effects and were classified as *Schedule B* projects.

Subsequent permitting or approvals required for the implementation of each project should be identified in the following project-specific planning and design studies.

Table 8-1: Master Plan Infrastructure Recommendations Implementation Plan and 2023 MCEA Project Type

Site	Upgrade Type	Upgrade	Timeline	2023 MCEA Project Type *To be confirmed in project-specific follow up study*
Riverview Dr / McNab St	Confirm the inverts along Riverview Dr with a topographical survey	Confirm the inverts along Riverview Dr with a topographical survey	Within 3-5 years	Exempt
	Existing Sanitary Sewer Upgrade	316 m @ 450 mm		
		356 m @ 525 mm		
	Water distribution pressure reduction measures			Exempt
Daniel St / Albert St	Existing Sanitary Sewer Upgrade	66 m @ 675 mm	Within 5-10 years	Exempt
		160 m @ 675 mm		
		38 m @ 675 mm		
Edward St	Confirm the inverts along Edward St with a topographical survey		Within 5-10 years	Exempt
	Existing Sanitary Sewer Upgrade	112 m @ 250 mm		
Elizabeth St	Existing Watermain Upgrades	180 m @ 250 mm	Within 5-10 years	Exempt
WFP/River Crossing	Twin of Existing Watermain River Crossing	420 m @ 400 mm	Within 3-5 years	Schedule B

Site	Upgrade Type	Upgrade	Timeline	2023 MCEA Project Type *To be confirmed in project-specific follow up study*
Sanitary PS#1	Monitor flows to upstream and downstream of PS #1		Within 5-10 years	Exempt
	Sewer Separation Measures			Exempt
	Existing Sanitary PS & Forcemain Upgrade	+56 L/s	Within 5-10 years	Eligible for Screening to Exempt
Sanitary PS#2	Monitor upstream flows		Within 5-10 years	Exempt
	Existing Sanitary PS Upgrade	+12 L/s	Within 10-20 years	Eligible for Screening to Exempt
Sanitary PS#3	Investigate and address sources of I/I upstream of PS #3		Within 3-5 years	Exempt
	Continue flow monitoring upstream of PS #3 to assess the efficacy of I/I reduction measures		Within 5-10 years	Exempt
	Existing Sanitary PS & Forcemain Upgrade	+96 L/s	Within 5-10 years	Schedule B
Water Filtration Plant (WFP)	WFP Upgrade (Treatment Capacity)	+631 m^3/d	Within 5-10 years	Eligible for Screening to Exempt

Site	**Upgrade Type**	**Upgrade**	**Timeline**	**2023 MCEA Project Type** *To be confirmed in project-specific follow up study*
	WFP Upgrade (Clearwell Expansion)	+1,592 m^3		
	WFP Upgrade (High-Lift Pumping Upgrade)	+45 L/s		
Overall Wastewater Collection Network	Sewer Separation Measures		Annually, or based on sewer separation projects' timelines	Exempt

9 Conclusions

This report presents the updated master plan for the Town's wastewater collection system and potable water distribution system's existing constraints, and to service future (growth), and includes the following discussions:

- Introduction of study area and problem statement (**Section 1**);
- Presentation of the Environmental Assessment Master Planning process (**Section 2**);
- Review of existing conditions (**Section 3**);
- Review of background data and data gap analysis (**Section 4 – Chapter 1**);
- Assessment of existing infrastructure (**Section 5 – Chapter 2**);
- Development of a servicing strategy (**Section 6 – Chapter 3**);
- Development of an implementation plan and cost estimates (**Section 0 – Chapter 4**);
- Review of the Class EA areas of interest (**Section 8**).

The following conclusions arose from this master plan:

- The residential population in the Town is projected to grow from a baseline of 10,038 (2022 estimate) to 17,051 in the 20-year horizon (2042). ICI areas are projected to grow from a baseline of 250 ha (2022 estimate) to 267 ha in the 20-year horizon (2042). The Town has also identified interest from areas outside of its municipal boundaries to connect to the municipal wastewater and water systems.
- Upgrades and expansion of the existing municipal wastewater collection and potable water distribution systems will be needed to service existing users and meet growth needs over a 20-year horizon.
- Supporting planning and operational studies and activities were also identified.
- Class D opinions of probable costs (OPC) and timelines were developed for projects which will be undertaken by the Town and funded by the Town and/or through development charges, and additional studies, planning and operational activities that the Town could undertake.

- The impact of climate change on sizing and timing of the proposed upgrades was also assessed, and measures to increase resilience to climate change were considered.

This Master Plan update satisfies Phases 1 and 2 of the Municipal Class Environmental Assessment (MCEA) process. Following completion of this Master Plan, the next steps for the Town include:

- Undertaking detailed investigations to confirm project types and complete associated Class EA studies;
- Proceed with the functional and detailed design of projects, once required Class EA requirements are fulfilled;
- Consider this Master Plan's findings and recommendations in reviewing the proposed servicing of new developments.

This Master Plan presents a long-term plan for providing potable water and wastewater infrastructure to meet future growth requirements. Nonetheless, growth projections may change over time and aging infrastructure may also affect the systems' performance. Therefore, it is recommended that this Master Plan be reviewed and updated regularly. Per the MCEA document, potential changes which may trigger the need for a review of the Master Plan include:

- Major changes to the assumptions;
- Major changes to the components of the Master Plan;
- Significant new environmental effects; and,
- Major changes in the proposed timing of projects.

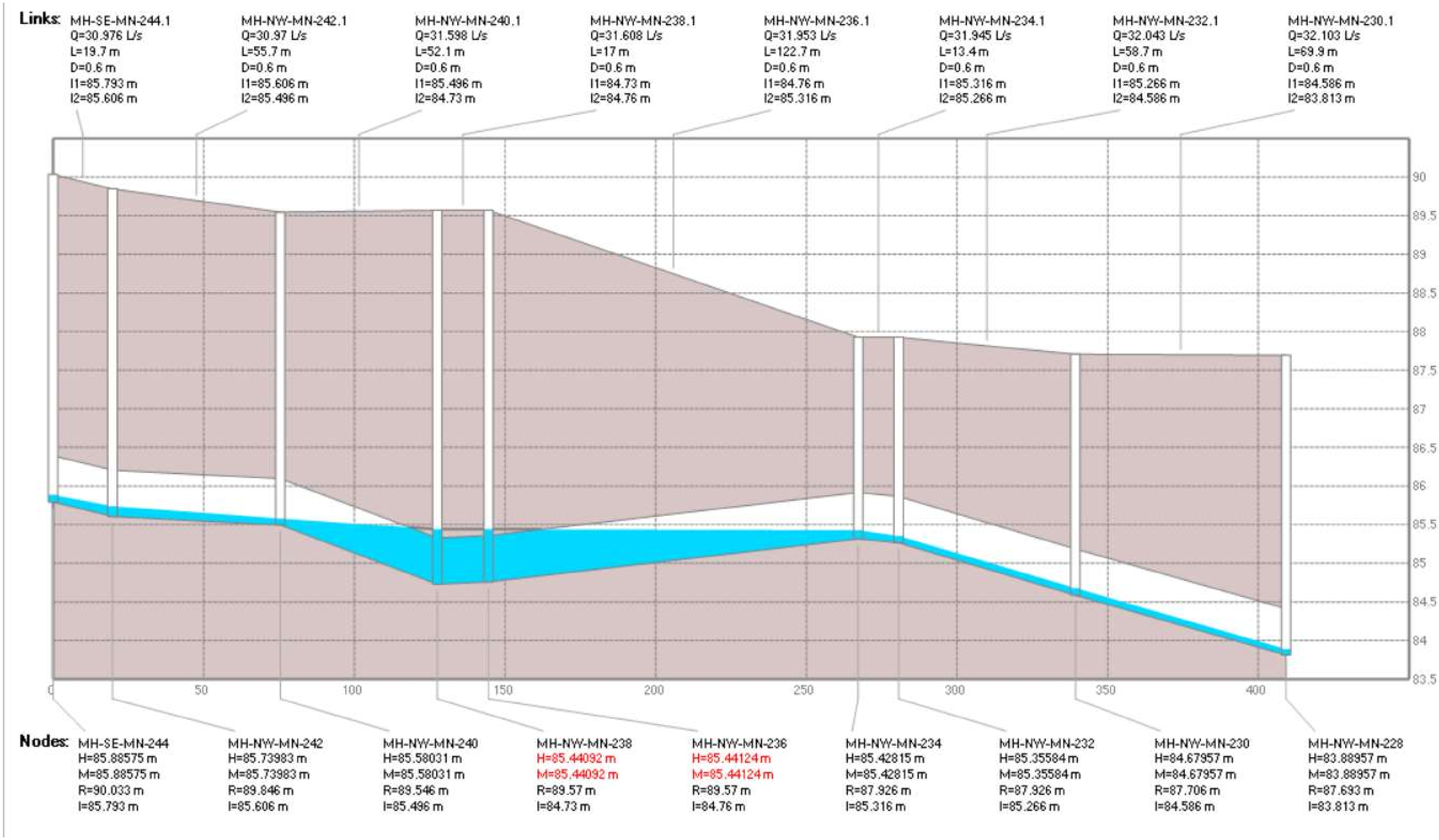
Appendices

Appendix A Wastewater Collection System Model Updates

A.1 Model Infrastructure Updates – Updated Profiles

Stantec

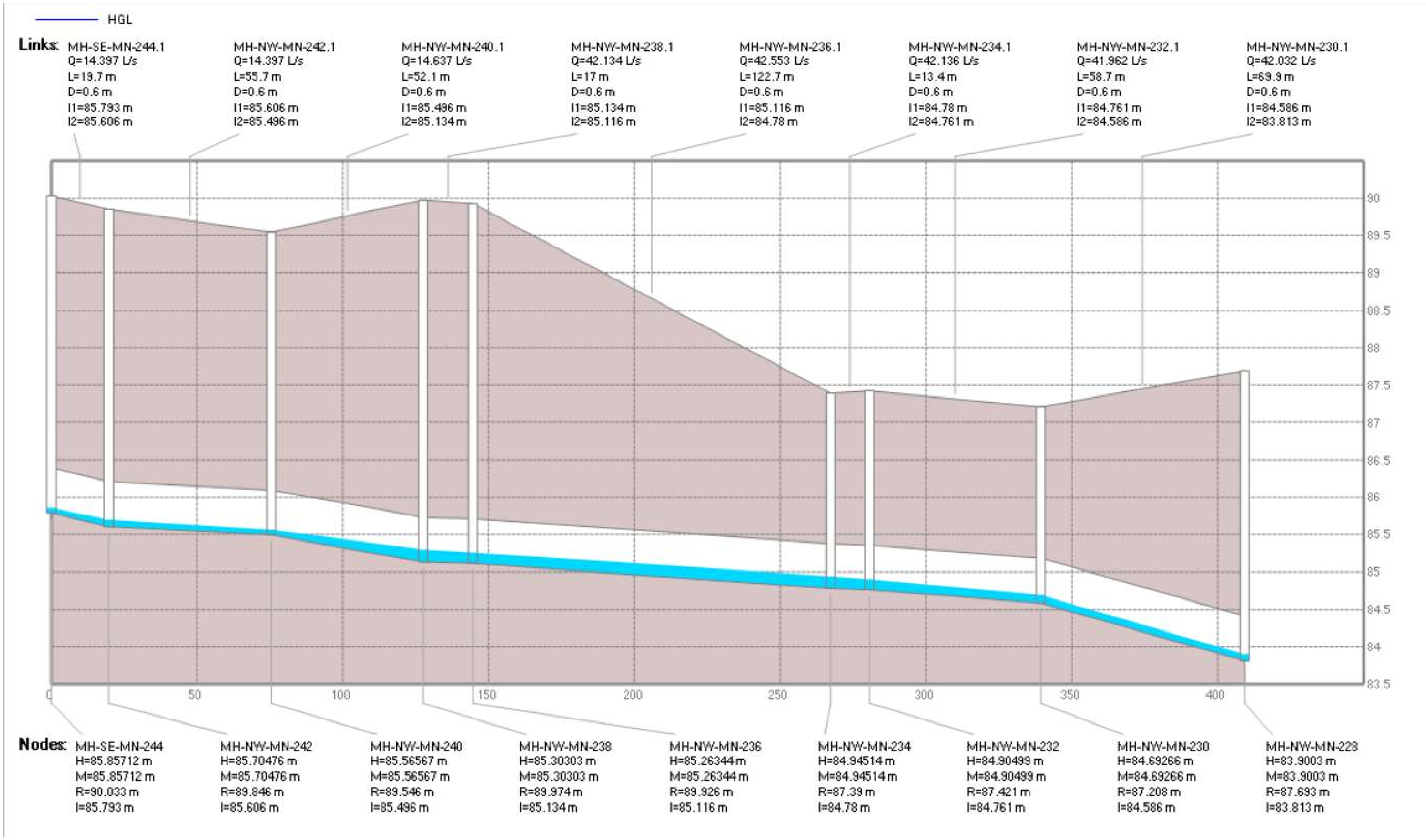
Sewer Profile Check: Daniel St (FM2)
Plan View



Stantec

Sewer Profile Check: Daniel St (FM2)

Profile Based on GIS Data from ArcGIS Online (Data downloaded on 2022/10/07)

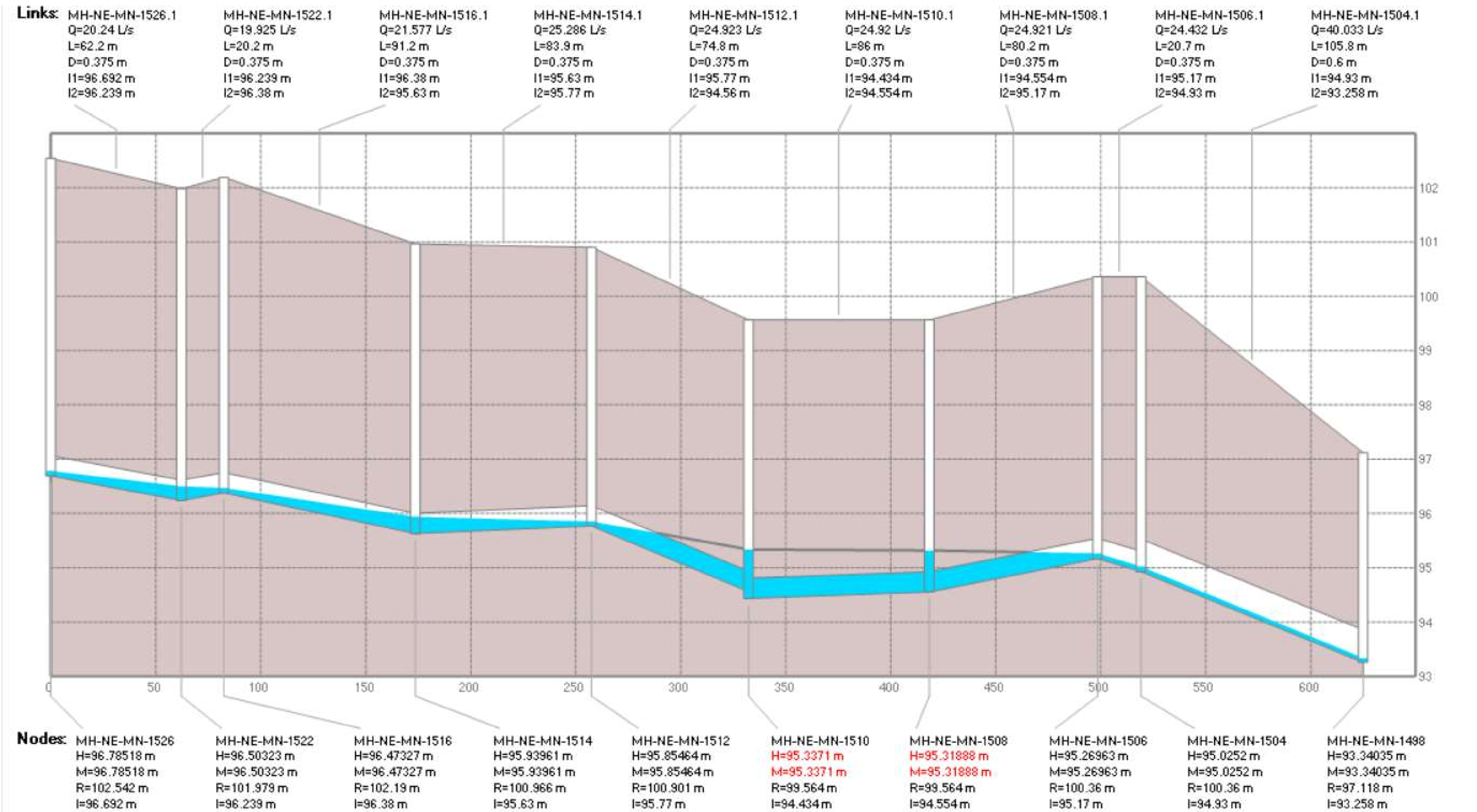


Stantec

Sewer Profile Check: Daniel St (FM2)
Adjusted Profile

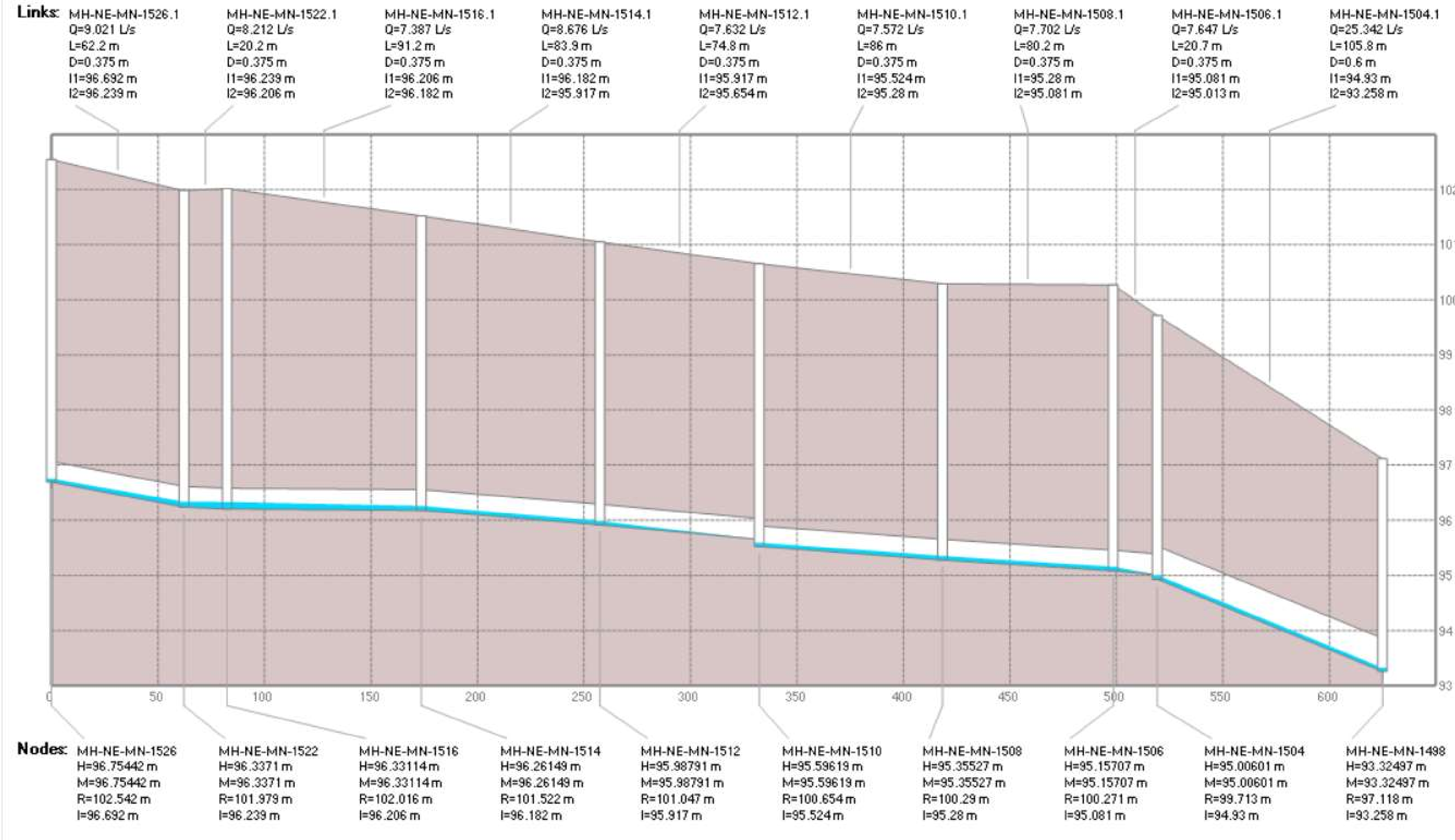
Stantec

Sewer Profile Check: DeCosta St/Madawaska Blvd (FM6)
Plan View



Stantec

Sewer Profile Check: DeCosta St/Madawaska Blvd (FM6)
Profile Based on GIS Data from ArcGIS Online (Data downloaded on 2022/10/07)

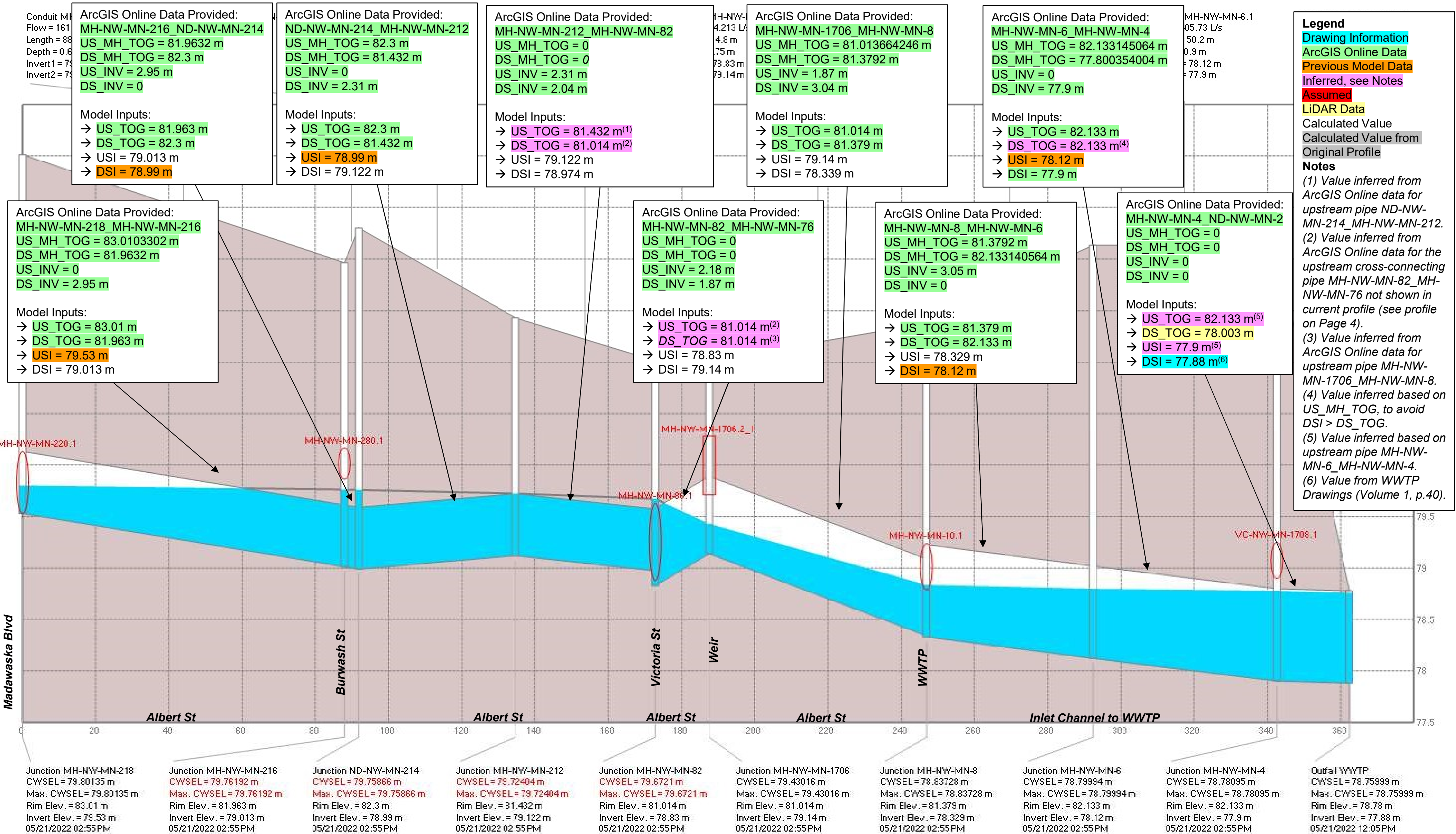


Stantec

Sewer Profile Check: DeCosta St/Madawaska Blvd (FM6)
Adjusted Profile

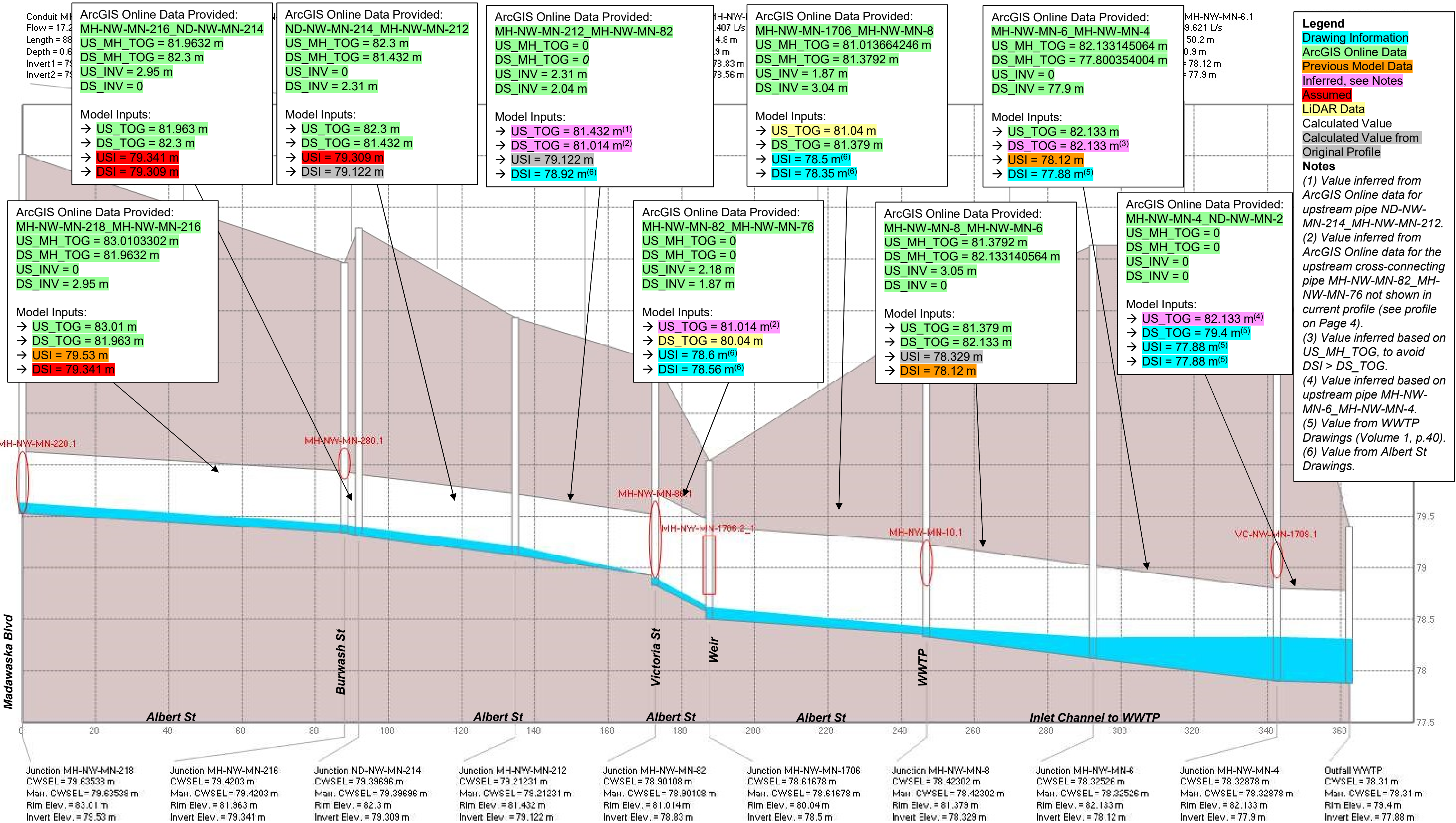
Stantec

Sewer Profile Check: Albert St from Madawaska Blvd to WWTP
Plan View



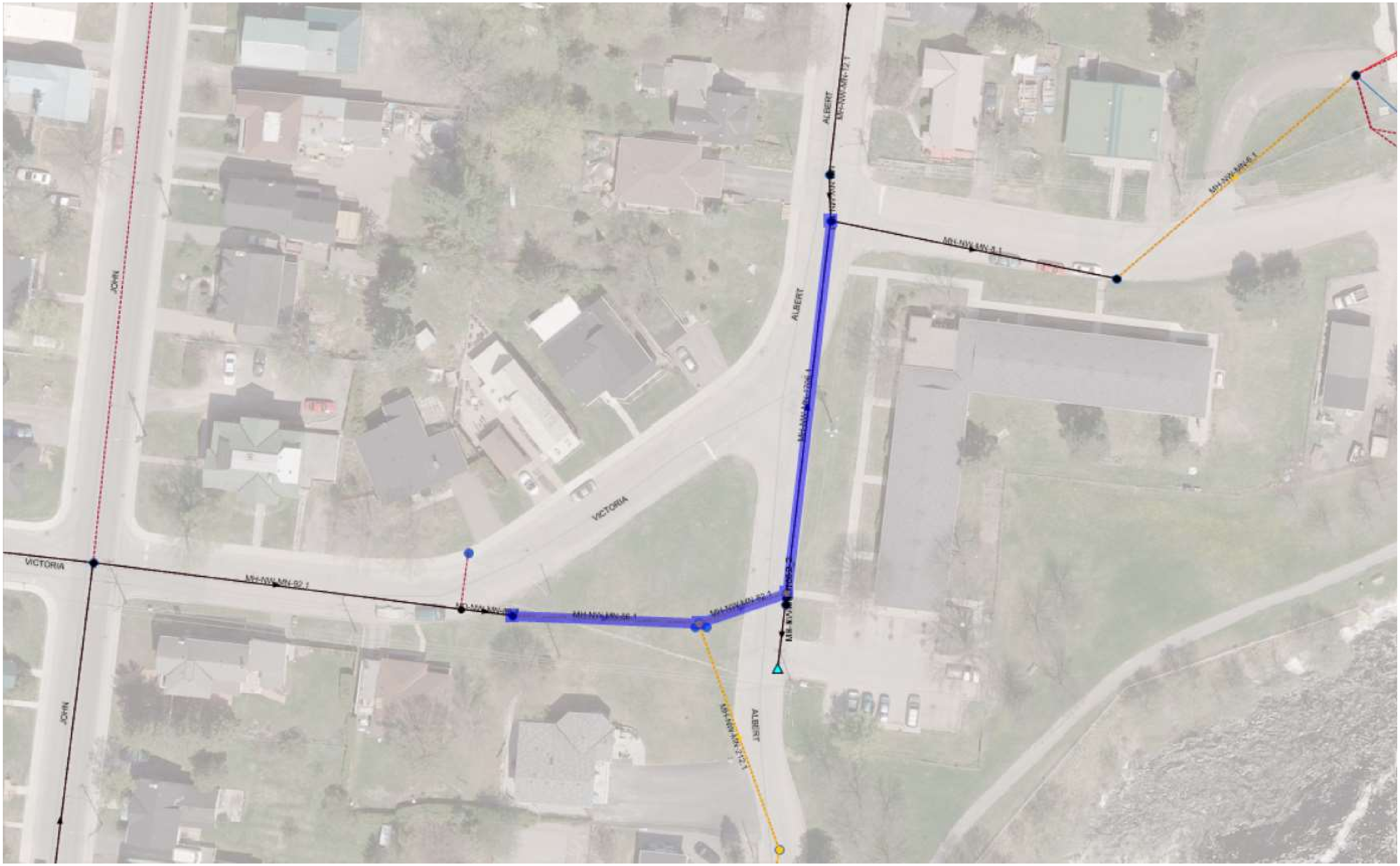
Stantec

Sewer Profile Check: Albert St from Madawaska Blvd to WWTP
Profile Based on GIS Data from ArcGIS Online (Data downloaded on 2022/10/07)



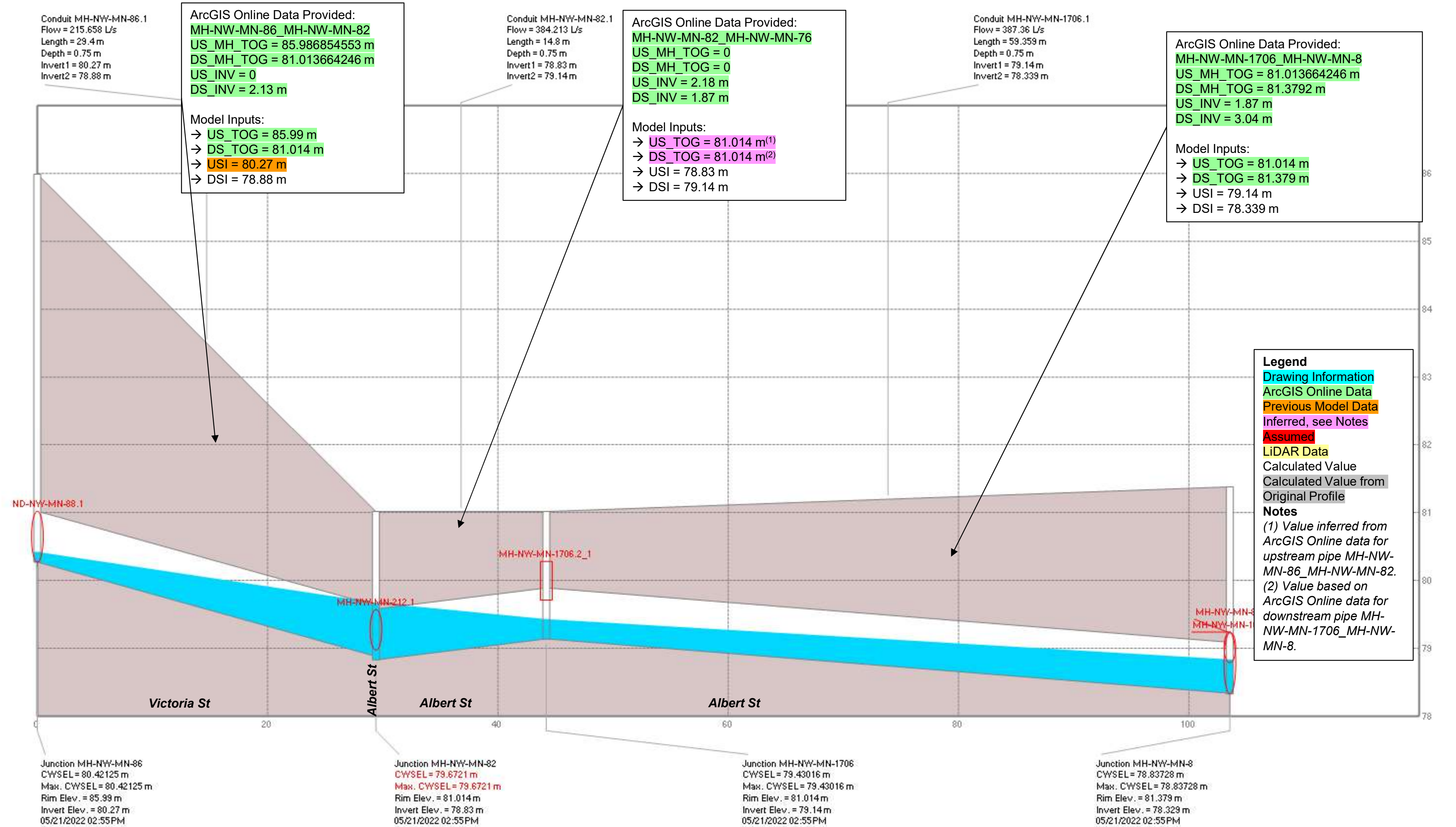
Stantec

Sewer Profile Check: Albert St from Madawaska Blvd to WWTP
Adjusted Profile



Stantec

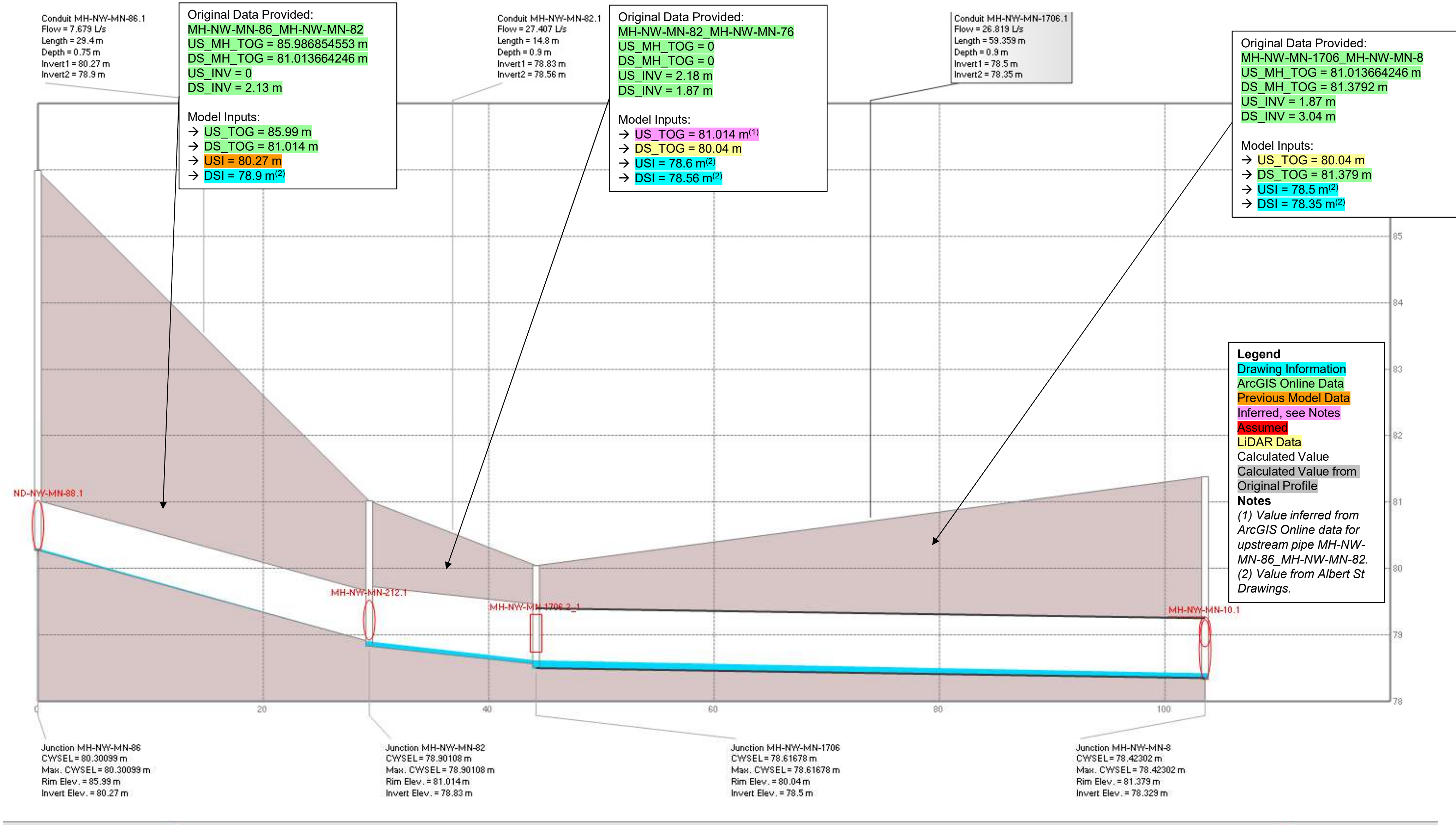
Sewer Profile Check: Victoria St/Albert St
Plan View



Stantec

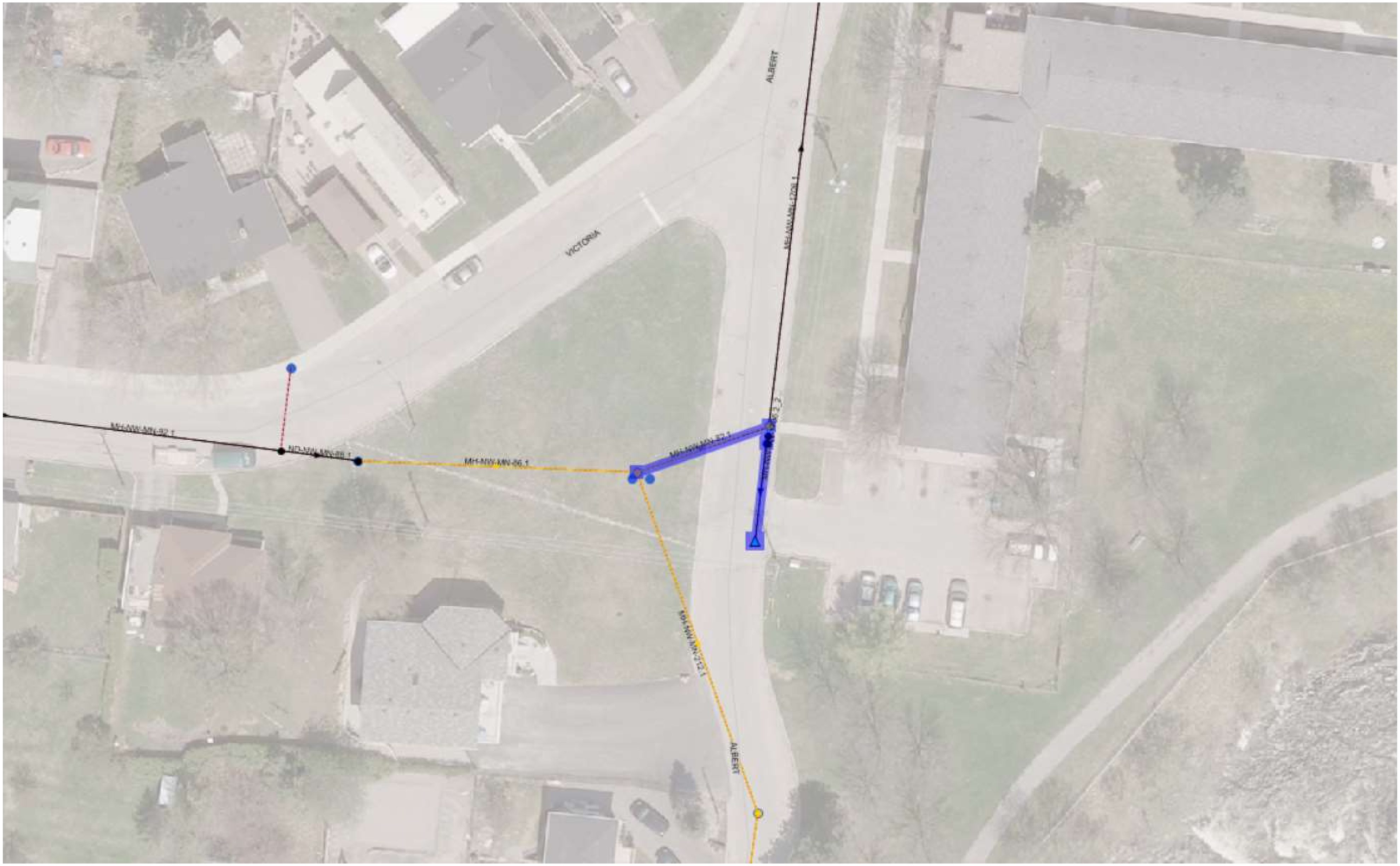
Sewer Profile Check: Victoria St/Albert St

Profile Based on GIS Data from ArcGIS Online (Data downloaded on 2022/10/07)



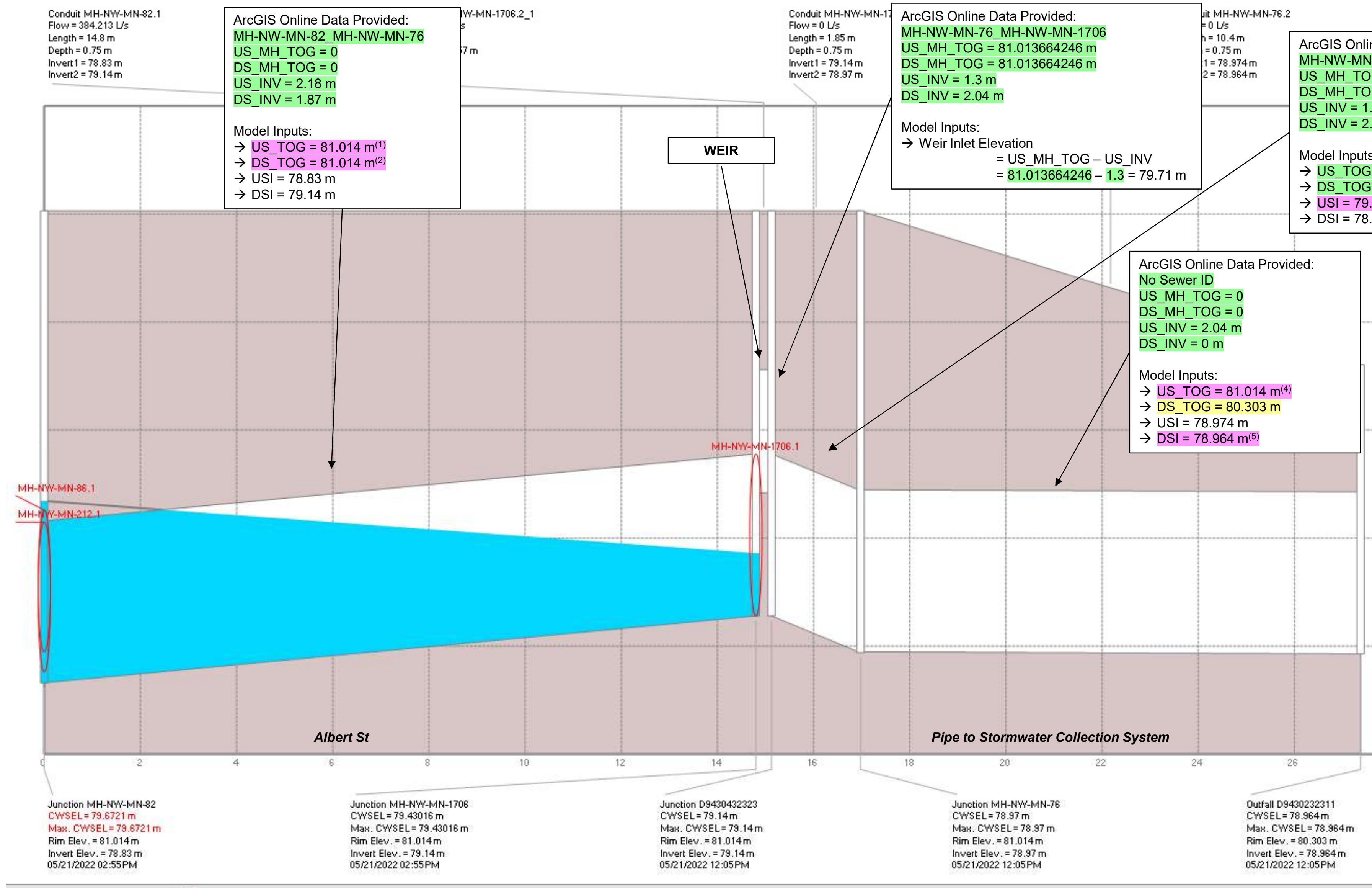
Stantec

Sewer Profile Check: Albert St
Adjusted Profile



Stantec

Sewer Profile Check: Albert St CSO
Plan View



Legend

Drawing Information
ArcGIS Online Data
Previous Model Data
Inferred, see Notes
Assumed
LiDAR Data
Calculated Value
Calculated Value from Original Profile

Notes

(1) Value inferred from ArcGIS Online data for the upstream pipe MH-NW-MN-86_MH-NW-MN-82 not shown in current profile (see profile on Page 4).

(2) Value inferred from ArcGIS Online data for the downstream pipe MH-NW-MN-1706_MH-NW-MN-8 not shown in current profile (see profile on Page 4).

(3) Value inferred from invert of pipe upstream of weir (MH-NW-MN-82_MH-NW-MN-76), based on review of photos from Albert St weir and CSO.

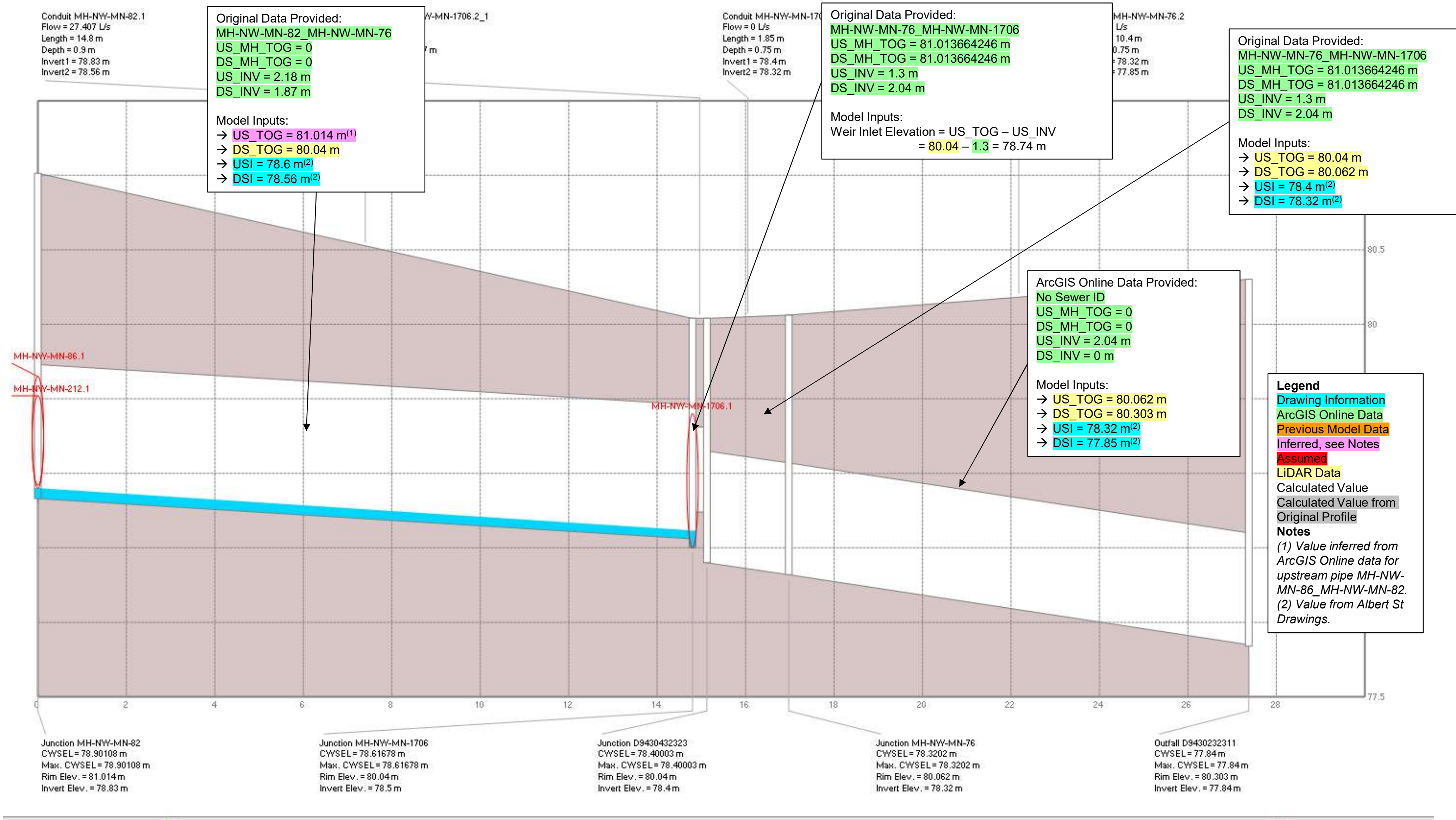
(4) Value inferred from ArcGIS Online data for the upstream pipe MH-NW-MN-76_MH-NW-MN-1706.

(5) Downstream invert inferred using minimum slope of 0.1%.

Stantec

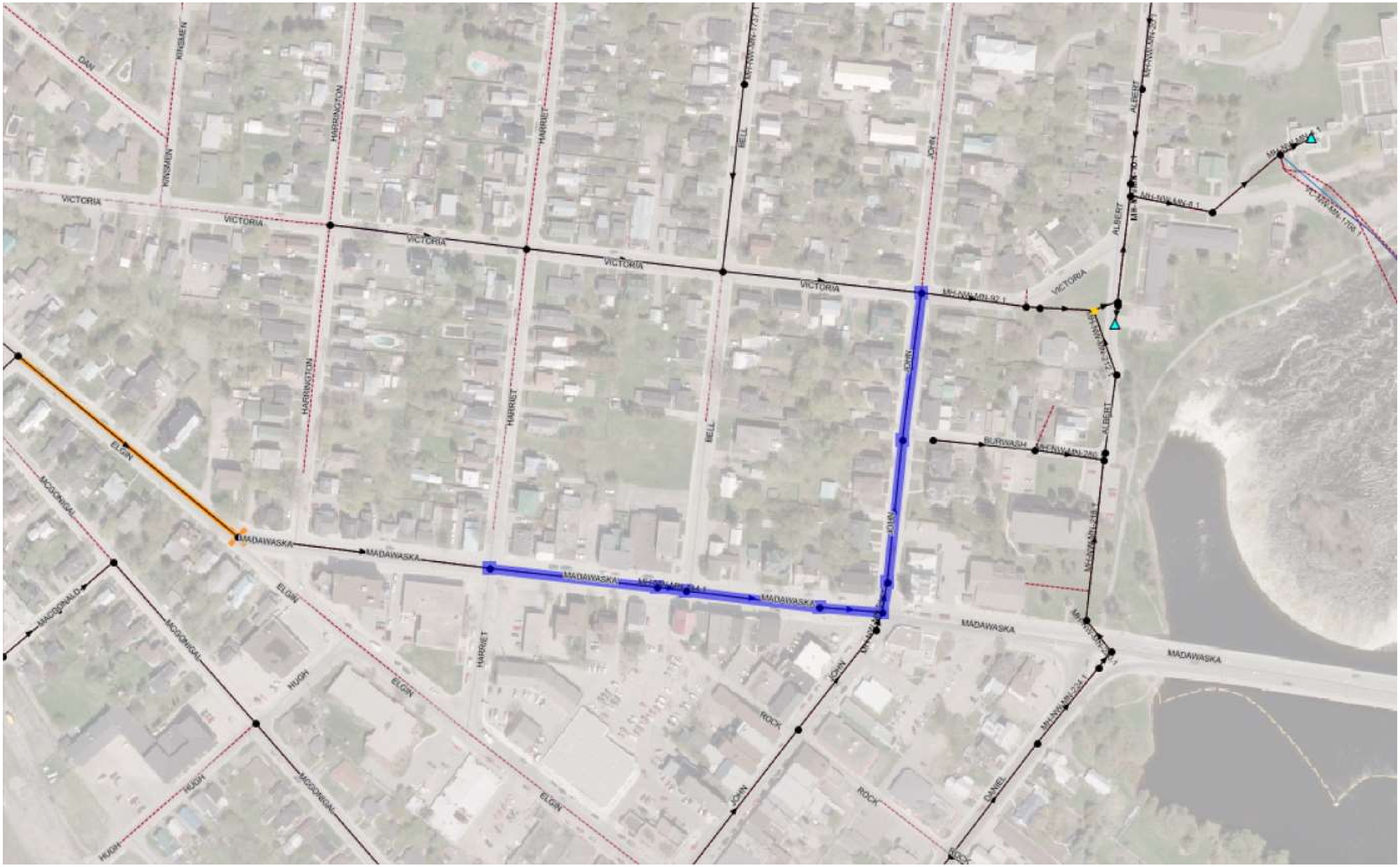
Sewer Profile Check: Albert St CSO

Profile Based on GIS Data from ArcGIS Online (Data downloaded on 2022/10/07)



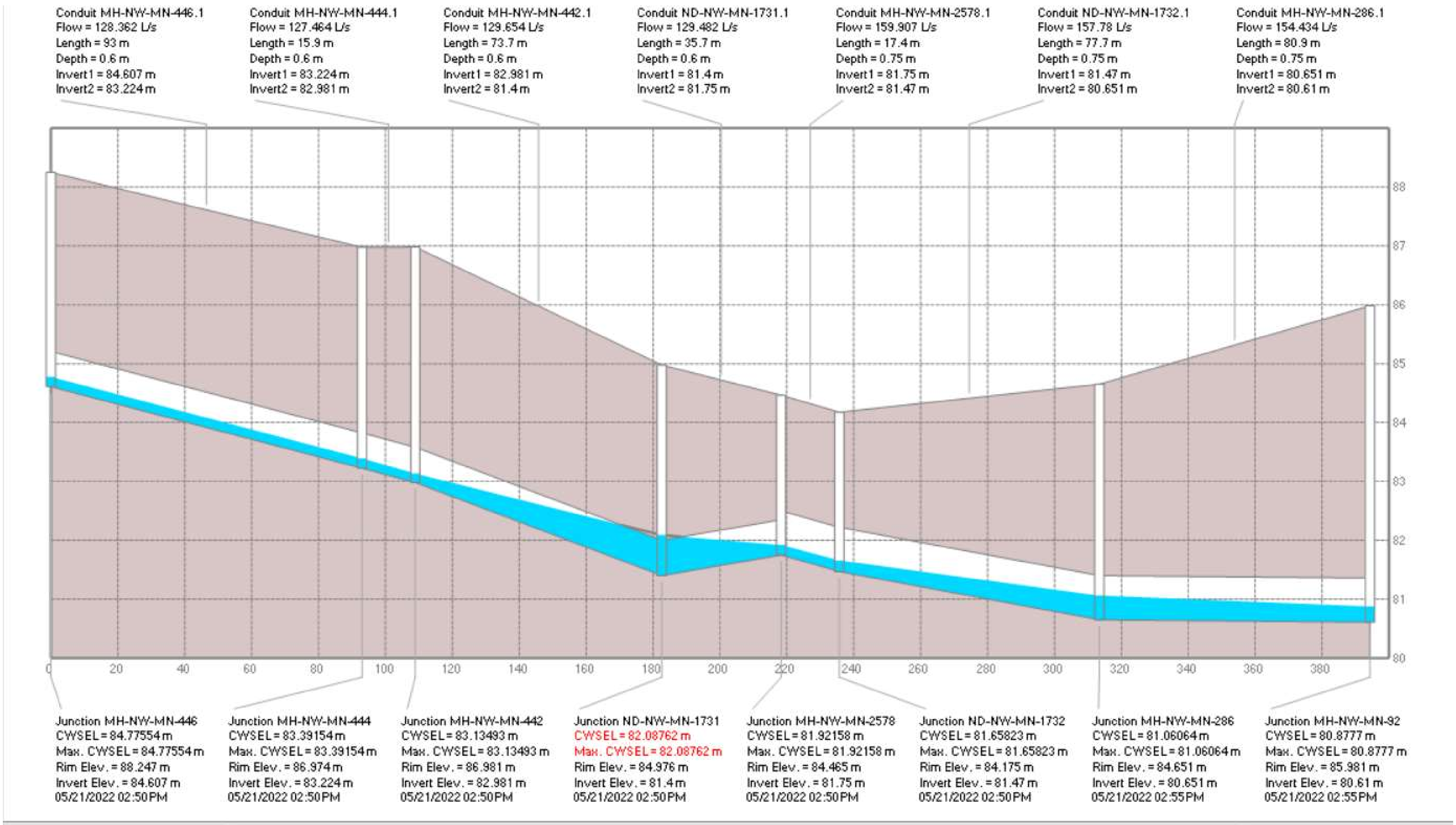
Stantec

Sewer Profile Check: Albert St
Adjusted Profile



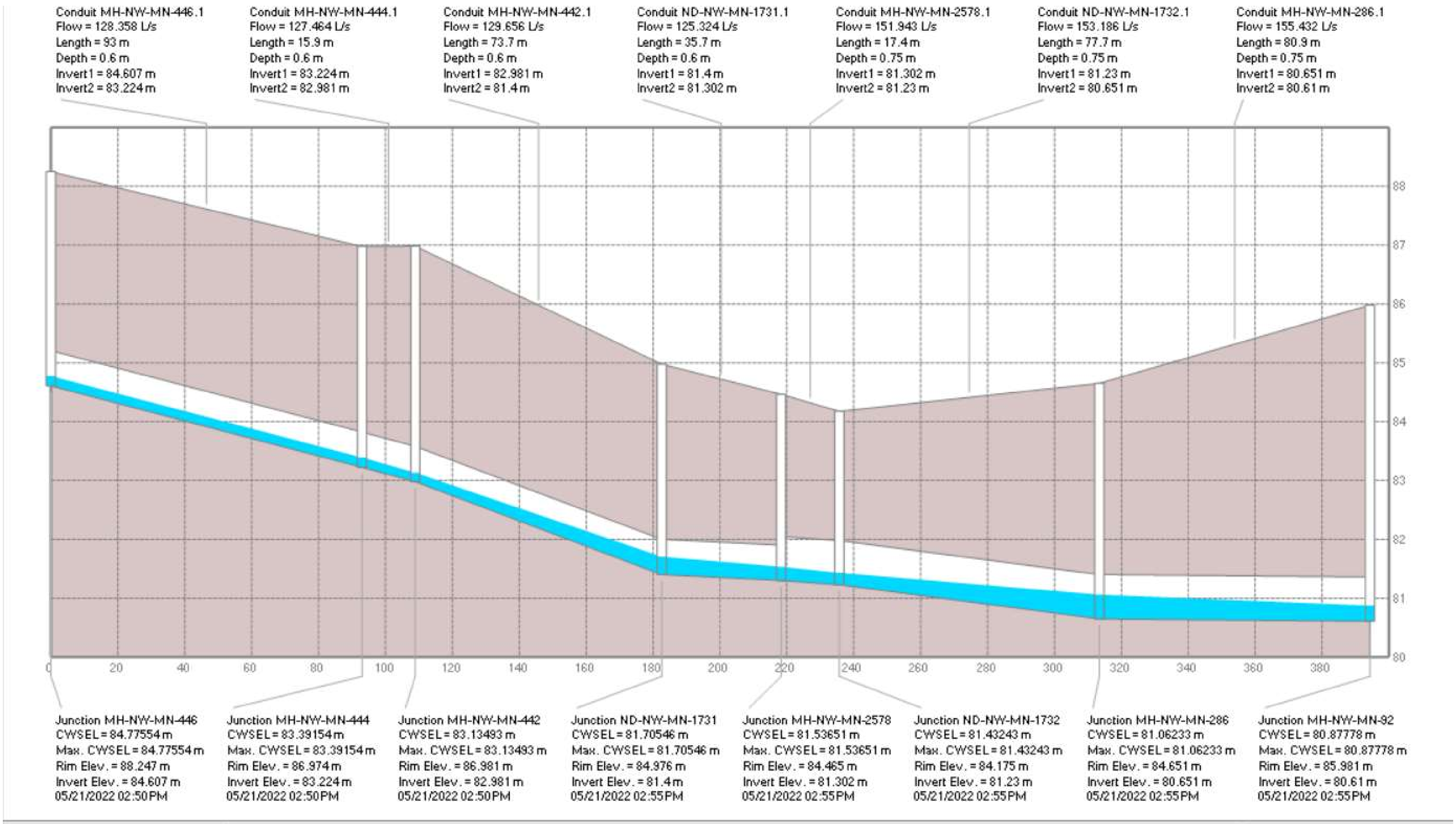
Stantec

Sewer Profile Check: Madawaska Blvd/Harriet St to John St/Victoria St
Plan View



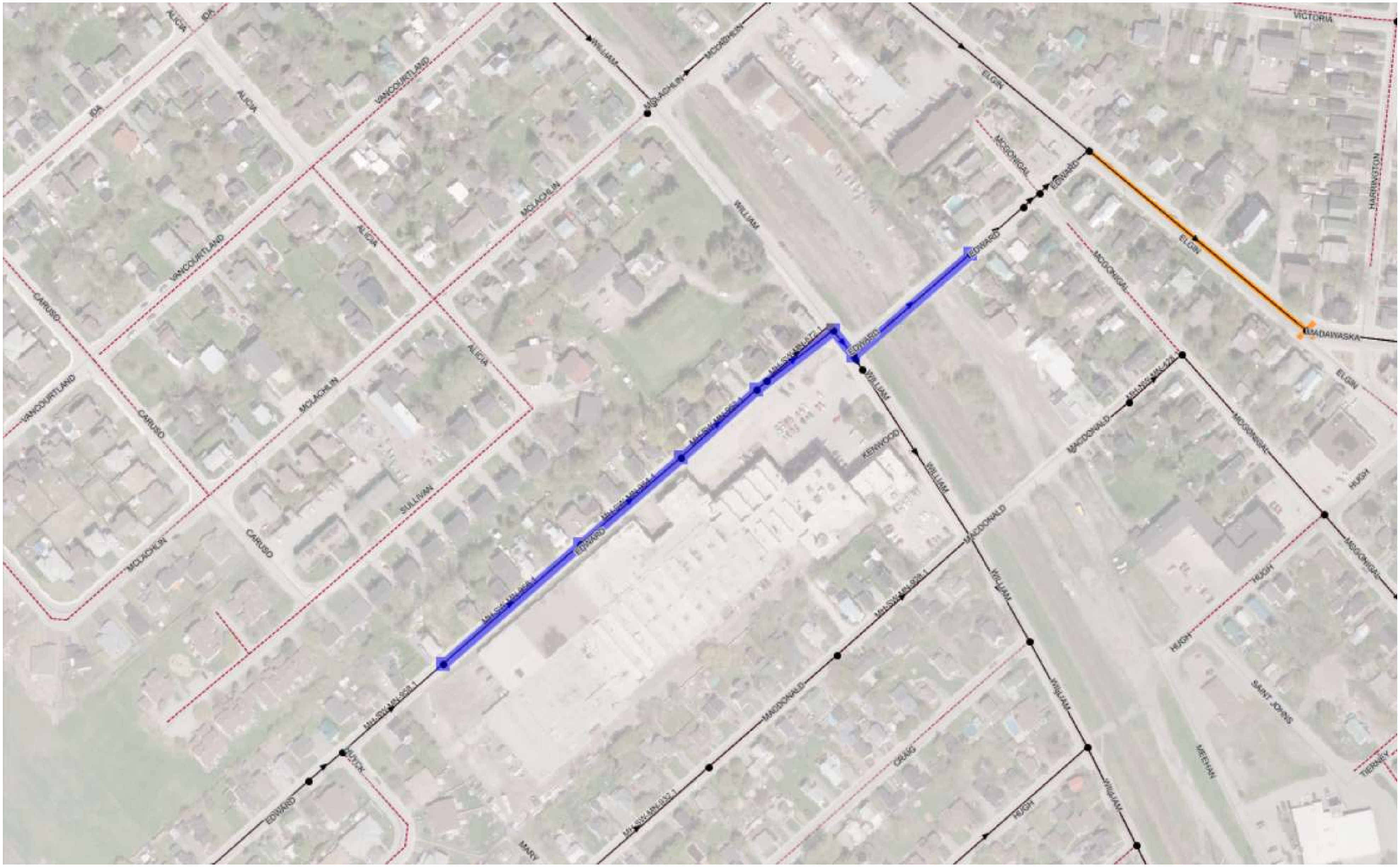
Stantec

Sewer Profile Check: Madawaska Blvd/Harriet St to John St/Victoria St
Profile Based on GIS Data from ArcGIS Online (Data downloaded on 2022/10/07)

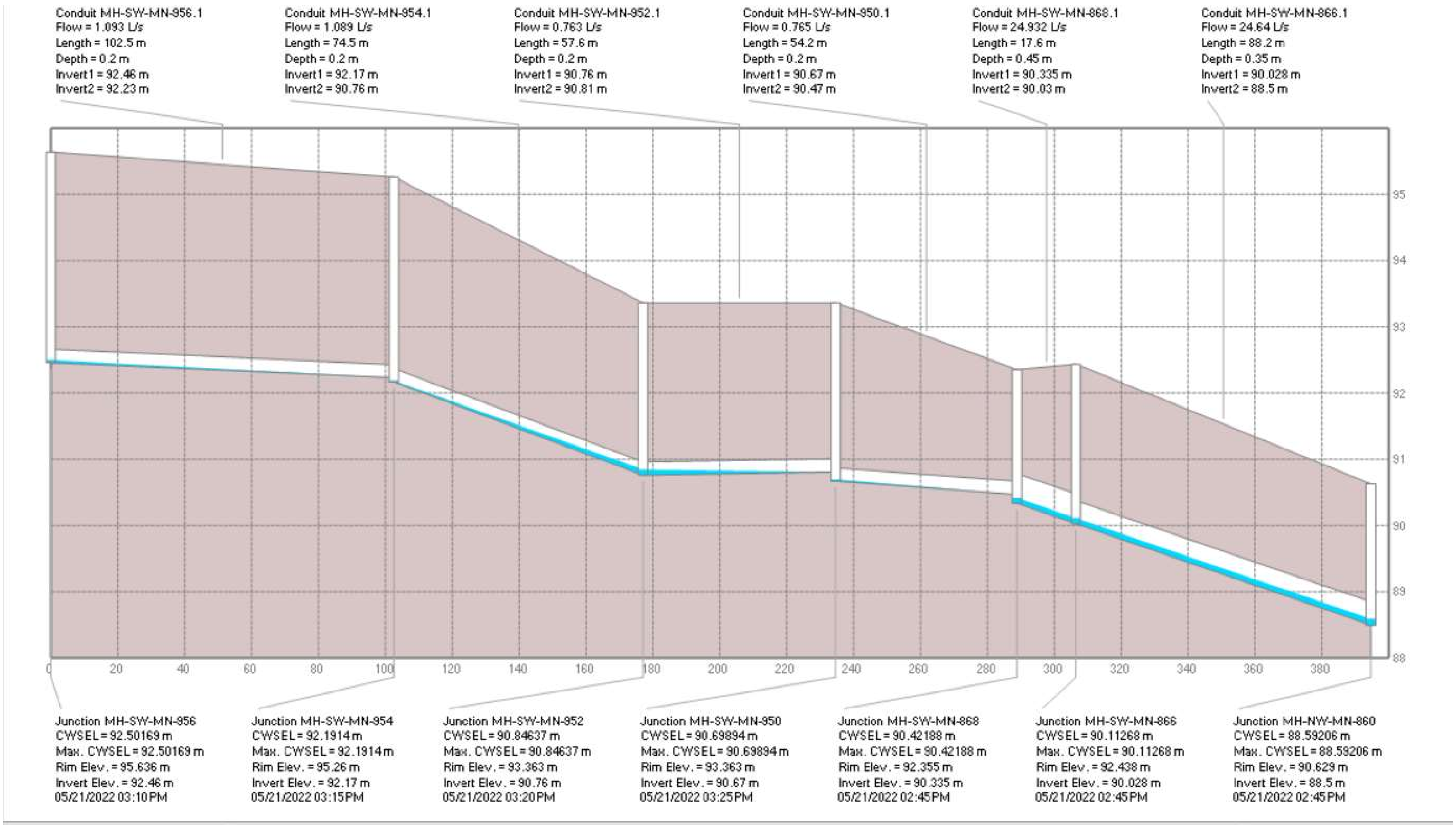


Stantec

Sewer Profile Check: Madawaska Blvd/Harriet St to John St/Victoria St
Adjusted Profile

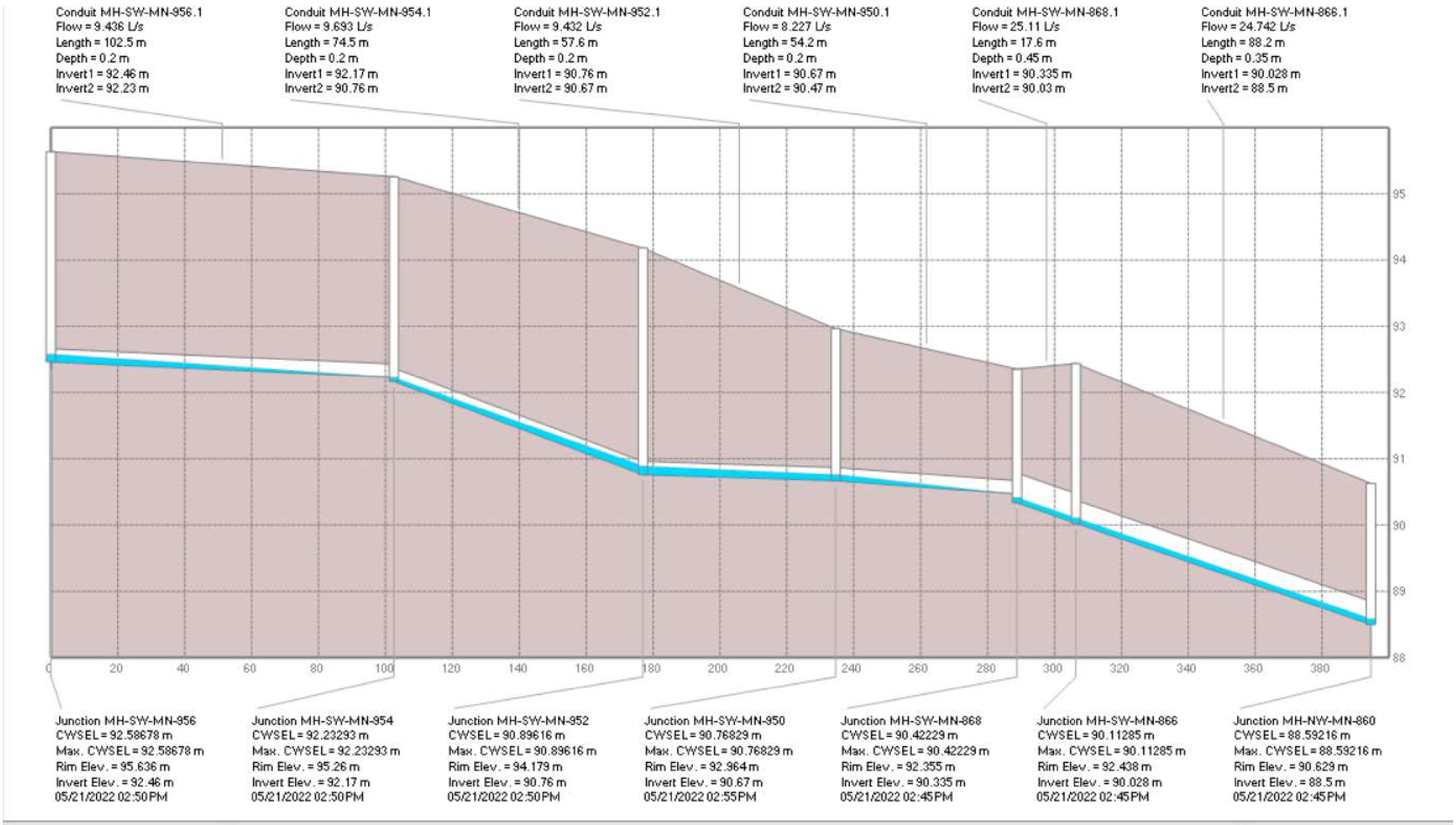


Sewer Profile Check: Edward St, from Huyck St to CN Rail Corridor
Plan View



Stantec

Sewer Profile Check: Edward St, from Huyck St to CN Rail Corridor
Profile Based on GIS Data from ArcGIS Online (Data downloaded on 2022/10/07)



Stantec

Sewer Profile Check: Edward St, from Huyck St to CN Rail Corridor
Adjusted Profile

A.2 Flow Monitoring Program Report

FLOWMETRIX | METCON | PROCESS

TOWN OF ARNPRIOR SEWER FLOW MONITORING FINAL REPORT

PREPARED FOR:

STANTEC CONSULTING LTD.

August 2022

Stantec Consulting Ltd. – Flow Monitoring Final Report
August 2022

Prepared by:

SCG Flowmetrix Technical Services Inc.
15 Connie Crescent, Unit 5
Concord, ON
L4K 1L3
www.scgprocess.com/flowmetrix

Brandon Lui, EIT
Project Manager

Mahsa Kheirandish, MSc
Data Analyst

SCG FLOWMETRIX

August 19, 2022

Marc Telmosse, P.Eng.
Associate, Water Delivery Canada
Engineering Delivery Lead, Urban Water Resources
Stantec
400 – 1331 Clyde Avenue
Ottawa, ON K2C 3G4
T: (613) 415-7655
E: marc.telmosse@stantec.com

RE: TOWN OF ARNPRIOR
SEWER FLOW MONITORING – SPRING 2022

Dear Mr. Telmosse,

SCG Flowmetrix is pleased to present the following data report for the Arnprior sewer flow monitoring project, which consisted of six (6) flow meters and one (1) rain gauge for a period of three (3) months.

All data results are outlined in the report. If after reviewing the report there are any questions or concerns regarding the content, please let me know at your earliest convenience.

We thank you for the opportunity to provide our services.

Sincerely,

Brandon Lui
Project Manager
T: 226-213-7274
blui@SCGflowmetrix.com

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1. Introduction

The Stantec Consulting Ltd. retained SCG Flowmetrix Technical Services Inc. (SCG Flowmetrix) in March of 2022 to provide real-time sewer flow monitoring services in six sanitary sewer maintenance holes and rainfall data in the Town of Arnprior. The main objective of the flow monitoring program was the assessment, installation, maintenance, and data acquisition of six flow monitoring locations along with corresponding rainfall data for three months. The monitoring period occurred between April 6th and July 20th, 2022.

2. Flow Monitoring

2.1 Site Locations

The flow monitoring site locations and related site information are presented below in Table 1.

Table 1. Flow Monitoring Site Information

Site Name	Pipe Size	Material	Install	Address
ARN-1 (MH-SW-MN-1092)	585 mm	PVC	Inlet	60 Staye Court Drive
ARN-2 (MH-NW-MN-236)	600 mm	PVC	Inlet	47 Daniel St N
ARN-3 (MH-NW-MN-448)	560 mm	Concrete	Inlet	122 Elgin St
ARN-4 (MH-NE-MN-1314)	350 mm	PVC	Inlet	70 Madawaska Blvd
ARN-5 (MH-NE-MN-1328)	780 mm	PVC	Outlet	70 Madawaska Blvd
ARN-6 (MH-NE-MN-1508)	350 mm	Concrete	Inlet	2 Decosta Rd

2.2 Site Assessments and Installations

Stantec provided six site locations for assessment by SCG Flowmetrix prior to the installation of the flow monitoring equipment. The sites were assessed based on hydraulic suitability and the condition of the infrastructure. The outlet of the target manhole for Arn-5 was deemed to be more suitable hydraulically for installation than the inlet due to whirlpooling flow. Arn-6 was installed in the upstream alternate location inlet to avoid a higher traffic road. At the same time, the inlets of the target manholes were deemed to be suitable for the installation of the rest of the sites. The installations were completed on April 6th, 2022. **Refer to Appendix A for the Installation Reports.**

3. Data Collection

3.1 Equipment Specifications

The ADS Triton+ monitor was selected for this project. This flow monitor is an area-velocity flow monitor that uses the Continuity Equation to measure flow. The ADS Triton+ monitors consist of data acquisition sensors and a battery-powered microcomputer. The microcomputer includes a processor unit, data storage, and an onboard clock to control and synchronize the sensor readings.

Figure 1. ADS Triton+ Meter with Peak Combo Sensor and Surface Combo Sensor

The Triton+ was paired with a Peak Combo Sensor, mounted at the invert of the pipe. The sensor includes three types of data acquisition technologies, as described below:

1. The up-looking ultrasonic depth uses sound waves from two independent transceivers to measure the distance from the sensor upward toward the flow surface, applying the speed of sound in the water and the temperature measured by the sensor to calculate depth.

2. The pressure depth is calculated using a piezo-resistive crystal to determine the difference between hydrostatic and atmospheric pressure. The pressure sensor is temperature compensated and vented to the atmosphere through a desiccant-filled breather tube.

3. To obtain peak velocity, the sensor sends an ultrasonic signal at an angle upward through the widest cross-section of the oncoming flow. The signal is reflected by suspended particles, air bubbles, or organic matter with a frequency shift proportional to the velocity of the reflecting objects. The reflected signal is received by the sensor and processed using digital spectrum analysis to determine the peak flow velocity.

The flow meter was synchronized to ***Eastern Standard Time*** and programmed to collect depth and velocity data at five (5) minute intervals and transmit the data via cellular telemetry at 12-hour intervals to the Remote Data Acquisition (RDA) application currently implemented using the FlowWorks web-hosting site (www.flowworks.com).

Please refer to Appendix B for full Equipment Specifications.

3.2 Field-Level Data QA/QC

During the monitoring period, field crews performed routine maintenance verifying proper monitor operation and documenting field conditions. **Refer to Appendix C for the Confirmation Reports.**

The following quality assurance steps are taken to assure the integrity of the collected data:

- Clock synchronization: Field crews synchronized monitor clocks to master clocks. **Please note all flow monitoring data is in Eastern Standard Time (EST).**

- Confirm depth and velocity readings: Field crews descended into meter manholes to manually measure depths and velocities and compare them to meter readings. If silt was present in the pipe invert, silt levels were measured.

- Confirm average velocities through cross-sectional velocity profiles: Since ADS velocity sensors measure peak velocity, field crews collected cross-sectional velocity profiles to develop a relationship between peak and average velocity to ensure that the hydraulic criteria were met.

- Upload and review data: Data collected from the monitor was uploaded and reviewed by a Data Analyst for completeness, outliers, and deviations in the flow pattern, which indicates system anomalies or equipment failure.

3.3 Data Analyst-Level Data QA/QC

SCG Flowmetrix data analysts reviewed the data daily and were responsible for issuing work orders if the site required service, or to schedule regular maintenance. The site was flagged for observations such as:

- No Telemetry Communication (i.e., no new data)
- Low Battery Voltage
- Depth Sensor Comparison
- Velocity Sensor Functionality
- Change in Typical Trend
- Response to Rain Events

4. Data Analysis

Data was uploaded via telemetry, or manually to the online RDA software. Data analysts had the ability to view the raw data collected by the meter and examine its integrity. SCG Flowmetrix analysts reviewed both site verification records and comments provided during each visit. This technique would allow the analyst to identify any inconsistencies in the data collected by the monitor and flag them for further investigation.

4.1 Data Quality

The flow was laminar within the ARN-1, ARN-2, ARN-4, ARN-5, and ARN-6 monitoring locations. The flow was whirpooling a bit in ARN-3 however the overall data quality was good. ARN-4, and ARN-5 experience a surcharge on May 21st and Jun 3rd,2022. Manual measurements matched the sensor, all sites responded to rain events, and the data quality was good.

4.2 Data Corrections

All data analysis and corrections were completed in-house by SCG Flowmetrix staff. The correction process involved weekly QA/QC, monthly corrections, and any additional final corrections, if necessary. The built-in data correction features in the RDA software gave analysts a variety of tools to correct raw data, so that the most accurate data is delivered.

4.2.1 Flow Quantification

The flow quantification method used strictly for this monitoring project was the Continuity Equation. There are two main equations used to calculate open channel flow – the Continuity Equation and Manning's Equation.

4.2.1.1 Continuity Equation

The Continuity Equation, which is considered the most accurate, can be used if both depth of flow and velocity are available.

$$Q = A \times V$$

Where,

$Q =$ Flow (L/s)
$A =$ Cross-sectional Flow Area (m^2)
$V =$ Average Velocity (m/s)

4.3 Data Results

The average flow depth, velocity, and quantity data observed during the monitoring period from April 6th, 2022, to July 20th, 2022, are provided in Table 2.

Table 2. Flow Data Results

	Depth (mm)	Velocity (m/s)	Quantity (L/s)
ARN-1 (MH-SW-MN-1092)			
Average	95	0.178	4.72
Minimum	56	0.014	0.21
Maximum	180	0.510	22.82
ARN-2 (MH-NW-MN-236)			
Average	104	0.495	17.24
Minimum	50	0.201	2.69
Maximum	312	0.938	135.4
ARN-3 (MH-NW-MN-448)			
Average	105	0.282	10.52
Minimum	73	0.018	0.37
Maximum	316	0.950	135.9
ARN-4 (MH-NE-MN-1314)			
Average	89	0.708	14.12
Minimum	61	0.510	6.28
Maximum	773	1.076	81.09
ARN-5 (MH-NE-MN-1328)			
Average	133	0.342	19.05
Minimum	31	0.057	4.03
Maximum	1158	1.114	107.9
ARN-6 (MH-NE-MN-1508)			
Average	40	0.379	2.74
Minimum	22	0.170	0.44
Maximum	189	0.689	24.15

5. Rainfall Measurement

A Telog Ru-32 rain gauge (Arnprior-RG) was installed on April 6th in the yard at 73 James Street which is shared between the Water Filtration Plant and Public Works Garage to collect rainfall data and supplement the data collected by the flow monitoring equipment.

6. Graphical Analysis

The following plots have been provided:

1. Monthly Hydrographs
   a. Rainfall
   b. Flow
   c. Level
   d. Velocity

The hydrographs for all monitoring locations are available in Appendix D.

SCG FLOWMETRIX

APPENDIX A

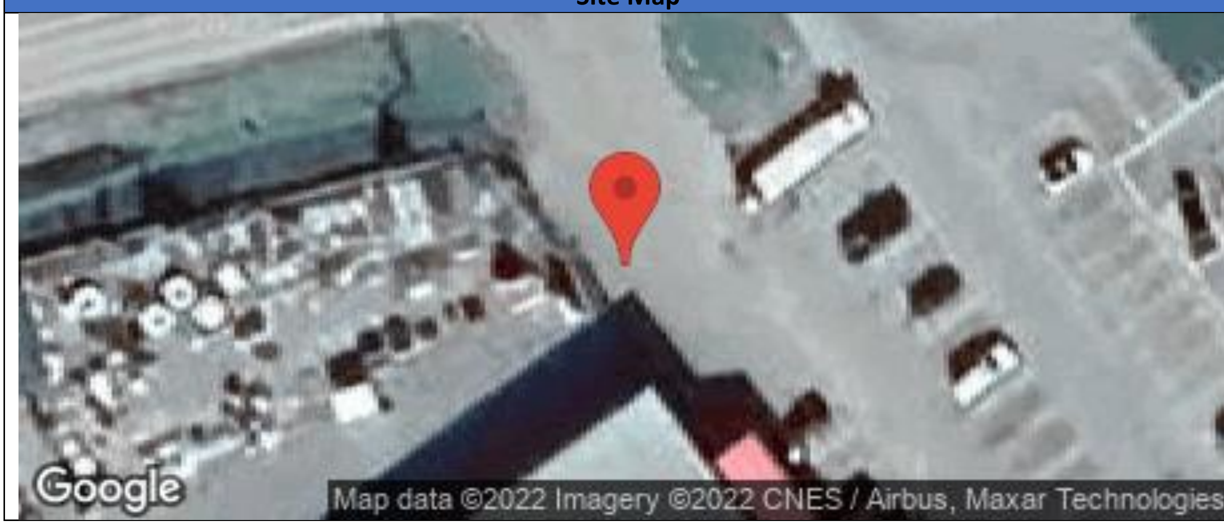
INSTALLATION REPORTS

SITE INSTALLATION REPORT

Site Information			
Site ID:	Arn-1 (MH-SW-MN-1092)	**Project:**	Arnprior SFS'22
Date: **Time:**	April 6, 2022 01:26 PM	**Site Address / Location:**	60 Staye Court Drive
Weather:	15C scattered clouds 22 km/h	**GPS Coordinates:**	
Traffic Plan:	TL-6	**Site Access Details:**	On the shoulder of the road
Atmospheric Hazard:	None		

Manhole / Pipe Assessment Information			
MH ID:	MH-SW-MN-1092	**Pipe Asset ID:**	
Manhole Depth (mm):		**Installation Target:**	Inlet
MH Chamber Condition:	Good	**Flow Type:**	Sanitary
Flow Condition:	Laminar	**Pipe Height (mm):**	585
Flow Depth (Wet) (mm):	94	**Pipe Width (mm):**	585
Silt Depth (mm):	20	**Pipe Shape:**	Circular
Velocity (m/s):	0.20	**Pipe Material:**	PVC

Site Map



INSTALLATION Information				
Meter Type:	Triton+	**Sensor Type: 1|2**	Peak (CS4)	
Meter S/N:	41015	**Sensor S/N: 1|2**	35087	
SIM / IP Address:	*49715/10.250.3.2	**Physical Offset: 1|2**	0	

Confirmation				
	Manual	**Meter**		**+/-**
Flow Depth (mm)	95	94	87	-1
Peak Velocity (m/s):	0.2	0.2		0

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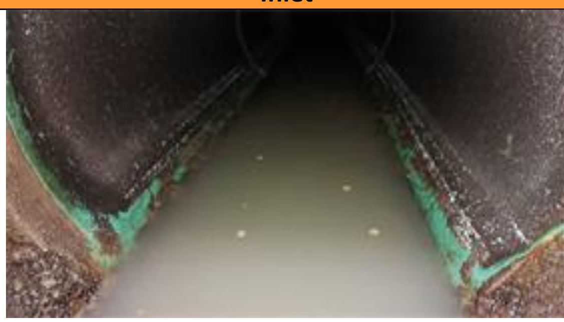
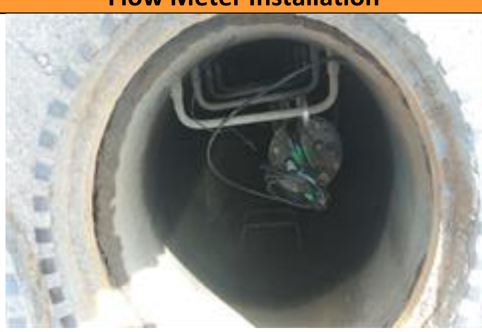
Site Photos	
Site Vicinity	**MH Top View**
	
Inlet	**Outlet**
	
Flow Meter Installation	**Sensor Installation**
	

Site Comments	
Date	**Comment**
Apr-06-2022	Installed in target inlet. The site has debris and asphalt in the pipe and may be covered by debris during the monitoring period. Flow is also very slow, resulting in debris settling on the bottom of the pipe
Apr-06-2022	The site also does not need flagman during a visit

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SITE INSTALLATION REPORT

Site Information			
Site ID:	Arn-2 (MH-NW-MN-236)	**Project:**	Arnprior SFS'22
Date: **Time:**	April 6, 2022 03:26 PM	**Site Address / Location:**	42 Daniel St N
Weather:	16C scattered clouds 22 km/h	**GPS Coordinates:**	
Traffic Plan:	TL-19	**Site Access Details:**	On-road
Atmospheric Hazard:	None		

Manhole / Pipe Assessment Information			
MH ID:	MH-NW-MN-236	**Pipe Asset ID:**	
Manhole Depth (mm):		**Installation Target:**	Inlet
MH Chamber Condition:	Good	**Flow Type:**	Sanitary
Flow Condition:	Laminar	**Pipe Height (mm):**	600
Flow Depth (Wet) (mm):		**Pipe Width (mm):**	600
Silt Depth (mm):		**Pipe Shape:**	Circular
Velocity (m/s):		**Pipe Material:**	PVC

Site Map

INSTALLATION Information					
Meter Type:	Triton+	**Sensor Type:**	**1|2**	Peak (CS4)	
Meter S/N:	62311	**Sensor S/N:**	**1|2**	62400	
SIM / IP Address:	*99069/10.250.0.100	**Physical Offset:**	**1|2**	0	

Confirmation				
	Manual	**Meter**		**+/-**
Flow Depth (mm)	141	149	140	-1
Peak Velocity (m/s):	0.6	0.6		0

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WESTCAN

Site Photos	
Site Vicinity	**MH Top View**
	
Inlet	**Outlet**
	
Flow Meter Installation	**Sensor Installation**
	

Site Comments	
Date	**Comment**
Apr-06-2022	Installed in target inlet. Due to its location, the road gets busier during rush hour. There should be no problem accessing earlier in the day

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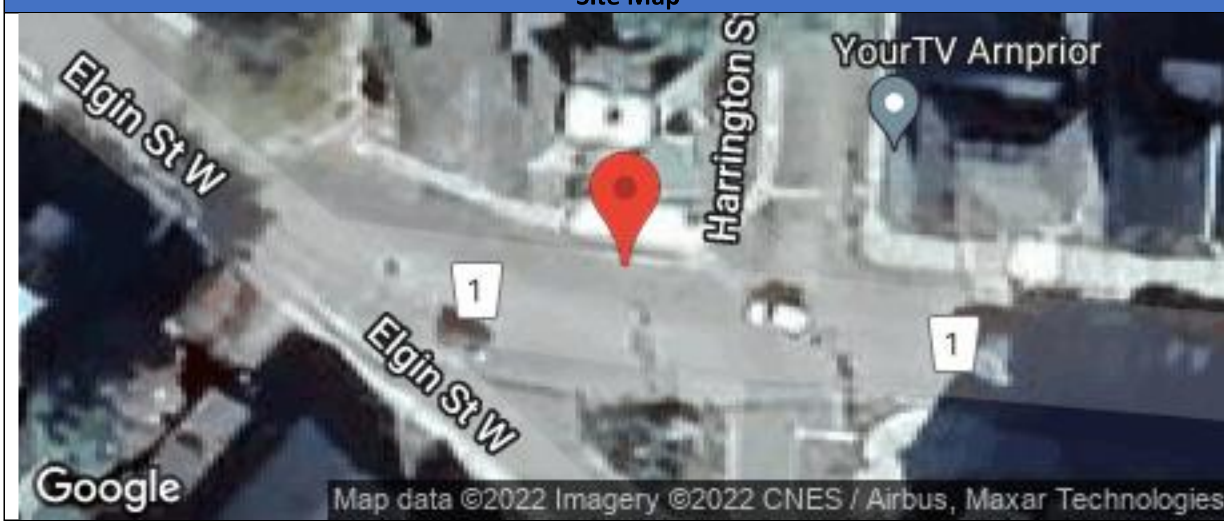
SITE INSTALLATION REPORT

Site Information			
Site ID:	Arn-3 (MH-NW-MN-448)	**Project:**	Arnprior SFS'22
Date: **Time:**	April 7, 2022 09:59 AM	**Site Address / Location:**	122 Elgin st
Weather:	6C overcast clouds 19 km/h	**GPS Coordinates:**	
Traffic Plan:	Tl-19	**Site Access Details:**	On-road
Atmospheric Hazard:	None		

Manhole / Pipe Assessment Information			
MH ID:	MH-NW-MN-448	**Pipe Asset ID:**	
Manhole Depth (mm):		**Installation Target:**	Inlet
MH Chamber Condition:	Good	**Flow Type:**	Sanitary
Flow Condition:	Choppy	**Pipe Height (mm):**	560
Flow Depth (Wet) (mm):	133	**Pipe Width (mm):**	560
Silt Depth (mm):	0	**Pipe Shape:**	Circular
Velocity (m/s):	0.74	**Pipe Material:**	Concrete

Site Map



INSTALLATION Information					
Meter Type:	Triton+	**Sensor Type:**	**1|2**	Peak (CS4)	
Meter S/N:	20498	**Sensor S/N:**	**1|2**	11406	
SIM / IP Address:	*17949/10.250.1.42	**Physical Offset:**	**1|2**	0	

Confirmation				
	Manual	**Meter**		**+/-**
Flow Depth (mm)	133	45	131	-2
Peak Velocity (m/s):	0.7	25.2		24.5

Site Photos	
Site Vicinity	**MH Top View**
	
Inlet	**Outlet**
	
Flow Meter Installation	**Sensor Installation**
	

Site Comments	
Date	**Comment**
Apr-07-2022	Site installed in target inlet on road. Site is located on a bend before the road splits in front of the median. Would recommend doing the site first before rush hour. Updepth for the sensor is not great, but Pdepth matching. Flow set to follow Pdepth.

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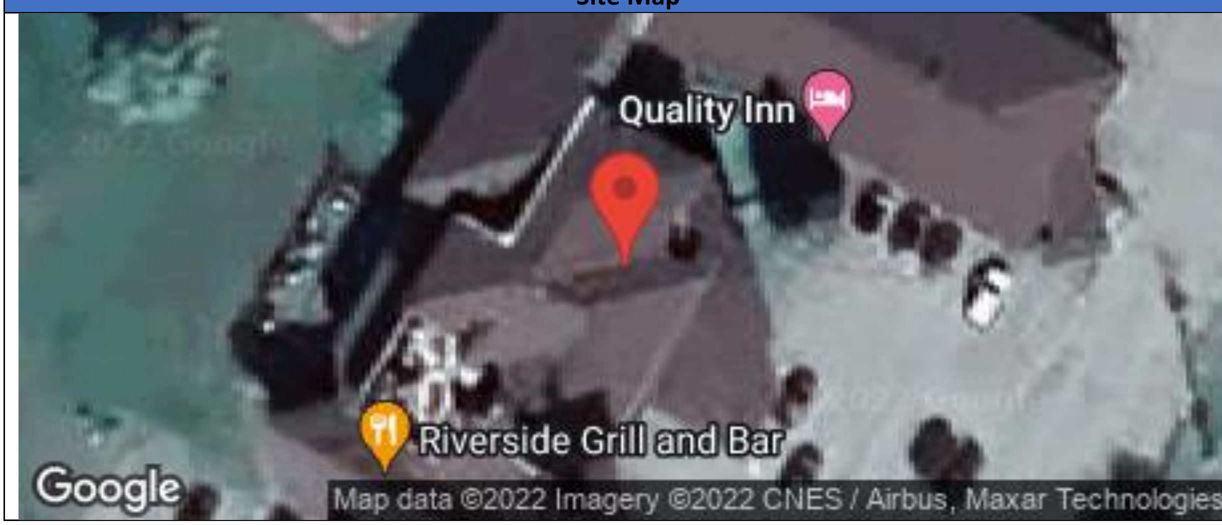
SITE INSTALLATION REPORT

Site Information			
Site ID:	Arn-4 (MH-NE-MN-1314)	**Project:**	Arnprior SFS'22
Date: **Time:**	April 6, 2022 05:31 PM	**Site Address / Location:**	70 Madawaska Blvd
Weather:	14C broken clouds 20 km/h	**GPS Coordinates:**	
Traffic Plan:	Pedestrian control	**Site Access Details:**	Behind the hotel beside the trail
Atmospheric Hazard:	None		

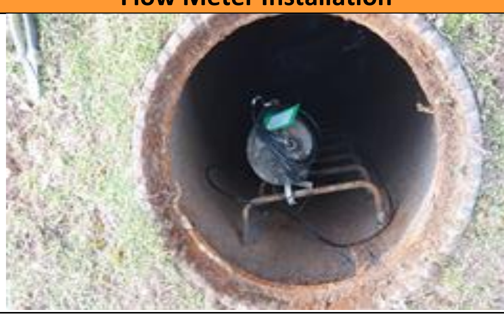
Manhole / Pipe Assessment Information			
MH ID:	MH-NE-MN-1314	**Pipe Asset ID:**	
Manhole Depth (mm):		**Installation Target:**	Inlet
MH Chamber Condition:	Good	**Flow Type:**	Sanitary
Flow Condition:	Laminar	**Pipe Height (mm):**	350
Flow Depth (Wet) (mm):	62	**Pipe Width (mm):**	350
Silt Depth (mm):	0	**Pipe Shape:**	Circular
Velocity (m/s):	0.72	**Pipe Material:**	PVC

Site Map



INSTALLATION Information				
Meter Type:	Triton+	**Sensor Type: 1|2**	Peak (CS4)	
Meter S/N:	43748	**Sensor S/N: 1|2**	64201	
SIM / IP Address:	*6015710.250.1.27	**Physical Offset: 1|2**	0	

Confirmation				
	Manual	**Meter**		**+/-**
Flow Depth (mm)	62	74	65	3
Peak Velocity (m/s):	0.7	0.7		0

Site Photos	
Site Vicinity	**MH Top View**
	
Inlet	**Outlet**
	
Flow Meter Installation	**Sensor Installation**
	

Site Comments	
Date	**Comment**
Apr-06-2022	Installed in target inlet, behind quality inn hotel. Velocity quality is not 100% but accurate.
Apr-06-2022	The site requires pry bars to open the MH lid and gain entry

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SITE INSTALLATION REPORT

Site Information			
Site ID:	Arn-5 (MH-NE-MN-1328)	**Project:**	Arnprior SFS'22
Date: **Time:**	April 6, 2022 05:56 PM	**Site Address / Location:**	70 Madawaska Blvd
Weather:	9C overcast clouds 29 km/h	**GPS Coordinates:**	
Traffic Plan:	Pedestrian control	**Site Access Details:**	In Easement behind Quality Inn parking lot
Atmospheric Hazard:	None		

Manhole / Pipe Assessment Information			
MH ID:	MH-NE-MN-1328	**Pipe Asset ID:**	
Manhole Depth (mm):		**Installation Target:**	Outlet
MH Chamber Condition:	Good	**Flow Type:**	Sanitary
Flow Condition:	Laminar	**Pipe Height (mm):**	780
Flow Depth (Wet) (mm):	62	**Pipe Width (mm):**	780
Silt Depth (mm):	0	**Pipe Shape:**	Circular
Velocity (m/s):	0.55	**Pipe Material:**	PVC

Site Map

INSTALLATION Information					
Meter Type:	Triton+	**Sensor Type:**	**1|2**	Peak (CS4)	
Meter S/N:	40998	**Sensor S/N:**	**1|2**	64075	
SIM / IP Address:	14905 / 10.250.0.71	**Physical Offset:**	**1|2**	0	

Confirmation				
	Manual	**Meter**		**+/-**
Flow Depth (mm)	163	164	157	1
Peak Velocity (m/s):	0.6	0.6		0

Site Photos	
Site Vicinity	**MH Top View**
	
Inlet	**Outlet**
	
Flow Meter Installation	**Sensor Installation**
	

Site Comments	
Date	**Comment**
Apr-06-2022	Installed in target outlet as inlet whirlpools and collects debris and ragging. Inlet also has eroded pipelining. A separate video has been added to show the flow quality

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PROCESS
WESTCAN

SITE INSTALLATION REPORT

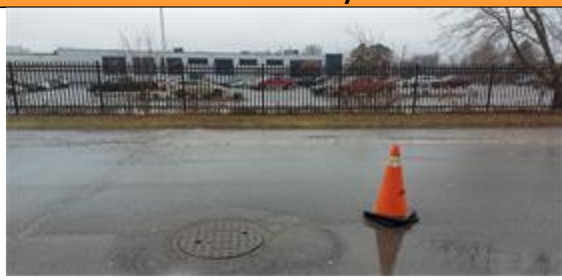
Site Information			
Site ID:	Arn-6 (MH-NE-MN-1508)	**Project:**	Arnprior SFS'22
Date:	April 7, 2022	**Site Address / Location:**	2 Decosta rd
Time:	08:56 AM		
Weather:	5C light rain 20 km/h	**GPS Coordinates:**	
Traffic Plan:	Tl-19	**Site Access Details:**	On-road
Atmospheric Hazard:	None		

Manhole / Pipe Assessment Information			
MH ID:	MH-NE-MN-1508	**Pipe Asset ID:**	
Manhole Depth (mm):		**Installation Target:**	Inlet
MH Chamber Condition:	Good	**Flow Type:**	
Flow Condition:	Laminar	**Pipe Height (mm):**	350
Flow Depth (Wet) (mm):	65	**Pipe Width (mm):**	350
Silt Depth (mm):	0	**Pipe Shape:**	Circular
Velocity (m/s):	0.53	**Pipe Material:**	Concrete

Site Map

INSTALLATION Information				
Meter Type:	Triton+	**Sensor Type: 1|2**	Peak (CS4)	
Meter S/N:	52563	**Sensor S/N: 1|2**	57096	
SIM / IP Address:	04109 / 10.250.2.81	**Physical Offset: 1|2**	0	

Confirmation				
	Manual	**Meter**		**+/-**
Flow Depth (mm)	65	69	68	3
Peak Velocity (m/s):		0.5		

Site Photos	
Site Vicinity	**MH Top View**
	
Inlet	**Outlet**
	
Flow Meter Installation	**Sensor Installation**
	

Site Comments	
Date	**Comment**
Apr-07-2022	After confirming with the office, we decided to install in the upstream alternate location, as the target location sits on the fringe of a busy highway in and out of the town. Installed in the alternate inlet

APPENDIX B

EQUIPMENT SPECIFICATIONS

HARDWARE

ADS TRITON+™

The new ***ADS TRITON+***™ is a "Fit-for-Purpose" open channel flow monitor for use in sanitary, combined, and storm sewers. It is designed to be the most versatile flow monitoring system available for wastewater collection applications. It supports single pipe or dual pipe flow measurement installations and is certified to the highest level of Intrinsic Safety.

ADS TRITON+

This multiple technology flow monitor will power almost every available sensor technology that is used in wastewater applications today. It is the most versatile and cost-effective, multiple-technology flow monitor on the market. The ***TRITON+*** includes three multiple technology sensor options: a Peak Combo Sensor, a Surface Combo Sensor, and an Ultrasonic Level Sensor (see inside for technology and specifications). This array of monitoring technologies provides for unmatched flexibility in a fully integrated, fit-for-purpose monitoring platform.

The ***TRITON+*** platform adapts to a wide range of customer applications and budgets. It can be configured as an economical single sensor monitor or dual sensor monitor. It offers a longer battery life and fewer parts for a more reliable system. This provides a lower purchase price and a lower ownership cost over the life of the monitor. The ***TRITON+*** has the lowest operational cost per data sample of any Intrinsically Safe flow monitor available.

About ADS

A leading technology and service provider, ADS Environmental Services® has established the industry standard for open channel flow monitoring and has the only ETV-verified flow monitoring technology for wastewater collection systems. These battery-powered monitors are specially designed to operate with reliability, durability, and accuracy in sewer environments.

TRITON+ Features

- Versatile performance that is easy to install and operate
- Two sensor ports supporting 3 interchangeable sensors providing up to 6 sensor readings at a time
- Single or dual pipe/monitoring point measurement capabilities
- Multi-carrier cellular or serial communication to help optimize coverage and cost
- Industry-leading battery life with a 3G/4G UMTS/HSPA+ wireless connection providing up to 15 months at the standard 15-minute sample rate (*varies with sensor configuration*)
- External power and Modbus network connectivity option available with an ADS External Power and Communications Unit (ExPAC) and a 9-36 VDC power supply
- Analog and digital I/O expansion (4-20 mA and dry contacts) available with an ADS External I/O unit (XIO)
- Modbus protocols enabling RTUs to help simplify SCADA system integration
- Supports the delivery of CSV files to an FTP site at user-defined intervals
- Supports actuation of a water quality sampler for flow proportional or level-based operation
- Monitor-Level Intelligence (MLI®) enables the ***TRITON+*** to effectively operate over a wide range of hydraulic conditions
- Superior noise reduction design for maximizing acoustic signal detection from depth and velocity sensors
- Five software packages for accessing flow information: Q*start*™ (configuration and activation); Profile® (data collection, analysis, and reporting); IntelliServe® (web-based alarming); Sliicer.com® (I/I analysis); and FlowView Portal® (online data presentation and reporting)
- Intrinsically-Safe (IS) certification by IECEx for use in Zone 0/Class I, Division 1, Groups C & D, ATEX Zone 0, and CSA Class I, Zone 0, IIB
- Thick, seamless, high-impact, ABS plastic canister with aluminum end cap (meets IP68 standard)
- Innovative circuit board dome-enclosure protects and limits exposure of electronics when opening the canister to change the battery

To Learn more, visit www.adsenv.com/TRITON+

ADS ENVIRONMENTAL SERVICES®
A Division of ADS LLC

Multiple Technology Sensors

The ***TRITON+*** features three depths and two velocities with three sensor options. Each sensor provides multiple technologies for continuous running of comparisons.

Peak Combo Sensor

Dimensions: 6.76 inches (172 mm) long x 1.23 inches (31 mm) wide x 0.83 inches (21 mm) high

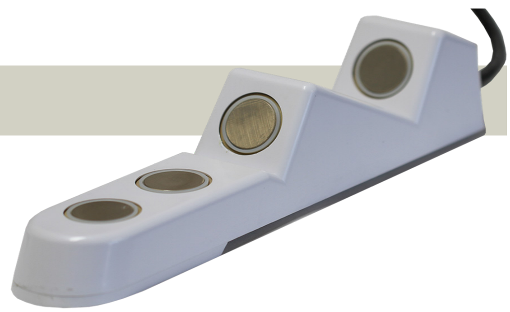
This versatile and economical sensor includes three measurement technologies in a single housing: ADS-patented continuous wave peak velocity, uplooking ultrasonic depth, and pressure depth.

Continuous Wave Velocity
Range: -30 feet per second (-9.1 m/s) to +30 ft/sec (9.1 m/s)
Resolution: 0.01 feet per second (0.003 m/s)
Accuracy: +/- 0.2 feet per second (0.06 m/s) or 4% of actual peak velocity (whichever is greater) in flow velocities between -5 and 20 ft/sec (-1.52 and 6.10 m/s)

Uplooking Ultrasonic Depth
Performs with rotation of up to 15 degrees from the center of the invert; up to 30 degrees rotation with Silt Mount Adapter
Operating Range: 1.0 inch (25 mm) to 5 feet (152 cm)
Resolution: 0.01 inches (0.254 mm)
Accuracy: 0.5% of reading or 0.125 inches (3.2 mm), whichever is greater

Pressure Depth
Range: 0-5 PSI up to 11.5 feet (3.5 m); 0-15 PSI up to 34.5 feet (10.5 m); or 0-30 PSI up to 69 feet (21.0 m)
Accuracy: +/-1.0% of full scale
Resolution: 0.01 inches (0.25 mm)

Surface Combo Sensor



Dimensions: 10.61 inches (269 mm) long x 2.03 inches (52 mm) wide x 2.45 inches (62 mm) high

This revolutionary new sensor features four technologies including surface velocity, ultrasonic depth, surcharge continuous wave velocity, and pressure depth.

Surface Velocity *
Minimum air range: 3 inches (76 mm) from the bottom of the rear, descended portion of the sensor
Maximum air range: 42 inches (107 cm)
Range: 1.00 to 15 feet per second (0.30 to 4.57 m/s)
Resolution: 0.01 feet per second (0.003 m/s)
Accuracy: +/-0.25 feet per second (0.08 m/s) or 5% of actual reading (whichever is greater) in flow velocities between 1.00 and 15 ft/sec (0.30 and 4.57 m/s)

** The flow conditions existing in some applications may prevent the surface velocity technology from being used.*

Ultrasonic Depth
(*Does not require electronic offsets*)
Minimum dead band: 1.0 inches (25.4 mm) from the face of the sensor or 5% of the maximum range, whichever is greater
Maximum operating air range: 10 feet (3.05 m)
Resolution: 0.01 inches (0.25 mm)
Accuracy: +/- 0.125 inches (3.2 mm) with 0.0 inches (0 mm) drift, compensating for variations in air temperature

Surcharge Continuous Wave Velocity (*Under submerged conditions, this technology provides the same accuracy and range as* **Continuous Wave Velocity** *for Peak Combo Sensors*)

Surcharge Pressure Depth (*Under submerged conditions, this technology provides the same accuracy and range as* **Pressure Depth** *for Peak Combo Sensors*)

Ultrasonic Level Sensor

Dimensions: 10.61 inches (269 mm) long x 2.03 inches (52 mm) wide x 2.45 inches (62 mm) high

This non-intrusive, zero-drift sensing method results in a stable, accurate, and reliable flow depth calculation. Two independent ultrasonic transducers allow for independent cross-checking.

Ultrasonic Depth (*See* **Ultrasonic Depth** *Specifications Above*)

TRITON+ Specifications

Connectors

U.S. Military specification MIL-C 26482 series 1, for environmental sealing, with gold-plated contacts

Communications

- Hepta band UMTS/HSPA+ cellular wireless modem
- Direct connection to PC using an ADS USB serial cable

Monitor Interfaces

- Supports simultaneous interfaces with up to two combo sensors
- Supports optional Analog and Digital I/O with ADS XIO: two 4-20 mA inputs and outputs, two switch inputs and two relay outputs

Power

Internal - Battery life with a cellular modem:

- Over 15 months at a 15-minute sample rate*
- Over 6 months at a 5-minute sample rate*

External - Optional external power available with ADS External Power and Communications Unit (ExPAC) with an ADS- or customer-supplied 9-36 Volt DC power supply

* *Rate based on collecting data once a day and varies according to sensor configuration and operating temperature*

Operating and Storage Temperature

-4 degrees to 140 degrees F (-20 degrees to 60 degrees C)

Connectivity

- Modbus ASCII: Wireless; Wired using ExPac
- Modbus RTU: Wireless; Wired using ExPac
- Modbus TCP: Wireless only

Intrinsic Safety Certification

- Certified under the ATEX European Intrinsic Safety standards for Zone 0 rated hazardous areas
- Certified under IECEx (International Electro technical Commission Explosion Proof) Intrinsic Safety standards for use in Zone 0/Class I, Division 1, Groups C&D rated hazardous areas
- CSA Certified to CLASS 2258 03 - Process Control Equipment, Intrinsically Safe and Non-Incendive Systems - For Hazardous Locations, Ex ia IIB T3 (152 degrees C)

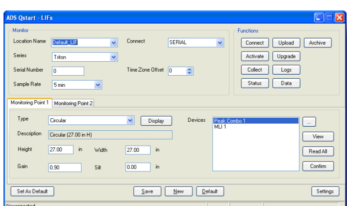
Other Certifications/Compliances

- FCC Part 15 and Part 68 compliant
- ROHS (lead-free) compliant
- Carries the EU CE mark
- Canada IC CS-03 compliant

ISO 9001 Registered Company sira CERTIFICATION UKAS MANAGEMENT SYSTEMS 011

Certificate No: 940056

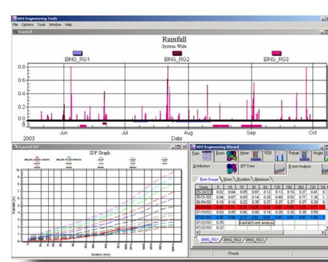
ADS Flow Monitoring Software



Q*start* is desktop software providing field crews with a simple, easy-to-use tool for quickly activating and configuring ADS flow monitors. Q*start* enables the user to collect and review the monitor's depth and velocity data in hydrograph and tabular views simultaneously.

FlowView Portal is web-hosted software providing robust report delivery, enabling the user to manage data, customize reports, and select viewing parameters. FlowView Portal has a virtually unlimited database for storing and accessing historical data, using data for comparison and trend analysis purposes, and sharing information electronically.

IntelliServe is web-hosted software providing real-time operational intelligence on the status of flow activity throughout the wastewater collection system. IntelliServe utilizes dynamic (or smart) alarming to inform clients about the occurrence of rain events, flow performance abnormalities, and data anomalies at the flow monitoring locations.



Sliicer.com is web-hosted software providing a powerful set of engineering tools designed for both the consulting and municipal engineer. Sliicer.com's inflow and infiltration tools examine wastewater collection system dry and wet weather flow data and provide rigorous performance measurements in one-tenth the time of other analysis tools.

Profile is desktop software providing the industry's best data analysis tools, from basic flow monitoring data to complex hydraulic analysis. Profile is intuitive software that saves time and improves data quality by compiling project data into one location for analysis and reporting.

FLOW MONITORING APPLICATIONS

- Billing
- Inflow/Infiltration
- Model Calibration
- Combined Sewer Overflows (CSOs)
- Stormwater Monitoring
- Capacity Analysis
- Spill Notification

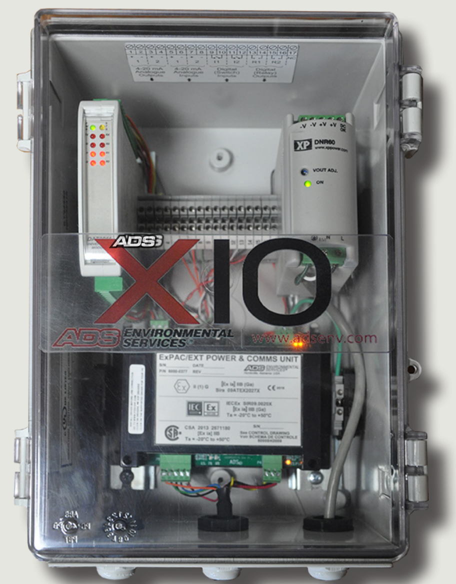
ADS' Self-Contained Solution for Power, Communication, Analog and Digital I/O

ADS XIO™

The new ADS External Input and Output device (**ADS XIO™**) is Intrinsically Safe and expands the monitoring and controlling capabilities of the ***TRITON+*** flow monitor. The XIO converts MODBUS RTU communications from the ***TRITON+*** to analog and digital inputs and outputs; the XIO also supplies external power to the ***TRITON+*** to allow continuous power operation in order to achieve near real-time data acquisition.

XIO Features

- Process variables measured by the ***TRITON+*** can be converted to a 4-20 mA loop signal for SCADA systems or local display and control
- Logging capabilities of the ***TRITON+*** can be used for 4-20 mA input process variables measured by other instrumentation
- Alarms produced by the ***TRITON+*** Monitor-Level-Intelligence (MLI) device can be output on the XIO relay contacts for process actuation
- Digital inputs such as switch or relay contacts can be sampled and logged
- Supports easy plug and play configuration and start-up
- Design facilitates easy field wiring
- Certified as Intrinsically Safe for Zone 0 / Class I, Division 1, Groups C & D
- Rugged indoor/outdoor NEMA 4x Case with hinged clear cover



XIO Specifications

Power Input: 85-264 VAC, 120-375 VDC; 47-63 Hz; 1.10 A @ 110/0.59 A @ 250 VAC

Power Output (to monitor): 8-11.5 VDC, 500mA, Intrinsically Safe

Analog Inputs: Two (2) 4-20 mA inputs; Isolation: 1500 VAC. Accuracy 0.05% F.S; Linearity 0.1% F.S; Thermal Drift 100ppm/C

Analog Outputs: Two (2) 4-20 mA outputs; 500 ohm. Isolation: 1500 VAC. Accuracy 0.1% F.S; Linearity 0.05% F.S; Thermal Drift 100ppm/C

Digital Inputs: Two (2) Switch or dry contacts; Input impedance 4.7 Kilo-ohms.

Digital Outputs: Two (2) SPST Relays; Max load 2 A @250 VAC, 2A @ 30 VDC; Min load 5 VDC, 20 mA

Dimensions: 11.024" (280 mm) high x 7.485 (190 mm) wide x 5.031(127.8 mm) deep

Enclosure: Indoor/Outdoor NEMA 4X (IP 66), PBT and Polycarbonate plastic with hinged clear cover

Operating and Storage Temperature: 14 degrees to 122 degrees F (-10 degrees to 50 degrees C)

Certifications: Intrinsically-Safe (IS) certification by IECEx for use in Zone 0/Class I, Division 1, Groups C & D; ATEX Zone 0 ; and CSA Class I, Zone 0, IIB

ADS ENVIRONMENTAL SERVICES®

ADS. An IDEX Water Services & Technology Business. IDEX

1300 Meridian Street, Suite 3000 - Huntsville, AL 35801
Phone: 256.430.3366/ Fax: 256.430.6633
Toll Free: 1.800.633.7246

APPENDIX C

CONFIRMATION REPORT

FLOWMETRIX
INDU-TECH
PROCESS
WESTCAN

MAINTENANCE LOG

Arn-1 (MH-SW-MN-1092)

All level measurements are in [mm]. All velocity measurements in [m/s].

Date / Time	Work Type	Level Confirmation					Velocity Confirmation			Silt Level	Comments
		Manual	Meter		% Error		Manual	Meter	Difference		
2022-04-06 13:26	INSTALLATION	95	94	87	1.05	8.42	0.2	0.2	0	20	Installed in target inlet. Site has debris and asphalt in the pipe and may be covered by debris during the monitoring period. Flow is also very slow, resulting in debris settling on the bottom of the pipe Site also does not need a flag man during visit.
2022-04-20 12:18	MAINTENANCE	91	85	82	6.59	9.89	0.3	0.3	0		Adjusted the sensor offset by 10mm. Measurements match meter flow laminar and slow at 0.31m/s. Flow is too slow for a surface combo.
2022-05-04 12:34	MAINTENANCE	114	111	109	2.63	4.39	0.2	0.2	0	20	Measurements match the meter. Flow laminar and slow.
2022-06-08 12:46	MAINTENANCE	120	114	116	5	3.33	0.2	0.2	0	15	Manual measurements match the sensor, flow is laminar but very slow. 15mm silt.
2022-07-20 11:36	REMOVAL	94	94	93	0	1.06	0.2	0.2	0		Removed and deactivated meter.

FLOWMETRIX
INDU-TECH
PROCESS
WESTCAN

MAINTENANCE LOG

Arn-2 (MH-NW-MN-236)

All level measurements are in [mm]. All velocity measurements in [m/s].

Date / Time	Work Type	Level Confirmation					Velocity Confirmation			Silt Level	Comments
		Manual	Meter		% Error		Manual	Meter	Difference		
2022-04-06 15:26	INSTALLATION	141	149	140	5.67	0.71	0.6	0.6	0		Installed in target inlet. Due to its location, the road gets busier during rush hour. There should be no problem accessing earlier in the day.
2022-04-20 12:47	MAINTENANCE	127	136	122	7.09	3.94	0.6	0.6	0		Battery swapped. Measurements match the meter. Flow laminar
2022-05-04 12:50	MAINTENANCE	122	120	114	1.64	6.56	0.5	0.5	0		Measurements match the meter. Flow laminar.
2022-06-08 13:31	MAINTENANCE	164	153	147	6.71	10.37	0.7	0.7	0		Manual measurements match the sensor flow is laminar.
2022-07-20 11:39	REMOVAL										Removed and deactivated meter.

MAINTENANCE LOG

Arn-3 (MH-NW-MN-448)

All level measurements are in [mm]. All velocity measurements in [m/s].

Date / Time	Work Type	Level Confirmation					Velocity Confirmation			Silt Level	Comments
		Manual	Meter		% Error		Manual	Meter	Difference		
2022-04-07 09:59	INSTALLATION	133	45	131	66.17	1.5	0.7	25.2	24.5	0	Site installed in target inlet on the road. The site is located on a bend before the road splits in front of the median. Would recommend doing the site first before rush hour. Manual measurements match the meter.
2022-04-20 13:34	MAINTENANCE	121	121	121	0	0	0.7	0.7	0		Flow whirlpooling in the inlet of the pipe causes velocity quality to drop. Despite that, velocity is accurate. Swapped meter due to connection issues. Old meter S/N 20498, new meter S/N 40998. Sim card still same
2022-05-04 13:05	MAINTENANCE	118	113	121	4.24	2.54	0.3	0.4	0.1		Depths matching.
2022-06-08 13:51	MAINTENANCE	122	120	129	1.64	5.74					Manual measurements match depths, and velocity is between .19-.22.
2022-07-20 11:43	REMOVAL	85	82	89	3.53	4.71	0.1	0.2	0.1		Removed and deactivated meter.

FLOWMETRIX
INDU-TECH
PROCESS
WESTCAN

MAINTENANCE LOG

Arn-4 (MH-NE-MN-1314)

All level measurements are in [mm]. All velocity measurements in [m/s].

Date / Time	Work Type	Level Confirmation					Velocity Confirmation			Silt Level	Comments
		Manual	Meter		% Error		Manual	Meter	Difference		
2022-04-06 17:31	INSTALLATION	62	74	65	19.35	4.84	0.7	0.7	0	0	Installed in target inlet, behind quality inn hotel. Site requires pry bars to open the MH lid and gain entry.
2022-04-20 14:09	MAINTENANCE	75	81	55	8	26.67	0.8	0.8	0		Manual measurements match the meter. Flow laminar and clear
2022-05-04 13:28	MAINTENANCE	85	81	79	4.71	7.06	0.7	0.7	0		Measurements match the meter. Flow laminar and clear.
2022-06-08 14:09	MAINTENANCE	85	86	81	1.18	4.71	0.8	0.8	0		Manual measurements match the sensor; flow is laminar.
2022-07-20 11:47	REMOVAL										Removed and deactivated meter.

FLOWMETRIX
INDU-TECH
PROCESS
WESTCAN

MAINTENANCE LOG

Arn-5 (MH-NE-MN-1328)

All level measurements are in [mm]. All velocity measurements in [m/s].

Date / Time	Work Type	Level Confirmation					Velocity Confirmation			Silt Level	Comments
		Manual	Meter		% Error		Manual	Meter	Difference		
2022-04-06 17:56	INSTALLATION	163	164	157	0.61	3.68	0.6	0.6	0	0	Installed in target outlet as inlet whirlpools and collects debris and ragging. Inlet also has eroded pipe lining. A separate video has been added to show the flow quality.
2022-04-20 13:55	MAINTENANCE	167	166	162	0.6	2.99	0.5	0.6	0.1		Measurements match the meter. Flow laminar
2022-05-04 13:32	MAINTENANCE	148	153	151	3.38	2.03	0.6	0.6	0		Measurements match the meter. Flow laminar.
2022-06-08 14:19	MAINTENANCE	116	120	114	3.45	1.72	0.4	0.4	0		Manual measurements match the sensor, and sensor reading is 100% quality.
2022-07-20 11:51	REMOVAL	129	132	128	2.33	0.78	0.3	0.4	0.1		Removed and deactivated meter.

SCG

FLOWMETRIX
INDU-TECH
PROCESS
WESTCAN

MAINTENANCE LOG

Arn-6 (MH-NE-MN-1508)

All level measurements are in [mm]. All velocity measurements in [m/s].

Date / Time	Work Type	Level Confirmation					Velocity Confirmation			Silt Level	Comments
		Manual	Meter		% Error		Manual	Meter	Difference		
2022-04-07 08:56	INSTALLATION	65	69	68	6.15	4.62		0.5		0	After confirming with the office, we decided to install in the alternate upstream location, as the target location sits on the fringe of a busy highway in and out of the town. Installed in the alternate inlet
2022-04-20 14:27	MAINTENANCE	62	63	60	1.61	3.23		0.6			Measurements match meter flow laminar at 0.56 m/s
2022-05-04 13:58	MAINTENANCE	61	65	56	6.56	8.2		0.6			Measurements match the meter. Flow laminar
2022-06-08 14:49	MAINTENANCE	63	62	45	1.59	28.57	0.4	0.4	0		Manual measurements match the sensor, activated meter, SIM is in session, and green on FlowWorks.
2022-07-20 11:53	REMOVAL	33	41	25	24.24	24.24	0.3	0.3	0		Removed and deactivated meter.

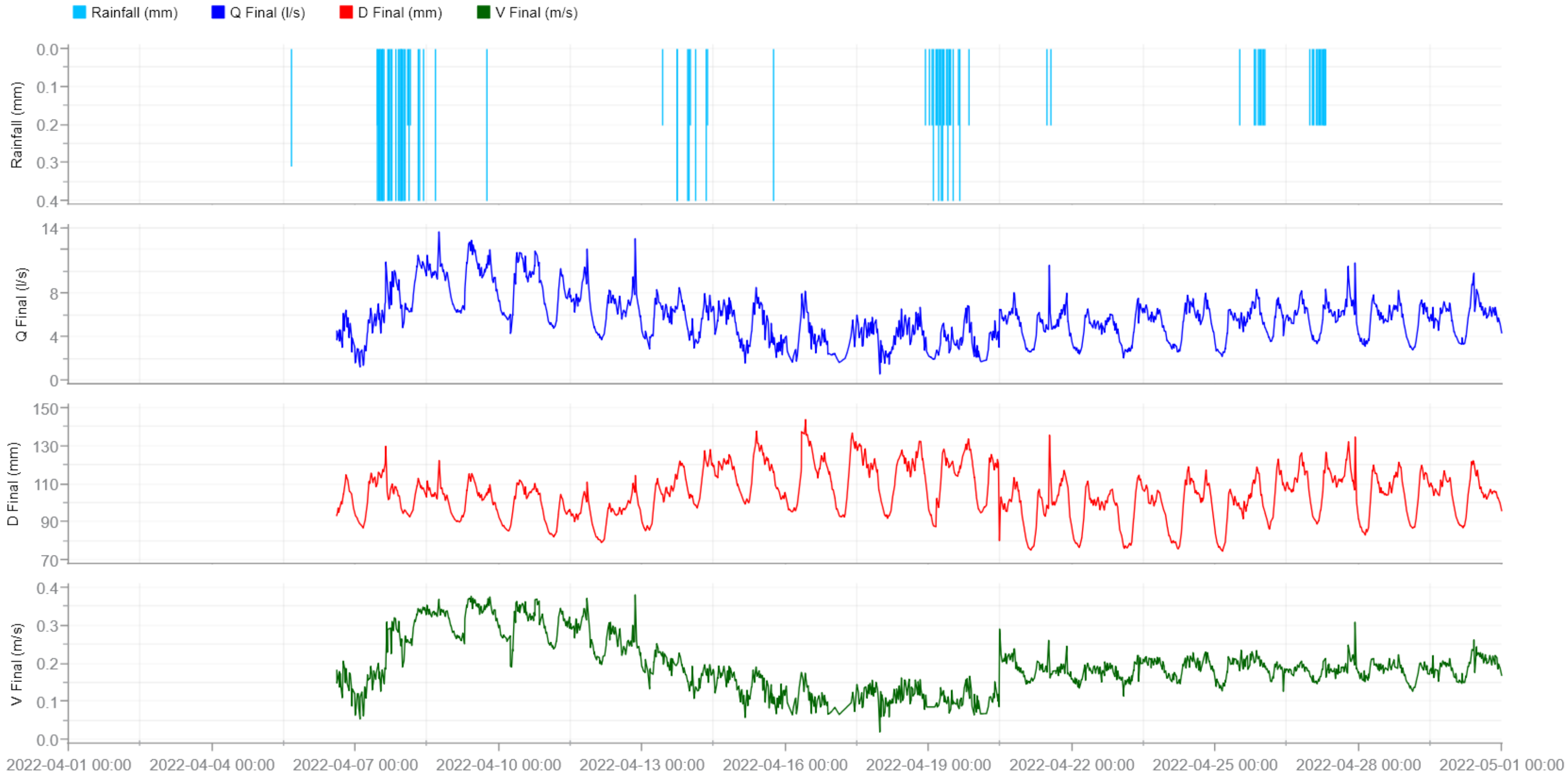
Arnprior SFS'22

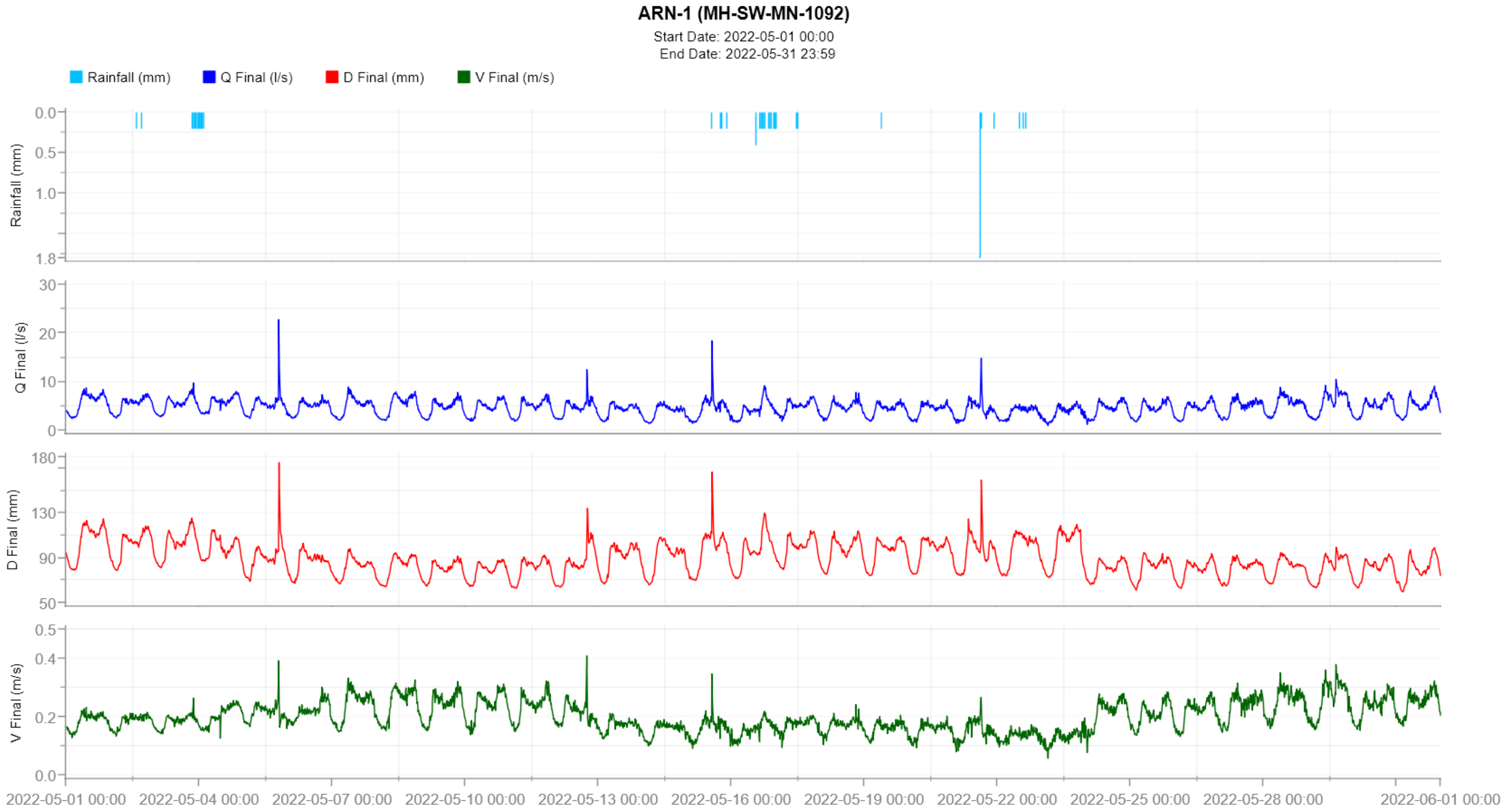
APPENDIX D

HYDROGRAPHS

ARN-1 (MH-SW-MN-1092)

Start Date: 2022-04-01 00:00
End Date: 2022-04-30 23:59

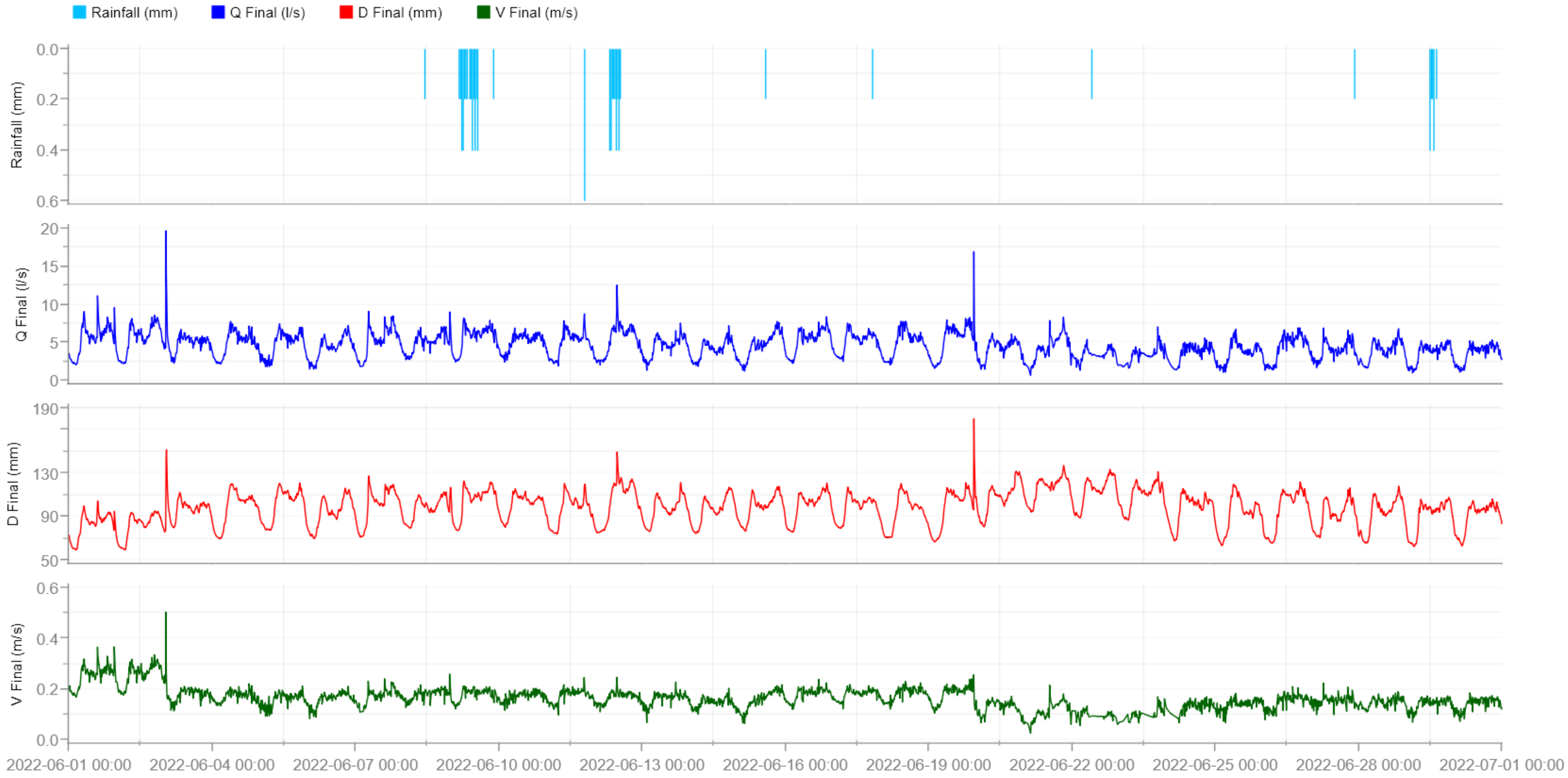




ARN-1 (MH-SW-MN-1092)
Start Date: 2022-05-01 00:00
End Date: 2022-05-31 23:59
Rainfall (mm)
Q Final (l/s)
D Final (mm)
V Final (m/s)
Rainfall (mm)
0.0
0.5
1.0
1.8
Q Final (l/s)
30
20
10
0
D Final (mm)
180
130
90
50
V Final (m/s)
0.5
0.4
0.2
0.0
2022-05-01 00:00
2022-05-04 00:00
2022-05-07 00:00
2022-05-10 00:00
2022-05-13 00:00
2022-05-16 00:00
2022-05-19 00:00
2022-05-22 00:00
2022-05-25 00:00
2022-05-28 00:00
2022-06-01 00:00

ARN-1 (MH-SW-MN-1092)

Start Date: 2022-06-01 00:00
End Date: 2022-06-30 23:59



ARN-1 (MH-SW-MN-1092)

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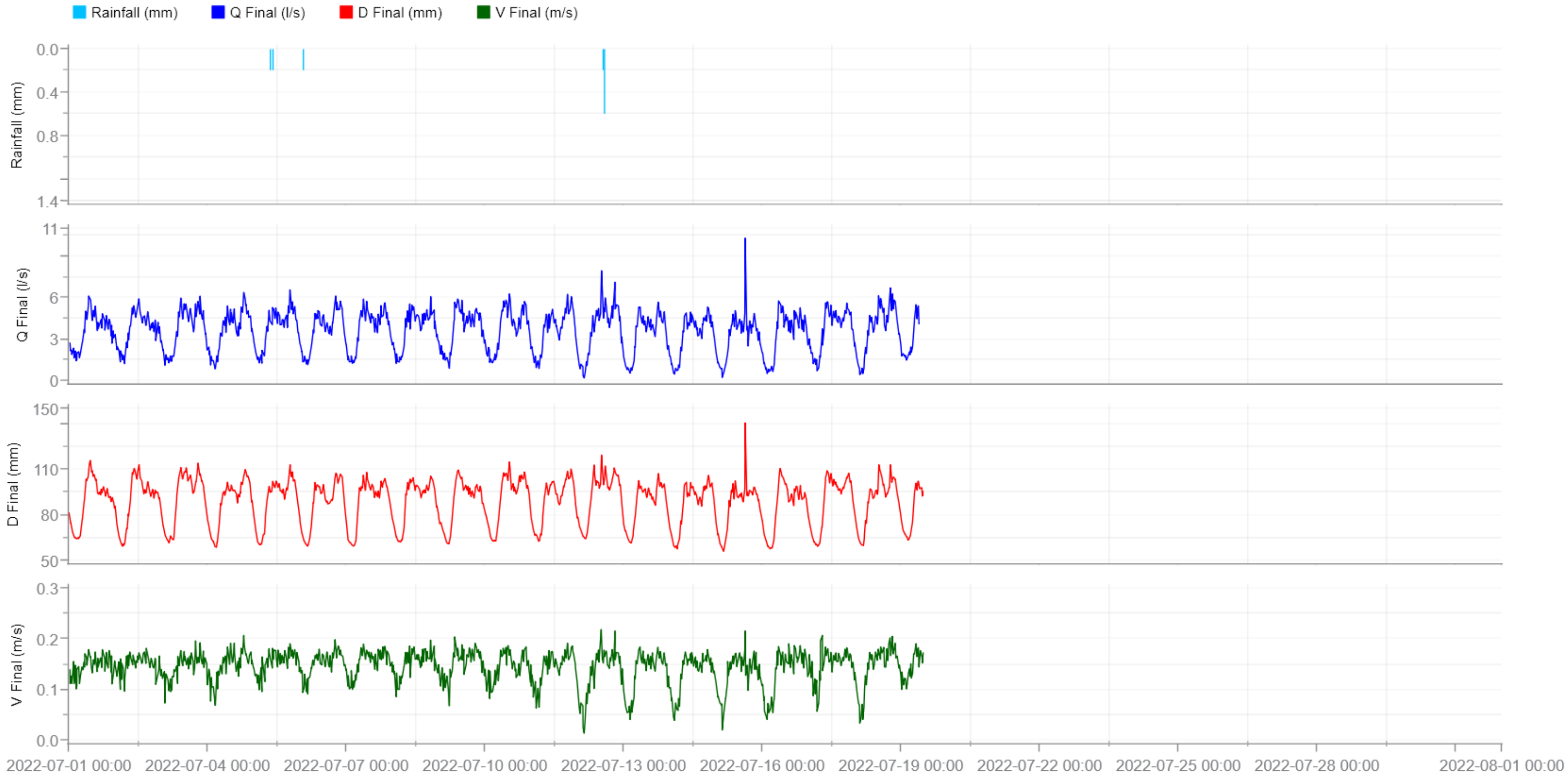
End Date: 2022-07-31 23:59



ARN-2 (MH-NW-MN-236)

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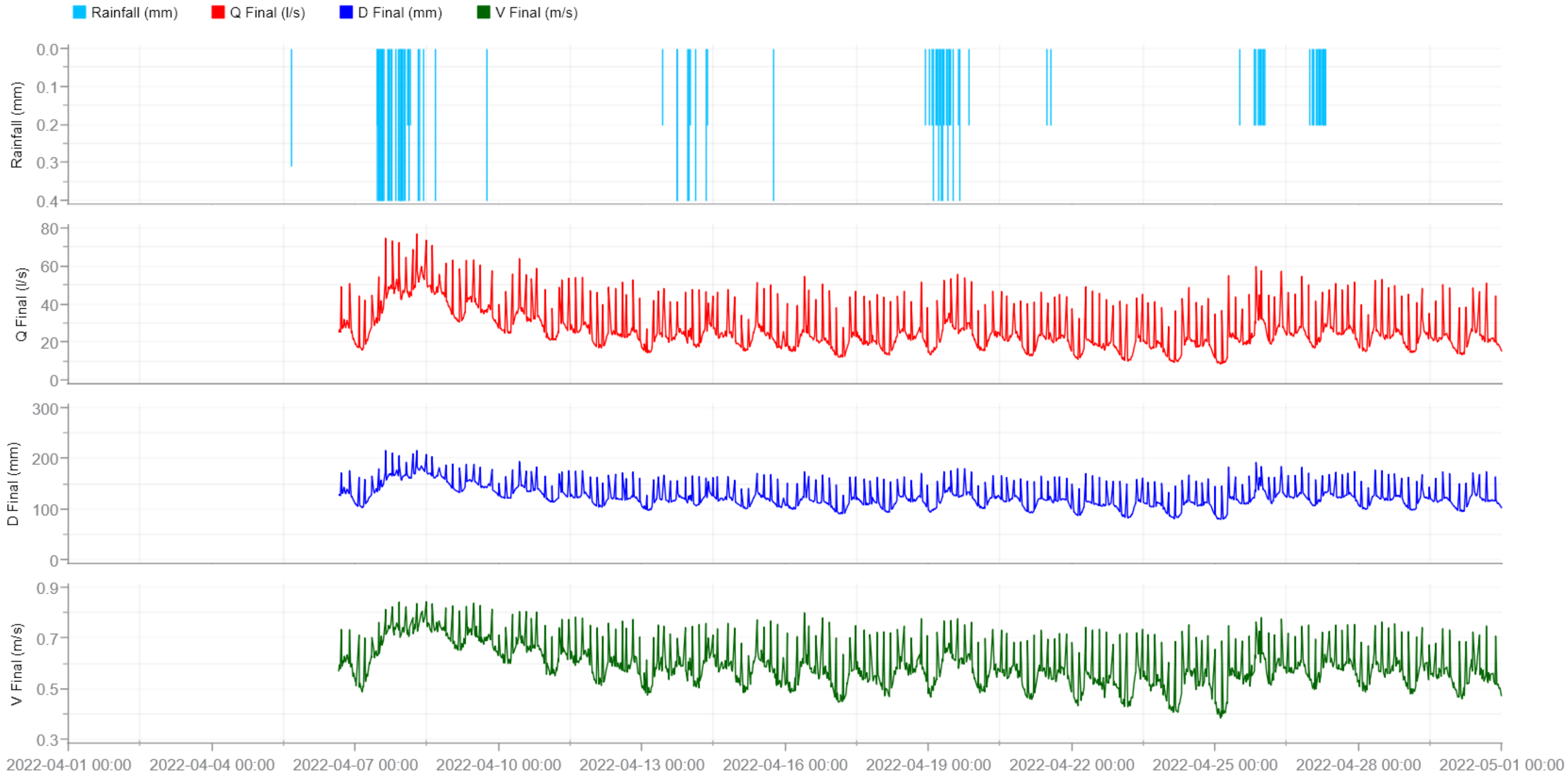
End Date: 2022-04-30 23:59



ARN-2 (MH-NW-MN-236)

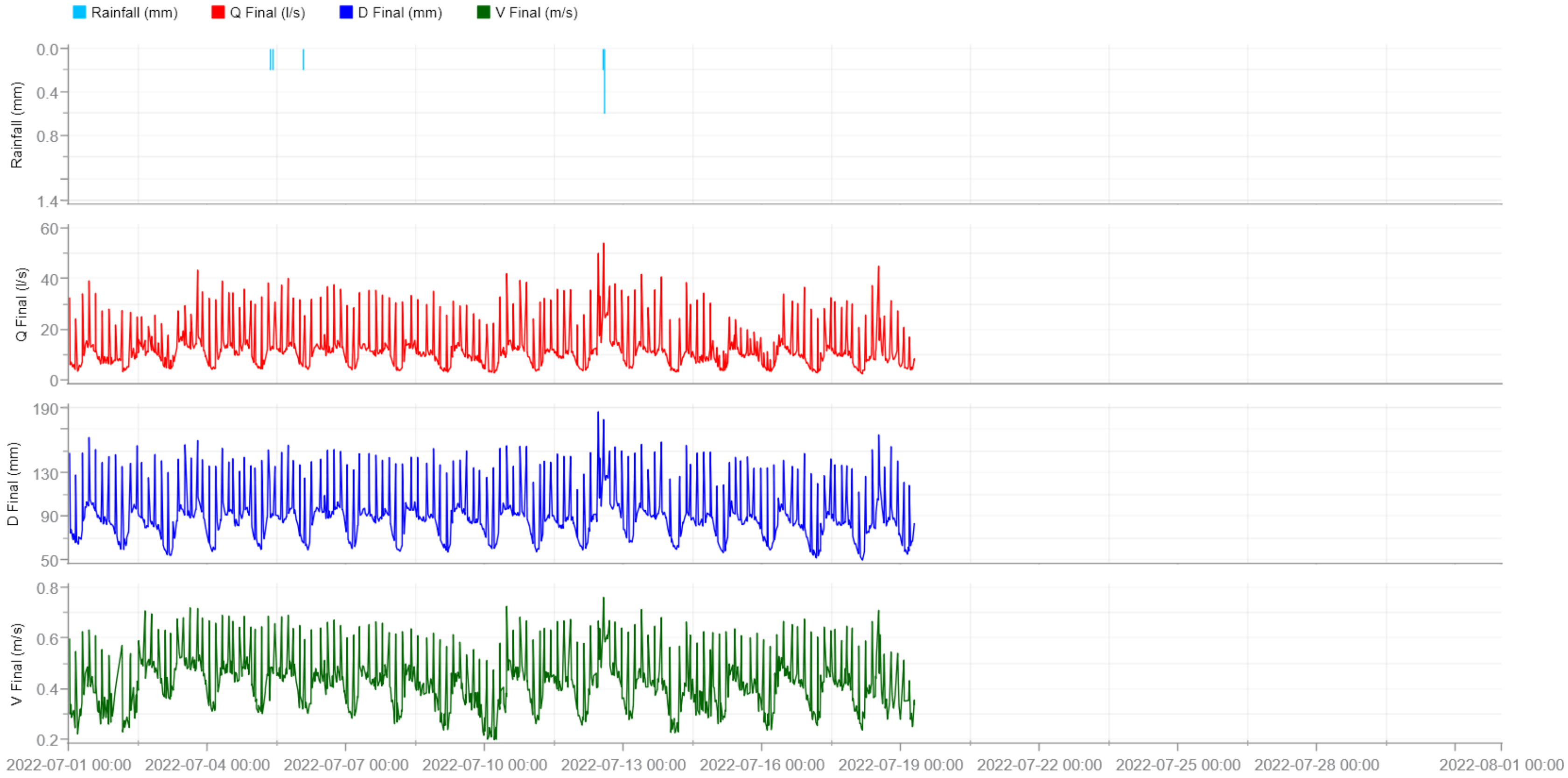
Start Date: 2022-05-01 00:00
End Date: 2022-05-31 23:59

ARN-2 (MH-NW-MN-236)

Start Date: 2022-06-01 00:00
End Date: 2022-06-30 23:59

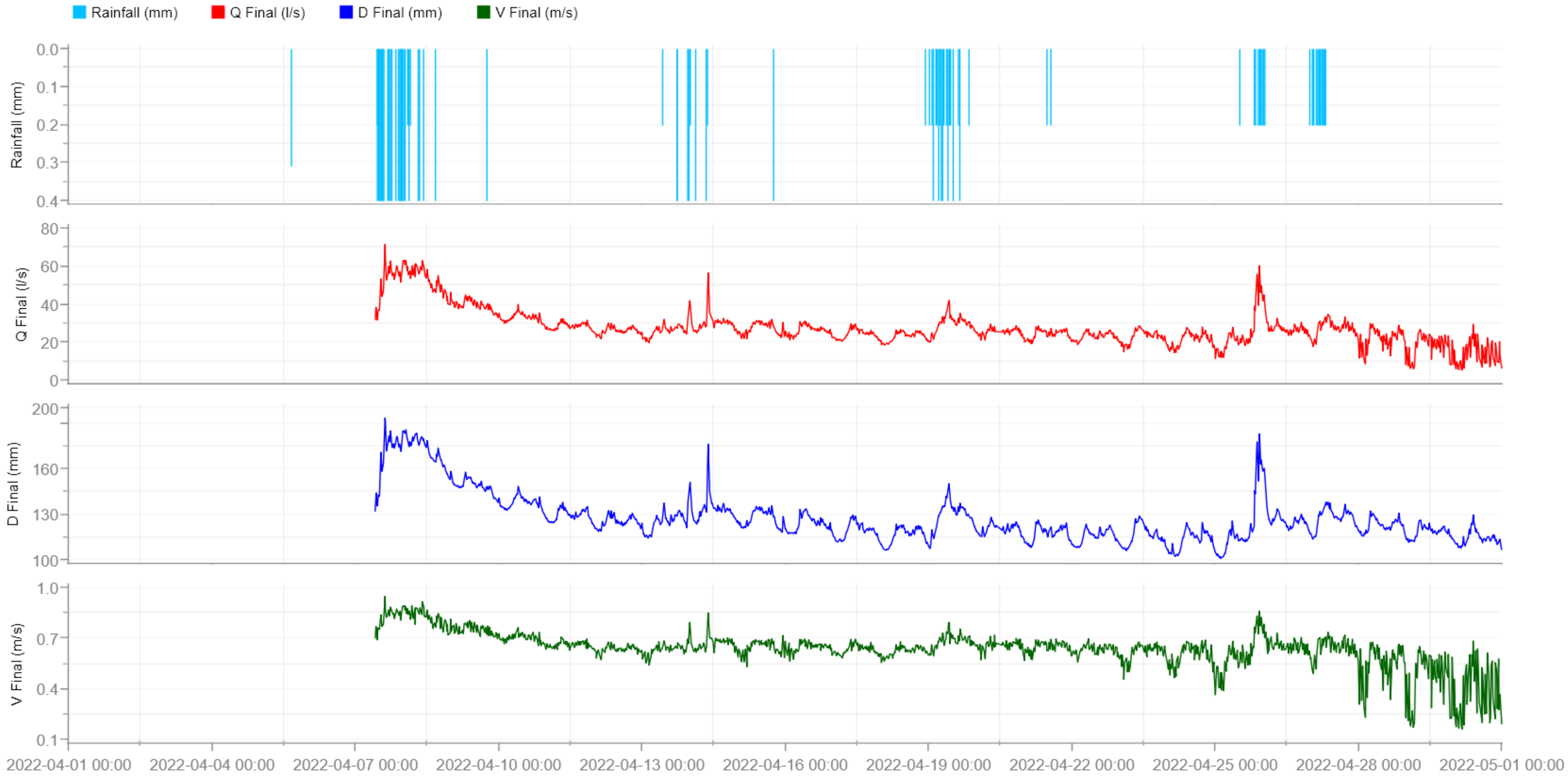
ARN-2 (MH-NW-MN-236)

Start Date: 2022-07-01 00:00
End Date: 2022-07-31 23:59



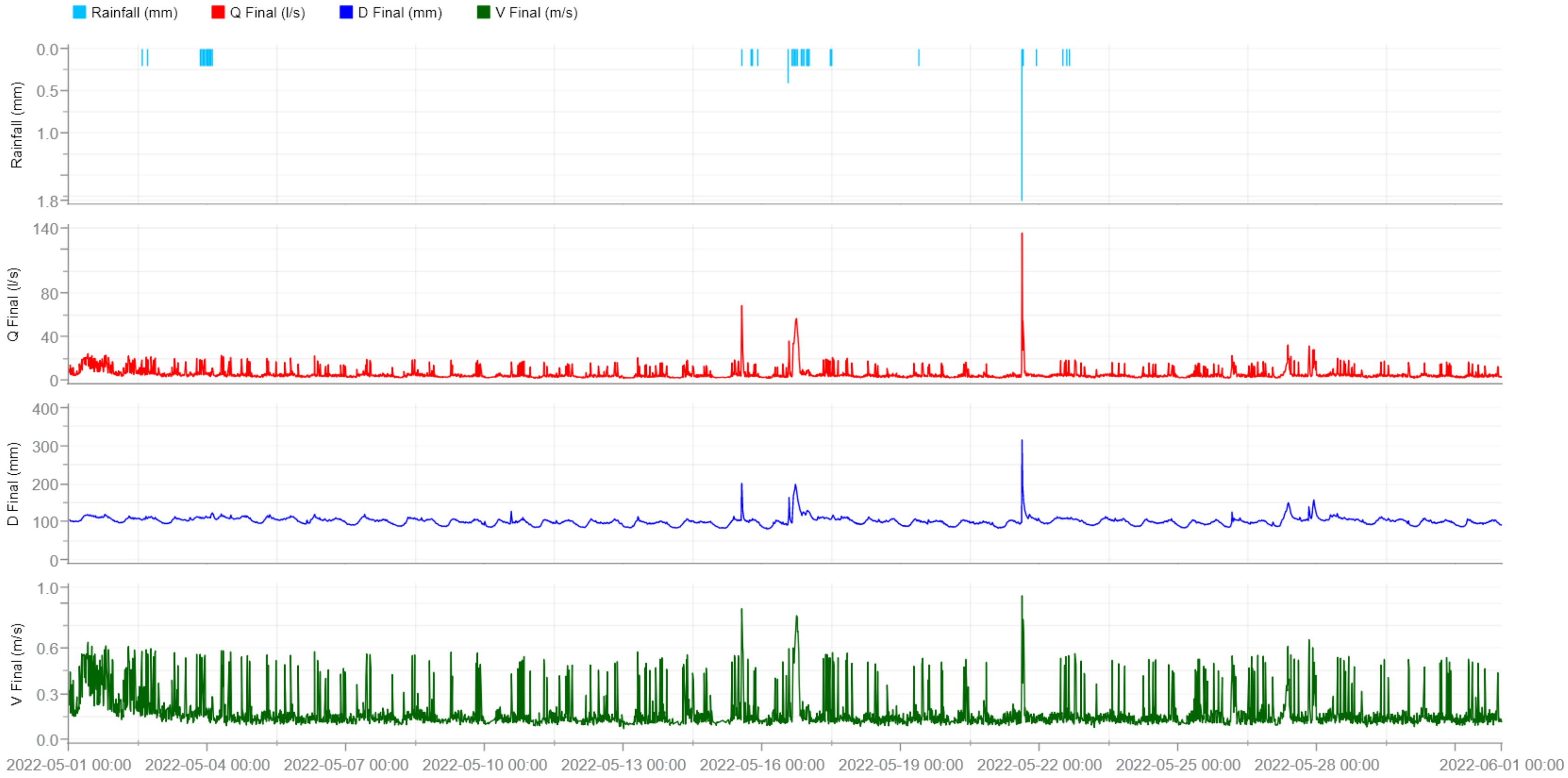
ARN-3 (MH-NW-MN-448)

Start Date: 2022-04-01 00:00
End Date: 2022-04-30 23:59



ARN-3 (MH-NW-MN-448)

Start Date: 2022-05-01 00:00
End Date: 2022-05-31 23:59



ARN-3 (MH-NW-MN-448)

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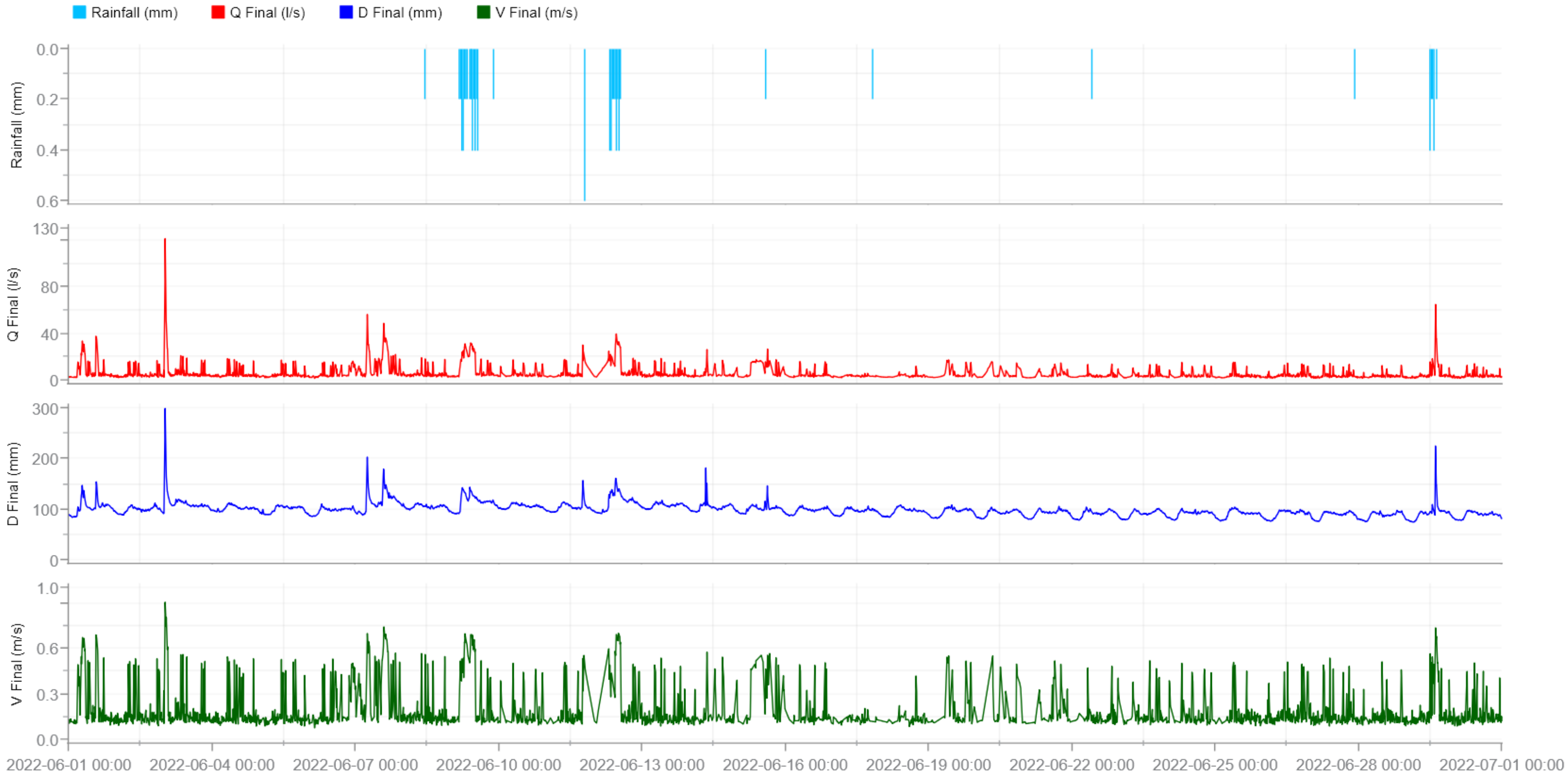
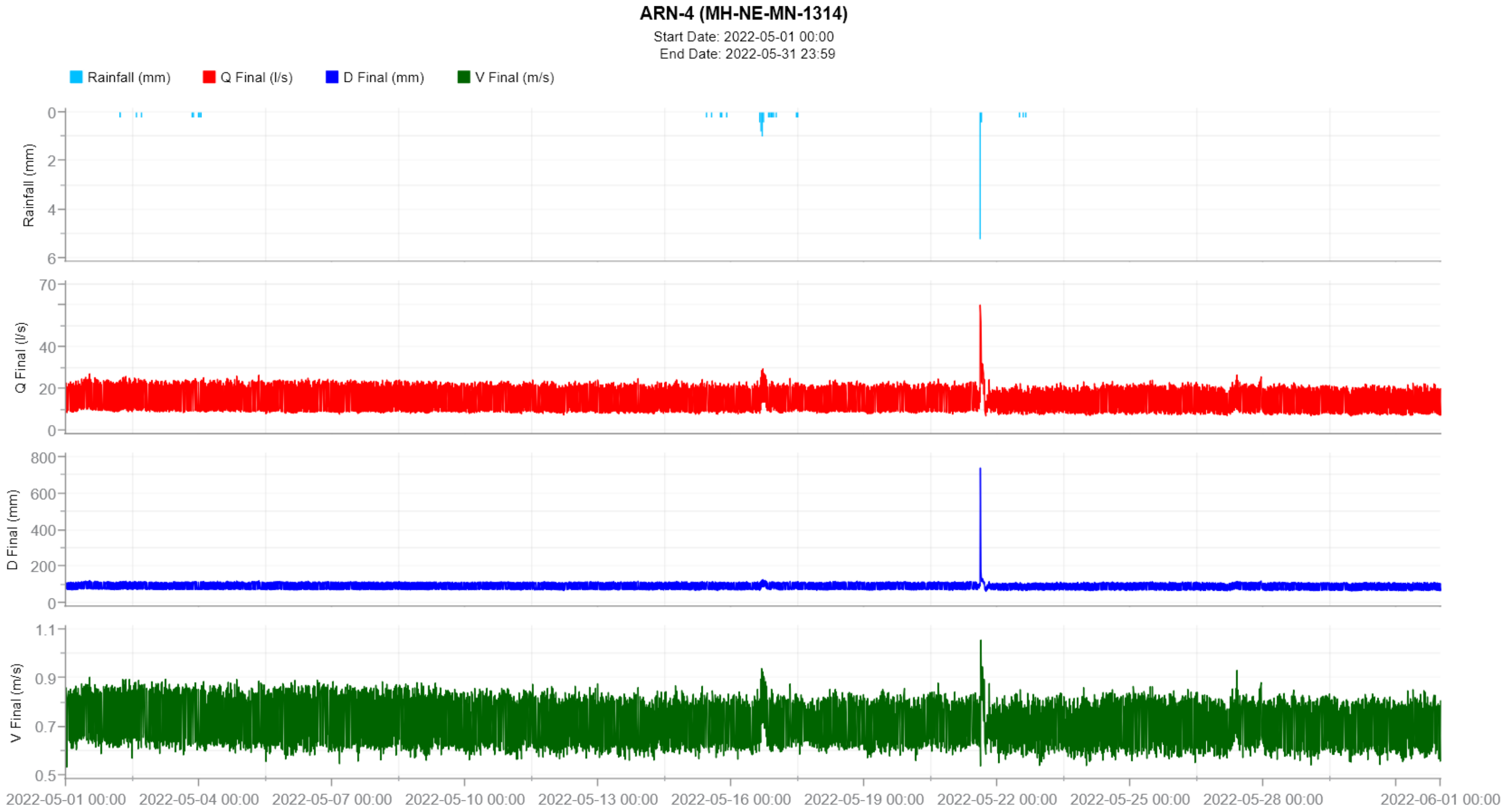
End Date: 2022-06-30 23:59



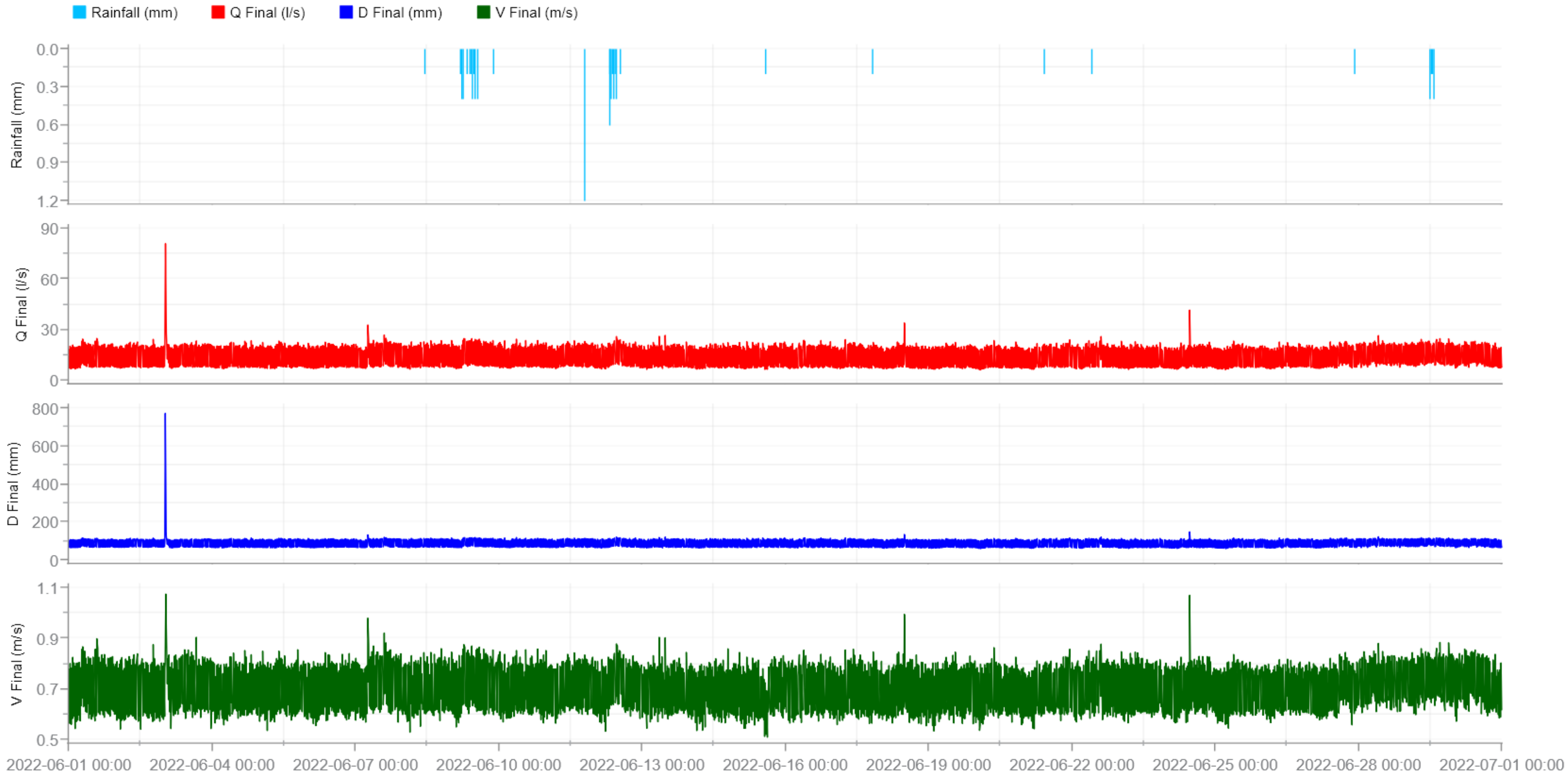
ARN-3 (MH-NW-MN-448)
Start Date: 2022-07-01 00:00
End Date: 2022-07-31 23:59
Rainfall (mm)
Q Final (l/s)
D Final (mm)
V Final (m/s)
Rainfall (mm)
0.0
0.4
0.8
1.4
Q Final (l/s)
50
40
20
0
D Final (mm)
180
130
100
70
V Final (m/s)
0.7
0.4
0.2
0.0
2022-07-01 00:00
2022-07-04 00:00
2022-07-07 00:00
2022-07-10 00:00
2022-07-13 00:00
2022-07-16 00:00
2022-07-19 00:00
2022-07-22 00:00
2022-07-25 00:00
2022-07-28 00:00
2022-08-01 00:00

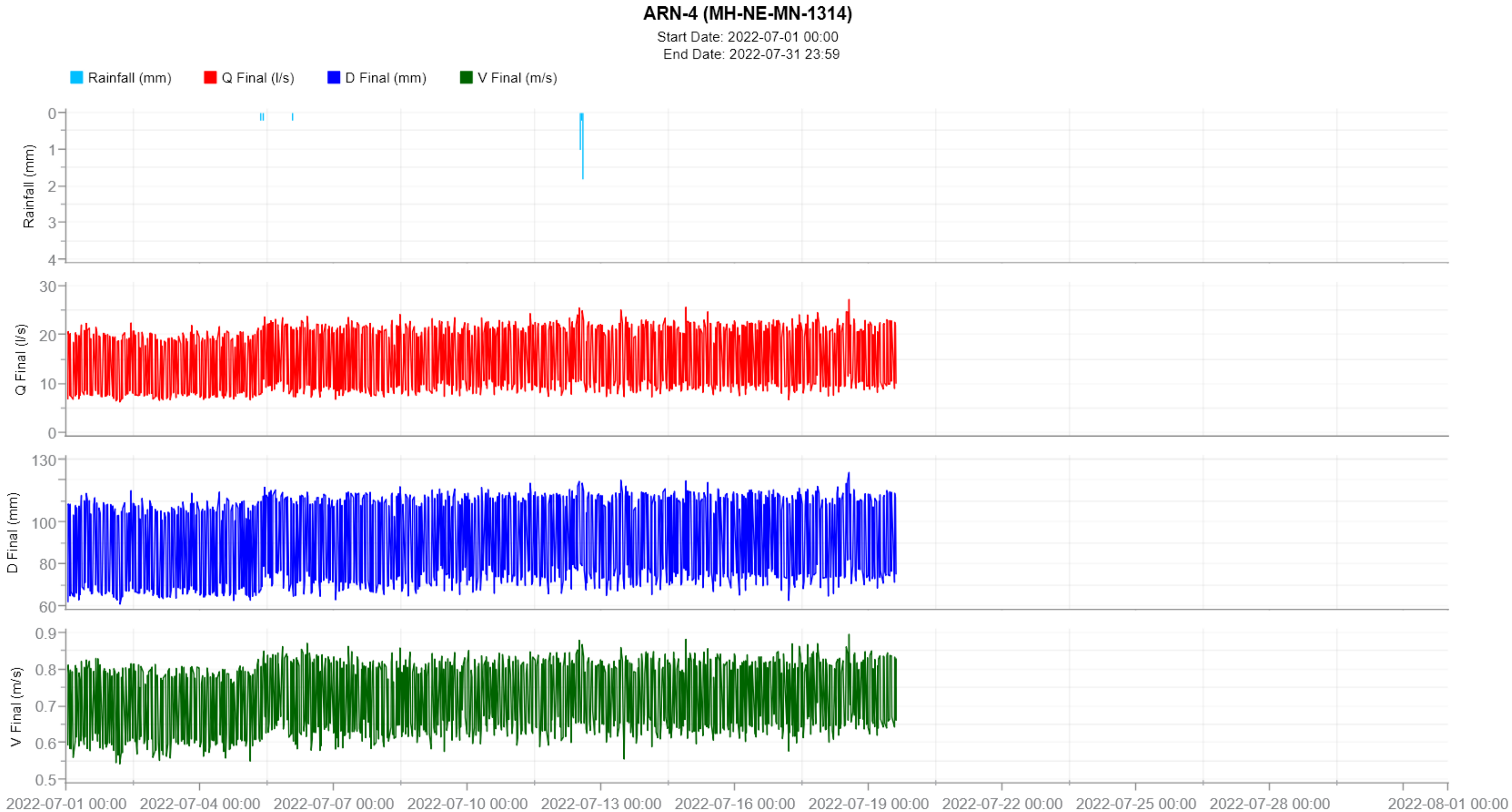

ARN-4 (MH-NE-MN-1314)
Start Date: 2022-04-01 00:00
End Date: 2022-04-30 23:59
Rainfall (mm)
Q Final (l/s)
D Final (mm)
V Final (m/s)
0.0
0.3
0.6
1.0
40
30
20
10
0
150
130
110
90
70
1.1
0.9
0.7
0.5
2022-04-01 00:00
2022-04-04 00:00
2022-04-07 00:00
2022-04-10 00:00
2022-04-13 00:00
2022-04-16 00:00
2022-04-19 00:00
2022-04-22 00:00
2022-04-25 00:00
2022-04-28 00:00
2022-05-01 00:00


ARN-4 (MH-NE-MN-1314)
Start Date: 2022-05-01 00:00
End Date: 2022-05-31 23:59
Rainfall (mm)
Q Final (l/s)
D Final (mm)
V Final (m/s)
Rainfall (mm)
0
2
4
6
Q Final (l/s)
70
40
20
0
D Final (mm)
800
600
400
200
0
V Final (m/s)
1.1
0.9
0.7
0.5
2022-05-01 00:00
2022-05-04 00:00
2022-05-07 00:00
2022-05-10 00:00
2022-05-13 00:00
2022-05-16 00:00
2022-05-19 00:00
2022-05-22 00:00
2022-05-25 00:00
2022-05-28 00:00
2022-06-01 00:00

ARN-4 (MH-NE-MN-1314)

Start Date: 2022-06-01 00:00
End Date: 2022-06-30 23:59

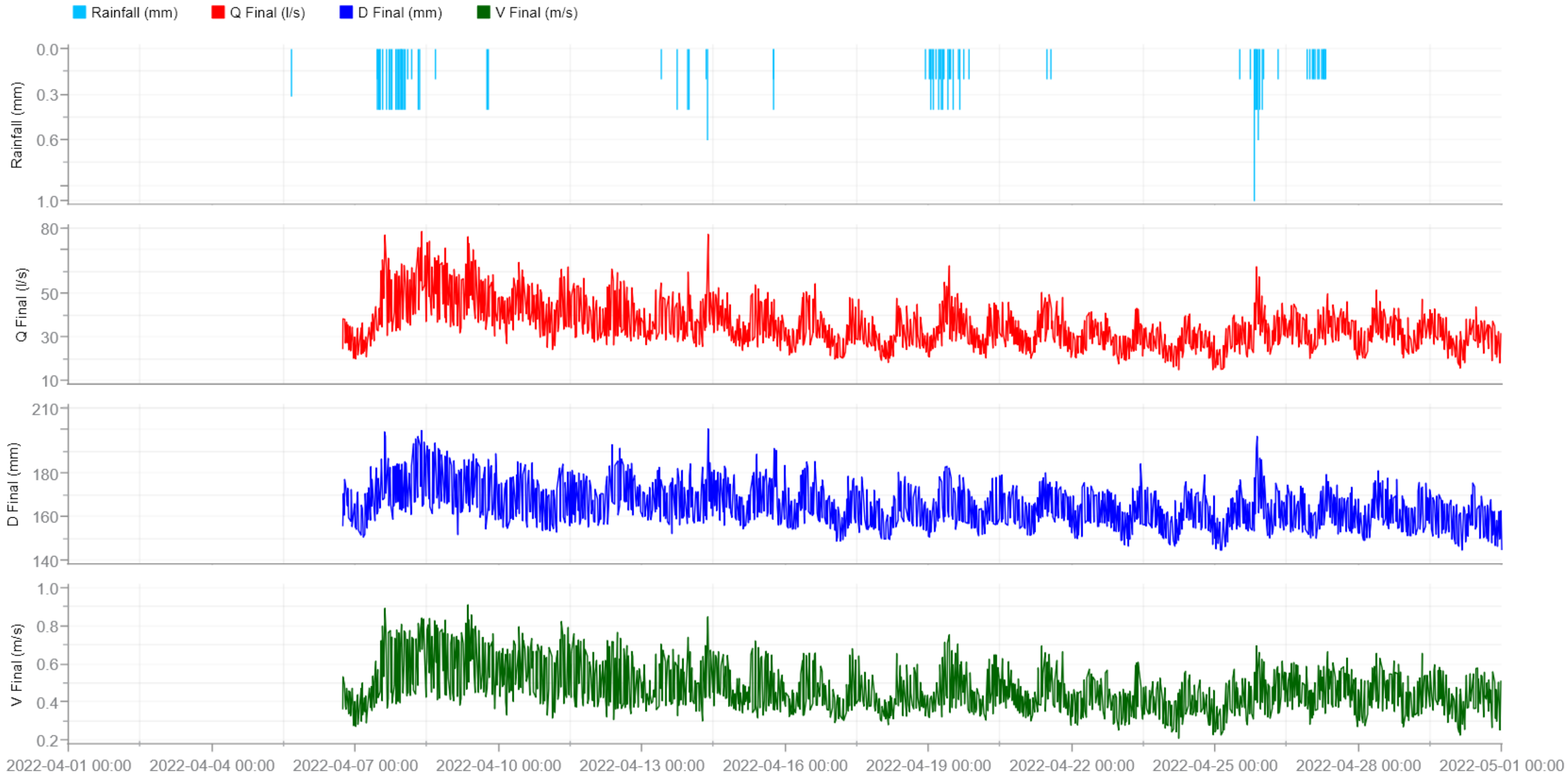


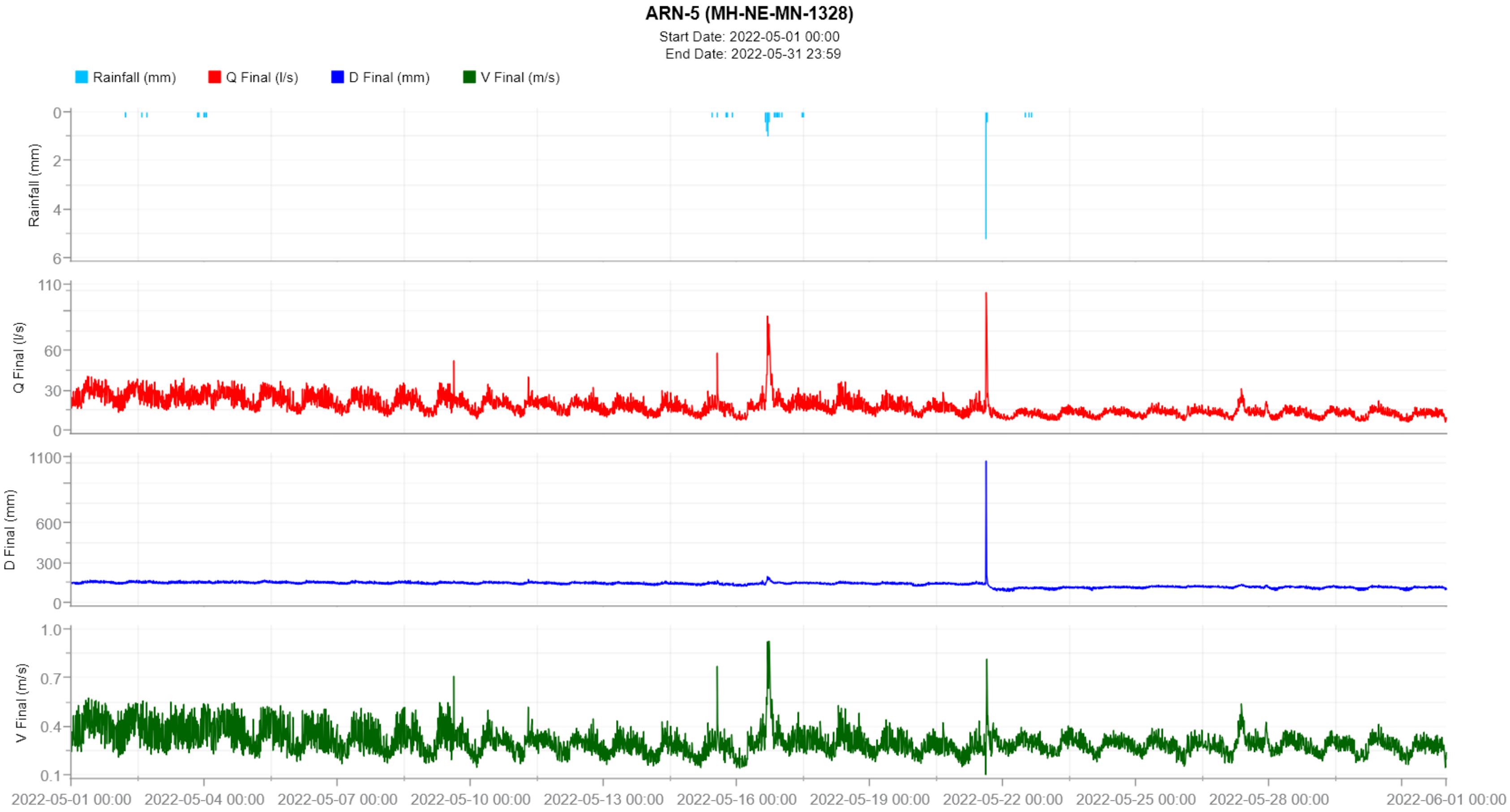


ARN-4 (MH-NE-MN-1314)
Start Date: 2022-07-01 00:00
End Date: 2022-07-31 23:59
Rainfall (mm)
Q Final (l/s)
D Final (mm)
V Final (m/s)
Rainfall (mm)
Q Final (l/s)
D Final (mm)
V Final (m/s)
2022-07-01 00:00
2022-07-04 00:00
2022-07-07 00:00
2022-07-10 00:00
2022-07-13 00:00
2022-07-16 00:00
2022-07-19 00:00
2022-07-22 00:00
2022-07-25 00:00
2022-07-28 00:00
2022-08-01 00:00

ARN-5 (MH-NE-MN-1328)

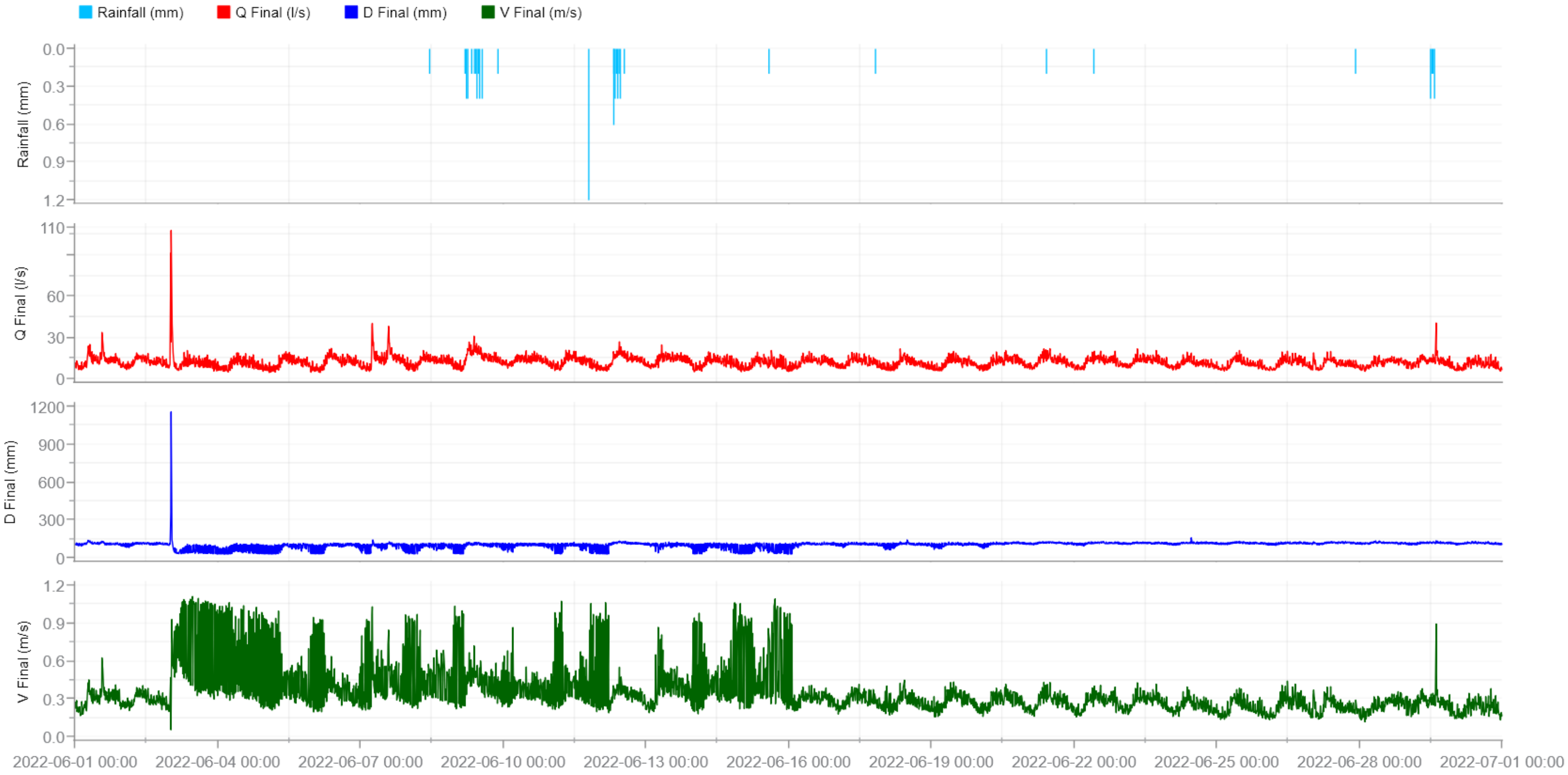
Start Date: 2022-04-01 00:00
End Date: 2022-04-30 23:59




ARN-5 (MH-NE-MN-1328)
Start Date: 2022-05-01 00:00
End Date: 2022-05-31 23:59
Rainfall (mm)
Q Final (l/s)
D Final (mm)
V Final (m/s)
Rainfall (mm)
Q Final (l/s)
D Final (mm)
V Final (m/s)
0
2
4
6
110
60
30
0
1100
600
300
0
1.0
0.7
0.4
0.1
2022-05-01 00:00
2022-05-04 00:00
2022-05-07 00:00
2022-05-10 00:00
2022-05-13 00:00
2022-05-16 00:00
2022-05-19 00:00
2022-05-22 00:00
2022-05-25 00:00
2022-05-28 00:00
2022-06-01 00:00

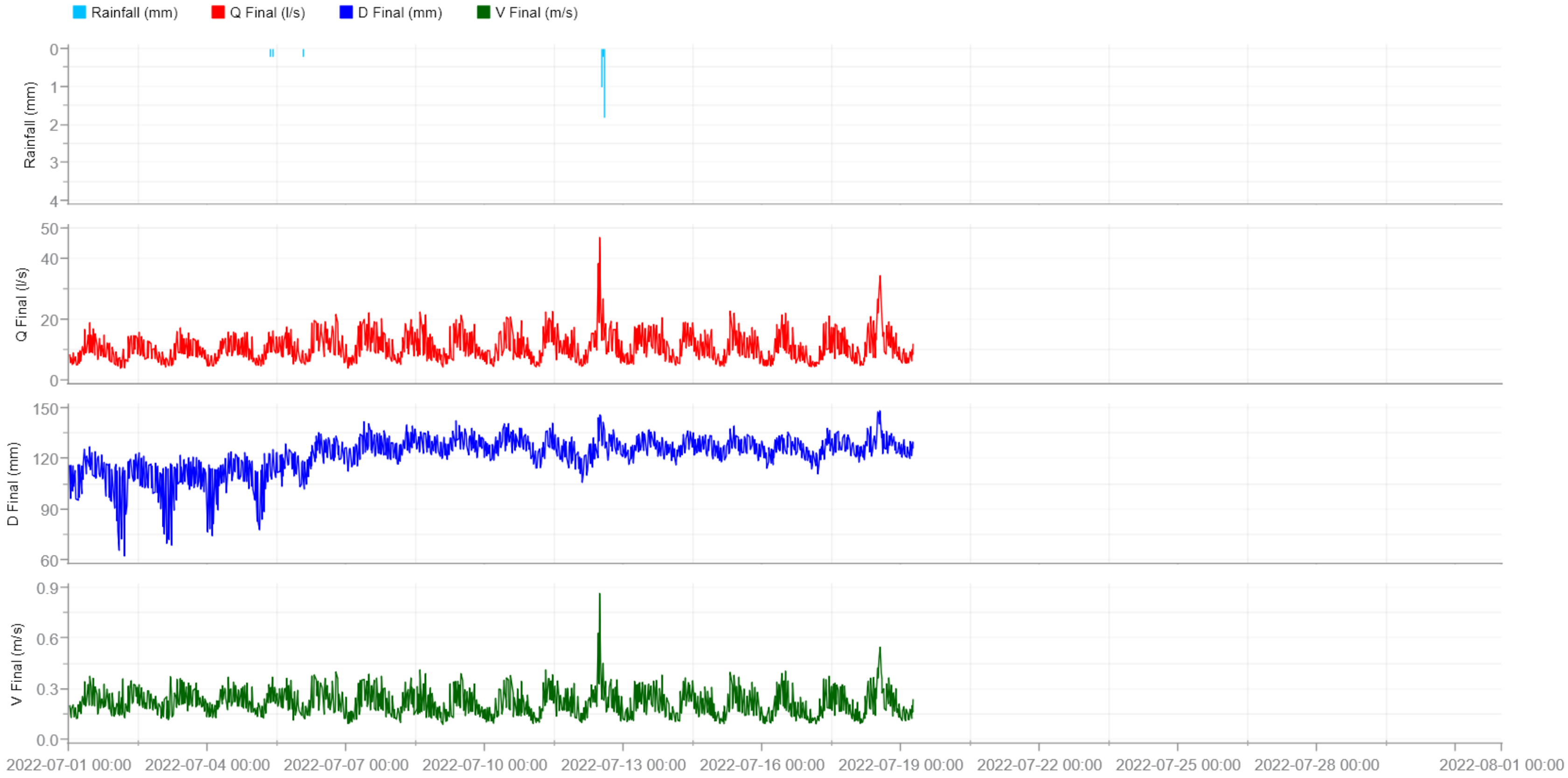
ARN-5 (MH-NE-MN-1328)

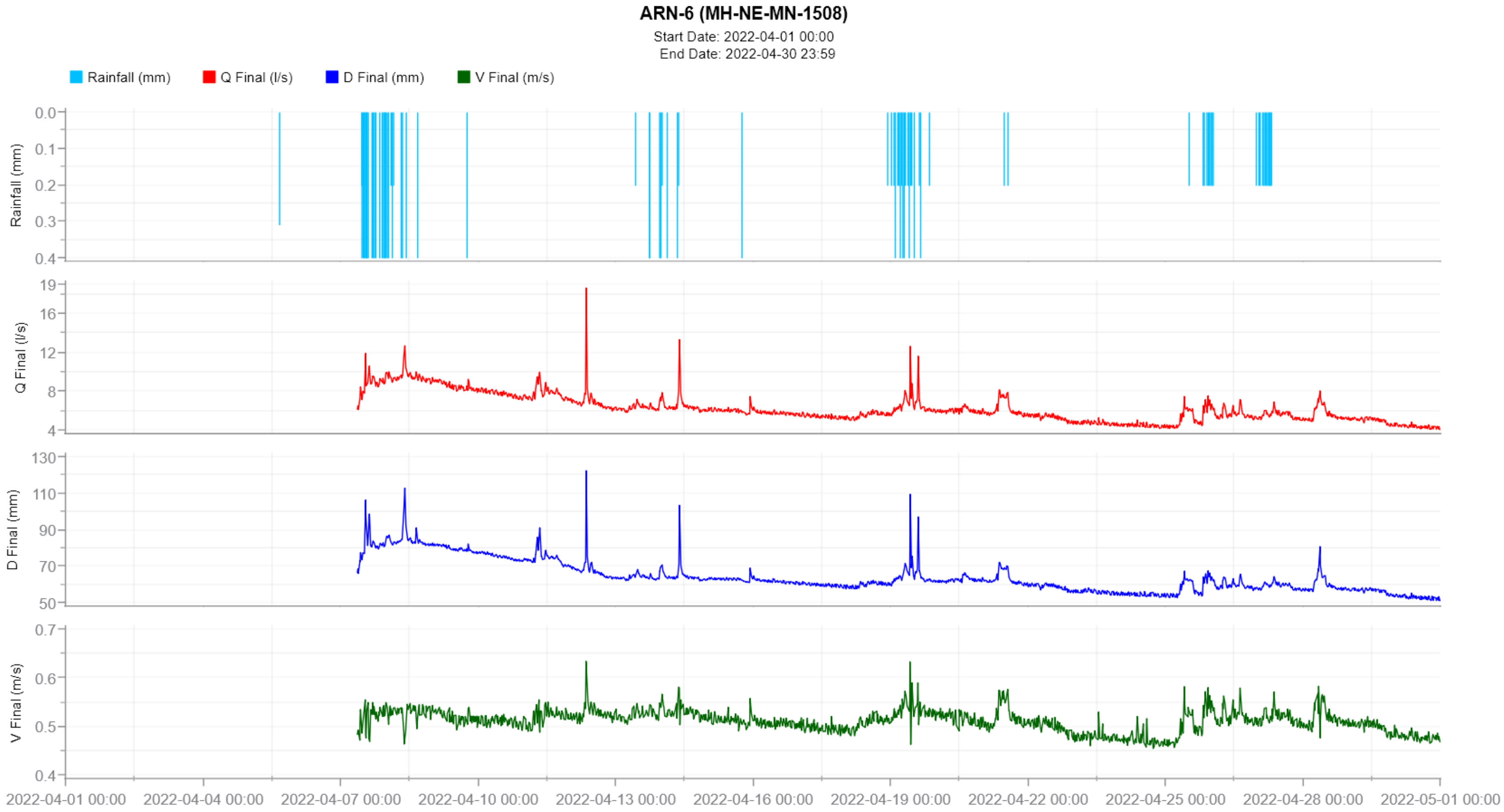
Start Date: 2022-06-01 00:00
End Date: 2022-06-30 23:59



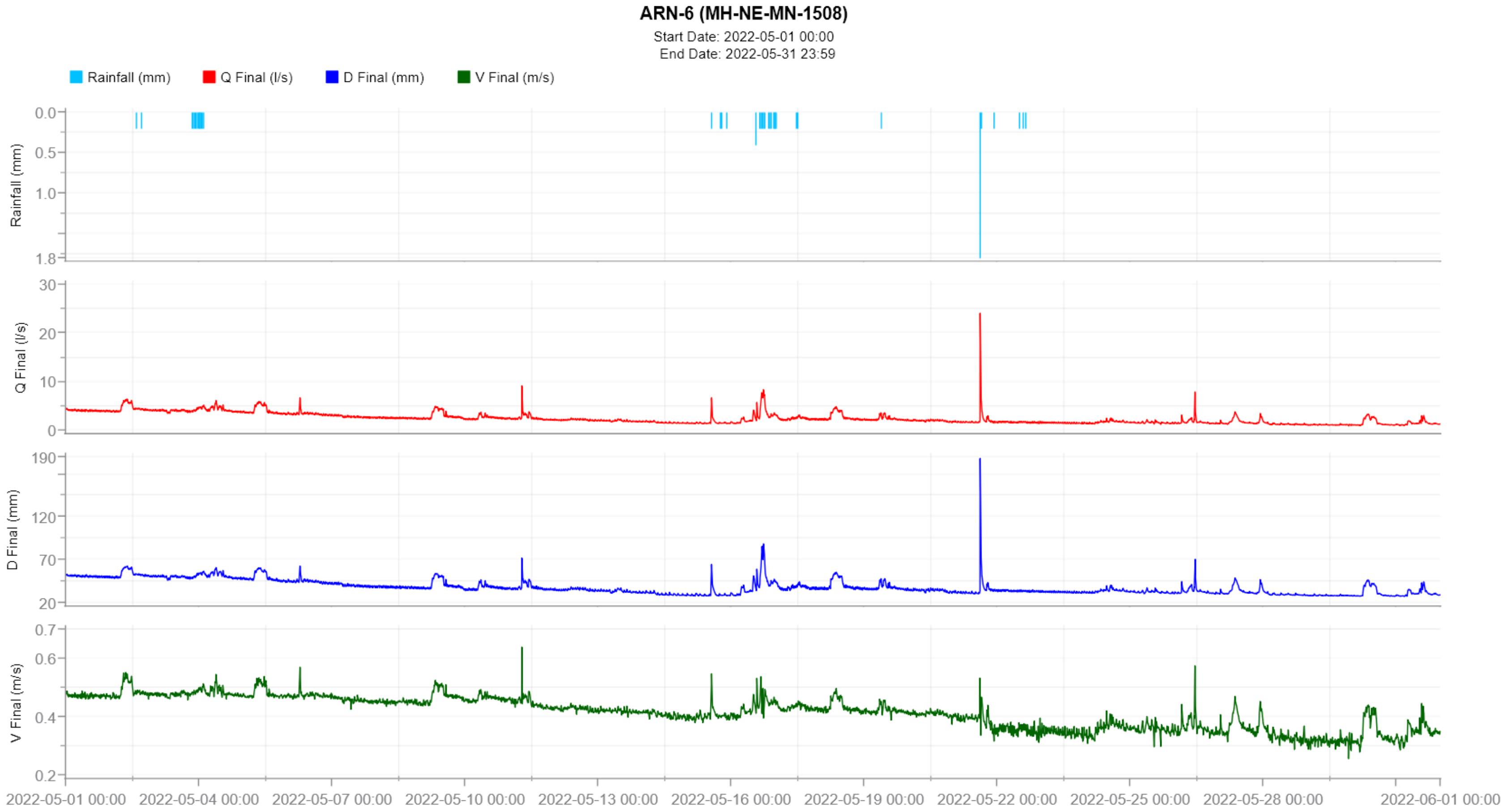
ARN-5 (MH-NE-MN-1328)

Start Date: 2022-07-01 00:00
End Date: 2022-07-31 23:59





ARN-6 (MH-NE-MN-1508)
Start Date: 2022-04-01 00:00
End Date: 2022-04-30 23:59
Rainfall (mm)
Q Final (l/s)
D Final (mm)
V Final (m/s)
0.0
0.1
0.2
0.3
0.4
19
16
12
8
4
130
110
90
70
50
0.7
0.6
0.5
0.4
2022-04-01 00:00
2022-04-04 00:00
2022-04-07 00:00
2022-04-10 00:00
2022-04-13 00:00
2022-04-16 00:00
2022-04-19 00:00
2022-04-22 00:00
2022-04-25 00:00
2022-04-28 00:00
2022-05-01 00:00

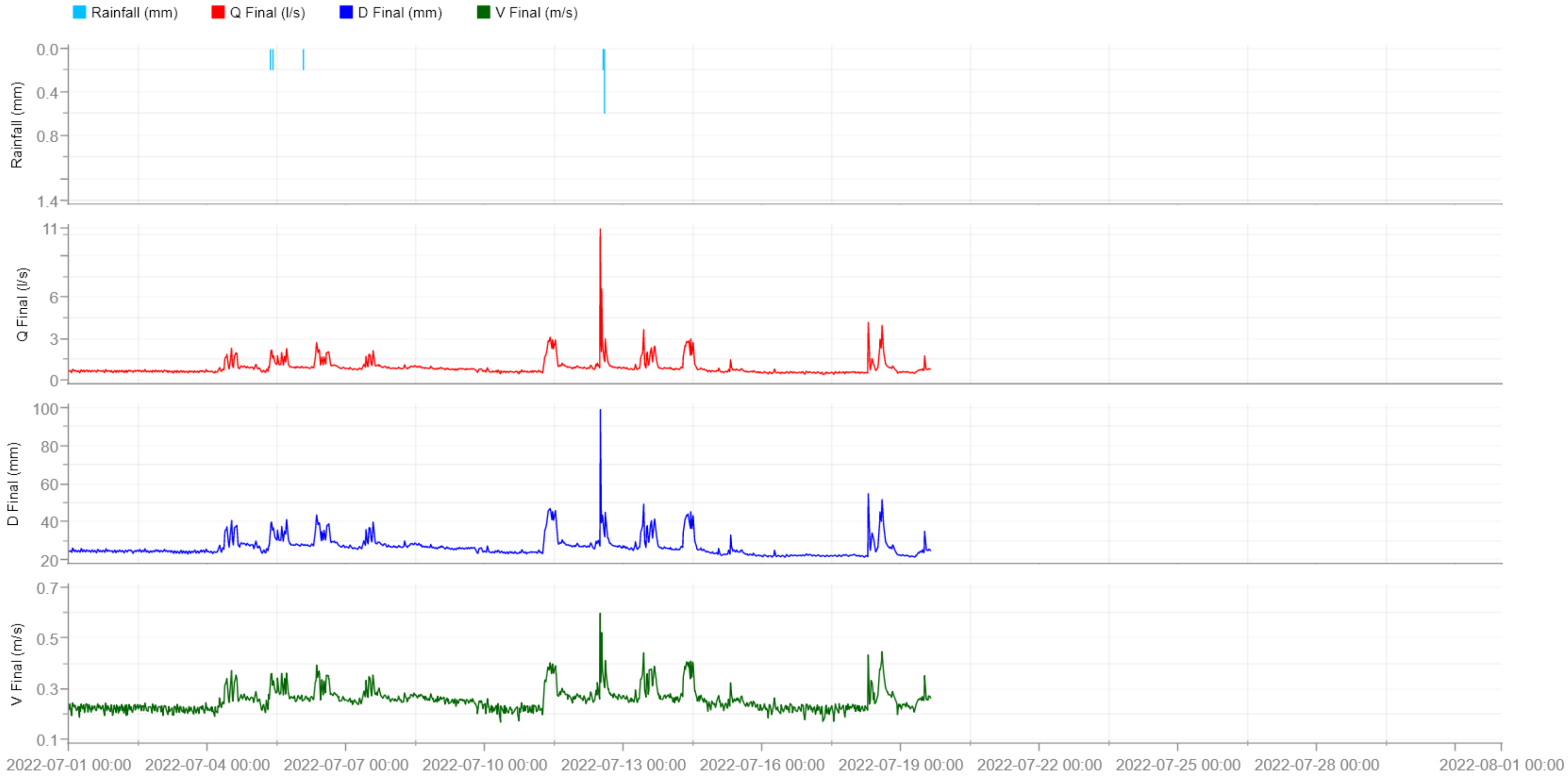

ARN-6 (MH-NE-MN-1508)
Start Date: 2022-05-01 00:00
End Date: 2022-05-31 23:59
Rainfall (mm)
Q Final (l/s)
D Final (mm)
V Final (m/s)
0.0
0.5
1.0
1.8
30
20
10
0
190
120
70
20
0.7
0.6
0.4
0.2
2022-05-01 00:00
2022-05-04 00:00
2022-05-07 00:00
2022-05-10 00:00
2022-05-13 00:00
2022-05-16 00:00
2022-05-19 00:00
2022-05-22 00:00
2022-05-25 00:00
2022-05-28 00:00
2022-06-01 00:00

ARN-6 (MH-NE-MN-1508)

Start Date: 2022-06-01 00:00
End Date: 2022-06-30 23:59

ARN-6 (MH-NE-MN-1508)

Start Date: 2022-07-01 00:00
End Date: 2022-07-31 23:59



A.3 Flow Monitoring Data Quality Review

Town of Arnprior 2022 Water Wastewater Master Plan

2022 Flow Monitoring Program Data Quality Review

Legend:

- Reliable Data
- Questionable Depth
- Questionable Velocity
- Questionable Depth & Velocity
- Missing Data
- Reliable Data w/ Surcharge
- Reliable Data w/ BackWater
- Reliable Data w/ BackWater and Surcharge
- Reliable Data w/ Debris/Sediment Accumulation
- Rainfall >= 2.54 mm

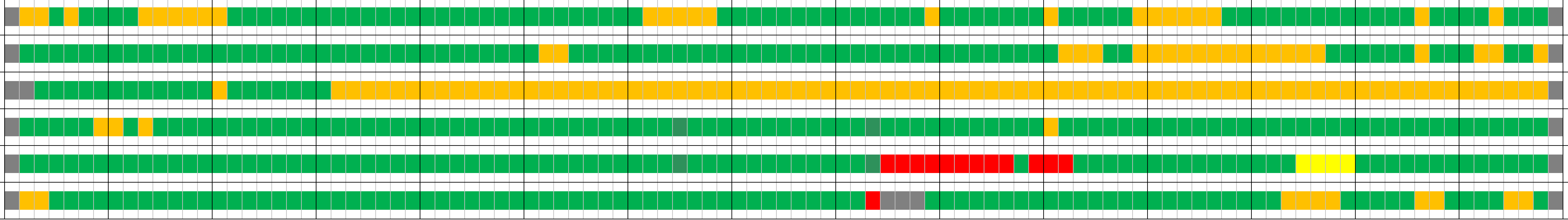
Monitoring period: 4/6 – 7/19 (April 2022, May 2022, June 2022, July 2022; Week 1 – Week 15)

Rain Gauges

Monitor	4/7	4/8	4/9	4/13	4/14	4/15	4/18	4/19	4/21	4/25	4/26	4/27	5/2	5/3	5/4	5/15	5/16	5/17	5/19	5/21	5/22
RG 1-JamesSt	16.6	6.2	1.4	4.6	5.0	0.6	0.2	11.2	0.4	12.6	6.2	5.2	1.0	1.6	6.2	6.2	23.4	6.2	0.8	15.0	1.4

Monitor	6/8	6/9	6/10	6/12	6/13	6/15	6/18	6/21	6/22	6/28	6/29	7/5	7/6	7/12
RG 1-JamesSt	0.2	9.6	0.4	9.8	0.2	0.2	0.2	0.8	0.2	0.2	3.8	0.4	0.6	10.2

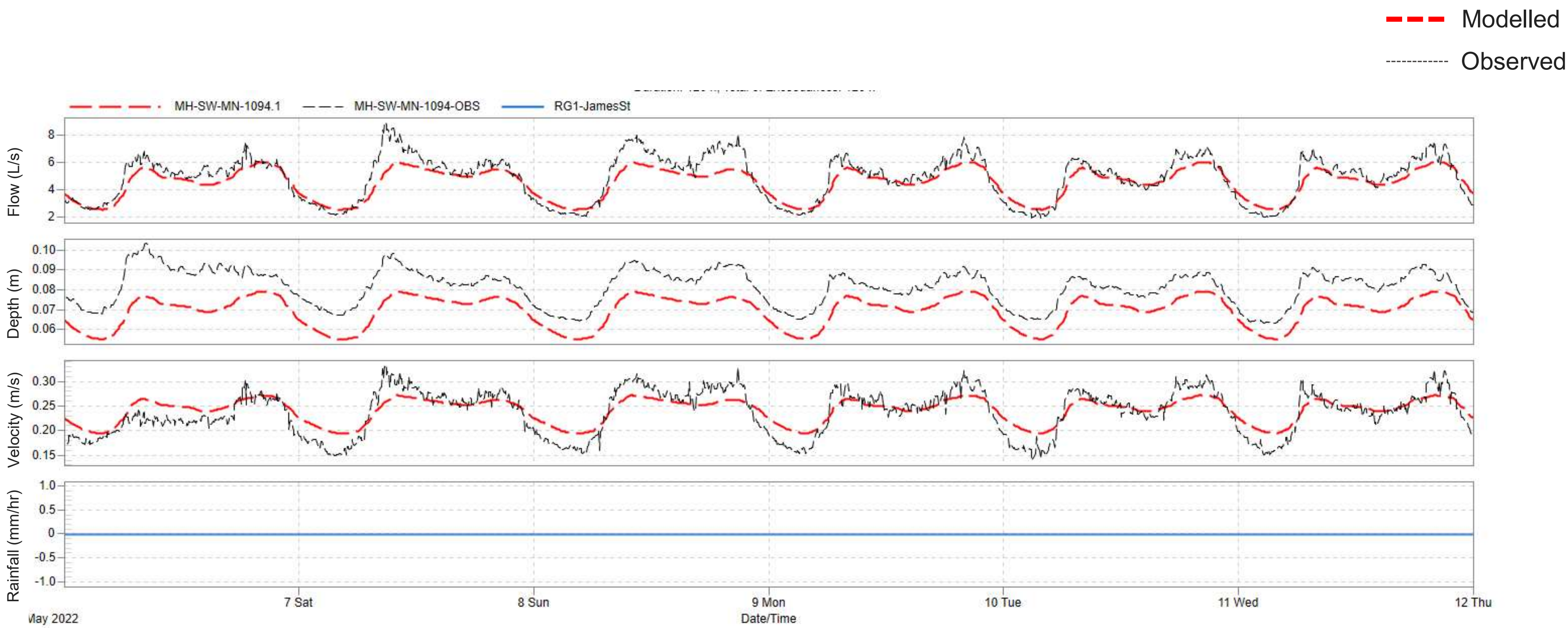
Flow Meters



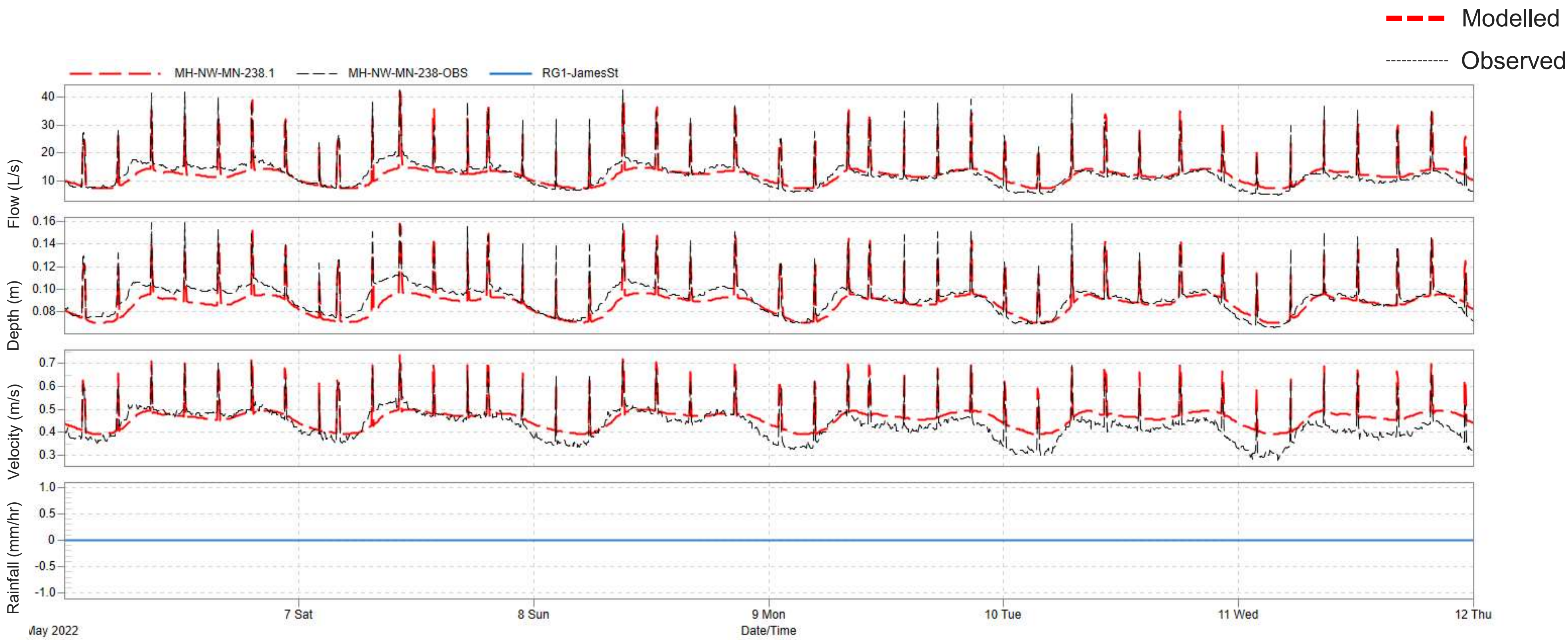
Monitor	Uptime (%)	Modeler Comments
FM1-StayeCt	75	Generally good data quality, questionable velocities around mid-April, mid-May and mid-June due to data drop outs in raw data (corrected/interpolated in final data set). 600mm pipe generally ~15% full on average, up to ~30% full during peaks.
FM2-DanielSt	77	Generally good data quality; questionable velocities in mid-May (raw data does not fully drop, but appears erroneous even in final corrected data set), and in mid-June (data drop outs in raw data, corrected with interpolation in final data set). Extended velocity data outage at the end of June/beginning of July (but PS velocity still measured), was corrected in final dataset. 600mm pipe is ~15% full on average, up to ~50% full during peaks. FM is influenced by PS (depth & velocity peak intermittently, pipe ~1/3 full at these times). FM is D/S of FM1.
FM3-ElginSt	18	Good depth data quality, but poor velocity data quality; Flowmetrix reported whirlpooling starting at the end of April; FM was maintained in original installation location. Average velocity is lower after the end of April, which could affect quality. 600mm pipe is ~20% full on average, ~25-30% during diurnal peaks.
FM4-NMdwBlvd	94	Revised data received 2022/11/09. Generally good data quality; FM is influenced by downstream PS#3. Backwater & surcharge on 5/21 and 6/3. 375mm is ~25-30% full.
FM5-MdwBlvd	83	Revised data received 2022/11/09. Generally good data quality; FM is influenced by downstream PS#3. Backwater & surcharge on 5/21 and 6/3. Questionable depth & velocities in early to mid-June. 600mm pipe is ~20-30% full. FM is D/S of FM6.
FM6-DeCosta	85	Generally good data quality. Missing raw data (D&V) in early June, was interpolated in the final dataset; intermittent data dropouts in early and mid-July, was interpolated in final dataset. 375mm pipe is ~10-15% full on average, ~20% full during diurnal peaks. FM is U/S of FM5.

Appendix B Wastewater Collection System Calibration

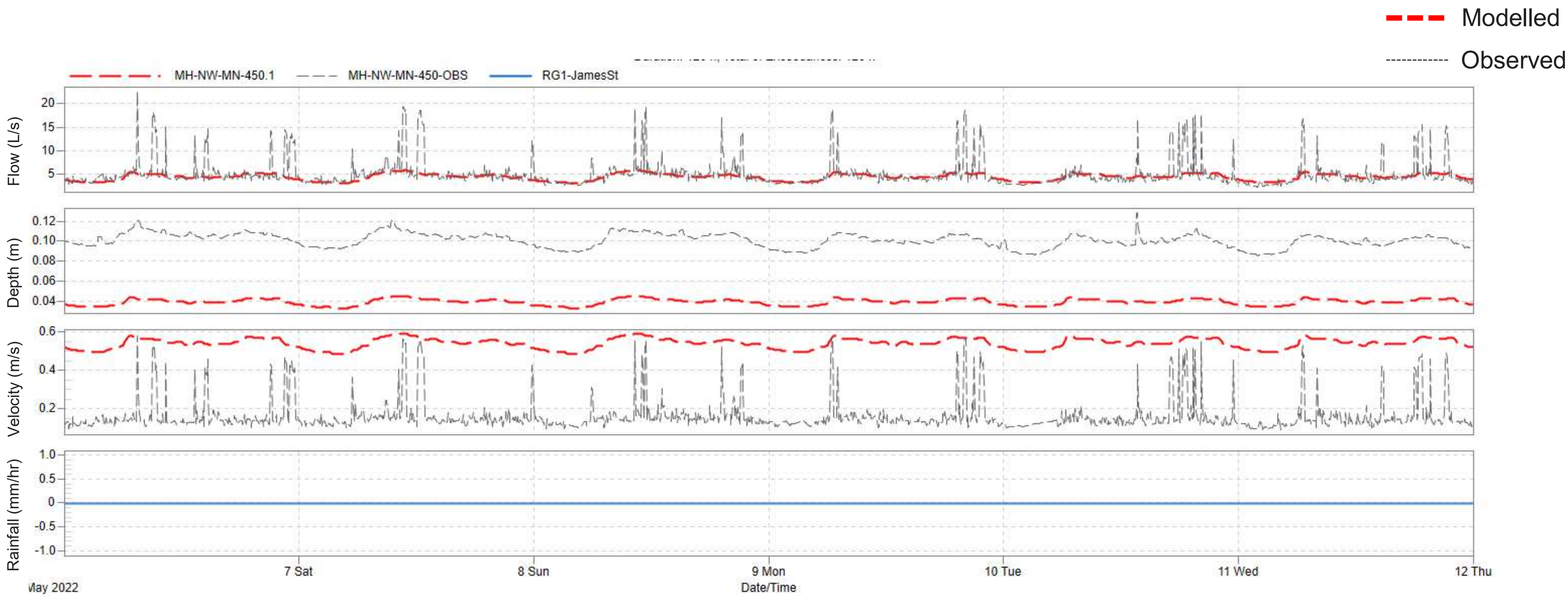
B.1 DWF Calibration Results – Hydrographs



Stantec	**Town of Arnprior** **2022 Water & Wastewater Master Plan** **Wastewater Collection System** **Hydraulic Modelling Results - Calibration**	**DWF Calibration** **DWF Period 1: May 6th, 2022 (00:00) to May 12th, 2022 (00:00)** **FM1 – Staye Court**



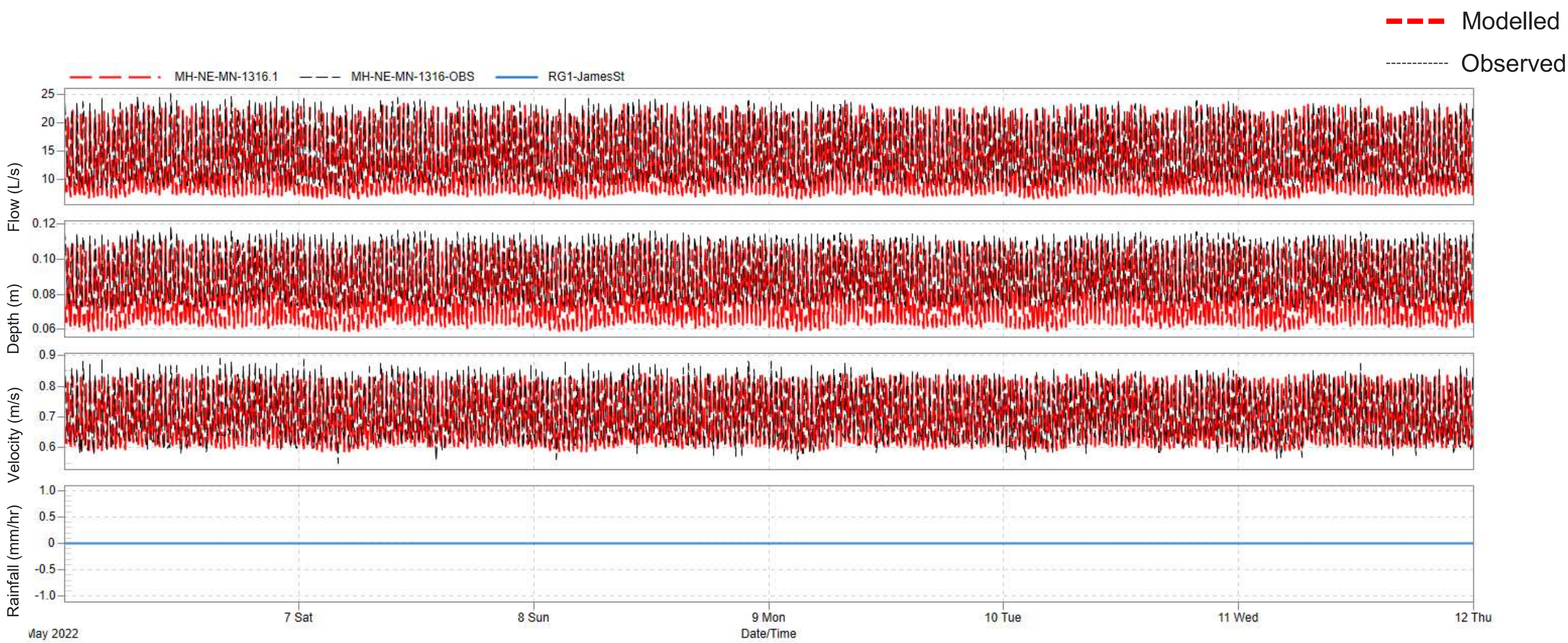
Stantec	Town of Arnprior 2022 Water & Wastewater Master Plan Wastewater Collection System Hydraulic Modelling Results - Calibration	**DWF Calibration** **DWF Period 1: May 6th, 2022 (00:00) to May 12th, 2022 (00:00)** **FM2 – Daniel St**	



Stantec

Town of Arnprior
2022 Water & Wastewater Master Plan
Wastewater Collection System
Hydraulic Modelling Results - Calibration

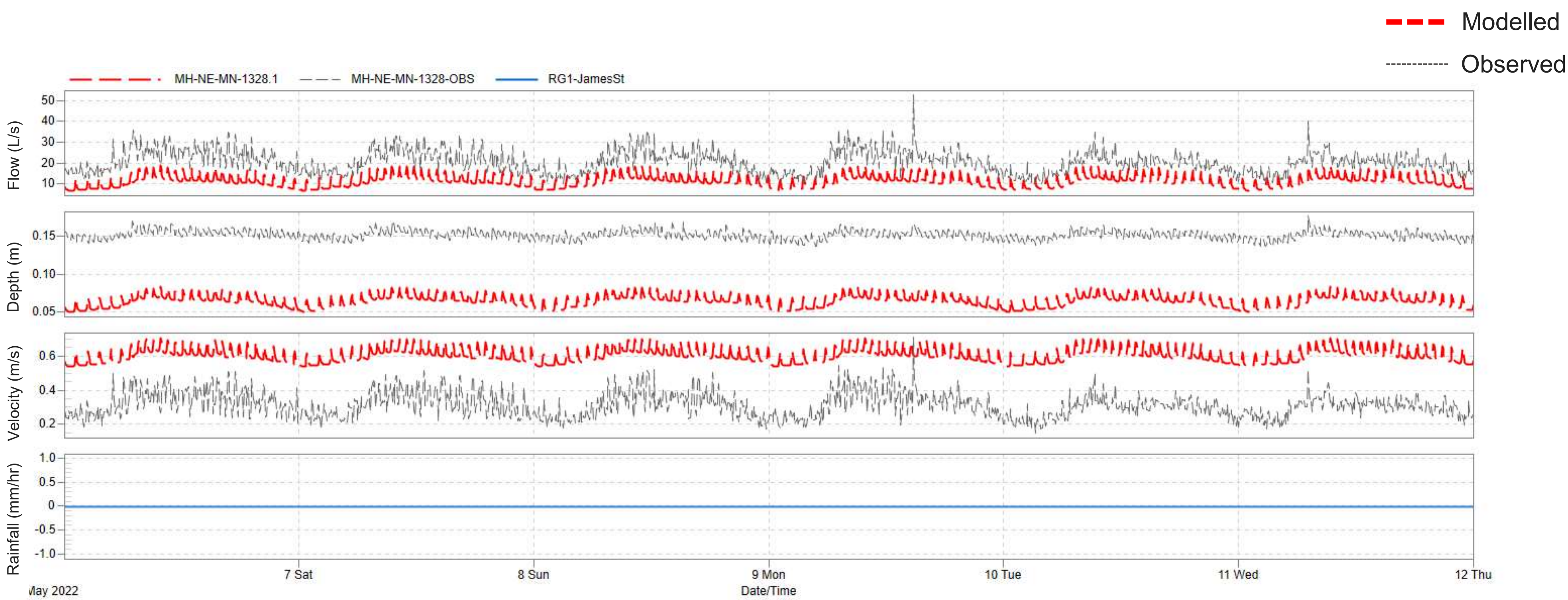
DWF Calibration
DWF Period 1: May 6th, 2022 (00:00) to May 12th, 2022 (00:00)
FM3 – Elgin St



Stantec

Town of Arnprior
2022 Water & Wastewater Master Plan
Wastewater Collection System
Hydraulic Modelling Results - Calibration

DWF Calibration
DWF Period 1: May 6th, 2022 (00:00) to May 12th, 2022 (00:00)
FM4 – Riverview Dr

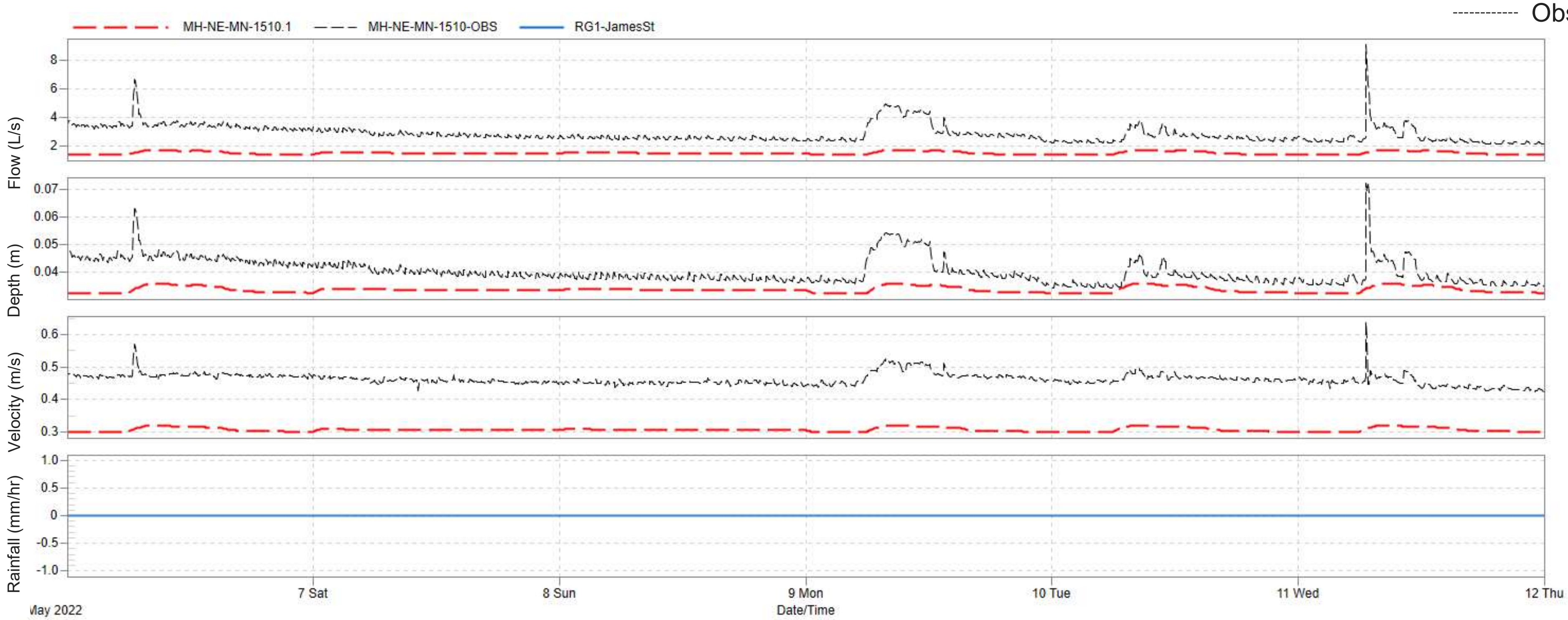


Stantec

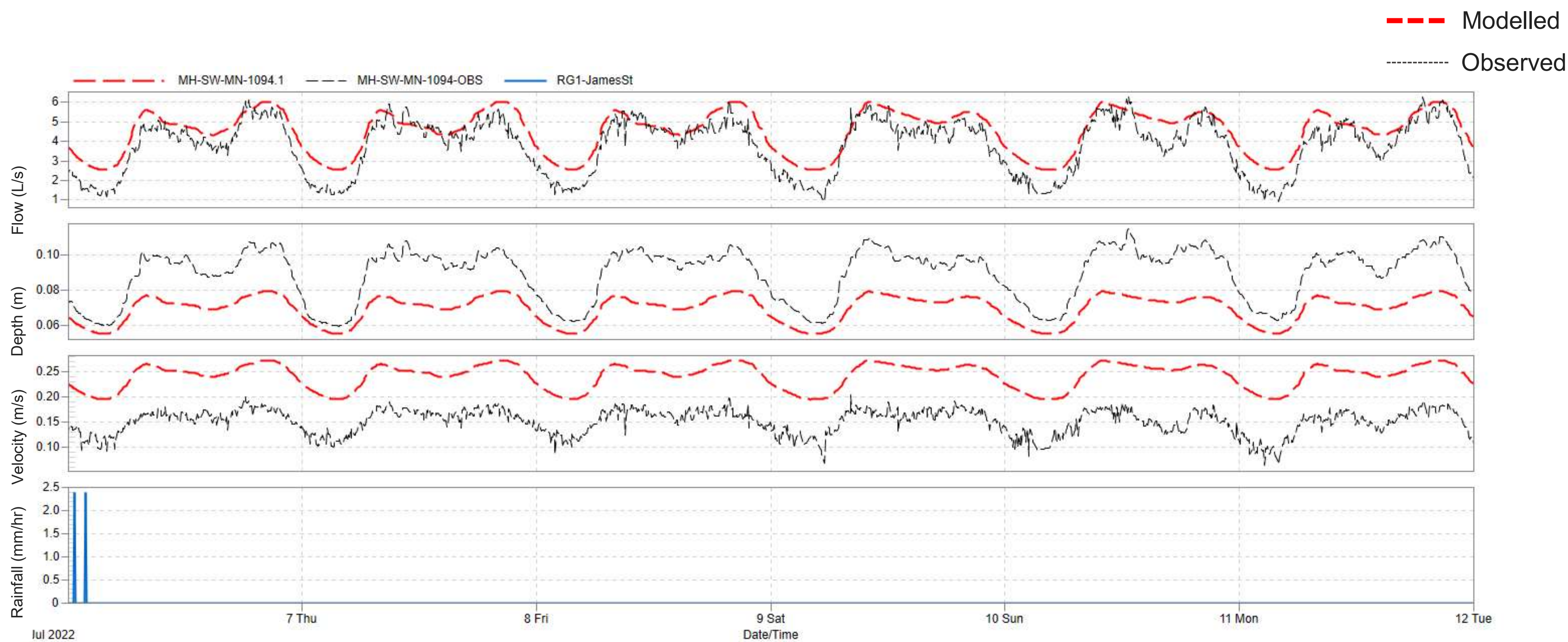
Town of Arnprior
2022 Water & Wastewater Master Plan
Wastewater Collection System
Hydraulic Modelling Results - Calibration

DWF Calibration
DWF Period 1: May 6th, 2022 (00:00) to May 12th, 2022 (00:00)
FM5 – Madawaska Blvd

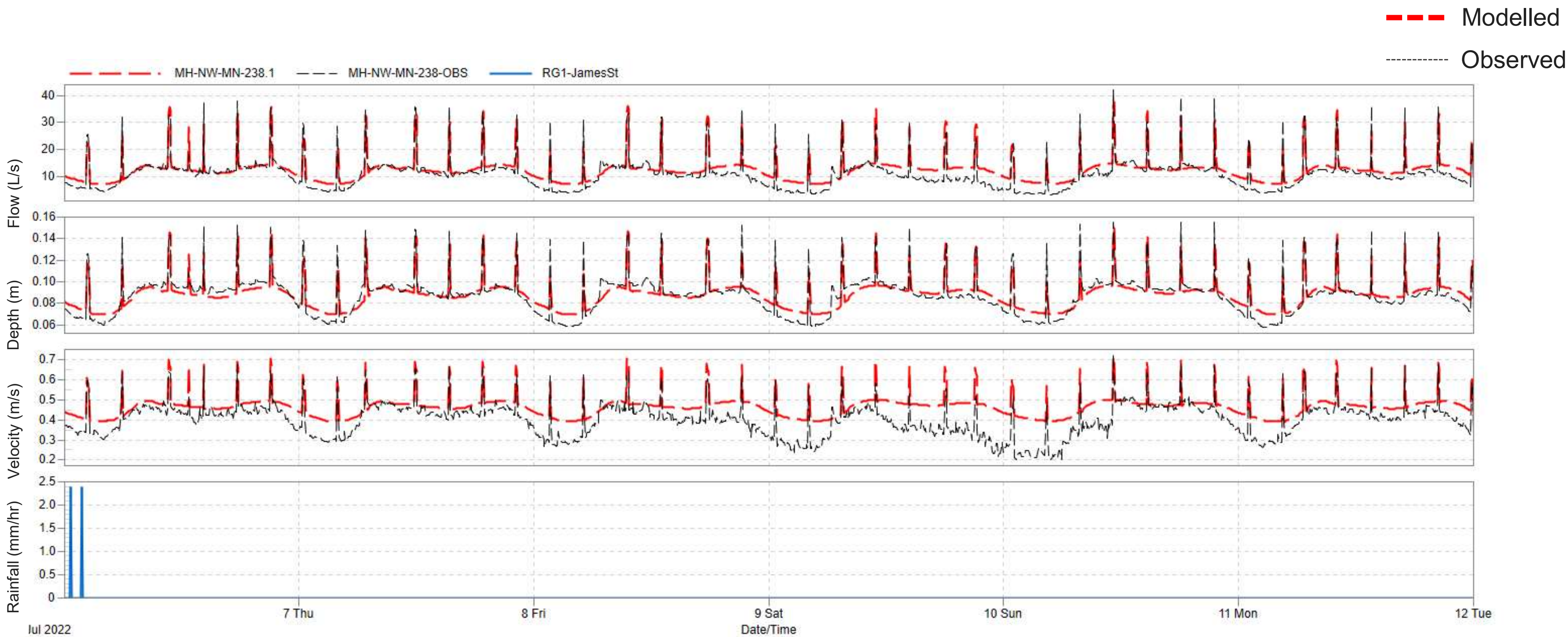
Modelled
Observed



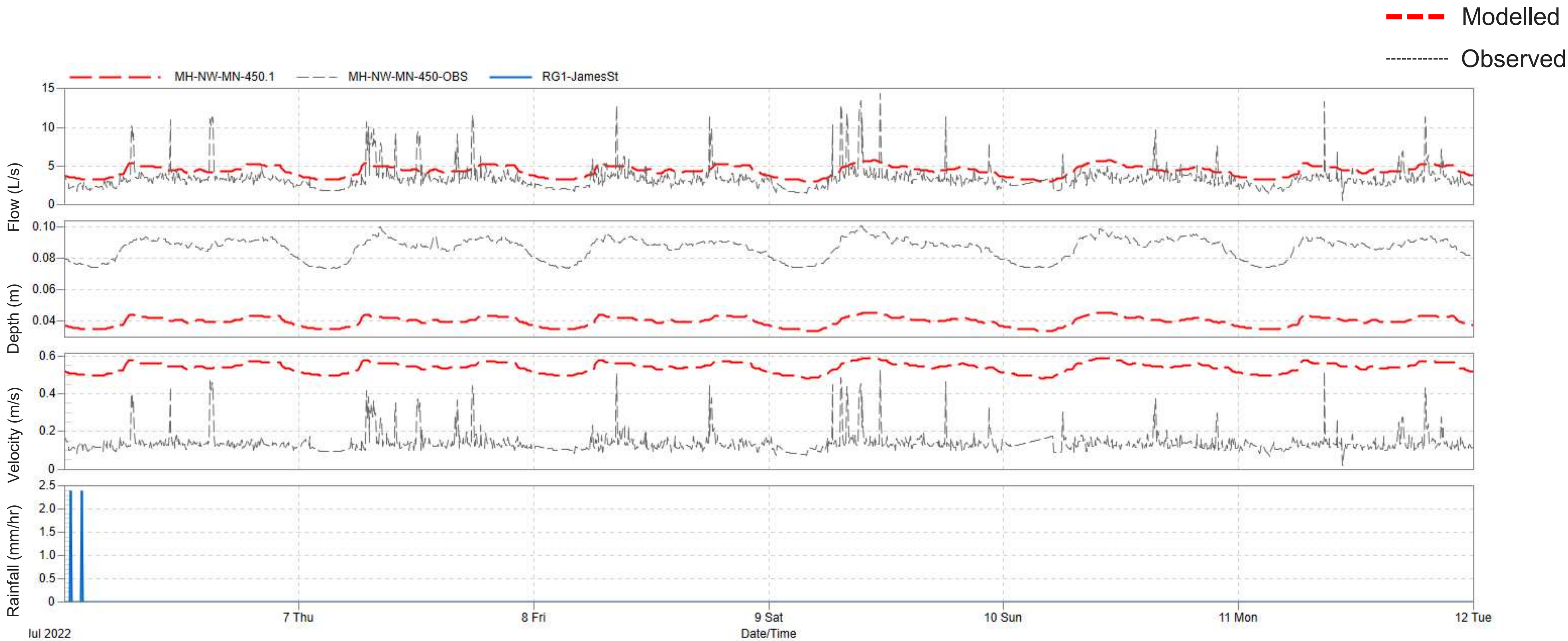
Stantec	Town of Arnprior 2022 Water & Wastewater Master Plan Wastewater Collection System Hydraulic Modelling Results - Calibration	**DWF Calibration** **DWF Period 1: May 6th, 2022 (00:00) to May 12th, 2022 (00:00)** **FM6 – DeCosta St**	



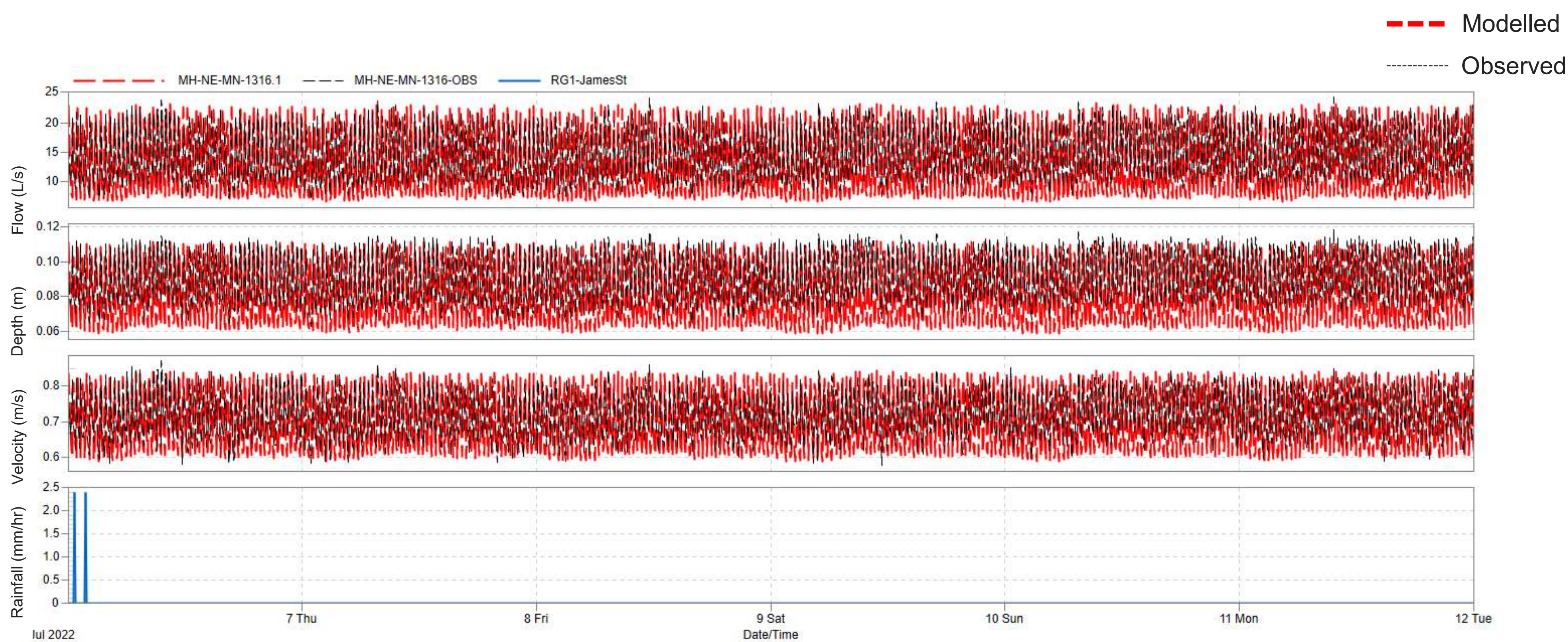
Stantec	Town of Arnprior 2022 Water & Wastewater Master Plan Wastewater Collection System Hydraulic Modelling Results - Calibration	**DWF Calibration** **DWF Period 2: July 6th, 2022 (00:00) to July 12th, 2022 (00:00)** **FM1 – Staye Court**



Stantec	Town of Arnprior 2022 Water & Wastewater Master Plan Wastewater Collection System Hydraulic Modelling Results - Calibration	**DWF Calibration** **DWF Period 2: July 6th, 2022 (00:00) to July 12th, 2022 (00:00)** **FM2 – Daniel St**	



Stantec	**Town of Arnprior** **2022 Water & Wastewater Master Plan** **Wastewater Collection System** **Hydraulic Modelling Results - Calibration**	**DWF Calibration** **DWF Period 2: July 6th, 2022 (00:00) to July 12th, 2022 (00:00)** **FM3 – Elgin St**

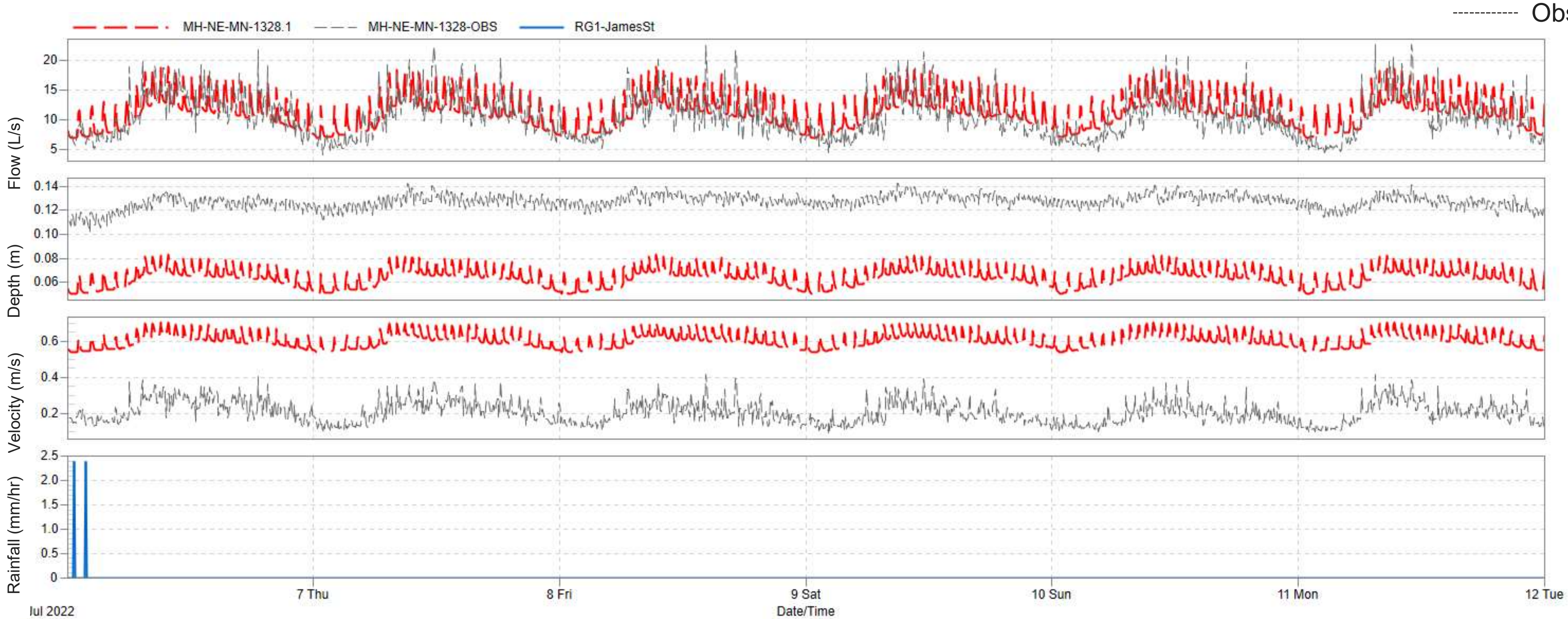


Stantec

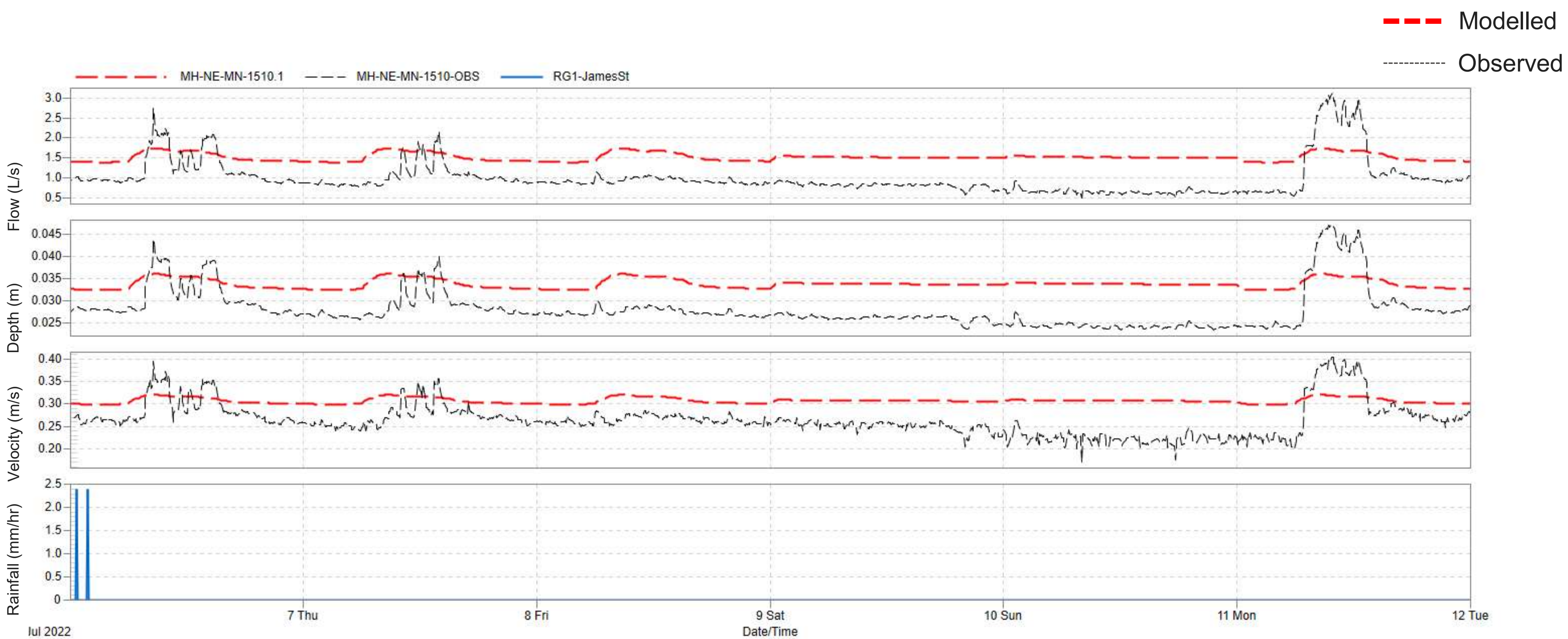
Town of Arnprior
2022 Water & Wastewater Master Plan
Wastewater Collection System
Hydraulic Modelling Results - Calibration

DWF Calibration
DWF Period 2: July 6th, 2022 (00:00) to July 12th, 2022 (00:00)
FM4 – Riverview Dr

Modelled
Observed

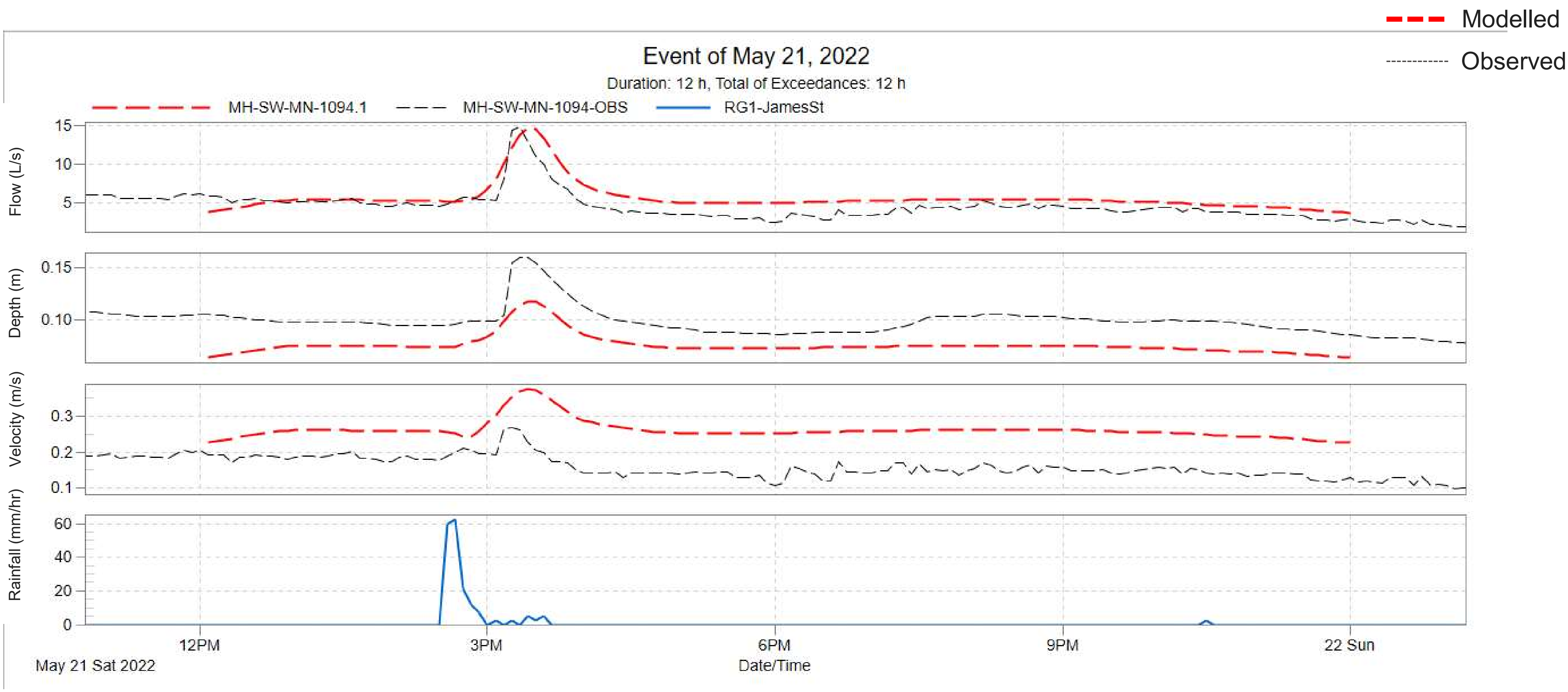


Stantec	Town of Arnprior 2022 Water & Wastewater Master Plan Wastewater Collection System Hydraulic Modelling Results - Calibration	**DWF Calibration** **DWF Period 2: July 6th, 2022 (00:00) to July 12th, 2022 (00:00)** **FM5 – Madawaska Blvd**	

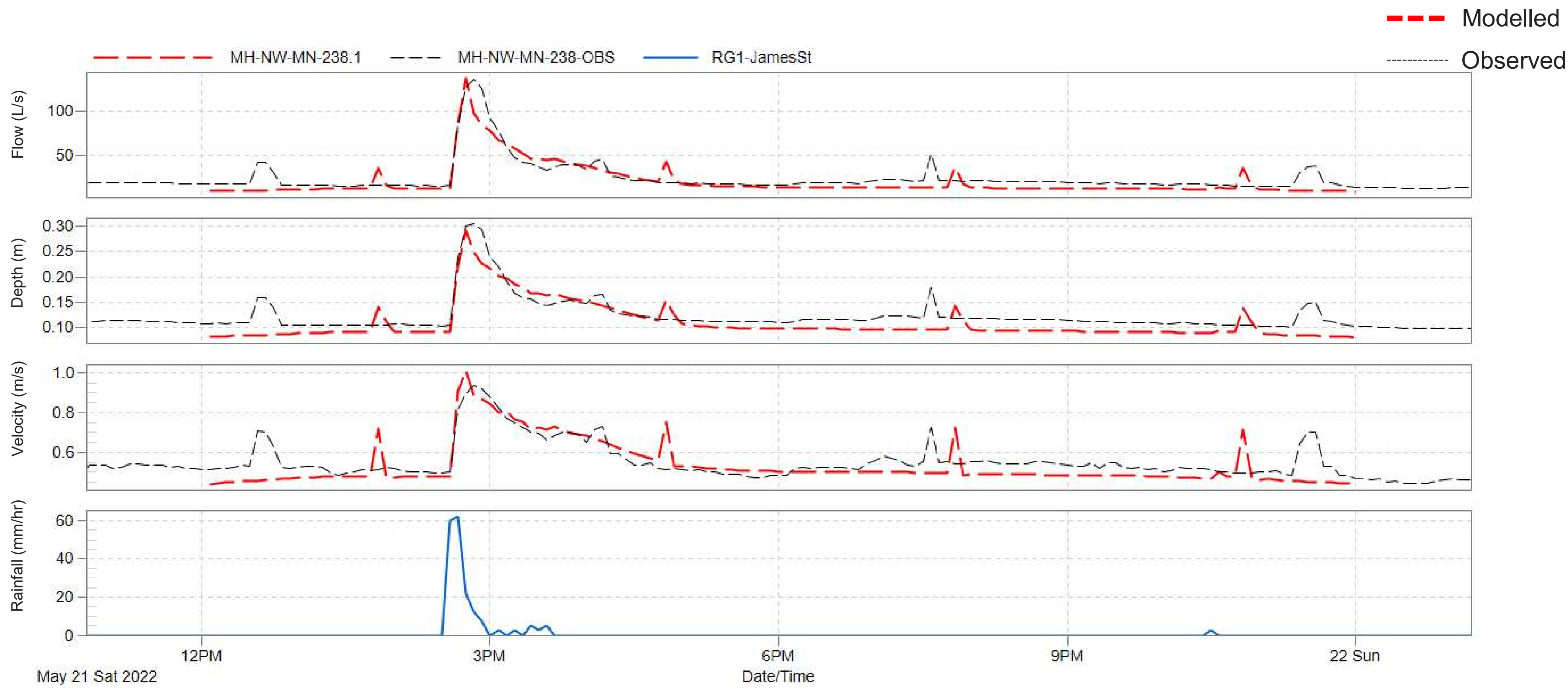


Stantec	Town of Arnprior 2022 Water & Wastewater Master Plan Wastewater Collection System Hydraulic Modelling Results - Calibration	**DWF Calibration** **DWF Period 2: July 6th, 2022 (00:00) to July 12th, 2022 (00:00)** **FM6 – DeCosta St**	

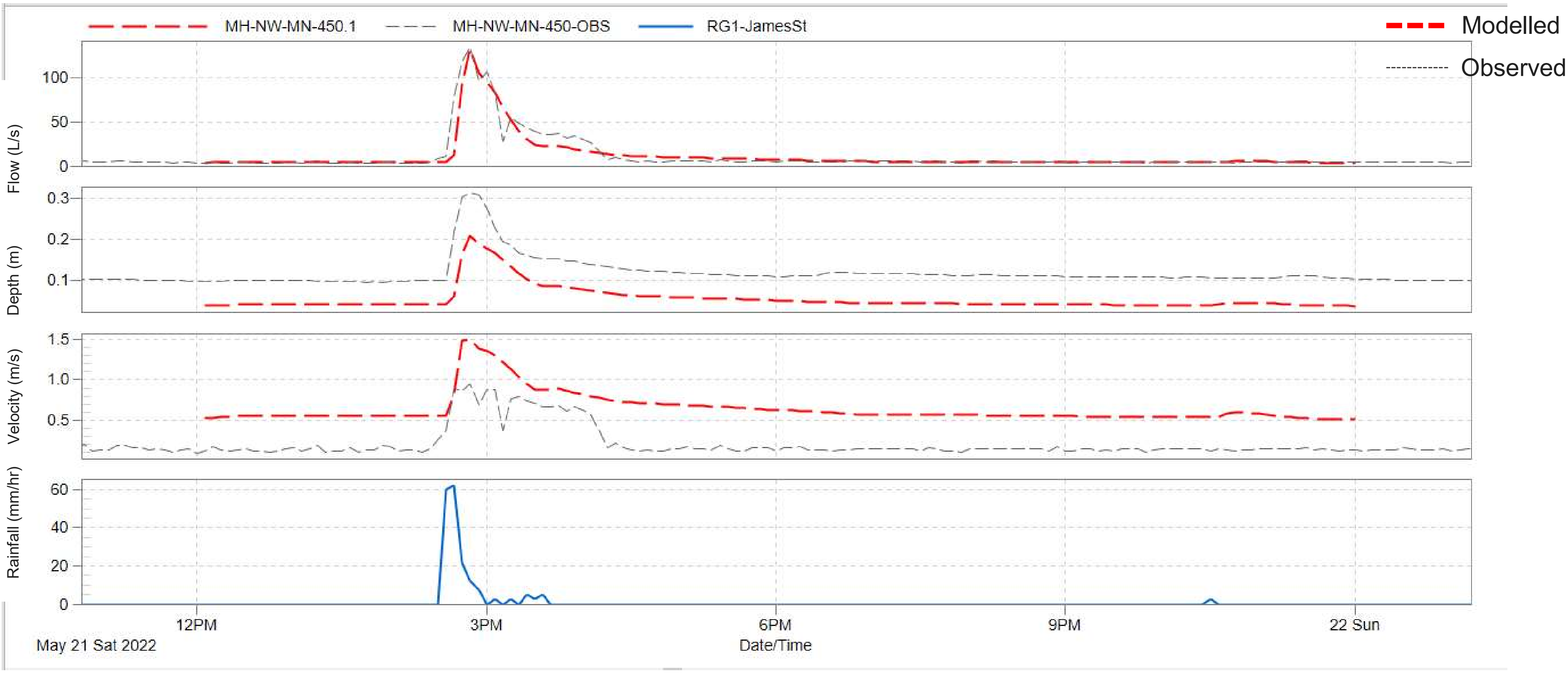
B.2 WWF Calibration Results – Hydrographs



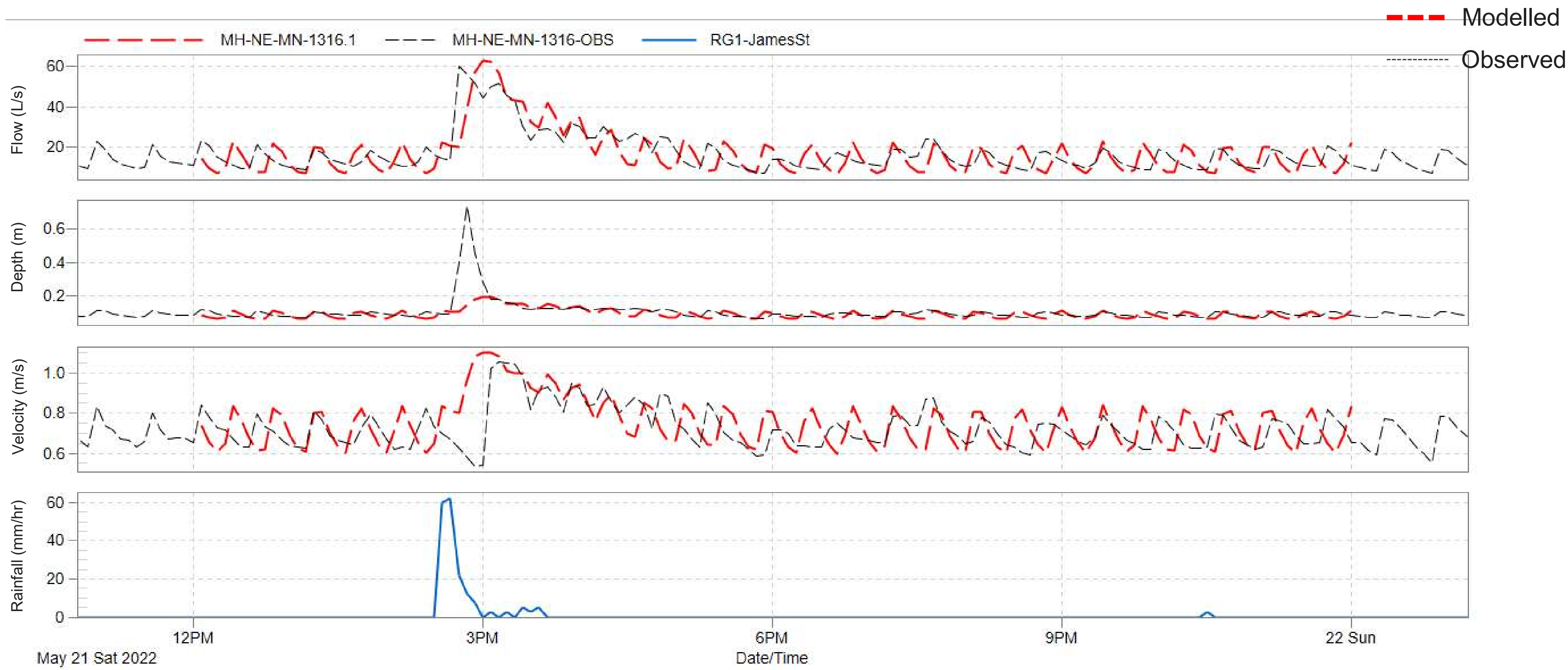
Stantec	Town of Arnprior 2022 Water & Wastewater Master Plan Wastewater Collection System Hydraulic Modelling Results - Calibration	**WWF Calibration** **WWF Event 1: May 21st, 2022 (12:00) to May 22nd, 2022 (0:00)** **FM1 – Staye Court**	



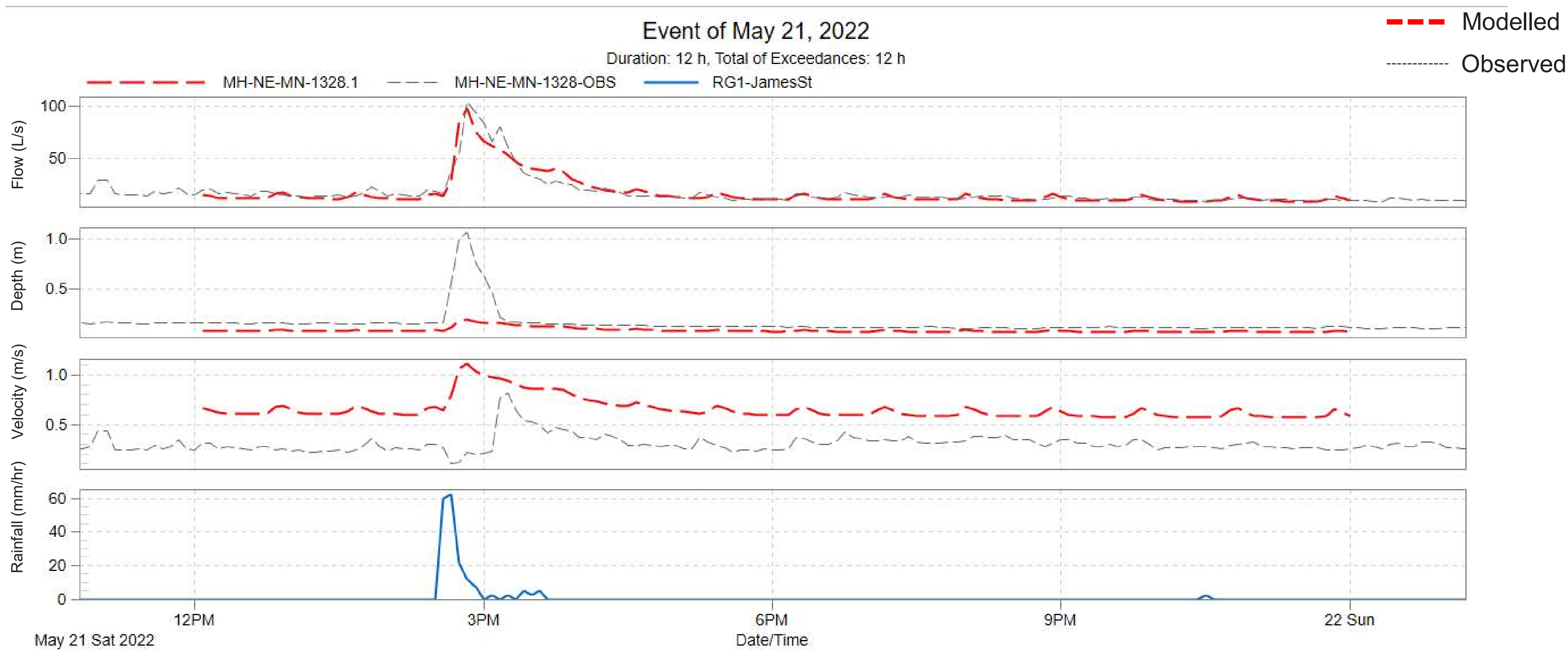
Stantec	Town of Arnprior 2022 Water & Wastewater Master Plan Wastewater Collection System Hydraulic Modelling Results - Calibration	**WWF Calibration** **WWF Event 1: May 21st, 2022 (12:00) to May 22nd, 2022 (0:00)** **FM2 – Daniel St**	



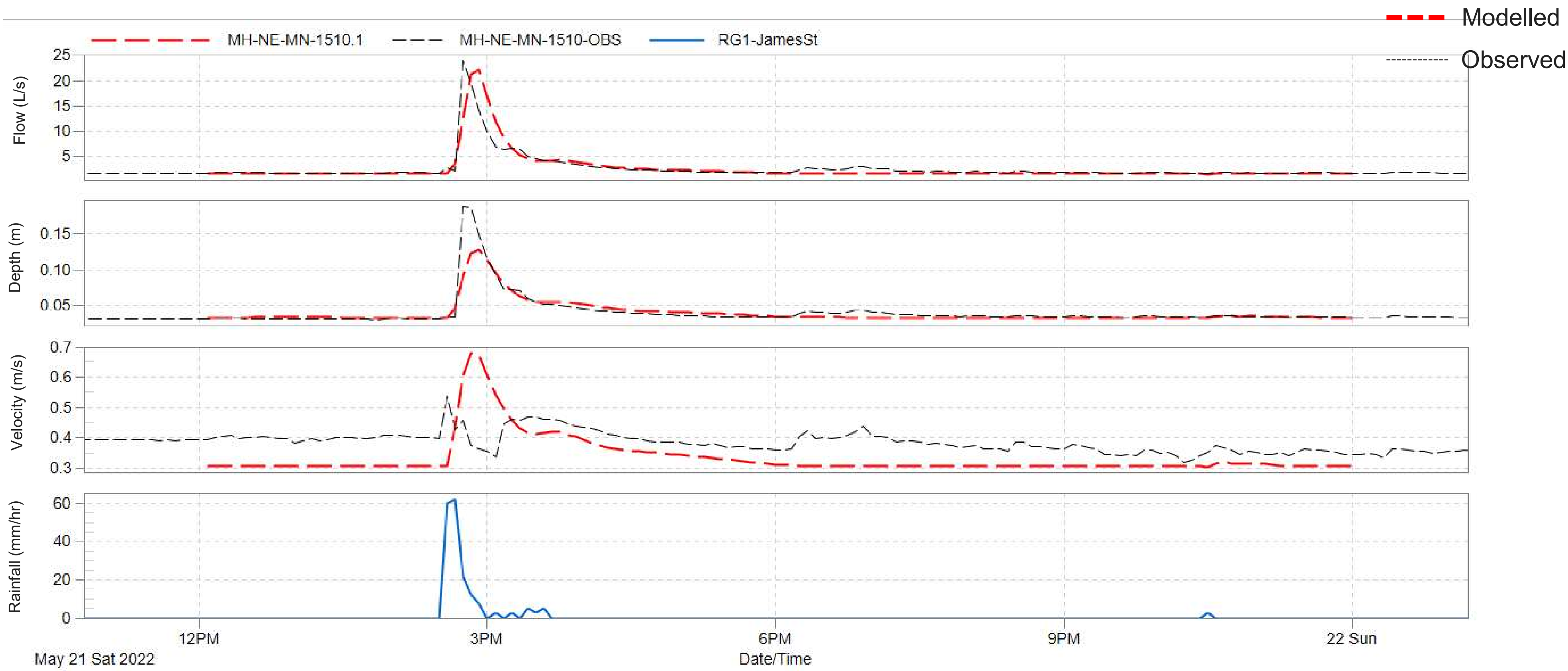
Stantec	Town of Arnprior 2022 Water & Wastewater Master Plan Wastewater Collection System Hydraulic Modelling Results - Calibration	**WWF Calibration** **WWF Event 1: May 21st, 2022 (12:00) to May 22nd, 2022 (0:00)** **FM3 – Elgin St**	



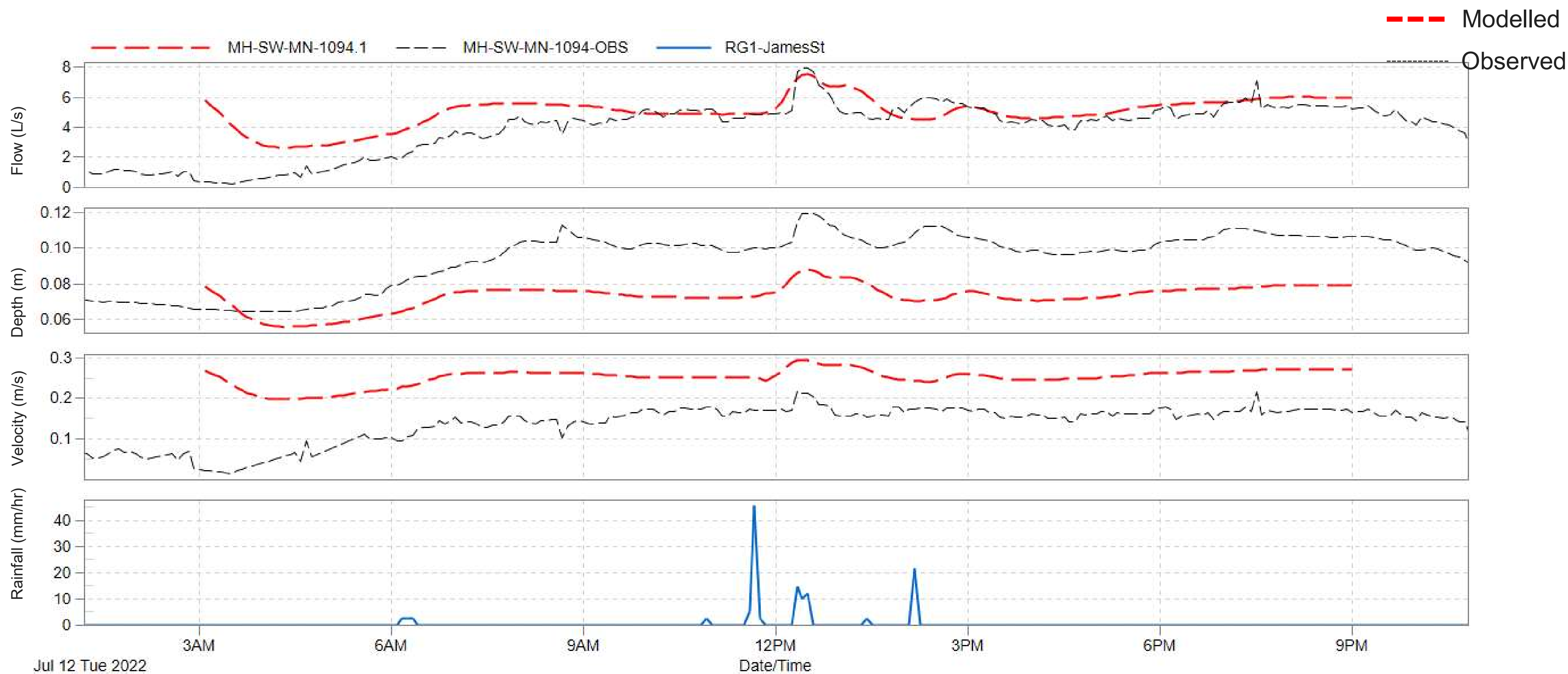
Stantec	**Town of Arnprior** **2022 Water & Wastewater Master Plan** **Wastewater Collection System** **Hydraulic Modelling Results - Calibration**	**WWF Calibration** **WWF Event 1: May 21st, 2022 (12:00) to May 22nd, 2022 (0:00)** **FM4 – Riverview Dr**	



Stantec	**Town of Arnprior** **2022 Water & Wastewater Master Plan** **Wastewater Collection System** **Hydraulic Modelling Results - Calibration**	**WWF Calibration** **WWF Event 1: May 21st, 2022 (12:00) to May 22nd, 2022 (0:00)** **FM5 – Madawaska Blvd**	



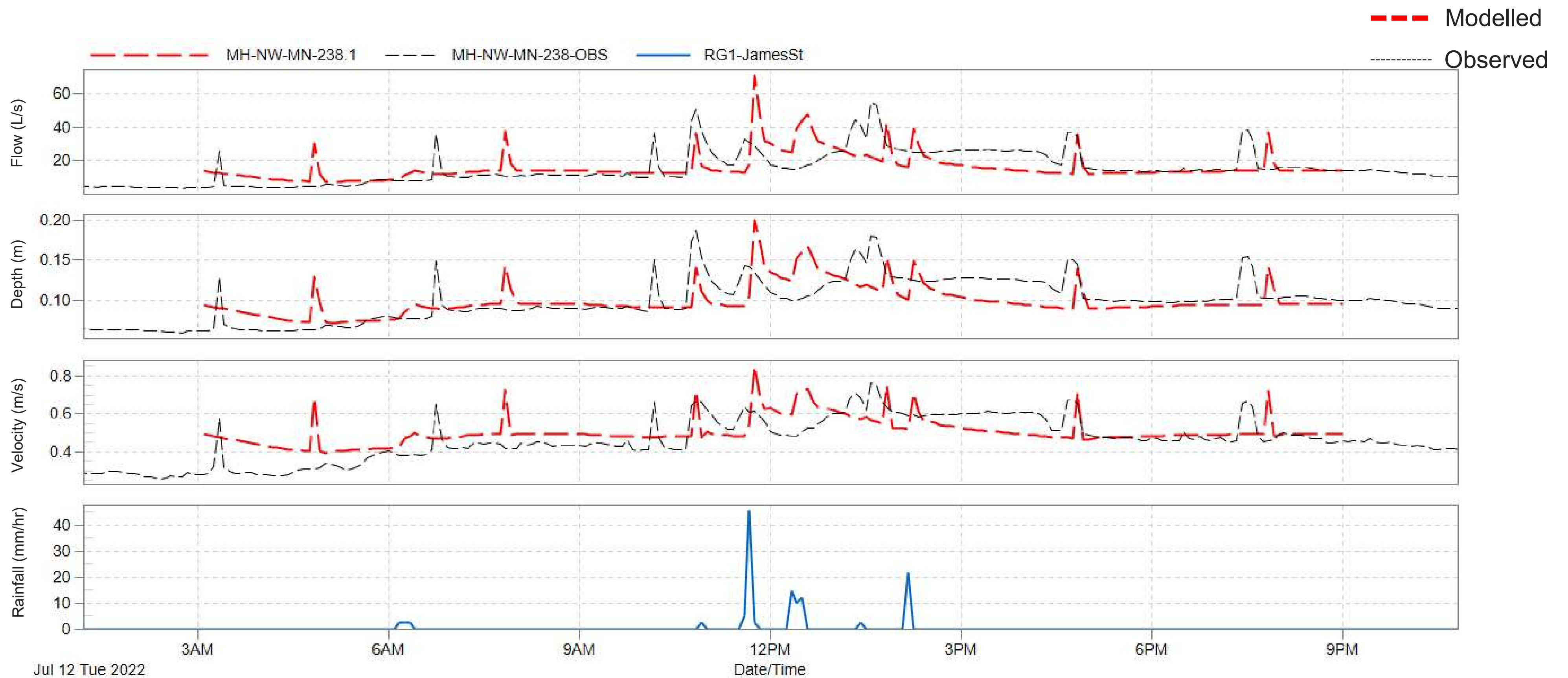
Stantec	Town of Arnprior 2022 Water & Wastewater Master Plan Wastewater Collection System Hydraulic Modelling Results - Calibration	**WWF Calibration** **WWF Event 1: May 21st, 2022 (12:00) to May 22nd, 2022 (0:00)** **FM6 – DeCosta St**	



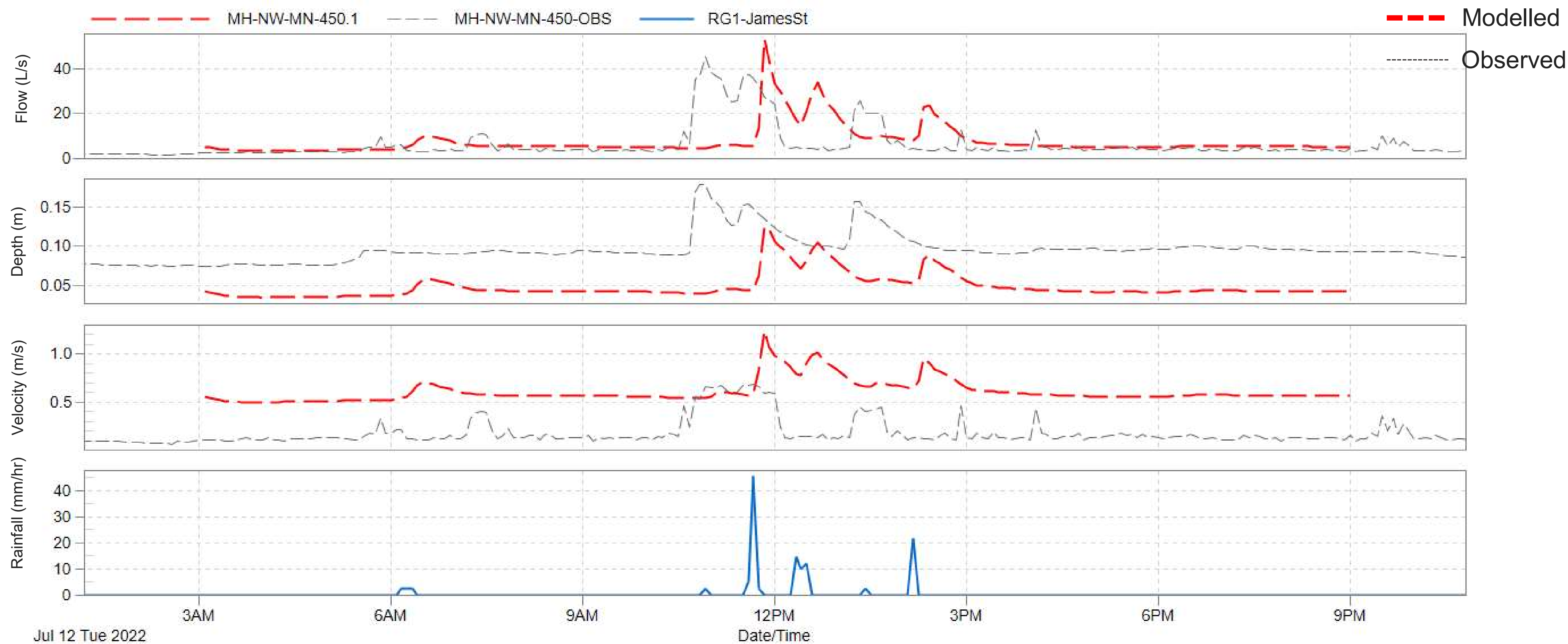
Stantec

Town of Arnprior
2022 Water & Wastewater Master Plan
Wastewater Collection System
Hydraulic Modelling Results - Calibration

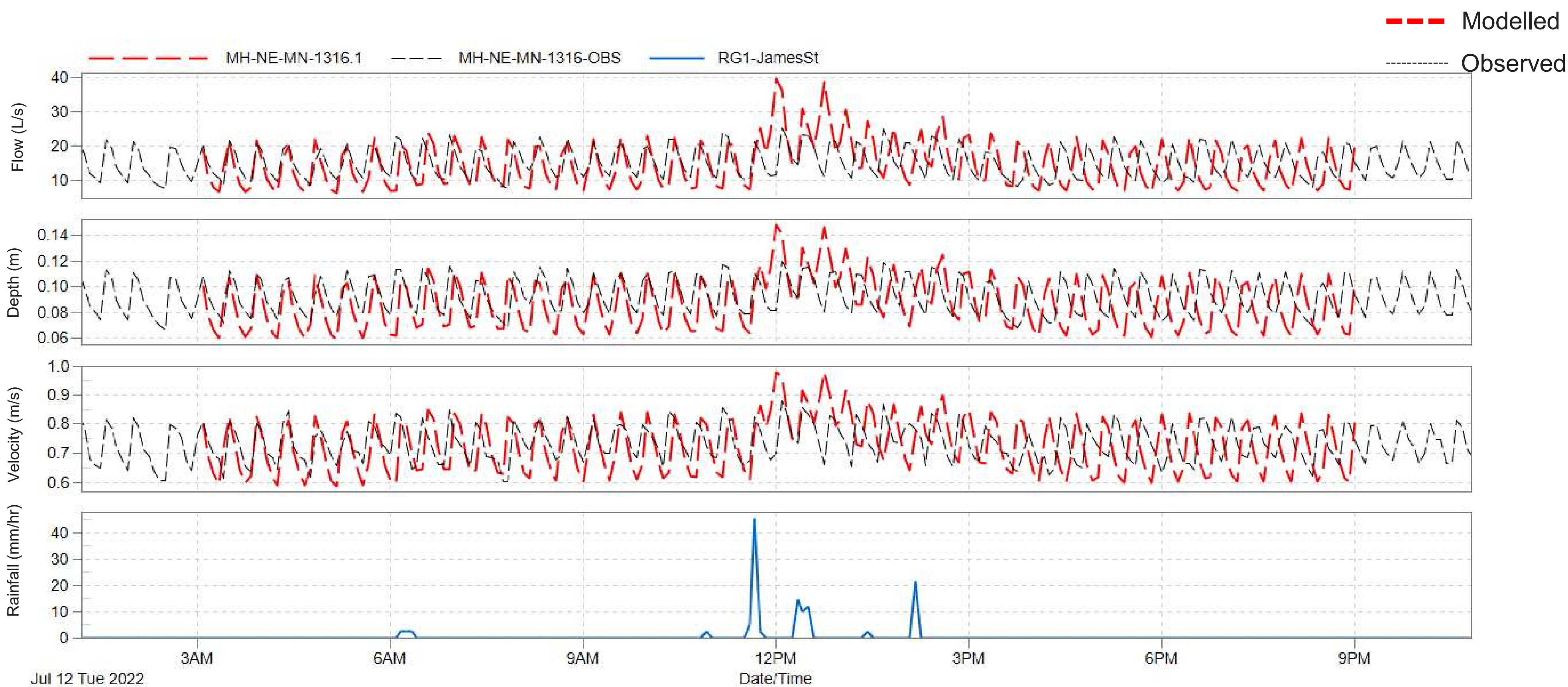
WWF Calibration
WWF Event 2: July 12th, 2022 (3:00 to 21:00)
FM1 – Staye Court



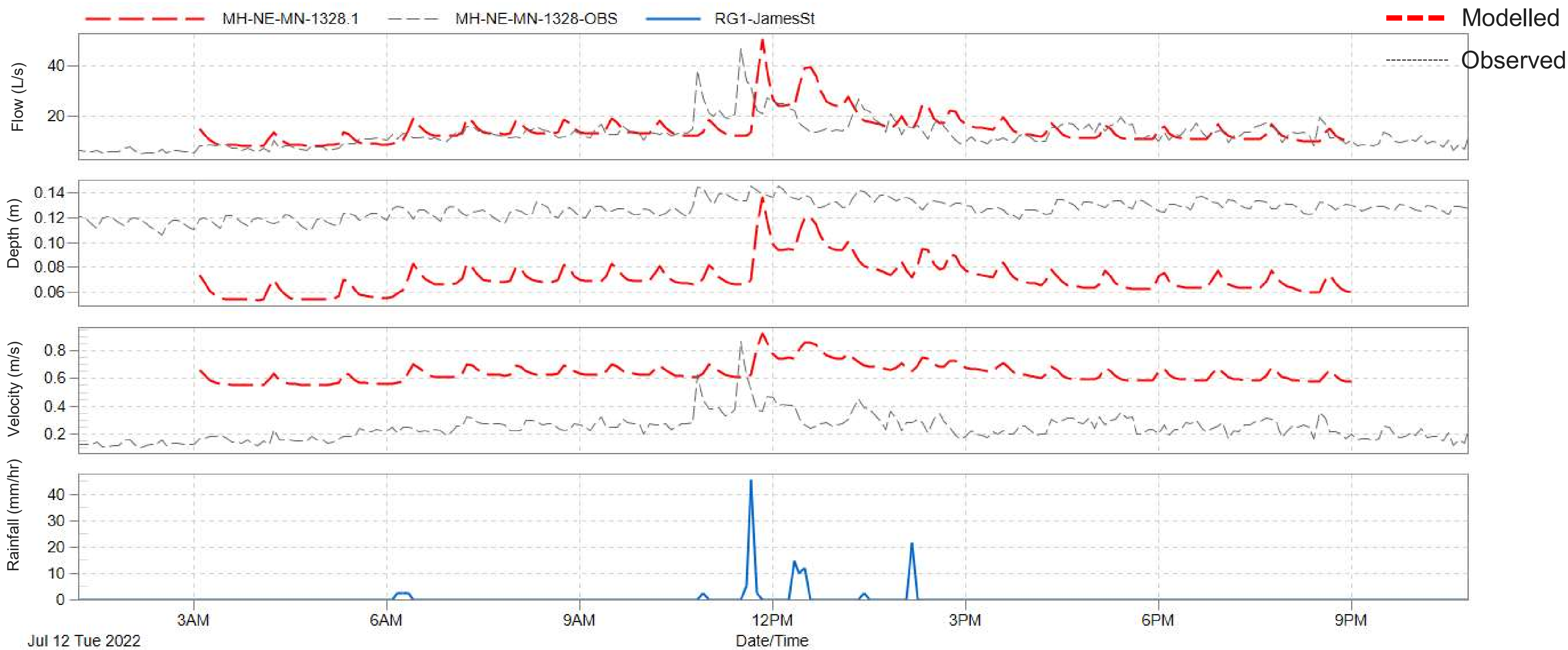
Stantec	**Town of Arnprior** **2022 Water & Wastewater Master Plan** **Wastewater Collection System** **Hydraulic Modelling Results - Calibration**	**WWF Calibration** **WWF Event 2: July 12th, 2022 (3:00 to 21:00)** **FM2 – Daniel St**



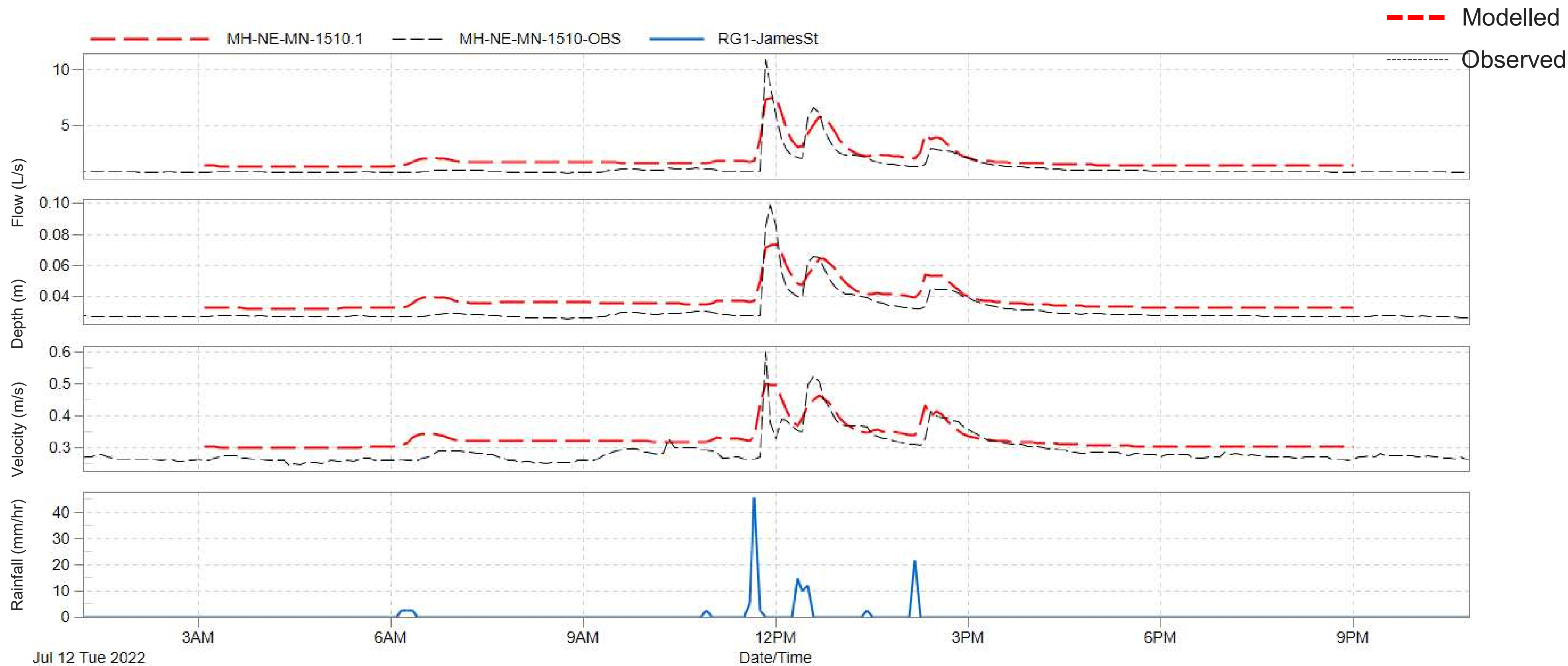
Stantec	Town of Arnprior 2022 Water & Wastewater Master Plan Wastewater Collection System Hydraulic Modelling Results - Calibration	**WWF Calibration** **WWF Event 2: July 12th, 2022 (3:00 to 21:00)** **FM3 – Elgin St**	



Stantec	**Town of Arnprior** **2022 Water & Wastewater Master Plan** **Wastewater Collection System** **Hydraulic Modelling Results - Calibration**	**WWF Calibration** **WWF Event 2: July 12th, 2022 (3:00 to 21:00)** **FM4 – Riverview Dr**

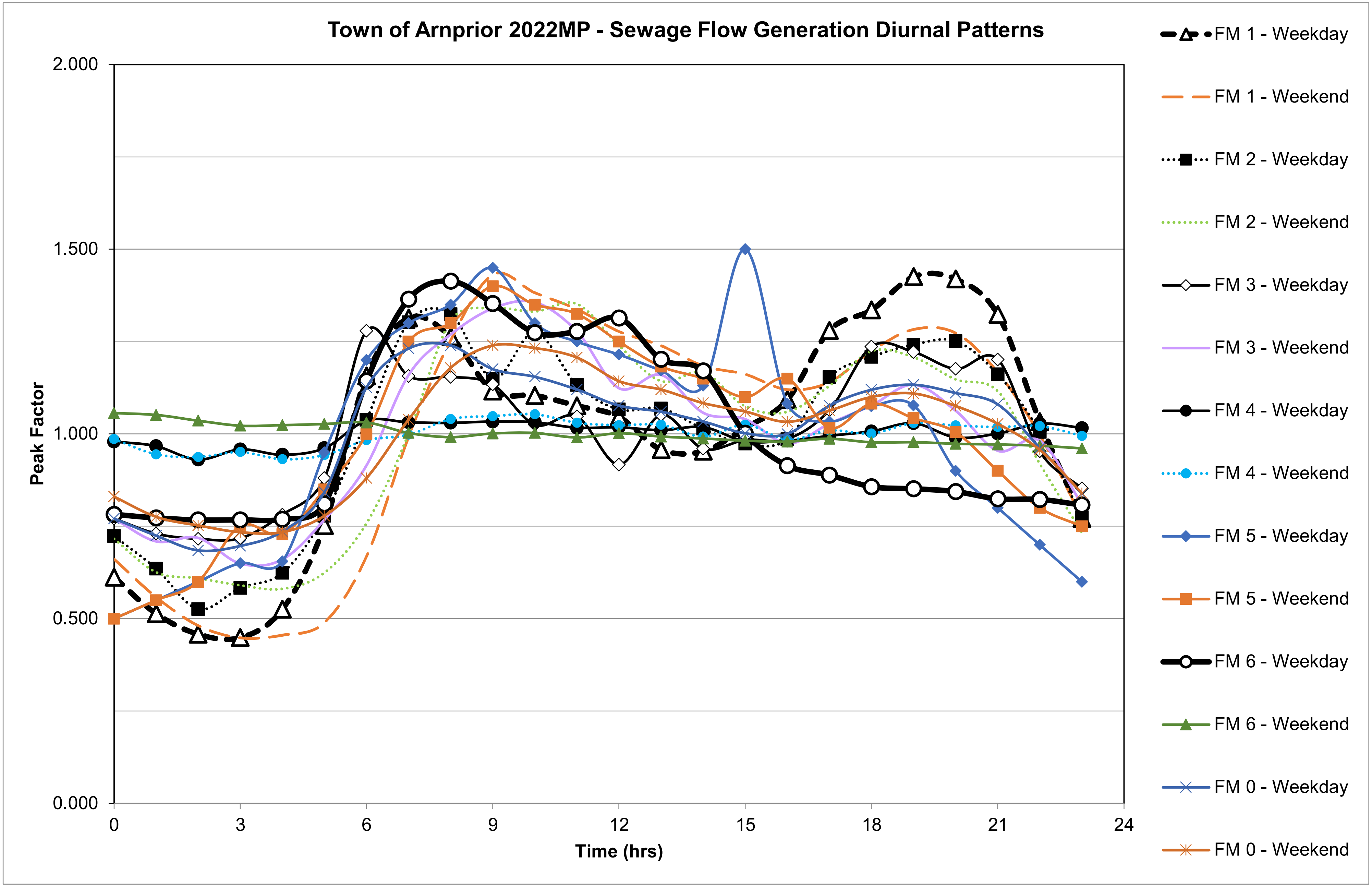


Stantec	Town of Arnprior 2022 Water & Wastewater Master Plan Wastewater Collection System Hydraulic Modelling Results - Calibration	**WWF Calibration** **WWF Event 2: July 12th, 2022 (3:00 to 21:00)** **FM5 – Madawaska Blvd**



Stantec	Town of Arnprior 2022 Water & Wastewater Master Plan Wastewater Collection System Hydraulic Modelling Results - Calibration	**WWF Calibration** **WWF Event 2: July 12th, 2022 (3:00 to 21:00)** **FM6 – DeCosta St**	

B.3 Calibrated Sewage Flow Generation Diurnal Patterns



Town of Arnprior 2022MP - Sewage Flow Generation Diurnal Patterns
2.000
1.500
1.000
0.500
0.000
Peak Factor
0
3
6
9
12
15
18
21
24
Time (hrs)
FM 1 - Weekday
FM 1 - Weekend
FM 2 - Weekday
FM 2 - Weekend
FM 3 - Weekday
FM 3 - Weekend
FM 4 - Weekday
FM 4 - Weekend
FM 5 - Weekday
FM 5 - Weekend
FM 6 - Weekday
FM 6 - Weekend
FM 0 - Weekday
FM 0 - Weekend

Appendix C Future Conditions

C.1 Growth Projections

163401723 - Arnprior W&WWMP Update

Growth Parcels from *Growth Management Strategy [GMS]* by Watson & Associates Economists Ltd., 2022)
WTP/WWTP Residual Capacity Units and Populations from provided *Uncommitted Reserve Capacity WFP & WPCC* spreadsheet (Town of Arnprior, 2022)

Refer to accompanying Chapter 2 Figure 4-1 (within main body of report)

Black Font - Originally Compiled Data by Stantec (based on Data Provided) for Town Review
Blue Font - Town Edits/Inputs (Hard-Coded Value)
Teal Font - Town Edits/Inputs (Calculated Value)
Burgundy Font - Town Edits/Inputs, Updated Based on Follow Up Discussions

Growth Parcels Data								Growth Projection Data															
								Buildout			Timing of Development												
								Residential			Residential			Industrial			Commercial			Institutional			
Parcel ID (Figure)	Address	Land Use	Development Name	GMS Status Comment #1	GMS Status Comment #2	Area (ha)	Alternative Name (Water & Sewage Plant Committed Capacity Assessment	WTP/WWTP Residual Cap. # of Units	WTP/WWTP Residual Cap. Population	WTP/WWTP Residual Cap Area (ha)	Short-Term (5 Year Horizon) 2027 Development	Medium-Term (10 Year Horizon) 2032 Development	Long-Term (20 Year Horizon) 2042 Development	Short-Term (5 Year Horizon) 2027 Development	Medium-Term (10 Year Horizon) 2032 Development	Long-Term (20 Year Horizon) 2042 Development	Short-Term (5 Year Horizon) 2027 Development	Medium-Term (10 Year Horizon) 2032 Development	Long-Term (20 Year Horizon) 2042 Development	Short-Term (5 Year Horizon) 2027 Development	Medium-Term (10 Year Horizon) 2032 Development	Long-Term (20 Year Horizon) 2042 Development	Notes/Comments
RES0		Vacant	Madawaska Boulevard - Lepine Apartments	Active Site Plan Pre-Consultations - High Density Apartments	Pre-Consultation	1.77	Lepine Apartments (has zoning)	185	398	1.77	0	199	199										
RES1		Vacant	16 Sheffield Street	Vacant Residential/Future Development Lands	Vacant	0.32	-	37	80	0.32	80	0	0										
RES2		Vacant	Bruce Yateman Retained Lands	Vacant Residential/Future Development Lands - Approved Site Plan	Registered	1.94	Tom Orr Apartments	118	254	1.94	167	0	84										
RES3	93 CLAUDE ST	Vacant	Claude Street	Vacant Residential/Future Development Lands	Pre-Consultation	0.15	-		29	0.15	0	0	0										
RES4	30 DANIEL ST N	Residential	30 Daniel Street	Vacant Residential/Future Development Lands	Vacant	0.36	-	46	72	0.36	0	72	0										
RES5		Vacant	Division and William Street	Vacant Residential/Future Development Lands	Vacant	0.19	-		37	0.19	0	0	0										
RES6		Vacant	Division and William Street	Vacant Residential/Future Development Lands	Vacant	0.06	-		11	0.06	0	0	0										
RES7		Vacant	Division to Vancourtland Vacant Block (Brent Mackie interested)	Vacant Residential/Future Development Lands	Pre-Consultation	3.21	Grove adjacent Lands (Mackie) (has zoning)	60	129	3.21	65	65	0										
RES8	398 JOHN ST N	Institutional	Galilee Property	Vacant Residential/Future Development Lands	Vacant	1.79	-			1.79	0	0	0										
RES9	398 JOHN ST N	Institutional	Galilee Property	Vacant Residential/Future Development Lands	Vacant	0.82	-			0.82	0	0	0										
RES10	398 JOHN ST N	Institutional	Galilee Property	Vacant Residential/Future Development Lands	Vacant	0.09	-			0.09	0	0	0										
RES11	398 JOHN ST N	Institutional	Galilee Property	Vacant Residential/Future Development Lands	Vacant	10.50	-			10.50	0	0	0										
RES12		Vacant	Fourth Avenue - Huntington Properties	Active Site Plan Pre-Consultations - High Density Apartments	Pre-Consultation	2.47	Fourth Ave Apartments (has zoning)	256	550	2.47	0	138	138										
RES13		Vacant	Fourth Avenue and Riverview Drive (Dave Simpson)	Vacant Residential/Future Development Lands	Concept	5.31	Fourth Ave Subdivision (Simpson) (uncommitted to date)	120	258	5.31	0	65	65										
RES14	251 BASKIN DR W	Farm	Division Street and Baskin Drive Interior Corner (Campanale)	Vacant Residential/Future Development Lands - Pipeline	Concept	3.41	Campanale (Callahan)	150	323	3.41	0	0	81										
RES15	251 BASKIN DR W	Farm	Division Street and Baskin Drive Interior Corner (Campanale)	Vacant Residential/Future Development Lands - Env Protection	Environmental Protection	2.83	Campanale (Callahan)	See RES14	See RES14	2.83	0	0	0										
RES16	Division St	Vacant	Division Street behind Caruso Park	Vacant Residential/Future Development Lands	Vacant	3.33	-		166	3.33	0	0	0										
RES17		Vacant	Division Street behind Caruso Park	Vacant Residential/Future Development Lands	Vacant	0.54	-		27	0.54	0	0	0										

163401723 - Arnprior W&WWMP Update
Growth Parcels from *Growth Management Strategy [GMS]* by Watson & Associates Economists Ltd., 2022)
WTP/WWTP Residual Capacity Units and Populations from provided *Uncommitted Reserve Capacity WFP & WPCC* spreadsheet (Town of Arnprior, 2022)

Refer to accompanying Chapter 2 Figure 4-1 (within main body of report)

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Growth Parcels Data								Growth Projection Data															
								Buildout			Timing of Development												Notes/Comments
								Residential			Residential			Industrial			Commercial			Institutional			
Parcel ID (Figure)	Address	Land Use	Development Name	GMS Status Comment #1	GMS Status Comment #2	Area (ha)	Alternative Name (Water & Sewage Plant Committed Capacity Assessment	WTP/WWTP Residual Cap. # of Units	WTP/WWTP Residual Cap. Population	WTP/WWTP Residual Cap Area (ha)	Short-Term (5 Year Horizon) 2027 Development	Medium-Term (10 Year Horizon) 2032 Development	Long-Term (20 Year Horizon) 2042 Development	Short-Term (5 Year Horizon) 2027 Development	Medium-Term (10 Year Horizon) 2032 Development	Long-Term (20 Year Horizon) 2042 Development	Short-Term (5 Year Horizon) 2027 Development	Medium-Term (10 Year Horizon) 2032 Development	Long-Term (20 Year Horizon) 2042 Development	Short-Term (5 Year Horizon) 2027 Development	Medium-Term (10 Year Horizon) 2032 Development	Long-Term (20 Year Horizon) 2042 Development	
RES18		Farm	131 Edward Street S	Vacant Residential/Future Development Lands	Vacant	1.62	-		81	1.62	0	41	41										
RES19		Farm	Edey Street beside Alexander Reid PS	Vacant Residential/Future Development Lands	Vacant	0.71	MacDonald St (has zoning)	50	108	0.71	0	27	81										
RES20	115 BASKIN DR W	Farm	Baskin Drive	Draft Plan Approved Plans of Subdivision	Draft Approved	1.62	Princiotti - Baskin Drive	80	172	1.62	86	86	0										
RES21		Farm	Vacant site behind Rexall Drug Store, Baskin Dr E	Vacant Residential/Future Development Lands	Vacant	0.91	-		91	0.91	0	23	69										
RES22		Farm	Vacant site behind Rexall Drug Store, Baskin Dr E	Vacant Residential/Future Development Lands	Vacant	7.80	-		780	7.80	0	195	585										
RES23		Farm	Vacant site behind Rexall Drug Store, Baskin Dr E	Vacant Residential/Future Development Lands - Env Protection	Vacant	1.08	-		108	1.08	0	27	81										
RES24		Farm	Vacant site behind Rexall Drug Store, Baskin Dr E	Vacant Residential/Future Development Lands	Vacant; could also develop as ICI80	0.10	-		10	0.10	0	3	8										
RES25	10 GALVIN ST	Special Purpose	Fairgrounds	Draft Plan Approved Plans of Subdivision	Registered Plan - Remove FD	2.04	Fairgrounds	147	276	2.04	276	0	0										
RES26	10 GALVIN ST	Special Purpose	Fairgrounds	Draft Plan Approved Plans of Subdivision	Registered	0.59	Fairgrounds	See RES25	See RES25	0.59	0	0	0										
RES27	10 GALVIN ST	Special Purpose	Fairgrounds	Draft Plan Approved Plans of Subdivision	Registered	0.24	Fairgrounds	See RES25	See RES25	0.24	0	0	0										
RES28	10 GALVIN ST	Special Purpose	Fairgrounds	Draft Plan Approved Plans of Subdivision	Registered	0.13	Fairgrounds	See RES25	See RES25	0.13	0	0	0										
RES29	10 GALVIN ST	Special Purpose	Fairgrounds	Draft Plan Approved Plans of Subdivision	Registered	0.71	Fairgrounds	See RES25	See RES25	0.71	0	0	0										
RES30	10 GALVIN ST	Special Purpose	Fairgrounds	Draft Plan Approved Plans of Subdivision	Registered	0.71	Fairgrounds	See RES25	See RES25	0.71	0	0	0										
RES31	10 GALVIN ST	Special Purpose	Fairgrounds	Draft Plan Approved Plans of Subdivision	Registered	0.19	Fairgrounds	See RES25	See RES25	0.19	0	0	0										
RES32	10 GALVIN ST	Special Purpose	Fairgrounds	Draft Plan Approved Plans of Subdivision	Registered	1.58	Fairgrounds	See RES25	See RES25	1.58	0	0	0										
RES33	10 GALVIN ST	Special Purpose	Fairgrounds	Draft Plan Approved Plans of Subdivision	Registered	2.00	Fairgrounds	See RES25	See RES25	2.00	0	0	0										
RES34		Vacant	Waterfront Development - Thomas St	Active Site Plan Pre-Consultations - High Density Apartments	Rezoning in process	1.87	Girotti Lands (Ottawa Valley Dev Group) (zoning application received)	144	310	1.87	102	102	102										
RES35		Vacant	Baskin Drive Vacant Block (near Stonehaven Way)	Vacant Residential/Future Development Lands	Vacant	1.44	-		144	1.44	0	0	72										

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Growth Parcels Data								Growth Projection Data															
								Buildout			Timing of Development												
								Residential			Residential			Industrial			Commercial			Institutional			
Parcel ID (Figure)	Address	Land Use	Development Name	GMS Status Comment #1	GMS Status Comment #2	Area (ha)	Alternative Name (Water & Sewage Plant Committed Capacity Assessment	WTP/WWTP Residual Cap. # of Units	WTP/WWTP Residual Cap. Population	WTP/WWTP Residual Cap Area (ha)	Short-Term (5 Year Horizon) 2027 Development	Medium-Term (10 Year Horizon) 2032 Development	Long-Term (20 Year Horizon) 2042 Development	Short-Term (5 Year Horizon) 2027 Development	Medium-Term (10 Year Horizon) 2032 Development	Long-Term (20 Year Horizon) 2042 Development	Short-Term (5 Year Horizon) 2027 Development	Medium-Term (10 Year Horizon) 2032 Development	Long-Term (20 Year Horizon) 2042 Development	Short-Term (5 Year Horizon) 2027 Development	Medium-Term (10 Year Horizon) 2032 Development	Long-Term (20 Year Horizon) 2042 Development	Notes/Comments
RES36		Farm	Division Street and Baskin Drive Exterior Corner	Vacant Residential/Future Development Lands	Vacant	21.57	-		942	21.57	0	471	471										
RES37		Farm	Van Dusen Drive	Vacant Residential/Future Development Lands - Tartan Concept for Subdivision	Concept	0.66	Vandusen - Tartan Homes (no zoning yet)	285	613	0.66	0	153	460										
RES38		Farm	Van Dusen Drive	Vacant Residential/Future Development Lands - Tartan Concept for Subdivision	Concept	22.29	Vandusen - Tartan Homes (no zoning yet)	See RES37	See RES37	22.29	0	0	0										
RES39		Vacant	Block 139 Olympia Subdivision	Vacant Residential/Future Development Lands - Pipeline Condo TOwnhouse Dev	Vacant	1.45	Pegasus / Olympia Homes	25	54	1.45	0	27	27										
RES40			Marshall Bay Meadows - Phase 3-5	Vacant Residential/Future Development Lands	Draft Approved	15.37	Marshall's Bay Meadows - Singles, semis, towns	630	1,316	15.37	658	329	329										
RES41				Vacant Residential/Future Development Lands	Under conversion pressure	2.25	-			2.25	0	0	0										
RES42				Draft Plan Approved Plans of Subdivision	Registered	7.23	-	See RES40	See RES40	7.23	0	0	0										
RES43			640 WhiteLake Rd	Conversion from MUCE to Residential	Concept	15.06	640 White Lake Road - Tartan Homes (OPA being appealed)	270	581	15.06	0	145	145										
RES44						1.56	Grove Nursing Home	96	96	1.56	96	0	0										
RES45					Institutional	4.22	French catholic school (has zoning. Site plan application received)	100	215	4.22										100%			
RES46					Area on map incorrect (Ph 2 vs Ph 3)	5.97	Campanale (Callahan)		299	5.97	299	0	0										
ICI1	10 DIDAK DR	Industrial			Underutilized	6.21	-			6.21				0%	0%	0%							
ICI15	405 DIDAK DR	Vacant	405 Didak Drive - Town Owned,	Vacant Employment Lands	Vacant	0.25	-			0.25				100%	0%	0%							
ICI16	365 MADAWASKA BLVD	Industrial	Pillar 5 Pharmaceutical	Underdeveloped Employment Lands	Underutilized	13.21	-			13.21				0%	0%	0%							*Town Comment: Potential for additional industrial*
ICI17		Vacant	Vacant lands owned by Sandvik (industrial building on other side of road)	Underdeveloped Employment Lands	Vacant	11.32	-			11.32				0%	50%	0%							Town Comment: New owner has interest in industrial development
ICI18	277 MADAWASKA BLVD	Industrial			Underutilized	2.07	-			2.07				0%	0%	0%							Town Comment: Current use by Hydro one, contamination issues?
ICI25		Vacant	Madawaska Boulevard - Lepine Apartments	Active Site Plan Pre-Consultations - High Density Apartments	Converted to Residential	1.77	-			1.77				50%	50%	0%							Town Comment: Same property as RES0

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ICI41		Vacant			Vacant	0.30	-			0.30				0%	0%	0%							Town Comments: No plans			
ICI44		Vacant			Vacant	0.02	-			0.02				0%	0%	0%							Town Comments: No plans			
ICI55		Vacant			Underutilized	0.19	-			0.19							0%	0%	100%				Town Comment: Wes' chips, want to redevelop			
ICI59		Vacant			Underutilized	0.37	-			0.37				0%	0%	0%							Town Comment: Chysler dealer owns, no plans for development			
ICI65		Vacant			Vacant	0.34	-			0.34				0%	0%	0%							Town Comment: Reid dealer owns, no plans for development			
ICI66	276 MADAWASKA BLVD	Industrial			Underutilized	0.86	-			0.86				0%	0%	0%							Town Comment: Sullivan's bought Smith Const site, no plans?			
ICI67		Vacant			Vacant	4.18	-			4.18				0%	0%	0%							Town Comment :Smith selling, no plans			
ICI68	451 MADAWASKA BLVD	Farm			Vacant	0.54	-			0.54				0%	0%	0%							Town Comment :No plans			
ICI69	451 MADAWASKA BLVD	Farm			Vacant	21.09	-			21.09				0%	0%	0%							Town Comment :No plans			
ICI71	245 DANIEL ST S	Vacant			Underutilized	1.41	-			1.41							100%	0%	0%				Town Comment: Site Plan under review			
ICI73		Industrial			Vacant	8.01	-			8.01				0%	0%	0%							Town Comment: OPG lands, no plans			
ICI74	210 BASKIN DR E	Farm			Underutilized	9.05	-			9.05							0%	0%	0%				Town Comment: Former farm, no plans			
ICI76	102 BASKIN DR E	Vacant			Vacant	0.05	-			0.05							0%	0%	0%				Town Comment: Owned with ICI189			
ICI80		Farm	Vacant site behind Rexall Drug Store, Baskin Dr E	Vacant Residential/Future Development Lands	Vacant; could also develop as RES24	0.10	-			0.10							0%	0%	0%				Town Comment: Pre-consultation held, proposed rest. On three lots			
ICI85	242 DANIEL ST S	Vacant			Vacant	0.09	-			0.09							0%	0%	0%				Town Comment: Entrance to Villa, no plans			
ICI89		Vacant			Vacant	5.14	-			5.14							0%	0%	50%				Town Comment: Potential dev., owner taking offers of interest			
ICI91		Special Purpose			Underutilized	1.07	-			1.07							0%	0%	0%				Town Comment: No plans			
ICI94	531 JOHNSTON RD	Vacant			Vacant	2.73	-			2.73							0%	0%	0%				Town Comment: No plans			

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ICI95		Vacant			Vacant	0.52	-			0.52							0%	0%	0%				Town Comment: Same owner ast IC194
ICI98		Vacant	Pre-Application - MU-CE - 39 Winner's Circle	Applications for Conversion	Subject to conversion	1.37	-			1.37								50%	50%				Town Comment: same as RES41
ICI99		Vacant	Successful conversion from Employment to Residential for high density	Applications for Conversion	Subject to conversion	2.25	-			2.25								50%	50%				Town Comment: same as RES41
ICI102	416 DANIEL ST S	Residential			Vacant	0.09	-			0.09							0%	0%	0%				Town Comment: Owned by MTO still
ICI103	424 DANIEL ST S	Commercial			Vacant	0.29	-			0.29							0%	0%	0%				Town Comment: Owned by MTO still
ICI104		Vacant			Underutilized	5.32	-			5.32							0%	0%	0%				Town Comment: No plans
ICI105		Vacant			Underutilized	4.04	-			4.04							100%	0%	0%				Town Comment: Plans for storage units
ICI106		Commercial	MU-CE to Residential - 640 White Lake Road Tartan	Applications for Conversion	Converted to Residential	13.79	-			13.79													Town Comment: Same as RES43
ICI107	8 VAN DUSEN DR	Residential			Converted to Residential	0.80	-			0.80													Town Comment: Same as RES43
ICI114		Commercial			Vacant	0.20	-			0.20							0%	100%	0%				Town Comment: Town sold, no plans yet
ICI118	39 STAYE COURT DR	Vacant			Vacant - Proposal for new Mall	0.32	-			0.32							0%	50%	50%				Town Comment: Preconsulted on Mall a couple years ago
ICI119	39 STAYE COURT DR	Vacant			Vacant - Proposal for New Mall	0.28	-			0.28							0%	50%	50%				Town Comment: same
ICI120	31 STAYE COURT DR	Commercial			Underutilized	0.62	-			0.62							0%	0%	0%				Town Comment: Chip wagon currently, no plans
ICI121	30 BASKIN DR W	Commercial			Underutilized	0.45	-			0.45							0%	0%	0%				Town Comment: Underutilized underutilized; Haven't heard any plans to expand
ICI125		Commercial			Underutilized	12.15	-			12.15							0%	0%	50%				Town Comment: Underutilized underutilized; Haven't heard any plans to expand
RES44A	CON 14 PT LOT 5 RP 49R4104				Institutional	12.80		32	32	12.80	32												

C.2 Future Wastewater Flows

163401723 - Arnprior W&WWMP Update

Summary of Modelled Peak Flows

Total Added Peak Flows (L/s)	**9.1**	**17.9**	**22.4**	**55.1**	**47.9**	**117.6**
Total Added Peak Flows (L/s) - Redevelopments	**4.4**	**4.4**	**5.6**	**5.6**	**9.5**	**9.5**
Total Added Peak Flows (L/s) - New Areas	**4.7**	**13.5**	**16.8**	**49.5**	**38.4**	**108.1**

		Peak Flows (L/s)					
		2027	**2027**	**2032**	**2032**	**2042**	**2042**
Subcatchment	**Growth Area Type**	**DWF**	**WWF**	**DWF**	**WWF**	**DWF**	**WWF**
SC1_FUT	Redevelopment	0	0	0	0	2.82	2.82
SC10_FUT	Redevelopment	0	0	0.13	0.13	0.26	0.26
SC111_FUT	Redevelopment	0.39	0.39	0.39	0.39	0.39	0.39
SC121_FUT	Redevelopment	0	0	0.29	0.29	0.29	0.29
SC15_FUT	Redevelopment	0.62	0.62	0.62	0.62	0.62	0.62
SC169_FUT	Redevelopment	1.31	1.31	1.31	1.31	1.31	1.31
SC172_FUT	Redevelopment	1.21	1.21	1.21	1.21	1.21	1.21
SC180_FUT	Redevelopment	0	0	0.18	0.18	0.36	0.36
SC182_FUT	Redevelopment	0.13	0.13	0.13	0.13	0.13	0.13
SC188_FUT	Redevelopment	0.38	0.38	0.75	0.75	1.07	1.07
SC44_FUT	Redevelopment	0.36	0.36	0.36	0.36	0.36	0.36
SC48_FUT	Redevelopment	0	0	0	0	0.08	0.08
SC9_FUT	Redevelopment	0	0	0.09	0.09	0.09	0.09
SC92_FUT	Redevelopment	0	0	0.12	0.12	0.47	0.47
SC-FUT_ICI105	New	1.42	4.42	1.42	4.42	1.42	4.42
SC-FUT_ICI15	New	0.12	0.3	0.12	0.3	0.12	0.3
SC-FUT_ICI17	New	0	0	2.65	6.84	2.65	6.84
SC-FUT_ICI89	New	0	0	0	0	0.88	2.79
SC-FUT_ICI98	New	0	0	0.24	0.75	0.47	1.49
SC-FUT_ICI99	New	0	0	0.39	1.22	0.78	2.45
SC-FUT_RES0	New	0	0	0.97	1.52	1.93	3.04
SC-FUT_RES12	New	0	0	0.67	1.06	1.34	2.11
SC-FUT_RES13	New	0	0	0.37	1.33	0.73	2.66
SC-FUT_RES14	New	0	0	0	0	0.41	0.96
SC-FUT_RES2	New	0.84	1.71	0.84	1.71	1.26	2.57
SC-FUT_RES21	New	0	0	0.12	0.28	0.47	1.11
SC-FUT_RES22	New	0	0	1	2.36	4.01	9.45
SC-FUT_RES23	New	0	0	0.14	0.33	0.56	1.31
SC-FUT_RES24	New	0	0	0.01	0.03	0.05	0.12
SC-FUT_RES34	New	0.5	0.91	1.01	1.83	1.51	2.74
SC-FUT_RES36	New	0	0	2.72	10.6	5.45	21.2
SC-FUT_RES37	New	0	0	0.85	2.93	3.42	11.74
SC-FUT_RES39	New	0	0	0.16	0.69	0.32	1.38
SC-FUT_RES40	New	0	0	0	0	6.67	14.45
SC-FUT_RES43	New	0	0	0.86	3.62	1.72	7.25
SC-FUT_RES45	New	1.48	4.61	1.48	4.61	1.48	4.61
SC-FUT_RES7	New	0.38	1.55	0.76	3.11	0.76	3.11

C.3 Future Potable Water Demands

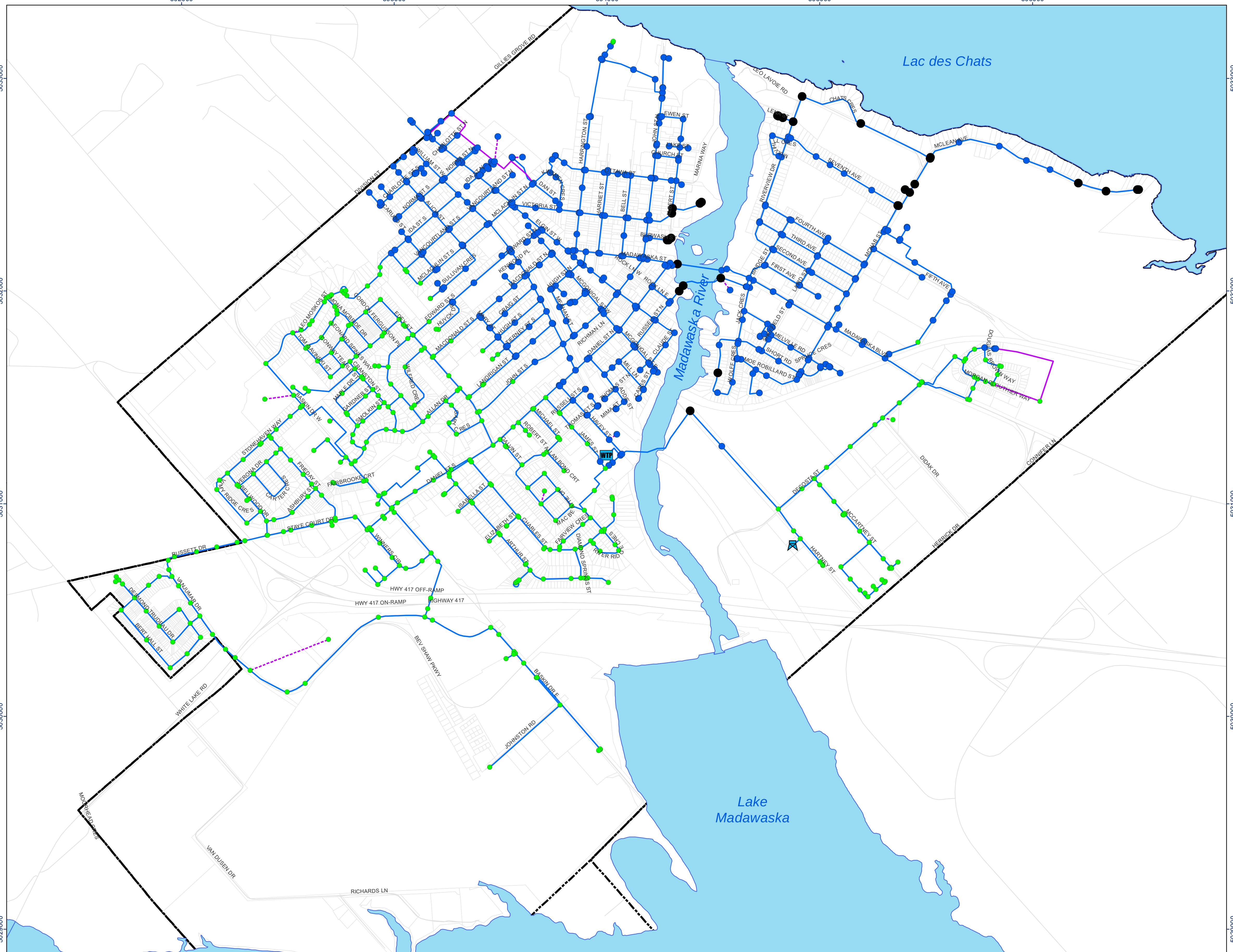
163401723 - Arnprior W&WWMP Update

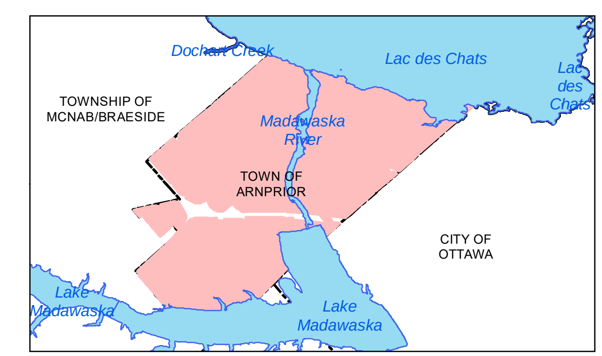
Future Potable Water Demands for Each Growth Area

Demands updated based on Town's comments on 20230223

Growth Area ID	AVDY Demands (L/s)			MXDY Demands (L/s)		
	2027	2032	2042	2027	2032	2042
RES0	0.00	0.64	0.64	0.00	1.23	1.23
RES1	0.26	0.00	0.00	0.49	0.00	0.00
RES2	0.54	0.00	0.27	1.03	0.00	0.52
RES4	0.00	0.24	0.00	0.00	0.45	0.00
RES7	0.21	0.21	0.00	0.40	0.40	0.00
RES12	0.00	0.45	0.45	0.00	0.85	0.85
RES13	0.00	0.21	0.21	0.00	0.40	0.40
RES14	0.00	0.00	0.26	0.00	0.00	0.50
RES18	0.00	0.13	0.13	0.00	0.25	0.25
RES19	0.00	0.09	0.26	0.00	0.17	0.50
RES20	0.28	0.28	0.00	0.53	0.53	0.00
RES21	0.00	0.07	0.22	0.00	0.14	0.42
RES22	0.00	0.63	1.90	0.00	1.20	3.60
RES23	0.00	0.09	0.27	0.00	0.17	0.50
RES24	0.00	0.01	0.03	0.00	0.02	0.05
RES25	0.89	0.00	0.00	1.70	0.00	0.00
RES34	0.33	0.33	0.33	0.63	0.63	0.63
RES35	0.00	0.00	0.23	0.00	0.00	0.44
RES36	0.00	1.53	1.53	0.00	2.90	2.90
RES37	0.00	0.50	1.49	0.00	0.95	2.83
RES39	0.00	0.09	0.09	0.00	0.17	0.17
RES40	2.13	1.07	1.07	4.05	2.03	2.03
RES43	0.00	0.47	0.47	0.00	0.90	0.90
RES44	0.31	0.00	0.00	0.59	0.00	0.00
RES45	1.37	0.00	0.00	2.05	0.00	0.00
RES46	0.97	0.00	0.00	1.84	0.00	0.00
ICI15	0.10	0.00	0.00	0.15	0.00	0.00
ICI17	0.00	2.29	0.00	0.00	3.44	0.00
ICI55	0.00	0.00	0.06	0.00	0.00	0.09
ICI71	0.46	0.00	0.00	0.69	0.00	0.00
ICI89	0.00	0.00	0.83	0.00	0.00	1.25
ICI98	0.00	0.22	0.22	0.00	0.33	0.33
ICI99	0.00	0.37	0.37	0.00	0.55	0.55
ICI105	1.31	0.00	0.00	1.96	0.00	0.00
ICI114	0.00	0.06	0.00	0.00	0.10	0.00
ICI118	0.00	0.05	0.05	0.00	0.08	0.08
ICI119	0.00	0.04	0.04	0.00	0.07	0.07
ICI125	0.00	0.00	1.97	0.00	0.00	2.95
RES44A	0.10	0.00	0.00	0.20	0.00	0.00

C.4 Potable Water Model Results: Future (Growth) Conditions





Legend

Maximum Pressure

- Max. Pressure ≤ 40 psi
- 40 psi < Max. Pressure ≤ 60 psi
- 60 psi < Max. Pressure ≤ 80 psi
- 80 psi < Max. Pressure ≤ 100 psi
- Max. Pressure > 100 psi
- Existing Watermains

Watermains for Growth Areas

- Distribution Mains
- Dummy Pipes
- Water Treatment Plant (WTP)
- Elevated Storage Tank (EST)
- Municipal Boundary

N

0 250 500 Meters
(At original document size of 11x17)
1:18,500

Notes

1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Ontario_Hydro_Network_(OHN)_-_Waterbody.shp, Ontario_Hydro_Network_(OHN)_-_Waterbody (2).shp, Municipal_Boundary_-_Lower_and_Single_Tier.shp,* and *Arnprior_Roads_20220324* and *Arnprior_PropertyParcels_wAssessment_20220324.shp* provided by the Town of Arnprior.
3. Background: Contains information licensed under the Open Government Licence – Ontario

Project Location Prepared by CZ on 2023-02-23
Revised by CZ on 2023-07-28

Arnprior, ON

Client/Project 163401723

Town of Arnprior
2022 W&WW Master Plan Update

Figure No.

C4-1

Title

Future Conditions (2027) – AVDY Maximum Pressures

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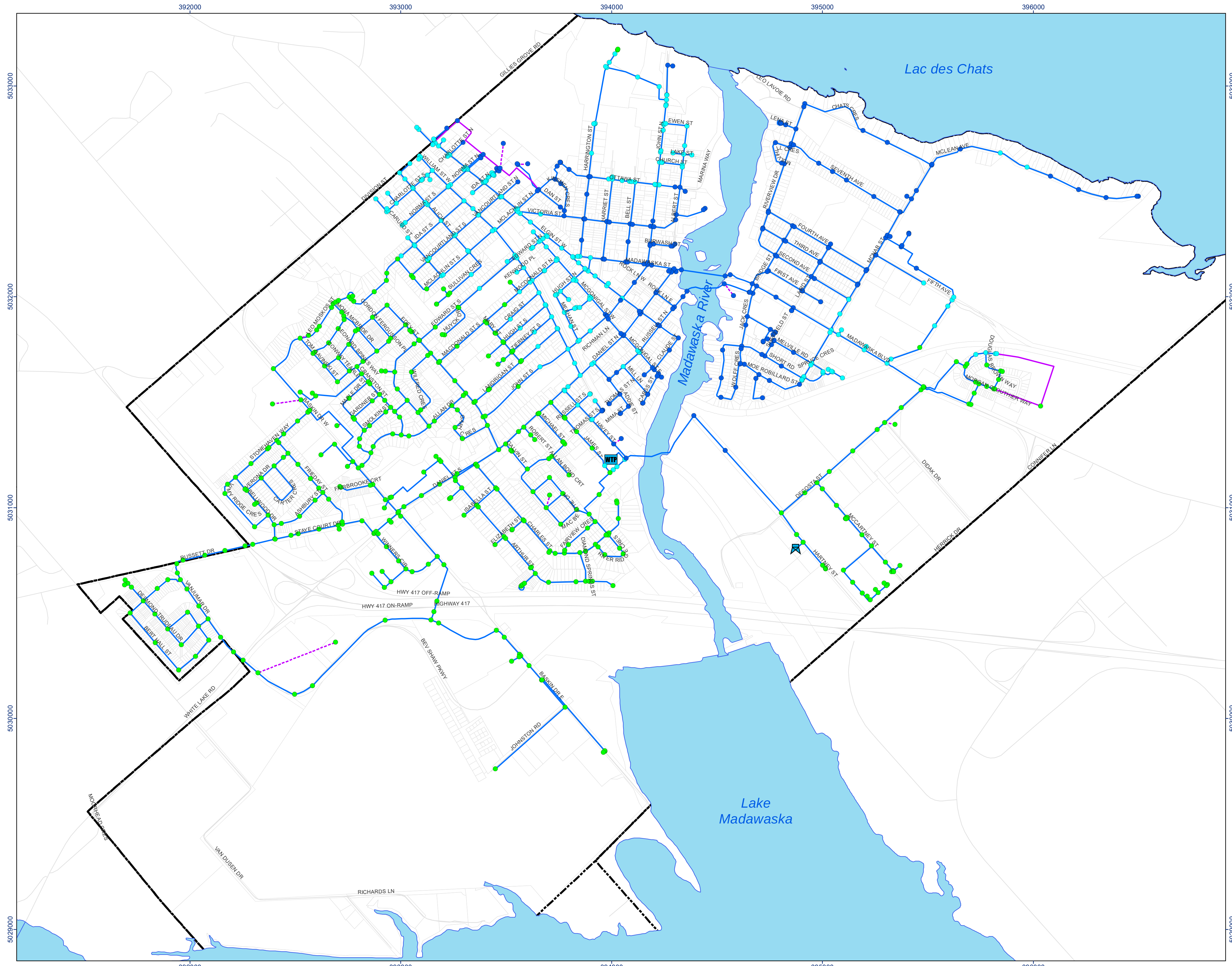


Stantec

Legend

Minimum Pressure

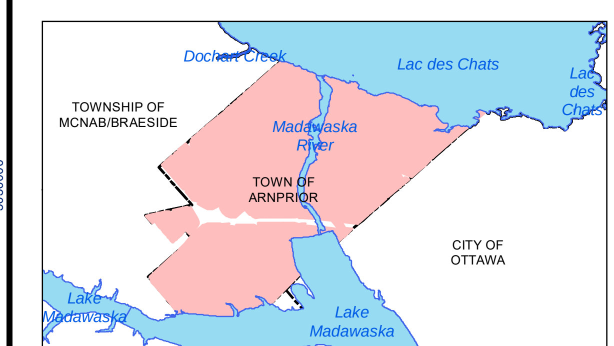
- Min. Pressure ≤ 20 psi
- 20 psi < Min. Pressure ≤ 40 psi
- 40 psi < Min. Pressure ≤ 50 psi
- 50 psi < Min. Pressure ≤ 70 psi
- 70 psi < Min. Pressure ≤ 80 psi
- 80 psi < Min. Pressure ≤ 100 psi
- Min. Pressure > 100 psi
- Existing Watermains

Watermains for Growth Areas

- Distribution Mains
- Dummy Pipes
- Water Treatment Plant (WTP)
- Elevated Storage Tank (EST)
- Municipal Boundary

Notes

1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Ontario_Hydro_Network_(OHN)_-_Waterbody.shp, Ontario_Hydro_Network_(OHN)_-_Waterbody (2).shp, Municipal_Boundary_-_Lower_and_Single_Tier.shp,* and *Arnprior_Roads_20220324* and *Arnprior_PropertyParcels_wAssessment_20220324.shp* provided by the Town of Arnprior.
3. Background: Contains information licensed under the Open Government Licence – Ontario



Project Location

Arnprior, ON

Prepared by CZ on 2023-02-23
Revised by CZ on 2023-07-28

Client/Project

Town of Arnprior
2022 W&WW Master Plan Update

163401723

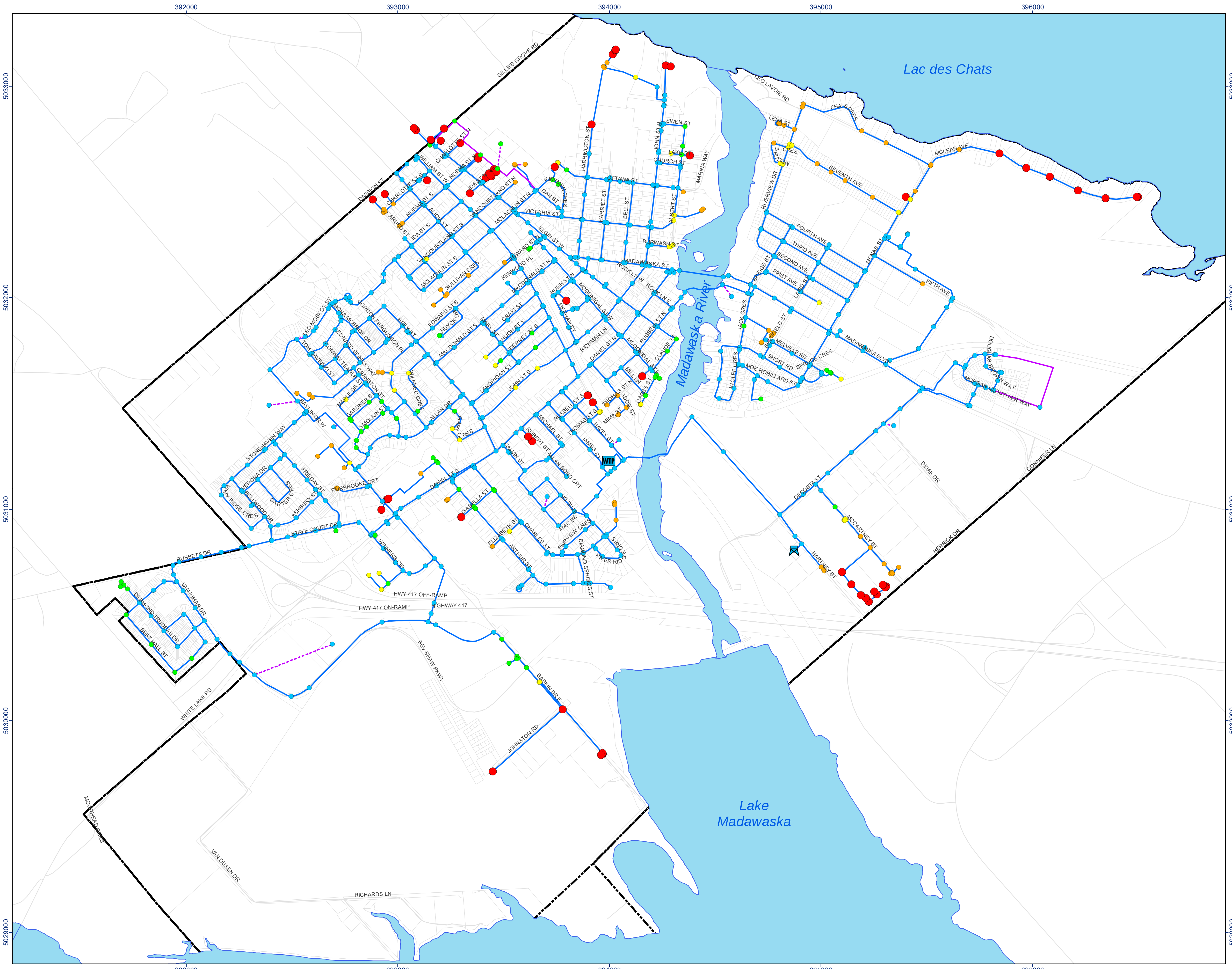
Figure No.

C4-2

Title

Future Conditions (2027) – MXDY Minimum Pressures

\\Ca0218-ppfss01\01-634\active\1634_01723\planning\drawing\gis\MXDs\tm3_figs\appA4-7to9_am_wtr_2027_no_solns_model_results_20231117.mxd Revised: 2023-11-17 By: jsidhu



Stantec

Legend

Available Fire Flow at 20 psi (AFF)

- AFF < 33.33 L/s
- 33.33 L/s ≤ AFF ≤ 75 L/s
- 75 L/s < AFF ≤ 100 L/s
- 100 L/s < AFF ≤ 125 L/s
- AFF > 125 L/s
- Existing Watermains

Watermains for Growth Areas

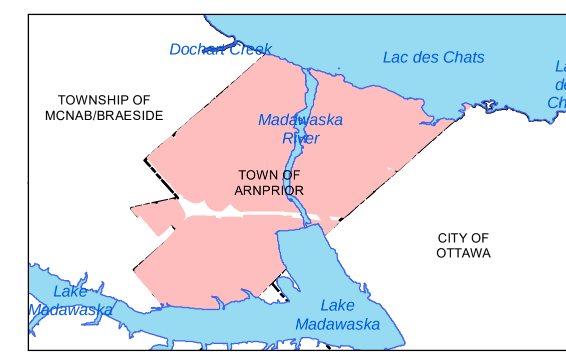
- Distribution Mains
- Dummy Pipes
- Water Treatment Plant (WTP)
- Elevated Storage Tank (EST)
- Municipal Boundary

N

0 250 500 Meters
(At original document size of 11x17)
1:18,500

Notes

1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Ontario_Hydro_Network_(OHN)_-_Waterbody.shp*, *Ontario_Hydro_Network_(OHN)_-_Waterbody (2).shp*, *Municipal_Boundary_-_Lower_and_Single_Tier.shp*, and *Arnprior_Roads_20220324* and *Arnprior_PropertyParcels_wAssessment_20220324.shp* provided by the Town of Arnprior.
3. Background: Contains information licensed under the Open Government Licence – Ontario



Project Location Arnprior, ON

Prepared by CZ on 2023-02-23
Revised by CZ on 2023-07-28

Client/Project 163401723
Town of Arnprior
2022 W&WW Master Plan Update

Figure No.
C4-3

Title
Future Conditions (2027) – MXDY Available Fire Flow at 20 psi

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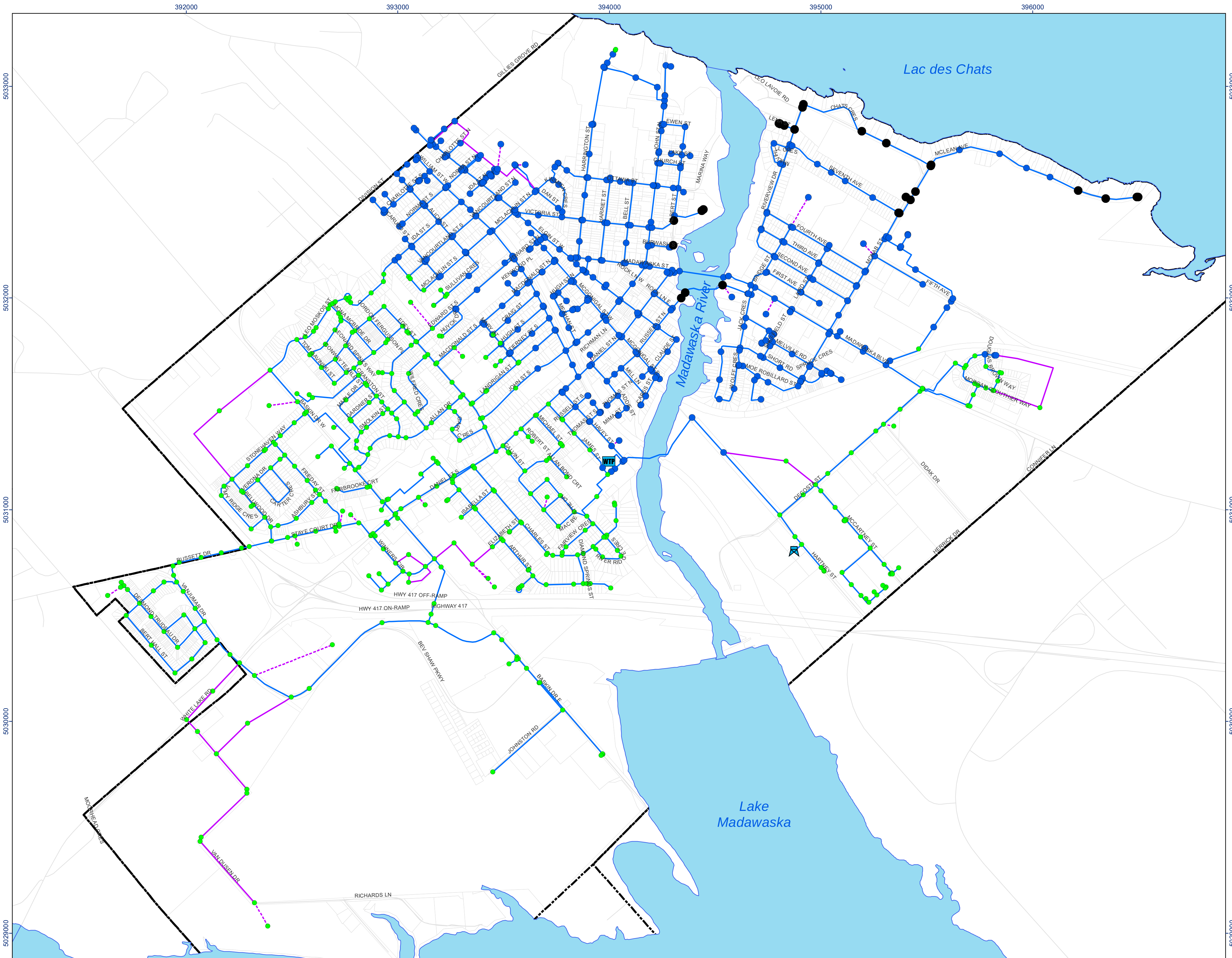


Stantec

Legend

Maximum Pressure

- Max. Pressure ≤ 40 psi
- 40 psi < Max. Pressure ≤ 60 psi
- 60 psi < Max. Pressure ≤ 80 psi
- 80 psi < Max. Pressure ≤ 100 psi
- Max. Pressure > 100 psi
- Existing Watermains

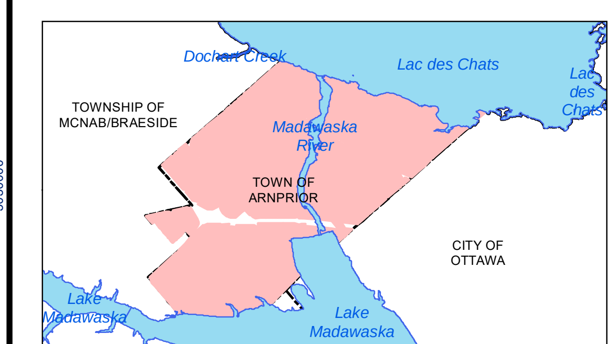
Watermains for Growth Areas

- Distribution Mains
- Dummy Pipes
- WTP Water Treatment Plant (WTP)
- Elevated Storage Tank (EST)
- Municipal Boundary

N

0 250 500 Meters
(At original document size of 11x17)
1:18,500

Notes
1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Ontario_Hydro_Network_(OHN)_-_Waterbody.shp*, *Ontario_Hydro_Network_(OHN)_-_Waterbody (2).shp*, *Municipal_Boundary_-_Lower_and_Single_Tier.shp*, and *Arnprior_Roads_20220324* and *Arnprior_PropertyParcels_wAssessment_20220324.shp* provided by the Town of Arnprior.
3. Background: Contains information licensed under the Open Government Licence – Ontario



Project Location
Arnprior, ON

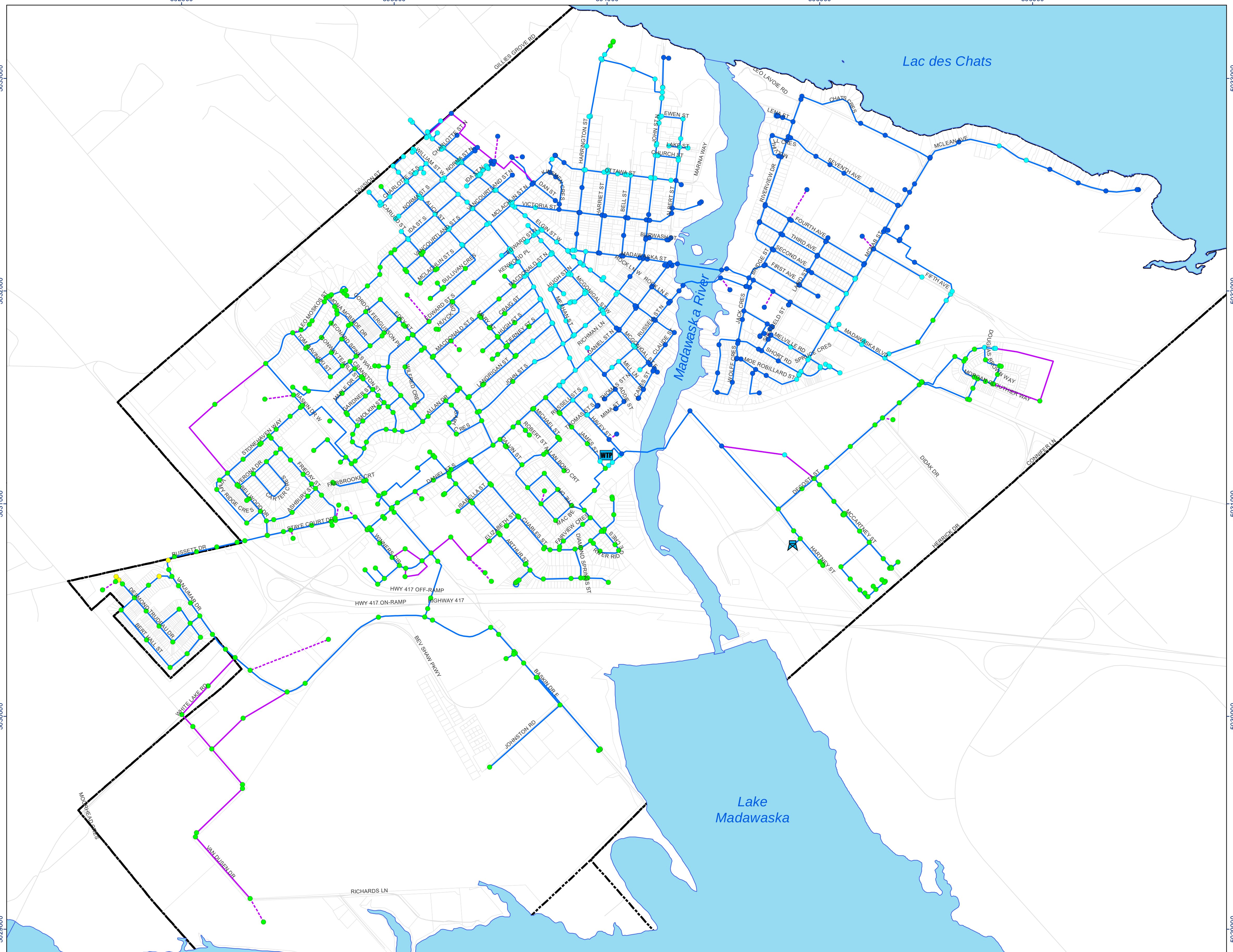
Prepared by CZ on 2023-02-23
Revised by CZ on 2023-07-28

Client/Project
Town of Arnprior
2022 W&WW Master Plan Update
163401723

Figure No.
C4-4

Title
Future Conditions (2032) – AVDY Maximum Pressures

\\Ca0218-ppfss01\01-634\active\1634_01723\planning\drawing\gis\MXDs\tm3_figs\appA4-10to12_am_wtr_2032_no_solns_model_results_20231117.mxd Revised: 2023-11-17 By: jsidhu



Stantec

Legend

Minimum Pressure

- Min. Pressure ≤ 20 psi
- 20 psi < Min. Pressure ≤ 40 psi
- 40 psi < Min. Pressure ≤ 50 psi
- 50 psi < Min. Pressure ≤ 70 psi
- 70 psi < Min. Pressure ≤ 80 psi
- 80 psi < Min. Pressure ≤ 100 psi
- Min. Pressure > 100 psi
- Existing Watermains

Watermains for Growth Areas

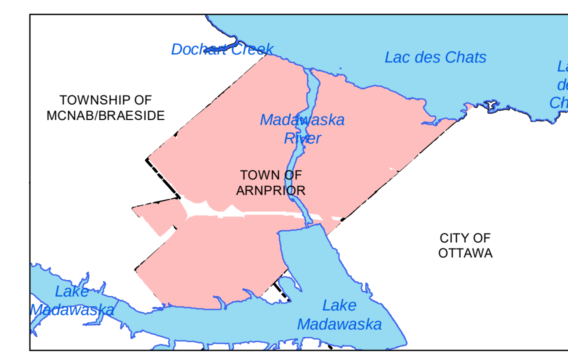
- Distribution Mains
- Dummy Pipes
- Water Treatment Plant (WTP)
- Elevated Storage Tank (EST)
- Municipal Boundary

N

0 250 500 Meters
(At original document size of 11x17)
1:18,500

Notes

1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Ontario_Hydro_Network_(OHN)_-_Waterbody.shp, Ontario_Hydro_Network_(OHN)_-_Waterbody (2).shp, Municipal_Boundary_-_Lower_and_Single_Tier.shp*, and *Arnprior_Roads_20220324* and *Arnprior_PropertyParcels_wAssessment_20220324.shp* provided by the Town of Arnprior.
3. Background: Contains information licensed under the Open Government Licence – Ontario



Project Location Prepared by CZ on 2023-02-23
Revised by CZ on 2023-07-28

Arnprior, ON

Client/Project 163401723

Town of Arnprior
2022 W&WW Master Plan Update

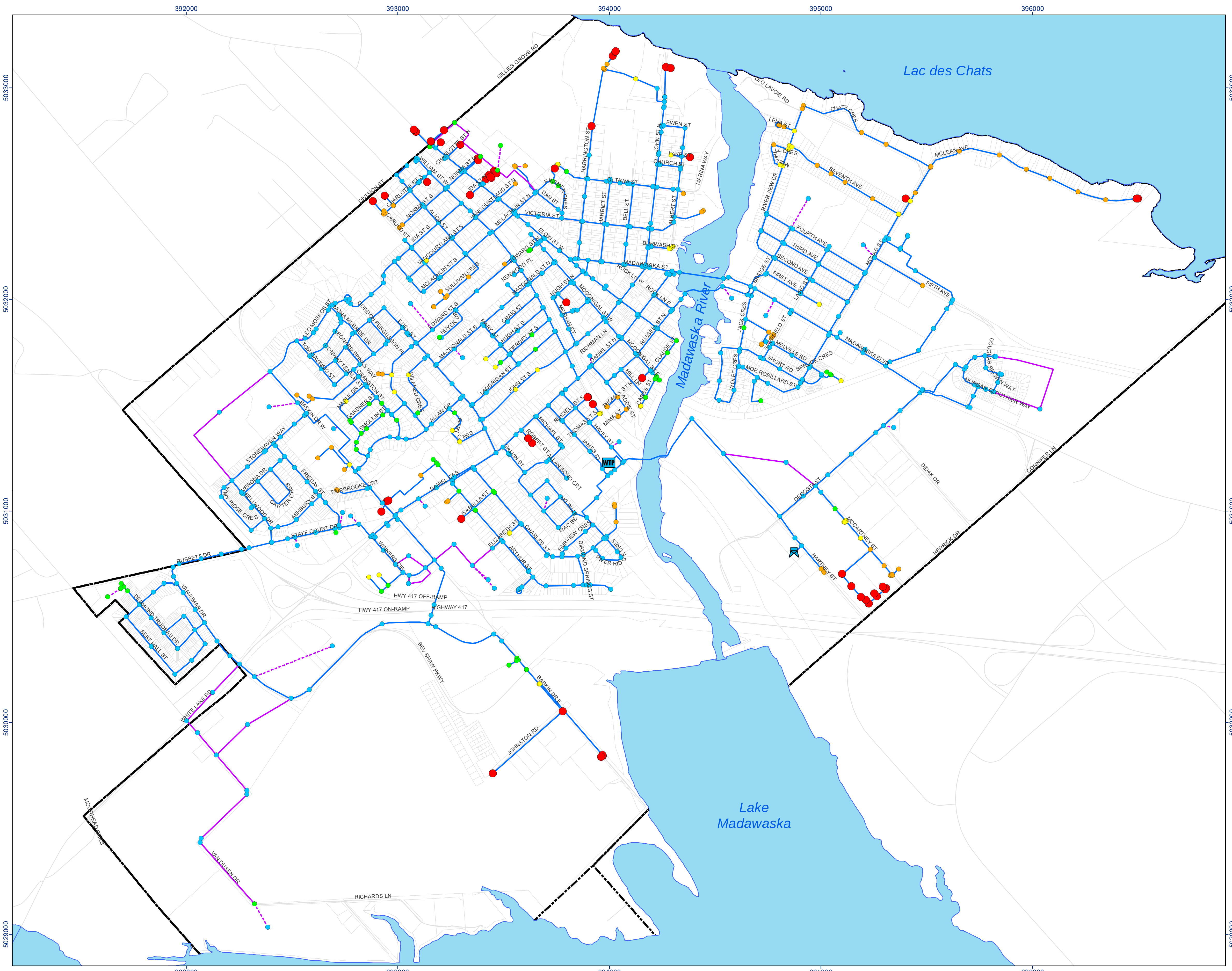
Figure No.

C4-5

Title

Future Conditions (2032) – MXDY Minimum Pressures

\\Ca0218-ppfss01\01-634\active\1634_01723\planning\drawing\gis\MXDs\tm3_figs\appA4-10to12_am_wtr_2032_no_solns_model_results_20231117.mxd Revised: 2023-11-17 By: jsidhu



Legend

Available Fire Flow at 20 psi (AFF)

- AFF < 33.33 L/s
- 33.33 L/s ≤ AFF ≤ 75 L/s
- 75 L/s < AFF ≤ 100 L/s
- 100 L/s < AFF ≤ 125 L/s
- AFF > 125 L/s
- Existing Watermains

Watermains for Growth Areas

- Distribution Mains
- Dummy Pipes
- Water Treatment Plant (WTP)
- Elevated Storage Tank (EST)
- Municipal Boundary

N

0 250 500 Meters
(At original document size of 11x17)
1:18,500

Notes
1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Ontario_Hydro_Network_(OHN)_-_Waterbody.shp*, *Ontario_Hydro_Network_(OHN)_-_Waterbody (2).shp*, *Municipal_Boundary_-_Lower_and_Single_Tier.shp*, and *Arnprior_Roads_20220324* and *Arnprior_PropertyParcels_wAssessment_20220324.shp* provided by the Town of Arnprior.
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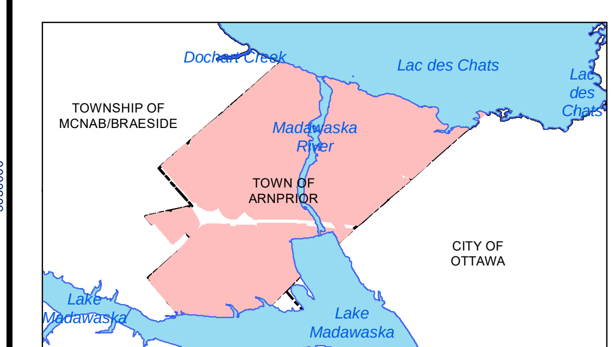

Project Location
Arnprior, ON

Prepared by CZ on 2023-02-23
Revised by CZ on 2023-07-28

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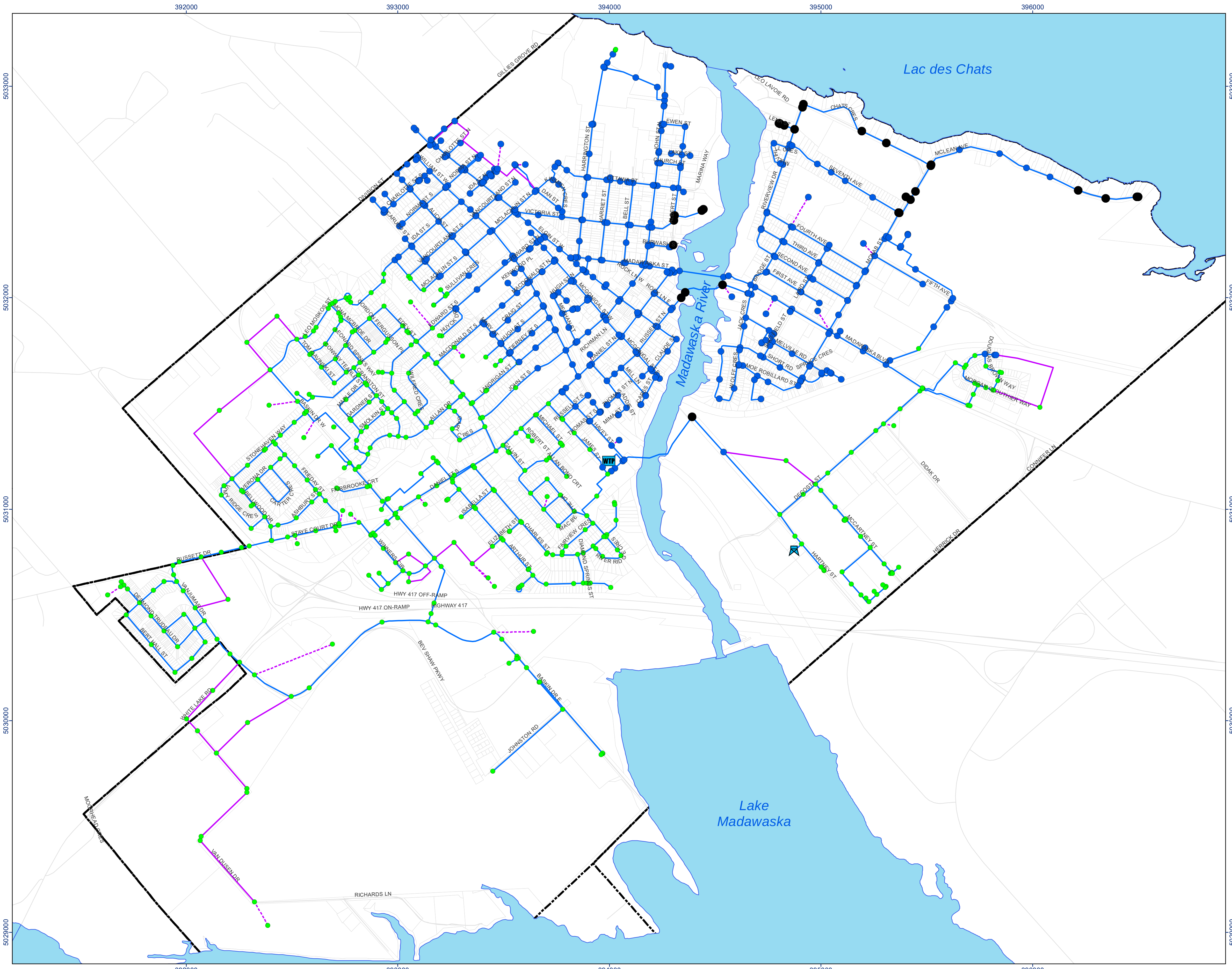
Town of Arnprior
2022 W&WW Master Plan Update

163401723

Figure No.
C4-6

Title
Future Conditions (2032) – MXDY Available Fire Flow at 20 psi



Stantec

Legend

Maximum Pressure

- Max. Pressure ≤ 40 psi
- 40 psi < Max. Pressure ≤ 60 psi
- 60 psi < Max. Pressure ≤ 80 psi
- 80 psi < Max. Pressure ≤ 100 psi
- Max. Pressure > 100 psi
- Existing Watermains

Watermains for Growth Areas

- Distribution Mains
- Dummy Pipes
- Water Treatment Plant (WTP)
- Elevated Storage Tank (EST)
- Municipal Boundary

N

0 250 500 Meters
(At original document size of 11x17)
1:18,500

Notes
1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Ontario_Hydro_Network_(OHN)_-_Waterbody.shp, Ontario_Hydro_Network_(OHN)_-_Waterbody (2).shp, Municipal_Boundary_-_Lower_and_Single_Tier.shp*, and *Arnprior_Roads_20220324* and *Arnprior_PropertyParcels_wAssessment_20220324.shp* provided by the Town of Arnprior.
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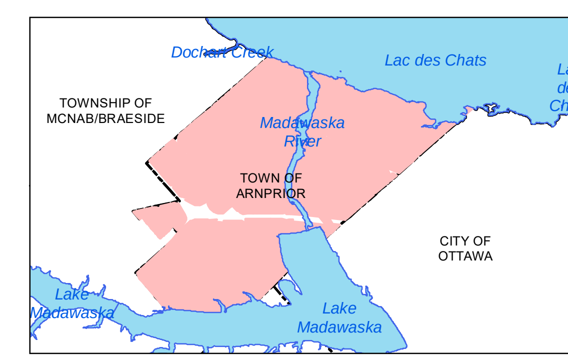


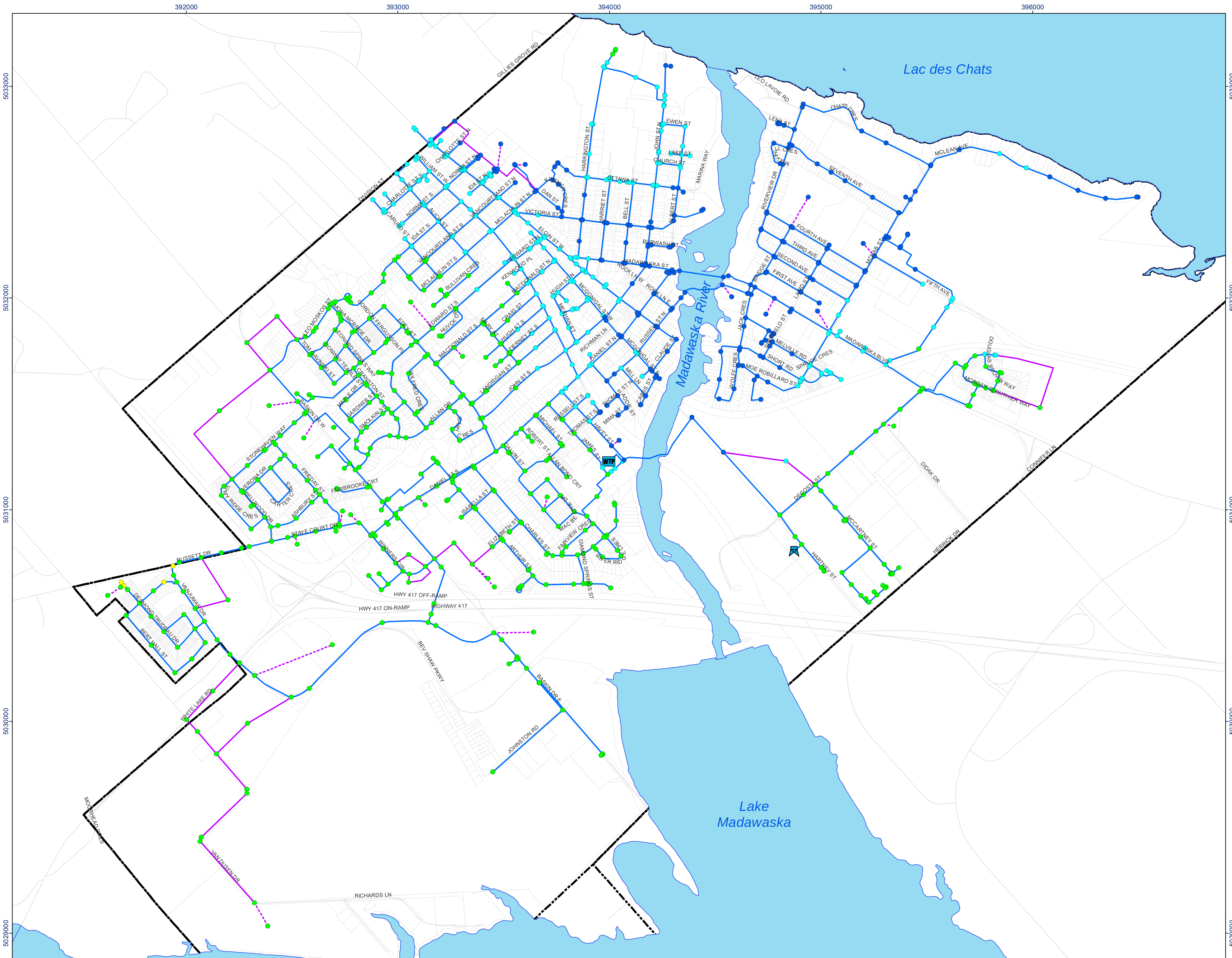
Project Location
Arnprior, ON

Prepared by CZ on 2023-02-23
Revised by CZ on 2023-07-28

Client/Project
163401723
Town of Arnprior
2022 W&WW Master Plan Update

Figure No.
C4-7

Title
Future Conditions (2042) – AVDY Maximum Pressures



Stantec

Legend

Minimum Pressure

- Min. Pressure ≤ 20 psi
- 20 psi < Min. Pressure ≤ 40 psi
- 40 psi < Min. Pressure ≤ 50 psi
- 50 psi < Min. Pressure ≤ 70 psi
- 70 psi < Min. Pressure ≤ 80 psi
- 80 psi < Min. Pressure ≤ 100 psi
- Min. Pressure > 100 psi
- Existing Watermains

Watermains for Growth Areas

- Distribution Mains
- Dummy Pipes
- Water Treatment Plant (WTP)
- Elevated Storage Tank (EST)
- Municipal Boundary

N

0 250 500 Meters

(At original document size of 11x17)
1:18,500

Notes

1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Ontario_Hydro_Network_(OHN)_-_Waterbody.shp, Ontario_Hydro_Network_(OHN)_-_Waterbody (2).shp, Municipal_Boundary_-_Lower_and_Single_Tier.shp,* and *Arnprior_Roads_20220324* and *Arnprior_PropertyParcels_wAssessment_20220324.shp* provided by the Town of Arnprior.
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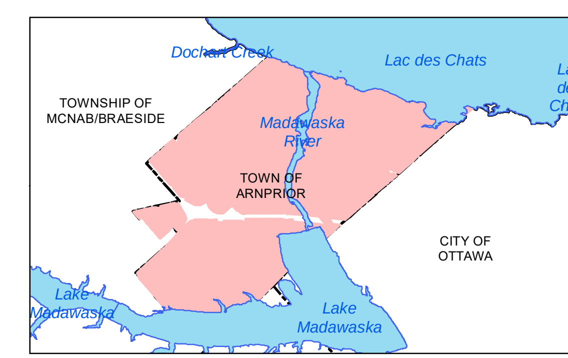


Project Location
Arnprior, ON

Prepared by CZ on 2023-02-23
Revised by CZ on 2023-07-28

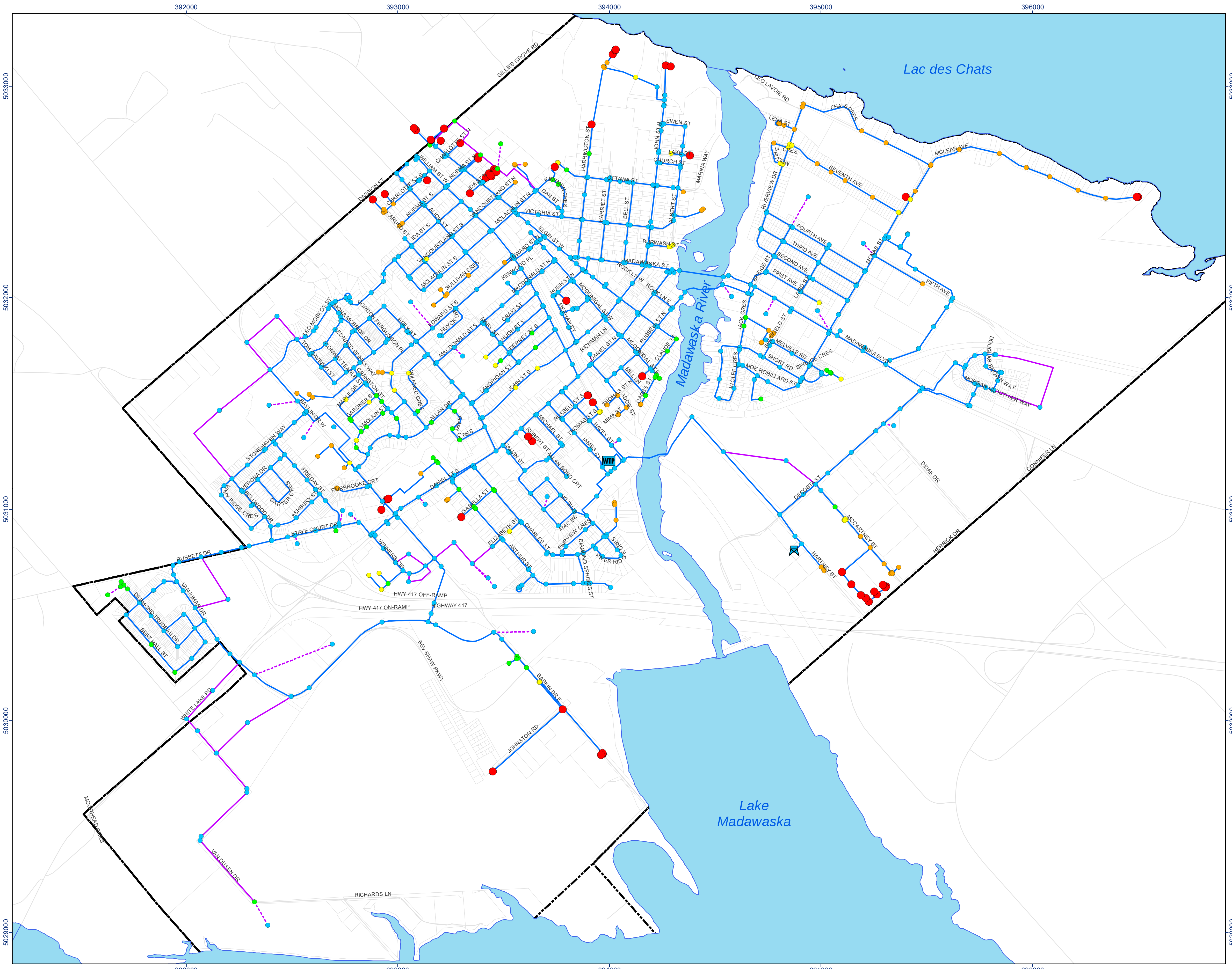
Client/Project
Town of Arnprior
2022 W&WW Master Plan Update

163401723

Figure No.
C4-8

Title
Future Conditions (2042) – MXDY Minimum Pressures

\\Ca0218-ppfss01\01-634\active\1634_01723\planning\drawing\gis\MXDs\tm3_figs\fig2-6to8_arn_wtr_2042_no_solns_model_results_20231116.mxd Revised: 2023-11-17 By: jsidhu



Legend

Available Fire Flow at 20 psi (AFF)

- AFF < 33.33 L/s
- 33.33 L/s ≤ AFF ≤ 75 L/s
- 75 L/s < AFF ≤ 100 L/s
- 100 L/s < AFF ≤ 125 L/s
- AFF > 125 L/s
- Existing Watermains

Watermains for Growth Areas

- Distribution Mains
- Dummy Pipes
- Water Treatment Plant (WTP)
- Elevated Storage Tank (EST)
- Municipal Boundary

(At original document size of 11x17)
1:18,500

Notes
1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Ontario_Hydro_Network_(OHN)_-_Waterbody.shp*, *Ontario_Hydro_Network_(OHN)_-_Waterbody (2).shp*, *Municipal_Boundary_-_Lower_and_Single_Tier.shp*, and *Arnprior_Roads_20220324* and *Arnprior_PropertyParcels_wAssessment_20220324.shp* provided by the Town of Arnprior.
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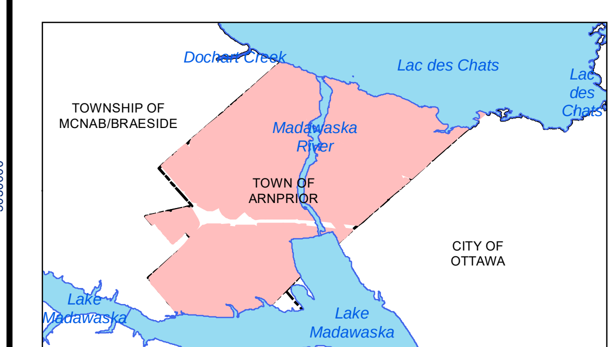


Project Location
Arnprior, ON

Prepared by CZ on 2023-02-23
Revised by CZ on 2023-07-28

Client/Project
Town of Arnprior
2022 W&WW Master Plan Update
163401723

Figure No.
C4-9

Title
Future Conditions (2042) – MXDY Available Fire Flow at 20 psi

Appendix D Alternatives Evaluation Tables

D.1 Wastewater Collection System Alternatives Evaluation

Evaluation of Wastewater Servicing Alternatives

Environment and Criteria Categories	Criteria Indicators	Alternative 1 Do Nothing	Alternative 2 I/I Reduction and Re-Use Alternatives	Alternative 3 Partial Private/Communal & Municipal Wastewater Servicing	Alternative 4 Communal Wastewater Collection System	Alternative 5 Improvement & Expansion of the Municipal Wastewater Collection System
ENVIRONMENTAL						
Protects Environmental Features	• Protect sensitive natural features and regulated areas. • Minimize the potential impact from construction and operation to existing terrestrial and aquatic habitats/features, species at risk, vegetation, wetlands, woodlots, and steep slopes. • Allow for scheduling and roll-out of construction activities in a way and at a time of year that would limit the negative impacts on the vegetation of the site and surrounding area.	• Environmental features, wildlife and species at risk would remain in their current conditions, as no construction/upgrades are completed. • Risk of intrusive emergency repairs is higher.	• Environmental features, wildlife and species at risk would remain in their current conditions, as no construction/upgrades are completed.	• Impacts are expected, but are limited to the areas serviced by this alternative.	• Impacts are expected, but are limited to the areas serviced by this alternative.	• Refinement of preferred alignments and routes can be optimized to reduce or eliminate impacts.
Protects Groundwater, Streams and Rivers	• Protect groundwater / surface water, and meet Clean Water Act requirements. • Minimize sewage discharge to the environment during design conditions, and mitigate spills during extreme rainfall. • Minimize impacts within Madawaska River and Ottawa River regulated areas.	• Groundwater, streams, and rivers would remain in their current conditions, as no construction/upgrades are completed. • Risk of intrusive emergency repairs is higher.	• Groundwater, streams, and rivers would remain in their current conditions, as no construction/upgrades are completed.	• Potential impacts if groundwater, streams or rivers are located near the service area. Protection areas would need to be established.	• Potential impacts if groundwater, streams or rivers are located near the service area. Protection areas would need to be established.	• Portions of projects in proximity to the Madawaska River.
Minimizes Impact on Climate Change	• Minimize GHG emissions and negative impacts on the landscape which may alter the ecosystems' ability to remove carbon dioxide from the atmosphere (e.g., changes vicinity plant cover). • Prioritize energy and water conservation and efficiency measures and/or adaptive re-use of buildings or structures to reduce new energy or material demands. • Evaluate contributions to or investments in natural spaces that offset or mitigate the alternative's climate change impacts.	• Low potential to reduce GHG emissions as infrastructure would remain in current conditions. • No additional GHG emissions for operations compared to existing conditions.	• Activities to remove I/I would be expected to add to GHG emissions in the short term (low in comparison to Alternative 5).	• Infrastructure upgrades would be expected to add to GHG emissions in the short term. (more than Alternative 2). • Increased GHG emissions for operations compared to existing conditions to operate new systems. • Conceptually would result in tree removal in certain instances. These could be replanted to renew the resource.	• Infrastructure upgrades would be expected to add to GHG emissions in the short term. (more than Alternative 2). • Increased GHG emissions for operations compared to existing conditions to operate new systems. • Conceptually would result in tree removal in certain instances. These could be replanted to renew the resource.	• Infrastructure upgrades would be expected to add to GHG emissions in the short term. (more than Alternative 2). • No additional GHG emissions for operations of existing collection system compared to existing conditions. Increased GHG emissions for operations compared to existing conditions due to expanded PS operations. • Conceptually would result in tree removal in certain instances. These could be replanted to renew the resource.
ENVIRONMENTAL SUMMARY		◐	◐	◔	◔	◔

Legend				
● Very well aligned with criteria	◕ Well aligned with criteria	◐ Somewhat aligned with criteria	◔ Not well aligned with criteria	○ Low alignment with criteria

Environment and Criteria Categories	Criteria Indicators	Alternative 1 Do Nothing	Alternative 2 I/I Reduction and Re-Use Alternatives	Alternative 3 Partial Private/Communal & Municipal Wastewater Servicing	Alternative 4 Communal Wastewater Collection System	Alternative 5 Improvement & Expansion of the Municipal Wastewater Collection System
SOCIAL/CULTURAL						
Minimizes Long-Term Impacts to the Community Related to Noise, Odour, Traffic and Aesthetics	• Minimize noise, odour, and traffic affecting the community during system operation and maintenance. • Maintain access to, and aesthetics of, public spaces. • Minimize negative impacts that may result due to changes to the neighbourhood characteristics (e.g., recreational features, green space, property values).	• Low potential of impacts to residents related to noise, odour, traffic, and aesthetics as infrastructure would remain in current conditions. • Higher risk of intrusive emergency repairs when required.	• Low potential of impacts to residents related to noise, odour, traffic, and aesthetics as infrastructure would remain in current conditions.	• Moderate potential of impacts to residents related to noise, odour, traffic, during construction (not expected to influence long-term). • New permanent infrastructure would require additional maintenance activity.	• Moderate potential of impacts to residents related to noise, odour, traffic, during construction (not expected to influence long-term). • New permanent infrastructure would require additional maintenance activity.	• Moderate potential of impacts to residents related to noise, odour, traffic, during construction (not expected to influence long-term). • New permanent infrastructure would require additional maintenance activity. • Aesthetics would be returned to existing conditions following construction within existing right-of-way or existing PS building footprint; potential for impact on aesthetics for new infrastructure and PS expansions.
Minimizes Impacts to Businesses and Major Transportation Corridors	• Maintain access for businesses during construction and system operation. • Minimize potential negative effects on short-term and long-term business vitality, and community growth and development. • Minimize potential negative impacts on major transportation corridors and bus routes	• No impacts to business operations are anticipated. • High potential for negative effects on long-term business vitality, community growth and development as existing infrastructure may not have sufficient transmission capacity and lacks redundancy and failure protection.	• No impacts to business operations for construction. • No impacts to business vitality and community growth.	• Impacts to businesses and business operations anticipated during construction expected (but less than Alternative 5). • Limited ability to meet short-term and long-term community growth and development.	• Impacts to businesses and business operations anticipated during construction expected (but less than Alternative 5). • Limited ability to meet short-term and long-term community growth and development.	• Impacts to businesses and business operations anticipated during construction expected. These could be minimized if impacts to existing roadways is minimized (e.g., if trenchless construction is possible. • Reduces short-term and long-term risks to business vitality and community growth and development through improved level of service.
Manages and Minimizes Short-Term Construction Impacts	• Minimize noise, odour, road closures, and truck traffic affecting the community during construction.	• No construction required as infrastructure would remain in existing condition. • Higher risk of intrusive emergency repairs when required.	• No construction required.	• Normal construction impacts expected.	• Normal construction impacts expected.	• Normal construction impacts expected. Potential for reduced impact if trenchless found to be feasible.
Protects Health and Safety	• Minimize the potential risk to public health and safety, particularly on downstream users (including for recreation and tourism). • Minimize the potential risk to operator and maintenance staff health and safety.	• Low potential to minimize public health and safety as existing infrastructure may not have capacity to provide adequate wastewater service under 2042 conditions. • Higher risk of intrusive emergency repairs when required.	• No anticipated impacts to operator health and safety compared to existing operations.	• Short-term potential increased risk during construction activities. • No long-term anticipated impacts to operator health and safety compared to existing operations.	• Short-term potential increased risk during construction activities. • No long-term anticipated impacts to operator health and safety compared to existing operations.	• Short-term potential increased risk during construction activities. • No long-term anticipated impacts to operator health and safety compared to existing operations.
Protects Cultural Heritage Resources	• Minimize potential impact to cultural heritage resources.	• No anticipated impacts to cultural heritage features as no construction is required.	• No anticipated impacts to cultural heritage features as no construction is required.	• Medium risk of impacts to cultural heritage features during construction activities on development property.	• Medium risk of impacts to cultural heritage features during construction activities on development property.	• Low risk of impacts to cultural heritage features during construction activities along existing easements.
SOCIAL/CULTURAL SUMMARY		○	◐	◐	◐	◐

Legend				
● Very well aligned with criteria	◕ Well aligned with criteria	◐ Somewhat aligned with criteria	◔ Not well aligned with criteria	○ Low alignment with criteria

Town of Arnprior Water & Wastewater Master Plan – Chapter 3 – Servicing Strategy – Evaluation of Alternatives: Wastewater Collection System
February 8, 2024

Environment and Criteria Categories	Criteria Indicators	Alternative 1 Do Nothing	Alternative 2 I/I Reduction and Re-Use Alternatives	Alternative 3 Partial Private/Communal & Municipal Wastewater Servicing	Alternative 4 Communal Wastewater Collection System	Alternative 5 Improvement & Expansion of the Municipal Wastewater Collection System
ECONOMIC						
Provides Low Lifecycle Costs	• Minimize capital, operation and maintenance (life cycle) costs over a 50-year period.	• No capital costs. • No additional 50year lifecycle costs.	• Minor capital costs for programs. • Potential for increased lifecycle costs due to system aging and replacement/emergency needs.	• Higher capital costs than Alternatives 1, and 2. Potentially higher capital costs than Alternatives 4 and 5, depending on proposed design. • Increased lifecycle costs to operate and maintain new infrastructure.	• Higher capital costs than Alternatives 1 and 2. Potentially higher capital costs than Alternatives 3 and 5, depending on proposed design. • Increased lifecycle costs to operate and maintain new infrastructure.	• Higher capital costs than Alternatives 1 and 2. Potentially higher capital costs than Alternatives 3 and 4, depending on proposed design. • Increased lifecycle costs to operate and maintain new infrastructure. Lifecycle costs to operate and maintain existing municipal system infrastructure are unchanged.
ECONOMIC SUMMARY		●	◐	◔	◔	◔
TECHNICAL						
Meets Existing and Future Needs	• Addresses the existing system capacity constraints. • Mitigate the impact on level-of-service performance of existing infrastructure. • Meets the long-term capacity requirements to service the projected population growth to 2042.	• Does not meet long-term collection system capacity requirements to service the projected population growth or provide existing targeted level of service.	• I/I reduction is not of sufficient magnitude to address existing constraints.	• Does not meet long-term collection system capacity requirements to service the projected population growth or provide existing targeted level of service.	• Does not meet long-term collection system capacity requirements to service the projected population growth or provide existing targeted level of service.	• Meets long-term wastewater collection capacity requirements to service projected population growth.
Provides Ease of Maintenance	• Provide operational improvements to allow for safe and efficient maintenance activities. • Minimize increases in operational and/or maintenance complexity of the system.	• Portions of wastewater collection system are not easily accessible, and maintenance can be challenging. • No impacts to operational complexity compared to existing operations.	• No impacts to operational complexity compared to existing operations.	• Increases operational complexity with new communal facilities to maintain.	• Increases operational complexity with new communal facilities to maintain.	• Minimal anticipated impacts to operational complexity compared to existing operations. • Significantly increases operational complexity and staff impact if new pump stations are introduced.
Aligns with Existing and Planned Infrastructure	• Optimize existing infrastructure investment. • Minimize requirement for upgrades/expansion to recent infrastructure • Align with other planned infrastructure initiatives (Transportation, Stormwater Master Plans, Capital projects). • Ability to implement in a phased manner over time.	• Does not optimize existing infrastructure. • Does not align with planned initiatives.	• Slight potential to minimize requirement for upgrades/expansion to recent infrastructure. • Does not optimize existing infrastructure. • Does not align with planned infrastructure initiatives.	• Minimize requirement for upgrades/expansion to recent infrastructure. • Does not optimize existing infrastructure. • Does not align with planned infrastructure initiatives.	• Minimize requirement for upgrades/expansion to recent infrastructure. • Does not optimize existing infrastructure. • Does not align with planned infrastructure initiatives.	• Aligns with planned initiatives to provide high and consistent level of service. • Can be configured to work with recent and planned Town projects and commitments (e.g., transportation projects, road renewal).
Aligns with Existing and Future Land Use	• Evaluate need to acquire land for new/expanded utility corridors or facilities (pumping stations, storage tanks) including ownership requirements.	• Does not require additional land as infrastructure will remain in current conditions.	• Does not require additional land as infrastructure will remain in current conditions.	• Additional land needed for new communal facilities.	• Additional land needed for new communal facilities.	• Does not require additional land if upgraded infrastructure can be placed in existing easements. • Additional land may be needed if PS expansion requires it.

Legend				
● Very well aligned with criteria	◕ Well aligned with criteria	◐ Somewhat aligned with criteria	◔ Not well aligned with criteria	○ Low alignment with criteria

Environment and Criteria Categories	Criteria Indicators	Alternative 1 Do Nothing	Alternative 2 I/I Reduction and Re-Use Alternatives	Alternative 3 Partial Private/Communal & Municipal Wastewater Servicing	Alternative 4 Communal Wastewater Collection System	Alternative 5 Improvement & Expansion of the Municipal Wastewater Collection System
Aligns with Efficient Approval and Permitting Process	• Minimize the complexity and time spent to obtain approvals from various regulatory agencies.	• Does not require approvals or permits as no improvements will be completed.	• Does not require approvals or permits as no improvements will be completed.	• Potential need for permitting if groundwater, streams or rivers are located near the service area.	• Potential need for permitting if groundwater, streams or rivers are located near the service area.	• Potential need for permitting for projects near the Madawaska River.
Manages and Minimizes Construction Risks	• Minimize complexity of construction and maximize ability to maintain adequate water/wastewater servicing during construction.	• No impacts to services as no improvements are proposed.	• No impacts to services as no improvements are proposed.	• Standard construction risk expected.	• Standard construction risk expected.	• Standard construction risk expected.
Ability to Adapt to Climate Change	• Promote resiliency to extreme weather events. • Prioritize climate change adaptation to minimize risk associated with variation in climate parameters (temperature, precipitation, wind gusts, or other) and natural hazards (flooding, high river levels, or other). • Prioritize the surrounding area's ability to be resilient and maintain its adaptive capacity to climate change.	• Does not promote resiliency to extreme weather events or minimize risk associated with variation in climate parameters.	• Does not promote resiliency to extreme weather events or minimize risk associated with variation in climate parameters.	• Does not promote resiliency to extreme weather events or minimize risk associated with variation in climate parameters.	• Does not promote resiliency to extreme weather events or minimize risk associated with variation in climate parameters.	• Can be sized to include resiliency to extreme weather events. • Inclusion of additional pumping station(s) introduces a need for additional power sources, backup power requirements, etc.
TECHNICAL SUMMARY		○	○	◐	◐	●
SUMMARY		○	◐	◔	◔	●
Alternative Ranking						**Most Aligned with Criteria**

Legend				
● Very well aligned with criteria	◕ Well aligned with criteria	◐ Somewhat aligned with criteria	◔ Not well aligned with criteria	○ Low alignment with criteria

D.2 Potable Water Distribution System Alternatives Evaluation

Evaluation of Potable Water Servicing Alternatives

Environment and Criteria Categories	Criteria Indicators	Alternative 1 Do Nothing	Alternative 2 Water Conservation and Re-Use	Alternative 3 Communal Potable Water System	Alternative 4 Partial Private/Communal & Municipal Potable Water Servicing	Alternative 5 Improvement & Expansion of the Municipal Potable Water Distribution System
ENVIRONMENTAL						
Protects Environmental Features	• Protect sensitive natural features and regulated areas. • Minimize the potential impact from construction and operation to existing terrestrial and aquatic habitats/features, species at risk, vegetation, wetlands, woodlots, and steep slopes. • Allow for scheduling and roll-out of construction activities in a way and at a time of year that would limit the negative impacts on the vegetation of the site and surrounding area.	• Environmental features, wildlife and species at risk would remain in their current conditions, as no construction/upgrades are completed. • Risk of intrusive emergency repairs is higher.	• Terrestrial environmental features, wildlife and species at risk would remain in their current conditions, as no construction/upgrades are completed. • Moderate potential to reduce water taking, minimizing impacts on fish and aquatic habitats/features.	• Impacts are expected, but are limited to the areas serviced by this alternative.	• Impacts are expected, but are limited to the areas serviced by this alternative.	• Refinement of preferred alignments and routes can be optimized to reduce or eliminate impacts.
Protects Groundwater, Streams and Rivers	• Protect groundwater / surface water, and meet Clean Water Act requirements. • Minimize sewage discharge to the environment during design conditions, and mitigate spills during extreme rainfall. • Minimize impacts within Madawaska River and Ottawa River regulated areas.	• Groundwater, streams, and rivers would remain in their current conditions, as no construction/upgrades are completed. • Risk of intrusive emergency repairs is higher.	• Groundwater, streams, and rivers would remain in their current conditions, as no construction/upgrades are completed.	• Potential impacts if there are sources of contamination near the service area. Protection areas would need to be established.	• Potential impacts if there are sources of contamination near the service area. Protection areas would need to be established.	• Portions of projects in proximity to the Madawaska River and Ottawa River.
Minimizes Impact on Climate Change	• Minimize GHG emissions and negative impacts on the landscape which may alter the ecosystems' ability to remove carbon dioxide from the atmosphere (e.g., changes vicinity plant cover). • Prioritize energy and water conservation and efficiency measures and/or adaptive re-use of buildings or structures to reduce new energy or material demands. • Evaluate contributions to or investments in natural spaces that offset or mitigate the alternative's climate change impacts.	• Low potential to reduce GHG emissions as infrastructure would remain in current conditions. • No impacts to known climate change contributors (e.g., GHG emissions) compared to existing conditions.	• Activities/construction to reduce water consumption and re-use water would be expected to add to GHG emissions in the short term. (low in comparison to Alternatives 3-5)	• Infrastructure upgrades would be expected to add to GHG emissions in the short term. (more than Alternative 2). • Increased GHG emissions for operations of new systems compared to existing conditions. • Conceptually would result in tree removal in certain instances. These could be replanted to renew the resource.	• Infrastructure upgrades would be expected to add to GHG emissions in the short term. (more than Alternative 2). • Increased GHG emissions for operations of new systems compared to existing conditions. • Conceptually would result in tree removal in certain instances. These could be replanted to renew the resource.	• Infrastructure upgrades would be expected to add to GHG emissions in the short term. (more than Alternative 2). • No additional GHG emissions for operations of existing potable water distribution system compared to existing conditions. Increased GHG emissions for operations compared to existing conditions due to expanded WTP operations. • Conceptually would result in tree removal in certain instances. These could be replanted to renew the resource.
ENVIRONMENTAL SUMMARY		◐	◐	◔	◔	◔

Legend				
● Very well aligned with criteria	◕ Well aligned with criteria	◐ Somewhat aligned with criteria	◔ Not well aligned with criteria	○ Low alignment with criteria

Environment and Criteria Categories	Criteria Indicators	Alternative 1 Do Nothing	Alternative 2 Water Conservation and Re-Use	Alternative 3 Communal Potable Water System	Alternative 4 Partial Private/Communal & Municipal Potable Water Servicing	Alternative 5 Improvement & Expansion of the Municipal Potable Water Distribution System
SOCIAL/CULTURAL						
Minimizes Long-Term Impacts to the Community Related to Noise, Odour, Traffic and Aesthetics	• Minimize noise, odour, and traffic affecting the community during system operation and maintenance. • Maintain access to, and aesthetics of, public spaces. • Minimize negative impacts that may result due to changes to the neighborhood characteristics (e.g., recreational features, green space, property values).	• Low potential of impacts to residents related to noise, odour, traffic, and aesthetics as infrastructure would remain in current conditions. • Higher risk of intrusive emergency repairs when required.	• Moderate potential of impacts to residents related to noise, odour, traffic, during construction related to water conservation and re-use measures (not expected to influence long-term).	• Moderate potential of impacts to residents related to noise, odour, traffic, during construction (not expected to influence long-term). • New permanent infrastructure would require additional maintenance activity.	• Moderate potential of impacts to residents related to noise, odour, traffic, during construction (not expected to influence long-term). • New permanent infrastructure would require additional maintenance activity.	• Moderate potential of impacts to residents related to noise, odour, traffic, during construction (not expected to influence long-term). • New permanent infrastructure would require additional maintenance activity. • Aesthetics would be returned to existing conditions following construction within existing right-of-way or existing WTP building footprint; potential for impact on aesthetics for new infrastructure and WTP upgrades.
Minimizes Impacts to Businesses and Major Transportation Corridors	• Maintain access for businesses during construction and system operation. • Minimize potential negative effects on short-term and long-term business vitality, and community growth and development. • Minimize potential negative impacts on major transportation corridors and bus routes.	• No impacts to business operations are anticipated. • High potential for negative effects on long-term business vitality, community growth and development as existing infrastructure may not have sufficient transmission capacity and lacks redundancy and failure protection.	• Impacts to businesses and business operations are anticipated due to water conservation and re-use measures (not expected to influence long-term). • Low potential to meet short-term and long-term community growth and development.	• Impacts to businesses and business operations are anticipated during construction (but less than Alternative 5). • Limited ability to meet short-term and long-term community growth and development depending on quantity and quality of groundwater supply. • Restraints in types of development that could be built as aquifers that service the groundwater wells have to be protected.	• Impacts to businesses and business operations are anticipated during construction (but less than Alternative 5). • Limited ability to meet short-term and long-term community growth and development depending on quantity and quality of groundwater supply. • Restraints in types of development that could be built as aquifers that service the groundwater wells have to be protected.	• Impacts to businesses and business operations are anticipated during construction. These could be reduced if impacts to existing roadways is minimized (e.g., if trenchless construction is possible). • Short-term and long-term risks to business vitality and community growth and development are reduced through system improvement and expansion.
Manages and Minimizes Short-Term Construction Impacts	• Minimize noise, odour, road closures, and truck traffic affecting the community during construction.	• No construction required as infrastructure would remain as existing conditions. • Higher risk of intrusive emergency repairs when required.	• Normal construction impacts might be expected (e.g., installation of water meters).	• Normal construction impacts are expected.	• Normal construction impacts are expected.	• Normal construction impacts are expected. Potential for reduced impact if trenchless methods would be feasible.
Protects Health and Safety	• Minimize the potential risk to public health and safety, particularly on downstream users (including for recreation and tourism). • Minimize the potential risk to operator and maintenance staff health and safety.	• Low potential to minimize public health and safety as existing infrastructure may not have capacity to provide adequate potable water service for 20-yr planning horizon. • Higher risk of intrusive emergency repairs when required.	• Short-term potential increased risk during construction activities (e.g., installation of water meters). • No long-term anticipated impacts to operator health and safety compared to existing operations.	• Short-term potential increased risk during construction activities. • No long-term anticipated impacts to operator health and safety compared to existing operations. • Higher risk of groundwater source contamination compared to surface water.	• Short-term potential increased risk during construction activities. • No long-term anticipated impacts to operator health and safety compared to existing operations. • Higher risk of groundwater source contamination compared to surface water.	• Short-term potential increased risk during construction activities. • No long-term anticipated impacts to operator health and safety compared to existing operations.
Protects Cultural Heritage Resources	• Minimize potential impact to cultural heritage resources.	• No anticipated impacts to cultural heritage features as no construction is required.	• Low risk of impacts to cultural heritage features during construction activities along existing easements (e.g., installation of water meters).	• Medium risk of impacts to cultural heritage features during construction activities on development property.	• Medium risk of impacts to cultural heritage features during construction activities on development property.	• Low risk of impacts to cultural heritage features during construction activities along existing easements.
SOCIAL/CULTURAL SUMMARY						

Legend				
Very well aligned with criteria	Well aligned with criteria	Somewhat aligned with criteria	Not well aligned with criteria	Low alignment with criteria

Environment and Criteria Categories	Criteria Indicators	Alternative 1 Do Nothing	Alternative 2 Water Conservation and Re-Use	Alternative 3 Communal Potable Water System	Alternative 4 Partial Private/Communal & Municipal Potable Water Servicing	Alternative 5 Improvement & Expansion of the Municipal Potable Water Distribution System
ECONOMIC						
Provides Low Lifecycle Costs	• Minimize capital, operation and maintenance (life cycle) costs over a 50-year period.	• No capital cost. • Moderate to high operation and maintenance costs to keep up with current and future population demands. The costs are anticipated to increase due to system aging and emergency needs.	• Low capital costs for water conservation and re-use measures/programs. • Moderate operation and maintenance costs. The costs are anticipated to increase due to system aging and emergency needs.	• High capital costs to build communal potable water systems at different areas of the Town. • High operational and maintenance costs.	• Moderate to high capital costs to build private/communal systems at different development areas. • Moderate to high operational and maintenance costs.	• Moderate capital costs to upgrade and expand the existing system. • Moderate operational and maintenance costs.
ECONOMIC SUMMARY		◕	◕	◔	◔	◑
TECHNICAL						
Meets Existing and Future Needs	• Addresses the existing system capacity constraints. • Mitigate the impact on level-of-service performance of existing infrastructure. • Meets the long-term capacity requirements to service the projected population growth to 2042.	• Does not address existing constraints. • Does not meet long-term capacity requirements to service the projected population growth to 2042.	• Water conservation and re-use measures are not of sufficient magnitude to address existing constraints and meet long-term capacity requirements to service the projected population growth to 2042.	• Limited ability to address existing constraints and meet long-term capacity requirements to service the projected population growth depending on quantity and quality of groundwater supply.	• Limited ability to address existing constraints and meet long-term capacity requirements to service the projected population growth depending on quantity and quality of groundwater supply.	• Able to address existing constraints and meet long-term capacity requirements to service the projected population growth.
Provides Ease of Maintenance	• Provide operational improvements to allow for safe and efficient maintenance activities. • Minimize increases in operational and/or maintenance complexity of the system.	• No impacts to operational complexity compared to existing operations.	• No impacts to operational complexity compared to existing operations.	• Increases operational complexity with new communal facilities to maintain.	• Increases operational complexity with new communal facilities to maintain.	• Potential to increase operational complexity depending on upgrades being selected to meet the treatment, storage, and pumping capacity requirements in the 20-yr planning horizon.
Aligns with Existing and Planned Infrastructure	• Optimize existing infrastructure investment. • Minimize requirement for upgrades/expansion to recent infrastructure. • Align with other planned infrastructure initiatives (Transportation, Stormwater Master Plans, Capital projects). • Ability to implement in a phased manner over time.	• Does not optimize existing infrastructure. • Does not align with planned initiatives.	• Does not optimize existing infrastructure. • Potential to minimize requirement for upgrades/expansion to recent infrastructure. • Does not align with planned infrastructure initiatives.	• Does not optimize existing infrastructure. • Minimize requirement for upgrades/expansion to recent infrastructure. • Does not align with planned infrastructure initiatives.	• Does not optimize existing infrastructure. • Minimize requirement for upgrades/expansion to recent infrastructure. • Does not align with planned infrastructure initiatives.	• Optimize existing infrastructure investment. • Aligns with planned initiatives to provide high and consistent level of service. • Can be configured to work with recent and planned Town projects and commitments (e.g., transportation projects, road renewal).
Aligns with Existing and Future Land Use	• Evaluate need to acquire land for new/expanded utility corridors or facilities (pumping stations, storage tanks) including ownership requirements.	• Does not require additional land as infrastructure will remain in current conditions.	• Does not require additional land as infrastructure will remain in current conditions.	• Additional land would be needed for new communal facilities.	• Additional land would be needed for new communal facilities.	• Does not require additional land if upgraded infrastructure can be placed in existing easements. • Additional land may be needed if WTP or storage expansion is required.
Aligns with Efficient Approval and Permitting Process	• Minimize the complexity and time spent to obtain approvals from various regulatory agencies.	• Does not require approvals or permits as no improvements will be completed.	• Potential need for permitting for construction projects (e.g., installation of water meters)	• Various permits and approvals would be required (e.g., building permit, permit to take water, and approvals from municipality, conservation authority, and MECP).	• Various permits and approvals would be required (e.g., building permit, permit to take water, approvals from municipality, conservation authority, and MECP, and road cut permit).	• Various permits and approvals would be required (e.g., road cut permit, building permit, drinking water works permit, and approvals from municipality and MECP).

Legend				
● Very well aligned with criteria	◕ Well aligned with criteria	◑ Somewhat aligned with criteria	◔ Not well aligned with criteria	○ Low alignment with criteria

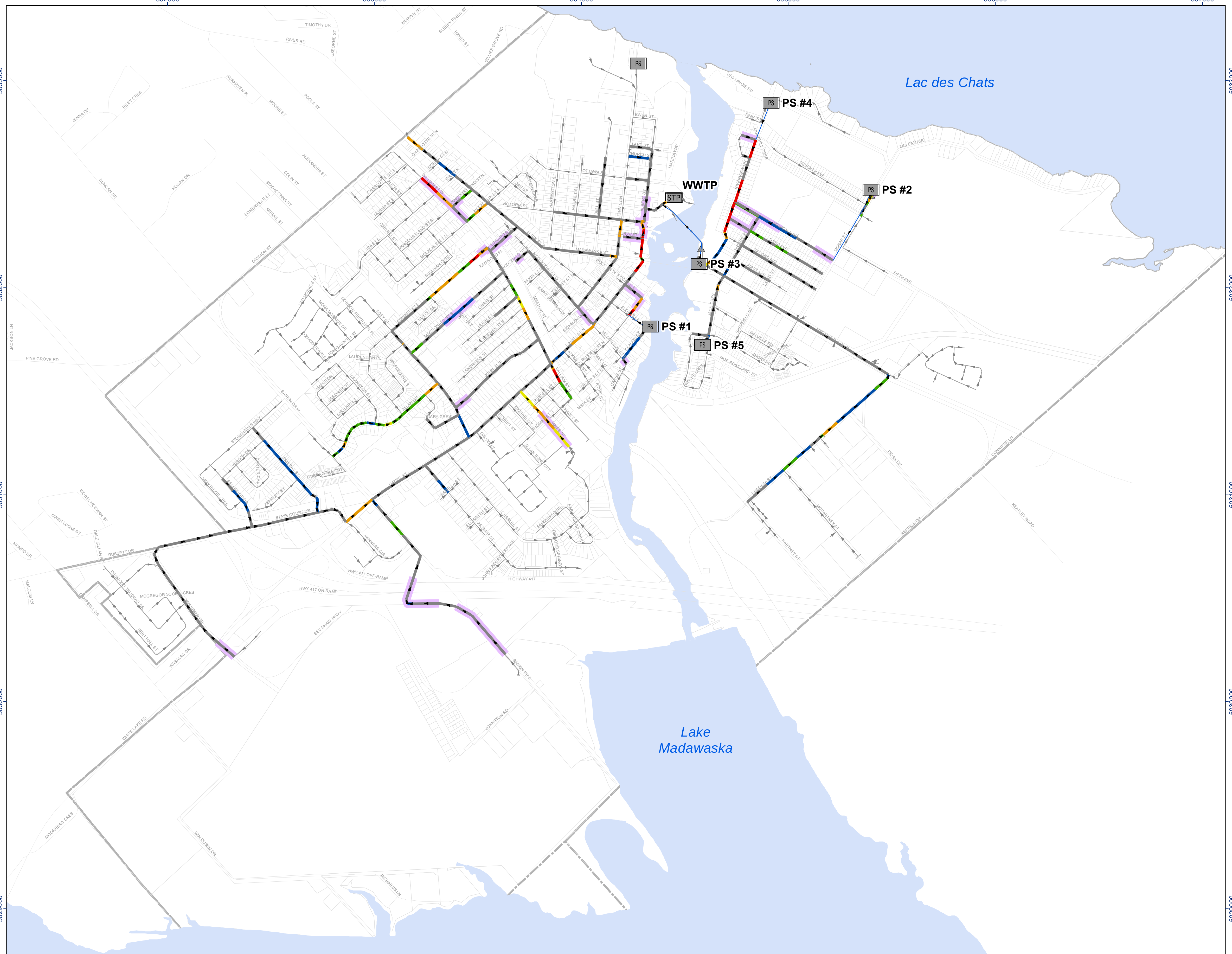
Town of Arnprior Water & Wastewater Master Plan – Chapter 3 – Servicing Strategy – Evaluation of Alternatives: Potable Water Distribution System
February 8, 2024

Environment and Criteria Categories	Criteria Indicators	Alternative 1 Do Nothing	Alternative 2 Water Conservation and Re-Use	Alternative 3 Communal Potable Water System	Alternative 4 Partial Private/Communal & Municipal Potable Water Servicing	Alternative 5 Improvement & Expansion of the Municipal Potable Water Distribution System
Manages and Minimizes Construction Risks	• Minimize complexity of construction and maximize ability to maintain adequate water/wastewater servicing during construction.	• No impacts to services as no improvements are proposed.	• Minor construction risks are expected.	• Standard construction risks are expected. • No impacts to functionality of existing infrastructure during construction. • Comprehensive environmental, geotechnical, hydrogeological investigations of site would be required.	• Standard construction risks are expected. • Low impacts to functionality of existing infrastructure during construction. • Comprehensive environmental, geotechnical, hydrogeological investigations of site would be required.	• Standard construction risks are expected. • Moderate to high impacts to functionality of existing infrastructure during construction. • Geotechnical investigation of new site would be required.
Ability to Adapt to Climate Change	• Promote resiliency to extreme weather events. • Prioritize climate change adaptation to minimize risk associated with variation in climate parameters (temperature, precipitation, wind gusts, or other) and natural hazards (flooding, high river levels, or other). • Prioritize the surrounding area's ability to be resilient and maintain its adaptive capacity to climate change.	• Does not promote resiliency to extreme weather events or minimize risk associated with variation in climate parameters.	• Does not promote resiliency to extreme weather events or minimize risk associated with variation in climate parameters.	• Proposed communal systems could be designed to include resiliency to extreme weather events or minimize risk associated with variation in climate parameters. • High potential to increase vulnerability to climate change due to escalated vulnerability to drought.	• Proposed communal and municipal systems could be designed to include resiliency to extreme weather events or minimize risk associated with variation in climate parameters. • High potential to increase vulnerability to climate change due to escalated vulnerability to drought.	• Proposed improvement and expansion could be designed to include resiliency to extreme weather events or minimize risk associated with variation in climate parameters.
TECHNICAL SUMMARY		○	◔	◑	◑	◕
SUMMARY		○	◑	◔	◔	◕
Alternative Ranking						**Most Aligned with Criteria**

Legend									
●	Very well aligned with criteria	◕	Well aligned with criteria	◑	Somewhat aligned with criteria	◔	Not well aligned with criteria	○	Low alignment with criteria

Appendix E Wastewater Servicing Refined Alternatives

E.1 Wastewater Collection System Residual Capacities



Stantec

Legend

- Sanitary Pump Station (PS)
- Overflow
- Wastewater Treatment Plant (WWTP)
- Sanitary Sewer (Not Modelled)
- Forcemains

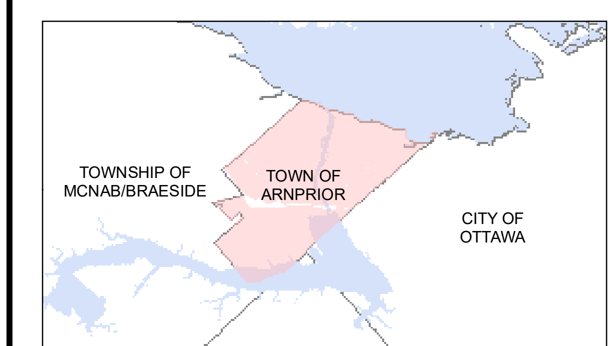
Sewer WWF Residual Capacity

- No Capacity (0 L/s; Sewer is Surcharged)
- Limited Capacity (0 L/s; Sewer is not Surcharged)
- <= 5 L/s
- 5 - 25 L/s
- 25 - 50 L/s
- > 50 L/s

N

0 250 500 Meters
(At original document size of 11x17)
1:19,000

Notes
1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Export_Output_Parcel_Fabric.shp*, *Export_Output_Roads.shp*, *Export_Output_San_MH.shp* and *Export_Output_SAN_SEWER.shp* provided by the Town of Arnprior
3. Background: Contains information licensed under the Open Government Licence – Ontario
4. Abbreviations: FM: Flow Monitor; MH: Maintenance Hole; PS: Pump Station; WWTP: Wastewater Treatment Plant



Project Location
Arnprior, ON

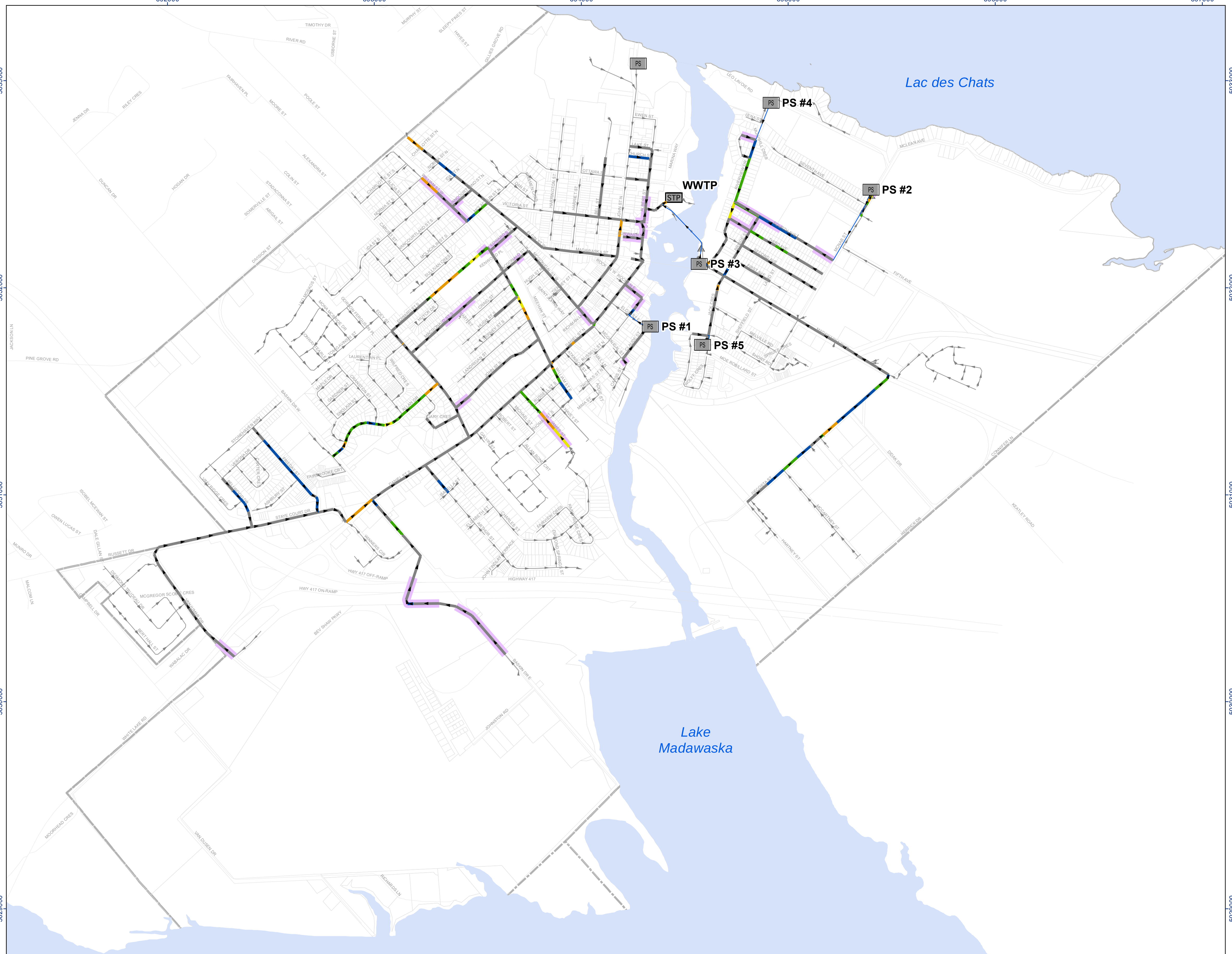
Prepared by CR on 2023-11-08
Revised by CR on 2024-02-02

Client/Project
163401723
Town of Arnprior
2022 W&WW Master Plan Update

Figure No.
E1-1

Title
Sewer Residual Capacity – Existing Conditions with Existing Infrastructure

C:\Users\crazafimaharo.CORP\Documents\Local_Work_Tmp\Local-163401723-ArnpriorMP\gis_local\MXDs\mprpt_figs\appE1-1_am_san_resCap_Ex_noFutPrj-noSolns_20240202.mxd Revised: 2024-02-02 By: crazafimaharo



Legend

- Sanitary Pump Station (PS)
- Overflow
- Wastewater Treatment Plant (WWTP)
- Sanitary Sewer (Not Modelled)
- Forcemains

Sewer WWF Residual Capacity

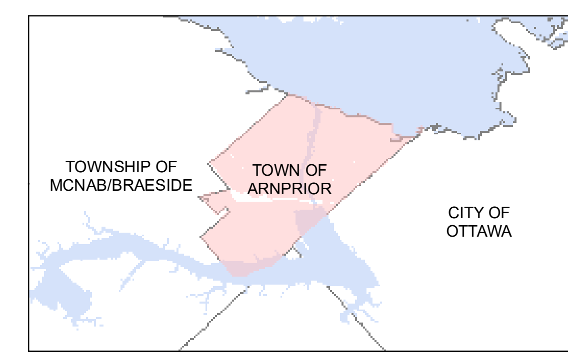
- No Capacity (0 L/s; Sewer is Surcharged)
- Limited Capacity (0 L/s; Sewer is not Surcharged)
- <= 5 L/s
- 5 - 25 L/s
- 25 - 50 L/s
- > 50 L/s

N

0 250 500 Meters
(At original document size of 11x17)
1:19,000

Notes

1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Export_Output_Parcel_Fabric.shp*, *Export_Output_Roads.shp*, *Export_Output_San_MH.shp* and *Export_Output_SAN_SEWER.shp* provided by the Town of Arnprior
3. Background: Contains information licensed under the Open Government Licence – Ontario
4. Abbreviations: FM: Flow Monitor; MH: Maintenance Hole; PS: Pump Station; WWTP: Wastewater Treatment Plant



Project Location
Arnprior, ON

Prepared by CR on 2023-11-08
Revised by CR on 2024-02-02

Client/Project
163401723
Town of Arnprior
2022 W&WW Master Plan Update

Figure No.
E1-2

Title
Sewer Residual Capacity – Existing Conditions with Planned Projects & Proposed Upgrades

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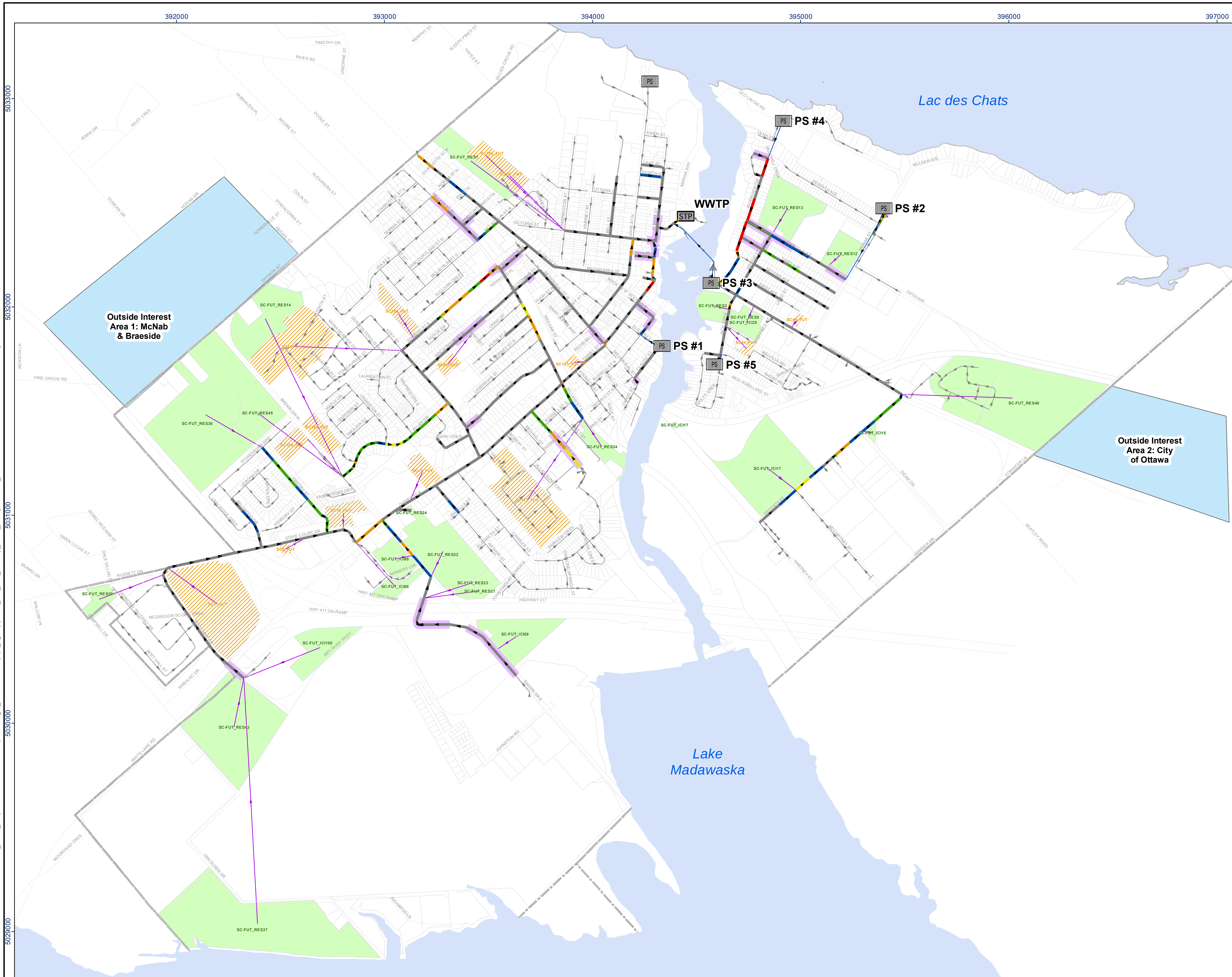


Stantec

Legend

- Sanitary Pump Station (PS)
- Overflow
- Wastewater Treatment Plant
- Sanitary Sewer (Not
- Forcemains

Sewer WWF Residual Capacity

- No Capacity (0 L/s; Sewer is Surcharged)
- Limited Capacity (0 L/s; Sewer is not Surcharged)
- <= 5 L/s
- 5 - 25 L/s
- 25 - 50 L/s
- > 50 L/s

Growth Areas

- Growth Area
- Existing Subcatchment (with Redevelopments or Development/Occupancy of Vacant Properties)
- New Subcatchment
- Outside Interest

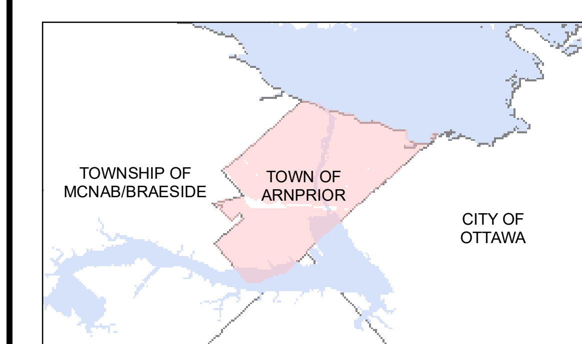
N

0 250 500 Meters

(At original document size of 11x17)
1:19,000

Notes

1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Export_Output_Parcel_Fabric.shp*, *Export_Output_Roads.shp*, *Export_Output_San_MH.shp* and *Export_Output_SAN_SEWER.shp* provided by the Town of Arnprior
3. Background: Contains information licensed under the Open Government Licence – Ontario
4. Abbreviations: FM: Flow Monitor; MH: Maintenance Hole; PS: Pump Station; WWTP: Wastewater Treatment Plant



Project Location
Arnprior, ON

Prepared by CR on 2023-11-08
Revised by CR on 2024-02-02

Client/Project
Town of Arnprior
2022 W&WW Master Plan Update

163401723

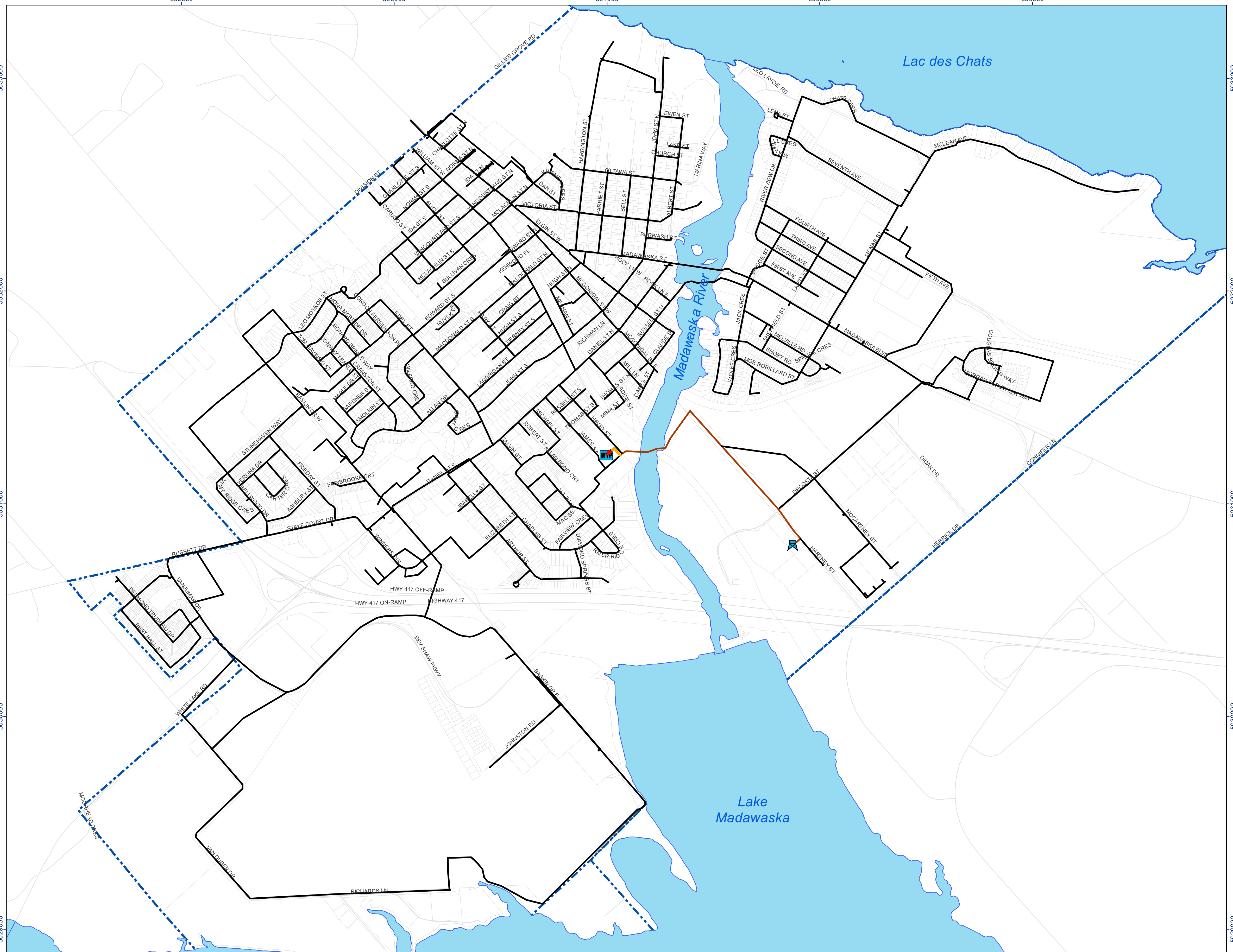
Figure No.
E1-3

Title
Sewer Residual Capacity – 2042 Growth Conditions with Planned Projects Only (No Proposed Upgrades)

C:\Users\crazafimaharo.CORP\Documents\Local_Work_Tmp\Local-163401723-ArnpriorMP\gis_local\MXDs\mprpt_figs\appE1-3_am_san_resCap_2042_FuPj-noSolns_20240202.mxd Revised: 2024-02-02 By: crazafimaharo

Appendix F Potable Water Servicing Refined Alternatives

F.1 Potable Water Model Results – 2042 Conditions with Solutions: Velocities and Head Losses



Stantec

Legend

Watermain Maximum Velocity

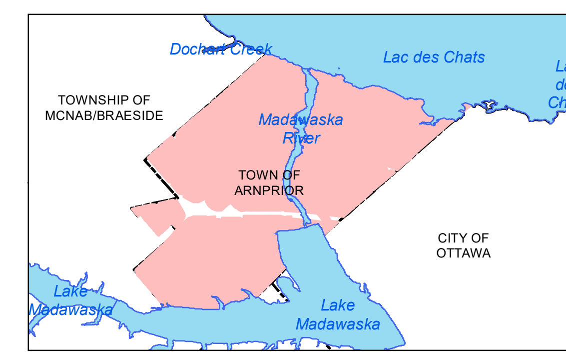
- Max. Velocity ≤ 0.8 m/s
- 0.8 m/s < Max. Velocity ≤ 1.5 m/s
- 1.5 m/s < Max. Velocity ≤ 2.0 m/s
- 2.0 m/s < Max. Velocity ≤ 3.0 m/s
- 3.0 m/s < Max. Velocity ≤ 4.0 m/s
- Max. Velocity > 4.0 m/s
- Water Treatment Plant (WTP)
- Elevated Storage Tank (EST)
- Municipal Boundary

N

0 250 500 Meters
(At original document size of 11x17)
1:18,500

Notes

1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Ontario_Hydro_Network_(OHN)_-_Waterbody.shp, Ontario_Hydro_Network_(OHN)_-_Waterbody (2).shp, Municipal_Boundary_-_Lower_and_Single_Tier.shp*, and *Arnprior_Roads_20220324* and *Arnprior_PropertyParcels_wAssessment_20220324.shp* provided by the Town of Arnprior.
3. Background: Contains information licensed under the Open Government Licence – Ontario



Project Location
Arnprior, ON

Prepared by CZ on 2023-08-04
Revised by CZ on 2023-10-17

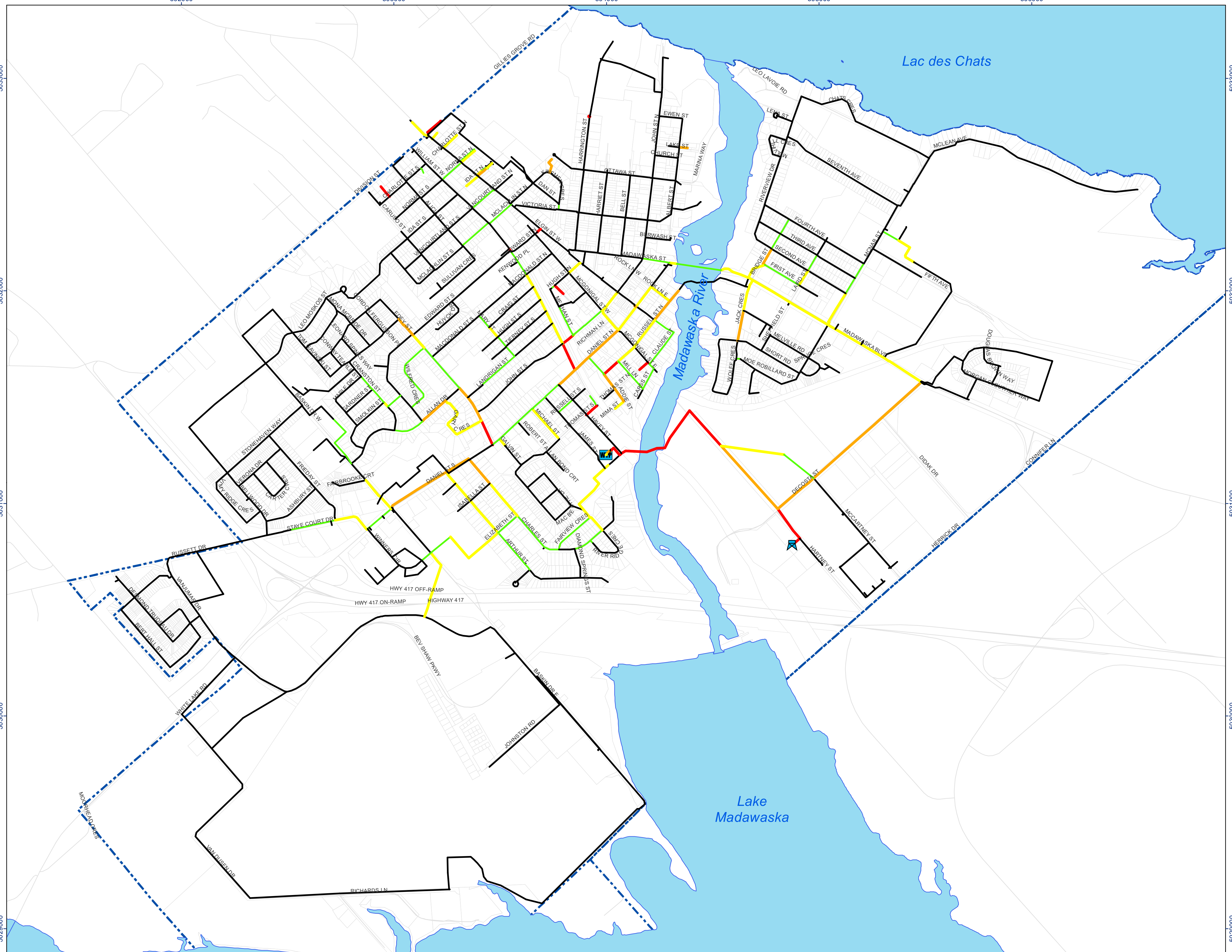
Client/Project
Town of Arnprior
2022 W&WW Master Plan Update

163401723

Figure No.
F1-1

Title
Model Results: 2042 Conditions with Solutions – MXDY Maximum Velocities

\\Ca0218-ppfss01\01-634\active\1634_01723\planning\drawing\gis\MXDs\tm3_figs\appD1-1to2_arn_wtr_2042_w_solns_model_results_20230804.mxd Revised: 2023-11-17 By: jsidhu



Stantec

Legend

Watermain Maximum Head Loss (HL) per km

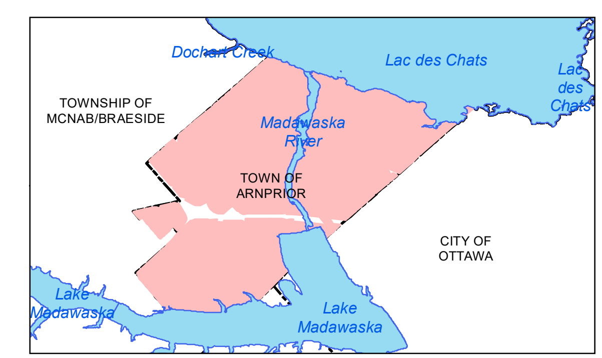
- HL ≤ 0.5 m/km
- 0.5 m/km < HL ≤ 1.0 m/km
- 1.0 m/km < HL ≤ 2.5 m/km
- 2.5 m/km < HL ≤ 5.0 m/km
- HL > 5.0 m/km
- WTP Water Treatment Plant (WTP)
- Elevated Storage Tank (EST)
- Municipal Boundary

N

0 250 500 Meters
(At original document size of 11x17)
1:18,500

Notes

1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Ontario_Hydro_Network_(OHN)_-_Waterbody.shp*, *Ontario_Hydro_Network_(OHN)_-_Waterbody (2).shp*, *Municipal_Boundary_-_Lower_and_Single_Tier.shp*, and *Arnprior_Roads_20220324* and *Arnprior_PropertyParcels_wAssessment_20220324.shp* provided by the Town of Arnprior.
3. Background: Contains information licensed under the Open Government Licence – Ontario



Project Location
Arnprior, ON

Prepared by CZ on 2023-08-04
Revised by CZ on 2023-10-17

Client/Project 163401723
Town of Arnprior
2022 W&WW Master Plan Update

Figure No.
F1-2

Title
Model Results: 2042 Conditions with Solutions – MXDY Maximum Head Losses

F.2 Watermain Upgrades Recommended in 2013 W&WWMP

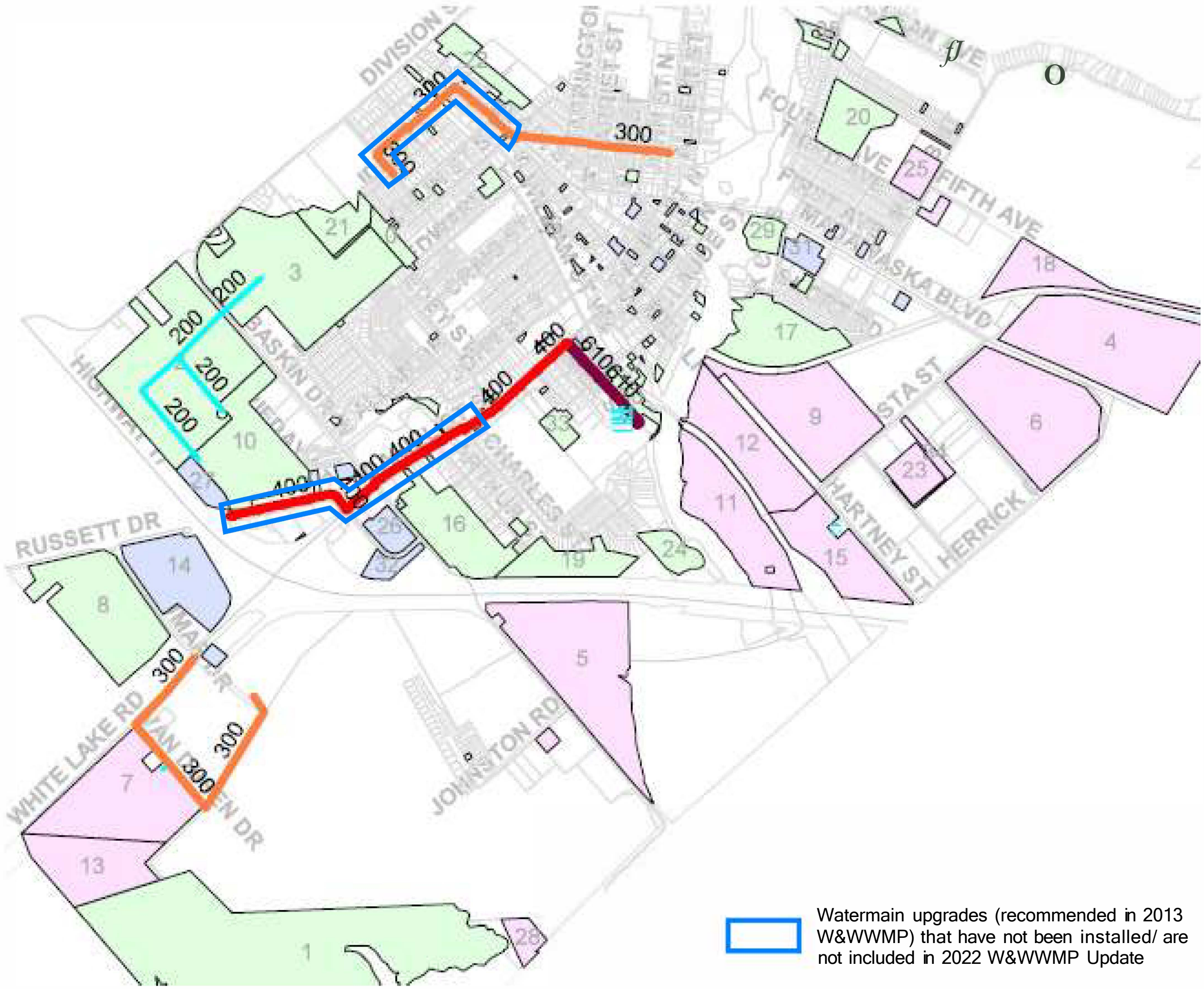
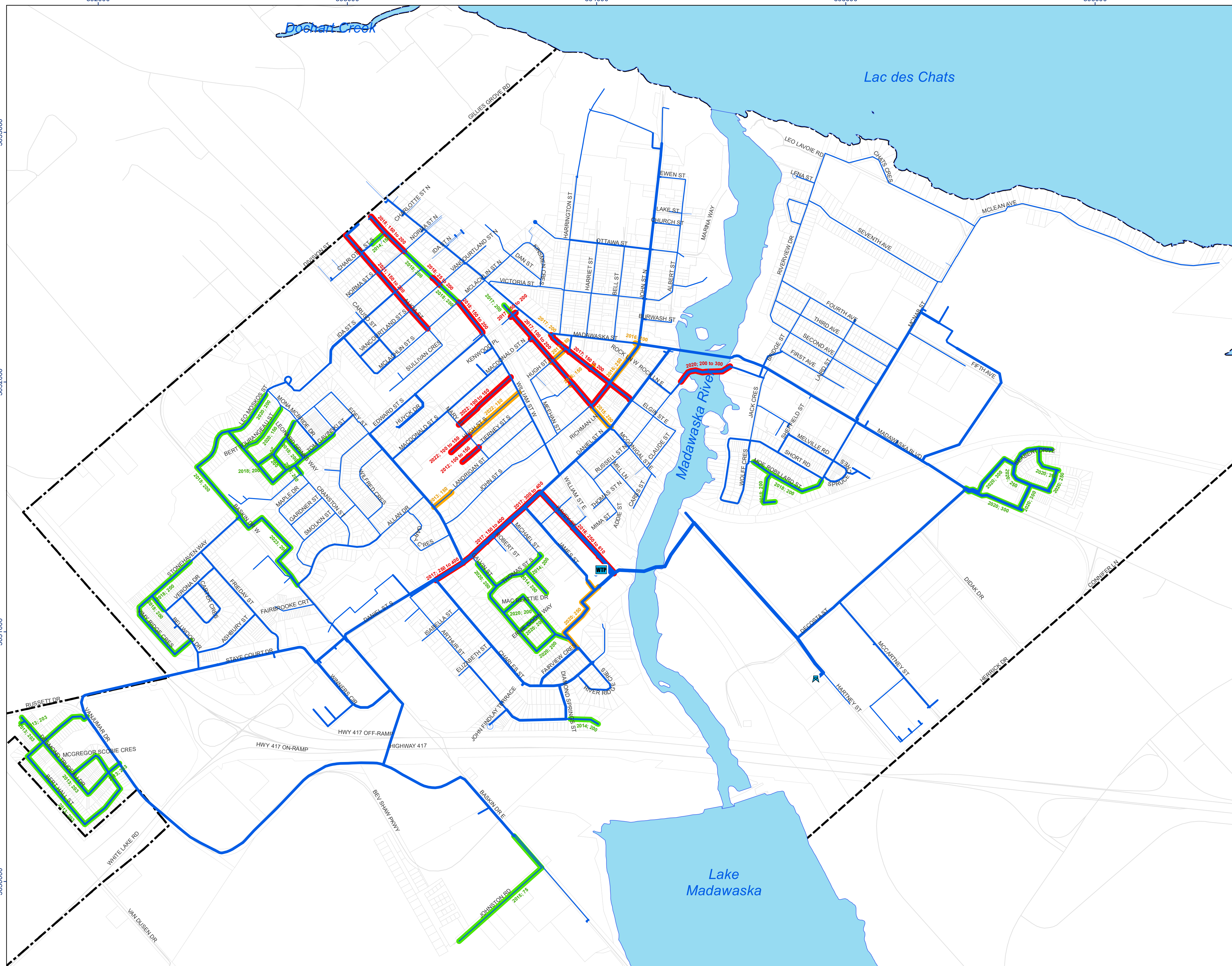


Figure F2-1: Watermain Upgrades Recommended in 2013 W&WWMP

F.3 Watermains Installed After 2011



Stantec

Legend

Watermains - Diameter (mm)

- < 75 mm
- 75 mm - 150 mm
- 150 mm - 225 mm
- 225 mm - 350 mm
- 350 mm - 600 mm
- Watermains Upgraded After 2011
- Watermains Replaced After 2011
- New Watermains Installed After 2011
- WTP Water Treatment Plant (WTP)
- Elevated Storage Tank (EST)
- Municipal Boundary
- XXXX; YYY to ZZZ — Watermain upgraded from "YYY" mm to "ZZZ" mm in the year "XXXX"
- XXXX; YYY — Watermain replaced with the same diameter of "YYY" mm in the year "XXXX"
- XXXX; YYY — New "YYY" mm diameter watermain installed in the year "XXXX"

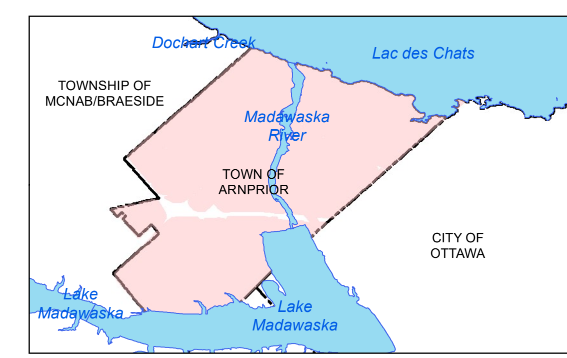
N

0 250 500 Meters

(At original document size of 11x17)
1:16,000

Notes

1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: *Ontario_Hydro_Network_(OHN)_-_Waterbody.shp, Ontario_Hydro_Network_(OHN)_-_Waterbody (2).shp, Municipal_Boundary_-_Lower_and_Single_Tier.shp,* and *0837ARNP.sid*, *Arnprior_PropertyParcels_wAssessment_20220324.shp, Arnprior_Roads_20220324.shp* and *WTR_NODE.shp* provided by the Town of Arnprior
3. Background: Contains information licensed under the Open Government Licence – Ontario



Project Location Prepared by CZ on 2023-11-08

Arnprior, ON

Client/Project 163401723

Town of Arnprior
2022 W&WW Master Plan Update

Figure No.

F3-1

Title

Water Distribution Network (Existing Conditions) - Watermains Installed After 2011

Appendix G Consultation Documents

G.1 Stakeholder Contact List

	First Name	Last Name	Job Title	Company/Organization	Address 1	Address 2	City	Province	Postal Code	Phone Number	Email
Provincial Government/Ministries											
			MECP Eastern Region	EA Notifications E Region							eanotification.eregion@ontario.ca
	Allan	Scott	Regional Director	Ministry of Municipal Affairs and Housing	8 Estate Lane		Kingston	ON	K7M 9A8	613-545-2133	allan.scott@ontario.ca
	John	Almond	District Planner	Ministry of Northern Development, Mines, Natural Resources and Forestry Kemptville District	10 Campus Dr		Kemptville	ON	K0G 1J0	289-380-1039	john.almond@ontario.ca
	Karla	Barboza	Team Lead, Heritage – Heritage Program Unit	Ministry of Tourism, Culture and Sport	401 Bay Street, Suite 1700		Toronto	ON	M7A 0A7	416.314.7120	karla.barboza@ontario.ca
	Lise	Chabot	Manager, Ministry Partnerships Unit	Ministry of Indigenous Affairs	160 Bloor Street East, 4th Floor		Toronto	ON	M7A 2E6	416-325-7032	lise.chabot@ontario.ca
	Michele	Doncaster	Manager, Land Use Policy and Stewardship	Ministry of Agricultural Food and Rural Affairs	1 Stone Road W	3rd Floor	Guelph	Ontario	N1G 4Y2		michele.doncaster@ontario.ca
	Rita	Kelly	Project Manager, Land Transactions, Hydro Corridors & Public Works	Infrastucture Ontario	1 Dundas St. West Suite 2000	Toronto	ON	M5G 1Z3			rita.kelly@infrastructureontario.ca
			Linear Development	Fisheries and Oceans Canada, Fisheries Protection Program	867 Lakeshore Road		Burlington	ON	L7R 4A6		DFO.CA_Linear_Development-Developpement_Lineaire_CA.MPO@dfo-mpo.gc.ca
Other Agencies/Stakeholders											
	Mike	Mortimer	President, OMWA	Ontario Municipal Water Association	30 Spence Ave		Midhurst	ON	L9X 0P2		mmortimer@ocwa.com
	Andy	Trader	Regional Hub Manager	Ontario Clean Water Agency	20 Bennett Drive	Suite 200	Carleton Place	ON	K7C 4J9		ATrader@ocwa.com
	Bill	Murray	Facility Manager	Renfrew County District School Board	1270 Pembroke St. West		Pembroke	ON	K8A 4G4	613-735-0151	murrayb@rcdsb.on.ca
	Wendy	Charbonneau	Main Board Reception	Renfrew County Catholic District School Board	499 Pembroke St West		Pembroke	ON	K8A 5P1	613-735-1031	boardoffice@rccdsb.edu.on.ca
	Marc	Bertrand	Director of Education and Secretary-Treasurer	Conseil des écoles catholiques du Centre-Est	4000 Labelle Street		Ottawa	ON	K1J 1A1		bertrma@ecolecatholique.ca
	Stéphane	Vachon	Superintendent of Business	Conseil des écoles publiques de l'Est de l'Ontario	2445 St-Laurent Blvd		Ottawa	ON	K1G 6C3		stephane.vachon@cepeo.on.ca
Utilities											
			Eastern Region Crossing	Enbridge Pipelines Inc.	1080 Modeland Road	Bldg 1050	Sarnia	ON	N7S 6L2		est.reg.crossing@enbridge.com
				Enbridge	101 Honda Boulevard		Markham	ON	L6C 0M6		Mark-Ups@enbridge.com
				Hydro One, Real Estate Services	483 Bay Street, North Tower	North Tower, 15th Floor	Toronto	ON	M5G 2P5		RE@HydroOne.com
			Crossings	Trans Northern Pipelines							crossingrequestseast@tnpi.ca
	Chris	Lockyer	Implementation Manager	Bell Canada	450 Princess Street		Kingston	ON	K7L 1C2	613-542-4636	christopher.lockyer@bell.ca
	Richard	Austria	Outside Plant Engineer	Rogers Communications	8200 Dixie Road		Brampton	ON	L6T 0C1	647-747-2976	richardaustria@rci.rogers.com
	Bruce	Pearson	Network Planner / OSP	Cogeco	517 Pitt Street		Cornwall	ON	K6J 5T4	613 878-2822	bruce.pearson@cogeco.com
Indigenous Nations											
				Algonquins of Ontario	31 Riverside Drive	Suite 101	Pembroke	ON	K8A 8R6	1-855-735-3759	algonquins@tanakiwin.com
	Doreen	Davis		Sharbot Obaadijiwan First Nation	29649 Highway 7	P.O. Box 175	Sharbot Lake	ON	K0H 2P0	343-233-0167	chiefdoreendavis@gmail.com
	Wendy	Jocko		Algonquins of Pikwàkanagàn	1657A Mishomis Inamo		Pikwàkanagàn	ON	K0J 1X0	613-625-1551	chief@pikwakanagan.ca
	David Patrick	Mowat		Alderville First Nation	P.O. Box 46		Roseneath	ON	K0K 2X0		dmowat@alderville.ca
	Kelly	LaRocca		Mississaugas of the Scugog Island First Nation	22521 Island Road		Port Perry	ON	L9L 1B6		info@scugogfirstnation.com
	Monica	Sanford	Community Consultation Specialist	Mississaugas of the Scugog Island First Nation	22521 Island Rd.		Port Perry	ON	L9L 1B6	(905) 985-3337 ext. 229	msanford@scugogfirstnation.com / info@scugogfirstnation.com
	Laurie	Carr		Hiawatha First Nation	123 Paudash Street		Hiawatha	ON	K9J 0E6		info@hiawathafn.ca
	Tom	Cowie	Lands Resource Consultation Liaison	Hiawatha First Nation	123 Paudash Street		Hiawatha	ON	K9J 0E6	(705) 295-4421	tcowie@hiawathafn.ca
	Emily	Whetung		Mississaugas of Curve Lake First Nation	22 Winookeedaa Road		Curve Lake	ON	K0L 1R0		Communication@curvelake.ca
	Kaitlin	Hill	Lands & Resources Consultation Liaison	Mississaugas of Curve Lake First Nation	22 Winookeedaa Road		Curve Lake	ON	K0L 1R0		kaitlinh@curvelake.ca
	Julie	Kapyrka	Lands & Resources Consultation Liaison	Mississaugas of Curve Lake First Nation	22 Winookeedaa Road		Curve Lake	ON	K0L 1R0		JulieK@curvelake.ca
				Metis Nation of Ontario	66 Slater Street	Suite 1100	Ottawa	ON	K1P 5H1		consultations@metisnation.org
	Eric	Gjos	President	MNO Ottawa Region Métis Council	214 Montreal Road		Ottawa	ON	K1L 8L8	613-748-1880 x. 306	president.ormc@gmail.com
Public											
	Erin	O'Connor	Regional Group	1737 Woodward Drive			Ottawa	ON	K2C 0P9	613-230-2100 x620	eoconnor@regionalgroup.com
	Trevor	McKay									t.mckay@novatech-eng.com
	Charlotte	Leitch									charlotte@charlotteleitch.com

G.2 Notice of Commencement and Correspondence

ARNPRIOR
105 Elgin St. West
Arnprior, ON K7S 0A8
tel 613 623 4231
fax 613 623 8091
arnprior@arnprior.ca
www.arnprior.ca

Notice of Study Commencement

The Town of Arnprior (Town) is seeking to better understand its existing water and wastewater systems conditions and assess these systems abilities to service future growth area. The Town will be updating their Water and Wastewater Master Plan (WWMP), 2013 and will involve a comprehensive review and assessment of the Town's sanitary sewer collection and potable water distribution systems. The MP will review opportunities to optimize the performance of existing infrastructure, while identifying the most sustainable approach to serve the Town's existing communities as well as new development (**Figure 1**).

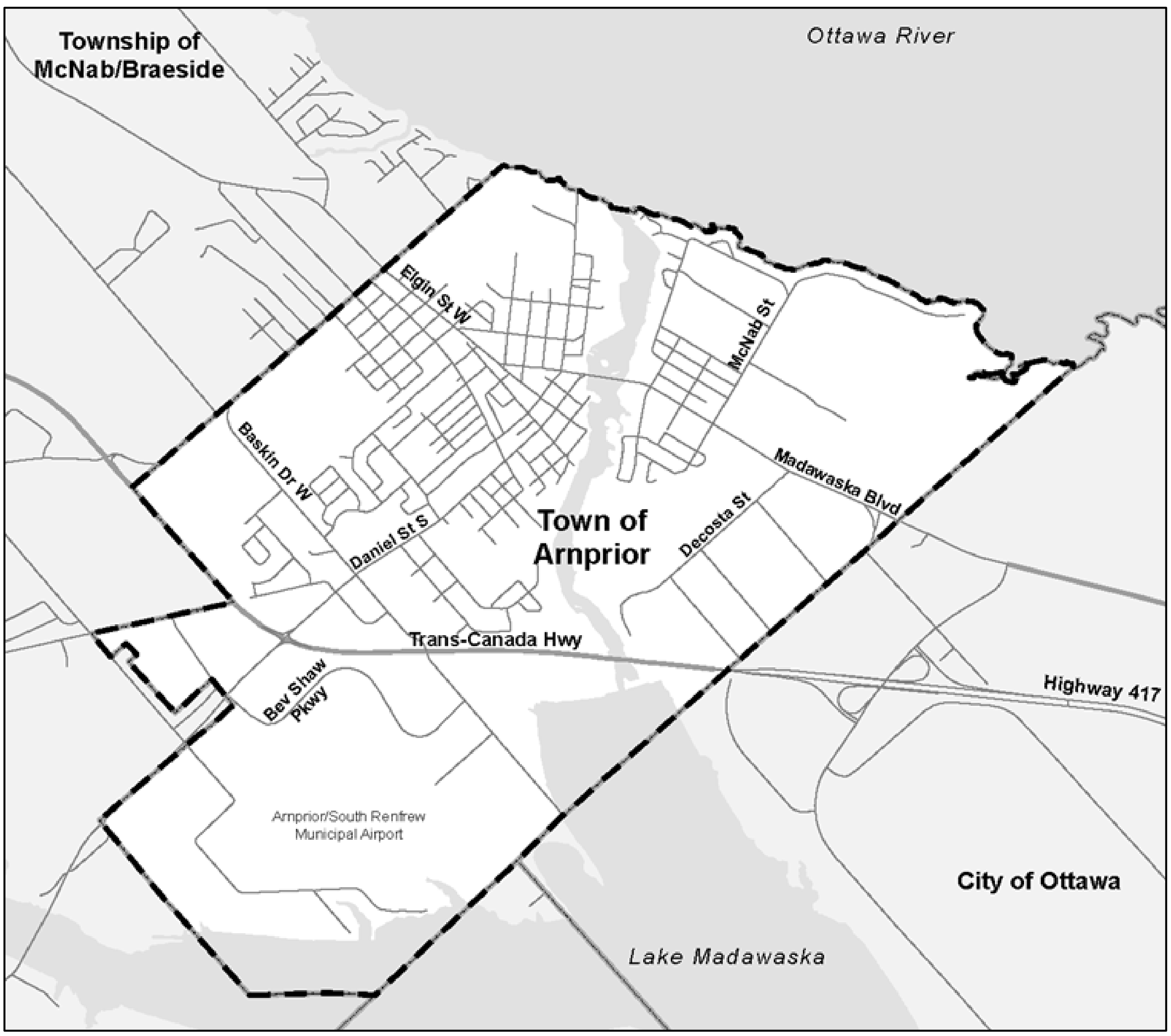


Figure 1: Key Map of the Town of Arnprior

This study is being undertaken in accordance with Approach #1 of the Master Planning Process, as outlined in Appendix 4 of the Municipal Class Environmental Assessment (MCEA) document (October 2000, as amended in 2007, 2011 and 2015). As such, the WWMP will address Phases 1 and 2 of the MCEA process to fulfill the requirements for the recommended Schedule A, and A+ projects and will form the basis for the recommended Schedule B and C water and wastewater projects identified within the WWMP report.

How to get involved?

Various opportunities for public involvement will be provided during this important study, and your feedback is encouraged to provide input to project planning by helping to identify potential water and wastewater servicing needs and opportunities. You are invited to visit the study website *https://www.arnprior.ca/en/town-hall/plans-reports-and-studies.aspx* to learn more about this study.

We look forward to hearing from you!

Please visit the Town's website or contact one of the following study team members if you would like to learn more about this study:

John Steckly, A.Sc.T.
General Manager, Operations
Town of Arnprior
Tel: 613-623-4231 ext. 1831
Email: jsteckly@arnprior.ca

Marc Telmosse P.Eng.
Project Manager
Stantec Consulting Ltd.
Email: marc.telmosse@stantec.com

All information will be collected in accordance with the *Freedom of Information and Protection of Privacy Act* (2009). Except for personal information, all comments will become part of the public record.

This notice was issued on April 7, 2022

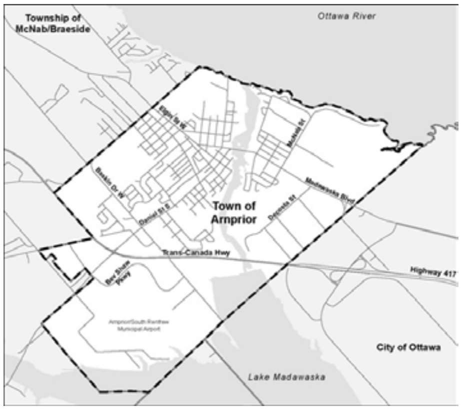
Water and Wastewater Master Plan Public Information Centre

Posted on Friday, February 09, 2024

The Town of Arnprior (Town) is seeking to better understand its existing water and wastewater systems conditions and assess these systems abilities to service future growth area. The Town has initiated an update to their Water and Wastewater Master Plan (WWMP), 2013, which will involve a comprehensive review and assessment of the Town's sanitary sewer collection and potable water distribution systems. The WWMP will review opportunities to optimize the performance of existing infrastructure, while identifying the most sustainable approach to serve the Town's existing communities as well as new development (**Figure 1**).

This study is being undertaken in accordance with Approach #1 of the Master Planning Process, as outlined in Appendix 4 of the Municipal Class Environmental Assessment (MCEA) document (October 2000, as amended in 2007, 2011, and 2015). As such, the WWMP will address Phases 1 and 2 of the MCEA process to fulfill the requirements for the recommended Schedule A, A+ and B projects and will form the basis for the recommended Schedule C water and wastewater projects identified within the WWMP report.

Figure 1: Key Map of the Town of Arnprior



How to get Participate?

Various opportunities for public involvement will be provided during this important study, and your feedback is encouraged to provide input to project planning by helping to identify potential water and wastewater servicing needs and opportunities. You are invited to attend the Public Information Centre on February 28, 2024, from 6:00 PM to 8:00 PM at the Nick Smith Center (77 James Street, Arnprior).

We look forward to hearing from you!

Please visit the project website or contact one of the following study team members if you would like to learn more about this study:

John Steckly, A.Sc.T. General Manager, Operations Town of Arnprior Tel: 613-623-4231 ext. 1831 Email: jsteckly@arnprior.ca	**Marc Telmosse P.Eng.** Project Manager Stantec Consulting Ltd. Email: marc.telmosse@stantec.com

All information will be collected in accordance with the *Freedom of Information and Protection of Privacy Act* (2009). Except for personal information, all comments will become part of the public record.

Water and Wastewater Master Plan

Town of Arnprior

Public Information Centre

February 28, 2024

6:00 PM to 8:00 PM

Nick Smith Center

77 James Street, Arnprior

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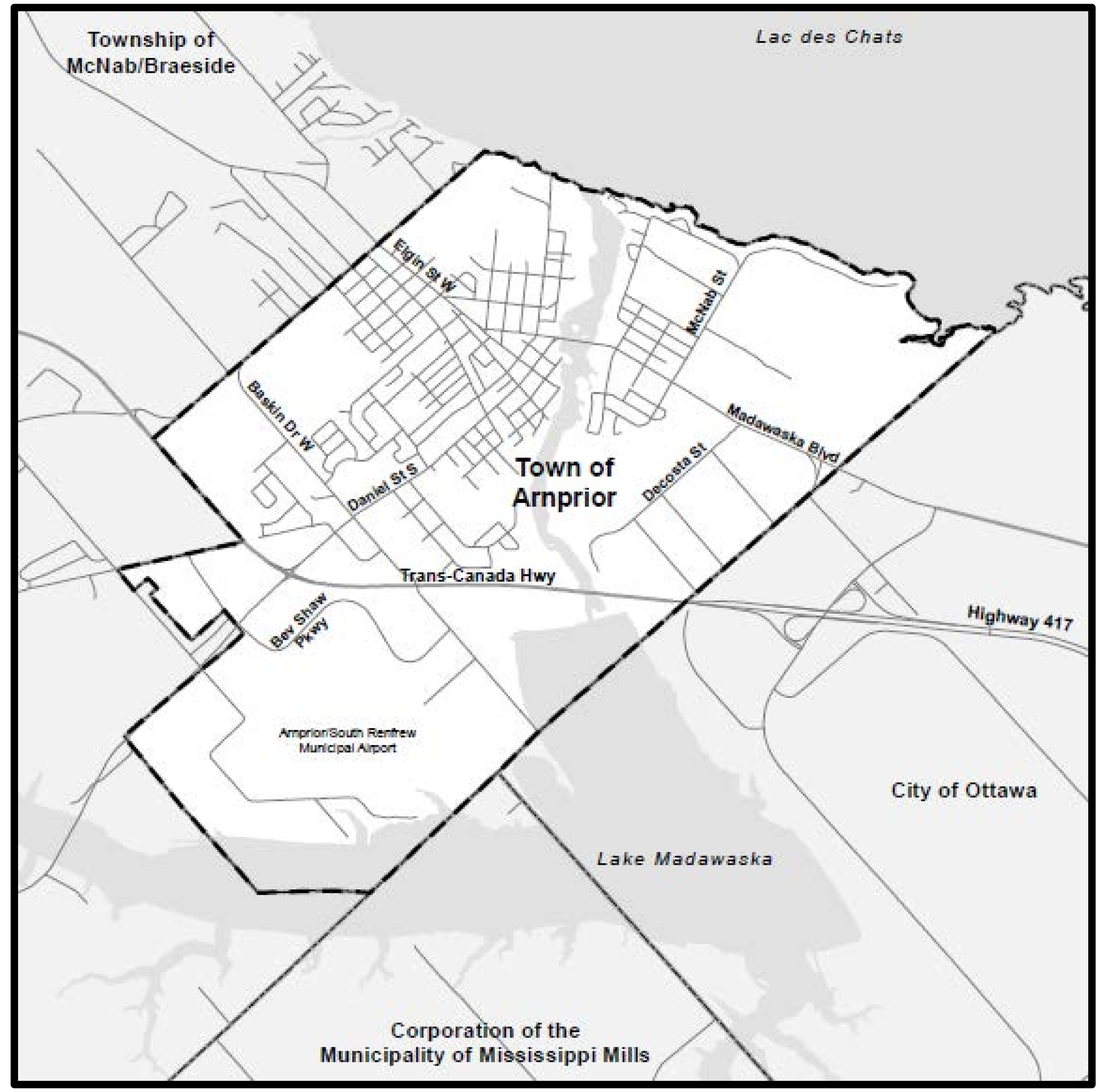
Source: Town of Arnprior

Study Area

The study area reflects the boundaries of the Town of Arnprior, in which the new Water and Wastewater Master Plan (W&WW MP) will service.

A Municipal Class Environmental Assessment (Class EA) is being prepared for the expansion of water and wastewater infrastructure to accommodate the Town's population growth.



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What is the Purpose of this PIC?

While updating the W&WW MP, we aim to present and gather your feedback on the:

- Study background and purpose
- Master Planning process
- Existing and future water servicing
- Problem and opportunities
- Existing environmental conditions
- Evaluation of Alternative Solutions
- Recommended solution
- Potential impacts to the environment and proposed mitigation measures
- Next Steps in the process

DEVELOPING THE MASTER PLAN

Review and assess the sanitary sewer collection and potable water distribution systems

↓

Review the existing municipal drinking water and wastewater treatment facilities

↓

Develop a timeline that identifies future expansion requirements to meet anticipated growth over a 5-year (2027), 10-year (2032) and 20-year (2042) planning horizon

Master Planning Process

Municipal Class Environmental Assessment

Phase 1
Problem and Opportunity

- Information Gathering
- Identify Problems and Opportunities

Phase 2
Alternative Solutions
WE ARE HERE

- Identify and Evaluate Alternative Solutions
- Develop Implementation Strategy

- Prepare Water & Wastewater Master Plan (W&WW MP)

CONTINUOUS CONSULTATION

Notice of Study Commencement
(April 7, 2022)

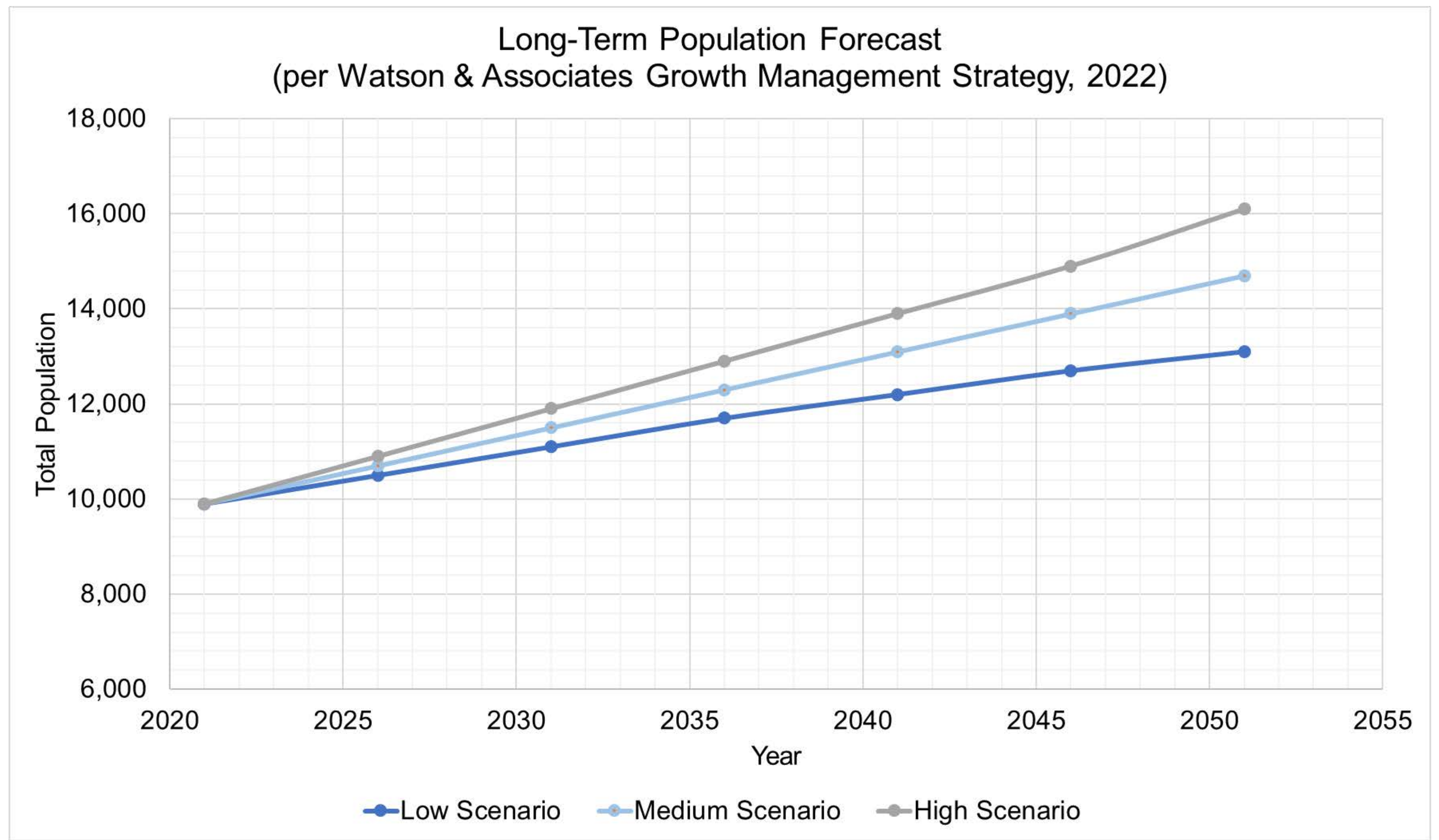
Public Information Centre
(February 28, 2024)

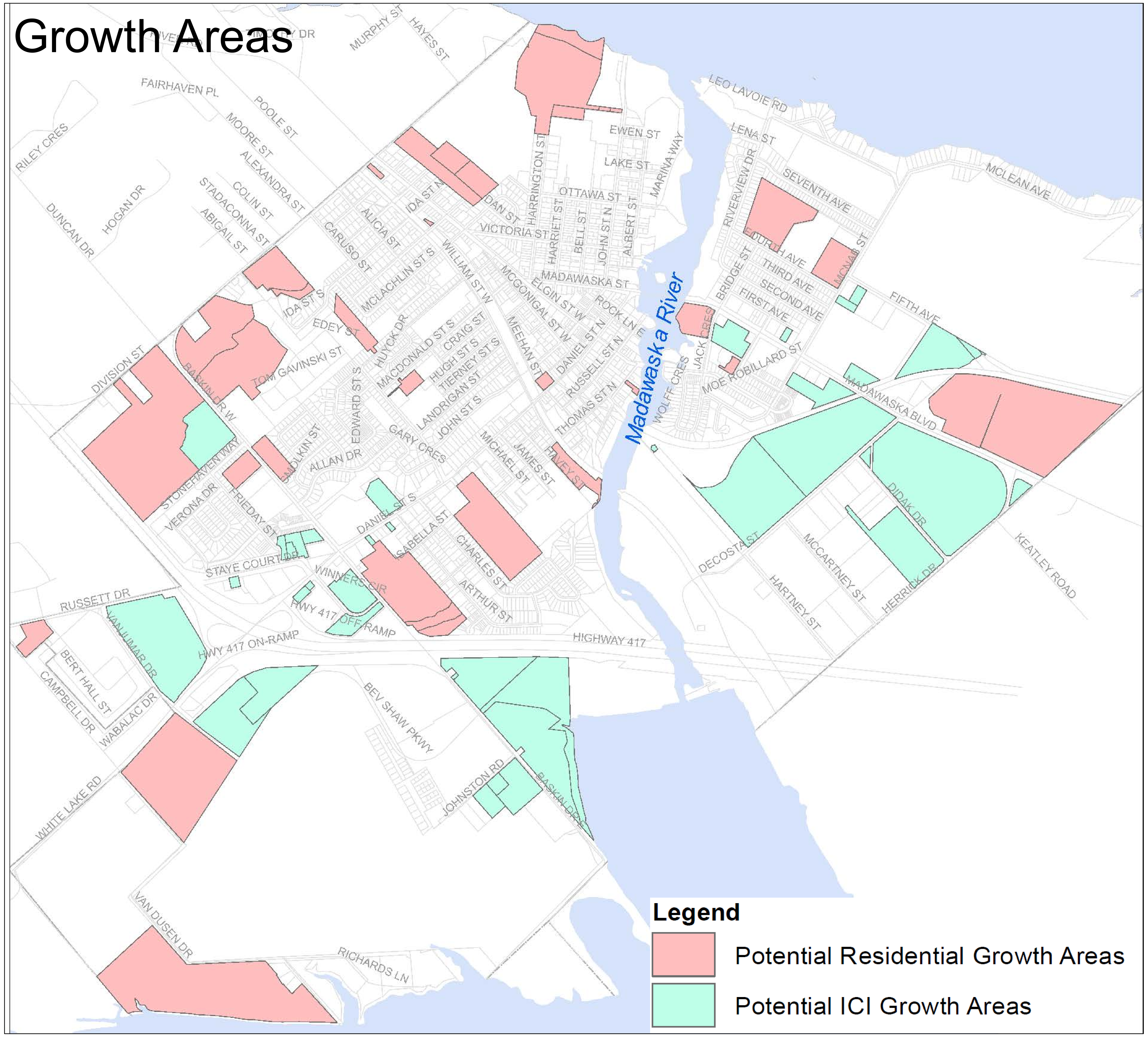
Notice of Master Plan
(Proposed for Spring 2024)

This study is being undertaken in accordance with Approach #1 of the Master Planning Process, as outlined in Section A.2.7. of the Municipal Class Environmental Assessment (MCEA) document (2023). As such, the W&WW MP will address Phases 1 and 2 of the MCEA process to become the basis for, and be used in support of, future investigations for the specific Schedule B and C projects identified within it.

Growth Projections

- Developed growth projections to assess the wastewater collection and potable water distribution systems' capacities, and to identify growth areas' servicing needs
- Identified distribution and phasing of growth across the Town
- Population is projected to increase from 10,000 in 2022 to 13,900 by 2042 (high scenario).





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Master Plan Recommendations

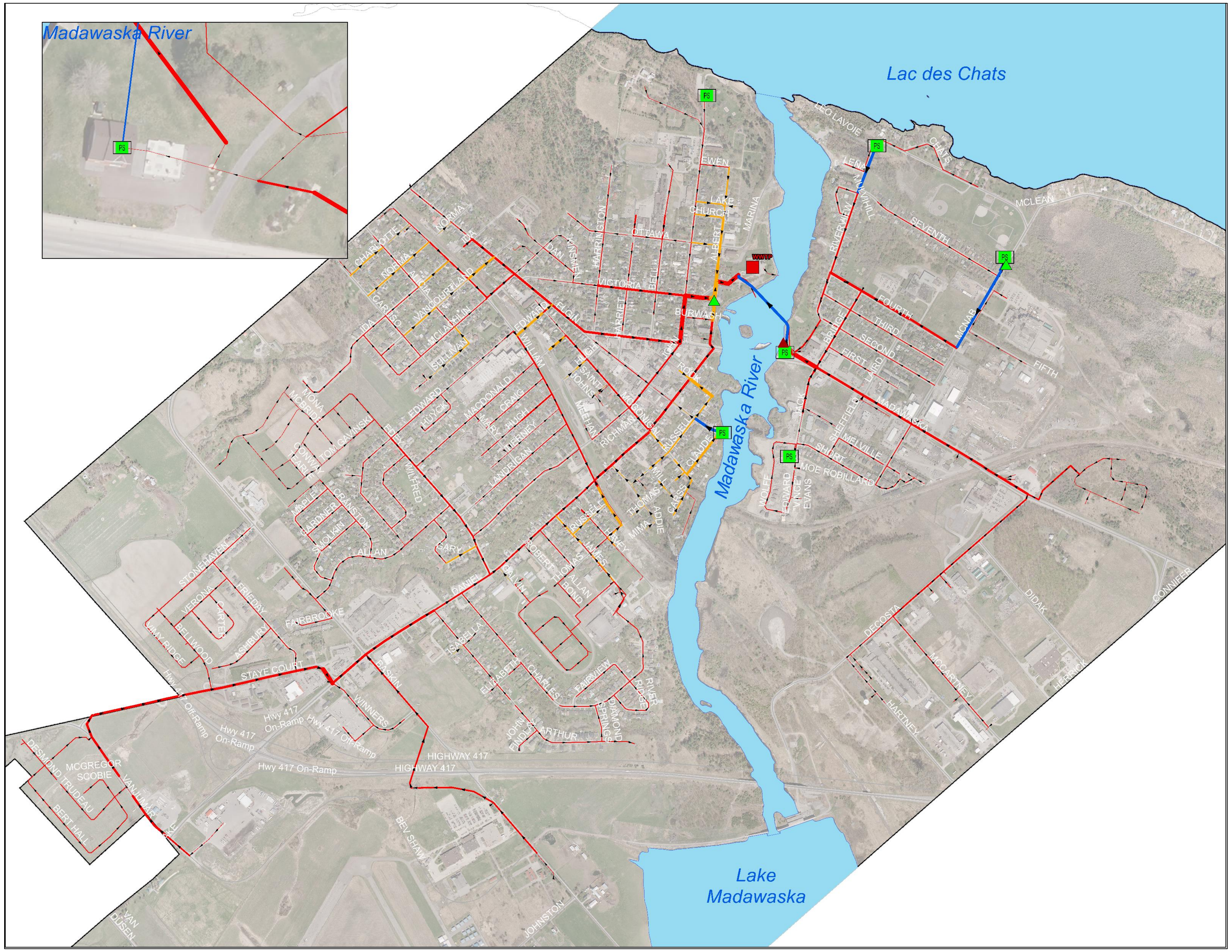
2013 Water & Wastewater Master Plan

- New sanitary sewers and sewage pumping stations were identified to service growth areas by 2031
- Existing watermain upgrades were identified to accommodate growth by 2031
- Water filtration plant (WFP) treatment upgrades needed by 2026

Current Master Plan (2022-2024)

- Will consider service needs over the short (5-year), medium (10-year) and long-term (20-year) planning horizon
- Existing sewer and sewage pumping station upgrades needed to accommodate existing peak wet weather flows
- WFP treatment, storage and pumping expansions needed to accommodate population growth
- New servicing areas will require new wastewater collection and potable water distribution infrastructure

Existing Infrastructure: Wastewater Collection System



Existing Wastewater Collection System

- Approximately 60 km of sewers
- Sewage pumping stations
- Water Pollution Control Centre (WPCC) on Albert St. The last WPCC expansion was completed in 2011.
- Under extreme events, sanitary flows can overflow to the stormwater collection system or to the Madawaska River.

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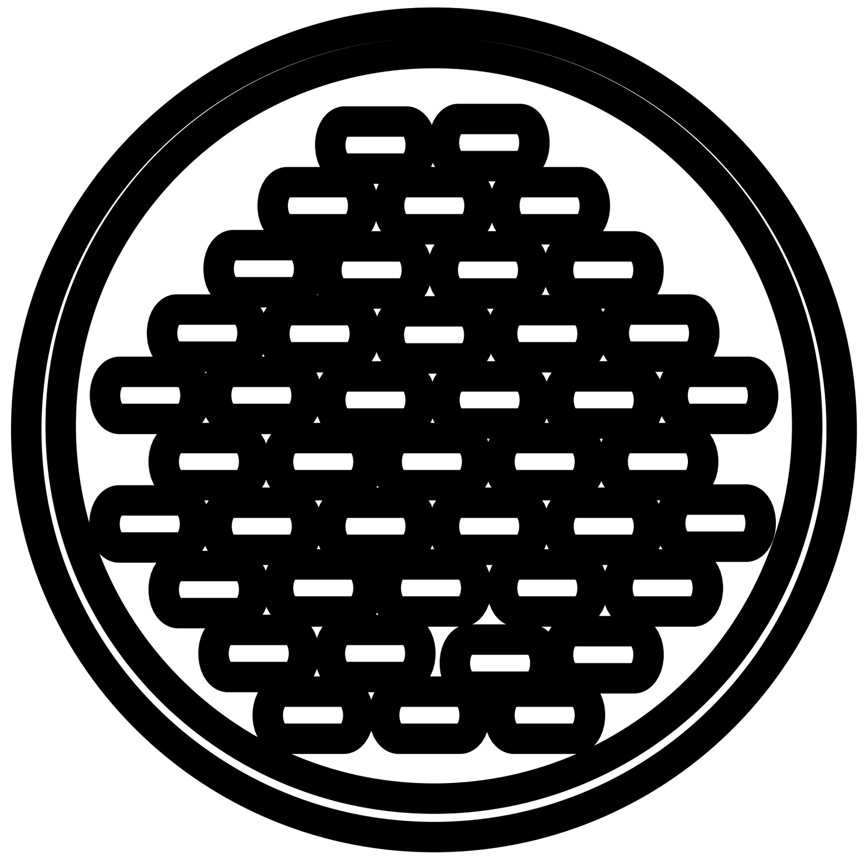
Existing Infrastructure: Potable Water Distribution System

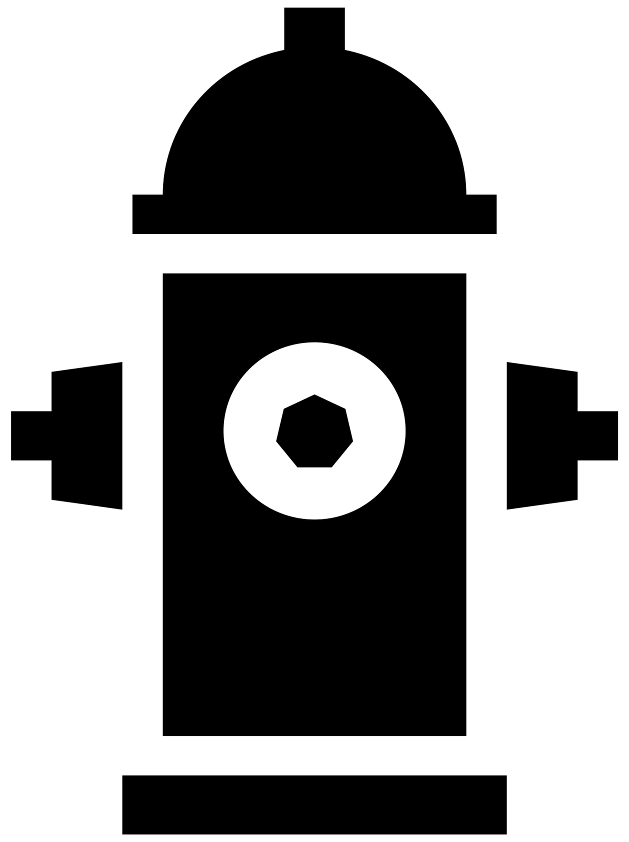
Existing Potable Water Distribution System

- A Water Filtration Plant (WFP), taking raw water from the Madawaska River. The WFP was last upgraded in 2010.
- The WFP provides storage in its clearwells, and pumping from high-lift pumps (HLPs).
- An elevated storage tank (EST) on Hartney St, constructed in 1993.
- Approximately 65 km of watermains and 315 hydrants.

Problems and Opportunities

Long-term operational and capital improvements to the Town's Wastewater Collection System and Potable Water Distribution System are required to meet current regulations and growth up to 2042.





Wastewater Collection System

- Existing peak wet weather flows create constraints in the sewer system and at the sewage pump stations
- The sewer system and sewage pump stations will need to accommodate higher flows from new developments

Potable Water Distribution System

- 2042 growth demands will exceed the system's treatment, storage and pumping capacity and require an increase in capacity
- The potable water distribution system will benefit from improved reliability in the event of watermain breaks

- Additional capacity required to meet future demand
- Impacts of climate change (increase and decrease of precipitation, temperature, significant weather events)
- Opportunities to adapt to climate change, mitigate climate change & generate energy savings

Problems and Opportunities

Long-term operational and capital improvements to the Town's Water Pollution Control Centre (WPCC) and Water Filtration Plant (WFP) are required to meet current regulations and growth up to 2042.

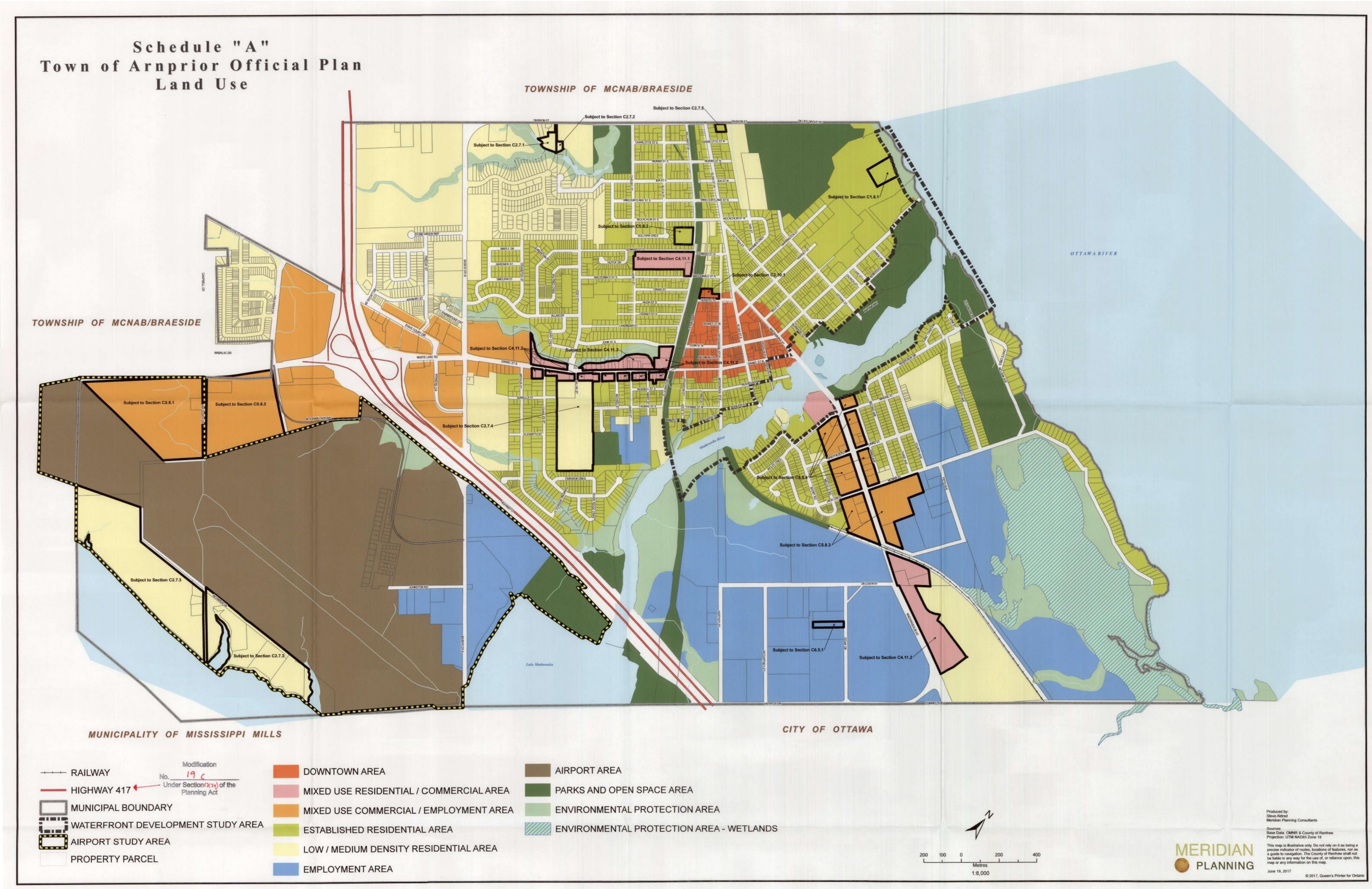
Water Pollution Control Centre (WPCC)

- The WPCC's capacity can accommodate the projected growth to 2042. The WPCC does not require an expansion by 2042.
- Internal process improvements and studies are recommended to enhance treatment steps.

Water Filtration Plant (WFP)

- The WFP will require the following upgrades to accommodate growth to 2042:
  - 6% increase in treatment capacity.
  - 25% increase in clearwell storage.
  - 18% increase in pumping capacity.

Existing Conditions: Land Use & Environmental Protection



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Existing Conditions: Heritage

Cultural Heritage

- The 2017 Town of Arnprior OP outlines objectives for the conservation of cultural heritage resources.
- As part of project-specific detailed investigations, cultural heritage resources that retain heritage attributes should be identified and avoided where possible.
- Where avoidance is not possible, potential effects to these attributes should be identified and minimized.

Source: Town of Arnprior

Archaeology

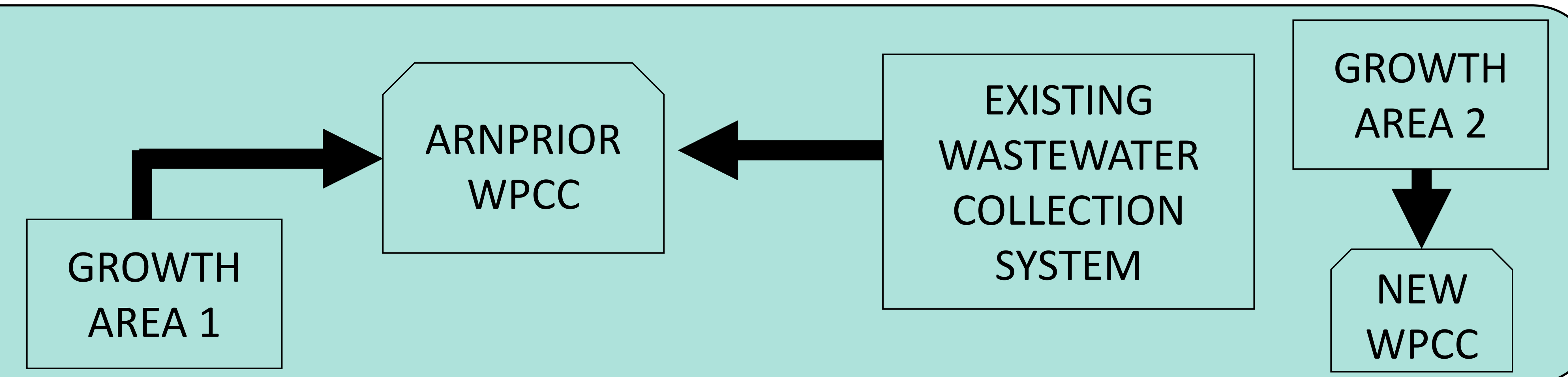
- Study area is located within the Ottawa Valley, which has the potential for the recovery of pre- and post-contact Indigenous and Euro-Canadian archaeological resources.
- Appropriate archaeological investigations are required for certain infrastructure projects in accordance with the MCEA process.
- Any projects identified as a Schedule B or C project will require an archaeological assessment to be completed.

Alternative Solutions: Wastewater Collection System

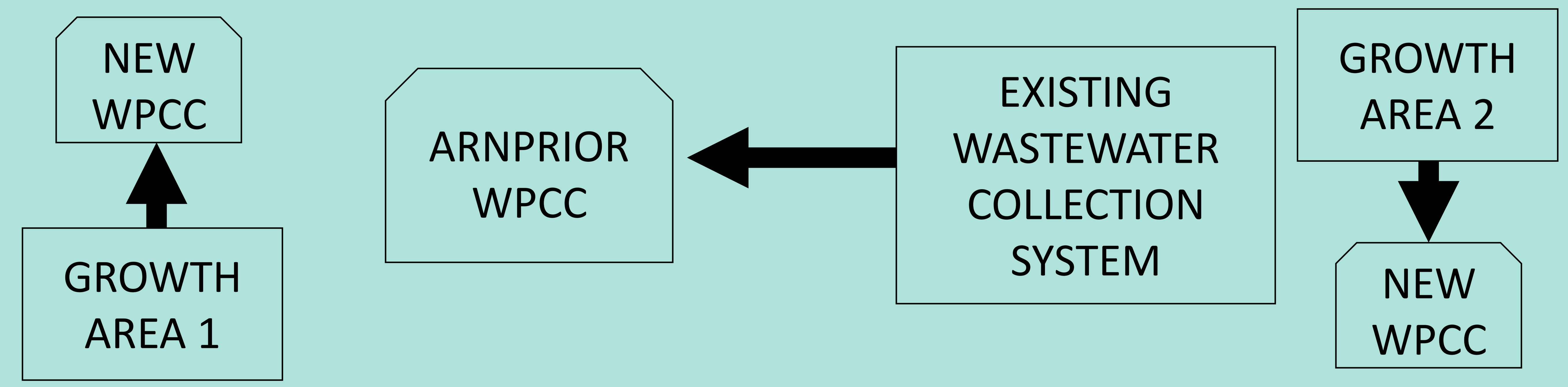
Alternative 1
Do Nothing

Alternative 2
Inflow & Infiltration Reduction and Re-Use Alternatives

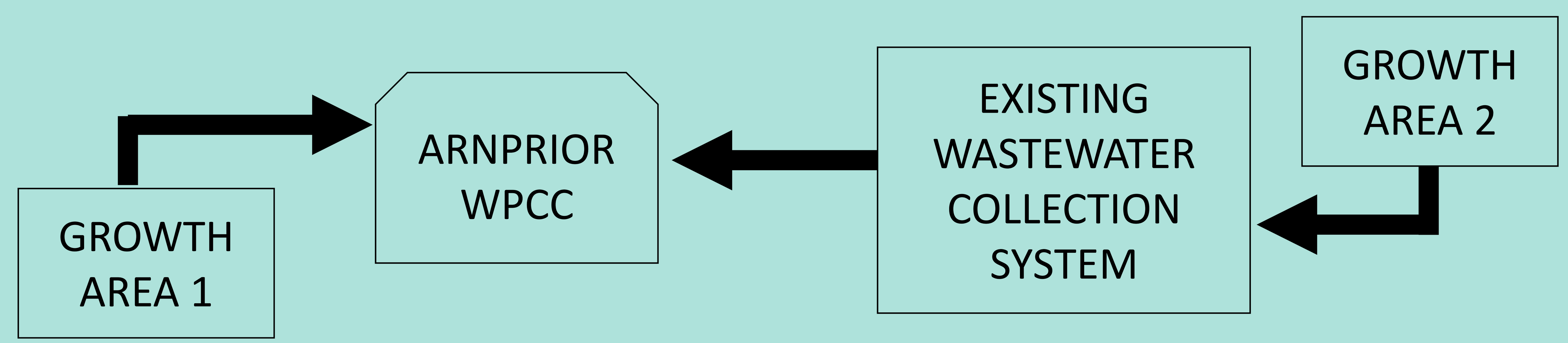
Alternative 3
Partial Private/Communal & Municipal Wastewater Servicing



Alternative 4
Communal Wastewater Collection System



Alternative 5
Improvement & Expansion of the Municipal Wastewater Collection System

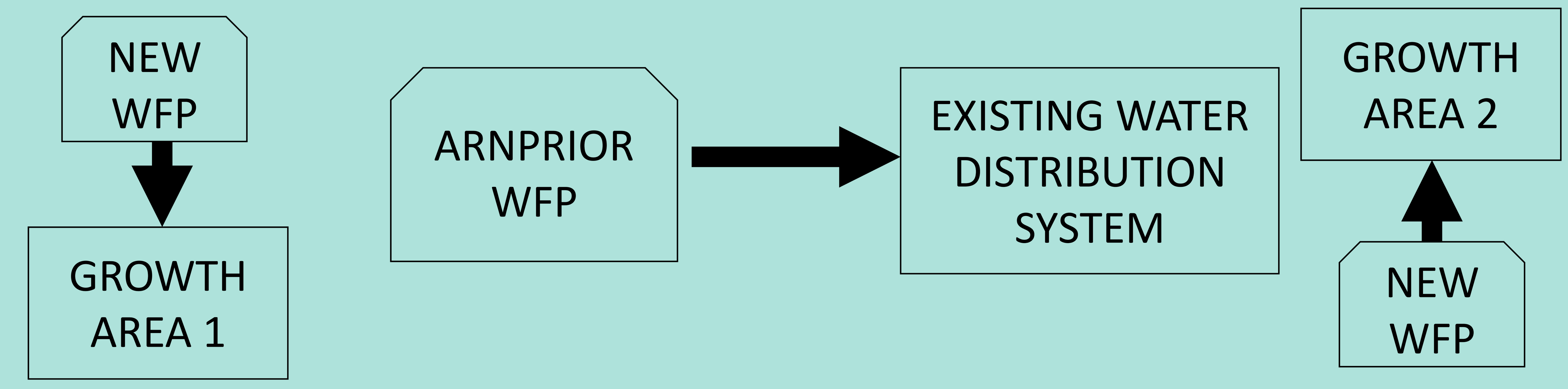


Alternative Solutions: Potable Water Distribution System

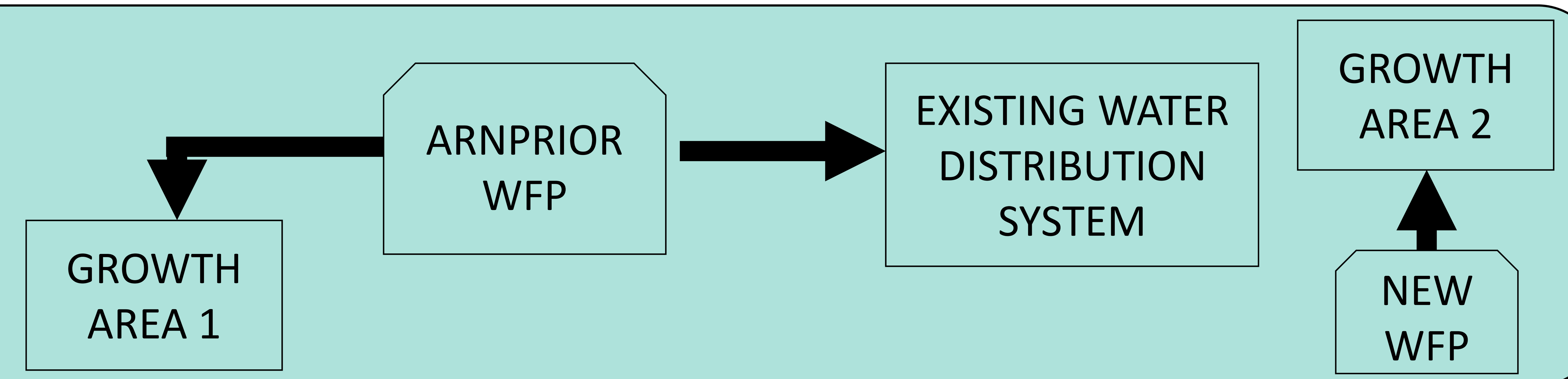
Alternative 1
Do Nothing

Alternative 2
Water Conservation and Re-Use

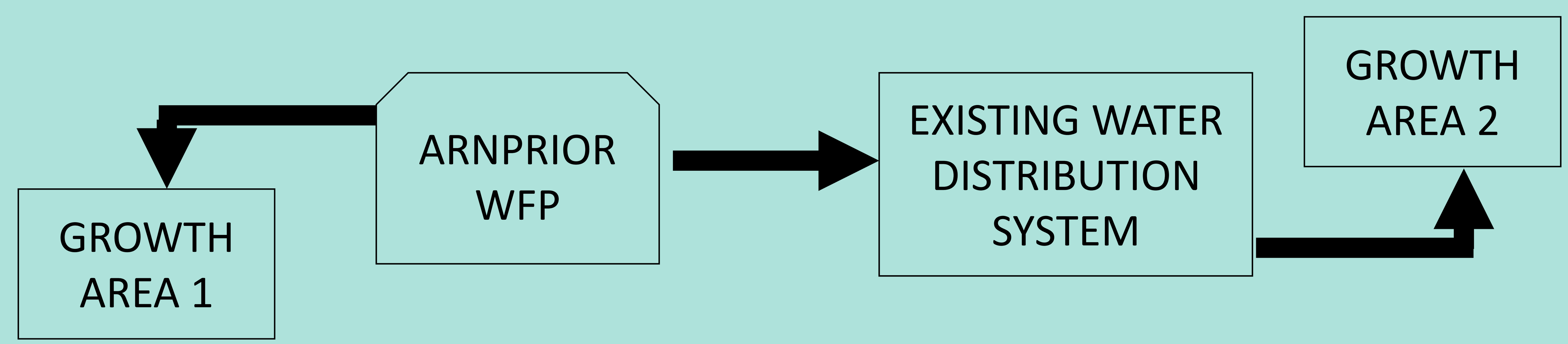
Alternative 3
Communal Potable Water System



Alternative 4
Partial Private/Communal & Municipal Potable Water Servicing



Alternative 5
Improvement & Expansion of the Municipal Potable Water Distribution System



Evaluation Criteria

1. Environmental

- Protects Environmental Features
- Protects Groundwater, Streams and Rivers
- Minimizes Impact on Climate Change

2. Social/Cultural

- Minimizes Long-Term Impacts to the Community Related to Noise, Odour, Traffic and Aesthetics
- Minimizes Impacts to Businesses and Major Transportation Corridors
- Manages and Minimizes Short-Term Construction Impacts
- Protects Health and Safety
- Protects Cultural Heritage Resources

3. Economic

- Provides Low Lifecycle Costs

4. Technical

- Meets Existing and Future Needs
- Provides Ease of Maintenance
- Aligns with Existing and Planned Infrastructure
- Aligns with Existing and Future Land Use
- Aligns with Efficient Approval and Permitting Process
- Manages and Minimizes Construction Risks
- Ability to Adapt to Climate Change

Evaluation of Alternative Solutions: Wastewater Collection System

	Alternative 1 "Do Nothing"	**Alternative 2** I/I Reduction and Re-Use Alternatives	**Alternative 3** Partial Private/Communal & Municipal Wastewater Servicing	**Alternative 4** Communal Wastewater Collection System	**Alternative 5** Improvement & Expansion of the Municipal Wastewater Collection System
Environmental	◐	◐	◔	◔	◔
Social/Cultural	○	◐	◐	◐	◐
Economic	●	◐	◔	◔	◔
Technical	○	○	◐	◐	●
CONCLUSION	Not Recommended	Not Recommended	Not Recommended	Not Recommended	**Recommended Solution**

Low alignment with criteria ○ → ◔ → ◐ → ◕ → ● **Very well aligned with criteria**

Recommended Solution: Wastewater Collection System

Alternative 5: Improvement & Expansion of the Municipal Wastewater Collection System is the recommended solution based on the following:

- Capacity to support future population needs to the 2042 horizon.
- Potential to impact the environment can be mitigated during design, construction and operation.
- Potential to impact private property and health and safety of Town residents during construction can be mitigated.
- Implementation costs can be subject to cost-sharing.

The recommended solution includes:

- Sewer upgrades on Riverview Dr, Daniel St, and Edward St
- Sewage pumping station upgrades (PS#1, PS#2, PS#3)
- Supporting studies

Legend
- Sanitary Pump Station (PS)
- Overflow
- Wastewater Treatment Plant (WWTP)
- Sanitary Trunk Sewer (Modelled; No Upgrades)
- Sanitary Sewer (Not Modelled)
- Forcemains

Servicing Solutions
- Problem Areas (Growth-Related)
- Pipe Upgrades (for Growth)
- Problem Areas (Growth, with Climate Change Considerations)
- Pipe Upgrades (for Growth, with Climate Change Considerations)
- New Gravity Sewer
- New PS (Growth Area Servicing)
- New Forcemain

Growth Areas Servicing Approach
- Direct Servicing from Adjacent Local (Non-Modelled) Sewers
- Direct Servicing from Adjacent Trunk Sewer
- Direct Servicing by Extending Local (Non-Modelled) Sewers
- Servicing from New Trunk Sewer Infrastructure

Evaluation of Alternative Solutions: Potable Water Distribution System

	Alternative 1 “Do Nothing”	**Alternative 2** Water Conservation and Re-Use	**Alternative 3** Communal Potable Water System	**Alternative 4** Partial Private/Communal & Municipal Potable Water Servicing	**Alternative 5** Improvement & Expansion of the Municipal Potable Water Distribution System
Environmental	◑	◑	◔	◔	◔
Social/Cultural	○	◔	◔	◔	◑
Economic	◕	◕	◔	◔	◑
Technical	○	◔	◑	◑	◕
CONCLUSION	Not Recommended	Not Recommended	Not Recommended	Not Recommended	**Recommended Solution**

Low alignment with criteria ○ → ◔ → ◑ → ◕ → ● **Very well aligned with criteria**

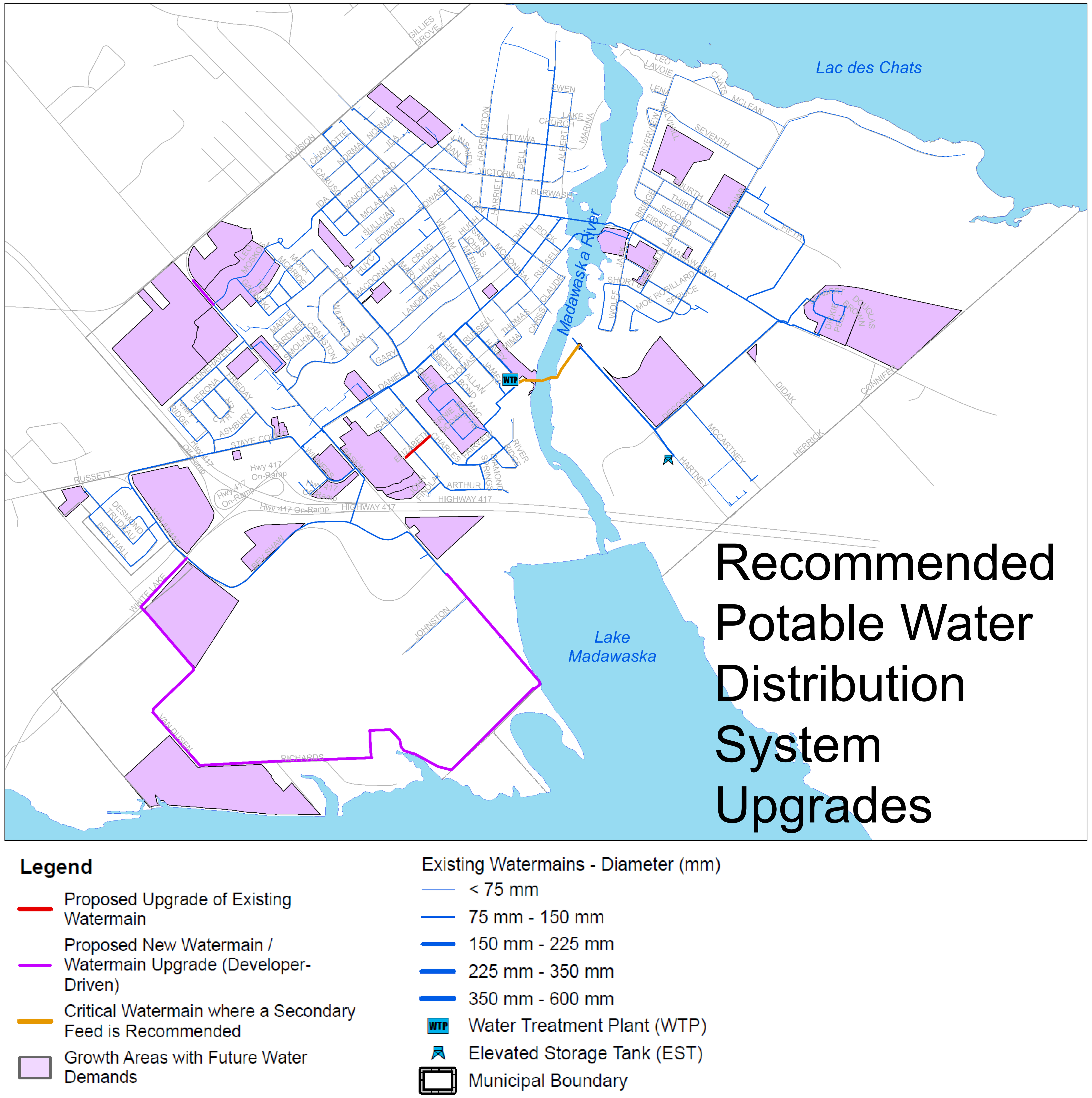
Recommended Solution: Potable Water Distribution System

Alternative 5: Improvement & Expansion of the Municipal Potable Water Distribution System is the recommended solution based on the following:

- Capacity to support future population needs to the 2042 horizon.
- Potential to impact the environment can be mitigated during design, construction and operation.
- Potential to impact private property and health and safety of Town residents during construction can be mitigated.
- Implementation costs can be subject to cost-sharing.

The recommended solution includes:

- Watermain upgrades
- WFP treatment, storage and pumping upgrades
- Supporting studies



Climate Change Considerations

Wastewater Collection System

- Stress-test of system using climate projections
- Additional resilience measures identified (pipe upsizing; additional pumping station capacity)

Potable Water Distribution System

- Stress-test of system using increased water demands
- Upgrades needed earlier
- Additional resilience measures identified (additional treatment, storage and pumping capacity)

Thank You For Participating!

NEXT STEPS

- Review and consider feedback received
- Confirm preferred water and wastewater solutions
- Prepare Master Plan Report
- Issue Notice of Master Plan

We would appreciate receiving any comments and/or questions that you may have by **March 13, 2024**.

John Steckly, A.Sc.T.
General Manager, Operations
Town of Arnprior
Tel: 613-623-4231 ext. 1831
Email: jsteckly@arnprior.ca

Marc Telmosse P.Eng.
Project Manager, Water
Stantec Consulting Ltd.
Email:
marc.telmosse@stantec.com

All information will be collected in accordance with the *Freedom of Information and Protection of Privacy Act* (2009). Except for personal information, all comments will become part of the public record.

G.3 Notice of PIC and Correspondence

Public Information Centre Summary Report

Town of Arnprior Water and Wastewater Master Plan

March 4, 2024

Prepared for:
Town of Arnprior
105 Elgin Street W.
Arnprior, ON
K7S 0A8

Prepared by:
Stantec Consulting Ltd.
300-1331 Clyde Avenue
Ottawa, ON
K2C 3G4

Project Number:
163401723

Limitations and Sign-off

The conclusions in the Report titled Public Information Centre Summary Report are Stantec's professional opinion, as of the time of the Report, and concerning the scope described in the Report. The opinions in the document are based on conditions and information existing at the time the scope of work was conducted and do not take into account any subsequent changes. The Report relates solely to the specific project for which Stantec was retained and the stated purpose for which the Report was prepared. The Report is not to be used or relied on for any variation or extension of the project, or for any other project or purpose, and any unauthorized use or reliance is at the recipient's own risk.

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Prepared by: Gibson, Shelby
Digitally signed by Gibson, Shelby
Date: 2024.04.22 15:14:37 -04'00'

Signature

Shelby Gibson, MES
Environmental Planner

Printed Name and Title

Reviewed by:
Digitally signed by Raheem, Ferenaz
Date: 2024.04.22 15:00:25 -04'00'

Signature

Ferenaz Raheem, MES RPP MCIP
Senior Environmental Planner

Printed Name and Title

Approved by: Telmosse, Marc
Digitally signed by Telmosse, Marc
Date: 2024.04.22 15:22:41 -04'00'

Signature

Marc Telmosse, P.Eng.
Senior Associate, Water Delivery

Printed Name and Title

Executive Summary

This project has completed Phase 2 of the Municipal Class Environmental Assessment (MCEA) process. In this Phase, the Project Team identifies and evaluates alternative design concepts. This report is a summary of the comments received during the Public Information Centre (PIC). This included four (4) alternative design concepts.

The evaluation of alternatives included consideration of:

- Natural environment
- Socio-economic
- Cultural environment
- Technical environment

Several consultation activities were undertaken through Phase 2 including:

- Notice of Public Information Centre sent to stakeholders, residents, and registrants (online/ in-person)
- Posting of the Notice on the Town's Project website and shared
- Updating the Project website with consultation materials
- hosting an in-person Public Information Centre (PIC)

The work undertaken in Phase 2 developed alternative design concepts. Consultation confirmed the following as the preferred design concept that will move forward:

Improvement & Expansion of the Municipal Wastewater Collection System

The next step is to move forward with the development of the Water & Wastewater Master Plan (W&WW MP).

Table of Contents

Acronyms / Abbreviations

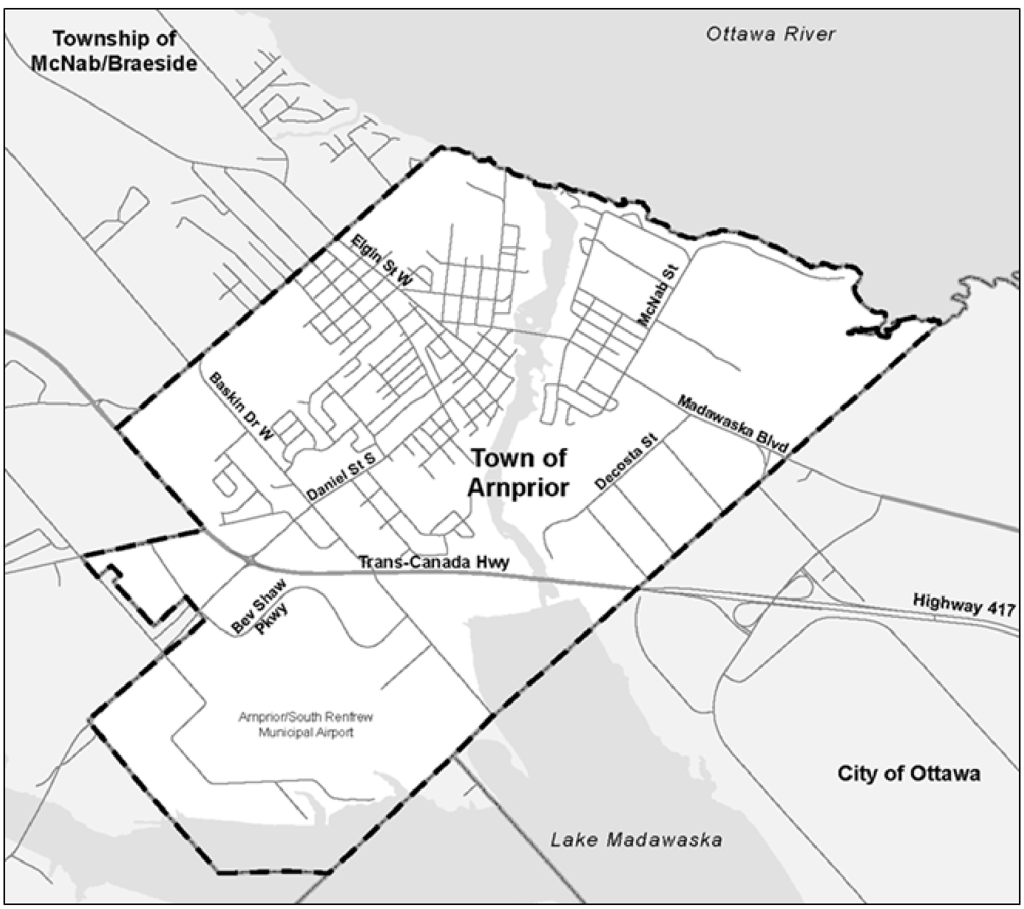
MP	Master Plan
MCEA	Municipal Class Environmental Assessment
PIC	Public Information Centre
W&WWT MP	Water & Wastewater Treatment Master Plan

1 Introduction

The Town requires an update to its Water and Wastewater Master Plan (W&WW MP) (Stantec, 2013) to better understand its existing systems conditions and to assess its ability to service future growth areas. This W&WW MP update will involve a comprehensive review and assessment of the Town's sanitary sewer collection and potable water distribution systems. The W&WW MP update will also include a review of the existing municipal drinking water and wastewater treatment facilities with goals of understanding current system capacity constraints and of developing a timeline that identifies future expansion requirements to meet anticipated growth requirements.

The study area for the Town of Arnprior municipal class environmental assessment (MCEA) is shown below in **Figure 1.1**.

Figure 1.1 Study area for the Town of Arnprior Water and Wastewater Treatment Plan MCEA.



2 Public Information Centre

2.1 Purpose

The purpose of the PIC was to identify alternative design concepts for the Water & Wastewater Treatment Master Plan, present the evaluation of alternative design concepts, and gather input to confirm the preferred alternative design. The PIC is a requirement of the regulatory process for the MCEA process. The MCEA process was also shared and discussed at the PIC.

2.2 Town of Arnprior Project Page

The Town of Arnprior Project Page (https://renfrew-county.civilspace.io/en/projects/water-and-wastewater-master-plan) is a central location where all PIC materials are available for the public to view and provide feedback in the event that they were not able to attend the meeting or wanted to revisit the information presented. The Notice of PIC (Notice) was posted on the website on February 9, 2024, along with the registration form and further details about the PIC. The materials that were presented at the PIC were included on the Project Page on March 1, 2024 including the display boards. The Project Page also includes the Project's team contact information and the status of the timeline of the project. Details and summary of comments can be found in Section 3 of this report.

2.3 Notice of Public Information Centre

The Notice for the EA was issued on April 7, 2022. The intent of the Notice was to inform readers about the purpose and format of the PIC, and to outline how to attend the PIC in person. Project team member contact information was provided in the Notice along with the project website address (provided in Section 2.2).

Interested persons were encouraged to attend the PIC in-person, view the project website, and/or to contact the Project Team directly should they have any comments, questions, concerns, or wish to be added to the study mailing list.

The Notice was distributed to the residents within a 1 km radius of the project site, agencies, municipal staff, elected officials, and Indigenous communities through the 4 (four) methods outlined in **Table 1** below.

Table 1.1 Notice Distribution

Method of Distribution	Date of Distribution
Posted on the Town or Arnprior Project Page	February 8, 2024

Notice follow up emailed to the study contact list	February 23, 2024

2.4 Format

The PIC was an in-person event held at the Nick Smith Centre at 77 James Street in Arnprior, Ontario on February 28, 2024, from 6:00pm to 8:00pm including a short presentation introducing the project team and describing the layout of the room, how to ask questions, and how to provide feedback. It was announced that the display boards would be made available on the project website. There was an opportunity for attendees to view display boards throughout the meeting room. There were display boards throughout the room describing the project background, purpose of the PIC, the MCEA process, the evaluation criteria, the four (4) alternative design concepts, the preliminary preference, and next steps. The Project Team, which included members of the Town of Arnprior and Stantec Consulting Ltd. (Stantec) were on hand to discuss the information with attendees and to answer questions. An information sheet for the project was offered to each attendee, comment sheets were available for attendees to write down their comments to be submitted, and a handout of the display boards was available in language. There were no requests received for translated materials.

2.5 Attendance

Attendees were encouraged to sign in at the PIC before proceeding to view the display boards with an option to be added to the email distribution list. A total of 10 people attended - 3 attendees signed in and 2 attendees requested to be added to the email distribution list.

3 Summary of Comments Received

The comments received from attendees, feedback written on the Alternative Boards and any communication via project email were received up to February 28, 2024, and are summarized below.

The City of Arnprior and Stantec representatives heard:

- Local land developers attended the PIC and asked questions about the Town of Arnprior's W&WW MP capacity to service the proposed developments.
    - Project representatives explained that a few upgrades will assist the W&WW MP with meeting the land development needs, and no issues have been found in development of the W&WW MP that relate to those land development sites specifically.
- Written comment conveyed their thanks for the invitation and indicated it was very informative, easy to follow the different options and they believed the proposed plan 'is a good one'. They appreciated the Project Team's efforts in taking good care of the Town.

4 Next Steps

The presentation boards from the PIC are available on the Project Page. The Project Team have reviewed the comments received during the PIC. Results of consultation confirms the Preferred Alternative Design Concept is Alternative 5. The next step is preparing the Water and Wastewater Master Plan.