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Copy:		Date:	**March 23, 2023**
Subject:	**Guelph WWSMP – Draft Master Plan Report – Volume I**		

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City of Guelph

Water and Wastewater Servicing Master Plan Report
Volume I

C3 WATER INC.

STANTEC CONSULTING LTD.

March 23, 2023

VERSION	DATE	DESCRIPTION OF REVISIONS	REVISED BY	REVIEWED BY
1	March 23, 2023	First Draft	Michelle Scott Marc Telmosse	Sam Ziemann Dave Eadie

SIGN OFF

This document, entitled "Guelph WWSMP Report Volume I**"**, was prepared by C3 Water Inc. (C3W) and Stantec Consulting Ltd. (Stantec) for the **City of Guelph**.

C3W and Stantec certify that the information contained in this report is accurate, complete and in accordance with the terms of our engagement. This assessment is based, in part, on information provided by others. Unless specifically noted, C3W and Stantec have assumed that this information is correct, and has relied on it in the development of conclusions.

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DATE: March 23, 2023

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TABLE OF CONTENTS

1.0 Introduction 1
1.1 Document Organization 1
1.2 City of Guelph Master Planning Approach 1
1.3 Environmental Assessment Master Planning Process 2
1.3.1 Class EA Project Classification 6
1.3.2 Consultation and Engagement 6
1.4 Planning Horizons 12
2.0 Existing Water Supply and Distribution System 13
2.1 Supply 13
2.2 Pumping 14
2.3 Storage and Hydraulic Grade Line (HGL) 15
3.0 Existing Wastewater Collection System 18
3.1 Pumping Stations 18
3.2 Siphons 19
4.0 Water and Wastewater Systems Modelling 21
4.1 Water System 21
4.1.1 Water Model Development 21
4.1.2 Water Model Demand 21
4.1.3 Water Model Calibration 22
4.2 Wastewater System 22
4.2.1 Wastewater Model Development 22
4.2.2 Wastewater Load Calculation and Allocation 23
4.2.3 Wastewater Model Calibration 23
5.0 Level of Service Criteria 24
5.1 Water Service Criteria 24
5.2 Wastewater Service Criteria 25
5.2.1 Discussion – Area-based and Population-based Flow Generation 26
6.0 Existing System Constraints/Opportunities 30
6.1 Water System 30
6.2 Wastewater System 35

7.0 Development and Evaluation of Alternatives 38
7.1 Water Servicing Alternatives 40
7.1.1 Do Nothing 42
7.1.2 Limit Growth 42
7.1.3 Water Conservation 42
7.1.4 Improvements to Existing System: New Facilities and Watermains 42
7.2 Evaluation of Water Servicing Alternatives 53
7.2.1 Environmental 53
7.2.2 Social/Cultural 53
7.2.3 Economic 55
7.2.4 Technical 56
7.2.5 Water System Servicing Evaluation Summary 58
7.3 Wastewater Collection Alternatives 58
7.3.1 Do Nothing 59
7.3.2 Limit Growth 59
7.3.3 Inflow and Infiltration (I/I) Reduction 59
7.3.4 Improvements to Existing System: Gravity Sewers 60
7.3.5 Improvements to Existing System: Pumping Station(s) and Forcemains(s) 60
7.4 Evaluation of Wastewater Collection Alternatives 60
7.4.1 Environmental 60
7.4.2 Social/Cultural 61
7.4.3 Economic 61
7.4.4 Technical 62
7.4.5 Wastewater System Servicing Evaluation Summary 62
8.0 Preferred Servicing Plans 64
8.1 Preferred Water Servicing Alternative 64
8.1.1 Facilities 68
8.1.2 Zone Boundary Adjustments 69
8.1.3 Major Watermains 71
8.1.4 Minor Watermains 71
8.1.5 Cast Iron Replacement Program 73
8.2 Preferred Wastewater Servicing Alternative 74

8.2.1 Refinement of Alternatives Through the Design Phases 75
8.2.2 Area 1 System Improvements 78
8.2.3 Area 2 System Improvements 78
8.2.4 Area 3 System Improvements 78
8.2.5 Area 4 System Improvements 79
8.2.6 Area 5 System Improvements 79
8.2.7 Area 6 System Improvements 81
8.2.8 Area 7 System Improvements 81
8.2.9 Siphons 81
9.0 Implementation Planning 83
9.1 Water Servicing 83
9.1.1 Short Term Recommendations (Present – 2031) 83
9.1.2 Mid-Term Recommendations (2032 – 2041) 88
9.1.3 Long-Term Recommendations (2042 – 2051+) 90
9.1.4 Water Projects Summary 103
9.2 Wastewater Servicing 106
9.2.1 Short Term Recommendations (Present – 2031) 106
9.2.2 Mid-Term Recommendations (2032 – 2041) 110
9.2.3 Long-Term Recommendations (2042 – 2051+) 112
9.2.4 Wastewater Projects Summary 114
10.0 Innovation 116
10.1 Existing System and Ongoing Innovation 116
10.1.1 Water Innovation 116
10.1.2 Wastewater Innovation 117
10.2 Workshop Review 117
10.3 Integrating Innovation within Existing City Frameworks 117
10.4 Evaluation of Innovation Ideas for Guelph 119
11.0 Capital Planning 121
11.1 Funding Methodology 121
11.1.1 Water 121
11.1.2 Wastewater 121
11.2 Capital Projects Cost Estimates 122

11.3 Cost Estimates for Other Programs and Studies 122
11.4 Risk Analysis 138
11.4.1 Risk Analysis and Priority Projects 138
11.4.2 Climate Change Risk 142
11.5 Lifecycle Extension Activities 146
11.5.1 Water 146
11.5.2 Wastewater 148
12.0 Conclusion and Summary 152

Tables

Table 1-1 Key Points of Contact 7
Table 1-2 Planning Horizon Projected Reference Populations 12
Table 2-1 Existing Supply Summary (2021 WSMP Table 4-2) 13
Table 2-2 Existing Pump Stations Summary 14
Table 2-3 Existing Available Storage 16
Table 4-1 Water Model Existing Demands Summary (L/s) 22
Table 5-1 Water Servicing Criteria 24
Table 5-2 Recommended Wastewater Design Criteria 26
Table 5-3 Recommended Wastewater Level of Service Criteria and Approach (Existing and Infill Development) 29
Table 7-1 Alternative Evaluation Criteria 38
Table 7-2 Arkell Wellfield Redundancy/Resiliency Concept A: Arkell Aqueduct Twin 45
Table 7-3 Arkell Wellfield Redundancy/Resiliency Concept B1: New Watermain, Pump Station and Reservoir (GW Only) 48
Table 7-4 Arkell Wellfield Redundancy/Resiliency Concept B2: New Watermain, Pump Station and Reservoir (All Arkell Sources) 51
Table 7-5 Arkell Wellfield Redundancy/Resiliency Cost Estimates 56
Table 8-1 Summary of Water System Upgrades- Facilities 66
Table 8-2 Summary of Water System Upgrades- Major Linear 66
Table 8-3 Summary of Water System Upgrades- Minor Linear 67
Table 8-4 Summary of Wastewater System Upgrades 77
Table 9-1 Short-Term Water Project Prioritization 84
Table 9-2 2031 Model Results Summary 85
Table 9-3 2031 Model Results Summary – Arkell PS Offline 86
Table 9-4 2041 Model Results Summary 88
Table 9-5 2051+ Model Results Summary 90
Table 9-6 Summary of Water System Upgrades Timing- Facilities 104
Table 9-7 Summary of Water System Upgrades Timing- Watermains 104
Table 9-8 Short Term Wastewater Improvements 107
Table 9-9 Short-Term Wastewater Project Prioritization 108
Table 9-10 Mid Term Wastewater Improvements 110
Table 9-11 Long Term Wastewater Improvements 112
Table 9-12 Summary of Wastewater System Upgrades - Sewers 115
Table 9-13 Summary of Wastewater System Upgrades - Siphons 115
Table 10-1 Evaluation Summary of Innovation Initiatives 119
Table 11-1 Water Capital Projects Summary- Facilities 123
Table 11-2 Water Capital Projects Summary- Watermains 125
Table 11-3 Wastewater Capital Projects Summary- Sewers 132
Table 11-4 Studies Summary 136
Table 11-5 Pilot Projects 137
Table 11-6 Wastewater Projects Prioritization Risk 141
Table 11-7 Mid-Range Climate Adjusted IDF Data 143

Table 11-8 Lifecycle Extension Activities (Water and Wastewater) 150
Table 12-1 Cost Estimates Summary 153

Figures

Figure 1-1 Municipal Class Environmental Assessment Process 4
Figure 2-1 Existing Water System Overview 17
Figure 3-1 Existing Wastewater System Overview 20
Figure 6-1 Existing MDD Minimum Pressure 33
Figure 6-2 Existing MDD Available Fire Flow 34
Figure 6-3 Existing System DWF Results 36
Figure 6-4 Existing System WWF Results 37
Figure 7-1 Arkell Wellfield Redundancy/Resiliency Concept A: Arkell Aqueduct Twin 43
Figure 7-2 Arkell Wellfield Redundancy Concept B1: New Watermain, Pump Station and Reservoir (GW Only) 47
Figure 7-3 Arkell Wellfield Redundancy Concept B1: Preliminary Layout 49
Figure 7-4 Arkell Wellfield Redundancy Concept B2: New Watermain, Pump Station and Reservoir (All Arkell Sources) 50
Figure 7-5 Arkell Wellfield Redundancy Concept B2: Preliminary Layout 52
Figure 7-6 Available Supply With Woods/Arkell Aqueduct Offline 58
Minor Watermain Projects – Downtown Area Figure 8-1 Water System Recommended Upgrades 65
Figure 8-2 Proposed Pressure Zone Boundary Adjustments 70
Figure 8-3 Minor Watermain Projects – Downtown Area 72
Figure 8-4 Minor Watermain Projects – Old University Area 73
Figure 8-5 CI Replacement High Priority 74
Figure 8-6 Wastewater System Recommended Upgrades 76
Figure 9-1 Water Projects – Short Term (2031) 87
Figure 9-2 Water Projects – Mid Term 89
Figure 9-3 Water Projects – Long Term 91
Figure 9-4 2051+ MDD Minimum Pressure – Proposed Upgrades 92
Figure 9-5 2051+ MDD Maximum Pressure – Proposed Upgrades 93
Figure 9-6 2051+ MDD Max Headloss – Proposed Upgrades 94
Figure 9-7 2051+ MDD ET Levels – Proposed Upgrades 95
Figure 9-8 2051+ MDD Reservoir Levels – Proposed Upgrades 95
Figure 9-9 2051+ MDD PS Flows – Proposed Upgrades 96
Figure 9-10 2051+ MDD PS Flows – Proposed Upgrades 96
Figure 9-11 2051+ MDD Available Fire Flow – Proposed Upgrades Active –CI Replacement Complete 98
Figure 9-12 2051+ MDD Available Fire Flow – Proposed Upgrades Active –CI Replacement Complete 99
Figure 9-13 2051+ MDD Available Fire Flow – Proposed Upgrades Active –CI Replacement Complete – Residential Only 101
Figure 9-14 2051+ MDD Available Fire Flow – Proposed Upgrades Active –CI Replacement Complete – ICI Only 102
Figure 9-15 Wastewater Short Term Upgrades 109

Figure 9-16 Wastewater Mid Term Upgrades 111
Figure 9-17 Wastewater Long Term Upgrades 113
Figure 10-1 Framework for including the WWSMP in the City's Integrated Water Management Strategy 118
Figure 11-1 Turfgrass 25-Year 3-Hour Chicago Design Storm 144
Figure 11-2 Mid-Range Climate Adjusted 25-Year 3-Hour Chicago Design Storm . 145

Appendices

Appendix A: Public Consultation

Appendix B: Indigenous Consultation

1.0 Introduction

The City of Guelph has initiated this update to the 2009 Water and Wastewater Servicing Master Plan (WWSMP). The purpose of the WWSMP is to identify water and wastewater servicing requirements for existing service areas and growth areas to 2051 and consider the impact of potential intensification and greenfield growth beyond 2051 (2051+).

This master plan reviews the previous WWSMP recommendations and relevant work completed since 2009 and examines new water and wastewater servicing alternatives. In accordance with the Class Environmental Assessment (Class EA) process, the resultant listing of recommended projects includes phased implementation schedules and recommended Class EA Schedules. Through this master planning process, focus is maintained on the development of Guelph as a Smart City through the innovative use of technologies for improved water and wastewater level of service. The impacts of climate change were considered as it relates to the effectiveness of the recommendations provided.

This WWSMP was completed in parallel with the Municipal Comprehensive Review (MCR) to align with the Provincial Growth Plan, A Place to Grow: Growth Plan for the Greater Golden Horseshoe (amended in August 2020) (Places to Grow).

1.1 Document Organization

A number of technical memorandums (TMs) have been completed through the master planning process. This document, titled Master Plan Report: Volume I, provides a consolidated summary of the process and key findings of the WWSMP. Additional details and information can be found in Volume II which contains TMs developed through this project including:

- TM1: Background Review
- TM2: Model Assessment and Software Recommendation
- Model Update, Field Testing and Calibration TM
- TM3A: Existing and Future Population, Employment and Land Use, and Servicing Implications
- TM3: Water and Wastewater Servicing Recommendations
- TM4: Capital Infrastructure Funding and Risk Analysis
- TM5: Design Criteria, Level of Service (LOS) and Sensitivity Analysis
- Innovation Strategy TM

1.2 City of Guelph Master Planning Approach

The City's master plans assess the current infrastructure, to support today's services and determine what will be needed as the community grows. The various master plans build on the goals and policies from the Official Plan to integrate existing and future land use plans and define long-term objectives. Looking at the City as a whole helps to evaluate options, consider a variety of perspectives, understand different outcomes, and make better decisions for a future ready Guelph.

1.3 Environmental Assessment Master Planning Process

The *Environmental Assessment Act of Ontario, R.S.O 1990* (EA Act) provides for the protection, conservation, and management of the environment in Ontario. The Ministry of the Environment, Conservation and Parks (MECP) is responsible for administration of the EA Act.

The *Municipal Class Environmental Assessment* (MCEA) is an approved Class EA under the EA Act that applies to municipal infrastructure projects including roads, water, wastewater and transit. This process provides a comprehensive planning approach to consider alternative solutions and evaluate their impacts based on a set of criteria (e.g., environmental, transportation, socio-economic, engineering considerations) and determine mitigating measures to arrive at a preferred alternative for addressing an identified problem or opportunity. The MCEA process involves a rigorous public consultation component that includes various provincial and municipal agencies, Indigenous communities, and the public.

Key components of the MCEA planning process include:

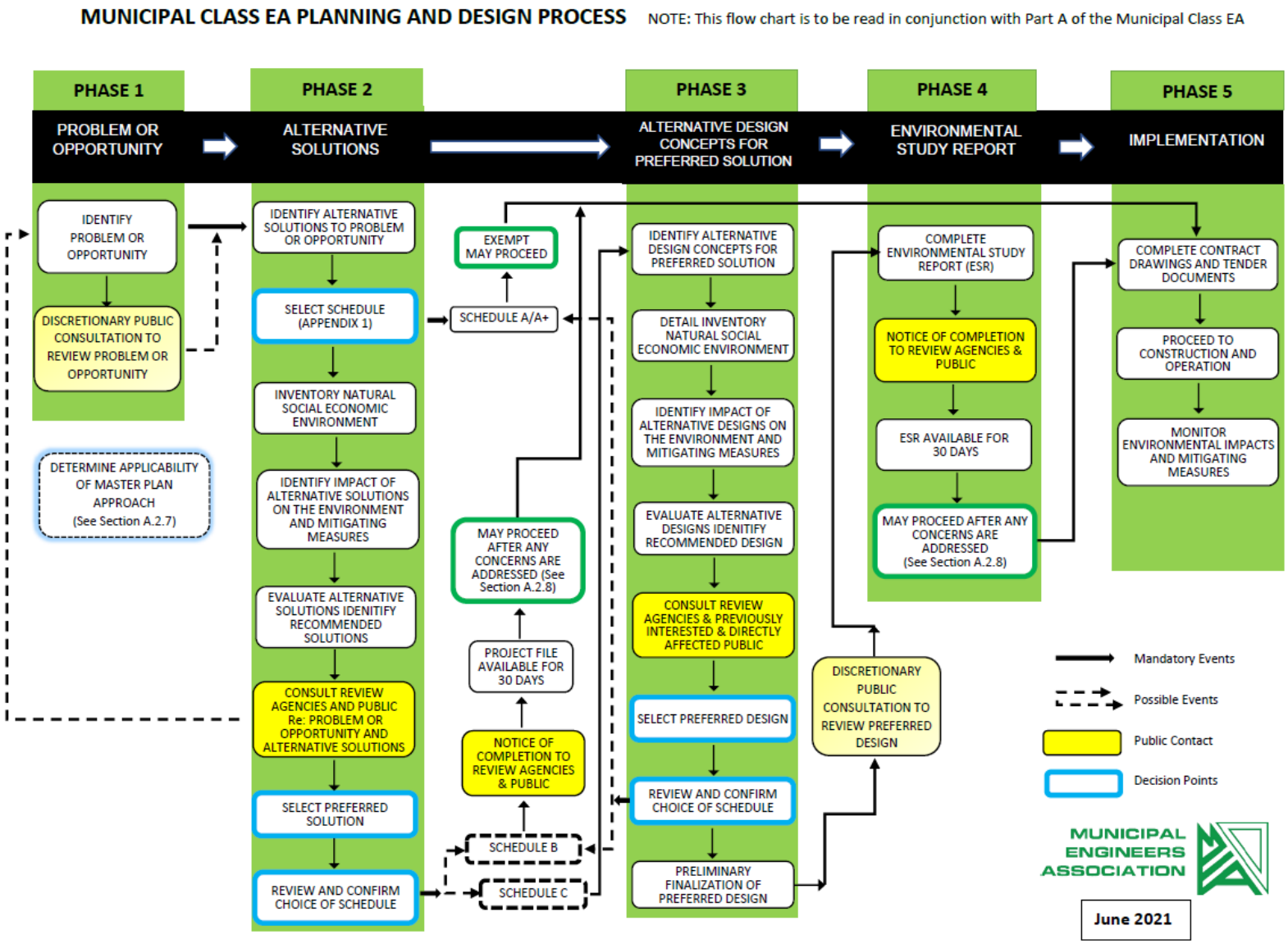
- Consultation with potentially affected parties early and throughout the process
- Consideration of a reasonable range of alternative solutions

- Systematic evaluation of alternatives
- Clear and transparent documentation
- Traceable decision-making

The MCEA process as illustrated in Figure 1-1, is undertaken prior to modifications or additions to municipal infrastructure, to consider potential impacts associated with all project aspects. The MCEA process consists of the following phases:

Phase 1: Identify the problem/opportunity.
Phase 2: Identify and evaluate alternative solutions.
Phase 3: Identify and examine alternative design concepts for the preferred solution.
Phase 4: Formally document the planning process.
Phase 5: Proceed to implementation of the project.

Figure 1-1 Municipal Class Environmental Assessment Process



Based on the nature of a project and its anticipated impacts to the surrounding environment, the MCEA document specifies four different schedules for project planning, and the assessment process required for each:

Schedule A projects are pre-approved under the MCEA and can proceed directly to Phase 5, implementation. Schedule A projects are limited in scale and have minimal anticipated impacts to the environment. Routine and emergency operational and maintenance activities are often classified as Schedule A. These are now Exempt under the 2023 amendment.

Schedule A+ projects are pre-approved under the MCEA, although the proponent is required to advise the public of the project prior to construction activities. These types of projects are limited in scale with minimal environmental impacts, and thus require no formal documentation. These are now Exempt under the 2023 amendment.

Schedule B projects are required to proceed through the first two phases of the MCEA process to identify the problem or opportunity and identify and assess any reasonable/feasible alternative solutions and select a preferred solution. Proponents must contact all relevant agencies, Indigenous communities and affected members of the public to communicate the scope of the project so that their concerns are considered and addressed. A record of the process followed is also documented within a Project File or a Project File Report and filed for a 30-day public review period. If there are no significant impacts identified, and no requests are received to undertake the project as an individual Environmental Assessment (through the Part II Order process), the project may then proceed to Phase 5, detailed design.

Schedule C projects are required to proceed through all five stages of the MCEA process, as they have the potential for significant environmental effects. These projects generally include the construction of new facilities, or major expansions to existing facilities. Schedule C projects require an Environmental Study Report be completed and filed for a 30-day public review period.

The selection of the appropriate project schedule to be followed is dependent on the anticipated level of environmental impact, and at times the estimated construction costs.

The MCEA document also identifies four different approaches to completing Master Plans corresponding to different levels of assessment. Regardless of the approach selected, Master Plans must follow at least the first two phases of the MCEA process.

Approach 1 follows Phases 1 and 2 as defined above, and then uses the Master Plan as a basis for future investigations of site-specific Schedule ‘B’ and ‘C’ projects. Any Schedule ‘B’ and ‘C’ projects that need specific Phase 2 work, and Phase 3 and 4 work, usually have these phases deferred until the actual project is implemented.

Approach 2 is to complete all work necessary for Schedule ‘B’ site-specific projects at the time they are identified. Using this approach, a municipality will identify everything needed in the first five years and complete all the site specific work required, including public consultation, to meet Class EA requirements. The Master Plan in such cases has

to be completed with enough detail so that the public can be reasonably informed, and so that the approving government agencies (Conservation Authorities, MECP, MCM, etc.) can be satisfied, in principle, that their concerns will be addressed before construction commences.

Approach 3 is to complete the requirements of Schedule 'B' and Schedule 'C' at the Master Plan stage.

Approach 4 is to integrate approvals under the EA Act and Planning Act. For example, the preparation of new or amended Official Plans could be undertaken simultaneously with Master Plans for water, wastewater and transportation, and approval for both sought through the same process.

1.3.1 Class EA Project Classification

This Master Plan is being undertaken in accordance with Approach #1 of the Master Planning Process, as outlined in Appendix 4 of the MCEA document, using a broad level of assessment. Detailed investigations at the project-specific level will be required in order to fulfil the MCEA documentation requirements for the specific Schedule B and C projects identified within this Master Plan. This Master Plan will become the basis for, and be used in support of, future investigations for the specific Schedule B and C projects identified within it. Schedule B projects would require the filing of the Project file for public review while Schedule C projects would have to fulfil Phases 3 and 4 prior to filing an Environmental Study Report (ESR) for public review. The schedules for future projects identified as part of this master plan were reviewed utilizing the 2023 MCEA amendments.

1.3.2 Consultation and Engagement

Consultation is a fundamental part of the MCEA process. Active, targeted, and ongoing engagement with all potentially affected parties including government agencies, community members, special interest groups, Indigenous communities and First Nations ensures a transparent and responsible planning process. Table 1-1 provides an overview of the key points of contact:

First, a stakeholder contact list was created, including relevant Federal and Provincial government agencies, local government officials, Indigenous communities and First Nations, local stakeholders and residents. Those who expressed interest were included on the project mailing list. All project notifications were mailed to the study contact list, delivered to residents within the study area, and posted on the City of Guelph's website (https://guelph.ca/plans-and-strategies/water-and-wastewater-servicing-master-plan/).

Two Open Houses were held during the study to serve as platforms for information sharing between the project team and members of the public.

The first Virtual Open House for the WWSMP was held from October 28-November 30, 2020. The purpose was to present the objectives of the Master Plan, the City's current water distribution and wastewater collection systems, preliminary water and wastewater

servicing alternatives for meeting the City's growth needs, and proposed criteria for evaluating the water and wastewater servicing strategies. The Open House was presented as a link from the City's WWSMP webpage (https://www.haveyoursay.guelph.ca/water-and-waste-water-master-plan-update) and was presented via an online ArcGIS StoryMaps platform. The presentation is provided in Appendix A.

The second Open House was held in person at Guelph City Hall - Room C (1 Carden Street, Guelph) on November 29, 2022, from 5:30 PM to 7:30 PM. A virtual meeting was held simultaneously via Microsoft Teams. The purpose of the second Open House was to present and gather feedback on the evaluation of water and wastewater servicing alternatives, proposed water and wastewater strategies and upgrades, and implementation strategies. The Open House # 2 PowerPoint presentation was made available as a link on the City's website. Comment sheets were provided at the in-person event and online on the City's Water and Wastewater Servicing Master Plan Have Your Say platform.

Table 1-1 Key Points of Contact

Point of Contact	Method of Communication
Notice of Commencement *to introduce the project*	▼ Mailed and emailed to contact list, February 14, 2020 ▼ Published a combined newspaper advertisement for all City of Guelph water-related master plan studies, February 14, 2020 ▼ Published on the City's website (https://guelph.ca/plans-and-strategies/water-and-wastewater-servicing-master-plan)
Online Open House 1	▼ Mailed and emailed to contact list, November 13, 2020 ▼ Published a combined newspaper advertisement for all City of Guelph water-related master plan studies, October 29, 2020, November 12, 2020, and November 26, 2020. ▼ Open House 1 display material posted to the City's website (https://guelph.ca/plans-and-strategies/water-and-wastewater-servicing-master-plan)
Online and In-Person Open House 2	▼ Mailed and emailed to contact list (November 10, 2022) ▼ Emailed project update letters to Indigenous communities, October 31, 2022 ▼ Published a combined newspaper advertisement for all City of Guelph water-related master plan studies, November 24th, December 1st, December 8th and December 15th, 2023, in the Guelph Mercury Tribune.

Point of Contact	Method of Communication
	▼ Published notifications and updates for the WWSMP on the City of Guelph Facebook page, November 24th, November 27th, December 3rd, December 8th and December 14th, 2022. ▼ Posted Open House 2 display material to the City's website (https://guelph.ca/plans-and-strategies/water-and-wastewater-servicing-master-plan)
Notice of Completion *to provide an overview of study recommendations, public review period (Dates TBD)*	▼ Mail and email to contact list ▼ Publish notice ▼ Post report to the City's website (https://guelph.ca/plans-and-strategies/water-and-wastewater-servicing-master-plan/)

1.3.2.1 Indigenous Community and First Nation Engagement

The following Indigenous communities and First Nations were engaged over the duration of the study:

- Six Nations of the Grand River Territory
- Six Nations Haudenosaunee Confederacy Council
- Mississaugas of the New Credit First Nation
- Métis Nation of Ontario

The first point of contact for this project was the Notice of Study Commencement, which was emailed on February 14, 2020.

All public material has been forwarded, and follow-up emails were sent to ensure that sufficient information was provided. All interested parties were notified and invited to all Open Houses and given the opportunity to express concerns and provide feedback through an invitation to meet.

The Six Nations of the Grand River Territory requested a meeting with City of Guelph staff members. A meeting was held on July 8th, 2021 and City of Guelph staff presented an overview of the Master Planning process and study progress. The presentation materials and meeting minutes are provided in Appendix A.

The Indigenous Communication Log, notification materials and correspondence from Indigenous communities is provided in Appendix B.

1.3.2.2 Public Consultation

For this study, the main points of public consultation are:

- To notify the public that the study was commencing,

- To review and receive public input regarding the problem being addressed and discuss issues related to the project including alternative solutions, environmental considerations, conceptual corridors, and evaluation criteria,
- To review and receive feedback on the preliminary preferred solution, and
- To review the Servicing Master Plan report

The City of Guelph utilized online surveys at critical stages of the study for gathering information and feedback from stakeholders and the public.

Two online surveys were administered using the City's Have Your Say online platform. The purpose of the first online survey was to gather information on residents' experience with the existing water and wastewater infrastructure. In particular, the survey was focused on disruption of water services, water pressure, sewer back-up and blockage issues. A total of 26 people submitted responses to the online survey. Below is a summary of responses provided to each question:

- The majority of respondents noted that their water pressure was strong to moderately strong.
- The majority of respondents noted that disruption to water services has occurred "Never" or "Once or twice a year".
- There was split interest in a smart water meter with 11 "Yes", 8 "No" , and 7 "I don't know" responses.
- The majority of people noted that they have not experienced a sewer backup that isn't attributed to a household plumbing or drainage issue.
- Three (3) respondents noted that sewer blockage has only occurred once, 3 times due to freezing, and once every 1-5 years.

The purpose of the second online survey was to gather input from stakeholders on refining the study goals and objectives and identified opportunities and constraints and obtain input on the proposed upgrades to the water and wastewater system. One person submitted responses to the online survey. The individual commented on keeping the Innovation District a naturalized area, providing opportunity for flow diversion instead of decommissioning sewers, mandating or incentivizing retrofits to industrial, commercial, institutional (ICI), setting constraints to developers to encourage source management of sewage, and protecting critical stormwater mitigation provided by forests, riparian zones and other significant wetlands. The individual responses to each survey question are included in Appendix A.

The Project Team acknowledged all submitted comments and provided responses on how these stakeholder comments, questions and/or issues have been considered in the servicing study. All questions, comments and subsequent responses from all sources have been tracked and documented.

A copy of all public consultation is included in Appendix A.

1.3.2.3 Agency Consultation

Agencies and developers invited to participate in the study are listed below:

Federal

Transport Canada
Environment and Climate Change Canada
Fisheries and Oceans Canada

Provincial

Ministry of Natural Resources and Forestry
Ministry of the Environment, Conservation and Parks (MECP)
Ministry of Tourism, Culture and Sport
Infrastructure Ontario
Ministry of Agriculture, Food and Rural Affairs
Ministry of Municipal Affairs and Housing
Ministry of Community Safety and Correctional Services
Ministry of Transportation

Municipal/Regional

Guelph Eramosa Township
Puslinch Township
Region of Waterloo
Town of Milton
Township of Centre Wellington
Wellington County
Wellington-Dufferin-Guelph Health Unit
Grand River Conservation Authority (GRCA)

Local Stakeholders and Businesses

Christian Farmers Federation of Ontario
Wellington Federation of Agriculture
Brant Avenue Neighbourhood Group
Brothers Brewing Company
Guelph Chamber of Commerce
Clean Water Coalition
Cutten Fields
Doline Quarry
Exhibition Park Neighbourhood Groups
Fixed Gear Brewing Company
Gay Lea Foods
Get Concerned
Grange Hill East Neighbourhood Group

Guelph and Guelph Eramosa Township Community Liaison Group
Guelph Community Foundation
Guelph and District Homebuilders Association
Guelph Wellington Developers Association
Guelph Youth Council
Hanlon Creek Neighbourhood Group
Linmar Corporation
Mandarin Restaurant
Maple Leaf Foods Inc.
McNeil Consumer Healthcare
Nature Guelph
Nestle Waters Canada
North Riverside Neighbourhood Group
North Riverside Neighbourhood Group
Ontario Public Interest Research Group (OPIRG)
Onward Willow Neighbourhood Group
Our Lady of Lourdes School
Parkwood Gardens Neighbourhood Group
Polycon Industries
Protect Our Moraine
Rickson Ridge Neighbourhood Group
Royal City Brewing Company
Saint George's Park Neighbourhood Group
Save our Water
Sleeman Breweries Ltd.
Springfield Golf and Country Club
St. Joseph's Health Centre
The Council of Canadians
The Guelph Country Club
The Junction Neighbourhood Group
Two Rivers Neighbourhood Group
Victoria Park East Golf Club
Wellington Brewery
Wellington Water Watchers

Utilities and Emergency Services

Wellington-Dufferin-Guelph Health Unit
City of Guelph Police Services
City of Guelph Fire Department
Guelph-Wellington EMS
Guelph Hydro
Ontario Power Generation
Hydro One

Rogers Cable Systems Utilities Coordinating Committee
Bell Canada

The following agencies and stakeholders provided comments during the study:

- Infrastructure Ontario
- Grand River Conservation Authority
- Ministry of Tourism, Culture and Sport
- Hydro One

All comments and subsequent responses have been tracked and documented. (Appendix A)

1.4 Planning Horizons

Future servicing infrastructure requirements are largely driven by population growth and water consumption. Growth projections were developed for 2031, 2041 and 2051+ planning horizons with input from the City's ongoing Municipal Comprehensive Review (Shaping Guelph) and the parallel Water Supply, Wastewater Treatment and Biosolids, and Stormwater Management master plans.

The City's Shaping Guelph project outlines projected growth to 203,000 people and 116,000 jobs by 2051. However, when assessing underground infrastructure and its life expectancy, it is important to consider that new infrastructure will be in use past 2051 and thus must be sized to service growth that occurs beyond 2051. As such, the City has projected the maximum allowable growth that could be supported in each strategic growth area to create a 2051+ Ultimate Buildout population distribution for the purpose of this study. The 2051+ Ultimate Buildout scenario includes 239,770 people and 126,198 jobs and was established by applying the maximum densities across land uses for strategic growth areas and incorporating established populations for greenfield development within the existing urban boundary. This maximum growth scenario was used for the WWSMP to evaluate the largest impact on water and wastewater linear infrastructure. Greenfield development areas include the Guelph Innovation District (GID) and Clair Maltby Secondary Plan (CMSP).

A summary of the equivalent population for each planning horizon is shown in Table 1-2. The reference populations for 2031 and 2041 horizons are consistent with the Water Supply Master Plan (WSMP), while the 2051+ horizon is based on the Shaping Guelph ultimate buildout population.

Table 1-2 Planning Horizon Projected Reference Populations

Horizon	2031	2041	2051 (WSMP)*	2051+
Population	164,852	183,926	203,000	239,770
Employment	94,906	105,453	116,000	126,198

**Not used for this WWSMP, as justified above.*

2.0 Existing Water Supply and Distribution System

The Guelph water distribution system consists of approximately 600 km of watermains throughout three pressure zones. The primary water sources are the Arkell wells and the Glen Collector which feed into the F.M. Woods Water Treatment Plant (Woods WTP) via the Arkell Aqueduct. The Woods WTP and pump station (PS) supplies approximately 60-80% of the City's drinking water into Zone 1. There are also several groundwater supply wells throughout the City. The Paisley, Robertson and Clythe PSs boost water from Zone 1 into Zone 2. The Clair PS boosts water from Zone 1 into Zone 3. The system has three elevated storage tanks (ETs), Verney and Clair ET located in Zone 1 and the Speedvale ET in Zone 2. There are four (4) in-ground storage reservoirs, Woods and University in Zone 1 and Paisley and Clythe in Zone 2. An overview of the existing water distribution system is presented in Figure 2-1.

2.1 Supply

The existing available supply is summarized in Table 2-1. The existing capacity of each source was based on Table 4-2 of the Water Supply Master Plan completed by AECOM Canada Ltd. (AECOM) in 2021 (2021 WSMP). The largest existing source is the Arkell Wellfield which supplies the Woods WTP via the Arkell Aqueduct along with the Glen Collector and the Carter Wells. Including all City water supply sources, the system has an available supply capacity of 918 L/s, 878 L/s of which is located in Zone 1.

Table 2-1 Existing Supply Summary (2021 WSMP Table 4-2)

Facility	Capacity (m^3/day)	Capacity (L/s)
Zone 1		
Arkell Well 1	2,000	23
Arkell Wells 6, 7, 8, 14, 15	28,800	333
Glen Collector	5,100	59
Carter Wells (1, 2)	5,184	60
Burke Well	6,500	75
Dean Well	1,500	17
Downey Well	5,237	61
Emma Well	2,800	32
Membro Well	5,200	60
Park Wells (1, 2)	8,000	93
Queensdale Well	1,100	13
University Well	2,500	29
Water Well	1,901	22
Zone 2		
Calico Well	1,400	16
Helmar Well	800	9

Facility	Capacity (m^3/day)	Capacity (L/s)
Paisley Well	1,400	16
Summary		
Zone 1	75,822	878
Zone 2	3,582	41
Total System	**79,422**	**918**

2.2 Pumping

The existing system pump stations are summarized in Table 2-2. The pump information was sourced from the City's 2020 Drinking Water Works Permit (2020 DWWP). The firm capacity was calculated as the total capacity minus the rated flow of the largest pump at each facility. At well pump stations, the firm capacity was based on the supply capacity values from the 2021 WSMP.

Table 2-2 Existing Pump Stations Summary

Facility	Existing Pump Stations				Firm Capacity (L/s)
	# of Pumps	Rated Flow (L/s)	Rated Head (m)	Total Capacity (L/s)	
Zone 1					
Woods Pump Station	2	284	70	1325	1050
	1	347	81		
	1	259	70		
	1	151	85		
Burke Pump Station*	2	76	58	152	75
Dean Pump Station*	1	20	64	20	17
Downey Pump Station*	1	61	70	61	61
Emma Well*	1	33	99	33	32
Membro Pump Station*	1	76	71	76	60
Park Pump Station	2	70	54	140	70
Queensdale Pump Station	1	30	66	30	13
University Pump Station	1	27	52	76	27
	1	49	51		
Water St Well*	1	30	145	30	22
Zone 2					
Calico Pump Station*	1	61	67	61	0
Helmar Pump Station*	1	38	53	38	9
Paisley - Vertical Turbine Pump Station	3	53	82	287	212
	1	75	82		

Facility	Existing Pump Stations				Firm Capacity (L/s)
	# of Pumps	Rated Flow (L/s)	Rated Head (m)	Total Capacity (L/s)	
	1	53	62		
Paisley - Horizontal In-Line Pump Station	2	53	37	182	106
	1	76	37		
Robertson Pump Station	2	44	24	167	88
	1	79	23		
Clythe Pump Station	3	63	76	189	126
Zone 3					
Clair Pump Station	2	35	35	545	470
	1	75	35		
	2	200	35		
Summary					
Zone 1					1,428
Zone 2					541
Zone 3					470

Existing pump data sourced from 2020 DWWP
**Firm Capacity based on Well Supply Capacity (2021 WSMP)*

2.3 Storage and Hydraulic Grade Line (HGL)

The existing available storage is summarized in Table 2-3.

In Zone 1, the largest available storage is at the Woods Reservoir with an existing volume of 29 ML. In-ground storage is also located at the University Reservoir. The Zone 1 HGL is set by the Speedvale and Clair ETs, each with a top water level (TWL) of 277m.

In Zone 2, the largest available storage is at the Paisley Reservoir. A small volume of in-ground storage is also available at the Clythe Reservoir. The Zone 2 HGL is set by the Speedvale ET with a TWL of 393m.

Zone 3 does not have any existing storage. Water is supplied from Zone 1 via the Clair in-line booster pump station utilizing the Clair ET as pumped storage. The existing target HGL for Zone 3 is approximately 393m.

Table 2-3 Existing Available Storage

Facility	Type		Volume (ML*)
Zone 1/3			
FM Woods Reservoir	Pumped		29
Verney Elevated Tank	Floating	277m HGL	4
Clair Elevated Tank	Floating	277m HGL	5
University Reservoir	Pumped		2
Zone 2			
Speedvale Elevated Tank	Floating	393m HGL	2
Clythe Reservoir	Pumped		1
Paisley Reservoir	Pumped		13
Summary - Total Storage			
Zone 1 and 3 Total	41		
Zone 2 Total	16		
Total Available Storage	**57**		

*Megalitres (ML) = 1,000 liters

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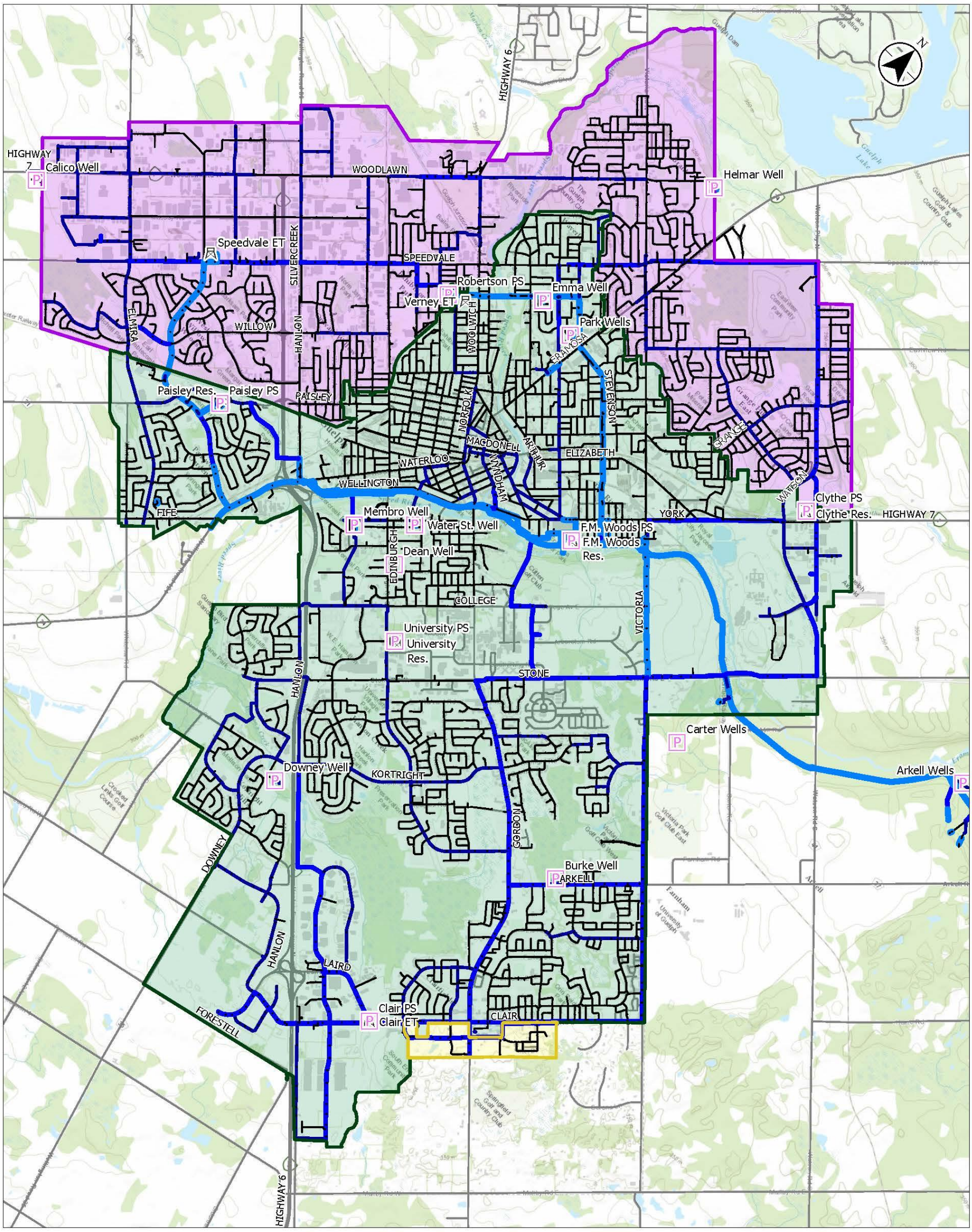

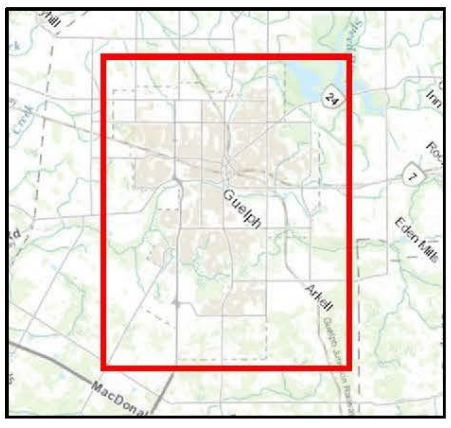

Legend

Pipe
Diameter (mm)
- < 300
- 300 - 350
- 400 - 450
- > 450

- Pump Stations & Wells
- Reservoirs & Tanks

Pressure Zone
- 1
- 2
- 3

0 1 2 Km
1:50,000 (At Original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018. World Topographic Map: City of Guelph, Region of Waterloo, Province of Ontario, Ontario MNR, Esri Canada, Esri, HERE, Garmin, INCREMENT P, USGS, METI/NASA, EPA, USDA, AAFC, NRCan
World Topographic Map: City of Guelph, Region of Waterloo, Ontario Base Map, Province of Ontario, Ontario MNR, Esri Canada, Esri, © OpenStreetMap contributors, HERE, Garmin, USGS, NGA, EPA, USDA, NPS, AAFC, NRCan

Stantec

C3 WATER

Project Location
City of Guelph

Client/Project
CITY OF GUELPH WATER AND WASTEWATER SERVICING MASTER PLAN - REPORT

Figure No.
2-1

Title
Existing Water System Overview

3.0 Existing Wastewater Collection System

The City's wastewater collection system is primarily gravity-based. There are approximately 520 km of gravity sewers within the City, with pipe diameters ranging from 200 mm to 1650 mm. Over 85% of the wastewater system has pipe diameters of 375 mm or less. The wastewater collection system discharges, via trunk sewers, into the City Water Resource Recovery Center (WRRC) located in the central west-end of the City adjacent to the Speed River.

The York Trunk is the main trunk of the wastewater collection system centrally located along the Speed and Eramosa Rivers. It flows east to west to the WRRC, as shown in Figure 3-1. Several collectors discharge into the main trunk:

- The majority of the south of the City is serviced by a 900 - 1200 mm collector on the western City limit that ultimately crosses the Speed River through a triple barrel siphon (300 mm, 600 mm, 750 mm) to connect to the WRRC. Two other smaller 675 mm and 750 mm collectors service the southeast side of the City. They connect to the York Trunk after crossing Eramosa River through two other siphons.
- The north side of the City is serviced by four main collectors. The northwest is serviced by a 1050 mm pipe on Deerpath Dr with a 1200 mm rail crossing and a reduction to 600 mm crossing Wellington St W. This reduction in sewer size is irregular, however the capacities are similar due to an increased slope on the 600 mm sewer. The north-centre of the City is serviced by a 900 mm pipe that runs southernly on Dawson Rd and Alma St, with a reduction to 600 mm, and ultimately connects to the main trunk at the intersection of Waterloo Rd and Wellington St. The northeast is serviced by two collectors: a 825 mm along the east shore of Speed River, and a 750 mm on York Rd. The Rockwood community is also serviced by Guelph's wastewater collection system. Rockwood flows have been included as a constant flow, connected to the 300 mm sewer on the eastern edge of the City on York Rd.

Over 45% of the wastewater collection system is composed of polyvinyl chloride (PVC) pipe. The remainder is a combination of several pipe materials, including asbestos cement, reinforced concrete, non-reinforced concrete, vitrified clay, iron, clay tile, etc. The age of the system ranges from recently installed to over 100 years old, with the older infrastructure largely located in the downtown core.

3.1 Pumping Stations

Sanitary pumping stations (SPS) are required where topographical constraints do not allow gravity sewer servicing. These stations are located throughout the local collection system, as shown in Figure 3-1, lifting wastewater to a gravity sewer. This master plan considers the following active pump stations:

1. Barton Estates
2. Gazer Mooney
3. Kortright
4. Northern Heights
5. Terraview
6. Nima Trails
7. Landfill Eastview

Note that the Gazer Mooney SPS is owned by the Guelph-Eramosa Township, but is operated by the City of Guelph. Private pump stations are not operated by the City and therefore are not accounted for in the WWSMP.

3.2 Siphons

Siphons are used to convey wastewater under an obstruction, such as a watercourse or parallel underground utility. They operate as a pressurized system that connects to a gravity system on both the upstream and downstream sides of the obstruction. There are currently 10 locations with active inverted siphons in the City's wastewater collection system (see Figure 3-1):

1. Alma-Mercer
2. Elizabeth-Beaumont
3. Eramosa River
4. Hanlon-Massey-Campbell
5. Ptarmigan
6. Speed River-Crane Park
7. Speed River – Manor Park
8. Speed River – Municipal Street
9. Stevenson-Eramosa
10. Willow-Guelph

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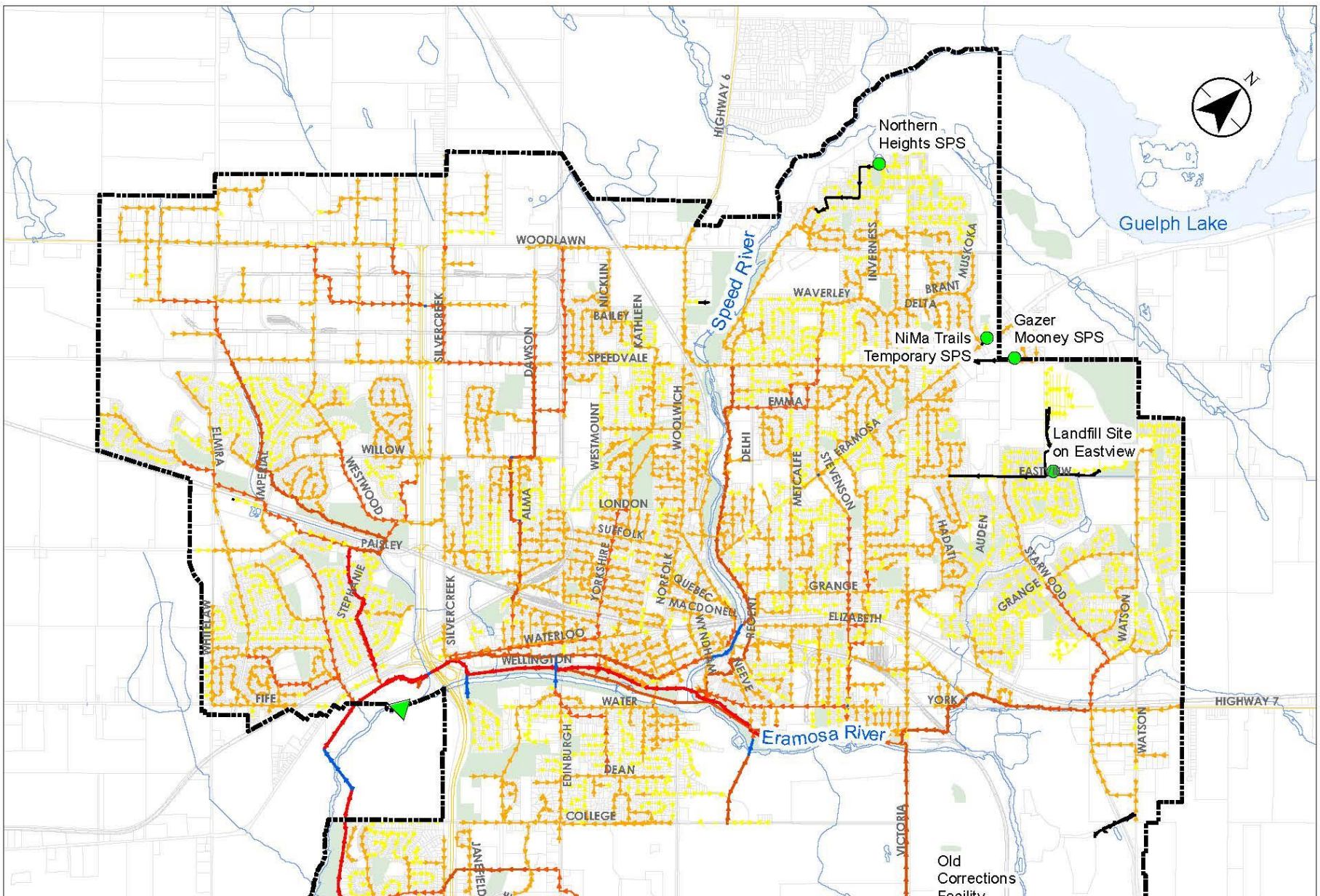

Legend

- Study Area
- Parks
- Watercourse
- Railway
- Expressway / Highway
- Major Road
- Property
- Forcemain
- Siphon

Sanitary Sewer by Diameter

- < 200 mm
- 250 mm - 375 mm
- 450 mm - 600 mm
- 675 mm - 900 mm
- > 1075 mm
- Pump Station
- Wastewater Treatment Plant

0 500 1,000 metres

1:48,717 (At Original document size of 11x17)

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Project Location
City of Guelph

165640298

Client/Project
CITY OF GUELPH WATER AND WASTEWATER SERVICING MASTER PLAN – TMI BACKGROUND REVIEW

Figure No.
3-1

Title
Sanitary Sewer System

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018.

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4.0 Water and Wastewater Systems Modelling

Hydraulic models are valuable tools for simulating various demand and infrastructure conditions for master planning of water and wastewater distribution systems. The City has historically invested in the development of computer simulation models to help support capacity assessments and capital planning. The City's existing water and wastewater models were updated as part of the WWSMP, including consideration for migration to a different modelling platform. Available modelling software was reviewed, and preferred software was recommended as presented in *Volume II: TM2 Model Assessment and Software Recommendation (TM2)*.

Hydraulic model updates included a refresh of existing demands and infrastructure to represent current conditions. Model calibration was then completed to achieve a sufficient level of accuracy for master planning purposes. The model updates are detailed in *Volume II: Model Update, Field Testing and Calibration (Model Update TM)* and are summarized in the sections that follow.

4.1 Water System

4.1.1 Water Model Development

The City's first water model was developed in 2001 using WaterCAD software. Since then, several updates and improvements have been made. The most recent model was built in InfoWater software and was utilized for development applications, operational support, project planning and master planning as required. Through the analysis of available hydraulic modelling software completed in *TM2*, it was determined that the preferred software for master planning purposes was InfoWater Pro. InfoWater Pro was used for this update of the model.

The water distribution system was re-built in the model using the City's geographic information system (GIS) records and includes all hydrants and system valves. Facilities were carried forward from the previous model as they were up to date.

4.1.2 Water Model Demand

Existing demands were updated using 2019 SCADA data and billing meter records. Two demand types were allocated throughout the system, billed consumed and non-revenue water (NRW). A summary of the average day demand (ADD) and maximum day demand (MDD) used in the existing conditions scenarios is summarized in Table 4-1 below. Flow monitoring was completed on the City's five (5) largest water users to develop unique diurnal patterns for these customers.

Table 4-1 Water Model Existing Demands Summary (L/s)

Scenario	Total Production	Billed Consumed	NRW
ADD 2019	544	452	92
MDD 2019	729	637	92

4.1.3 Water Model Calibration

The water model was calibrated using City-collected SCADA data at facilities as well as field data that was collected in 2020. Fifteen (15) pressure data loggers were installed throughout the distribution system for a one-month period in the summer of 2020. Additionally, there are 50 district metering area (DMA) flowmeters and pressure data loggers throughout the system that continuously collect data. Field data was compared to model results under a range of demand conditions. The model was updated to simulate existing conditions within reasonable accuracy for purposes of master planning.

4.1.3.1 Future Calibration and Field Testing

To further improve the model accuracy, it was recommended that additional field testing and calibration be completed in select DMAs.

Additional field testing and calibration was not required for the purpose of the WWSMP. However, as the model is also used for operational purposes, it was recommended that a second phase of field testing occur to fine tune the model. For accurate operational level modeling, it was recommended that detailed and localized information be gathered. Since the largest unknown is the water consumption usage patterns, it is recommended that the DMAs be isolated, and testing occur within the isolated DMAs. The additional field testing and calibration is currently scheduled for summer 2023.

4.2 Wastewater System

4.2.1 Wastewater Model Development

The City has been using hydraulic modelling for wastewater collection system analysis to support growth capacity assurance, flood risk reduction, operational assessment, and long-term capital planning. The City's first wastewater model was developed in XPSWMM and was converted in 2008 to the InfoSWMM software. Similar to the water model development history, several updates and improvements have been made by various consultants since the initial model was developed. Through the analysis of available hydraulic modelling software completed, it was determined that the preferred software for master planning purposes was PCSWMM.

The wastewater collection system was validated in the model using the City's GIS records and includes all maintenance holes and sewers. Pump stations and siphons are

included and the representation of these were validated through consultation with the City and review of previously completed modelling assignments.

4.2.2 Wastewater Load Calculation and Allocation

Flow generation in a hydraulic model is primarily based on tributary population (existing and projected), groundwater infiltration, also known as baseflow, non-residential large users (usually ICI land users), and wet weather flow resulting from rainfall-derived infiltration and inflow (RDII). Details of how these parameters were calculated and allocated through the City's model are provided in *Model Update TM*.

4.2.3 Wastewater Model Calibration

The calibration process includes an iterative approach to bring key model results such as peak flow, volume, and hydrograph shape, within targeted ranges. Data from thirteen (13) sewer flow monitoring sites where data was collected in 2020 was used to calibrate the model for both dry and wet weather flow conditions. The location of flow monitoring sites is presented in *Model Update TM*.

4.2.3.1 Future Calibration and Sewer Flow Monitoring

The flow monitoring coverage was generally sufficient for the purposes of this WWSMP; nevertheless, increasing data coverage can be beneficial for future master planning initiatives. This can be achieved by continuing with regular sewer flow and rainfall monitoring programs to collect system operational data. This can also be used to support other City initiatives such as infiltration and inflow monitoring/characterization, design, post-event forensic evaluations, and proactive emergency response tracking.

5.0 Level of Service Criteria

Establishing appropriate design criteria and levels of service (LOS) is an important step in the development of alternative solutions and planning cost-effective infrastructure investment. Relevant water and wastewater servicing design criteria and LOS from provincial, regional and City guidelines and previous studies completed for the City and neighboring municipalities were summarized to provide recommendations for the WWSMP. Regional and provincial Guidelines that were reviewed include:

- Region of Waterloo and Area Municipalities 2020 Design Guidelines and Supplemental Specifications for Municipal Services (2020 DGSSMS)
- Ontario Ministry of the Environment, Conservation and Parks 2019 Design Guidelines for Sewage Works (2019 MECP Sewage Guidelines)
- Ontario Ministry of the Environment, Conservation and Parks 2019 Design Guidelines for Drinking Water Systems (2019 MECP Water Guidelines)
- 2012 Ontario Building Code (2012 OBC)

The development of the LOS criteria is described in *Volume II: TM5 Design Criteria, LOS and Sensitivity Analysis (TM5)* and the criteria used for the WWSMP are summarized in the following sections.

5.1 Water Service Criteria

The water servicing criteria established and used for the WWSMP are summarized in Table 5-1 below.

Table 5-1 Water Servicing Criteria

Criteria	Level of Service Targets
System Pressure	▼ 40 – 100 psi allowable ▼ 50 – 80 psi preferred where applicable
Fire Flow	▼ Minimum allowable for infrastructure: 30 L/s ▼ Residential – low density: 80 L/s for 2 hours ▼ Residential – medium density: 150 L/s for 2 hours ▼ Residential – high density: 200 L/s for 2.5 hours ▼ Commercial – small: 200 L/s for 2.5 hours ▼ Commercial – medium: 267 L/s for 3.5 hours ▼ Commercial – large: 367 L/s for 5 hours ▼ Institutional – small: 150 L/s for 2 hours ▼ Institutional – large: 250 L/s for 3.5 hours ▼ Industrial – 250 L/s for 3.5 hours
Headloss	▼ Maximum 2 m/km under typical operating conditions
Velocity	▼ Maximum 1.5 m/s under typical operating conditions

Criteria	Level of Service Targets
	▼ Maximum 5 m/s under fire or emergency conditions
Storage	▼ Guidelines for Total Storage, A+B+C ○ A = Fire Storage ○ B = Equalization Storage (25% of maximum day demand) ○ C = Emergency Storage (25% of A+B) ▼ Fire storage: ○ Zone 1/3: Commercial – large: 367 L/s for 5 hours ○ Zone 2: Commercial – medium: 267 L/s for 3.5 hours
Pump Capacity	▼ Firm capacity must exceed the MDD for each pressure zone. ▼ If no floating storage is available, firm capacity must exceed MDD plus fire flow.
Demand	▼ Residential: 167 Lcd ▼ Employment: 191 Lcd ▼ NRW: 61 Lcd ▼ MDD peaking factor: 1.34 x ADD
Redundancy*	▼ MDD must be met with Arkell Aqueduct or Woods PS offline. ▼ ADD for each pressure zone must be met with largest pump supply offline.

*Redundancy criteria for planning purposes only and not required to be met under existing conditions.

5.2 Wastewater Service Criteria

The City's guidelines (2019 Development Engineering Manual) were reviewed and compared to the regional and provincial guidelines. In general, it is recommended to align with the MECP and then regional guidelines. This alignment will ensure that expected considerations are included and maintained. The City's guideline can then act to further characterize variances specifically for its own use. This will provide an approach to design and level of service criteria that include the components required at the provincial and regional level that are then characterized to the City of Guelph's unique needs and priorities.

Recommendations as they pertain to the City's current design criteria and LOS analysis approach are provided in Table 5-2 and Table 5-3.

5.2.1 Discussion – Area-based and Population-based Flow Generation

The City currently requires an area-based approach for generating flows as part of the design criteria (2019 Development Engineering Manual). The recommendation is to update this to a population-based approach. There are several reasons for this recommendation:

- Both the regional and provincial guidelines recommend a population-based approach. Adopting this would align Guelph with most other municipalities in Ontario while satisfying the local regional and province wide recommendations.
- The population-based approach is more accurate in estimating the flow generation parameters as it considers the actual occupancy type and density considered. With an area-based approach, no matter the number of units and expected dwelling densities, the flow per area rate remains unchanged.
- Differentiating between average and peak dry weather flow (DWF) and wet weather flow (WWF) conditions is often of interest. The current area-based approach does not provide instruction on how to calculate these differences. A population-based approach can be used to calculate these flows as the Harmon peak factor equation can be applied. By calculating the average DWF and peak DWF, the extraneous flow allowance can be used to estimate the WWF condition.

Table 5-2 Recommended Wastewater Design Criteria

Criteria	2019 Engineering Manual	Recommendation
Flow Generation and Sewer Sizing	Design flow at maximum of 80% full flow design capacity of pipe size Eliminate any potential surcharging Wastewater flow calculated using area-based coefficients	<u>Sewer Sizing</u> New Development (greenfield) sewer sizing: For sewers greater than 450mm diameter: Design flow at maximum 70% full (design flow/full flow, Q/Qf) and trigger upsizing at 80%. For sewers equal or less than 450mm diameter: Design flow at maximum of 60% full and trigger upsizing at 70% full. Infill development or existing infrastructure sewer sizing:

Criteria	2019 Engineering Manual	Recommendation
		Design to eliminate full pipe conditions (i.e., no surcharging). Deviations from this approach (less or more surcharging) may be considered but will require consultation with the City for operational considerations. <u>Design Flows</u> Calculate design flows using population and 300L/c/d aligned with the 2020 DGSSMS and 2019 MECP Guideline recommendations. Apply Harmon peaking factor equation. • Minimum PF = 2 • Maximum PF = 4 Add extraneous flows of 0.25 L/s/ha. Extraneous flow to be established on an effective area basis. This effective area should not include areas that do not contribute flows (grassy areas, parks, etc.). The method for estimating this area must be provided. A suggested approach would be to apply a buffer around the sewer or roadway network. Evaluate present and future conditions
Wastewater Sewer Design – Minimum Pipe Size	Minimum diameter: 200 mm	Maintain requirement
Sewer Design - Manning's "n" Roughness Coefficient	All pipe sizes and types: 0.013	Maintain requirement
Wastewater Sewer Design – Flow Velocities	Not mentioned for Wastewater	Minimum velocity: 0.6 m/s Maximum velocity: 3 m/s

Criteria	2019 Engineering Manual	Recommendation
		Actual velocities to be established, not theoretical full pipe conditions. Requirements to help prevent operational problems including solids deposition and H2S generation.
Wastewater Sewer Design – Pipe Depth	A minimum cover of 2.7m (from future road grade) is required to the top outside edge of pipe barrel for the storm and wastewater sewers. Piping must be insulated if minimum burying depth cannot be achieved.	Maintain requirement
Wastewater Maintenance Hole Design - Benching	Plan and profile drawings must show benching specifications.	Any sewers designed with flows greater than 50% capacity will have their MH benching set to the obvert of the sewer to reduce hydraulic losses.
Pumping Stations	No mention of pumping stations	Min Design according to 2019 MECP Guidelines. Recommend the City develop a Water/Wastewater Vertical Design Manual, or a Wastewater Pumping Station Design Manual.
Siphons	No mention of siphons	Avoid inverted siphons. If required, design according to Follow MECP Guidelines.

Table 5-3 Recommended Wastewater Level of Service Criteria and Approach (Existing and Infill Development)

Criteria	Recommendation
DWF Performance	HGL should be within sewer obvert. Diurnal pattern considered. This could be based on recent sewer flow monitoring data, or an established City approach considering residential and ICI contributions (if applicable).
WWF Performance	Conveyance and Storage Requirements: 3-hr 25yr Chicago event for peak flow conveyance considerations 24-hr 25yr SCS Type II event for peak volume storage considerations. Other return periods and event distributions can be considered. Consultation with the City required. Surcharge: No surcharge above obvert is permitted without express approval form the City. Confirmation with the City and approval of any design allowing surcharge is required.
Pumping Stations	The as-operating condition should be used to establish the resultant upstream HGL. The downstream HGL with the pumping station conveying the peak WWF to be established.
Siphons	Minimum velocity (DWF) and upstream HGLs (WWF) to be considered.
Wastewater Treatment Plant	The range of operating levels at the WWTP is to be considered in the hydraulic modelling of the collection system. Ensure an appropriate boundary condition is considered. The City to be consulted.

6.0 Existing System Constraints/Opportunities

The existing water and wastewater systems were assessed under existing and 2051+ population conditions to identify constraints and opportunities. The complete analysis can be found in *Volume II: TM3A Existing and Future Population, Employment and Land Use, and Servicing Implications (TM3A)*. The results of this analysis are summarized below.

6.1 Water System

Based on the analysis of the water system under existing and 2051+ growth projections, the following conclusions were made:

1. Storage:
    a. Based on the desktop analysis, there is sufficient storage under existing and 2051+ demand conditions.
    b. Based on the hydraulic analysis, limitations were seen in the model for balancing the Zone 1 storage between the Verney and Clair ETs. The Verney ET was found to overflow while the Clair ET level dropped to 47% full under 2051+ MDD conditions. This is due to the hydraulic connectivity of the system as the Verney ET is located closer and is better connected to the Woods PS and Reservoir than the Clair ET. The Woods Reservoir also drained throughout the day as the Woods PS struggled to maintain the Clair ET level.
    c. The hydraulic analysis showed that in Zone 2, the Paisley Reservoir and Speedvale ET levels were maintained under existing and 2051+ conditions. The Clythe Reservoir was found to drop below 50% full during peak hour under existing conditions, but this was mitigated under 2051+ conditions with the expanded Clythe Reservoir, inflow from the Clythe Well and the additional supply sources on the east side of Zone 2.
2. Supply:
    a. The desktop analysis showed that the existing and planned future supply sources, as per the 2021 WSMP, are sufficient to meet the projected 2051+ demands.
    b. The hydraulic analysis showed that the sources which supply the Woods Reservoir via the Arkell Aqueduct (Arkell Wells, Glen Collector, Lower Collector and Carter Wells) were not sufficient to maintain the Woods Reservoir level under 2051+ MDD conditions. This was partially due to the Verney ET overflowing, causing water loss in the system as well as hydraulic limitations in the water system and some sources not able to operate 24 hours per day.
3. Pump Capacity:
    a. The desktop analysis showed sufficient pump capacity under existing and 2051+ conditions.

   b. The hydraulic analysis showed that under 2051+ MDD conditions, the pump capacity in the south end of Zone 1 was not sufficient to maintain the Clair ET level, while the north end of Zone 1 was being oversupplied, causing the Verney ET to overflow.
   c. The hydraulic analysis showed sufficient Zone 2 pump capacity under 2051+ MDD conditions, with Paisley, Robertson and Clythe PSs running well below their planned firm capacities.
   d. The Clair BPS was found to have sufficient capacity to supply the Zone 3 2051+ MDD.
4. Fire Flow
   a. Localized fire flow concerns were seen in the model under both existing and 2051+ conditions in areas with small (<200mm diameter) cast iron watermains.
5. Watermain Capacity
   a. Limited watermain capacity and increased demands under 2051+ MDD conditions prevented the Woods PS from being able to supply the south end of Zone 1 to sufficiently maintain the Clair ET level.
   b. The headloss was found to exceed 2 m/km in a number of watermains throughout Zone 2 under 2051+ MDD conditions.
   c. Velocity was not found to exceed 3 m/s under existing or 2051+ conditions.
6. Pressure
   a. Under existing MDD conditions, pressure below 40 psi was seen in the model in pockets of Zone 1 with ground elevations above 344m and one high elevation area on the east side of Zone 2 with ground elevations above 357m.
   b. Under existing MDD conditions, pressure above 100 psi was seen in the model in areas of Zone 1 along the Speed River with elevations below 310m.
   c. Existing low pressure concerns in the south end of Zone 1 were found to worsen under 2051+ conditions when the Clair ET level dropped during peak hour.
   d. Existing high pressure concerns along the Speed River in Zone 1 were found to worsen under 2051+ conditions when the Woods PS ran at a higher flow to meet demands and fill the Clair ET.
7. A failure assessment was completed on significant infrastructure in the City. The water system failure analysis showed the following infrastructure to be critical to the system's performance and was considered when developing proposed future projects:
   a. High Criticality:
      i. Woods PS
      ii. Arkell Aqueduct
   b. Medium Criticality:

i. University Watermain River crossing
ii. Paisley PS and Reservoir
iii. Clythe PS
iv. Clair BPS (2051+ conditions only)

The minimum pressure results and available fire flow under existing MDD conditions are shown in Figure 6-1 and Figure 6-2 below, respectively.

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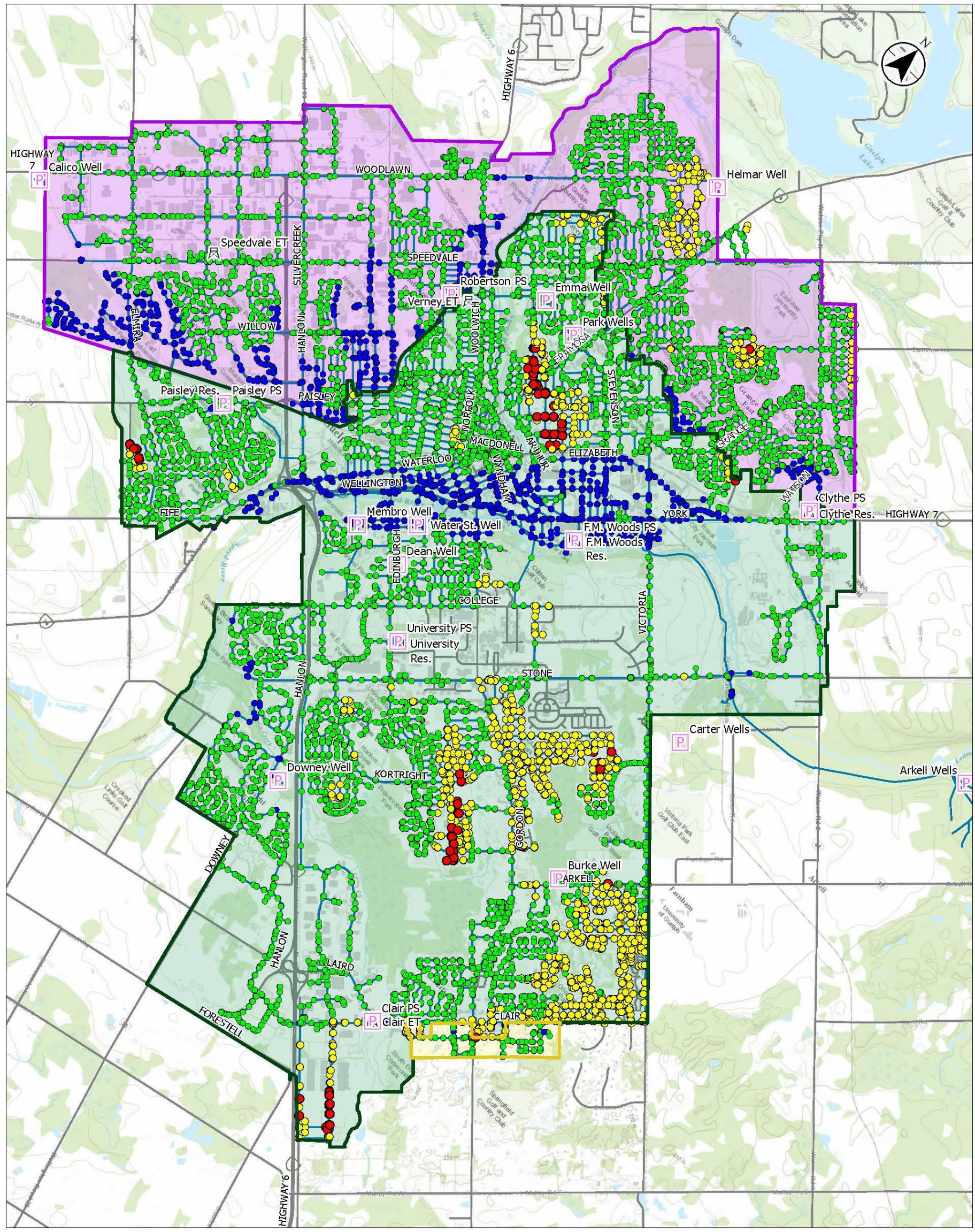

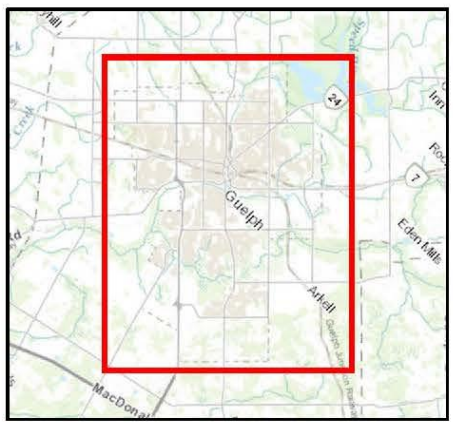

Legend

Min. Pressure (psi)
- < 40
- 40 - 50
- 50 - 80
- 80 - 100
- > 100

- Pump Stations & Wells
- Reservoirs & Tanks

Pressure Zone
- 1
- 2
- 3

0 1 2 Km
1:50,000 (At Original document size of 11x17)

Stantec

C3 WATER

Project Location
City of Guelph

Client/Project
CITY OF GUELPH WATER AND WASTEWATER SERVICING MASTER PLAN - REPORT

Figure No.
6-1

Title
Existing MDD - Minimum Pressure

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018. World Topographic Map: City of Guelph, Region of Waterloo, Province of Ontario, Ontario MNR, Esri Canada, Esri, HERE, Garmin, INCREMENT P, USGS, METI/NASA, EPA, USDA, AAFC, NRCan
World Topographic Map: City of Guelph, Region of Waterloo, Ontario Base Map, Province of Ontario, Ontario MNR, Esri Canada, Esri, © OpenStreetMap contributors, HERE, Garmin, USGS, NGA, EPA, USDA, NPS, AAFC, NRCan

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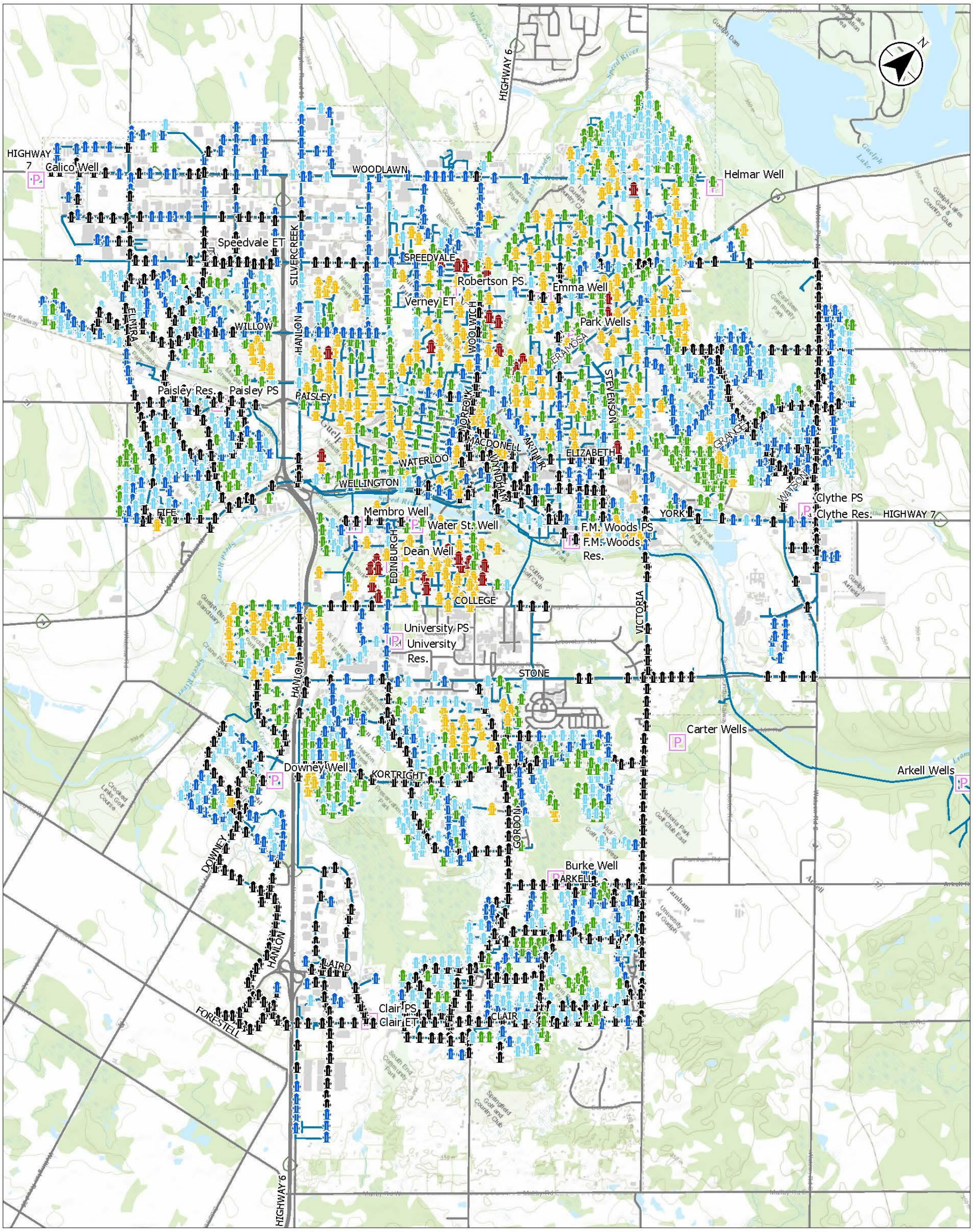

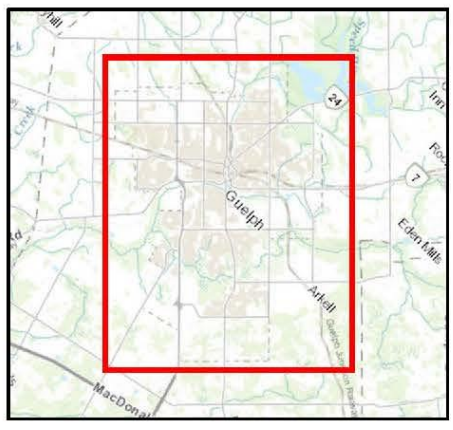

Legend

Available Fire Flow (L/s)

- < 30
- 30 - 80
- 80 - 150
- 150 - 250
- 250 - 367
- > 367

0 1 2 Km

1:50,000 (At Original document size of 11x17)

Stantec

C3 WATER

Project Location
City of Guelph

Client/Project
CITY OF GUELPH WATER AND WASTEWATER SERVICING MASTER PLAN - REPORT

Figure No.
6-2

Title
Existing MDD - Available Fire Flow

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018. World Topographic Map: City of Guelph, Region of Waterloo, Province of Ontario, Ontario MNR, Esri Canada, Esri, HERE, Garmin, INCREMENT P, USGS, METI/NASA, EPA, USDA, AAFC, NRCan
World Topographic Map: City of Guelph, Region of Waterloo, Ontario Base Map, Province of Ontario, Ontario MNR, Esri Canada, Esri, © OpenStreetMap contributors, HERE, Garmin, USGS, NGA, EPA, USDA, NPS, AAFC, NRCan

6.2 Wastewater System

Based on the analysis of the wastewater system under existing and 2051+ growth conditions, the following conclusions were made:

1. There are no capacity issues under the DWF conditions for either the existing or future scenarios. There are isolated locations where sewers are identified as minimal or flat slopes, however no surcharging is identified in these locations. These locations may warrant additional maintenance.
2. Seven (7) areas are identified with capacity constraints/bottlenecks under the WWF condition for both the existing and future scenarios, with surcharging observed. Specific reaches within these areas are considered for upgrade requirements.
3. The City's pump stations have adequate capacity for the DWF and WWF conditions under both the existing and future scenarios.

The existing DWF and WWF results are presented in Figure 6-3 and Figure 6-4 below, respectively.

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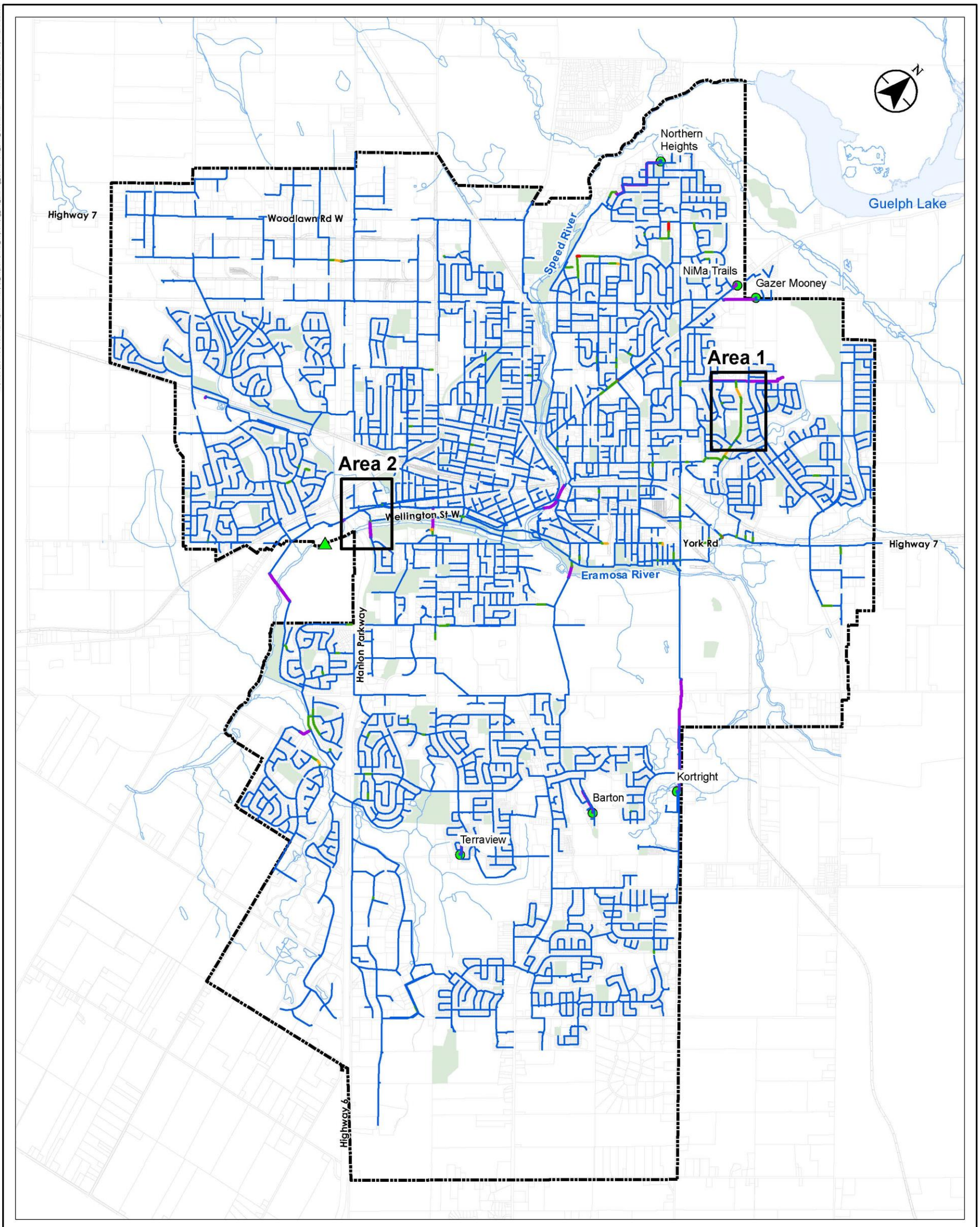

Legend

- Active Pump Station
- Water Resource Recovery Center
- Railway
- Watercourse
- Study Area
- Property
- Forcemain / Siphon

d / D

- <= 50 %
- > 50 % - 80 %
- > 80 % - 99 %
- Surcharged

0 1,000 2,000 Meters

1:50,000 (At Original document size of 11x17)

Stantec

C3 WATER

Project Location
City of Guelph

165640298

Client/Project
CITY OF GUELPH WATER AND WASTEWATER SERVICING MASTER PLAN

Figure No.
6-3

Title
Existing System DWF Results

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018. Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community

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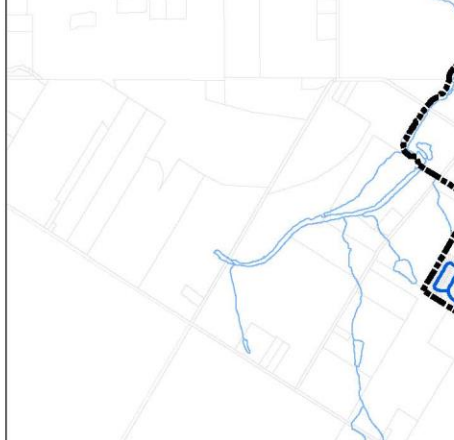
V:\1656\active\165640298\preliminary\3_Report\Final_Report\fig_6-4_Exiting_Conditions_WWF_results.mxd Revised: 2023-03-21 By: McAnderson

Area 1
Area 2
Area 3
Area 4
Area 5
Area 6
Area 7
Highway 7
Woodlawn Rd W
Speed River
Northern Heights
Guelph Lake
NiMa Trails
Gazer Mooney
Wellington St W
York Rd
Highway 7
Eramosa River
Hanlon Parkway
Kortright
Barton
Terraview
Highway 6



Legend
- Active Pump Station
- Water Resource Recovery Center
- Railway
- Watercourse
- Study Area
- Property
- Forcemain / Siphon

d / D
- <= 50 %
- > 50 % - 80 %
- > 80 % - 99 %
- Surcharged

0 1,000 2,000 Meters
1:50,000 (At Original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018. Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community

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Stantec
C3 WATER

Project Location
City of Guelph

165640298

Client/Project
CITY OF GUELPH WATER AND WASTEWATER SERVICING MASTER PLAN

Figure No.
6-4

Title
Existing System WWF Results

7.0 Development and Evaluation of Alternatives

Following the identification of system opportunities and constraints, servicing solution alternatives were developed and evaluated.

The criteria used to evaluate the servicing alternatives were developed by the project team with input from the City and included Environmental, Social/Cultural, Economic, and Technical considerations. Details of the evaluation categories and criteria indicators are summarized in Table 7-1.

Table 7-1 Alternative Evaluation Criteria

Environment and Criteria Categories	Criteria Indicators
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.
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 GRCA regulated areas.
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.
Social/Cultural	
Minimizes Long-Term Impacts to the Community Related to Noise,	▼ Minimize noise, odour, and traffic affecting the community during system operation and maintenance. ▼ Maintain access to, and aesthetics of, public spaces.

Environment and Criteria Categories	Criteria Indicators
Odour, Traffic and Aesthetics	▼ Minimize negative impacts that may result due to changes to the neighbourhood characteristics (e.g., recreational features, green space, property values).
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
Manages and Minimizes Short-Term Construction Impacts	▼ Minimize noise, odour, road closures, and truck traffic affecting the community during construction.
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.
Protects Cultural Heritage Resources	▼ Minimize potential impact to cultural heritage resources.
Minimizes Risks to Historical Landfill Sites	▼ Minimize potential impact to known historical landfill sites.
Economic	
Provides Low Lifecycle Costs	▼ Minimize capital, operation and maintenance (life cycle) costs over a 50-year period.
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 2051.

Environment and Criteria Categories	Criteria Indicators
Provides Ease of Maintenance	▼ Provide operational redundancy to allow for safe and efficient maintenance activities. ▼ Minimize increases in operational and/or maintenance complexity of the system.
Aligns with Existing and Planned Infrastructure	▼ Optimize existing infrastructure investment. ▼ Minimize requirement for upgrades/expansion to recent infrastructure. ▼ Align with other planned infrastructure initiatives (Trails, Transportation, Stormwater Master Plans, Capital projects). ▼ Ability to implement in a phased manner over time.
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.
Aligns with Efficient Approval and Permitting Process	▼ Minimize the complexity and time spent to obtain approvals from various regulatory agencies.
Manages and Minimizes Construction Risks	▼ Minimize complexity of construction and maximize ability to maintain adequate water/wastewater servicing during construction.
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.

7.1 Water Servicing Alternatives

To address the identified system deficiencies, the following water servicing alternatives were considered:

1. Do Nothing
2. Limit Community Growth
3. Water Conservation/Demand Management

4. Improvements to Existing System: New Facilities and Watermains

A failure analysis was completed to determine the criticality of significant water system infrastructure. This analysis can be found in *TM3A*. As a result of the failure analysis completed, the Arkell Aqueduct and the Woods PS were both flagged as being highly critical for water servicing. It was found that if either were to fail in the model, the existing system would run out of water in approximately 12-24 hours, under existing average day demand (ADD) conditions.

Upgrades to the Woods PS are underway to improve the resiliency of the facility. Construction is planned to be completed by 2025. While this project reduces the criticality of the Woods PS, the Arkell Aqueduct will still be a critical singular supply to Woods.

The Arkell Aqueduct is referred to in three (3) reaches:

1. Upper Reach from the Arkell Spring Grounds to Watson Road
2. Middle Reach from Watson Road to Scout Camp Station
3. Lower Reach from Scout Camp to Woods WTP

The Arkell Aqueduct is of particular importance because it supplies approximately 60-80% of the City's drinking water on any given day. The aqueduct is approximately six kilometers long and is a single non-redundant pipe, making this an extremely critical piece of infrastructure. Additionally, portions of the Aqueduct, specifically the Middle Reach, are of concern due to age and condition and are difficult to access for maintenance and repair.

A previous study was completed to assess how the redundancy of this key supply can be improved, including the "Arkell Aqueduct – Redundancy and Resiliency" TM completed by AECOM in 2019 (Aqueduct Redundancy TM). Two overall alternatives were considered including twinning the existing Aqueduct along the same alignment or directing a portion of the Arkell Wellfield supply towards the south end of the City.

Each of the two alternatives has a different impact on the water distribution system. Twinning the existing aqueduct would maintain the supply system with the F.M Woods PS continuing to be the largest point of supply into the distribution system. Adding a new connection from the Arkell Wellfield to the south end of the City's water system would provide a large new point of entry (POE) to the distribution system toward an area where significant growth is occurring. The decision on how to provide redundancy to the Arkell Wellfield will greatly impact other needs in the distribution system. Therefore, it is important to first determine the long-term plan for providing redundancy from the City's largest supply.

For the purposes of the WWSMP, the following sub-alternatives for improvements to the existing system were considered for redundancy/resiliency of the Arkell Wellfield:

A. Twin Existing Arkell Aqueduct – FM Woods WTP POE
B. New Watermain, Reservoir and Pump Station (South end POE)

7.1.1 Do Nothing

The “Do Nothing” alternative is that for which no improvements or changes would be undertaken to address water servicing requirements. This alternative does not address system deficiencies; however, it has been included as one of the potential solutions as it serves as a benchmark against which all other alternatives may be compared or evaluated. A decision to “Do Nothing” may be made if the financial and environmental costs of all other alternatives outweigh the benefits.

In this case, the “Do Nothing” alternative would fail to address existing system limitations as identified in Section 6.1 and meet future growth requirements outlined by Shaping Guelph and the Province’s Places to Grow. This alternative is not recommended as a viable solution as the level of service provided would not meet the City’s criteria and will not be carried forward.

7.1.2 Limit Growth

Limiting growth would limit distribution system demands thus reducing the future water servicing requirements. This would involve limiting future residential, industrial, commercial and institutional growth and does not conform with the Shaping Guelph project. This is not a feasible alternative.

7.1.3 Water Conservation

Conserving water would help to reduce peak demands and overall water usage in the system. Water conservation measures would also decrease the volume of sanitary flows produced. Typically, water conservation is an economical method of delaying both water and wastewater infrastructure costs.

The City has been a leader in their development of a multi-faceted strategy for water efficiency. Water use per person in Guelph is lower than many comparable municipalities. The City updated their Water Efficiency Strategy in 2016 and continues to pursue various conservation efforts. Examples of conservation measures that have and will continue to be taken include public education programs, irrigation reduction incentives, switching to water efficient water softeners and increasing water efficiency in gardens and pools.

While water conservation could partially address the future supply deficiency, this alternative would be implemented in conjunction with other system improvements to meet demands. Additional supply and distribution infrastructure would still be required but timelines would be adjusted.

7.1.4 Improvements to Existing System: New Facilities and Watermains

The “Improvements to Existing System” alternative involves implementation of capital projects such as watermains, reservoirs and pump facilities to both address existing

constraints and meet the needs to future growth. Under this alternative, sub-alternatives were considered:

A. Twin Existing Arkell Aqueduct – FM Woods WTP POE
B. New Watermain, Reservoir and Pump Station (South end POE)

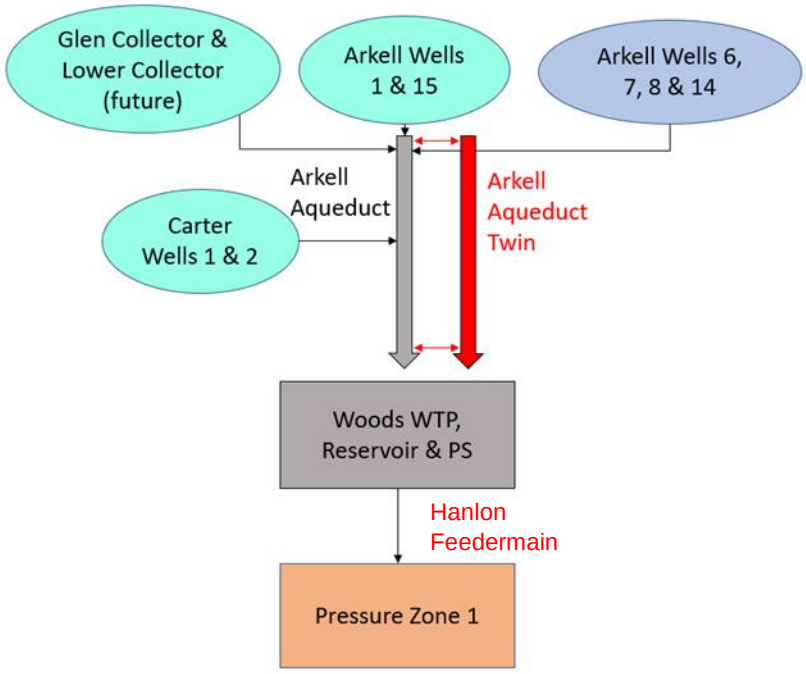
7.1.4.1 Arkell Wellfield Redundancy/Resiliency Concept A: Twin Existing Arkell Aqueduct

The first sub-alternative considered was to twin the existing Aqueduct along the same or similar alignment as existing Aqueduct. The Arkell Wells, Glen Collector, Carter Wells and future lower collector would feed into the existing and the new parallel Arkell Aqueduct which fills the Woods Reservoir. After ultraviolet (UV) treatment, water is then supplied into Zone 1 via the Woods PS.

Twinning the Aqueduct alone does not address the lack of capacity to move water from the Woods PS to the Clair ET in the South end of Zone 1. As such, the proposed feedermain along the Hanlon Parkway from Wellington Street to Clair Road is necessary in order for this alternative to be viable. This is a significant watermain project that would improve the transmission capacity between the Woods PS and the Clair ET. Previous studies have been completed for this project including the "Wellington – Clair Feedermain Municipal Class EA" by AECOM in 2020 (Wellington-Clair Feedermain EA).

This alternative is depicted in Figure 7-1.

Figure 7-1 Arkell Wellfield Redundancy/Resiliency Concept A: Arkell Aqueduct Twin



This would reduce the criticality of the existing Aqueduct and improve operational flexibility as one Aqueduct could remain operational while the other is isolated for maintenance.

While this alternative does provide redundancy to the existing Aqueduct, the resiliency is still limited. An extreme weather event has the potential to cause failure to or reduce access to both pipes as they would follow the same alignment and be subject to the same risks.

This alternative does not address the criticality of the Woods Reservoir and PS as this would still be the single POE for these sources into the distribution system. However, it is noted that the upgrades underway at the Woods PS will significantly improve the redundancy of the PS.

Benefits and drawbacks of this option are summarized in Table 7-2.

Table 7-2 Arkell Wellfield Redundancy/Resiliency Concept A: Arkell Aqueduct Twin

Benefits and Drawbacks	
Redundancy/Criticality	▼ Does not reduce criticality or improve redundancy of the F.M Woods PS. ▼ Reduces criticality, improves redundancy and capacity of the existing Arkell Aqueduct. ▼ Does not significantly improve resiliency of existing Arkell Aqueduct.
Pressure	▼ Improves but does not completely address low pressures at south end of Zone 1. ▼ Improves but does not completely address high pressures along Speed River in Zone 1.
Watermain Capacity	▼ Hanlon Feedermain improves ability for Woods to supply the south end of Zone 1.
Storage	▼ Clair ET maintained above 60% full under 2051+ MDD due to improved transmission from Woods via Hanlon feedermain. Woods Reservoir found to fall below 50%.
Pumping	▼ Woods pump station reaching firm capacity under 2051+ MDD conditions.

7.1.4.2 Arkell Wellfield Redundancy/Resiliency Concept B: New Watermain, Reservoir and Pump Station

The second sub-alternative considered was a new direct POE into the distribution system at Arkell Road and Victoria Road from the Arkell Wellfield. This alternative includes a new watermain, reservoir and PS. Sources from the Arkell Wellfield would be directed to a new Arkell reservoir and WTP facility. The water would then be pumped to the south end of Zone 1.

This alternative would reduce the criticality of both the existing Aqueduct and the Woods WTP, Reservoir and PS. This alternative improves the resiliency of supply to the system as the likelihood of complete failure to supply Arkell sources would be significantly reduced.

As the new Arkell PS would supply directly into the south end of Zone 1, this would reduce the need for improved north-south linear capacity. While additional watermain upgrades may be beneficial to improve system performance, no distribution system upgrades were necessary for this concept to be viable.

Secondary benefits of this alternative include the opportunity to supply other potential users, such as Arkell Village along the watermain route. Consultation should be conducted with Puslinch and Wellington County to discuss the needs or interest to service Arkell.

Two concepts were developed for this sub-alternative:

- Concept B1: Redundancy of Groundwater Arkell Wells
- Concept B2: Redundancy of all Arkell Sources

7.1.4.2.1 Arkell Wellfield Redundancy/Resiliency Concept B1: Redundancy of Groundwater Arkell Wells

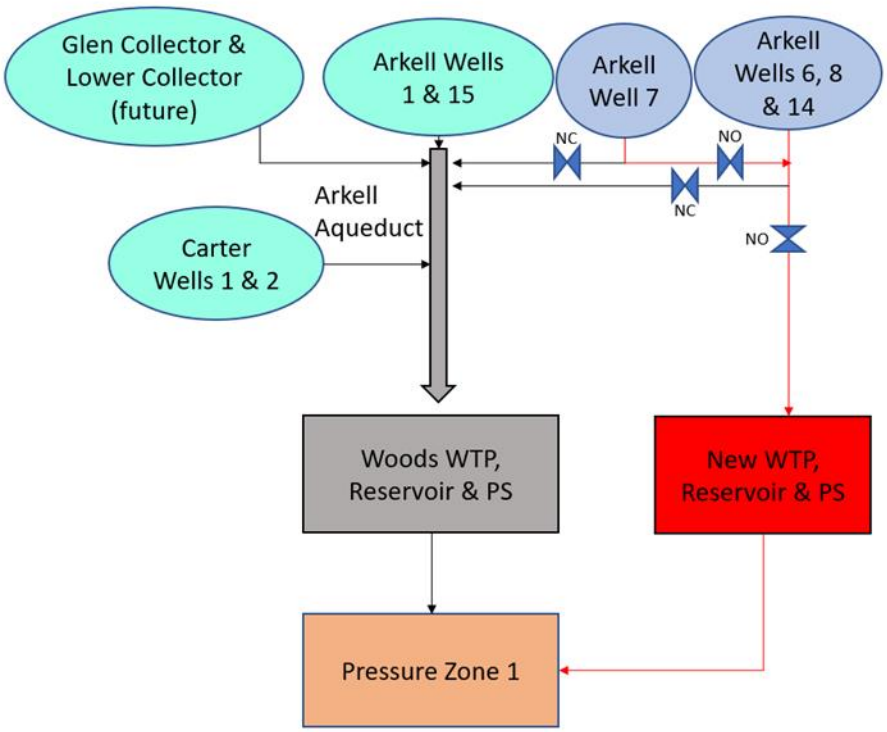
Of the existing sources into the Aqueduct, Arkell Wells 6, 7, 8 and 14 are designated as groundwater (GW, category 1) sources, while the remainder are designated as groundwater under the direct influence of surface water with effective filtration (GUDIWEF, category 2).

A preliminary concept for this alternative would be for the Arkell Wells 6, 7, 8 and 14 to be redirected, using existing Valve Chamber 2 (VC), to a new reservoir, WTP and PS. Since the treatment requirements for GW are less intensive, and treatment requirements for those designated GUDIWEF are already provided at the Woods WTP, having only the GW wells directed to the new system is a simplified concept for this sub-alternative.

This concept B1 is depicted in Figure 7-2 below. Preliminary layout is shown in Figure 7-3. This project would be subject to a Schedule C EA to determine site feature locations and watermain routing. As such, the preliminary layout is conceptual only.

Infrastructure upgrades required for this concept include a new reservoir, chlorination treatment facility and watermain from the reservoir to the south end of Zone 1 POE. Additionally, it is expected that existing pumps for Arkell Wells 6, 7, 8 and 14 would require replacement.

Figure 7-2 Arkell Wellfield Redundancy Concept B1: New Watermain, Pump Station and Reservoir (GW Only)

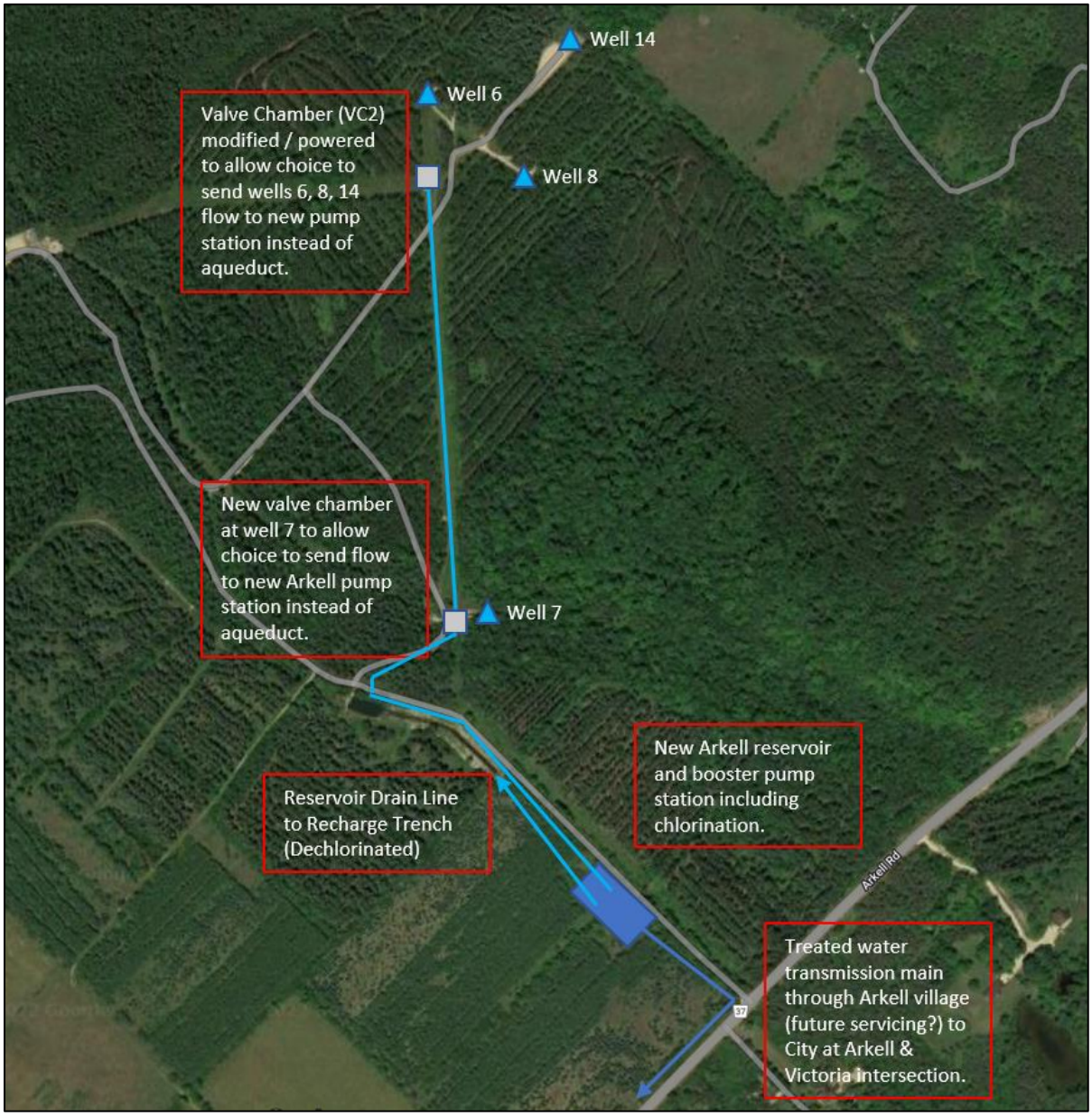


This concept does not provide complete redundancy for supplying the Arkell sources as the conceptual plan for the proposed PS only has the ability to convey water from the GW Wells and not the GUDIWEF Wells, the Glen Collector, the future Lower Road Collector, or the Carter Wells. Benefits and drawbacks of this option are summarized in Table 7-3.

Table 7-3 Arkell Wellfield Redundancy/Resiliency Concept B1: New Watermain, Pump Station and Reservoir (GW Only)

Benefits and Drawbacks	
Redundancy/Criticality	▼ Reduces criticality of Arkell Aqueduct and Woods PS. ▼ Improves resiliency of system supply. ▼ Provides partial redundancy of supply of Arkell sources.
Pressure	▼ Improves but does not completely address low pressures at south end of Zone 1. ▼ Improves but does not completely address high pressures along Speed River in Zone 1.
Watermain Capacity	▼ Reduces need for improved watermain capacity in Zone 1.
Storage	▼ Woods Reservoir remained above 60% full and Clair ET maintained above 70% full under 2051+ MDD conditions.
Pumping	▼ Woods pump station operating below firm capacity under 2051+ MDD conditions.

Figure 7-3 Arkell Wellfield Redundancy Concept B1: Preliminary Layout



7.1.4.2.2 Arkell Wellfield Redundancy/Resiliency Concept B2: Redundancy of All Arkell Sources

The second concept for this sub-alternative is to configure the Arkell infrastructure such that there is complete redundancy to supply all Arkell Sources in the event of a failure of the existing Aqueduct or the Woods facility. The concept is depicted in Figure 7-4 and allows all Arkell sources to supply the system via either Woods or the new facility.

Under this concept, the new watermain, reservoir, WTP and PS would be configured such that all Arkell wells and the Glen Collector can be redirected to the south end of Zone 1. This concept involves a bypass chamber off of the existing Aqueduct, east of Watson Road, to the proposed reservoir. The WTP facility would require UV as the sources would consist of both GW and GUDIWEF. For complete redundancy, the existing Aqueduct would need to be twinned upstream of the by-pass chamber. A preliminary layout for this concept is shown in Figure 7-5 below. This project would be subject to a Schedule C EA to determine site feature locations and watermain routing. As such, the preliminary layout is conceptual only. Under this concept, the existing Arkell well pumps would not need to be replaced.

Due to challenges associated with directing the Carter Wells to the new reservoir, it is suggested that a designated watermain is installed such that these wells can be redirected to Victoria Road and the distribution system, bypassing the existing Aqueduct and the Woods Reservoir. This would require a retrofit of the Carter facility to include UV treatment, nitrate treatment and pump upgrades.

Figure 7-4 Arkell Wellfield Redundancy Concept B2: New Watermain, Pump Station and Reservoir (All Arkell Sources)

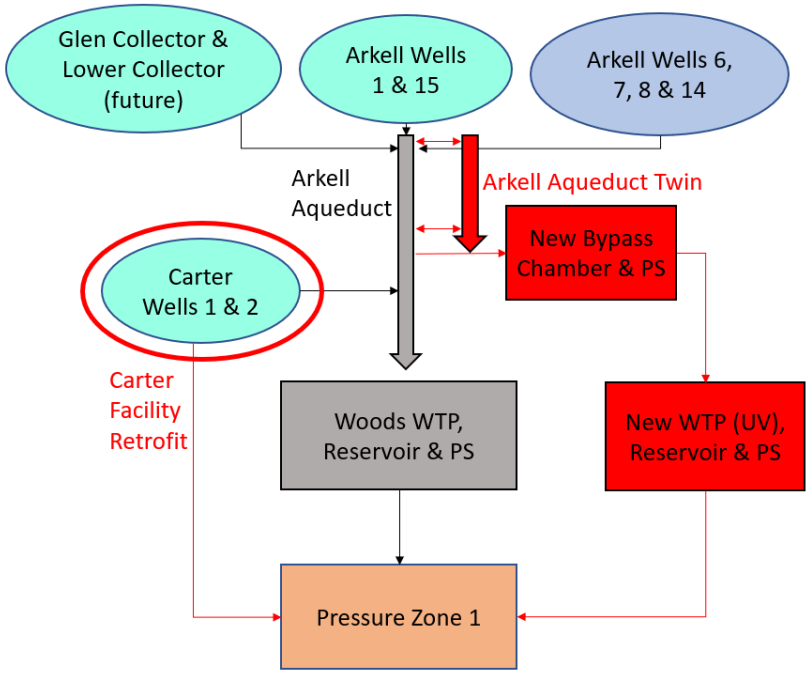
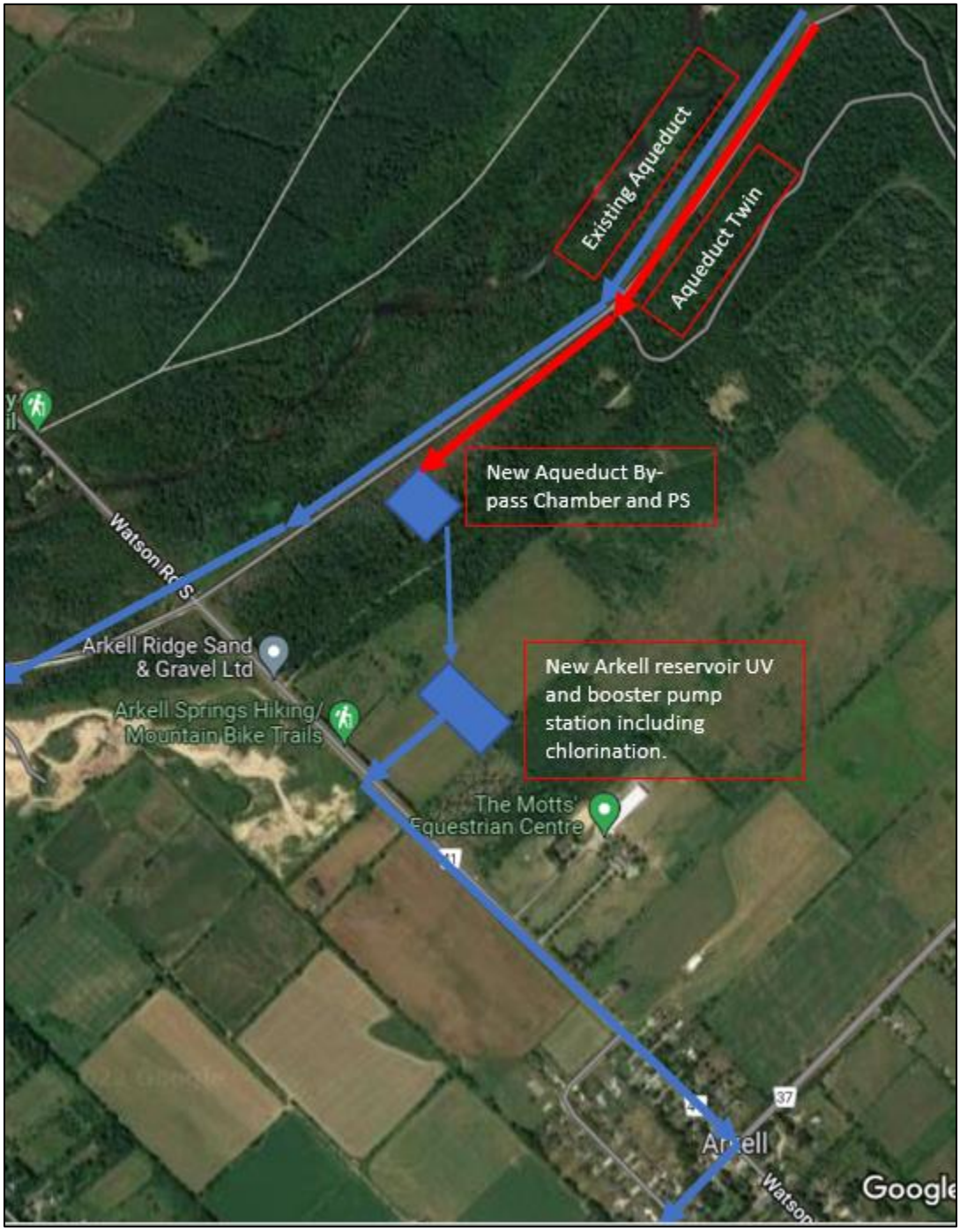


Table 7-4 Arkell Wellfield Redundancy/Resiliency Concept B2: New Watermain, Pump Station and Reservoir (All Arkell Sources)

Benefits and Drawbacks	
Redundancy/Criticality	▼ Reduces criticality of Arkell Aqueduct and Woods PS. ▼ Improves resiliency of system supply. ▼ Provides complete redundancy of supply of Arkell sources.
Pressure	▼ Improves but does not completely address low pressures at south end of Zone 1. ▼ Improves but does not completely address high pressures along Speed River in Zone 1.
Watermain Capacity	▼ Reduces need for improved watermain capacity in Zone 1.
Storage	▼ Woods Reservoir remained above 60% full and Clair ET maintained above 70% full under 2051+ MDD conditions.
Pumping	▼ Woods pump station operating below firm capacity under 2051+ MDD conditions.

Figure 7-5 Arkell Wellfield Redundancy Concept B2: Preliminary Layout



7.2 Evaluation of Water Servicing Alternatives

The water servicing alternatives were evaluated. Full evaluation is provided in *Volume II: TM3 Water and Wastewater Servicing Recommendations (TM3)* and summarized below.

7.2.1 Environmental

The *improvements to existing system* alternative is expected to have the largest negative impact on environmental features due to construction requirements. The *do nothing* alternative would maintain status quo with no change in environmental risk. *Water conservation* has the potential to reduce the impact on water resources. *Limiting future growth* is expected to have a minor impact on environmental features due to reduced development.

A significant portion of the existing Arkell Aqueduct is within a GRCA floodplain and in close proximity to GRCA regulated wetlands. Additionally, much of the Aqueduct is within woodlots and designated Natural Heritage System (NHS). As such, Arkell Alternative A is not well aligned with the criteria to protect environmental features, groundwater, streams and rivers. Portions of the upgrades required for Arkell Alternative B would likely be within woodlots, NHS and GRCA regulated floodplain, however the extent of the projects within these areas would be significantly less than under Alternative A, with new infrastructure installed in areas already mainly clear of trees; i.e., the existing hydro cut and access roads.

Under the Arkell Alternative B, B2 is expected to have a greater negative impact on environmental features than B1 due to the partial twinning of the Arkell Aqueduct and the additional construction at the Carter facility.

In terms of greenhouse gas emissions (GHGs), Alternative A is not expected to be significantly different compared to *do nothing* (existing conditions) as this scenario would not impact the operation of the well pumps or the Woods PS. However, the installation of the Hanlon Feedermain, under Alternative A, would likely decrease GHGs to some extent compared to existing conditions, due to the reduced headloss required to supply the south end of Zone 1.

Alternative B is also not expected to have significantly different GHGs compared to existing conditions, since energy used to pump from the new Arkell PS reduces energy used at Woods PS.

7.2.2 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 transmission capacity and lacks redundancy and failure protection.

Limiting future growth would have limited impact on existing customers, however, it does not align with the Shaping Guelph requirements.

Water conservation measures have the potential to delay construction projects. The City has an ongoing water conservation program in effect which has been extremely successful. There may be limited opportunities in the future for significant additional water conservation benefits.

Improvements to existing infrastructure are expected to have the highest social/cultural impact related to construction projects.

Under Arkell Alternative A, the building of the twinned Aqueduct is expected to have some impact on residents and businesses near the lower reach, between Victoria Road and Woods. However, the majority of the aqueduct twinning is in rural areas and the operation of businesses during construction would not be impacted.

Under Alternative A, the construction of the Hanlon Feedermain is expected to have significant impact on residents and businesses due to required road closures.

Arkell Alternative B is expected to have some impact on residents and businesses during construction along Arkell Road, however, this is a rural road and disruptions would be expected to be less significant than those caused by the Hanlon Feedermain project or the lower reach of the aqueduct under Alternative A.

The New PS and Reservoir under Alternative B is expected to have some long-term impact on the existing community in this area such as slightly increased traffic by operations and maintenance, although staff visits to the Arkell Spring Grounds are already frequent. Alternative A is not expected to have long-term impacts on the community as the operations and visible infrastructure would not significantly change compared to existing conditions.

Both Alternatives A and B are expected to improve short-term and long-term business vitality and community growth and development through improved water supply, with Alternative B providing greater long-term water system security.

The *do nothing* alternative has low potential to minimize impact to public health and safety as existing infrastructure may not have sufficient linear capacity to provide adequate water service under 2051+ conditions. Alternatives A and B are expected to reduce risks to water-supply related public health and safety due to the improved redundancy and security of supply.

Under the Arkell Alternative B, B2 would have a greater improvement in redundancy and security of supply than B1 due to the ability to supply any of the Arkell Sources with the Woods facility or the Arkell Aqueduct offline.

There is not expected to be a significant impact to operator's health and safety between Alternative A and existing conditions as day-to-day operations are not expected to significantly change. Alternative B has a minor potential to increase risk of operator health and safety due to the operations of the new PS and sodium hypochlorite storage on-site, common to all treatment locations. Concept B2 also involves the operation of two (2) additional UV treatment facilities.

7.2.3 Economic

The *do nothing* and *limiting future growth* alternatives do not involve any capital costs, however there is potential for increased lifecycle costs due to system aging and replacement/emergency needs. *Limiting future growth* has the potential for reduced revenue from development charges and taxes.

Water conservation has limited implementation costs depending on the programs put in place. But may delay the cost for proposed infrastructure.

Improvements to the existing system will have significant capital costs. There is potential, however, for reduced lifecycle costs due to upgraded infrastructure. This alternative has the potential for cost sharing with developers.

Conceptual cost estimates were completed for each of the Arkell alternatives and are presented in Table 7-5 . A detailed breakdown of the cost estimates is presented in *TM3*. The City has noted that land acquisition is required for the twinned Aqueduct alignment (Alternative A) and an easement is required for the proposed watermain on Arkell Road (Alternative B). Cost estimates for land requirements have been included in the capital costs.

Table 7-5 Arkell Wellfield Redundancy/Resiliency Cost Estimates

Alternative	Description	Capital Cost	Additional O&M** (50-yr)	Total 50-yr Lifecycle Cost
A	Twin Existing Aqueduct*	$85.2 M	$1.5 M	$86.7 M
B1	New Watermain, Reservoir and PS. (GW only)	$61.5 M	$3.5 M	$65.0 M
B2	New Watermain, Reservoir and PS. (All Arkell Sources)	$110.4 M	$3.5 M	$113.9

**Includes cost for Hanlon Feedermain*
***O&M Costs for comparison purposes only. Existing O&M costs common to both alternatives have not been included.*

7.2.4 Technical

While the *improvements to the existing system* alternatives are expected to have the highest technical impact due to construction projects, it is the only alternative that meets existing and future system needs. *Water conservation* is expected to delay but not remove the need for infrastructure. No construction is required for *do nothing* or *limit growth*.

Twinning of the existing Arkell Aqueduct under alternative A poses constructability challenges due to its proximity to the existing pipe, as well as forested land and watercourses in the project area.

In terms of level of service, *do nothing* does not meet long-term capacity requirements to service the projected population growth. The existing watermain infrastructure lacks the capacity to move water from Woods PS to Clair ET in the south end of Zone 1 leading to insufficient levels of service under 2051+ MDD conditions.

Based on model results, Arkell Alternatives A and B were both found to improve, but not completely mitigate, high pressure concerns along the Speed River and low-pressure concerns in the south end of Zone 1. Ultimately, the service pressures in these areas are limited by the ground elevation and the target HGL of Zone 1.

Under Alternative A, the Hanlon feedermain improved the ability for Woods to maintain the water level in the Clair ET, without over filling the Verney ET. Under Alternative B, the Clair ET level issue was further improved compared to Alternative A due to the proximity of the discharge feedermain from the new Arkell PS to the Clair ET.

Alternative B addresses the criticality concerns of the existing Arkell Aqueduct and the criticality of the Woods WTP, while Alternative A only addresses the criticality of the Arkell Aqueduct.

Alternative B has greater resiliency of supply than Alternative A. Alternative B1 provides a higher level of redundancy than Alternative A but does not provide complete

redundancy for transmission of the Arkell Sources into the distribution system. The B1 concept does not have the ability to treat/supply GUDIWEF sources.

Under Alternative B1, if the Arkell PS, reservoir or watermain were to fail, all Arkell Wells could be directed to the existing Aqueduct and operate as it does under existing conditions. If the Arkell Aqueduct or Woods WTP were to fail, the GUDIWEF sources could not be supplied.

Under Alternative B2, there is complete redundancy for transmission of all of the Arkell Sources. If the Arkell Aqueduct or Woods WTP were to fail, the Arkell Wells and Glen and future Lower Collectors could continue to be supplied to the system via the proposed Arkell PS. The Carter Wells could supply the system via the proposed direct connection. If either the Arkell PS, reservoir or watermain or the Carter Wells direct connection were to fail, all sources could continue to be supplied to the system via the existing Arkell Aqueduct and Woods PS.

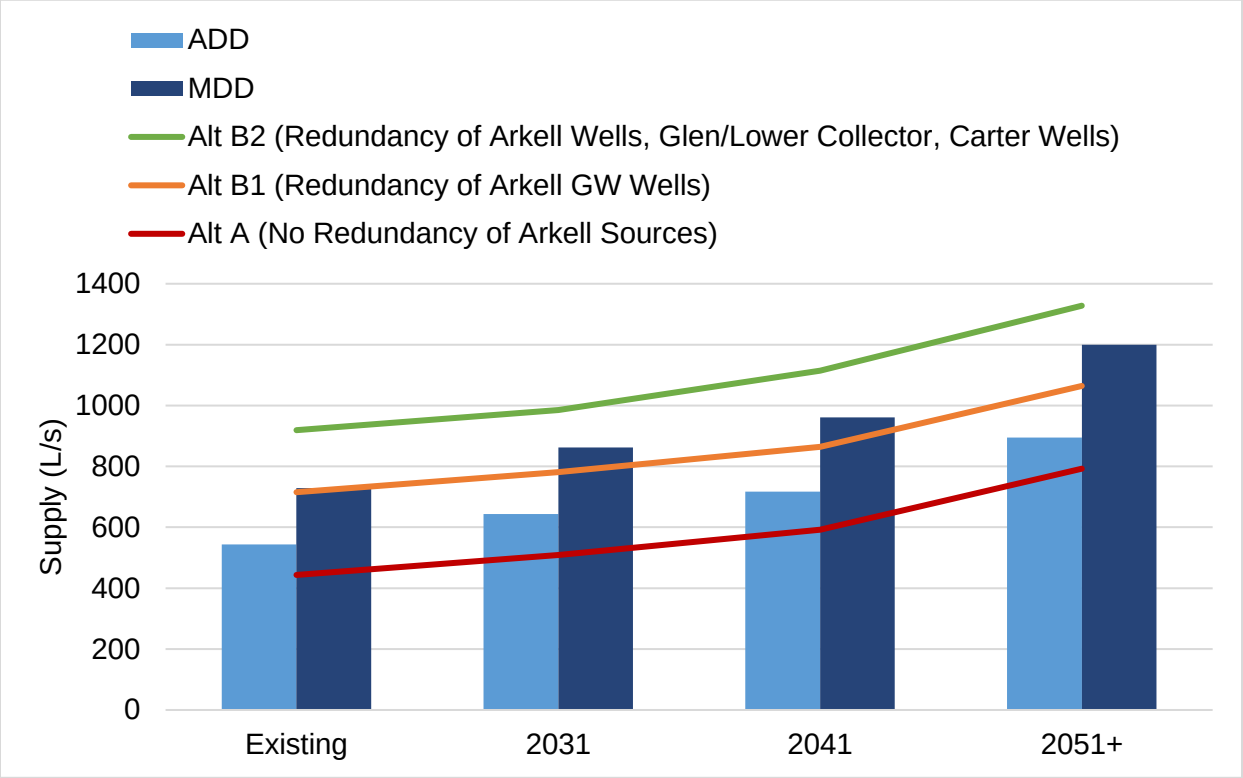
A summary of the available supply under each planning horizon is show in Figure 7-6 below. The green line represents the condition with Woods or the Arkell Aqueduct offline under Alternative B2. Under this alternative, all sources could be supplied to the distribution system through alternative means and there would be no reduction to available supply. The MDD could be met under all planning horizons.

The orange line represents a condition with Woods or the Arkell Aqueduct offline under Arkell Alternative B1. Under this condition, the GW Arkell wells can still be supplied to the distribution system via the new PS and the available supply exceeds the ADD for each horizon, but not the MDD.

The red line represents a condition with Woods or the Arkell Aqueduct offline under Arkell Alternative A. Under this condition, none of the Arkell sources can be supplied to the distribution system and the ADD cannot be met under any of the planning horizons. Although under this alternative, the Arkell sources could be supplied if there were a failure of the existing Aqueduct, through the twinned Aqueduct, none of the sources would be available if Woods were offline.

The criteria for future water supply redundancy are that MDD must be met with the Arkell Aqueduct or Woods PS out of service. Only concept B2 meets this criterion.

Figure 7-6 Available Supply With Woods/Arkell Aqueduct Offline



7.2.5 Water System Servicing Evaluation Summary

Of the alternatives assessed, *improvements to the existing system* is the only one that can meet the future requirements for the system while aligning with Shaping Guelph requirements. Therefore, this was carried forward as the preferred alternative.

Of the two Arkell Sub-Alternatives assessed, only Alternative B (New Watermain, Reservoir and PS) reduces the criticality of both the existing Aqueduct and the Woods PS, improves resiliency of supply of the Arkell Sources and provides some extent of redundancy of the Arkell Wellfield. The hydraulic performance associated with the B alternatives was also superior to the other alternatives. Therefore, Alternative B was carried forward as the preferred alternative to build out the distribution system.

Under a scenario with the existing Arkell Aqueduct or the Woods PS offline, concept B2 could meet MDD while B1 could meet only ADD. The City's criterion for system redundancy is that MDD must be met with the Arkell Aqueduct or Woods PS out of service. Therefore, B2 is the preferred concept for this alternative.

A full evaluation is provided in Volume II, *TM3.*

7.3 Wastewater Collection Alternatives

To address the identified system deficiencies, the following servicing alternatives were considered, in keeping with the framework of the original Master Plan:

1. Do Nothing
2. Limit Growth
3. I/I Reduction and Re-Use Alternatives
4. Improvements to Existing System: New Trunk Sewers
5. Improvements to Existing System: Pumping Station(s) and Forcemains(s)

7.3.1 Do Nothing

The *do nothing* alternative maintains the existing wastewater collection system as is. This alternative does not address system deficiencies; however, it is included as a benchmark against which all other alternatives may be considered. A decision to o Nothing" may be made if the financial and environmental costs of all other alternatives outweigh the benefits.

In this case, the *do nothing* alternative fails to address existing system limitations as identified and meet future growth requirements outlined by Shaping Guelph and the Province's Places to Grow Act. This alternative is not recommended as a viable solution as the level of service provided would not meet the City's criteria, and therefore will not be carried forward.

7.3.2 Limit Growth

This alternative essentially reduces or eliminates future wastewater servicing requirements by limiting collection system flow generation. This would involve limiting future residential, industrial, commercial and institutional growth and does not conform with the City's ongoing Municipal Comprehensive Review (Shaping Guelph) project. Additionally, this alternative does not address system limitations under existing conditions. Therefore, this is not a feasible alternative.

7.3.3 Inflow and Infiltration (I/I) Reduction

In tandem with the *water conservation* alternative, reducing water usage to decrease the system demand via water conservation actions would decrease the volume of wastewater flows produced. However, the City 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 as measured at the WRRC, where despite reduction in water usage per capita there is a trend towards increasing I/I volumes. I/I reduction is an ongoing effort by the City, to monitor and manage the impact of extraneous clean water sources from compromising existing capacity in the collection system, with the additional benefit of reduced volumetric impact at the WRRC. To date, the City has completed an I/I Strategy document and commenced with ongoing temporary flow monitoring programs to provide supporting data to characterize relative system performance against key performance indicators in dry and wet weather conditions. The City has advanced a pilot I/I study in the downtown core completing systematic field investigations to identify sources on both public and private property. This work provides a framework for

completing additional field investigation programs; however, there is a need to update and formalize the I/I strategy to integrate I/I considerations in activities across the organization. It is proposed that the I/I Strategy be updated with input from the rainfall and flow monitoring data collection activities, findings of the pilot field investigation studies, and observations at the WRRC.

I/I reduction alone cannot resolve existing conveyance deficiencies nor offset future growth demands. Nonetheless, I/I reduction and mitigation are prudent measures of collection system management that complement conveyance system upgrades, building in resiliency to uncertain implications of climate change. I/I reduction and mitigation are therefore considered a viable strategy to be carried forward in the WWSMP recommendations.

7.3.4 Improvements to Existing System: Gravity Sewers

This alternative involves 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 overall benefits from environmental, social/cultural, economic, technical, and financial perspectives. In general, improvements to the City's existing wastewater collection system by replacing/upgrading sewers is the preferred approach for local system deficiencies.

7.3.5 Improvements to Existing System: Pumping Station(s) and Forcemains(s)

This alternative strategy involves implementation of pumping station facilities to both address existing constraints and meet the needs to future growth. This strategy considers the introduction of additional pump stations and forcemains to collect flows and have more control over discharge to receiving sewers where residual capacity already exists, or to avoid gravity / siphon crossings of watercourses. Although technically feasible, additional pumping stations are more costly and introduce further risk and more components to maintain over the lifecycle of the assets.

Although not preferred as an overall servicing strategy for the City, the addition of pumping stations may be considered if the alternative gravity solution is found to be particularly challenging or introduces risks that could be mitigated with a strategic pumping station.

7.4 Evaluation of Wastewater Collection Alternatives

7.4.1 Environmental

Both of the *improvements to existing system* alternatives, are expected to have the largest impact on environmental features due to construction requirements. The *do*

nothing alternative is expected to have no impact on environmental features compared to existing conditions. *I/I reduction and re-use* has the potential to lessen the flows into the City's wastewater collection system, thereby reducing energy consumption at the WRRC. *Limiting future growth* is expected to have a minor impact on environmental features due to reduced development.

The *improvements to existing system* alternatives would both increase GHGs during construction activities. These alternatives would also introduce the risk that certain trees would need removal. These could be replanted to renew the resource. However, the bulk of work is recommended in existing disturbed road right of ways. Where possible, tree removal is avoided on road reconstruction and utility reconstruction project through careful design.

7.4.2 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.

Limiting future growth would have limited impact on existing residents, however, it does not align with the Shaping Guelph requirements and the requirements of recent Provincial legislation.

I/I reduction measures have the potential to lessen the servicing needs and extend the lifecycle of existing infrastructure. The sewer flow monitoring analysis completed show little to negligible I/I in the local collection system. As such, it is not expected that this alternative is very effective as an overall approach. However, it is understood that at the trunk level and at the WRRC that I/I does remain an operational issue. While there is no evidence to date of significant flood risk, elevated I/I rates in the system can lead to sewer back-up and spill to the environment, affecting the socio-cultural environments.

Improvements to the existing infrastructure alternatives, both *gravity sewer* and *pump station,* are expected to have the highest social/cultural impact related to construction projects. However, eliminating bottlenecks in the system will reduce the risk of basement backups and support a thriving and growing economy. These construction projects would be short-term in duration; however, it is expected that a *pump station* strategy would result in the need for increased operational and maintenance activity that could prove to have a higher impact than the *gravity sewer* upgrade alternative.

7.4.3 Economic

Both *do nothing* and *limiting future growth* do not involve any capital costs, however there is potential for increased lifecycle costs due to system aging and replacement/emergency needs. *Limiting future growth* has the potential for reduced revenue from development charges and taxes. The "Do Nothing" approach combined with allowing the City to continue to grow also increases the risk of basement flooding and sewage spills. The cleanup and remedial tasks that these would trigger would be costly both financially, socially, and environmentally.

I/I reduction would conceptually require limited cost (when compared to infrastructure needs for the *gravity sewer* and/or *pump station* 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. It is acknowledged that in the downtown pilot I/I study, no such large public sources were readily discovered.

Improvements to the existing system alternatives, both *gravity sewer* and *pumping station* are expected to have major capital costs. However, costs for the work that are required to support growth are captured through Development Charges and have been referred to the ongoing Development Charges Background Study.

The *pumping station* approach is expected to be significantly more expensive both in the short term and in the long-term, due to additional operations and maintenance requirements. Introducing larger pumping stations may delay the needed to replace existing trunk sewers, but these will eventually require renewal. Thus, the overall cost is significantly more as it is a combined increase due to new pumping station(s) and the increase O&M needs, plus the renewal needs of existing infrastructure that would be unchanged.

7.4.4 Technical

Do nothing, *limit future growth*, and *I/I reduction* alternatives are all the easiest to implement. These do not, however, meet the overall technical requirements and are therefore not satisfactory within the context of satisfying the City's long-term servicing needs.

Both *improvements to the existing system* alternatives*, gravity sewers and pumping stations/forcemains* are feasible approaches that would satisfy the City's commitment to existing residents and enable growth to occur. The inclusion of new pumping stations, however, is more complex and introduces the need for additional considerations. *I/I reduction* measures should be considered where feasible, as part of an overarching I/I Strategy.

7.4.5 Wastewater System Servicing Evaluation Summary

Of the alternatives assessed, *improvements to the existing system, gravity sewers and pumping stations/forcemains* are the only ones that can meet the future requirements for the system while aligning with Shaping Guelph. Therefore, this was carried forward as the preferred alternative.

Two overall strategies were considered. One that is gravity based with consideration for new trunk sewers, and the other which considered pumping station(s) and forcemains. The *pump station* strategy is feasible but is found to be more expensive and less favorable overall. As such, the *gravity sewer* alternative of *improvements to existing system* was carried forward as the preferred alternative for the wastewater collection system. *I/I reduction* and mitigation measures are proposed to complement the

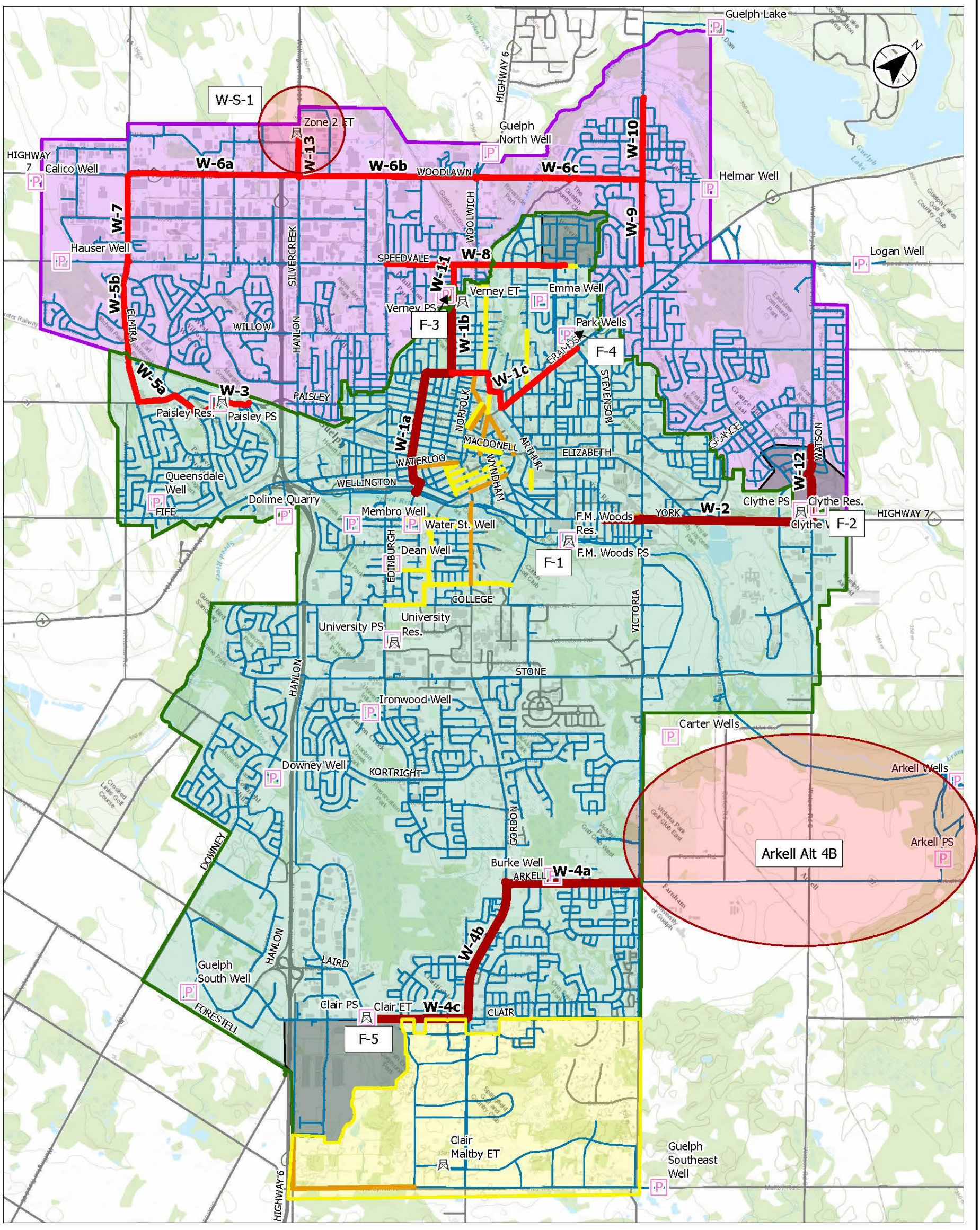
recommended solution, through update to the City's I/I Strategy including long-term monitoring, integrated data management and data analytical performance indicators.

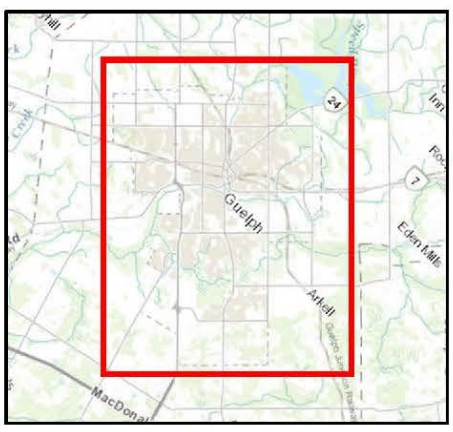
The full evaluation of each of the water and wastewater alternatives against the criteria listed is provided in *Volume II, TM3*.

8.0 Preferred Servicing Plans

8.1 Preferred Water Servicing Alternative

As discussed in Section 7.2, the preferred water servicing alternative is *improvements to the existing system* with a new Arkell PS, Reservoir and WTP with a POE at the south end of Zone 1 to provide full redundancy for supplying the Arkell sources. Other system improvements were identified including watermain upgrades, facility upgrades and zone boundary adjustments. Details on how the water system upgrades were developed are described in *TM3* and summarized below. All proposed water upgrades are shown in Minor Watermain Projects – Downtown Area Figure 8-1 and listed in Table 8-1, Table 8-2 and Table 8-3.





Legend

Proposed Watermain Projects

Major
- 400mm
- 600mm

Minor
- 200 - 250mm
- 300mm

Pressure Zone
- 1
- 2
- 3
- Prop. Zone Change

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018. World Topographic Map: City of Guelph, Region of Waterloo, Province of Ontario, Ontario MNR, Esri Canada, Esri, HERE, Garmin, INCREMENT P, USGS, METI/NASA, EPA, USDA, AAFC, NRCan
World Topographic Map: City of Guelph, Region of Waterloo, Ontario Base Map, Province of Ontario, Ontario MNR, Esri Canada, Esri, © OpenStreetMap contributors, HERE, Garmin, USGS, NGA, EPA, USDA, NPS, AAFC, NRCan

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1:50,000 (At Original document size of 11x17)

Stantec

C3 Water

Project Location
City of Guelph

Client/Project
CITY OF GUELPH WATER AND WASTEWATER SERVICING MASTER PLAN - REPORT

Figure No.
8-1

Title
Water System Recommended Upgrades

Table 8-1 Summary of Water System Upgrades- Facilities

Project Number	Location	Summary of Upgrades	Purpose
Facilities			
F-1	Woods WTP	Upgrades to pump station, dual discharge feedermains. Upgrades to office spaces.	Replace aging infrastructure and improve redundancy within facility.
F-2	Clythe WTP. PS and Reservoir	New WTP, Pump Station and 6.9 ML Reservoir	Bring Clythe Well online. Increase storage in Zone 2 and pump capacity on east side of Zone 2.
F-3	Verney BPS	New BPS to replace existing Robertson	Increase pump capacity
F-4	Park Zone 2 PS	New PS at Park Wells Site	Supply to the east side of Zone 2
F-5	Clair BPS	Retrofit Existing PS	Replace existing pumps with suitable size once Clair Maltby ET is online.
W-S-1	North end of Zone 2.	6ML Elevated Tank	New ET to Improve Zone 2 floating storage. Increased volume and improved location.
Arkell Alt 4B2	New Arkell PS, Reservoir and WM	New PS, Reservoir and Watermain	Transfer water from Arkell/Carter Wellfields supply redundancy/resiliency

Table 8-2 Summary of Water System Upgrades- Major Linear

Project Number	Location	Summary of Upgrades		Purpose
		Major Linear		
		Size (mm)	**Length (m)**	
W-1a	Yorkshire from Wellington to London and Exhibition	600	1850	Improves downtown looping and connectivity to Verney ET. Reduces high headloss associated with future growth.
W-1b	Exhibition from London to Verney	600	940	
W-1c	London/Eramosa from Exhibition to Stevenson	400	2140	
W-2	York from Brockville to Watson	600	2500	Improve connectivity to Clythe PS fill.
W-3	Paisley from Hanlon to Paisley PS	400	400	Improve Connectivity to Paisley PS fill.
W-4a	Arkell from Gordon to Victoria	600	1600	Improve connectivity between future Arkell PS and Clair ET.
W-4b	Gordon from Arkell to Clair	600	1760	
W-4c	Clair from Gordon to ET	600	1200	
W-5a	Imperial/Elmira from Paisley PS to Willow	400	1970	Redundancy for Paisley PS discharge.
W-5b	Elmira from Speedvale to Willow	400	800	
W-6a	Woodlawn from Elmira to Silvercreek	400	2030	Improve East/West transmission. Reduce the criticality of Paisley and Clythe PSs. Redundancy for Speed River Crossing.
W-6b	Woodlawn from Silvercreek to Woolwich	400	2160	
W-6c	Woodlawn from Woolwich to Victoria	400	2022	
W-7	Elmira from Speedvale to Woodlawn	400	1070	Improve system looping.
W-8	Speedvale from Edinburgh to Manhattan	400	2150	Complete east/west Speedvale transmission main.
W-9	Victoria from Speedvale to Woodlawn	400	1010	Improve system looping.
W-10	Victoria from Woodlawn to Goldenview Drive	400	1000	Connectivity to Guelph Lake supply.
W-11	Exhibition from Robertson/Verney PS to Speedvale	400	375	Improve watermain capacity at Verney PS discharge
W-12	Watson from Clythe PS to Grange	600	760	Improve watermain capacity at Clythe PS discharge
W-13	Silvercreek from Woodlawn to Proposed Zone 2 ET	400	900	Connection to proposed Zone 2 ET

Table 8-3 Summary of Water System Upgrades- Minor Linear

Project Number	Location	Summary of Upgrades		Purpose
		Minor Linear		
		Size (mm)	Length (m)	
W-M-1	Woolwich from Norfolk to Macdonnell	300	930	Improve Downtown Looping
W-M-2	Cardigan from Norwich to Woolwich	200	260	Local Downtown Improvements
W-M-3	Wyndham from Woolwich to Carden	300	480	Local Downtown Improvements
W-M-4	Macdonell from Norfolk to Carden	200	440	Local Downtown Improvements
W-M-5	Dublin from Waterloo to Wellington	200	400	Local Downtown Improvements
W-M-6	Waterloo from Yorkshire to Essex	300	500	Improve Downtown Looping
W-M-7	Yarmouth from Woolwich to Quebec	200	320	Local Downtown Improvements
W-M-8	Baker from Woolwich to Quebec	300	300	Local Downtown Improvements
W-M-9	Essex from Dublin to Waterloo	200	170	Local Downtown Improvements
W-M-10	Nottingham from Dublin to Gordon	200	180	Local Downtown Improvements
W-M-11	Fountain from Dublin to Neeve	200	550	Local Downtown Improvements
W-M-12	Surrey from Dublin to Neeve	200	610	Local Downtown Improvements
W-M-13	Wellington from Gordon to Neeve	300	480	Improve Downtown Looping
W-M-14	Duke from Alice to existing PVC	200	220	Local Downtown Improvements
W-M-15	Woolwich from London to Norwich	300	210	Improve Downtown Looping. Connection to W-1
W-M-16	Gordon from York to University	300	1110	Reduce criticality of University River Crossing.
W-M-17	Dufferin from Mac to London	200	1300	Connectivity between London and Woolwich. Local FF improvements.
W-M-18	Delhi from Eramosa to existing 250mm	250	690	Connectivity between W-1 on Eramosa and Verney Feedermain. Improve fire flow capacity to Hospital
W-M-19	Speedvale from East of Woolwich to Stevenson	200	1020	Improved transmission north end of Zone 1 and connectivity to Stevenson
W-M-20	University/College from River Crossing to Edinburgh	200	1760	Improve Capacity and Looping in University Area
W-M-21	Water/Albert from River Crossing to Gordon	200	790	Improve Capacity and Looping in University Area
W-M-22	Dean from Edinburgh to Talbot	200	520	Improve Capacity and Looping in University Area
W-M-23	Talbot/Forest Hill from Water to University	200	850	Improve Capacity and Looping in University Area
W-M-24	Speedvale from Westmount to east of Woolwich	200	930	Improve watermain capacity near Robertson PS discharge
W-M-25	Crawley to Maltby	300	2130	Improve West Zone 3 Looping
W-M-26	York Road from Brockville to Clythe PS	300	450	Improve HL and FF
W-CI-1a	Small Diameter Cast Iron (CI) WMs throughout system	150	13600	Improve existing fire flow constraints
W-CI-1b	Small Diameter CI WMs throughout system	150	28000	Improve existing fire flow constraints
W-CI-2	Small Diameter CI WMs throughout system	150	41600	Improve existing fire flow constraints
W-CI-3	Small Diameter CI WMs throughout system	150	41600	Improve existing fire flow constraints

8.1.1 Facilities

The following facility projects have been recommended:

- Woods PS Upgrades (ongoing)
- Clythe PS and Reservoir Upgrades (ongoing)
- Verney BPS
- Park Zone 2 PS
- Clair PBS Retrofit
- Zone 2 ET

A project is currently in progress to complete upgrades to the existing Woods PS. The conceptual design includes replacing the existing pumps with two sets of three (3) pumps, each pump rated at 350 L/s. The upgraded pump station will have two discharge headers, one to the south and one to the north. Each of the two sets of pumps will be configured so that they can supply either the north discharge, the south discharge or both, for complete redundancy.

The existing Clythe PS operates to transfer water from Zone 1 to Zone 2. There is an existing Clythe Well which was operated between 1990 and 1999 but was taken offline due to water quality concerns related to iron, manganese and sulphides. A Clythe Well Treatment Upgrades Municipal Class EA (Clythe Well Treatment EA) was completed by GMBP in 2018. A number of treatment facility location alternatives were evaluated. The preferred location was found to be 25 Watson Road Industrial, across the road from the existing Clythe PS. A conceptual design was completed as part of the Clythe Well Treatment EA and included a new treatment facility, a raw watermain from the well to the treatment facility, treated water transmission main from the treatment facility to the existing Clythe Reservoir and PS, a well pump for the existing Clythe Well and upgrades to the existing Clythe PS. A study, Clythe Pump Station Storage and Pump Analysis was completed by C3W in 2021 and provided preliminary recommendations for the new reservoir and PS, reservoir volume and pump capacity. A total reservoir volume of 6.9 ML was recommended to satisfy the requirements for backwashing and meet emergency supply needs. For the new PS, four (4) 85 L/s vertical turbine pumps were recommended to meet a range of demand and emergency conditions, for a firm capacity of 255 L/s. A project for the new treatment facility, well pump, reservoir and booster pump and required yard piping commenced in 2022.

The existing Robertson BPS is an important POE for Zone 2. Due to its central location, it provides redundancy and operational flexibility for both Paisley and Clythe PS by allowing water to move both east and west along the Speedvale Feedermain. Replacement of the Robertson BPS with a new Verney BPS was recommended through the 2009 WWSMP. Further studies were completed as part of the Zone 2 Study and Proposed Infrastructure Plan (Zone 2 Study) completed by C3W in 2015. Through this study, a project to upgrade the Robertson BPS to the new Verney BPS was ranked as a high priority. A Verney Booster Pump Station Municipal Class Environmental

Assessment (Robertson PS EA) was completed by GM BluePlan Engineering (GMBP) in 2021. The conceptual design developed included four (4) inline centrifugal pumps with VFDs, each rated for 80 L/s based on an initial station firm capacity of 240 L/s. Sufficient space is included to allow for pump replacement with larger models as demand increases, for a future firm capacity of 320 L/s. Project commencement is scheduled for 2023.

Upgrades to the Park Wells facilities have been identified including replacing existing pumps with Zone 2 pumps and a connection to Zone 2. The Zone 2 watermain was installed in 2022. Due to the criticality of the Clythe PS and the limited east/west transmission capacity in Zone 2, the upgraded Park PS provides the opportunity to improve security of supply to the east side of Zone 2. This would also allow operational flexibility during the proposed upgrades to the Clythe PS and Reservoir. It is recommended that the upgraded Park PS be designed with the ability to transition to supply Zone 1 if needed. In the future, once sources such as the Logan Well and the Guelph Lake WTP come online, the benefit of the Park Wells supply to Zone 2 will decrease and there may be value in transitioning this back to a Zone 1 supply so that it is able to operate 24 hours a day during high demand periods.

The existing Speedvale ET is an aging piece of infrastructure, installed in 1969. It is expected that rehabilitation recently completed will keep the ET operational to approximately 2036. It is recommended that the existing Speedvale ET be decommissioned and replaced with a new, larger ET at the north end of Zone 2 in the future. The existing ET is in a poor location hydraulically as it is in the middle of the service area, creating a hydraulic break between the Paisley PS and the north end of Zone 2. The existing location of the Speedvale ET limits the amount of water that can be supplied by either the future Verney BPS or the Paisley PS to the north end of the City. Flow from the PSs will preferentially go to the ET, limiting how much water can be supplied to a specific location during an emergency. By relocating the floating storage to the edge of the system, the system HGL is more stable across the Zone, and water can more easily be supplied to all customers during emergency events. A desktop storage analysis was completed in *TM3* and a volume of 6ML was recommended for the new ET, to increase the total Zone 2 storage by 4 ML.

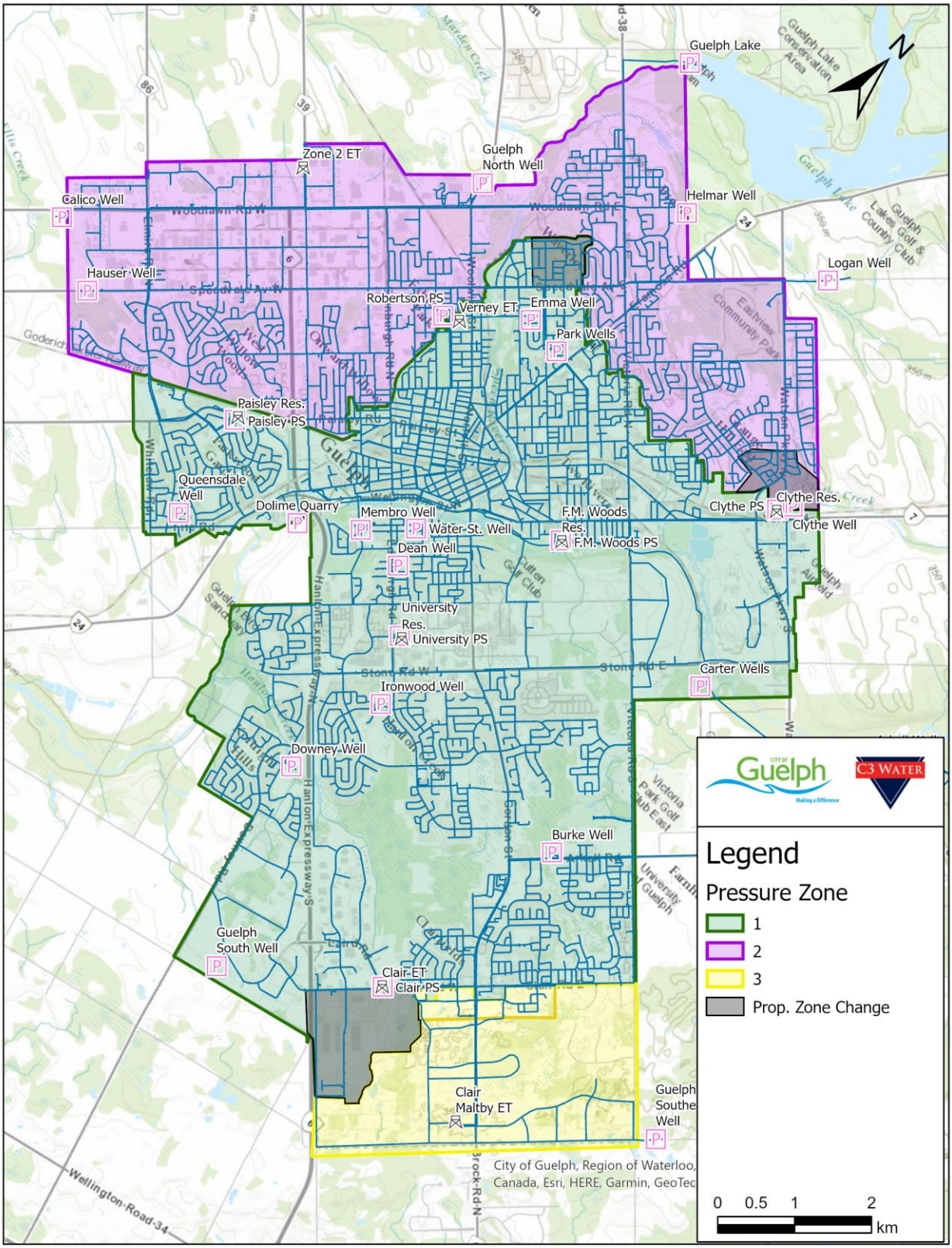
8.1.2 Zone Boundary Adjustments

There are areas of the system that experience operating pressures outside of the preferred range of 50-80 psi as a result of the group elevations. A number of areas of concern were identified in *TM3* and were assessed to determine if there was an overall benefit to adjusting the pressure zone boundary in these areas.

The following Zone boundary adjustments are recommended, as shown in Figure 8-2 :

- Southgate Dr area from Zone 1 to Zone 3. Timing based on Clair Maltby ET.
- Fleming Rd area from Zone 2 into Zone 1. Timing based on Clythe PS upgrades.
- Waverly Dr area from Zone 1 to Zone 2. Timing based on Speedvale feedermain.

Figure 8-2 Proposed Pressure Zone Boundary Adjustments



8.1.3 Major Watermains

Major watermains are defined as pipes greater than or equal to 400mm. In Zone 1, a focus for the upgrades was to improve watermain capacity in the downtown area and create looping between the Wellington Feedermain and the Verney Feedermain. Another area of focus was improved transmission between the proposed new Arkell POE and the Clair ET.

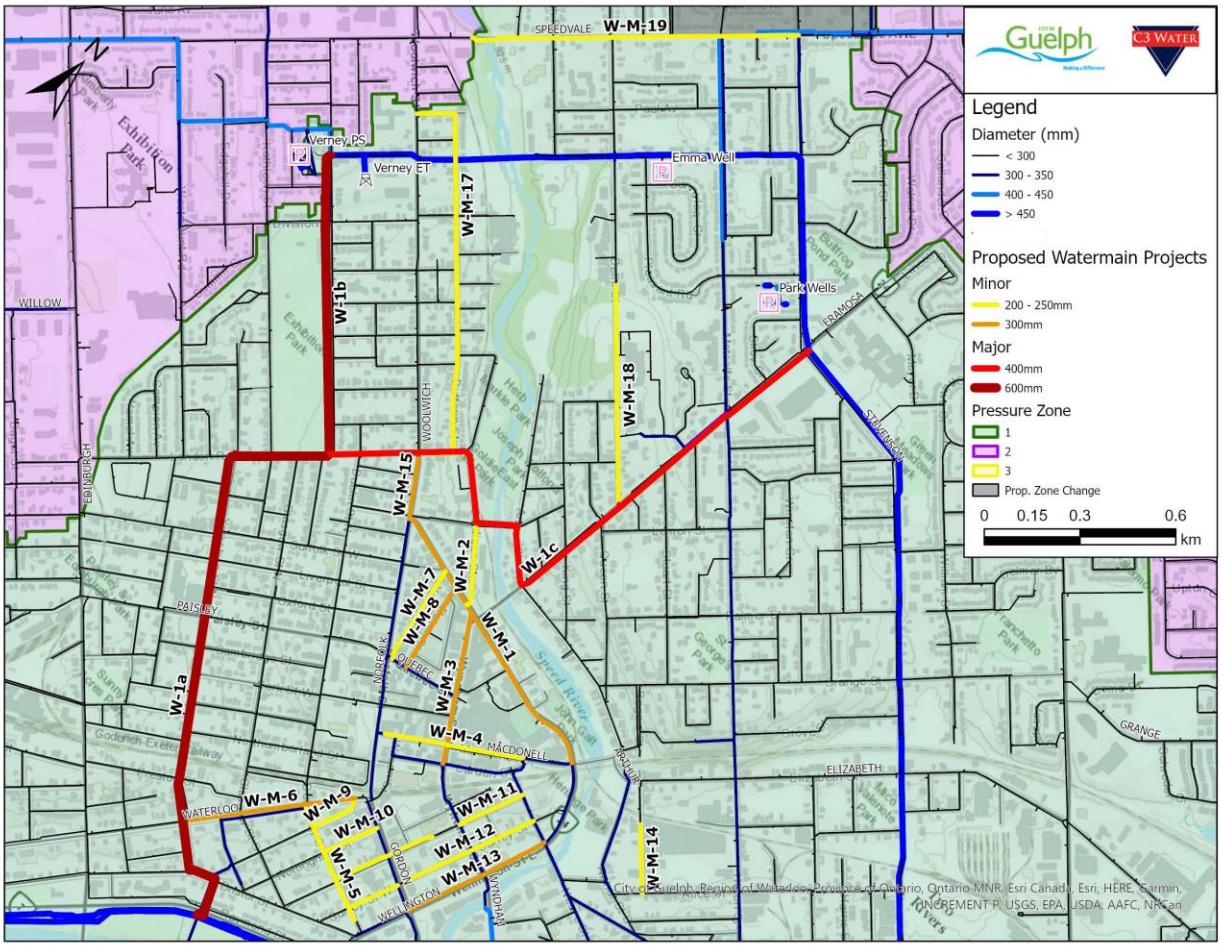
A primary focus for watermain upgrades in Zone 2 was to improve east/west transmission and overall looping throughout the zone to reduce the criticality of any one of the three pump stations.

Proposed watermain upgrades in Zone 3 have been established through the Clair Maltby Master Environmental Servicing Plan (MESP) and were not revisited through this project as no servicing concerns were identified through the analysis.

8.1.4 Minor Watermains

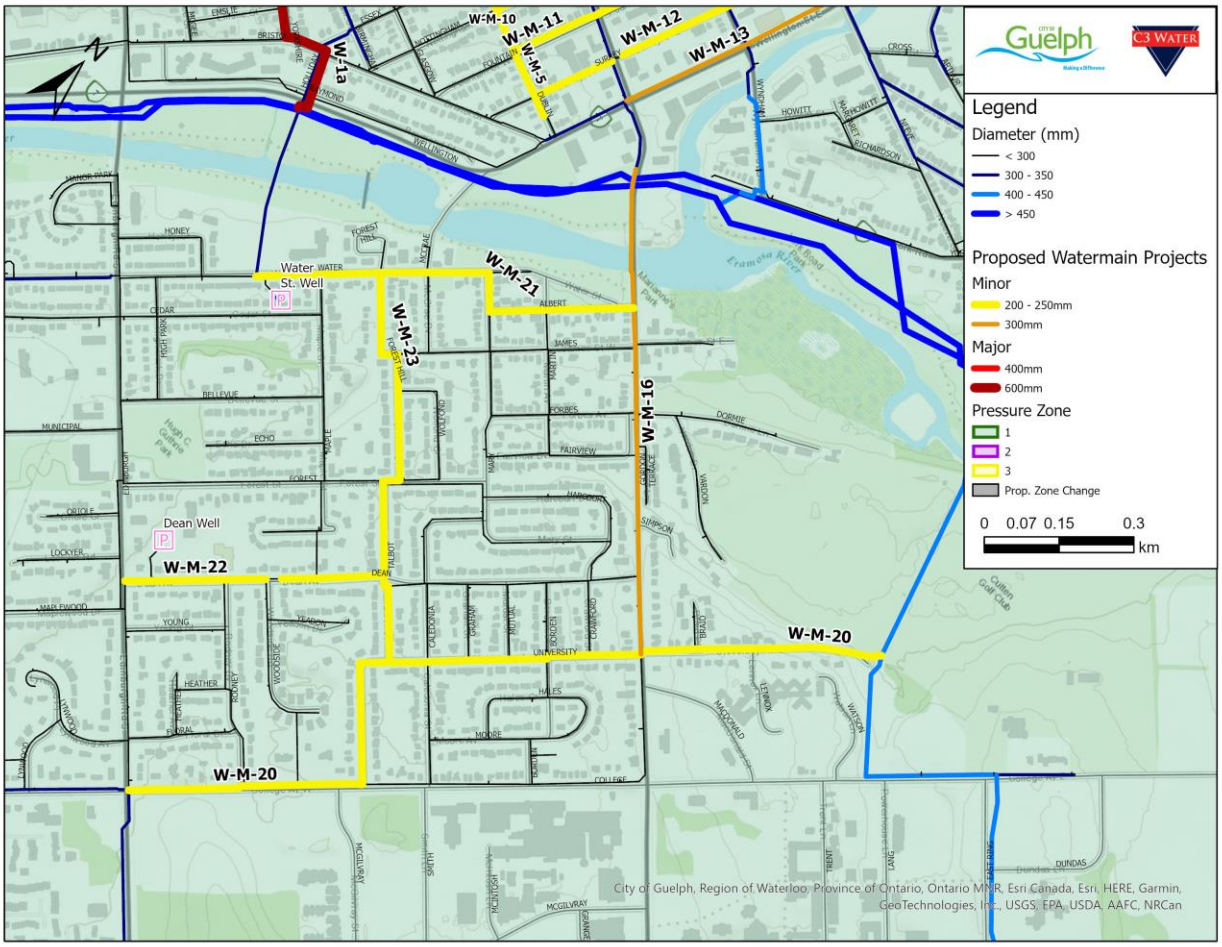
Minor (< 400mm) watermain upgrade projects were identified in areas with known capacity constraints, including downtown and the Old University area. Many of these projects were established though the Downtown Servicing Study (Cole Engineering Group Ltd and C3W, 2021) and were further confirmed through this study. Surrounding the Downtown area, a number of projects that were previously identified in the “Linear Capital Upgrades Prioritization” project completed by C3W in 2018 were carried forward in this study for localized capacity improvements. Downtown area projects are shown in Figure 8-3 below.

Figure 8-3 Minor Watermain Projects – Downtown Area



Within the Old University area, a number of 200mm projects were identified to improve overall looping and capacity of the area. Portions of projects W-M-20, 22 and 23 were identified in the 2018 Linear Capital Upgrades Prioritization project. Recommended projects in the Old University area are shown in Figure 8-4 below.

Figure 8-4 Minor Watermain Projects – Old University Area



8.1.5 Cast Iron Replacement Program

The existing water distribution system consists of a significant amount of aging cast iron (CI) watermains. Although many CI pipes are in very good condition structurally, CI pipe is subject to tuberculation of the inner pipe walls over time, leading to high roughness and reduced capacity. Capacity constraints are most significant in small diameter pipes of less than 200mm.

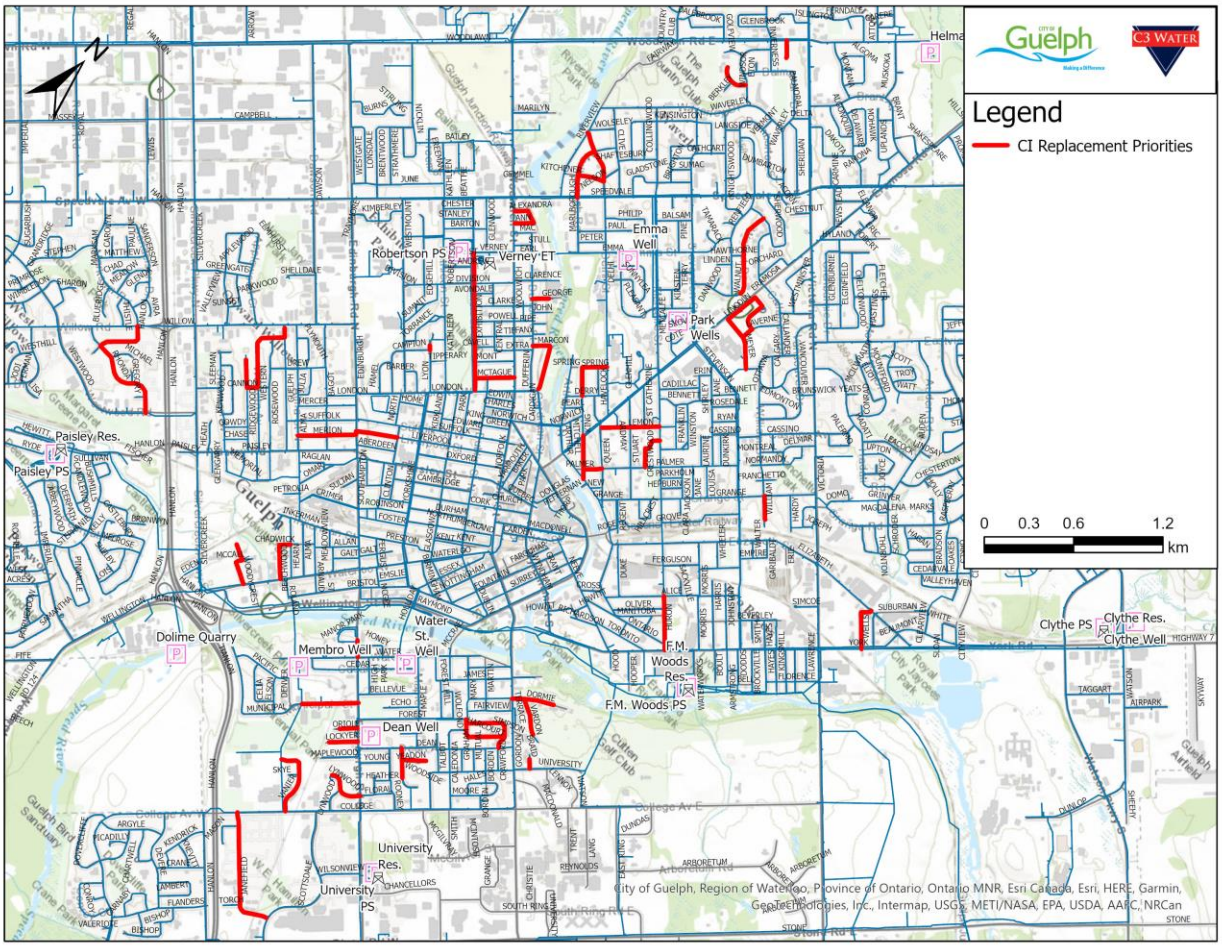
Based on the City's GIS records, there is currently approximately 194 km of CI pipe in the distribution system. Over 60% of this was installed prior to 1960 (over 60-years old). Approximately 65%, or 125km, is less than 200mm.

It is recommended that the City implement a 30-year CI replacement program to replace small diameter CI with 150mm PVC pipe.

A number of CI pipes have been identified through study this as high priority for replacement and are shown in Figure 8-5 below. The majority of these pipes are 100-150mm and upgrades are required to meet localized fire flow requirements. Additionally,

the 300mm CI pipe on Huron Street from York Road to Alice Street was flagged as high priority due to high headloss and proximity to the Woods PS. The total length of the high priority CI replacement projects was found to be approximately 14 km. It is recommended that these projects are completed within the first 10-years of the 30-year program. A list of the high-priority CI replacement projects is provided in *TM3*.

Figure 8-5 CI Replacement High Priority



8.2 Preferred Wastewater Servicing Alternative

As discussed in Section 7.4, the preferred wastewater servicing alternative is *improvements to existing system* with *gravity sewers*. Other wastewater collection system improvements include siphon upgrades to align with provincial guidelines. While I&I reduction was not sufficient as a standalone solution, I&I programs are recommended as part of the preferred strategy to realize the full capacity of the linear conveyance system and to reduce flows and treatment at the WRRC. Details on how the wastewater system upgrades were developed are described in *TM3* and

summarized below. All proposed wastewater upgrades are shown in Figure 8-6 and Table 8-4.

8.2.1 Refinement of Alternatives Through the Design Phases

Wastewater system improvements were developed for seven (7) general areas. Details on the deficiencies, the improvement option that was implemented, and the resultant benefits are outlined in the following sections. The identified upgrades have been sized to satisfy the City's LOS target for the future WWF conditions.

The recommended improvements are considered conceptual at this stage of evaluation. As their consideration progresses through functional, preliminary, and detailed design stages, these should be re-evaluated as site constraints (utility conflicts, existing natural environment constraints, etc.) become further understood. A single system upgrade is identified for each of the system deficiencies within the identified areas.

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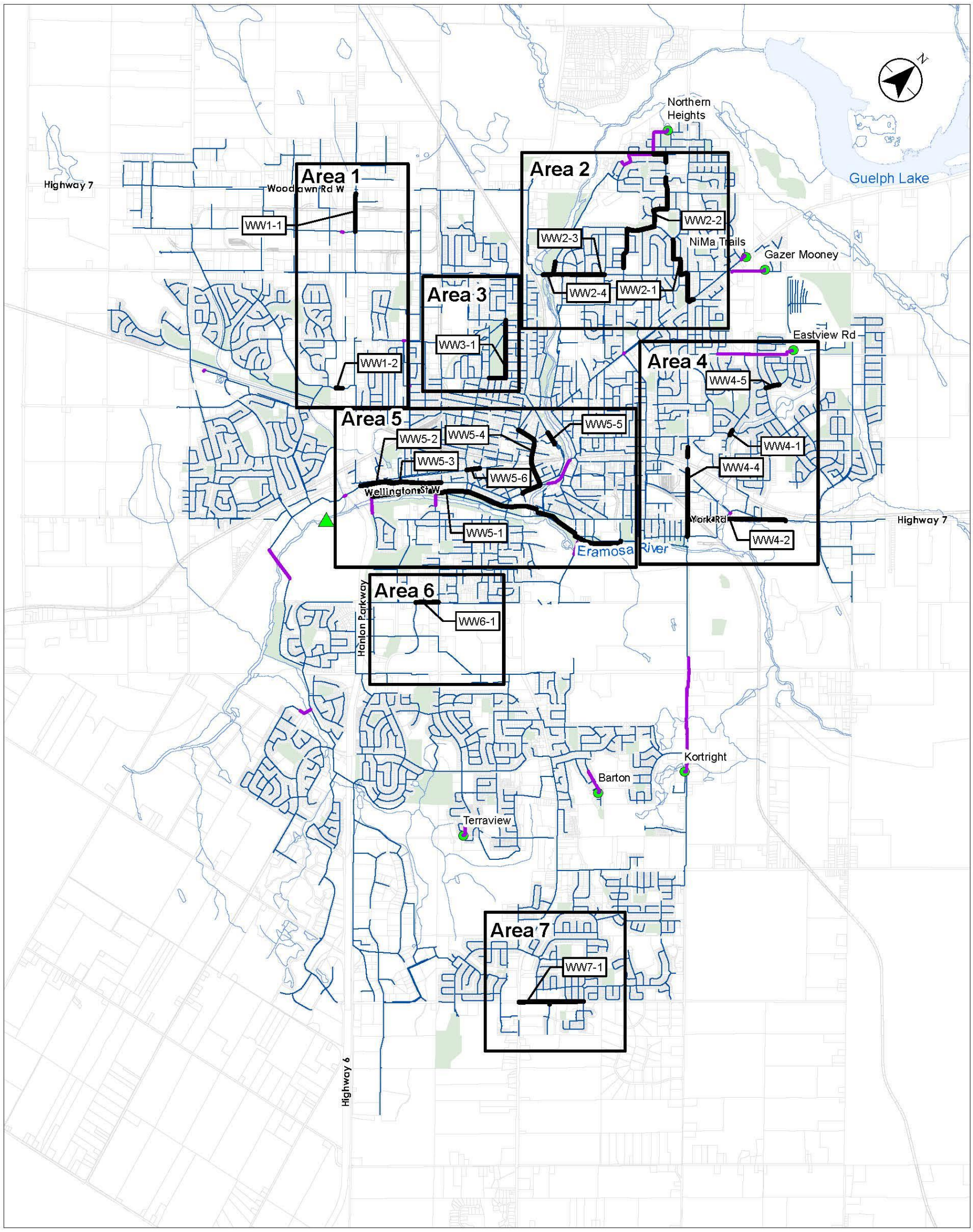

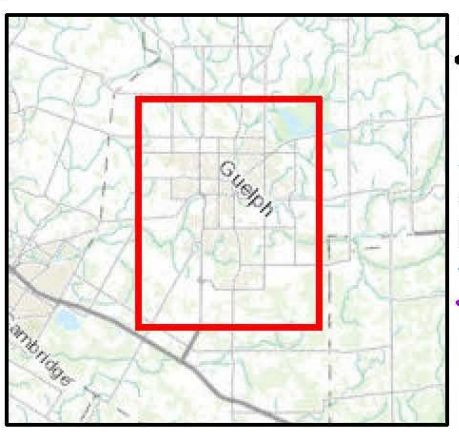

Legend

- Wastewater Upgrade
- Pump Station
- Water Resource Recovery Center
- Watercourse
- Railway
- Property
- Sanitary Sewer
- Forcemain / Siphon

0 1 2 Km

1:50,000 (At Original document size of 11x17)

Stantec

C3 Water

Project Location
City of Guelph

165640298

Client/Project
CITY OF GUELPH WATER AND WASTEWATER SERVICING MASTER PLAN – TM3 WATER AND WASTEWATER SERVICING RECOMMENDATIONS

Figure No.
8-6

Title
Wastewater System Recommended Upgrades (All)

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018. Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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Table 8-4 Summary of Wastewater System Upgrades

Project Number	Location	Size (mm)	Length (m)	Purpose
Area 1				
WW1-1	Silvercreek Parkway	375	472	Capacity
WW1-2	Westwood Rd	300	82	Capacity
Area 2				
WW2-1	Victoria Rd and Waverley Dr	300 / 375	1032	Capacity
WW2-2	Waverley Dr & Stevenson St	375 / 450	1593	Capacity
WW2-3	Wilton Rd, Inverness Dr & Speedvale Ave	150 / 300 / 375	1128	Capacity
WW2-4	Speedvale Ave	375	237	Capacity
Area 3				
WW3-1	Exhibition St & London Rd	450	926	Capacity
Area 4				
WW4-1	Audin Rd & Victoria Rd	300 / 375	186	Capacity
WW4-2	York Rd & Beaumont Cres.	675 / 900	1364	Capacity / Operational
WW4-4	Victoria Rd	375	777	Capacity
WW4-5	Summit Ridge Dr	300	173	Capacity
Area 5				
WW5-1	York Rd and Wellington St	1200 / 1350	3284	Capacity
WW5-2	Waterloo Ave	825	528	Capacity
WW5-3	Bristol St	600	1014	Capacity
WW5-4	Quebec St and Wyndham St	375 - 600	1066	Capacity
WW5-5	Woolwhich St	300	167	Capacity
WW5-6	Waterloo Ave	300	166	Capacity
Area 6				
WW6-1	College Ave	300 / 375	281	Capacity
Area 7				
WW7-1	Clair Rd	250 / 300	834	Capacity
Area 8				
S1	Manor Park Crescent / Speed River	250	130	Operational / Redundancy
S2	Municipal Street / Speed River	250 / 300 / 450 / 525	1113	Operational / Redundancy
S3	Alma Street North / Mercer Street	600	80	Operational / Redundancy
S4	Elizabeth Street North / Beaumont Crescent	450	22	Operational / Redundancy
S5	Eramosa River / Cutten Fields Golf Course	500	150	Operational / Redundancy
S6	Hanlon Parkway - Massey Road / Campbell Road	200 / 450	44	Operational / Redundancy
S7	Ptarmigan Drive	150 / 200	324	Operational / Redundancy
S8	Speed River - Crane Park	750 / 600 / 300	921	Operational / Redundancy
S9	Stevenson Street North / Eramosa Road	200	23	Operational / Redundancy
S10	Willow Road / Guelph Street	750	19	Operational / Redundancy

8.2.2 Area 1 System Improvements

Area 1 includes Reaches 1-1 and 1-2 in the northwest of the City.

Reach 1-1 includes 300 mm and 525 mm diameter sewers along Silvercreek Parkway North between Woodlawn Road West and Speedvale Avenue West. Surcharging was observed under existing and future WWF conditions. Gravity sewer replacement was selected as the improvement option in this location.

Reach 1-2 includes sewers ranging from 225 mm to 375 mm along Silvercreek Parkway and Westwood Road. Surcharging was observed under future WWF conditions and is not present under existing conditions. Gravity sewer replacement by including slope adjustment was selected as the improvement option in this location.

8.2.3 Area 2 System Improvements

Area 2 includes Reaches 2-1, 2-2, 2-3, and 2-4 in the northeast of the City.

Reach 2-1 ranges from 225 mm to 375 mm from Eramosa Road northwest along Victoria Road and Waverley Drive. Surcharging was observed under existing and future WWF conditions. Gravity sewer replacement was selected as the improvement option in this location.

Reach 2-2 includes 300 mm and 375 mm diameter sewers from Woodlawn Road East to Speedvale Avenue. Surcharging was observed under existing and future WWF conditions. Gravity sewer replacement was selected as the improvement option in this location.

Reach 2-3 ranges in diameter from 225 mm to 300 mm sewers from Pondview Crescent to the south across Woodlawn Road East and along Riverview Drive to Speedvale Avenue. Surcharging was observed under existing and future WWF conditions. Sewer replacement was reviewed at this location for feasibility. The sewer location near the Speed River through natural areas makes in-situ upgrade challenging. The preferred improvement in this location is the installation of a new sewer south on Riverview Drive to provide new front of lot servicing for the parcels with rear-lot servicing on Riverview Drive. The existing 225 mm sewer on Kitchener Avenue could be abandoned.

Reach 2-4 includes 300 mm and 375 mm sewers on Speedvale Avenue East from Woolwich Street to Marlborough Road. Surcharging is observed in only one manhole (MH) in the growth WWF condition. Gravity sewer replacement in conjunction with an adjustment to the sewer slope was selected as the improvement option in this location.

8.2.4 Area 3 System Improvements

Area 3 is a reach (Reach 3-1) of 375 mm sewers from Division Street to London Road West along Kathleen Street. The surcharge constraint was identified for both the existing and growth condition under the WWF scenario. The preferred upgrade is the realignment of sewers from the easements through Exhibition Park and reroute flow

south on Exhibition Street and London Road. The intent is to provide the necessary capacity upgrades while also eliminating sewers in the easements through the park.

8.2.5 Area 4 System Improvements

Area 4 includes Reaches 4-1, 4-2, 4-3, 4-4, and 4-5 in the eastern part of the City.

Reach 4-1 includes sewers with diameters ranging from 200 mm to 350 mm, from Eastview Road to Victoria Road. The surcharge constraint is identified for both the existing and growth condition under the WWF scenario. Sewer replacement was reviewed at this location for feasibility. Given the extent of surcharge observed and the relatively small diameter and small flow causing the surcharge, an alternate approach to sewer replacement was considered. Residual capacity in the sewer system upstream of this location was identified, therefore a full flow diversion of the Landfill Site on Eastview PS flow, upstream of this location, was explored. Diverting the flow away from the receiving trunk via a new forcemain allows use of residual capacity in existing infrastructure and eliminates most of the surcharge. Two sewer segments will still require upgrading with this flow diversion approach.

Reach 4-2 includes 675 mm sewers along York Road and Beaumont Crescent. The surcharge constraint is identified for the growth condition under the WWF scenario. The preferred improvement in this location is the construction of a trunk along York Road and Victoria Road. The intent is to provide the necessary capacity upgrades while also eliminating the easements of the existing alignments. The City is currently working on designs for York Road Phase 4 and this provides an opportunity to take advantage of the timing of this work. It is understood that a feasibility assessment to consider culvert and storm collection crossings is needed for this project.

Reach 4-3 includes 375 mm and 600 mm sewers along Stevenson Street South. Surcharging is observed in only one MH. This location also sees benefit from the diversion of the Landfill Site on Eastview PS. System improvements are not recommended at this location.

Reach 4-4 includes 225 mm and 300 mm sewers on Victoria Road South. The surcharge constraint is identified for both the existing and growth condition under the WWF scenario. Gravity sewer replacement was selected as the improvement option in this location.

Reach 4-5 includes 200 mm sewers on Creighton Avenue and Summit Ridge Drive. The surcharge constraint is identified for both the existing and growth condition under the WWF scenario. Gravity sewer replacement was selected as the improvement option in this location.

8.2.6 Area 5 System Improvements

Area 5 includes Reaches 5-1, 5-2, 5-3, 5-4, 5-5, and 5-6 in multiple reaches in the City Centre.

Reach 5-1 includes sewers ranging in diameter from 1050 mm to 1350 mm, along the Eramosa River and Wellington Street, from Boult Avenue to the Hanlon Parkway. The surcharge constraint is identified for both the existing and growth condition under the WWF scenario. This stretch of sanitary sewers was also previously identified by the Stormwater Master Plan team as exposed sanitary sewer at certain stormwater outlet discharge points to the Eramosa River. It is understood that the City completed emergency repairs at these locations in 2020/2021. These repairs were considered short- or medium-term solutions, with the WWSMP to address the long-term solution. The City's ongoing Stormwater Master Plan identified exposed sanitary sewer trunks crossing watercourses. One of these sewers is an existing 1050 mm trunk along Wellington Road near the Hanlon Parkway.

It is understood that the City has undertaken remediation activities to stabilize the sewer to mitigate/minimize the risk of deterioration of this sewer. These 2020/2021 emergency repairs were structural in nature and focused on the retaining walls. The sewers themselves were considered in good condition, however, a more permanent solution may be required.

One option is to lower the sewer by approximately 2.0 m, which will provide 1.0 m of cover over the currently exposed sewer and reduce the probability and impact of failure.

Review of this location also revealed options for diverting portions of the flows to new infrastructure that could act as a wet weather relief in lieu of costly repairs to the large trunk sewers.

Based on the 2020/2021 exchanges between the City, the Stormwater MP, and the WWSMP teams, it is assumed that upsizing and lowering of this sewer is preferred.

Reach 5-2 includes 750 mm diameter sewers between Bristol Street and Waterloo Avenue. The surcharge constraint is identified for the growth condition under the WWF scenario. Gravity sewer replacement was selected as the improvement option in this location.

Reach 5-3 includes 500 mm diameter sewers parallel to Reach 5-2, between Bristol Street and Waterloo Avenue. The surcharge constraint is identified for the growth condition under the WWF scenario. Gravity sewer replacement is the recommended improvement at this location.

Reach 5-4 includes sewers with diameters ranging from 200 mm to 600 mm, along Yarmouth Street, Quebec Street, Wyndham Street North and Wellington Street. The surcharge constraint is identified for both the existing and growth condition under the WWF scenario. Gravity sewer replacement is the recommended improvement at this location.

Reach 5-5 includes 225 mm sewers on Woolwich Street. The surcharge constraint is identified for both the existing and growth condition under the WWF scenario. Gravity sewer replacement was selected as the improvement option in this location.

Reach 5-6 includes 225 mm sewers on Waterloo Avenue. The surcharge constraint is identified for both the existing and growth condition under the WWF scenario. Gravity sewer replacement was selected as the improvement option in this location.

8.2.7 Area 6 System Improvements

Area 6 is a reach (**Reach 6-1**) including sewers ranging in diameter from 250 mm to 675 mm along College Avenue and Scottsdale Drive, and across W.E. Hamilton Park. The surcharge constraint identified for both the existing and growth condition under the WWF scenario. Gravity sewer replacement was selected as the improvement option in this location.

8.2.8 Area 7 System Improvements

Area 7 is a reach (**Reach 7-1**) of 200mm and 450mm sewers along Farley Drive and Clairfields Drive West. The surcharge constraint identified is triggered by growth under the WWF condition. The preferred upgrade to address the surcharge is to build a new sewer along Clair Road East as it will be widened as part of the Clair Maltby Secondary Plan Phase 2. This approach is preferred over replacement of existing sewers as it avoids construction of deep sewers.

8.2.9 Siphons

The model results suggest the City's siphons are not achieving the minimum MECP velocity (i.e. 1.1-1.3 m/s daily during DWF) under existing conditions. Under future buildout conditions, this finding is maintained for all but the Crane Park crossing. Additionally, there are five (5) crossings that are currently single barreled where the MECP guideline suggest a minimum of two (2) barrels be provided.

Recommendations include:

- Schedule regular inspections of all the City's siphons. These should establish if an accumulation of sediment is occurring and/or worsening. It is possible that regular increased flows experienced from frequent rainfall occurrences are adequate to maintain the functionality of the siphons. Should these inspections show that sediment accumulation is an ongoing issue, then it is recommended the City proceed with a regular flushing program to clean out the siphons.

- The Alma-Mercer, Eramosa River, Eramosa-Stevenson, and Willow-Guelph siphons are understood to be comprised of a single barrel.
    - Prioritize the inspection of these (over those locations with two (2) or more barrels) to review operation.
    - Undertake further study to establish if these crossings could be updated to include two (2) barrels or abandoned for an alternative servicing configuration.

- The Manor Park siphon crossing has already been studied and a project to update the crossing at this location has been developed. Construction is planned for 2028 at an estimated cost of $1.5M.

- The Municipal Street siphon has also been recently studied. The recommendations from this effort include connection to the upgraded Manor Park siphon and elimination of the existing Municipal Street siphon. The estimated cost of this project is $2.7-$4.0M. The timeline for this project is yet to be determined.

The above recommendations are provided within the context of satisfying the MECP's Guidelines and ongoing City interests. It is appreciated that the City may not be having issues with all of their existing siphons. The overall suggested approach is to inspect and track the performance of these hydraulic structures. Tactical maintenance may be sufficient to maintain their operation. Replacement/modification when concurrent opportunities arise may also be strategic.

9.0 Implementation Planning

9.1 Water Servicing

9.1.1 Short Term Recommendations (Present – 2031)

Water projects recommended in the short term are intended to address existing capacity constraints as well as meet growth requirements to 2031.

The new Arkell PS and watermain is recommended for completion by 2031 to create a resilient water system and reduce the risks associated with a single-feed from the Arkell Wellfield to the City.

All minor water projects (W-M-1 to W-M-24) excluding W-M-25 are recommended for implementation within the short-term horizon. These projects address existing capacity constraints in areas of concern. The majority of these projects have been previously recommended through other studies.

In Zone 1, major watermain projects W-1a and W-1b are recommended in the short term to improve transmission to the Verney ET and the Verney BPS and reduce headloss through the downtown area. Project W-2 is recommended to improve transmission to the Clythe PS. This project is currently in the design phase and is planned to be completed within the next five years. Project W-3 is recommended in the short term to complete the recent Hanlon crossing project and reduce existing high headloss in the area, to supply the Paisley PS and Reservoir.

The Woods PS upgrades are currently with scheduled completion by 2025.

In Zone 2, project W-5a is recommended in the short term to reduce the criticality of the existing Paisley discharge feedermain. Project W-8 (Speedvale Feedermain) is recommended in the short term and reduces the criticality of all Zone 2 PSs by improving east-west transmission. This project is currently in the design phase and is planned to be completed within the next five years.

The new Verney BPS project is scheduled for completion within the short term as it was flagged as a high priority for improving the security of supply to Zone 2 due to its central location. As such, linear project W-11 is also recommended in the short term.

It is anticipated that upgrades to the Clythe PS will be completed by 2031. As such, linear project W-12 is recommended in the short term. W-12 was also found to be beneficial for improving low pressures in PLo-3 (Eastview and Summit) by reducing headloss in this area during peak demands.

Upgrades to the Park PS to supply Zone 2 are recommended in the short term so that this facility can be used to supply the east side of Zone 2 and reduce the criticality of the Clythe PS especially prior to the completion of the Speedvale feedermain. This supply

to the east side of Zone 2 will be beneficial during the construction of the new Clythe PS, as the station will likely need to be taken offline for short durations.

The proposed short-term projects are depicted in Figure 9-1.

9.1.1.1 Short Term Prioritization

Within the short-term horizon, water projects have been prioritized based on need and alignment with other water projects. Suggested prioritization is summarized in Table 9-1 below. Project descriptions can be found in Table 8-1 above.

Table 9-1 Short-Term Water Project Prioritization

Project Number	Priority	Prioritization Considerations
Facility Projects		
F-3	2	W-8 and W-11 to be completed first
F-4	1	Following completion of Woods (F-1)
Arkell Alt 4B2	3	Conceptual Design and EA to be completed first
Watermain Projects		
W-8	1	High Priority to Address Existing Criticality
W-M-24	1	Align work with W-8
W-M-19	1	Align work with W-8
W-M-16	2	High Priority to Address Existing Criticality
W-CI-1a	3	High Priority to Address Existing FF Constraints
W-2	4	Complete Prior to F-2
W-M-26	4	Align work with W-2
W-11	5	Complete Prior to F-3
W-M-20	6	Existing Capacity Constraints
W-M-17	7	Existing Capacity Constraints
W-M-18	8	Existing Capacity Constraints
W-M-23	9	Existing Capacity Constraints
W-M-21	10	Existing Capacity Constraints
W-M-22	11	Existing Capacity Constraints
W-M-1	12	Existing Capacity Constraints
W-M-3	13	Existing Capacity Constraints
W-12	14	Complete Prior to F-2
W-M-6	15	Existing Capacity Constraints
W-M-13	16	Existing Capacity Constraints
W-5a	17	Existing Criticality
W-3	18	Growth
W-CI-1b	19	Align with other works when possible

Project Number	Priority	Prioritization Considerations
W-1a	20	Growth
W-1b	21	Growth
W-M-15	22	Growth
W-M-2	23	Timing Based on Local Development
W-M-4	23	Timing Based on Local Development
W-M-5	23	Timing Based on Local Development
W-M-7	23	Timing Based on Local Development
W-M-9	23	Timing Based on Local Development
W-M-10	23	Timing Based on Local Development
W-M-11	23	Timing Based on Local Development
W-M-12	23	Timing Based on Local Development
W-M-14	23	Timing Based on Local Development
W-M-8	N/A	Built

9.1.1.2 Short Term Performance

Model results for the 2031 horizon are presented in *TM3* and are summarized in Table 9-2. These proposed projects were found to provide acceptable LOS for this horizon.

Table 9-2 2031 Model Results Summary

Result	Results Summary
Pressure	▼ Minimum pressure maintained above 40 psi throughout system with exception of PLo-1 ▼ Minimum pressure of 38 psi in PLo-1 ▼ Maximum pressure in PHi-6 of 103 psi
Linear Capacity	▼ Headloss maintained under 2m/km with the exception of Dunlop Dr. and Huron from York to Alice ▼ Huron flagged as CI replacement priority.
Storage	▼ All ETs maintained above 80% full ▼ All reservoirs maintained above 60% full ▼ Woods and Arkell Res minimum levels 62%
Pump Station Flow	▼ All PSs operated below firm capacity ▼ Maximum flow at Woods of 600 L/s ▼ Maximum flow at Arkell of 240 L/s.

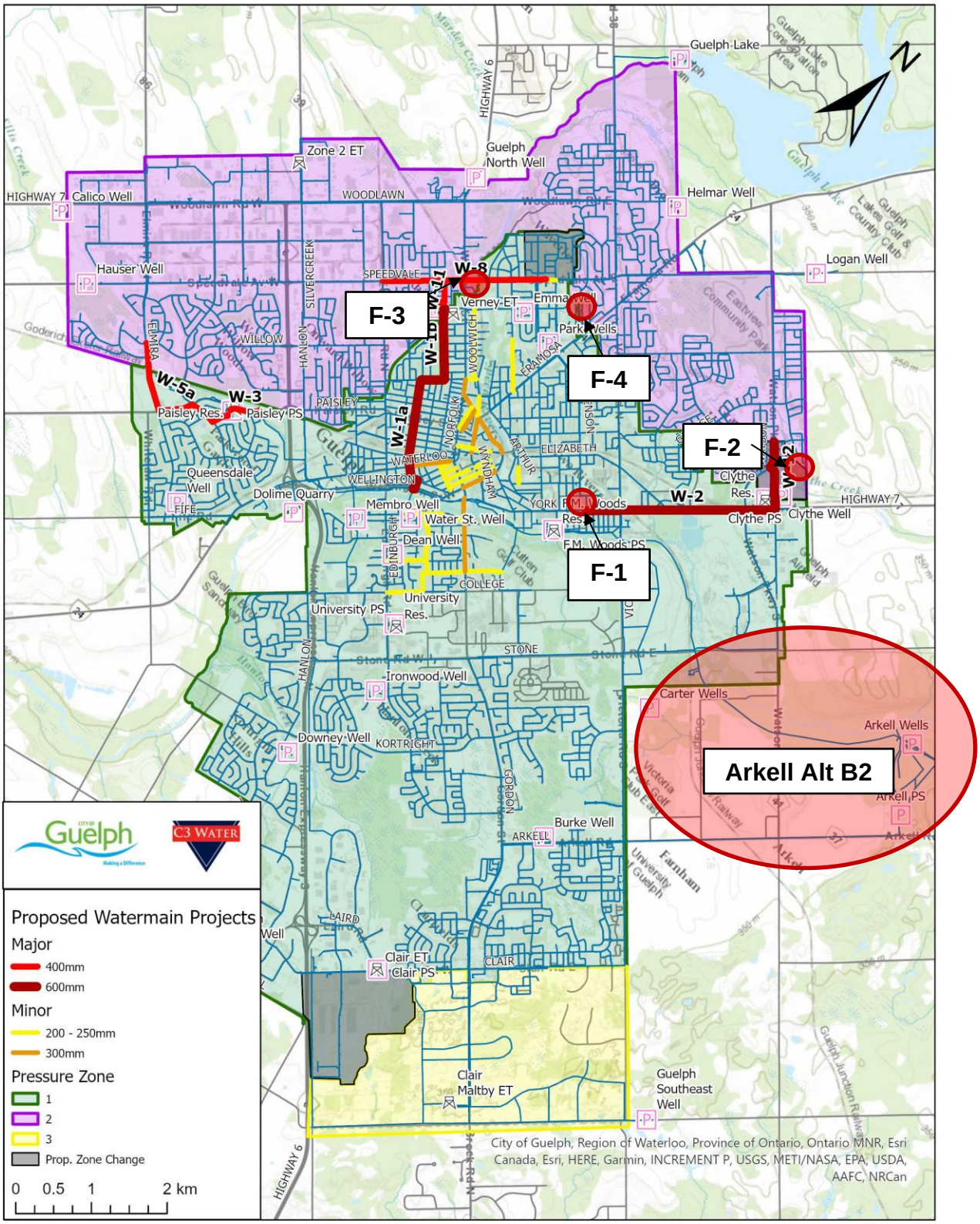
Although the Arkell PS and watermain project has been recommended for the short term, it is understood that it may not be feasible for a project of this size, complexity and cost to be completed by 2031. As such, a sensitivity analysis was completed without this project in place during a 2031 MDD. The results are summarized in Table 9-3. Due

to the planned implementation of the Ironwood Well and South Well by 2031, additional supply is expected in the South end of Zone 1, compared to existing conditions. It was found that the Clair ET was maintained at an acceptable level under this horizon, without the Arkell PS and Reservoir. In the event that the Ironwood Well and South Well are not brought online within the short-term, a Zone 1 split may be considered for improving supply from the Woods PS to the Clair ET. This is described in *Volume II: TM3*.

Table 9-3 2031 Model Results Summary – Arkell PS Offline

Result	Results Summary
Pressure	▼ Minimum pressure maintained above 40 psi throughout system with exception of PLo-1 Minimum pressure of 37 psi in PLo-1 Maximum pressure in PHi-6 of 104 psi
Linear Capacity	▼ Headloss maintained under 2m/km with exception of Dunlop Drive
Storage	▼ All ETs maintained above 75% full All reservoirs maintained above 60% full Woods Reservoir minimum level 62%
Pump Station Flow	▼ All PSs operated below firm capacity ▼ Max flow at Woods of 710 L/s

Figure 9-1 Water Projects – Short Term (2031)



9.1.2 Mid-Term Recommendations (2032 – 2041)

Water projects recommended in the mid-term are intended to meet growth requirements up to 2041.

In Zone 1, project W-1c is recommended to complete the large watermain connection through the downtown between the Stevenson feedermain and proposed feedermain projects W-1a and W-1b. W-4a is recommended to improve watermain capacity in the south end of Zone 1 as the required discharge flow from the Arkell PS increases to meet growth demands.

In Zone 2, the Zone 2 ET is recommended by 2041, as the existing Speedvale ET has a remaining service life of approximately 20 years. Watermain projects W-5b, W-7, W-6a and W-13 are recommended within this time horizon to provide strong transmission between the Paisley PS and the Zone 2 ET.

For Zone 3, timing of retrofitting of the Clair BPS, transition of area PLo-5 (Southgate ICI) and the minor linear project W-M-25 is associated with the Clair Maltby ET and Zone 3 growth.

The proposed mid-term projects are depicted in Figure 9-2.

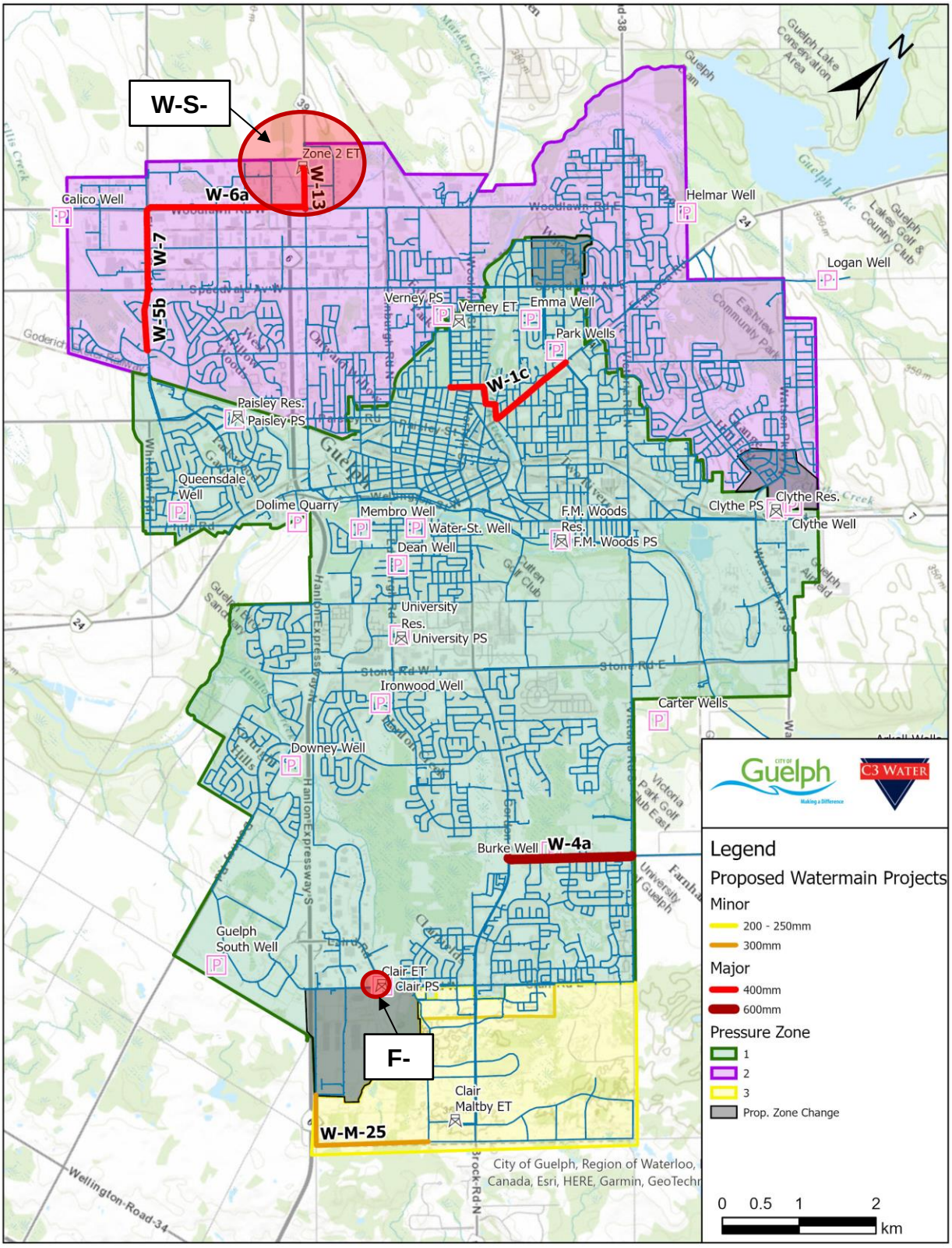
9.1.2.1 Mid Term Performance

Model results for the 2041 horizon are presented in *Volume II: TM3* and summarized in Table 9-4. These proposed projects were found to provide acceptable LOS for this horizon.

Table 9-4 2041 Model Results Summary

Result	Results Summary
Pressure	▼ Minimum pressure maintained above 40 psi throughout system with exception of PLo-1 ▼ Minimum pressure of 37 psi in PLo-1 ▼ Maximum pressure in PHi-6 of 103 psi
Linear Capacity	▼ Headloss maintained under 2m/km with exception of Dunlop Dr and Huron from York to Alice ▼ Huron has been flagged as CI replacement priority
Storage	▼ All ETs maintained above 75% full ▼ All reservoirs maintained above 60% full ▼ Woods Reservoir minimum level 60% ▼ Arkell Res minimum level 72%
Pump Station Flow	▼ All PSs operated below firm capacity ▼ Max flow at Woods of 600 L/s ▼ Max flow at Arkell of 330 L/s

Figure 9-2 Water Projects – Mid Term



9.1.3 Long-Term Recommendations (2042 – 2051+)

Water projects recommended in the long-term are intended to meet growth requirements up to the ultimate buildout growth.

In Zone 1, projects W-3b and W-4c are recommended to complete the transmission main from the Arkell PS to the Clair ET as growth and demands increase in the south end of the system.

In Zone 2, projects W-6b and W-6c are recommended to complete the east-west transmission main along Woolwich Street and improve capacity between the Zone 2 ET and the east side of Zone 2. Project W-9 is recommended to improve transmission between Speedvale and Woodlawn. Project W-10 is required to improve transmission from the Guelph Lake WTP.

The proposed long-term projects are depicted in Figure 9-3.

9.1.3.1 Long-Term Performance

Model results for the 2051+ ultimate buildout horizon are summarized in Table 9-5. Fire flow results are discussed in the following section.

Table 9-5 2051+ Model Results Summary

Result	Figure	Results Summary
Pressure	Figure 9-4 and Figure 9-5	▼ Minimum pressure maintained above 40 psi throughout system with exception of PLo-1 ▼ Minimum pressure of 38 psi in PLo-1. Maximum pressure in PHi-6 of 103 psi
Linear Capacity	Figure 9-6	▼ Headloss maintained under 2m/km with exception of Dunlop Dr.
Storage	Figure 9-7 and Figure 9-8	▼ All ETs maintained above 75% full Woods and Arkell Reservoir minimum levels 58%
Pump Station Flow	Figure 9-10	▼ All PSs operated below firm capacity ▼ Maximum flow at Woods of 840 L/s ▼ Maximum flow at Arkell of 350 L/s.

Figure 9-3 Water Projects – Long Term

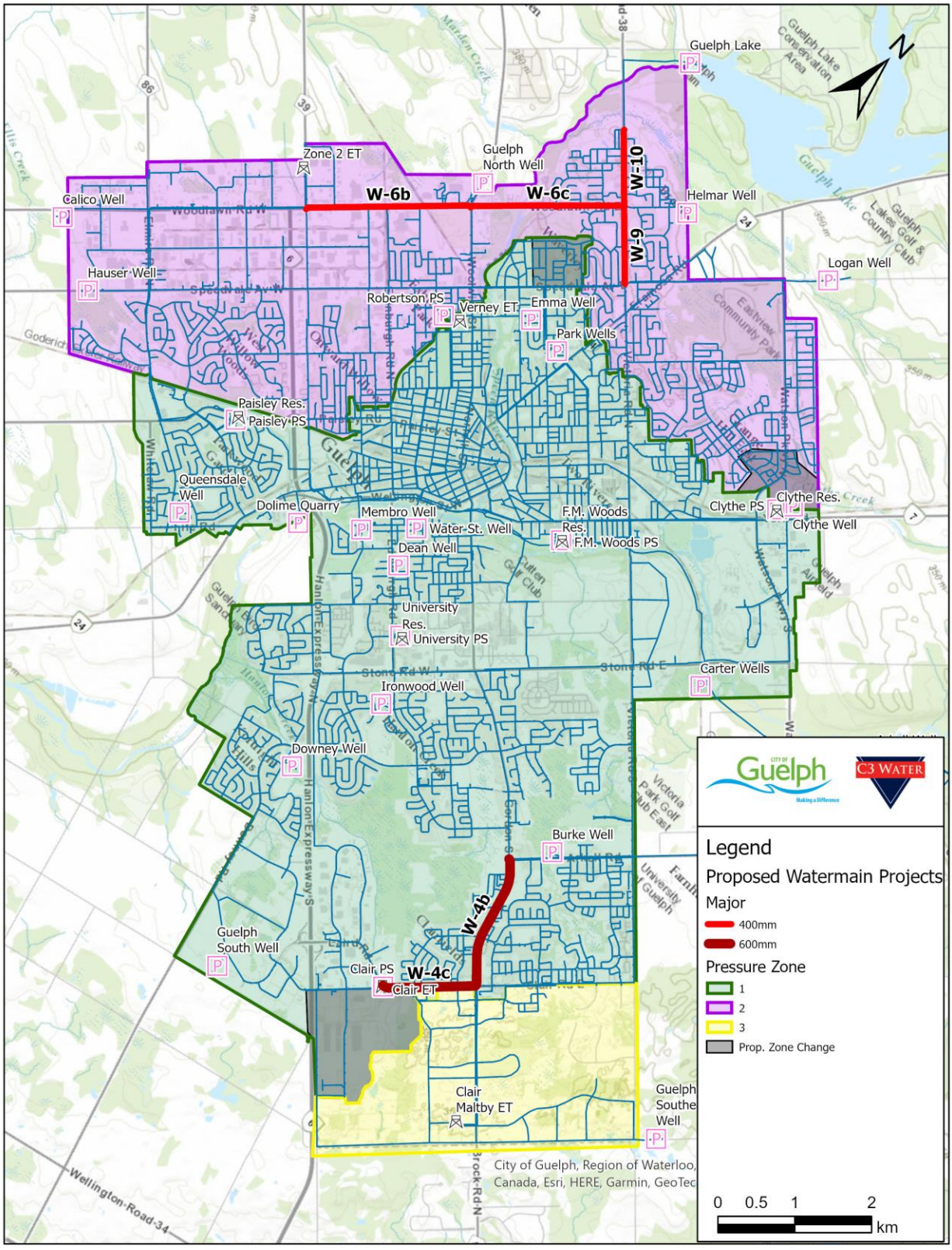


Figure 9-4 2051+ MDD Minimum Pressure – Proposed Upgrades

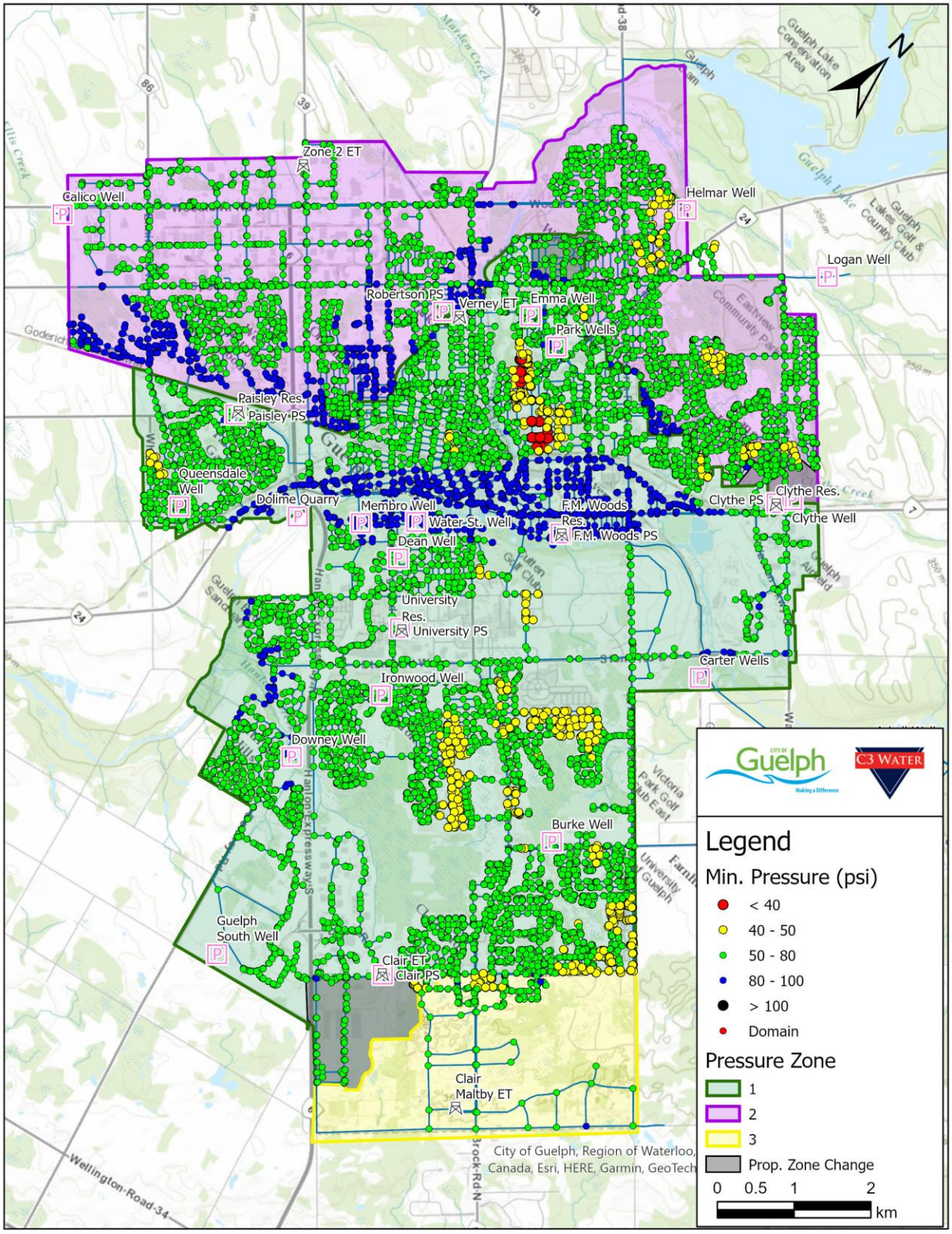


Figure 9-5 2051+ MDD Maximum Pressure – Proposed Upgrades

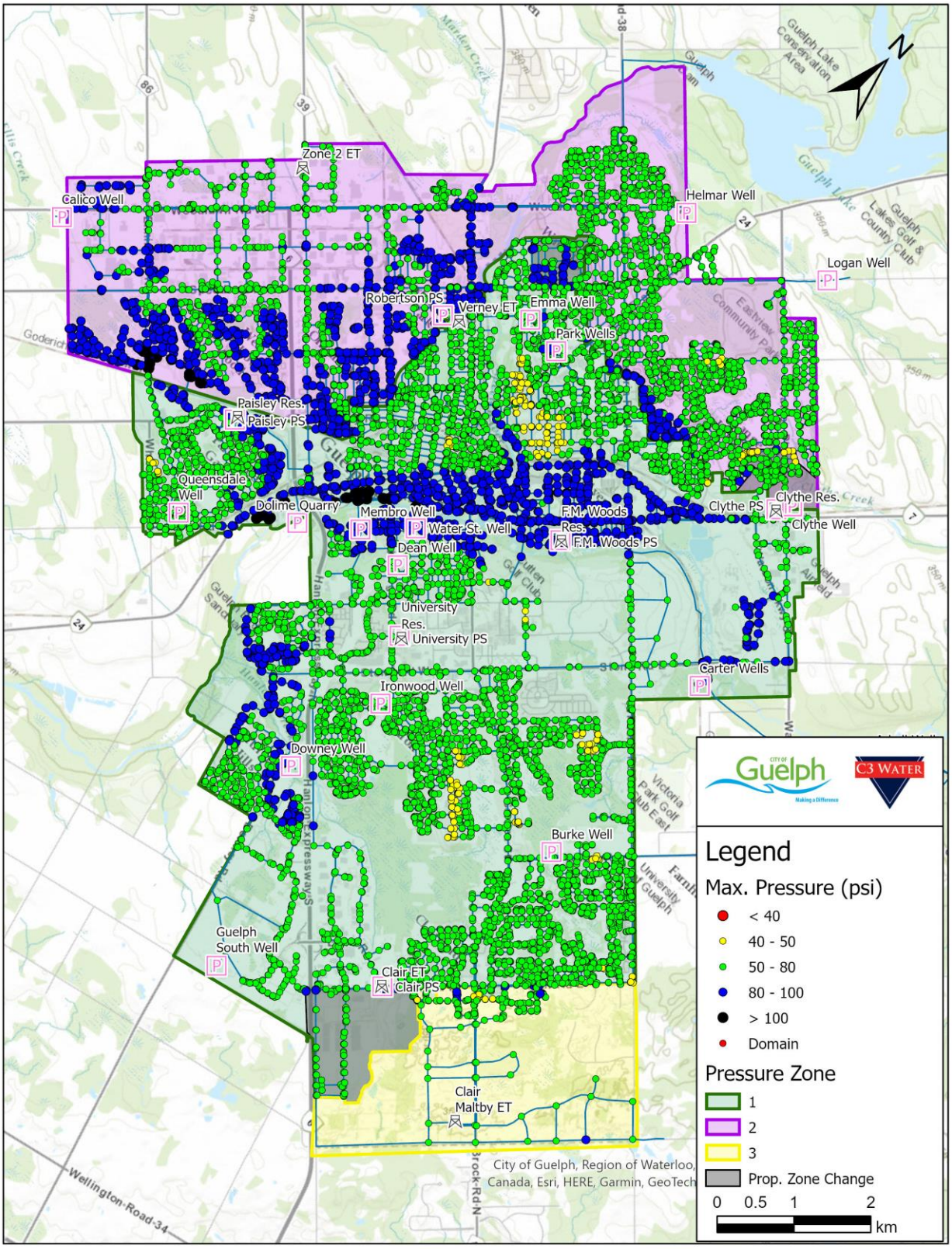


Figure 9-6 2051+ MDD Max Headloss – Proposed Upgrades

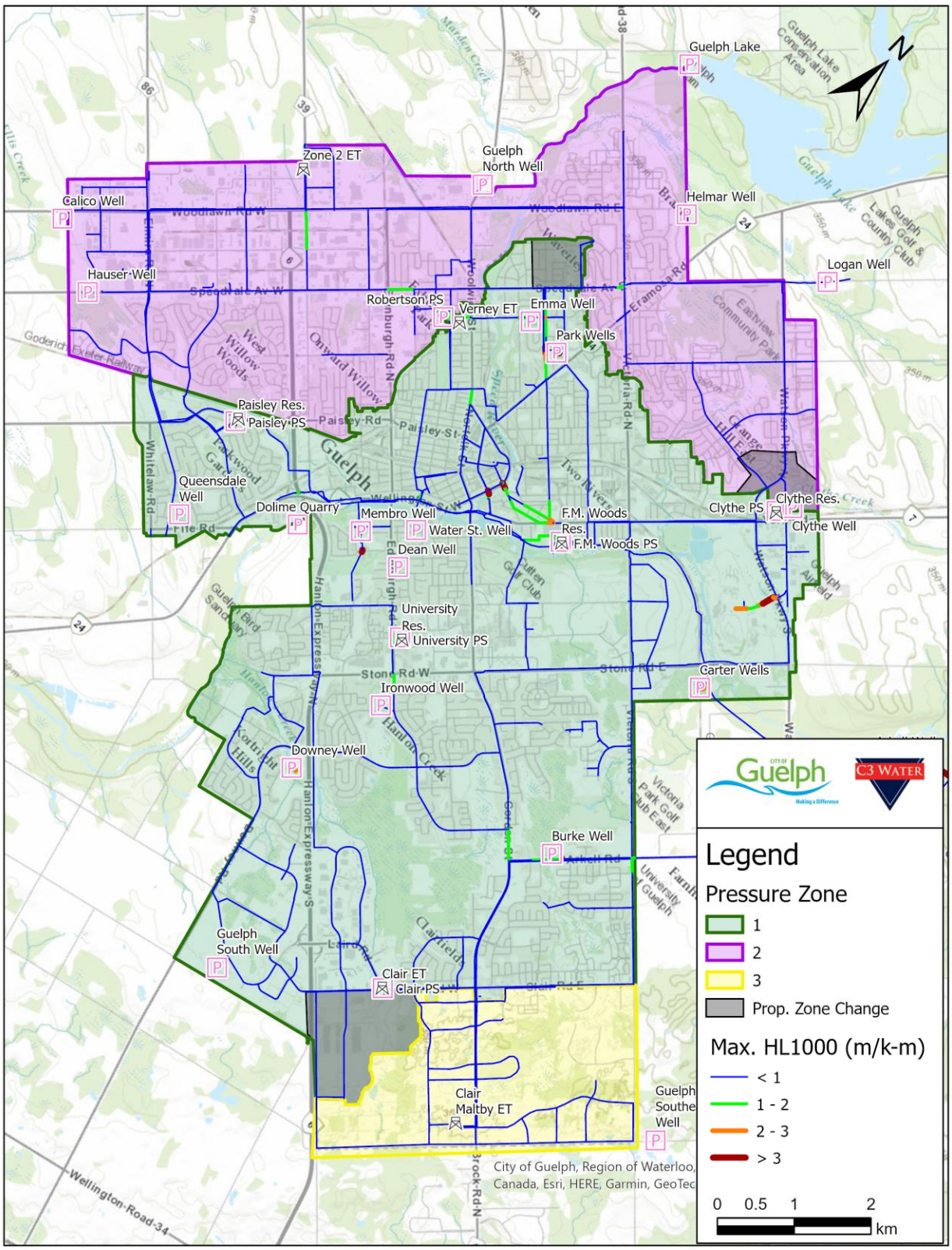


Figure 9-7 2051+ MDD ET Levels – Proposed Upgrades

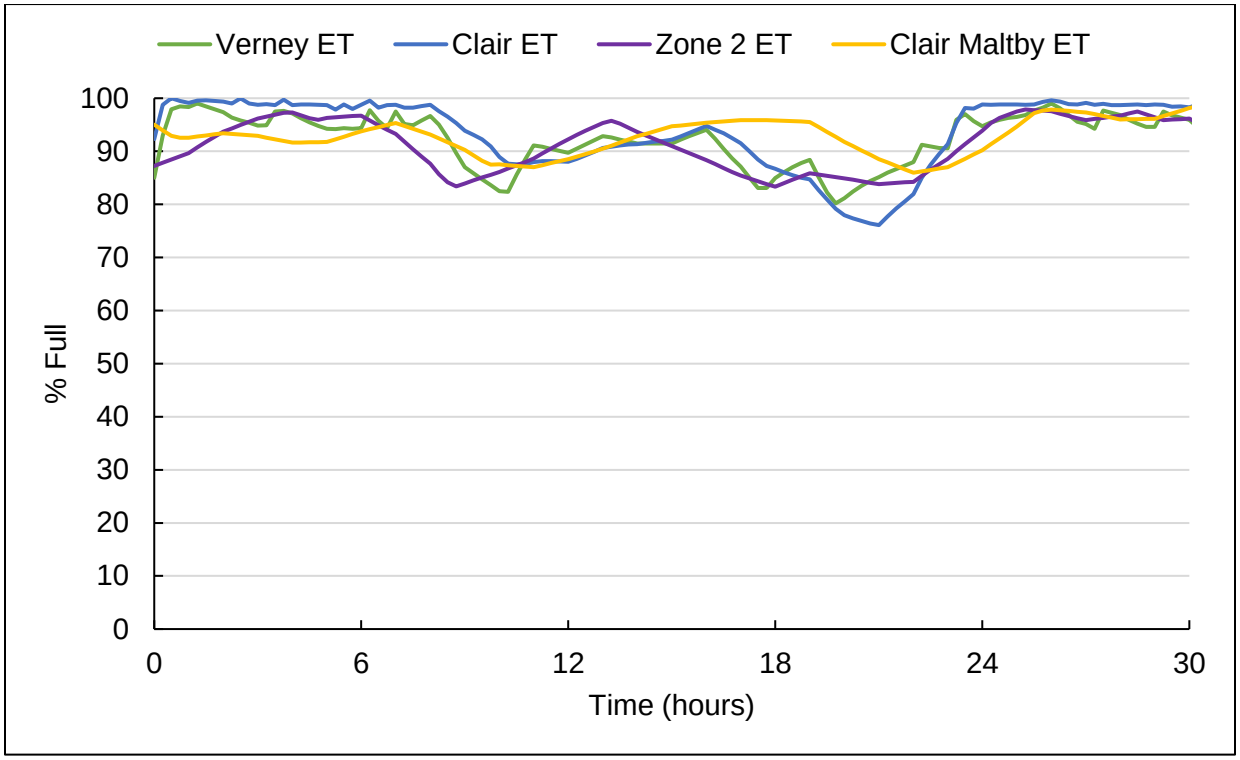


Figure 9-8 2051+ MDD Reservoir Levels – Proposed Upgrades

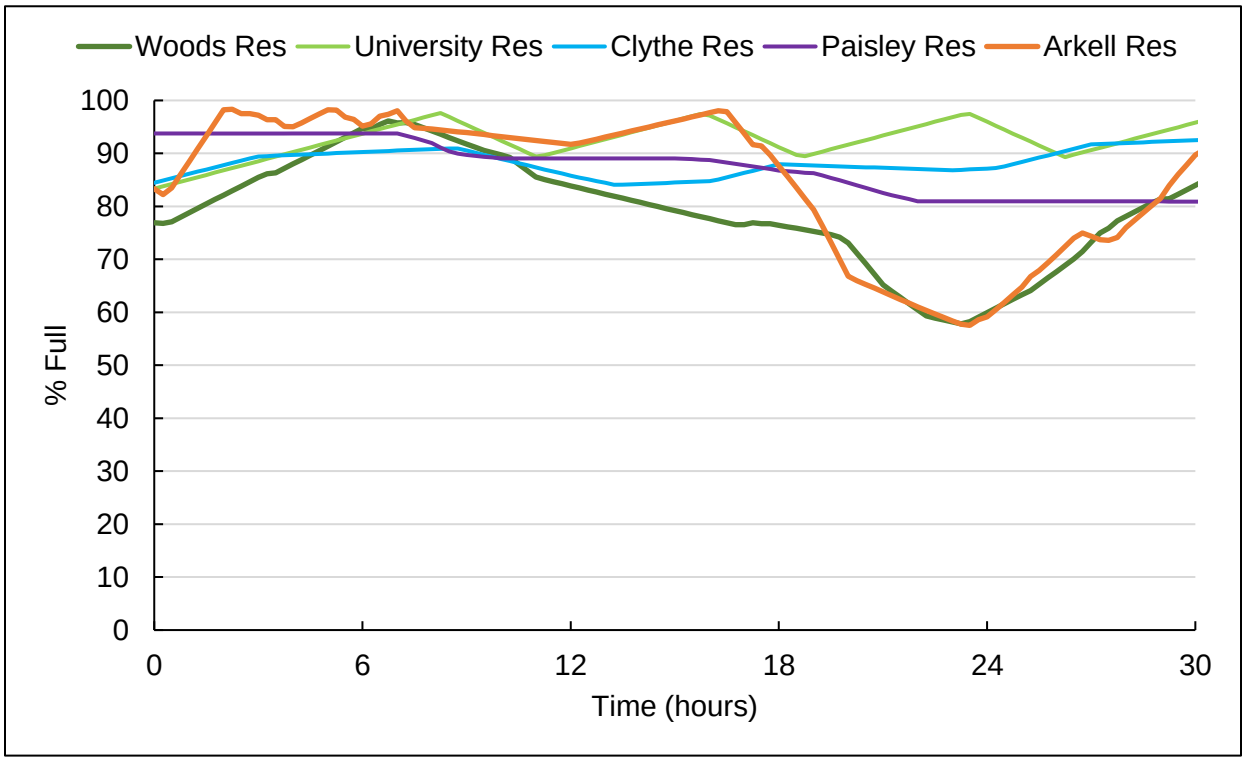


Figure 9-9 2051+ MDD PS Flows – Proposed Upgrades

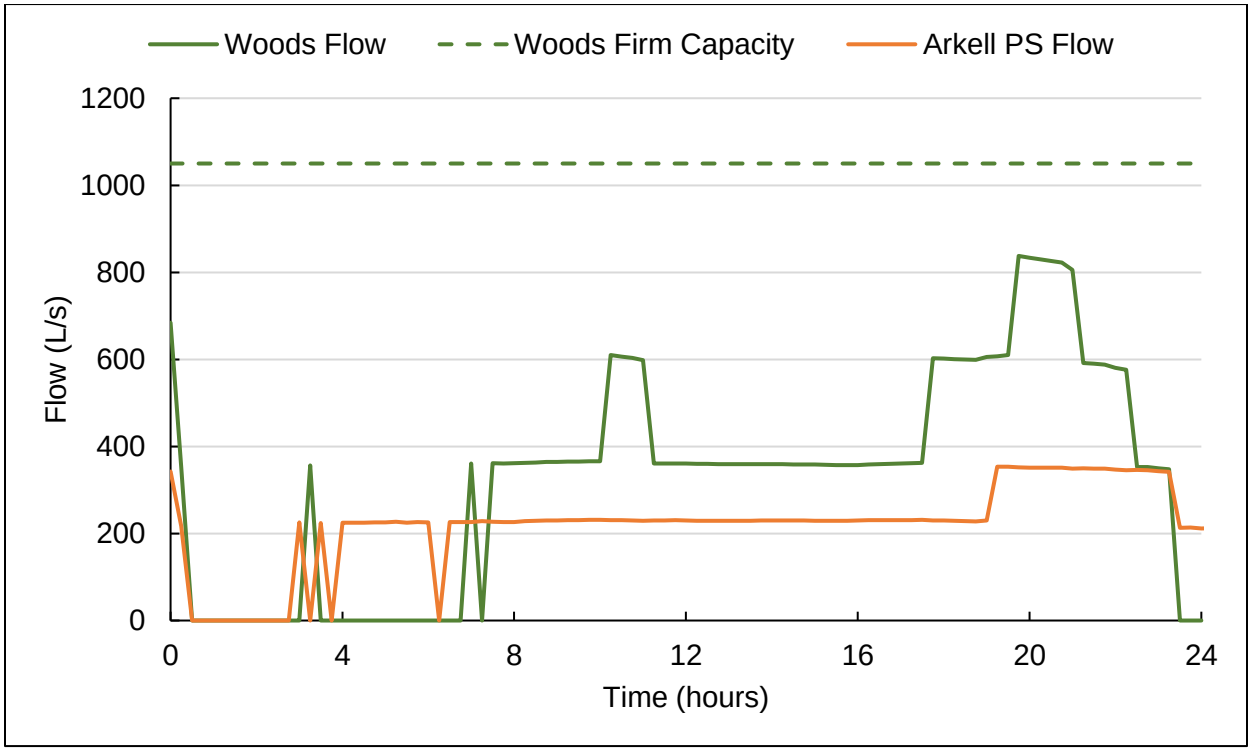
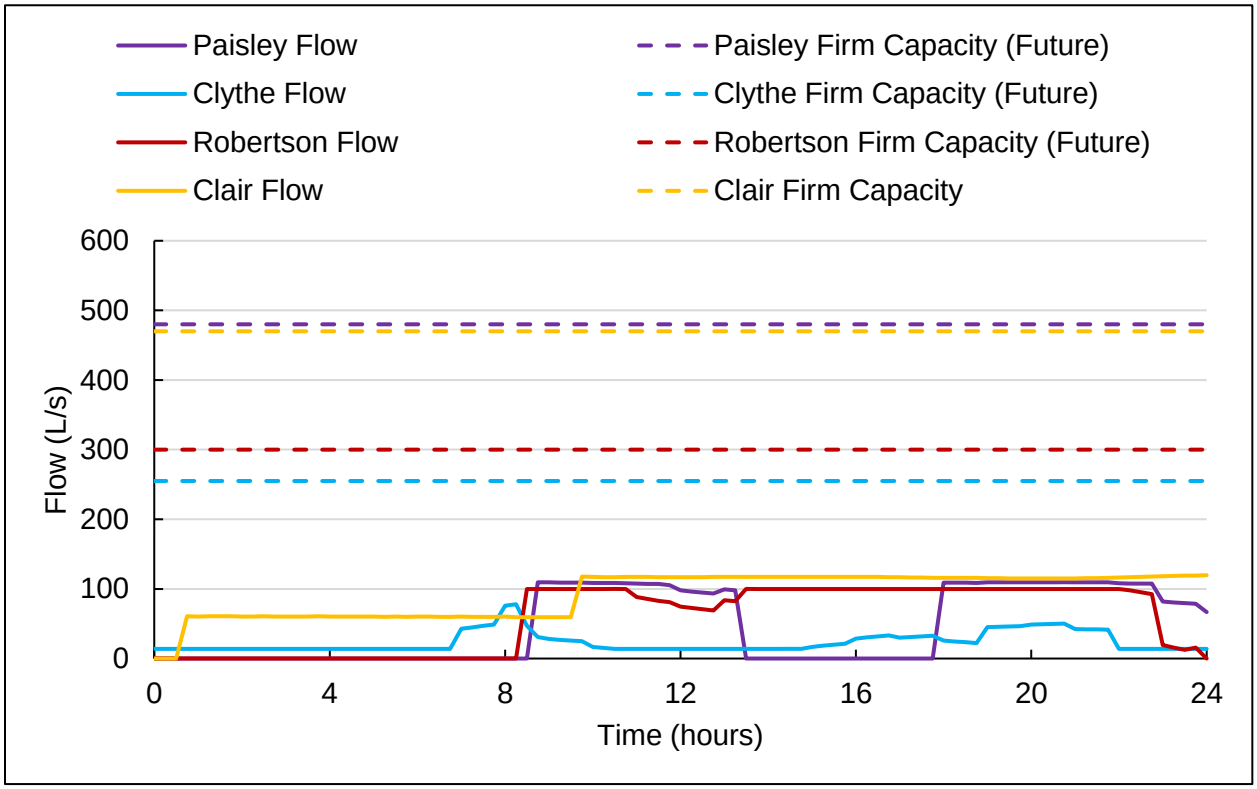


Figure 9-10 2051+ MDD PS Flows – Proposed Upgrades



9.1.3.1.1 *Long-Term Performance – Fire Flow*

Fire Flow results under 2051+ MDD conditions are presented in Figure 9-11. For this analysis, the CI replacement program was complete.

The minimum fire flow requirement of 30 L/s was met throughout the system. Areas with available flow of less than 80 L/s were found to be single-family residential.

Areas that were flagged as fire flow concerns in TM3A are highlighted in Figure 9-12 and summarized here.

F1: Upgrades in the Old University residential area resulted in fire flows above 80 L/s at all locations with the exception of three (3) dead-ends. A number of CI replacement priorities were flagged in this area and are critical for achieving fire flow above 30 L/s. Hydrants along proposed 200mm watermains exceeded 150 L/s.

F2: Upgrades resulted in fire flows primarily above 80 L/s in this. Proposed upgrades to Delhi Street resulted in fire flows above 250 L/s in the General Hospital area.

F3: Upgrades resulted in fire flow above 80 L/s at all locations. Significantly improved capacity in this area due to upgrades on Exhibition, Woolwich and Speedvale.

F4: Fire flows maintained above 80 L/s in this residential area due to CI replacement projects with the exception of three (3) dead-ends.

Downtown: Fire flows in the Downtown area were primary above the highest requirement of 367 L/s as a result of the proposed downtown projects.

Figure 9-11 2051+ MDD Available Fire Flow – Proposed Upgrades Active –CI Replacement Complete

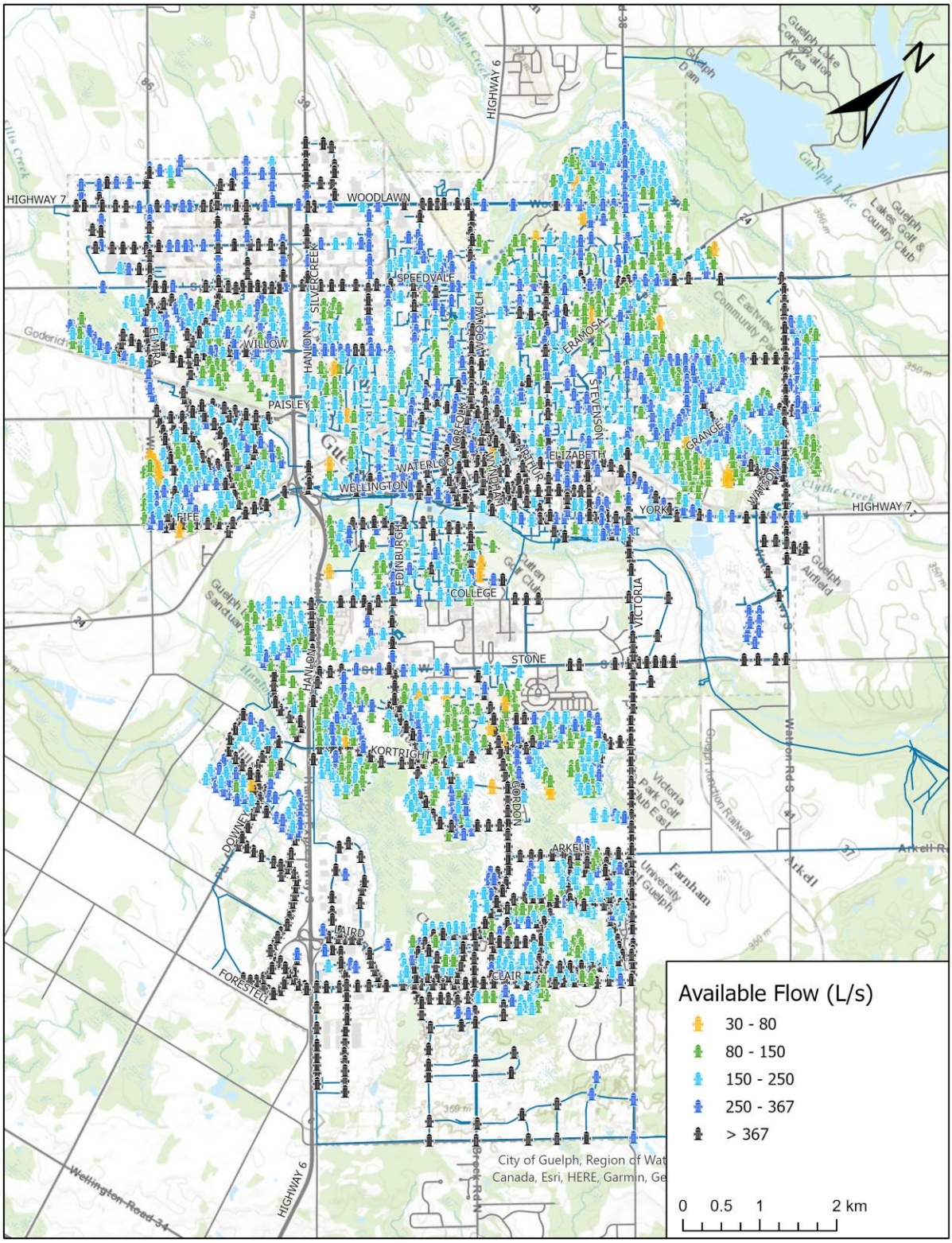
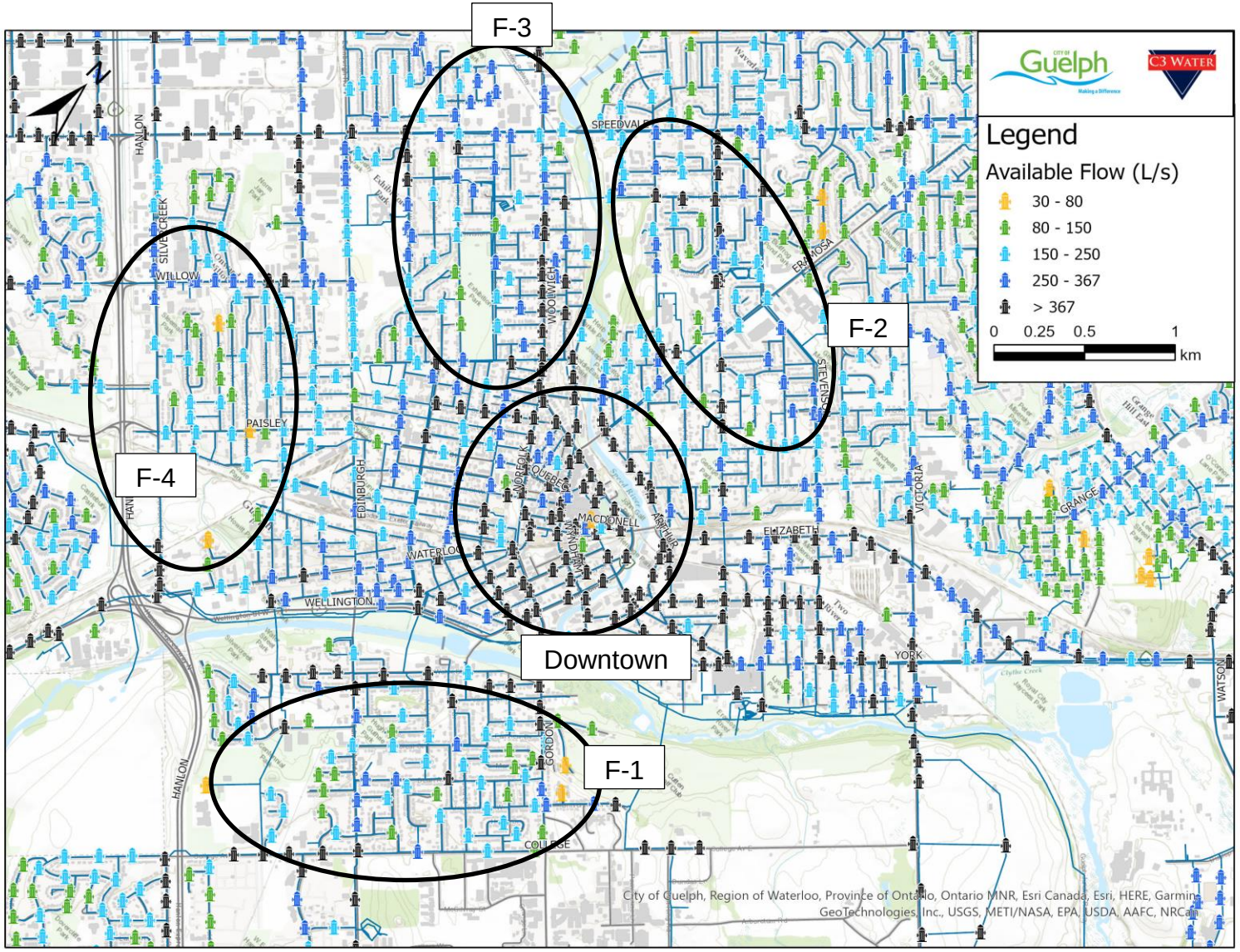


Figure 9-12 2051+ MDD Available Fire Flow – Proposed Upgrades Active –CI Replacement Complete



9.1.3.1.1.1 Fire Flow Analysis by Land Use

Fire flow results were assessed based on land use. For simplicity, land use was split into two categories: residential and ICI. Based on the criteria established in *TM5 Design Criteria, LOS and Sensitivity Analysis*, the fire flow requirements for future developments are:

- Residential: 80 – 200 L/s
- ICI: 150 – 250 L/s

The minimum fire flow requirement is 30 L/s for existing development based on Ontario Building Code (OBC) guidelines.

For this analysis, all proposed upgrades were complete including the CI replacement program.

The fire flow results for hydrants within residential land use areas are presented in Figure 9-13 A fire flow of greater than 200 L/s was achieved at most locations. The available fire flow was below 80 L/s only at dead ends.

The fire flow results for hydrants within ICI land use areas are presented in Figure 9-14 The fire flow was above 250 L/s at the majority of ICI hydrants. Hydrants below 150 L/s were dead ends.

Overall, the proposed upgrades were found to achieve sufficient available fire flows throughout the distribution system to meet the land use requirements.

Figure 9-13 2051+ MDD Available Fire Flow – Proposed Upgrades Active –CI Replacement Complete – Residential Only

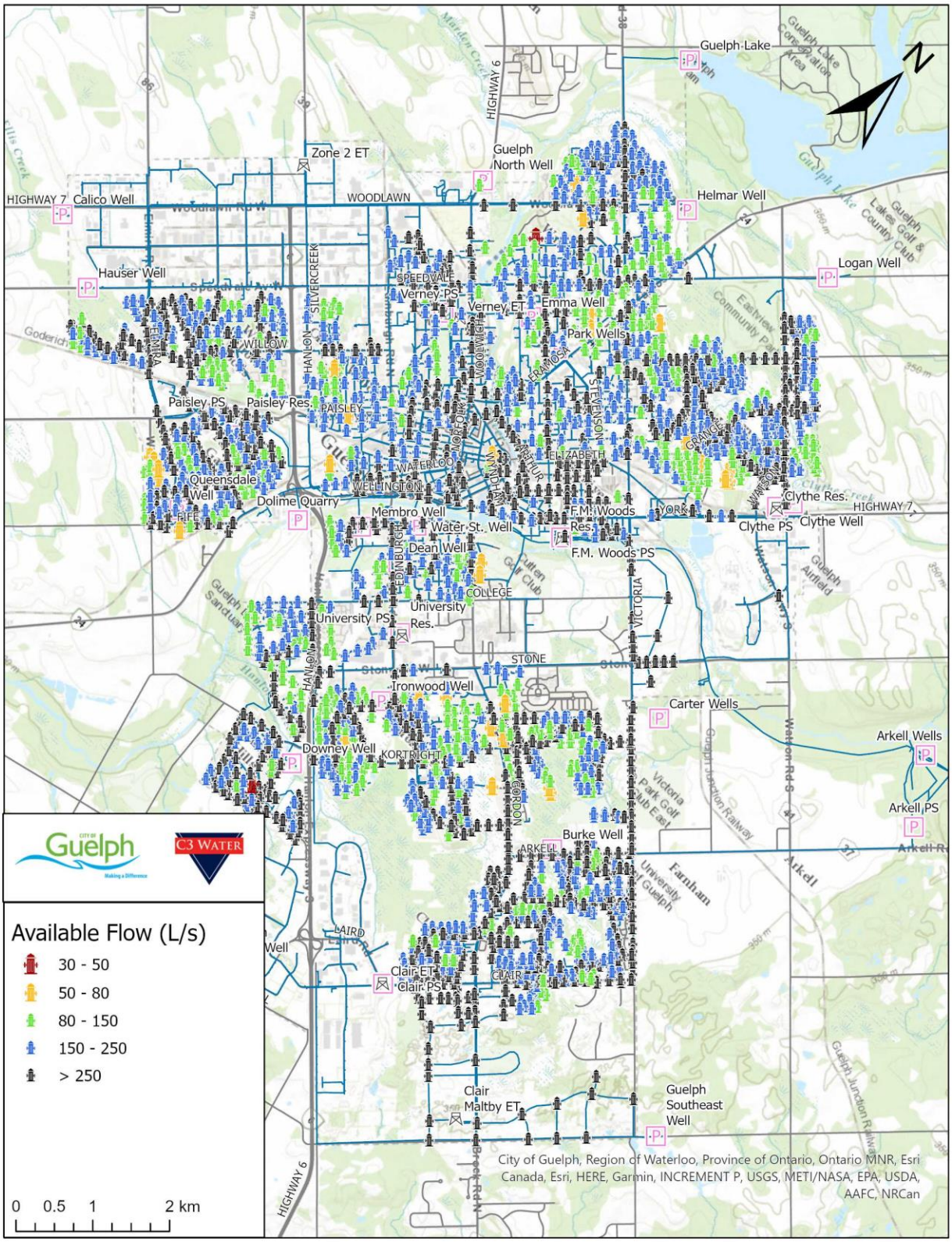
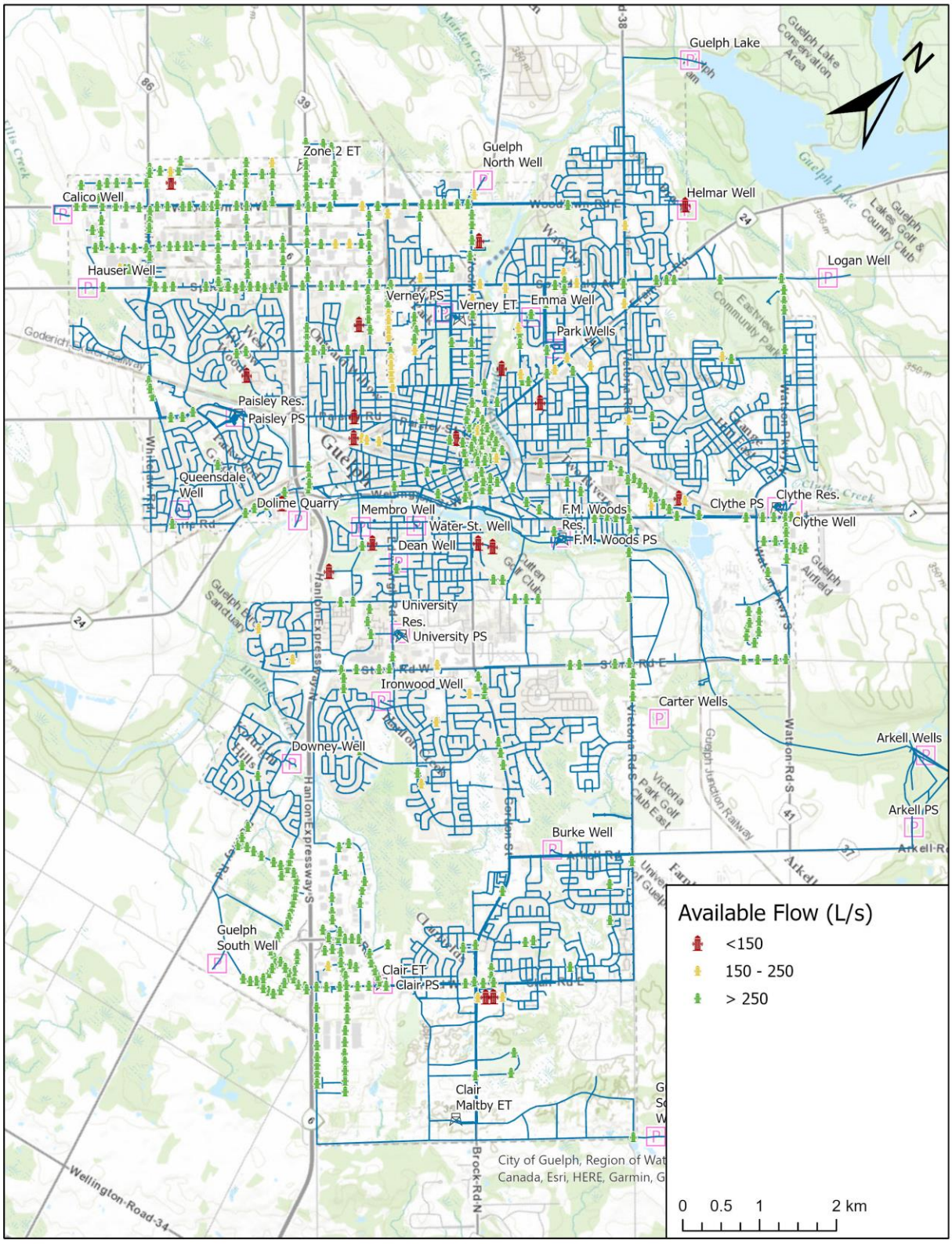


Figure 9-14 2051+ MDD Available Fire Flow – Proposed Upgrades Active –CI Replacement Complete – ICI Only



9.1.4 Water Projects Summary

Proposed watermain project timing is summarized in Table 9-6. Short-term projects have been listed in order of prioritization.

Table 9-6 Summary of Water System Upgrades Timing- Facilities

Project Number	Timing	Triggers/Sequencing	Location	Summary of Upgrades
Facilities				
F-1	Short-Term	In Progress	Woods WTP	Upgrades to pump station, dual discharge feedermains. Upgrades to office spaces.
F-2	Short-Term	In Progress	Clythe WTP. PS and Reservoir	New WTP, Pump Station and 6.9 ML Reservoir
F-3	Short-Term	W-8 and W-11 to be completed first	Verney BPS	New BPS to replace existing Robertson
F-4	Short-Term	Following Woods Upgrades (F-1)	Park Zone 2 PS	New PS at Park Wells Site
Arkell Alt B2	Short-Term	Existing Criticality	New Arkell PS, Reservoir and WM	New PS, Reservoir and Watermain
F-5	Mid-Term	Clair Maltby ET	Clair BPS	Retrofit Existing PS
W-S-1	Mid-Term	Speedvale ET Lifecycle	North end of Zone 2.	6ML Elevated Tank

Table 9-7 Summary of Water System Upgrades Timing- Watermains

Project Number	Timing	Triggers/Sequencing	Location	Size (mm)	Length (m)
Watermains					
W-8	Short-Term	High Priority to Address Existing Criticality	Speedvale from Edinburgh to Manhattan	400	2150
W-M-24	Short-Term	Align work with W-8	Speedvale from Westmount to east of Woolwich	200	930
W-M-19	Short-Term	Align work with W-8	Speedvale from East of Woolwich to Stevenson	200	1020
W-M-16	Short-Term	High Priority to Address Existing Criticality	Gordon from York to University	300	1110
W-CI-1a	Short-Term	High Priority to Address Existing FF Constraints	Small Diameter CI WMs throughout system	150	13600
W-2	Short-Term	Complete Prior to F-2	York from Brockville to Watson	600	2500
W-M-26	Short-Term	Align work with W-2	York Road from Brockville to Clythe PS	300	450
W-11	Short-Term	Complete Prior to F-3	Exhibition from Robertson/Verney PS to Speedvale	400	375
W-M-20	Short-Term	Existing Capacity Constraints	University/College from River Crossing to Edinburgh	200	1760
W-M-17	Short-Term	Existing Capacity Constraints	Dufferin from Mac to London	200	1300
W-M-18	Short-Term	Existing Capacity Constraints	Delhi from Eramosa to existing 250mm	250	690
W-M-23	Short-Term	Existing Capacity Constraints	Talbot/Forest Hill from Water to University	200	850
W-M-21	Short-Term	Existing Capacity Constraints	Water/Albert from River Crossing to Gordon	200	790
W-M-22	Short-Term	Existing Capacity Constraints	Dean from Edinburgh to Talbot	200	520
W-M-1	Short-Term	Existing Capacity Constraints	Woolwich from Norfolk to Macdonnell	300	930
W-M-3	Short-Term	Existing Capacity Constraints	Wyndham from Woolwich to Carden	300	480
W-12	Short-Term	Complete Prior to F-2	Watson from Clythe PS to Grange	600	760
W-M-6	Short-Term	Existing Capacity Constraints	Waterloo from Yorkshire to Essex	300	500

Project Number	Timing	Triggers/Sequencing	Location	Size (mm)	Length (m)
Watermains					
W-M-13	Short-Term	Existing Capacity Constraints	Wellington from Gordon to Neeve	300	480
W-5a	Short-Term	Existing Criticality	Imperial/Elmira from Paisley PS to Willow	400	1970
W-3	Short-Term	Growth	Paisley from Hanlon to Paisley PS	400	400
W-CI-1b	Short-Term	Align with other works when possible	Small Diameter CI WMs throughout system	150	28000
W-1a	Short-Term	Growth	Yorkshire from Wellington to London and Exhibition	600	1850
W-1b	Short-Term	Growth	Exhibition from London to Verney	600	940
W-M-15	Short-Term	Growth	Woolwich from London to Norwich	300	210
W-M-2	Short-Term	Timing Based on Local Development	Cardigan from Norwich to Woolwich	200	260
W-M-4	Short-Term	Timing Based on Local Development	Macdonell from Norfolk to Carden	200	440
W-M-5	Short-Term	Timing Based on Local Development	Dublin from Waterloo to Wellington	200	400
W-M-7	Short-Term	Timing Based on Local Development	Yarmouth from Woolwich to Quebec	200	320
W-M-9	Short-Term	Timing Based on Local Development	Essex from Dublin to Waterloo	200	170
W-M-10	Short-Term	Timing Based on Local Development	Nottingham from Dublin to Gordon	200	180
W-M-11	Short-Term	Timing Based on Local Development	Fountain from Dublin to Neeve	200	550
W-M-12	Short-Term	Timing Based on Local Development	Surrey from Dublin to Neeve	200	610
W-M-14	Short-Term	Timing Based on Local Development	Duke from Alice to existing PVC	200	220
W-M-8	Short-Term	Built	Baker from Woolwich to Quebec	300	300
W-1c	Mid-Term	Growth	London/Eramosa from Exhibition to Stevenson	400	2140
W-4a	Mid-Term	Arkell PS and Growth	Arkell from Gordon to Victoria	600	1600
W-5b	Mid-Term	Zone 2 ET	Elmira from Speedvale to Willow	400	800
W-6a	Mid-Term	Zone 2 ET	Woodlawn from Elmira to Silvercreek	400	2030
W-10	Long Term	Guelph Lake WTP	Victoria from Woodlawn to Goldenview Drive	400	1000
W-13	Mid-Term	Zone 2 ET	Silvercreek from Woodlawn to Proposed Zone 2 ET	400	900
W-M-25	Mid-Term	Clair Maltby ET	Crawley to Maltby	300	2130
W-CI-2	Mid-Term	Existing Capacity Constraints	Small Diameter CI WMs throughout system	150	41600
W-4b	Long Term	Growth	Gordon from Arkell to Clair	600	1760
W-4c	Long Term	Growth	Clair from Gordon to ET	600	1200
W-6b	Long Term	Growth	Woodlawn from Silvercreek to Woolwich	400	2160
W-6c	Long Term	Growth	Woodlawn from Woolwich to Victoria	400	2022
W-7	Long Term	Growth	Elmira from Speedvale to Woodlawn	400	1070
W-9	Long Term	Growth	Victoria from Speedvale to Woodlawn	400	1010
W-CI-3	Long Term	Existing Capacity Constraints	Small Diameter CI WMs throughout system	150	41600

9.2 Wastewater Servicing

There are a total of 19 projects identified in this study (excluding siphons), and of those 14 are required under existing conditions (short term), four (4) are required in the mid-term (2041 – 2051), and one (1) is required in the long term (2051+).

9.2.1 Short Term Recommendations (Present – 2031)

Wastewater projects recommended in the short term are intended to address existing capacity constraints as well as meet growth requirements to 2031. There are a total of 14 projects required in the short term to address capacity constraints and eliminate system surcharge. Other than the Manor Park Siphon upgrade, all projects are required under existing WWF conditions. No system upgrades are required under existing DWF conditions. The proposed short-term projects are summarized below, in Table 9-8 and shown in Figure 9-15.

Short-Term Projects

WW1-1 is a low-risk area as the surcharge observed in the growth conditions is minor (~250mm) and at least 2.0m of freeboard remains in the affected sewers.

WW1-2 is a low-risk area as minor surcharge is observed in only one MH in the growth conditions.

WW2-1 is a low-risk area as the surcharge observed in the growth conditions is minor (~250mm) and at least 1.8 m of freeboard remains in the affected sewers.

WW2-2 is a moderate-risk area as the surcharged observed in the growth conditions is (~650 mm) and the minimum freeboard along the reach is 1.33 m.

WW2-3 is a high-risk area. Although the surcharge observed is relatively minor, most of the sewers along the reach are shallow with less than 1.8 m of cover over the pipe obverts. This location is also adjacent to the Speed River where the consequences of an SSO would impact both the public and the environment.

WW3-1 is a low-risk area as the surcharge observed in the growth conditions is minor (~225 mm) and at least 1.5 m of freeboard remains in the affected sewers.

WW4-1 is a low-risk area. There are 2 maintenance holes where the surcharge exceeds 800 mm, however most of the surcharge observed in the growth conditions is minor (< 400 mm) and at least 1.98 m of freeboard remains in the affected sewers.

WW4-4 is a high-risk area as the surcharge observed in the growth conditions exceeds 500 mm and most of the sewers along the reach are shallow with less than 1.8 m of cover over the pipe obverts.

WW4-5 is a low-risk area. The surcharge observed in the growth conditions is moderate (~500 mm) however at least 2.94 m of freeboard remains in the affected sewers.

WW5-1 is a high-risk area as the surcharge observed in the growth conditions exceeds 900 mm in some locations and there are shallow sewers with less than 1.3 m of freeboard. This reach is also adjacent to the speed river where the consequences of an SSO would impact both the public and the environment.

WW5-4 is a moderate-risk area as the surcharge observed in the growth conditions reaches 1.9 m and the minimum freeboard along the lower portion of the reach is 0.9 m.

WW5-5 is a low-risk area as the surcharge observed in the growth conditions is a maximum of 500 mm and at least 2.4 m of freeboard remains in the affected sewers.

WW5-6 is a low-risk area as the surcharge observed in the growth conditions is a maximum of 600 mm and at least 2.2 m of freeboard remains in the affected sewers.

WW6-1 is a low-risk area as the surcharge observed in the growth conditions is minor (~250 mm) and at least 2.7 m of freeboard remains in the affected sewers.

Table 9-8 Short Term Wastewater Improvements

Project Number	Location
WW1-1	Silvercreek Parkway
WW1-2	Westwood Rd
WW2-1	Victoria Rd and Waverley Dr
WW2-2	Waverley Dr and Stevenson St
WW2-3	Wilton Rd, Inverness Dr and Speedvale Ave
WW3-1	Exhibition Park / Kathleen St
WW4-1	Audin Rd and Victoria Rd
WW4-4	Victoria Rd
WW4-5	Summit Ridge Dr
WW5-1	York Rd and Wellington St
WW5-4	Quebec St and Wyndham St
WW5-5	Woolwich St
WW5-6	Waterloo Ave
WW6-1	College Ave
S1	Manor Park Crescent / Speed River Siphon
S2	Municipal Street Siphon Decommissioning

9.2.1.1 Short Term Prioritization

Within the short-term horizon, wastewater projects have been prioritized based on need and risk. Suggested prioritization is summarized in Table 9-9 below.

Table 9-9 Short-Term Wastewater Project Prioritization

Project Number	Priority	Prioritization Considerations
WW5-1	1	Shallow sewer - Adjacent to Speed River
WW4-4	2	Shallow sewer - limited freeboard
WW2-3	3	Shallow sewer - Adjacent to Speed River
WW5-4	4	1900mm surcharge + 0.9m freeboard
WW4-1	5	800mm surcharge + 2.0m freeboard
WW2-2	6	650mm surcharge + 1.3m freeboard
WW5-6	7	600mm surcharge + 2.2m freeboard
WW5-5	8	500mm surcharge + 2.4m freeboard
WW4-5	9	500mm surcharge + 3.0m freeboard
WW1-1	10	250mm surcharge + 2.0m freeboard
WW6-1	11	250mm surcharge + 2.7m freeboard
WW3-1	12	225mm surcharge + 1.5m freeboard
WW2-1	13	225mm surcharge + 2.1m freeboard
WW1-2	14	60mm surcharge + 4.1m freeboard

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Area 1
Area 2
Area 3
Area 4
Area 5
Area 6
Area 7
WW1-1
WW1-2
WW2-1
WW2-2
WW2-3
WW3-1
WW4-1
WW4-4
WW4-5
WW5-1
WW5-4
WW5-5
WW5-6
WW6-1
Highway 7
Woodlawn Rd W
Northern Heights
Guelph Lake
NiMa Trails
Gazer Mooney
Eastview Rd
Wellington St W
York Rd
Highway 7
Eramosa River
Hanlon Parkway
Kortright
Barton
Terraview
Highway 6

Legend
- Wastewater Upgrade
- Pump Station
- Water Resource Recovery Center
- Watercourse
- Railway
- Property
- Sanitary Sewer
- Forcemain / Siphon

0 1 2 Km
1:50,000 (At Original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2018. Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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Project Location
City of Guelph

165640298

Client/Project
CITY OF GUELPH WATER AND WASTEWATER SERVICING MASTER PLAN – TM3 WATER AND WASTEWATER SERVICING RECOMMENDATIONS

Figure No.
9-15

Title
Wastewater Short Term Upgrades

9.2.2 Mid-Term Recommendations (2032 – 2041)

Wastewater projects recommended in the mid-term are intended to meet growth requirements up to 2041. There are a total of four (4) projects required in the mid-term to address capacity constraints and eliminate system surcharge. These projects are summarized below and in Table 9-10.

Mid-Term Projects

WW2-4 is a low-risk area as minor surcharge is observed in only one MH in the growth conditions.

WW4-2 is a low-risk area as minor surcharge is observed in only one MH in the growth conditions.

WW5-2 is a low-risk area as minor surcharge is observed in only one MH in the growth conditions.

WW7-1 is a low-risk area as the surcharge observed in the growth conditions is a maximum of 70 mm and at least 3.4 m of freeboard remains in the affected sewers.

Table 9-10 Mid Term Wastewater Improvements

Project Number	Location
WW2-4	Speedvale Ave
WW4-2	York Rd and Beaumont Cres.
WW5-2	Waterloo Ave
WW7-1	Clair Rd, Farley Dr and Clairfields Dr

The proposed mid-term project locations are depicted in Figure 9-16.

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Area 1
Area 2
Area 3
Area 4
Area 5
Area 6
Area 7
WW2-4
WW4-2
WW5-2
WW7-1
Northern Heights
NiMa Trails
Gazer Mooney
Eastview Rd
Guelph Lake
Highway 7
Woodlawn Rd W
Wellington St W
York Rd
Eramosa River
Hanlon Parkway
Kortright
Barton
Terraview
Highway 6

Legend
- Wastewater Upgrade
- Pump Station
- Water Resource Recovery Center
- Watercourse
- Railway
- Property
- Sanitary Sewer
- Forcemain / Siphon

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Stantec

C3 Water

Project Location
City of Guelph

165640298

Client/Project
CITY OF GUELPH WATER AND WASTEWATER SERVICING MASTER PLAN – TM3 WATER AND WASTEWATER SERVICING RECOMMENDATIONS

Figure No.
9-16

Title
Wastewater Mid Term Upgrades

Notes
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9.2.3 Long-Term Recommendations (2042 – 2051+)

Wastewater projects recommended in the long-term are intended to meet growth requirements up to the ultimate buildout growth. Only one (1) new project is required in the long term to address capacity constraints and eliminate system surcharge. This is project WW5-3 along Bristol St and Waterloo Ave.

Long-Term Projects

WW5-3 is a low-risk area as no surcharge is observed in the growth conditions, only three sewers flowing above capacity.

Table 9-11 Long Term Wastewater Improvements

Project Number	Location
WW5-3	Bristol St
S3 - Alma Mercer	Alma Street North / Mercer Street
S4 - Elizabeth-Beaumont	Elizabeth Street North / Beaumont Crescent
S5 - Eramosa River	Eramosa River / Cutten Fields Golf Course
S6 - Hanlon-Massey-Campbell	Hanlon Parkway - Massey Road / Campbell Road
S7 - Ptarmigan	Ptarmigan Drive
S8 - Speed River Crane Park	Speed River - Crane Park
S9 - Stevenson-Eramosa	Stevenson Street North / Eramosa Road
S10 - Willow-Guelph	Willow Road / Guelph Street

The proposed long-term project located are indicated in Figure 9-17**.**

9.2.3.1 Siphons

The identified preferred approach to the City's siphons includes continued maintenance and replacement/modification when opportunities arise. From this perspective, their required timing can be considered long term. It is emphasized, however, that the maintenance activities may identify that the siphons require upgrades sooner.

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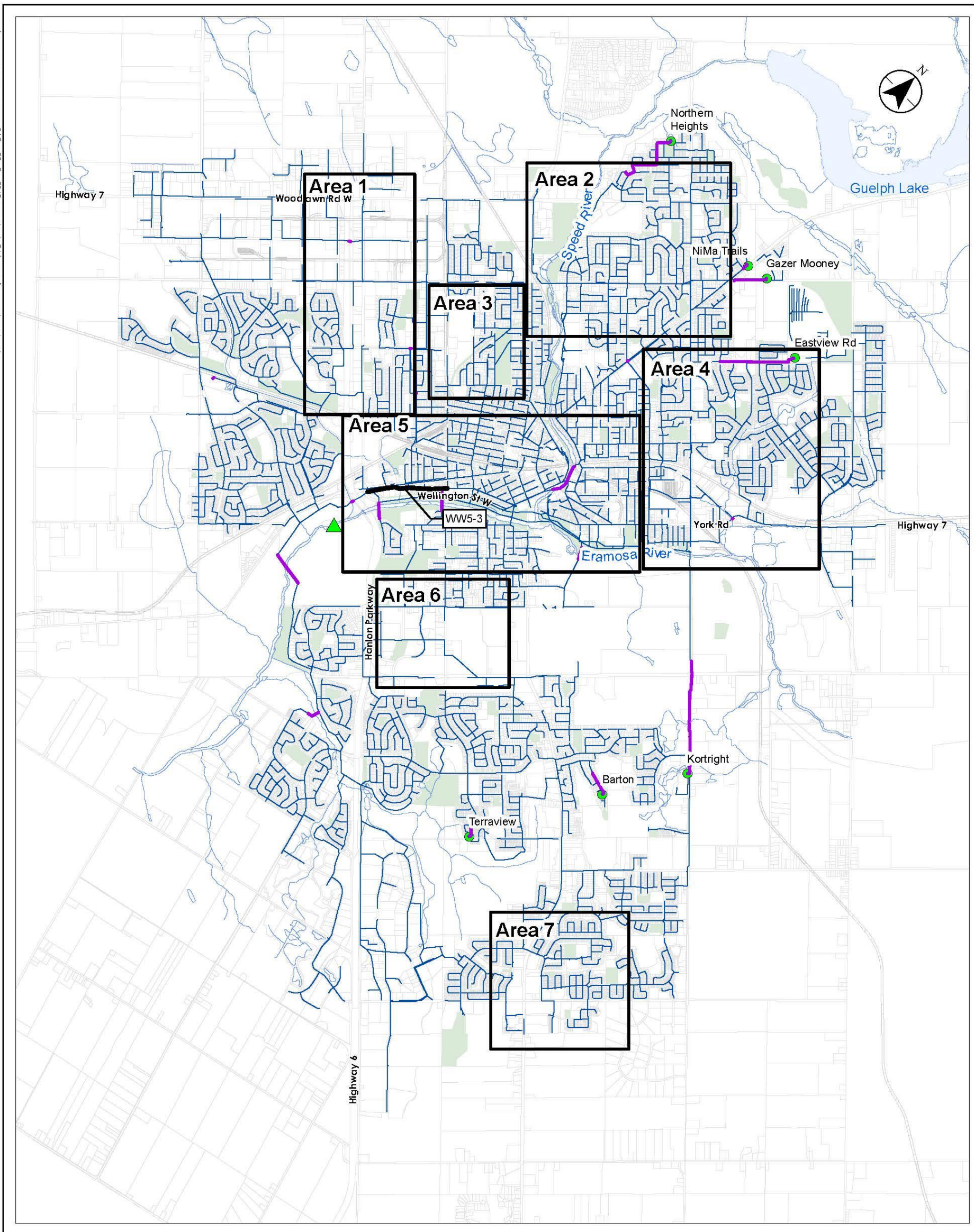

Legend

- Wastewater Upgrade
- Pump Station
- Water Resource Recovery Center
- Watercourse
- Railway
- Property
- Sanitary Sewer
- Forcemain / Siphon

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Stantec

C3 Water

Project Location
City of Guelph

165640298

Client/Project
CITY OF GUELPH WATER AND WASTEWATER SERVICING MASTER PLAN – TM3 WATER AND WASTEWATER SERVICING RECOMMENDATIONS

Figure No.
9-17

Title
Wastewater Long Term Upgrades

Notes

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9.2.4 Wastewater Projects Summary

There are 20 projects identified for the wastewater system to address capacity constraints, eliminate system surcharge, address operational issues. Alternative improvements concepts were identified and tested in seven (7) locations as well. These alternate improvements are intended to take advantage of existing/planned City works, improve operational efficiency and flexibility, and to move existing sewers/trunks into transportation right of ways (ROWs) and out of easements.

Proposed wastewater projects' timing is summarized in Table 9-12 and Table 9-13. Short-term projects have been listed in order of prioritization.

9.2.4.1 Recommended Further Study

Further study is warranted for Area 5. There are several options that warrant consideration beyond what has been considered in this WWSMP:

- Recent emergency works completed to stabilize the existing trunk sewer should be incorporated in a long-term solution. A long-term solution which results in these recent mitigative investments being replaced are to be avoided.
- There appears to be available elevation for lowering of the connection(s) to the WRRC. This provides the opportunity to consider lowered trunk infrastructure to satisfy the servicing needs for the area. This also provides a potential opportunity to explore modifications to the City's existing siphons.
- Gravity solutions may benefit from use of adjacent parallel roads/easements for alleviation of surcharge. These alignment options warrant further consideration.
- A diversion structure may be of benefit. This might be used to convey flow above the existing system's capacity to the WRRC. The diversion could be to a lowered trunk sewer, or to a new bypass pump station.

As such, the assessments and findings presented in the WWSMP for Area 5 should be considered as preliminary and used to help form the basis for further study of the Area.

Table 9-12 Summary of Wastewater System Upgrades - Sewers

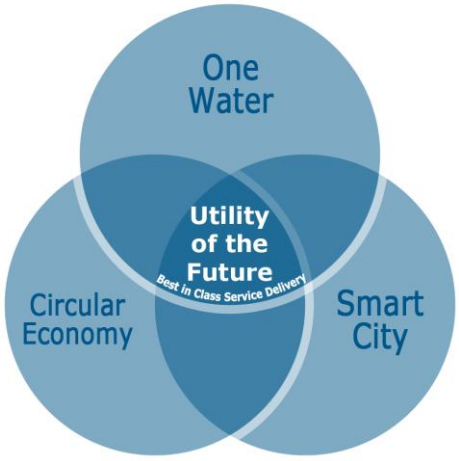
Project Number	Timing	Triggers	Location	Size (mm)	Length (m)
Sewers					
WW5-1	Short-Term	Existing Capacity Constraints	York Rd and Wellington St	1200 / 1350	3284
WW4-4	Short-Term	Existing Capacity Constraints	Victoria Rd	375	777
WW2-3	Short-Term	Existing Capacity Constraints	Wilton Rd, Inverness Dr and Speedvale Ave	150 / 300 / 375	1128
WW5-4	Short-Term	Existing Capacity Constraints	Quebec St and Wyndham St	375 - 600	1066
WW4-1	Short-Term	Existing Capacity Constraints	Audin Rd and Victoria Rd	300 / 375	186
WW2-2	Short-Term	Existing Capacity Constraints	Waverley Dr and Stevenson St	375 / 450	1593
WW5-6	Short-Term	Existing Capacity Constraints	Waterloo Ave	300	166
WW5-5	Short-Term	Existing Capacity Constraints	Woolwich St	300	167
WW4-5	Short-Term	Existing Capacity Constraints	Summit Ridge Dr	300	173
WW1-1	Short-Term	Existing Capacity Constraints	Silvercreek Parkway	375	472
WW6-1	Short-Term	Existing Capacity Constraints	College Ave	300 / 375	281
WW3-1	Short-Term	Existing Capacity Constraints	Exhibition Park / Kathleen St	450	926
WW2-1	Short-Term	Existing Capacity Constraints	Victoria Rd and Waverley Dr	300 / 375	1032
WW1-2	Short-Term	Existing Capacity Constraints	Westwood Rd	300	82
WW2-4	Mid-Term	Growth	Speedvale Ave	375	237
WW4-2	Mid-Term	Growth	York Rd and Beaumont Cres.	675 / 900	1364
WW5-2	Mid-Term	Growth	Waterloo Ave	825	528
WW7-1	Mid-Term	Growth	Clair Rd	250 / 300	834
WW5-3	Long-Term	Growth	Bristol St	600	1014

Table 9-13 Summary of Wastewater System Upgrades - Siphons

Project Number	Timing	Triggers	Location	Size (mm)	Length (m)
Siphons					
S1 - Manor Park Siphon	Long-Term	Operations	Manor Park Crescent / Speed River	-	-
S2 - Municipal Street Siphon	Long-Term	Operations	Municipal Street / Speed River	-	-
S3 - Alma Mercer	Long-Term	Operations	Alma Street North / Mercer Street	600	80
S4 - Elizabeth-Beaumont	Long-Term	Operations	Elizabeth Street North / Beaumont Crescent	450	22
S5 - Eramosa River	Long-Term	Operations	Eramosa River / Cutten Fields Golf Course	500	150
S6 - Hanlon-Massey-Campbell	Long-Term	Operations	Hanlon Parkway - Massey Road / Campbell Road	200 / 450	44
S7 - Ptarmigan	Long-Term	Operations	Ptarmigan Drive	150 / 200	324
S8 - Speed River Crane Park	Long-Term	Operations	Speed River - Crane Park	750 / 600 / 300	921
S9 - Stevenson-Eramosa	Long-Term	Operations	Stevenson Street North / Eramosa Road	200	23
S10 - Willow-Guelph	Long-Term	Operations	Willow Road / Guelph Street	750	19

10.0 Innovation

As part of the WWSMP, a strategy for innovation was developed and is summarized below. Additional details can be found in *Volume II: Innovation Strategy* TM.



The City is a forward-thinking organization that has had a history of innovation through the University of Guelph and other partners and programs. In 2019 the City, in partnership with Wellington County, were awarded grant funding for circular food economy titled "Our Food Future" through the Smart Cities Challenge. The WWSMP will continue in the spirit on the Smart Cities Challenge to pursue further innovative ideas to improve the level of service offered to the City.

Guelph's Future-Ready Strategic Plan (2019-2023), and the associated Future Ready Action Plan, provide a strong direction for innovation and were the catalyst for the recently developed City of Guelph Innovation Roadmap project (ref. An Innovation Framework and Implementation Plan for the City of Guelph | Project Summary Report, June 2022). The result is an implementation plan that serves to foster innovative practices within the City and in supporting the community.

In the process leading to the development of the recommended strategy for innovation, the City has indicated that their vision is to be *future-ready* and *best-in-class* in terms of service delivery. Furthermore, the City has been aligning its overall master planning program to a more integrated approach – where programs relating to water, wastewater and stormwater will be managed in a coordinated manner to realize enhanced performance and efficiencies in program delivery.

10.1 Existing System and Ongoing Innovation

10.1.1 Water Innovation

The City has invested in a number of technologies over the years to help monitor and maintain the water system. Approximately ten years ago the City was awarded grant funding from the "Showcasing Water Innovation" program to implement further monitoring in the water system. The program included the implementation of 28 district metered areas (DMAs) in the distribution system. The DMAs provide the City rapid feedback on the performance of the distribution system. Data collected includes pressure, flow and temperature at approximately 58 locations throughout the City. The City also implemented semi-permanent hydrant dataloggers that provide pressure and temperature data.

10.1.2 Wastewater Innovation

The City has taken steps towards innovation through the deployment of operator hand-held tablets with access to online digital records to facilitate information exchange and improved decision-making in the field. There is a searchable online database that houses engineering documents and drawings, which also allows external contractor access to support improved data sharing efficiencies. To gain better insights into the performance of the collection system, the City has undertaken temporary flow monitoring programs and has maintained a series of rain gauges to support the evaluation of infiltration and inflow (I/I) that is of concern due to observations at the plant. Operationally, staff continually review the latest trends in monitoring and performing maintenance activities, such as acoustic sounding for blockages in local sewers, and technology review for large diameter pipe inspections where the dry weather depth is greater than 80%.

10.2 Workshop Review

An Innovation Strategy Workshop was held with the City on September 12th, 2022. The goal of the workshop was to provide an opportunity for staff to provide feedback on potential innovation concepts that could be utilized in the City's water and wastewater systems to improve the level of service. City departments represented at the workshop included Water and Wastewater Operations, Infrastructure Planning, Design and Construction and Senior Management.

10.3 Integrating Innovation within Existing City Frameworks

One of the key goals of the WWSMP, is that it will continue in the spirit of the Smart Cities Challenge to pursue innovative and emerging ideas that touch on the economy, environment, governance and people in order to achieve a high quality of life for all the citizens and businesses of Guelph.

Figure 10-1 describes the framework under which the City's innovation strategy for water and wastewater servicing can be administered as a component of the City's planned integrated water management strategy – a "One-Water" approach that aligns with the Corporate Strategic Plan's vision and its main business drivers.

This represents a shift in thinking from typical drinking water-centric program to a *sustainable, balanced and integrated water management program*, shared by:

- Source water protection
- Drinking water
- Wastewater
- Stormwater

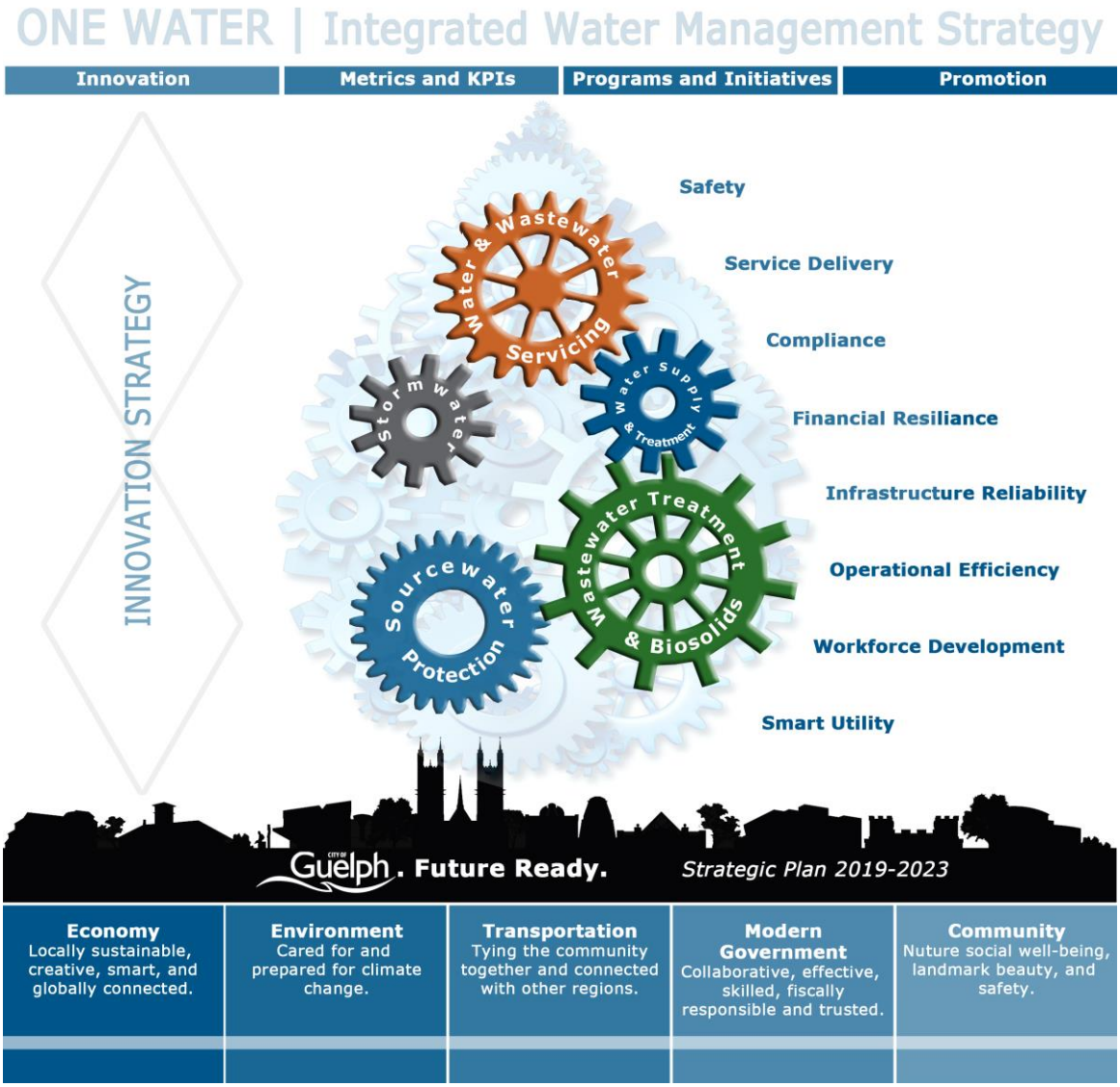
It also charts an easier pathway for:

- Delivering integrated programs with upfront planning

- Achieving budget and staffing efficiencies
- Consolidating a balanced perspective from water-related groups
- Innovating in a way that is directed by solid research and public interest

Through this framework the WWSMP (and its associated Innovation Strategy) will be represented as an integrated working group, directing the proposed Integrated Water Management Strategy. As shown in Figure 10-1, this strategy recognizes innovation (new initiatives, research, pilot projects/programs) as one of the key components and focus areas.

Figure 10-1 Framework for including the WWSMP in the City's Integrated Water Management Strategy



In this manner, innovation will be considered in parallel with the key business drivers that support the City's Corporate Strategic Plan. Working as an integrated working group that involves water-related disciplines will enable staff to provide oversight of the framework and deliver a cohesive strategy with coordinated and synergistic efforts for programs, research and pilot project initiatives.

The pursuit and/or adoption of an innovation must be accompanied by some form of a value proposition that identifies and measures potential risks and benefits. In some cases, proposed innovations will need to be tested or prototyped to understand if the impacts are as expected and that the recommended innovation is beneficial to the organization and community.

As such, the various innovative ideas that are brought forward for consideration as part of this strategy are each evaluated within an evaluation framework that assesses their merits relative to each of the business drivers depicted in Figure 10-1.

10.4 Evaluation of Innovation Ideas for Guelph

The following criteria were selected to evaluate innovation initiatives. These criteria align with the City's key business drivers:

- Safety
- Service delivery
- Compliance
- Financial resilience
- Infrastructure reliability
- Operational efficiency
- Workforce development
- Supports Smart City initiative

Table 10-1 summarizes the key initiatives and scoring rank for consideration as part of future integration of innovation in current business operations.

Table 10-1 Evaluation Summary of Innovation Initiatives

Innovation	System(s)	Score
Build on the existing leak detection program with extension of leak detection devices	Water	38
Establish a common/integrated data and analytics platform for all water related business functions (GIS, SCADA and cloud-based)	Water and Wastewater	37
Establish a long-term flow and level monitoring program	Wastewater	36
Development of a business case for advanced meter infrastructure (AMI)	Water	35

Innovation	System(s)	Score
Establish capacity assurance program with the development of a growth management tool	Water and Wastewater	33
Development of an automated demand prediction tool	Water	33
Establish a strategic I/I remediation program with cost-effectiveness and innovation as key guiding principles to achieve program objectives	Wastewater	32
Development of an automated water supply availability prediction model	Water	32
Develop flow prediction tools based on weather forecasts and system digital twin	Wastewater	29
Establish an integrated green infrastructure program as a multi-functional infrastructure solution	Wastewater	28
Development of a water system digital twin	Water	28
Wastewater energy transfer (wet) applications	Wastewater	27
Integration of real time GIS information into hydraulic models	Water	22

11.0 Capital Planning

The proposed Capital Plan is outlined in *Volume II TM4 Capital Infrastructure Funding and Risk Analysis (TM4)* provides a 25-year forecast of expected funding requirements to implement the capital works and associated studies recommended in the WWSMP. The forecast of funding requirements is provided to accommodate growth and intensification. The following sections provide cost estimates and details of the funding methodology applied for the water and wastewater requirements, as well as the prioritization and timing implications.

11.1 Funding Methodology

For each of the projects recommended through the WWSMP, cost estimates were developed and the proposed funding source was determined as either growth, non-growth or a split. The wastewater project funding sources were developed using a quantitative approach based on available pipe capacity described in Section 11.1.2 below. Due to the nature of water distribution systems, determining the available capacity of a watermain is not straightforward and therefore, the funding sources were determined using a qualitative methodology.

11.1.1 Water

The funding methodology employed for the water projects is a qualitative based approach. The approach reviewed two main questions;

1. Is the project required under existing conditions?
2. Is the project required to facilitate growth?

Each project was reviewed with the City's hydraulic model to answer these questions. If under existing conditions there was a water system deficiency and the project was required to remedy the concern, the allocation was considered non-growth. If the deficiency did not show up until growth was applied to the model, the project was considered a growth related project.

Where there was an advantage to both the existing conditions and to facilitate growth, the allocation was split between growth and non-growth.

If the project provided system redundancy and provided a benefit to both growth and non-growth the allocation was also split.

11.1.2 Wastewater

The funding methodology employed for the wastewater projects is a quantitative approach based on the peak flow observed in each of the sewers identified in the wastewater project list, under existing conditions and ultimate growth conditions (2051+). The approach considers the differences between the existing and ultimate wastewater collection system configuration and generated flows to quantify the existing and growth flow throughout.

The proportion of flow for each condition was then multiplied by the asset cost to calculate the total cost for each sewer segment that can be attributed to each condition. Then the total cost for each project was summarized for each, Existing, Growth and Residual Capacity. This resulted in a “weighted” cost allocation for each project by pipe segment.

11.2 Capital Projects Cost Estimates

Cost estimates and funding justification for each of the recommended water and wastewater infrastructure projects and presented in Table 11-1, and below, respectively. EA project schedules and justification have also been provided. Short term projects have been listed in order of prioritization.

11.3 Cost Estimates for Other Programs and Studies

A number of studies are recommended under the planning horizon of this WWSMP including 5-year updates to the WWSMP itself. Additional water studies include the Integrated Water Management study, a conceptual design and Schedule C EA for the Arkell Alternative and Schedule B EA for the Zone 2 ET. Recommended wastewater studies include preliminary studies for system improvements in specific areas and annual flow monitoring and I/I studies. These are summarized in Table 11-4 below.

Additionally, a number of pilot programs from the Innovation Strategy were recommended in Section 10.0. Cost estimates have been developed for these programs and are summarized in Table 11-5 below.

Table 11-1 Water Capital Projects Summary- Facilities

Project Number	Timing	Triggers/Sequencing	Location	Summary of Upgrades	Purpose	Cost***	Land Costs(1)	Funding Type	% Growth Related	Funding Type Justification	EA Schedule	EA Schedule Justification
Facilities												
F-1	Short-Term	Ongoing	Woods WTP	Upgrades to pump station, dual discharge feedermains. Upgrades to office spaces.	Replace aging infrastructure and improve redundancy within facility.	N/A*		N/A*	N/A*	N/A*	N/A*	N/A*
F-2	Short-Term	Ongoing	Clythe WTP. PS and Reservoir	New WTP, Pump Station and 6.9 ML Reservoir	Bring Clythe Well online. Increase storage in Zone 2 and pump capacity on east side of Zone 2.	N/A*		N/A*	N/A*	N/A*	N/A*	N/A*
F-4	Short-Term	Prior to Clythe Upgrades (F-2)	Park Zone 2 PS	New PS at Park Wells Site	Supply to the east side of Zone 2	$2,600,000		Non-Growth	0%	Address existing Criticality of Clythe PS	A	Increasing pumping station flexibility by adding or replacing equipment where new equipment is located within an existing building or structure;
F-3	Short-Term	In the Proposal Stage	Verney BPS	New BPS to replace existing Robertson	Increase pump capacity	$7,600,000		Growth/Non-Growth	50%	Increase Pump Supply to meet future growth and address deficiencies of existing station.	B	Already completed (GMBP, 2021)
F-5	Mid-Term	Clair Maltby ET	Clair BPS	Retrofit Existing PS	Replace existing pumps with suitable size once Clair Maltby ET is online.	$400,000		Growth	100%	Supply future Zone 3 growth	n/a	Retrofit within existing building. No capacity increase.

Project Number	Timing	Triggers/Sequencing	Location	Summary of Upgrades	Purpose	Cost***	Land Costs(1)	Funding Type	% Growth Related	Funding Type Justification	EA Schedule	EA Schedule Justification
Facilities												
W-S-1	Mid-Term	Speedvale ET Lifecycle	North end of Zone 2.	6ML Elevated Tank	New ET to Improve Zone 2 floating storage. Increased volume and improved location.	$10,500,000	$125,000	Growth	100%	Improve Zone 2 Floating Storage to supply future growth	B	Establish new or expand/replace existing water storage facilities.
Arkell Alt 4B2	Short-Term	Existing Criticality	New Arkell PS, Reservoir and WM	New PS, Reservoir and Watermain	Transfer water from Arkell/Carter Wellfields supply redundancy/resiliency	$110,400,000	$550,000	Growth/Non-Growth	50%	Address existing criticality of Arkell Aqueduct. Improves supply to south end to meet growth.	C	Construct new water treatment plant.

Table 11-2 Water Capital Projects Summary- Watermains

Project Number	Timing	Triggers	Location	Size (mm)	Length (m)	Purpose	Cost**	Funding Type	% Growth Related	Funding Type Justification	EA Sched.	EA Schedule Justification
Watermains												
W-8	Short-Term	Existing Criticality and Growth	Speedvale from Edinburgh to Manhattan	400	2150	Complete east/west Speedvale transmission main.	$3,400,000	Growth/Non-Growth	50%	Improve existing east-west limitations in Zone 2 and Zone 2 growth	A	Within existing road right-of-way. Presented at PIC2.
W-M-24	Short-Term	W-8	Speedvale from Westmount to east of Woolwich	200	930	Improve watermain capacity near Robertson PS discharge	$800,000	Growth/Non-Growth	50%	Address existing capacity constraints and meet growth requirements.	A	Within existing road right-of-way. Presented at PIC2.
W-M-19	Short-Term	W-8	Speedvale from East of Woolwich to Stevenson	200	1020	Improved transmission north end of Zone 1 and connectivity to Stevenson	$900,000	Growth/Non-Growth	50%	Address existing capacity constraints and meet growth requirements.	A	Within existing road right-of-way. Presented at PIC2.
W-M-16	Short-Term	Existing Criticality/ Growth	Gordon from York to University	300	1110	Reduce criticality of University River Crossing.	$1,400,000	Growth/Non-Growth	50%	Address existing river crossing criticality. Improved capacity to supply growth	A	Within existing road right-of-way. Presented at PIC2.
W-CI-1a	Short-Term	Existing Capacity Constraints	Small Diameter CI WMs throughout system	150	13600	Improve existing fire flow constraints	$10,400,000	Non-Growth	0%	Address existing WM capacity constraints	A	Within existing road right-of-way. Presented at PIC2.
W-2	Short-Term	Growth	York from Brockville to Watson	600	2500	Improve connectivity to Clythe PS fill.	$6,700,000	Growth	100%	Improve Zone 1 feedermain capacity to service growth in Zones 1 and 2	A	Within existing road right-of-way. Presented at PIC2.
W-M-26	Short-Term	W-2	York Road from Brockville to Clythe PS	300	450	Improve HL and FF	$500,000	Growth/Non-Growth	50%	Address existing capacity constraints and meet growth requirements.	A	Within existing road right-of-way. Presented at PIC2.

Project Number	Timing	Triggers	Location	Size (mm)	Length (m)	Purpose	Cost**	Funding Type	% Growth Related	Funding Type Justification	EA Sched.	EA Schedule Justification
Watermains												
W-11	Short-Term	Verney BPS (F-3)	Exhibition from Robertson/Verney PS to Speedvale	400	375	Improve watermain capacity at Verney PS discharge	$600,000	Growth	100%	Improve Zone 2 feedermain capacity to service growth in Zone 2	A	Within existing road right-of-way. Presented at PIC2.
W-M-20	Short-Term	Existing Capacity Constraints	University/College from River Crossing to Edinburgh	200	1760	Improve Capacity and Looping in University Area	$1,500,000	Non-Growth	0%	Address existing capacity constraints in Old University Area	A	Within existing road right-of-way. Presented at PIC2.
W-M-17	Short-Term	Existing Capacity Constraints	Dufferin from Mac to London	200	1300	Connectivity between London and Woolwich. Local FF improvements.	$1,100,000	Non-Growth	0%	Existing FF Improvement	A	Within existing road right-of-way. Presented at PIC2.
W-M-18	Short-Term	Existing Capacity Constraints	Delhi from Eramosa to existing 250mm	250	690	Connectivity between W-1 on Eramosa and Verney Feedermain. Improve fire flow capacity to Hospital	$600,000	Non-Growth	0%	Existing FF Improvement	A	Within existing road right-of-way. Presented at PIC2.
W-M-23	Short-Term	Existing Capacity Constraints	Talbot/Forest Hill from Water to University	200	850	Improve Capacity and Looping in University Area	$700,000	Non-Growth	0%	Address existing capacity constraints in Old University Area	A	Within existing road right-of-way. Presented at PIC2.
W-M-21	Short-Term	Existing Capacity Constraints	Water/Albert from River Crossing to Gordon	200	790	Improve Capacity and Looping in University Area	$700,000	Non-Growth	0%	Address existing capacity constraints in Old University Area	A	Within existing road right-of-way. Presented at PIC2.
W-M-22	Short-Term	Existing Capacity Constraints	Dean from Edinburgh to Talbot	200	520	Improve Capacity and Looping in University Area	$400,000	Non-Growth	0%	Address existing capacity constraints in Old University Area	A	Within existing road right-of-way. Presented at PIC2.
W-M-1	Short-Term	Existing Capacity/Growth	Woolwich from Norfolk to Macdonnell	300	930	Improve Downtown Looping	$1,000,000	Growth/Non-Growth	50%	Address existing FF and HL through DT core and improve capacity for future growth	A	Within existing road right-of-way. Presented at PIC2.

Project Number	Timing	Triggers	Location	Size (mm)	Length (m)	Purpose	Cost**	Funding Type	% Growth Related	Funding Type Justification	EA Sched.	EA Schedule Justification
Watermains												
W-M-3	Short-Term	Existing Capacity/Growth	Wyndham from Woolwich to Carden	300	480	Local Downtown Improvements	$500,000	Growth/Non-Growth	50%	Address existing FF and HL through DT core and improve capacity for future growth	A	Within existing road right-of-way. Presented at PIC2.
W-12	Short-Term	Clythe PS (F-2) and Zone Boundary Change	Watson from Clythe PS to Grange	600	760	Improve watermain capacity at Clythe PS discharge	$2,000,000	Growth/Non-Growth	50%	Required for Zone boundary change to address existing high pressures. Required increased capacity for Clythe upgrades to meet growth in area.	A	Within existing road right-of-way. Presented at PIC2.
W-M-6	Short-Term	Existing Capacity/Growth	Waterloo from Yorkshire to Essex	300	500	Improve Downtown Looping	$500,000	Growth/Non-Growth	50%	Address existing FF and HL through DT core and improve capacity for future growth	A	Within existing road right-of-way. Presented at PIC2.
W-M-13	Short-Term	Growth	Wellington from Gordon to Neeve	300	480	Improve Downtown Looping	$500,000	Growth	100%	Improve capacity for future growth	A	Within existing road right-of-way. Presented at PIC2.
W-5a	Short-Term	Existing Criticality	Imperial/Elmira from Paisley PS to Willow	400	1970	Redundancy for Paisley PS discharge.	$3,100,000	Growth/Non-Growth	50%	Addresses existing criticality of Paisley PS discharge and Zone 2 growth	A	Within existing road right-of-way. Presented at PIC2.
W-3	Short-Term	Growth	Paisley from Hanlon to Paisley PS	400	400	Improve Connectivity to Paisley PS fill.	$600,000	Growth	100%	Improve Zone 1 feedermain capacity to service growth in Zones 1 and 2	A	Within existing road right-of-way. Presented at PIC2.
W-CI-1b	Short-Term	Existing Capacity Constraints	Small Diameter CI WMs throughout system	150	28000	Improve existing fire flow constraints	$21,500,000	Non-Growth	0%	Address existing WM capacity constraints	A	Within existing road right-of-way. Presented at PIC2.

Project Number	Timing	Triggers	Location	Size (mm)	Length (m)	Purpose	Cost**	Funding Type	% Growth Related	Funding Type Justification	EA Sched.	EA Schedule Justification
Watermains												
W-1a	Short-Term	Growth	Yorkshire from Wellington to London and Exhibition	600	1850	Improves downtown looping and connectivity to Verney ET.	$4,900,000	Growth	100%	Improve Zone 1 feedermain capacity to service growth in Zones 1 and 2	A	Within existing road right-of-way. Presented at PIC2.
W-1b	Short-Term	Growth	Exhibition from London to Verney	600	940	Improves downtown looping and connectivity to Verney ET.	$2,500,000	Growth	100%	Improve Zone 1 feedermain capacity to service growth in Zones 1 and 2	A	Within existing road right-of-way. Presented at PIC2.
W-M-15	Short-Term	Growth	Woolwich from London to Norwich	300	210	Improve Downtown Looping. Connection to W-1	$200,000	Growth	100%	Improve capacity for future growth	A	Within existing road right-of-way. Presented at PIC2.
W-M-2	Short-Term	Existing Capacity/Growth	Cardigan from Norwich to Woolwich	200	260	Local Downtown Improvements	$200,000	Growth/Non-Growth	50%	Address existing FF and HL through DT core and improve capacity for future growth	A	Within existing road right-of-way. Presented at PIC2.
W-M-4	Short-Term	Existing Capacity/Growth	Macdonell from Norfolk to Carden	200	440	Local Downtown Improvements	$400,000	Growth/Non-Growth	50%	Address existing FF and HL through DT core and improve capacity for future growth	A	Within existing road right-of-way. Presented at PIC2.
W-M-5	Short-Term	Existing Capacity/Growth	Dublin from Waterloo to Wellington	200	400	Local Downtown Improvements	$300,000	Growth/Non-Growth	50%	Address existing FF and HL through DT core and improve capacity for future growth	A	Within existing road right-of-way. Presented at PIC2.
W-M-7	Short-Term	Growth	Yarmouth from Woolwich to Quebec	200	320	Local Downtown Improvements	$300,000	Growth	100%	Improve capacity for future growth	A	Within existing road right-of-way. Presented at PIC2.
W-M-9	Short-Term	Growth	Essex from Dublin to Waterloo	200	170	Local Downtown Improvements	$100,000	Growth	100%	Improve capacity for future growth	A	Within existing road right-of-way. Presented at PIC2.

Project Number	Timing	Triggers	Location	Size (mm)	Length (m)	Purpose	Cost**	Funding Type	% Growth Related	Funding Type Justification	EA Sched.	EA Schedule Justification
Watermains												
W-M-10	Short-Term	Growth	Nottingham from Dublin to Gordon	200	180	Local Downtown Improvements	$200,000	Growth	100%	Improve capacity for future growth	A	Within existing road right-of-way. Presented at PIC2.
W-M-11	Short-Term	Growth	Fountain from Dublin to Neeve	200	550	Local Downtown Improvements	$500,000	Growth	100%	Improve capacity for future growth	A	Within existing road right-of-way. Presented at PIC2.
W-M-12	Short-Term	Growth	Surrey from Dublin to Neeve	200	610	Local Downtown Improvements	$500,000	Growth	100%	Improve capacity for future growth	A	Within existing road right-of-way. Presented at PIC2.
W-M-14	Short-Term	Growth	Duke from Alice to existing PVC	200	220	Local Downtown Improvements	$200,000	Growth	100%	Improve capacity for future growth	A	Within existing road right-of-way. Presented at PIC2.
W-M-8	Short-Term	Growth	Baker from Woolwich to Quebec	300	300	Local Downtown Improvements	$300,000	Growth	100%	Improve capacity for future growth	A	Within existing road right-of-way. Presented at PIC2.
W-1c	Mid-Term	Growth	London/Eramosa from Exhibition to Stevenson	400	2140	Improves downtown looping and connectivity to Verney ET. Reduces high headloss associated with future growth.	$3,600,000	Growth	100%	Improve Zone 1 feedermain capacity to service growth in Zones 1 and 2	A	Within existing road right-of-way. Presented at PIC2.
W-4a	Mid-Term	Arkell PS and Growth	Arkell from Gordon to Victoria	600	1600	Improve connectivity between future Arkell PS and Clair ET.	$4,300,000	Growth	100%	Improve Zone 1 feedermain capacity to service growth in Zones 1 and 3	A	Within existing road right-of-way. Presented at PIC2.
W-5b	Mid-Term	Zone 2 ET	Elmira from Speedvale to Willow	400	800	Redundancy for Paisley PS discharge.	$1,300,000	Growth/Non-Growth	50%	Addresses existing criticality of Paisley PS discharge and Zone 2 growth	A	Within existing road right-of-way.

Project Number	Timing	Triggers	Location	Size (mm)	Length (m)	Purpose	Cost**	Funding Type	% Growth Related	Funding Type Justification	EA Sched.	EA Schedule Justification
Watermains												
												Presented at PIC2.
W-6a	Mid-Term	Zone 2 ET	Woodlawn from Elmira to Silvercreek	400	2030	Improve East/West transmission. Reduce criticality of Paisley and Clythe PSs. Redundancy for Speed River Crossing.	$3,200,000	Growth	100%	Improve Zone 2 feedermain capacity to service growth in Zone 2	A	Within existing road right-of-way. Presented at PIC2.
W-13	Mid-Term	Zone 2 ET	Silvercreek from Woodlawn to Proposed Zone 2 ET	400	900	Connection to proposed Zone 2 ET	$1,600,000	Growth	100%	Improve Zone 2 feedermain capacity to service growth in Zone 2	A	Within existing road right-of-way. Presented at PIC2.
W-4b	Long Term	Growth	Gordon from Arkell to Clair	600	1760	Improve connectivity between future Arkell PS and Clair ET.	$4,700,000	Growth	100%	Improve Zone 1 feedermain capacity to service growth in Zones 1 and 3	A	Within existing road right-of-way. Presented at PIC2.
W-4c	Long Term	Growth	Clair from Gordon to ET	600	1200	Improve connectivity between future Arkell PS and Clair ET.	$3,200,000	Growth	100%	Improve Zone 1 feedermain capacity to service growth in Zones 1 and 3	A	Within existing road right-of-way. Presented at PIC2.
W-6b	Long Term	Growth	Woodlawn from Silvercreek to Woolwich	400	2160	Improve East/West transmission. Reduce criticality of Paisley and Clythe PSs. Redundancy for Speed River Crossing.	$3,400,000	Growth	100%	Improve Zone 2 feedermain capacity to service growth in Zone 2	A	Within existing road right-of-way. Presented at PIC2.
W-6c	Long Term	Growth	Woodlawn from Woolwich to Victoria	400	2022	Improve East/West transmission. Reduce criticality of Paisley and Clythe PSs. Redundancy for Speed River Crossing.	$3,400,000	Growth	100%	Improve Zone 2 feedermain capacity to service growth in Zone 2	A	Within existing road right-of-way. Presented at PIC2.
W-7	Long Term	Growth	Elmira from Speedvale to Woodlawn	400	1070	Improve system looping.	$1,700,000	Growth	100%	Improve Zone 2 feedermain capacity to	A	Within existing road right-of-way.

Project Number	Timing	Triggers	Location	Size (mm)	Length (m)	Purpose	Cost**	Funding Type	% Growth Related	Funding Type Justification	EA Sched.	EA Schedule Justification
Watermains												
										service growth in Zone 2		Presented at PIC2.
W-9	Long Term	Growth	Victoria from Speedvale to Woodlawn	400	1010	Improve system looping.	$1,600,000	Growth	100%	Improve Zone 2 feedermain capacity to service growth in Zone 2	A	Within existing road right-of-way. Presented at PIC2.
W-10	Long Term	Guelph Lake WTP	Victoria from Woodlawn to Goldenview Drive	400	1000	Connectivity to Guelph Lake supply.	$1,600,000	Growth	100%	Improve Zone 2 feedermain capacity to service growth in Zone 2	A	Within existing road right-of-way. Presented at PIC2.
W-M-25	Mid-Term	Clair Maltby ET	Crawley to Maltby	300	2130	Improve West Zone 3 Looping	$2,200,000	Growth	100%	Servicing Zone 3 Growth	A	Within existing road right-of-way. Presented at PIC2.
W-CI-2	Mid-Term	Existing Capacity Constraints	Small Diameter CI WMs throughout system	150	41600	Improve existing fire flow constraints	$32,000,000	Non-Growth	0%	Address existing WM capacity constraints	A	Within existing road right-of-way. Presented at PIC2.
W-CI-3	Long Term	Existing Capacity Constraints	Small Diameter CI WMs throughout system	150	41600	Improve existing fire flow constraints	$32,000,000	Non-Growth	0%	Address existing WM capacity constraints	A	Within existing road right-of-way. Presented at PIC2.
Water Infrastructure Total							**$301,300,000**					

*Costs not included for projects previously approved through WSMP.
** Watermain unit costs include 20% Contingency and 15% Engineering
***Facility costs include 50% Contingency and 15% Engineering
(1) Included in total cost

Table 11-3 Wastewater Capital Projects Summary- Sewers

Project Number	Timing	Triggers	Location	Size (mm)	Length (m)	Purpose	Cost	Funding Type	% Existing Needs	% Growth Related	% Residual Capacity	Funding Type Justification	EA Schedule	EA Schedule Justification
Sewers														
WW5-1	Short-Term	Existing Capacity Constraints	York Rd and Wellington St	1200 / 1350	3284	Capacity	$27,820,000	Non-Growth	85%	17%	6%	Address Existing Capacity Constraint	A or B	Possible work outside of existing right-of-way
WW4-4	Short-Term	Existing Capacity Constraints	Victoria Rd	375	777	Capacity	$4,350,000	Non-Growth	57%	1%	43%	Address Existing Capacity Constraint / Meet Design guidelines	A	Within existing right-of-way
WW2-3	Short-Term	Existing Capacity Constraints	Wilton Rd, Inverness Dr and Speedvale Ave	150 / 300 / 375	1128	Capacity	$3,640,000	Growth / Non-Growth	59%	1%	41%	Address Existing Capacity Constraint	A	Within existing right-of-way
WW5-4	Short-Term	Existing Capacity Constraints	Quebec St and Wyndham St	375 - 600	1066	Capacity	$5,450,000	Non-Growth	68%	10%	23%	Address Existing Capacity Constraint / Meet Design guidelines	A	Within existing right-of-way
WW4-1	Short-Term	Existing Capacity Constraints	Audin Rd and Victoria Rd	300 / 375	186	Capacity	$680,000	Growth / Non-Growth	45%	1%	54%	Address Existing Capacity Constraint	A	Within existing right-of-way
WW2-2	Short-Term	Existing Capacity Constraints	Waverley Dr and Stevenson St	375 / 450	1593	Capacity	$5,260,000	Non-Growth	84%	0%	18%	Address Existing Capacity Constraint	A	Within existing right-of-way
WW5-6	Short-Term	Existing Capacity Constraints	Waterloo Ave	300	166	Capacity	$510,000	Non-Growth	71%	6%	24%	Address Existing Capacity Constraint	A	Within existing right-of-way
WW5-5	Short-Term	Existing Capacity Constraints	Woolwhich St	300	167	Capacity	$510,000	Non-Growth	52%	9%	40%	Address Existing Capacity Constraint / Meet Design guidelines	A	Within existing right-of-way

Project Number	Timing	Triggers	Location	Size (mm)	Length (m)	Purpose	Cost	Funding Type	% Existing Needs	% Growth Related	% Residual Capacity	Funding Type Justification	EA Schedule	EA Schedule Justification
WW4-5	Short-Term	Existing Capacity Constraints	Summit Ridge Dr	300	173	Capacity	$530,000	Non-Growth	44%	0%	56%	Address Existing Capacity Constraint	A	Within existing right-of-way
WW1-1	Short-Term	Existing Capacity Constraints	Silvercreek Parkway	375	472	Capacity	$3,340,000	Growth / Non-Growth	68%	5%	26%	Address Existing Capacity Constraint	A	Within existing right-of-way
WW6-1	Short-Term	Existing Capacity Constraints	College Ave	300 / 375	281	Capacity	$850,000	Non-Growth	64%	9%	27%	Address Existing Capacity Constraint	A	Within existing right-of-way
WW3-1	Short-Term	Existing Capacity Constraints	Exhibition Park / Kathleen St	450	926	Capacity	$3,110,000	Growth / Non-Growth	76%	3%	20%	Address Existing Capacity Constraint / Meet Design guidelines	A	Within existing right-of-way
WW2-1	Short-Term	Existing Capacity Constraints	Victoria Rd and Waverley Dr	300 / 375	1032	Capacity	$3,240,000	Non-Growth	67%	0%	33%	Address Existing Capacity Constraint	A	Within existing right-of-way
WW1-2	Short-Term	Existing Capacity Constraints	Westwood Rd	300	82	Capacity	$2,710,000	Growth	0%	100%	0%	Improve capacity for future growth	A	Within existing right-of-way
WW2-4	Mid-Term	Growth	Speedvale Ave	375	237	Capacity	$930,000	Growth	0%	100%	0%	Improve capacity for future growth	A	Within existing right-of-way
WW4-2	Mid-Term	Growth	York Rd and Beaumont Cres.	675 / 900	1364	Capacity / Operational	$8,460,000	Non-Growth	0%	100%	0%	Improve capacity for future growth / operational improvements	A	Within existing right-of-way
WW5-2	Mid-Term	Growth	Waterloo Ave	825	528	Capacity	$2,660,000	Growth / Non-Growth	0%	100%	0%	Improve capacity for future growth / operational improvements	A	Within existing right-of-way
WW7-1	Mid-Term	Growth	Clair Rd	250 / 300	834	Capacity	$2,370,000	Growth	0%	100%	0%	Improve capacity for future growth	A	Within existing right-of-way

Project Number	Timing	Triggers	Location	Size (mm)	Length (m)	Purpose	Cost	Funding Type	% Existing Needs	% Growth Related	% Residual Capacity	Funding Type Justification	EA Schedule	EA Schedule Justification
WW5-3	Long-Term	Growth	Bristol St	600	1014	Capacity	$3,680,000	Growth / Non-Growth	0%	100%	0%	Improve capacity for future growth / operational improvements	A	Within existing right-of-way
Siphons														
S1 - Manor Park Siphon	Long-Term	Operations	Manor Park Crescent / Speed River	-	-	Operational / Redundancy	$1,500,000	Non-Growth	100%	0%	-	Previous Assessment	A	Within existing utility corridor
S2 - Municipal Street Siphon	Long-Term	Operations	Municipal Street / Speed River	-	-	Operational / Redundancy	$4,000,000	Non-Growth	99%	1%	-	Previous Assessment	A	Gravity improvements within existing right-of-way
S3 - Alma Mercer	Long-Term	Operations	Alma Street North / Mercer Street	600	80	Operational / Redundancy	$270,000	Non-Growth	91%	9%	-	To be monitored and assessed if/as needed	A	Within existing right-of-way
S4 - Elizabeth-Beaumont	Long-Term	Operations	Elizabeth Street North / Beaumont Crescent	450	22	Operational / Redundancy	$210,000	Non-Growth	90%	10%	-	To be monitored and assessed if/as needed	A	Within existing utility corridor
S5 - Eramosa River	Long-Term	Operations	Eramosa River / Cutten Fields Golf Course	500	150	Operational / Redundancy	$1,460,000	Non-Growth	99%	1%	-	To be monitored and assessed if/as needed	A	Within existing utility corridor
S6 - Hanlon-Massey-Campbell	Long-Term	Operations	Hanlon Parkway - Massey Road / Campbell Road	200 / 450	44	Operational / Redundancy	$400,000	Non-Growth	95%	5%	-	To be monitored and assessed if/as needed	A	Within existing utility corridor
S7 - Ptarmigan	Long-Term	Operations	Ptarmigan Drive	150 / 200	324	Operational / Redundancy	$2,620,000	Non-Growth	92%	8%	-	To be monitored and assessed if/as needed	A	Within existing utility corridor
S8 - Speed River Crane Park	Long-Term	Operations	Speed River - Crane Park	750 / 600 / 300	921	Operational / Redundancy	$9,090,000	Non-Growth	64%	36%	-	To be monitored and assessed if/as needed	A	Within existing utility corridor
S9 - Stevenson-Eramosa	Long-Term	Operations	Stevenson Street North / Eramosa Road	200	23	Operational / Redundancy	$40,000	Non-Growth	95%	5%	-	To be monitored and assessed if/as needed	A	Within existing right-of-way

Project Number	Timing	Triggers	Location	Size (mm)	Length (m)	Purpose	Cost	Funding Type	% Existing Needs	% Growth Related	% Residual Capacity	Funding Type Justification	EA Schedule	EA Schedule Justification
S10 - Willow-Guelph	Long-Term	Operations	Willow Road / Guelph Street	750	19	Operational / Redundancy	$80,000	Non-Growth	92%	8%	-	To be monitored and assessed if/as needed	A	Within existing right-of-way
Wastewater Infrastructure Total							**$99,770,000**							

*A is Exempt under 2023 MEA Amendment

Table 11-4 Studies Summary

Project Number	Timing	Triggers/Sequencing	Description	Cost	Funding Type	% Growth Related	Justification	EA Schedule	EA Schedule Justification
MP-1	Short-Term	5 yr update	Water and Wastewater Servicing Master Plan: 5yr Update	$700,000	Growth/Non-Growth	50%*	Study existing constraints and plan for growth	B	
MP-2	Mid-Term	5 yr update	Water and Wastewater Servicing Master Plan: 10yr Update	$800,000	Growth/Non-Growth	50%*	Study existing constraints and plan for growth	B	
MP-3	Mid-Term	5 yr update	Water and Wastewater Servicing Master Plan: 15yr Update	$900,000	Growth/Non-Growth	50%*	Study existing constraints and plan for growth	B	
MP-4	Mid-Term	5 yr update	Water and Wastewater Servicing Master Plan: 20yr Update	$1,000,000	Growth/Non-Growth	50%*	Study existing constraints and plan for growth	B	
MP-5	Long-Term	5 yr update	Water and Wastewater Servicing Master Plan: 25yr Update	$1,100,000	Growth/Non-Growth	50%*	Study existing constraints and plan for growth	B	
MP-6	Long-Term	5 yr update	Water and Wastewater Servicing Master Plan: 30yr Update	$1,200,000	Growth/Non-Growth	50%*	Study existing constraints and plan for growth	B	
WS-1	Short-Term		Integrated Water Management	$300,000	Growth/Non-Growth	50%*	Study existing constraints and plan for growth	N/A	
WS-2	Short-Term	Short-term for existing criticality	Arkell Conceptual Design and Schedule C EA	$600,000	Growth/Non-Growth	50%	Address existing criticality of Arkell Aqueduct. Improves supply to south end to meet growth.	C	Construct new water treatment plant.
WS-3	Short-Term	Short-term to secure land	Zone 2 ET Schedule B EA	$200,000	Non-Growth	100%	Improve Zone 2 Floating Storage to supply future growth	B	Establish new or expand/replace existing water storage facilities
WWS-1	Short-Term	Required to further scope upgrades	Preliminary Study - Area 5	$100,000	Growth / Non-Growth	50%*	Preliminary studies for system improvements	B	
WWS-2	Short-Term	Required to further scope upgrades	Preliminary Studies (6 areas)	$300,000	Growth / Non-Growth	50%*	Preliminary studies for system improvements	B	
WWS-2	Short-Term	Required to further scope upgrades	Environmental Approvals and Mitigation	$1,050,000	Growth / Non-Growth	50%*	Preliminary studies for system improvements	B	
WWFM1	Short-Term	Annual Data Collection	Annual Flow Monitoring / I/I Studies (10 Years)	$500,000	Growth / Non-Growth	50%*	Data Collection for MP Updates	N/A	
WWFM2	Mid-Term	Annual Data Collection	Annual Flow Monitoring / I/I Studies (10 Years)	$500,000	Growth / Non-Growth	50%*	Data Collection for MP Updates	N/A	
WWFM3	Long-Term	Annual Data Collection	Annual Flow Monitoring / I/I Studies (10 Years)	$500,000	Growth / Non-Growth	50%*	Data Collection for MP Updates	N/A	
Studies Total				**$9,750,000**					

*Needed for growth but may not be included under Bill-23.

Table 11-5 Pilot Projects

Project Number	Timing	Triggers/Sequencing	Description	Cost	Funding Type	% Growth Related	Justification	EA Schedule
Pilot-1	Short-Term	n/a	Advanced Metering Infrastructure Business Case	$100,000	Growth	100%	Provide accurate real-time data for customer and municipal decision making and more equitable cost sharing	N/A
Pilot-2	Short-Term	n/a	Integrated Water Management and Analytics Platform Plan Development	$50,000	Growth	100%	Tool to help make better decisions by leveraging the data currently being gathered and stored in databases.	N/A
Pilot-3	Short-Term	n/a	Demand Prediction Tool Development	$50,000	Growth	100%	Development of a tool to help predict future water demand utilizing existing data streams.	N/A
Pilot-4	Short-Term	n/a	Water Availability Supply Capacity Model Development	$50,000	Growth	100%	Build on Water Services existing tool with an automated system reporting on the available capacity now and in the future.	N/A
Pilot-5	Short-Term	n/a	Leak Detection Pilot	$250,000	Growth	100%	Further the existing program through the testing of technology to identify and locate leaks.	N/A
Pilot-6	Short-Term	n/a	Development of a Digital Twin	$75,000	Growth	100%	Help to optimize operations and better prepare for emergency events	N/A
Pilot Programs Total				**$575,000**				

11.4 Risk Analysis

The *TM4* provides a vision of how the recommended projects will be supported as the City grows. The intent is to maintain or improve the existing and/or future level of service to the residents and businesses that reside within the City. Notwithstanding this plan, it is a worthwhile and prudent exercise to explore the risks associated with deviations to the implementation plan. The following sections present topics aligned to risk associated with the implementation plan with regards to:

- Prioritization plan for the identified infrastructure recommendations
- Potential impacts of climate change on the effectiveness of the recommendations
- Lifecycle extension activities

11.4.1 Risk Analysis and Priority Projects

It is appreciated that funding availability and capital investment priorities can change. The risk analysis and priority projects have been identified to further establish an understanding of the triggers and requirements that best serve the City's needs and enhance the level of service provided. This discussion is provided as an iteration to that produced in the WWSMP. This plan should be updated as components of the City's Official Plan progress, and at minimum after each capital project is further assessed and confirmed, and then implemented.

11.4.1.1 Water Projects Prioritization Risk Analysis

The City's water system is a well-designed robust system able to handle many types of planned maintenance activities and emergencies. Interconnectivity between pressure zones, large redundant watermains and significant storage are just some examples of how the system has been planned with redundancy and safety of supply and distribution in mind. Several key projects of the City's capital plan have been highlighted below.

The criticality analysis identified the Arkell Aqueduct as a key component currently lacking redundancy. The Aqueduct is a single supply line between the Arkell water sources and the Woods WTP that provides between 60-80% of the City's water. Portions of the aqueduct need rehabilitation. The aqueduct is also located in difficult to access locations and repairs would be difficult should a break occur. A project has been identified that will provide a secondary supply line from the Arkell sources to the City. Failure to provide a redundant system will put the City at risk of losing water supply within 24 hours should the existing aqueduct fail.

The existing water system is reliant on pumped storage through reservoirs, with approximately 80% of the storage located at ground level. It is important that the proposed elevated tanks for Zone 2 and Zone 3 are completed to maintain a portion of elevated water storage. As the system and demands grow, additional stress is placed on the water system and the time to react is reduced during emergencies. Elevated tanks provide system redundancy during power failures and other emergencies. They also provide a release to system pressures when pumps are stopped and started or

other changes in the water system occur, protecting the assets and reducing leakage and ultimately watermain breaks. If these projects are not completed as anticipated, the water system will be stressed further by growth and operations will be challenged in responding quickly to emergency situations.

There are a significant number of old, small diameter cast iron watermains, some as small as 100 mm. Replacement of cast iron watermains has been recommended as part of the capital plan. Generally, areas with small cast iron watermains have limited capacities due to tuberculation in the watermains. Over the years fire flow requirements have changed and the minimum watermain diameter has been increased to 150mm. The combination of reduced capacity due to tuberculation and additional fire flow requirements have left several areas within the City with reduced fire flows. As the watermains continue to age there will be further reduction in capacity and a risk of reduced fire flows. The replacement of these smaller cast iron watermains should remain a priority.

11.4.1.2 Wastewater Projects Prioritization Risk Analysis

There are a total of 19 projects identified (excluding siphons upgrades), and of those, 14 are required under existing conditions (short term), 4 are required in the mid-term (2041 – 2051), and 1 is required in the long-term (2051+). Additionally, preliminary studies to expand the recommended capital improvement are recommended. These also may trigger EAs depending on the approach ultimately selected.

The risks associated with not constructing the recommended projects following the identified timelines are similar for each of the projects but vary in magnitude. The projects recommended in this study are needed to prevent surcharge in the associated project areas and maintain the City's targeted level of service. The impact of surcharge will vary depending on the severity of surcharge, as well as the depth of the connected sewers and sewer services upstream.

A qualitative prioritization risk rating has been assigned to each project. This rating considers the recommended timing of the project (needed under existing conditions, triggered by growth, or identified as an operational improvement), severity of the surcharge identified, and presence of freeboard. In general, the following rating logic is applied:

- **Risk rating = High:** Project or recommendation is identified as needed immediately (i.e., short-term) to provide the City's target level of service to existing properties. Generally, they have higher surcharge depths, reduced available freeboard. The expected impact of not implementing the recommendation is an expected increase in basement and/or surface flooding risk.
- **Risk rating = Moderate:** Project or recommendation is needed immediately (i.e., short-term) to provide the City's target level of service to existing properties. The

expected impact of not implementing the recommendation is limited compared to the high priority projects, due to expected lower surcharge states, and/or the presence of freeboard that may provide additional protection to existing properties. These projects may also be triggered by operational interests. Note that all siphon upgrades have been given a rating of Moderate-Low as these are all triggered by redundancy and guideline compliance interests. It is recommended that inspection and maintenance of these locations be prioritized to maintain an understanding of their performance and adjust the criticality and priority ratings, if needed.

- **Risk rating = Low:** Project or recommendation is dependent on growth occurring (i.e., mid-term or long-term).

The rating assigned to each of the wastewater projects is described in Table 11-6 below.

Table 11-6 Wastewater Projects Prioritization Risk

Priority Rating	Project Number	Timing	Triggers	Location	Surcharge (approx.)	Freeboard (approx.)	Additional Comment
Moderate	WW1-1	Short-Term	Existing Capacity Constraints	Silvercreek Parkway	250mm	2.0m	
Low	WW1-2	Short-Term	Existing Capacity Constraints	Westwood Rd			Minor surcharge at 1 MH
Moderate-Low	WW2-1	Short-Term	Existing Capacity Constraints	Victoria Rd and Waverley Dr	250mm	1.8m	
Moderate	WW2-2	Short-Term	Existing Capacity Constraints	Waverley Dr and Stevenson St	650mm	1.3m	
High	WW2-3	Short-Term	Existing Capacity Constraints	Wilton Rd, Inverness Dr and Speedvale Ave			Shallow sewer – Adjacent to Speed River
Low	WW2-4	Mid-Term	Growth	Speedvale Ave			Minor surcharge at 1 MH
Moderate	WW3-1	Short-Term	Existing Capacity Constraints	Exhibition Park / Kathleen St	225mm	1.5m	
Moderate	WW4-1	Short-Term	Existing Capacity Constraints	Audin Rd and Victoria Rd	800mm	2.0m	
Low	WW4-2	Mid-Term	Growth	York Rd and Beaumont Cres.			Minor surcharge at 1 MH
High	WW4-4	Short-Term	Existing Capacity Constraints	Victoria Rd	500mm	<1.8m	Shallow sewer – limited freeboard
Moderate	WW4-5	Short-Term	Existing Capacity Constraints	Summit Ridge Dr	500mm	3.0m	
High	WW5-1	Short-Term	Existing Capacity Constraints	York Rd and Wellington St	900mm	1.3m	Shallow sewer – Adjacent to Speed River
Low	WW5-2	Mid-Term	Growth	Waterloo Ave			Minor surcharge at 1 MH
Low	WW5-3	Long-Term	Growth	Bristol St			Operational triggered and Long-term
Moderate	WW5-4	Short-Term	Existing Capacity Constraints	Quebec St and Wyndham St	1900mm	0.9m	
Moderate	WW5-5	Short-Term	Existing Capacity Constraints	Woolwhich St	500mm	2.4m	
Moderate	WW5-6	Short-Term	Existing Capacity Constraints	Waterloo Ave	600mm	2.2m	
Moderate	WW6-1	Short-Term	Existing Capacity Constraints	College Ave	250mm	2.7m	
Low	WW7-1	Mid-Term	Growth	Clair Rd	70mm	3.4m	
Moderate	S1 - Manor Park Siphon	Long-Term	Operations	Manor Park Crescent / Speed River			Previous Assessment
Moderate	S2 - Municipal Street Siphon	Long-Term	Operations	Municipal Street / Speed River			Previous Assessment
Moderate-Low	S3 - Alma Mercer	Long-Term	Operations	Alma Street North / Mercer Street			Operational/Redundancy
Moderate-Low	S4 - Elizabeth-Beaumont	Long-Term	Operations	Elizabeth Street North / Beaumont Crescent			Operational/Redundancy
Moderate-Low	S5 - Eramosa River	Long-Term	Operations	Eramosa River / Cutten Fields Golf Course			Operational/Redundancy
Moderate-Low	S6 - Hanlon-Massey-Campbell	Long-Term	Operations	Hanlon Parkway - Massey Road / Campbell Road			Operational/Redundancy
Moderate-Low	S7 - Ptarmigan	Long-Term	Operations	Ptarmigan Drive			Operational/Redundancy
Moderate-Low	S8 - Speed River Crane Park	Long-Term	Operations	Speed River - Crane Park			Operational/Redundancy
Moderate-Low	S9 - Stevenson-Eramosa	Long-Term	Operations	Stevenson Street North / Eramosa Road			Operational/Redundancy
Moderate-Low	S10 - Willow-Guelph	Long-Term	Operations	Willow Road / Guelph Street			Operational/Redundancy

11.4.2 Climate Change Risk

The impacts of climate change should be considered as a potential risk to the ultimate effectiveness of the various recommendations provided. Many climate models exist and there is no way to project with certainty what the climate changes may occur in the future at a municipal, provincial, or national level. The climate models consider the effectiveness of encouraged and legislated societal behavioral change, and the results of these are yet to be realized. Nonetheless, assessment of the recommended project effectiveness when considered with projected climate-based variables is warranted.

11.4.2.1 Water

The impact of climate change on the water distribution system relates mainly to how weather may impact water consumption habits. The biggest concern would be water supply and the potential of wells to decrease in capacity because of a reduction in precipitation and recharge if weather patterns become hotter and drier. This WWSMP focuses on the distribution system and the WSMP on the sources.

Many models predict the weather will become more extreme for both heat and precipitation. If the weather becomes hotter with less precipitation, water consumption will increase and may put a strain on the water distribution system. The City has an Outside Water Use Program and bylaw which can be used to limit outside water use should the City be concerned that water demands are nearing the City's supply capacity. The City has used this bylaw in the past based on precipitation rates, and have seen significant drops in water consumption when enacted. It is an effective tool that should be continued to be relied upon to reduce the risk of demand exceeding system capacity during hot and dry seasons.

If more precipitation falls within a given year, historical data shows that water consumption decreases. The concern of reduced water consumption is age of water in the system and potential water quality concerns. This concern is considered minimal based on the level of growth anticipated by the City. A potential reduction in consumption will be countered by the increased number of customers in the system.

11.4.2.2 Wastewater

In addition to the risk analysis presented above as it relates to upgrade timing, an additional model scenario was conducted to assess the potential impact to the collection system as it relates to climate change. The City has recently completed the Stormwater Management Master Plan: Rainfall and intensity-duration-frequency (IDF) Curve Analysis (Aquafor Beach, 2021). This document provided analysis of historical rainfall trends and projected impacts of climate change on IDF curves. The memo provided recommended IDF parameters for worst case mid-range scenarios. The mid-range scenario was used to test the collection system and determine what impact the adjusted IDF parameters would have on the rainfall distribution and how that would impact the results observed in the model.

The memo provided revised IDF parameters that can be used to derive a rainfall hyetograph to use in the model. Table 11-7 below is an excerpt from the Aquafor Beach memo and lists the IDF parameters.

Table 11-7 Mid-Range Climate Adjusted IDF Data

Return-Period	A	B	R^2
2-year	75.61	-0.738	0.9883
5-year	632.75	-0.741	0.9794
10-year	721.92	-0.736	0.9706
25-year	***822.74***	***-0.725***	***0.9513***
50-year	893.8	-0.719	0.9365
100-year	953.29	-0.711	0.9199

The A and B parameters for the 25-year were used to derive a new rainfall hyetograph for use in the model. Figure 11-1 and Figure 11-2 below show the hyetographs and total rainfall accumulation for the rainfall design storm used in the analysis to date and the climate change adjusted rainfall.

Figure 11-1 Turfgrass 25-Year 3-Hour Chicago Design Storm

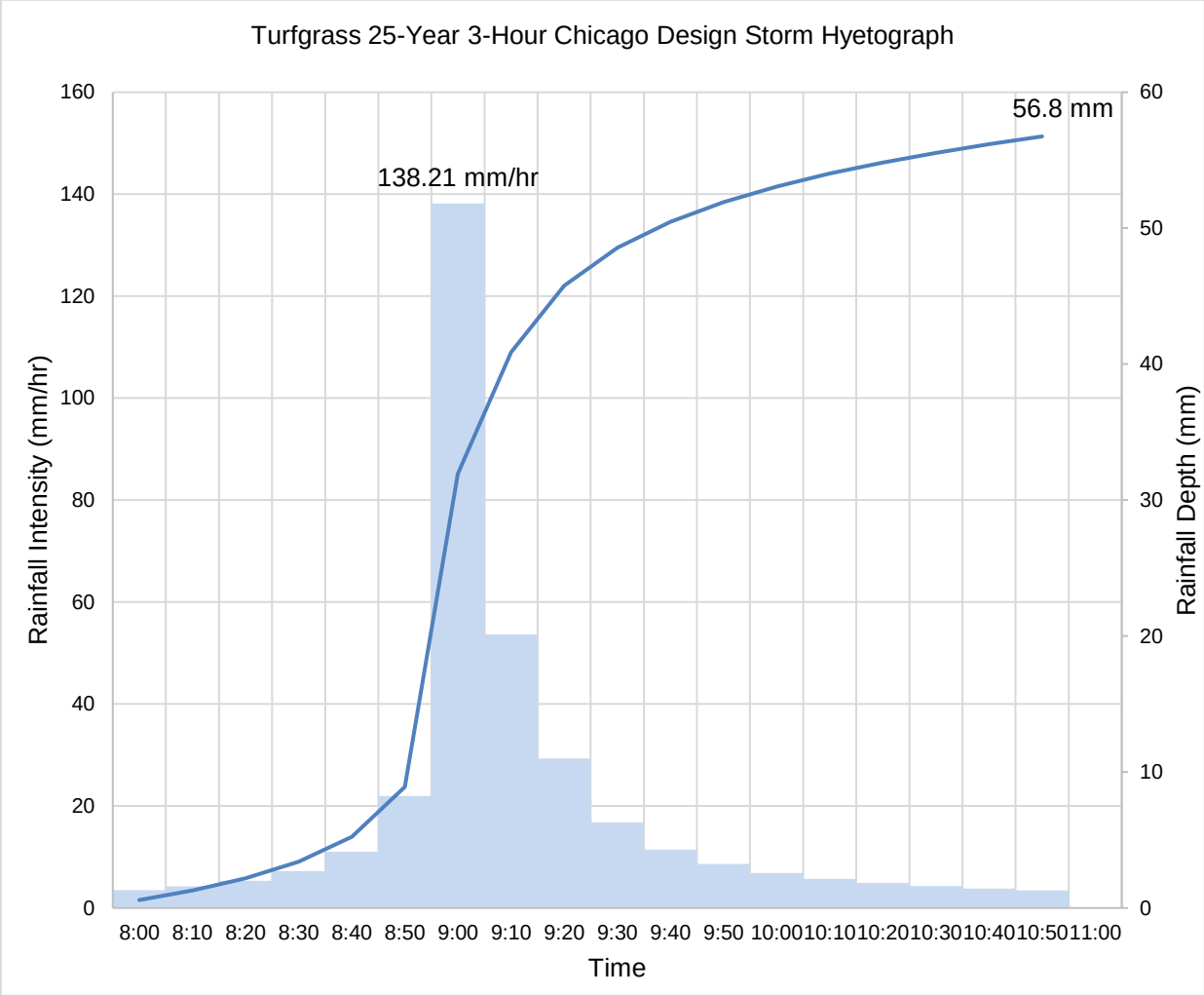
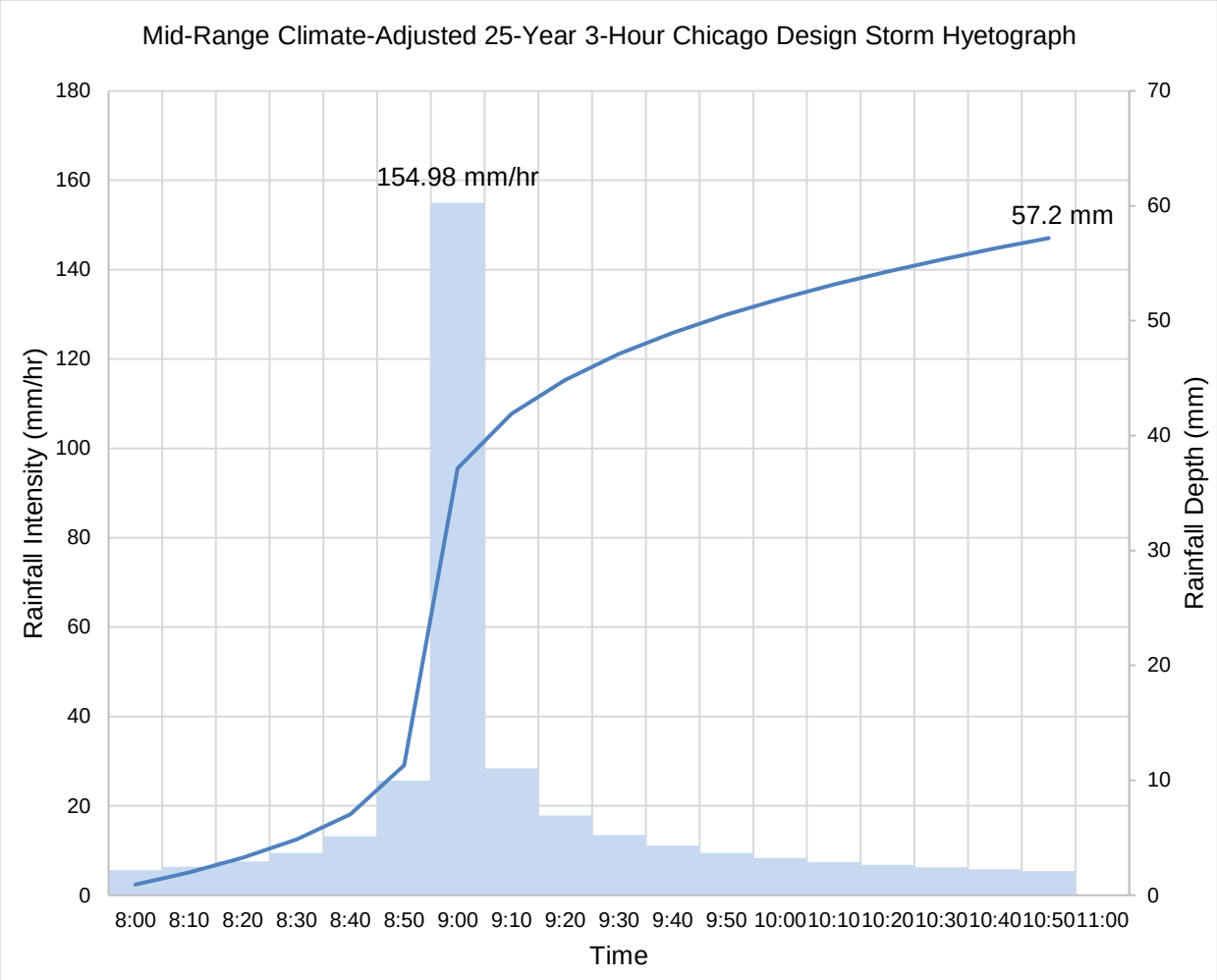


Figure 11-2 Mid-Range Climate Adjusted 25-Year 3-Hour Chicago Design Storm



As depicted, the climate change adjusted rainfall is similar to the existing design storm data. The climate change design storm does see a higher peak intensity for the 25-year 3-hour Chicago design storm with 154.98 mm/hr, as compared to the existing 25-year 3-hour Chicago design storm peak intensity of 138.21 mm. The total rainfall accumulation for the two hyetographs are 57.2 mm vs 56.8 mm, an increase of only 0.4 mm.

The growth model (2051+) with upgrades was used, with the new rainfall hyetograph to assess the impact. The results of the new model scenario using the climate change adjusted rainfall are very similar to those presented in the results of this WWSMP. The change is so small in fact that there is no observable difference in the HGL profiles and therefore no change to the improvements that were recommended. It is worth noting that this assessment looked at a single return period design storm under a single climate change scenario, and as such reflects the potential impact for these conditions only. The results cannot be used to infer potential impact using any other climate change conditions.

11.5 Lifecycle Extension Activities

Further development of the recommended projects may identify opportunities or challenges to conventional construction approaches. Additionally, the capital investment required to realize some of the recommendations may not be available at the recommended timing. Regardless of the reason for exploring lifecycle extension alternative activities, these may prove to be of interest and a mechanism to navigate/mitigate the impacts of risks to the prescribed implementation plan.

11.5.1 Water

There are many factors that contribute to the longevity of a water distribution system. Factors such as watermain material, operating pressure, age, and maintenance can influence the useful life of distribution assets. There are several watermain maintenance and small-scale upgrades that can benefit the overall lifespan of existing watermains through mitigation of risk factors. The proactive solutions are case specific and should be evaluated on a case-by-case basis to determine if one or more solutions would benefit the segment of distribution system in question. Through the implementation of applicable proactive solutions the risk of watermain failures and the requirement for costly and invasive watermain replacements and/or emergency repairs can be minimized.

Lifecycle extension activities can be separated into preventative maintenance and minor upgrades. Both categories of activities have unique benefits and drawbacks that should be considered when developing a distribution system lifecycle extension program.

11.5.1.1 Water Distribution Preventative Maintenance Based Lifecycle Extension Activities

Preventative maintenance activities represent the most cost-effective and easiest to implement lifecycle extension activities for the water distribution system. Activities in this category include:

- Establishment of a regular watermain flushing/swabbing program,
- Adoption of a regular valve exercising program.

The goal of preventative maintenance activities is to help prolong asset life through the removal of accumulated films, corrosion, and scale buildup from within the distribution system. Valve operability is verified, and issues can be documented for tracking, prioritization, and correction. A flushing and valve exercising program can help to detect larger issues for correction prior to reaching the point of critical failure.

The cost of a preventative maintenance program is limited to the labour and mechanical equipment costs. Typically existing swab points and hydrants are used and intrusive excavation is avoided. This may limit the range and areas that can be included in the maintenance program due to system layout constraints.

Depending on system configuration, a swabbing/exercising program may impact end users though temporary loss or reduction in pressure and/or water discolouration. A robust public communication plan should be included as part of the maintenance program.

11.5.1.2 Water Distribution Upgrades for Lifecycle Extension

There are minor upgrades to the distribution system that may help mitigate or eliminate damaging stresses within the distribution system. These upgrades include:

- Installation/replacement of sacrificial anodes on metallic mains/fittings,
- Installation of combination air release/vacuum breaking valves at critical system high points,
- Installation of transient protection devices (surge tanks, surge anticipator/relief valves, etc.),
- Re-lining existing watermains with cementitious grout or a cured-in-place liner system (CIPP).

Each of these options should be evaluated for applicability on a case-by-case basis. The relevance of each option will be based on system configuration, accessibility, construction impacts, and overall cost.

Installation/Replacement of Sacrificial Anodes: A cathodic protection program involving installation of anodes on existing metallic mains and fittings is typically implemented by two methods, hotspot and full retrofit. For a hotspot program, anodes are installed in an opportunistic manner whenever a local repair or upgrade is completed. This method offers some local cathodic protection benefits but typically does not extend to the entire system due to anode size and electrical continuity breaks. Hotspot installations can be targeted at known older metallic mains/fittings to help prolong their lifespan. A full retrofit program involves the strategic design and implementation of cathodic protection by systematically installing anodes throughout the system. While a full retrofit program provides a higher degree of cathodic protection, it is more costly and intrusive when compared to a hotspot program.

Installation of Combination Air Release/Vacuum Breaking Valves: Entrapped air and uncontrolled vacuums within a distribution system can result in dangerous pressure spikes and reduced capacity that can cause premature failure of pipelines and fittings. Through strategic design and implementation of combination valves targeted at areas where air entrainment or vacuums may occur within the system, the potential damaging effects can be mitigated. Combination valves could potentially be added to existing valve chambers or within facilities if sufficient space exists, otherwise they would require the installation of a new chamber. It should be noted that combination valves require regular maintenance and can potentially be a source for contamination to enter the system should they fail. It is important that the valve be housed within a clean and dry environment to minimize the risk of back contamination through the valve. Dedicated chambers should be designed to include flood protection.

Installation of Transient Protection Devices: Uncontrolled transient pressures within a system can result in premature failure of distribution piping and fittings. Transient protective devices such as surge tanks and anticipator valves (pressure and/or surge) can help to mitigate the effects of uncontrolled transient pressures. Due to size and cost restraints, surge tanks and anticipator valves would typically be added to the outlet of existing facilities. System modelling should be conducted to evaluate the benefit of implementing transient protection devices at existing facilities.

Re-lining existing watermains: Re-lining of watermains provides a restorative option that does not require the full excavation of the watermain. Access pits are placed at strategic intervals and the main is lined either using a sprayed in cementitious mortar or a cured-in-place pipe (CIPP). For both options the main is cleaned internally of debris by high pressure water flushing or robotic scraping before the liner is installed. While cement mortar lining is still used in select instances, CIPP lining has become the more popular option in industry due to the ease of installation and the resulting longevity of the finished product.

The level of effort required to complete CIPP lining is substantial. The subject section of watermain must be fully isolated, often requiring the establishment of a temporary watermain to service affected properties. The liner cannot be installed through valves and other watermain appurtenances. Valves and appurtenances have to be individually excavated and reconfigured to the new liner. Services and branch connections must also be individually reconnected to the new liner pipe. This can be done by robotic cutter from within the main in certain circumstances but often it requires excavation at each service and branch connection. The benefit of lining an existing watermain is that the level of excavation and restoration is minimized to the access and connection points. Mains that are within sensitive areas or under recently restored roadways can be rehabilitated without requiring full excavation. The final product is a stable and strong piping system with a projected lifespan of 75+ years.

11.5.2 Wastewater

Several lifecycle extension activities exist to prolong the life of sanitary sewer. These differ in complexity and cost, but all aim to avoid open-cut methods. The primary lifecycle extension activity considered for this WWSMP and the City's wastewater collection system is cured-in-place- pipe (CIPP) lining. CIPP is a trenchless method of sewer rehabilitation that minimizes the excavation requirements and is much faster to implement than other traditional sewer repair (or replacement) methods. CIPP involves the introduction of an uncured tube of resin into an existing pipe to reinforce it.

When comparing CIPP lining to traditional open-cut replacement, key deciding factors whether to use CIPP lining or open-cut replacement for a specific sewer may include:

- Diameter and depth
- Location and accessibility
- Ground conditions and depth of water table
- The condition of the sewer
- Configuration of the sewer (e.g., are significant bends present)
- Configuration of the maintenance holes to facilitate CIPP lining (e.g., do they need to be partially replaced or fully replaced)
- Capacity requirements (e.g., does the system require a significant increase in capacity)
- Impact to existing utilities
- Critical crossings where trenchless methods may be preferred (e.g., critical gas main, CN Rail, utility conflicts etc.)
- Soil conditions (e.g., CIPP may help mitigate contaminated and/or excess soils which may be problematic for open-cut replacement).

- Impact to stakeholders or property owners
- Overhead hydro
- Availability of staging area
- Traffic control requirements
- Asset management considerations and risk to the owner (e.g., capacity to rehabilitate infrastructure within a larger area over a faster timeframe)

When comparing CIPP lining to open-cut replacement, there can be various advantages or disadvantages that are applicable on a project-by-project basis. A major advantage of CIPP lining for a municipality is the ability to rehabilitate a significant amount of infrastructure in a shorter period and typically at relatively lower cost than would be possible with open-cut replacement.

Other rehabilitation methods as alternatives to CIPP lining are available and include:

Robotic Packers / Grouters: Robotic joint packers are often used for entry-less rehabilitation of smaller diameter sewers. A wheeled or pull-through robot moves along the sewer and inflates its ends at each defect or joint to form a seal. The space between the seals and the pipe wall is pressurized with air to test the joint for leakage. Failed joints are then pumped full of grout. The robot moves on when the grout is set. The centre of the machine is usually hollow to allow dry weather flow to travel through.

Cementitious or Chemical Grout: A cement-based or chemical (polyurethane) grout can be injected to fill potential voids in the soil behind the crack and to patch the crack from the inside wall. Since this method requires access from inside the sewer, worker safety is a concern. If necessary, divers with full air supply could be retained to complete the work, although this would incur additional costs. Flow bypass is typically not required as the grout can be set/cured in wet conditions (particularly the polyurethane-based grout). Any encrustation/calcite deposits must be ground and cleaned prior to grouting. Access is provided through maintenance holes, so no excavation is required. Cost is relatively low compared to other options, even if using divers, and is dependent on the amount of grout used.

Epoxy Adhesive Injection: Epoxy adhesive can also be used to fill minor cracks; however, it does not fill potential voids in the soil behind cracks. Like grouting, this method requires access from inside the sewer, so worker safety is a concern and flow bypass may be required. Furthermore, it requires the repair surface to be clean and dry. Access is provided through maintenance holes, so no excavation is required, and cost is relatively low compared to other options and is based on the volume of epoxy used.

Internal Joint Seals: Internal joint seals could be used to repair circumferential cracks and fractures or separated joints. This method requires direct access and presents the same worker safety and flow bypass concerns as grouting and epoxy injection. There are several different types and manufacturers of seals including LINK-PIPE, which involves installing a short pre-folded PVC sleeve at a joint or defect, and HYDRATITE, which consists of an EPDM rubber gasket and metal band. Both systems are hydraulically expanded into place. The metal bands and PVC sleeve hinges may introduce potential ragging points, although joint seals are generally low profile. Installation costs are like grouting as direct man access is required. The seals present an additional cost but provide a longer lasting solution than grouting.

***Slip lining*:** Slip lining is another common rehabilitation method which involves inserting a new rigid liner (typically PVC, HDPE or polypropylene) of smaller diameter than the host pipe, while the annular space is grouted to prevent leakage and provide structural integrity. This method often requires insertion pits to be excavated, which can incur significant costs and disruptions at surface, and may not be feasible along a straight section of sewer. Although slip lining can often be completed in wet conditions, flow management is required to construct and prepare the insertion pit. Like CIPP, the reduction in hydraulic capacity is mitigated by the lower friction of the liner.

Table 11-8 Lifecycle Extension Activities (Water and Wastewater)

Issue	Treatment	Extension of Service Life	Anticipated Cost
Seized Valves	Valve Exercising	10-12 years	$1,950,000 (assumes ~1500 valves exercised per year, or 6 per working day, $7500 per day cost for exercise truck and crew)
Reduced watermain capacity and water quality	Flushing	10-12 years	$190,000 (assumes 75-100km of main flushing per year)
Reduced pipe capacity, leakage and structural integrity	Cured-in-place liner (CIPP)	75-100 years	$1,200-$4,000 per m (WM diameter dependent)
Watermain integrity, leakage and breaks due to transient pressures	Transient Protection devices Surge tank	10-15 years	$10,000 + (varies on size and installation location)
	Transient Protection devices Pressure relief valve/surge anticipating valve	10-15 years	$2500+ (varies on size and installation location)
Reduced capacity and watermain	Air Valves	10-15 years	$28,000-$35,000 per chamber

Issue	Treatment	Extension of Service Life	Anticipated Cost
breaks due to trapped air			
Corrosion of metallic pipes	Hotspot Sacrificial Anode	10-15 years	$500-800 per anode (installed as part of other work)
	Full retrofit	10-15 years	$1500-$2,200 per anode, $30,000-$44,000 per km of watermain @ 50m spacing

11.5.2.1 Extension of Service Life

The life cycle expectancy of a new watewater sewer is generally accepted as approximately 100 years and is thus the baseline that the lifecycle extension activities are compared to. Certain lifecycle extension activities are considered as essentially establishing a new sewer, namely CIPP and slip lining. The other lifecycle extensions activities are challenging to assign estimates to. In all instances, there are several factors that influence the lifespan, such as: the corrosive nature of the flow, the amount of infiltration in the sewer, and the type and magnitude of the issue (if repairing a crack or break, etc.) being mitigated. This information will be referred to is Guelph's Asset Management Plan as it relates to existing assets.

12.0 Conclusion and Summary

The Water and Wastewater Servicing Master Plan update includes recommended infrastructure upgrades to satisfy the City's targeted level of service and growth projections. These recommendations are based on the results of calibrated hydraulic models which consider the existing and projected growth needs and build on the WSMP.

There are several ongoing activities that are recommended to continue in an effort to refine the findings from the system assessments and maintain and increase the confidence in the results of the developed models:

- Regularly update the City's hydraulic models as field data is collected and GIS systems are updated. The City's models should also be updated with growth and infrastructure updates as these occur.
- Continue annual strategic sewer flow monitoring. The focus of these efforts should be to further understand how the City's wastewater collection system responds to rainfall and ongoing growth. Additional interest in obtaining data adjacent to areas where upgrades are identified is also strategic. This data may help confirm the timing and/or actual need for these upgrades.
    - Sewer flow monitoring data analysis also allows the City to understand its I/I profile and where any leakier areas may be present in the City. The sewer flow monitoring analysis completed as part of this WWSMP showed minimal to null I/I in the data collected. It is valuable to continue with similar analysis to ensure this is representative of the entire City. This could be achieved by continuing the City's existing I/I program and expanding the effort to include a city-wide strategy.
- Correlation of basement flooding reports to the results of the City's hydraulic modelling findings. Combined with an understanding of the return period of the corresponding rainfall, this correlation can help validate the model's predictive findings, or identify that additional calibration is warranted. This data is also valuable in establishing and confirming project prioritization.
- Confirm the location and distribution of building lateral connections to the City's sewers through field measurements/inspections. Currently the City's design/development guidelines do not allow any surcharging of sewers. This may be overly conservative depending on the building lateral connection details. The City's sewers are also known to be shallow in certain areas, notably the City Centre / core area. An understanding of where there are basements and associated lateral connection to the shallow network would allow an understanding of the risk of allowing surcharging and possibly allow the City to allow surcharge in certain areas.
- Align the City's development review tracking methods to use the hydraulic model and track cumulative demands.
- Continuation and further refinement of the City's leak detection program.
- Take further advantage of the City's data collection system by providing performance metrics.

Additional recommendations pertaining to City procedures, policies, and non-capital upgrade initiatives were provided. These include recommendations about the City's Development Engineering Manual (DEM). The City's existing DEM was reviewed and compared to both regional and provincial comparable guidelines. Guidelines from nearby municipalities were also consulted.

A cost summary per time horizon for the recommended capital projects, studies and pilot programs is summarized in Table 12-1.

Table 12-1 Cost Estimates Summary

Horizon	Short-Term (2031)	Mid-Term (2041)	Long-Term (2051+)	Total
Capital Works - Water	$190,600,000	$59,100,000	$51,600,000	**$301,300,000**
Capital Works - Wastewater	$67,500,000	$14,420,000	$17,850,000	**$99,770,000**
Studies	$3,750,000	$3,200,000	$2,800,000	**$9,750,000**
Innovation Pilot Programs	$575,000	$0	$0	**$575,000**
Total	**$262,425,000**	**$76,720,000**	**$72,250,000**	**$411,395,000**