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Prepared for:

MUNICIPALITY OF NORTH GRENVILLE
285 County Road 44
Kemptville, ON
K0G 1J0

Prepared by:

J.L. RICHARDS & ASSOCIATES LIMITED
343 Preston Street, Tower II, Suite 1000
Ottawa, ON
K1S 1N4
TEL: 613-728-3571

Draft Phase 2 Report

North Grenville Water and Wastewater Master Plan

J.L.Richards
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1.0 Introduction

1.1 Background

The Municipality of North Grenville (Municipality) is comprised of a mix of rural and urban development adjacent to the southern border of the City of Ottawa. The urban settlement area of Kemptville is serviced by water and wastewater systems owned and operated by the Municipality.

The Municipality is one of the fastest growing communities in eastern Ontario, with most of the growth within the northwest quadrant of the urban area. Due to this high growth rate, the Municipality retained J.L. Richards & Associates Ltd. (JLR) in 2024 to update the Municipality's Water and Wastewater Servicing Master Plan originally published in 2010 and previously updated in 2015.

Investments in the Municipality's water and wastewater infrastructure since 2015 include:

- extending sanitary services;
- construction of a new well, pumphouse and storage facility in the East Quadrant;
- building a new sanitary pump station (SPS) in the Northwest Quadrant of Kemptville;
- and a new well, pumping station and storage facility in the Northwest Quadrant.

The purpose of this Master Plan update is to provide direction for water and wastewater servicing in Kemptville for the zero (0) to five (5) year, five (5) to ten (10) year, ten (10) to twenty (20) year and build out timelines, with a focus on water distribution and storage, wastewater conveyance and pumping, and capacity needs of the water supply system and wastewater treatment plant.

1.2 Class Environmental Assessment Process

The Ontario Environmental Assessment Act (Act) sets out a planning and decision-making process to consider potential environmental effects before a project begins. The purpose of the Act is to provide for the protection and conservation of the natural environment (R.S.O. 1990, c.E.18, s.2).

The Municipal Class EA (MCEA or Class EA) process is followed for common types of projects to streamline the review process while ensuring that the project meets the requirements of the Act. In 1987, the first Class EA document prepared by the Municipal Engineers Association (MEA) on behalf of Ontario Municipalities was approved under the Act. Amendments were subsequently made in 1993, 2000, 2007, 2011, 2015, and 2023.

The MCEA process includes the following stages:

- **Phase 1**: Problem and/or opportunity identification.
- **Phase 2**: Identification and evaluation of alternative solutions.
- **Phase 3**: Preparation of alternative design concepts to support a preferred solution.
- **Phase 4**: Preparation of an Environmental Study Report (ESR) for posting and review on the public record.
- **Phase 5:** Project implementation and monitoring.

Since projects may vary in their environmental impact, they are now classified in terms of the following schedules, pursuant to the most recent amendment to the MCEA process in 2023:

- 'Exempt' projects, most of which were formerly classified as Schedule 'A' and 'A+' projects, include various municipal maintenance, operational activities, rehabilitation works, minor reconstruction or replacement of existing facilities, and new facilities that are limited in scale and have minimal environmental effects. While these projects are exempt from the MCEA process, proponents should consider whether notice about the project should be given or consultation on the project should be carried out. Furthermore, proponents are also responsible for obtaining any other applicable permits, approvals, and authorizations for the project.

- 'Eligible for Screening to Exempt' projects may be eligible for exemption based on the results of a screening process. Proponents may choose to complete the applicable screening process to determine whether the project is eligible for exemption or proceed with the applicable Schedule 'B' or Schedule 'C' process, as noted below.

- Schedule 'B' projects have the potential for some adverse environmental impacts. Therefore, the proponent is required to undertake the first two phases of the MCEA process. This includes mandatory consultation with Indigenous Communities, the public and other affected stakeholders as well as relevant review agencies; and the preparation of a Project File which documents the Class EA process and is placed on the public record for review and comment. If there are no outstanding concerns and the regulatory process has been completed, then the proponent may proceed to implement the project. Generally, these projects include improvements and minor expansions to existing facilities or smaller new projects.

- Schedule 'C' projects have the potential for greater environmental impacts and are subject to the full MCEA process. This includes mandatory consultation with Indigenous Communities, the public, and other affected stakeholders as well as relevant review agencies; identifying, assessing, and refining alternative solutions to determine a preferred solution; and preparing the ESR which documents the Class EA process and is placed on the public record for review and comment. If there are no outstanding concerns and the regulatory process has been completed, then the proponent may proceed to implement the project. Generally, these projects include the construction of new facilities and major expansions to existing facilities.

A Master Plan is conducted under the framework of the MEA Class EA Process. It is a planning tool that identifies infrastructure requirements for existing and future land use, through the application of environmental assessment principles, and is intended to satisfy Phases 1 and 2 of the Class EA process. The Municipal Class EA guideline identifies four (4) basic approaches of the Master Planning process, including:

- **Approach No. 1:** This approach concludes at the end of Phases 1 and 2 of the Municipal Class EA Process. With this approach, the Master Plan is being completed at a broad level of assessment and may require further detailed assessment at the project-specific level depending on the nature of the project.

- **Approach No. 2:** This approach also concludes at the end of Phases 1 and 2 of the Municipal Class EA Process. However, the level of detail (i.e., investigation, consultation, and documentation) fulfills the requirements for Schedule 'B' projects.

- **Approach No. 3:** This approach involves the preparation of a Master Plan document at the conclusion of Phase 4 of the Municipal Class EA Process. The level of detail of the Master Plan document can fulfill requirements for Schedule 'B' and/or Schedule 'C' projects.

- **Approach No. 4:** This approach involves integration with the approvals under the Planning Act.

The North Grenville Water and Wastewater Master Plan has followed Approach No.1, which involves the preparation of a report at the conclusion of Phases 1 and 2. The Master Plan has been completed at a broad level of assessment, which requires more detailed investigations at a project-specific level to fulfill the Municipal Class EA documentation requirements for any specific Schedule 'B' and 'C' projects identified within the Master Plan. It is recommended that, in the event of any future updates to the MCEA process, these changes be reviewed prior to commencing these future projects.

This Master Plan should be reviewed every five years to determine the need for detailed formal review and/or updates. Potential changes, which may trigger the need for an update, include:

- Major changes to the original assumptions.
- Major changes to components of the Master Plan.
- Significant new environmental effects.
- Major changes in the proposed timing of projects within the Master Plan, based on changed conditions relative to the original projections/predictions.
- Acceleration of growth beyond the projections.

1.3 Phase 2 Methodology

Phase 2 of the Master Plan process will further evaluate the water and wastewater systems through hydraulic models and evaluation of the existing infrastructure. This Phase will ultimately identify alternative solutions to address the problems and opportunities identified in Phase 1 and select the preferred solutions. Solutions considered can include new construction, retrofits, upgrades, policy recommendations, future studies, and/or conservation measures to optimize the treatment and efficiency of the existing systems.

The following activities are planned for Phase 2:

- Water and Wastewater Conveyance: Model of the water distribution and wastewater collection systems for future development.
- Water Supply and Wastewater Treatment: Identify and evaluate alternate solutions to address capacity and treatment issues noted in Phase 1.
- Hold a Public Information Centre as part of the public consultation program to present proposed alternatives and recommended preferred solutions. The public and other stakeholders will be given the opportunity to review and comment on the information presented.

- Prepare a Master Plan Report to summarize Phase 2 findings, including costs and schedules, incorporating public feedback. It will be placed on record for a 30-day review period.

Condition assessments are not in the scope of this study.

1.4 Summary of Phase 1 Findings

A summary of the capacity limits in the existing water and wastewater systems determined during Phase 1 is included in Table 1 below. The planning periods considered as part of this Master Plan are the short-term, five-year scenario (2025-2031); mid-term, five-to-ten-year scenario (2031-2036); and long-term, ten-to-twenty-year (2036-2046), and build-out, twenty-plus-years (2046+) scenarios. Each column lists upgrades required in that period.

Table 1: Phase 1 Summary

	Short –Term	Mid–Term	Long –Term	Build –Out
Water Distribution	Upgrade select trunk watermains and pumping stations to supply minimum pressures and fire flows throughout Kemptville, and service new developments. Select aged watermains require condition upgrades.			
Water Storage	No storage deficits	573m^3 deficit	5,742m^3 deficit	12,814m^3 deficit
Water Supply (1)	No supply deficits	1,554m^3 deficit	7,419m^3 deficit	15,092m^3 deficit
Wastewater Conveyance (Curry St and Syphons)	Upgrades required	Upgrades required	Upgrades required	Upgrades required
Wastewater Pumping	Bridge Street SPS upgrade required.	Bridge Street SPS upgrade required.	Bridge Street SPS upgrade required.	Colonnade and Bridge Steet SPS upgrades required.
Wastewater Treatment (2)	No treatment deficits	No treatment deficits	4,023m^3 deficit	8,775m^3 deficit

Notes:
1) Water supply capacity with largest well out of service.
2) Wastewater Treatment rated capacity upon completion of ongoing upgrades

1.5 Problem/Opportunity Statement

Based on the work completed during the Phase 1 Master Plan process, the following Problem/Opportunity Statement has been developed:

The community of Kemptville in the Municipality of North Grenville is anticipating increased development pressures over the next 20 years. The drinking water system consists of five groundwater wells and six storage reservoirs and one booster pumping station. The wastewater system consists of four pumping stations and a wastewater treatment plant. There is an opportunity through the Master Planning process to review the water and wastewater systems holistically and develop a strategic plan of actions that can be implemented over a logical time period and in a prioritized fashion with the intended goal of addressing future servicing needs and ensuring appropriate performance and reliability of the water and wastewater systems in the 20-year planning horizon.

2.0 Study and Overview

2.1 Study Area

The Municipality's drinking water system is operated under the Ministry of Environment, Conservation and Parks (MECP) Municipal Drinking Water License (MDWL) Number 159-101 and Permit to Take Water (PTTW) Number 4703-C95KNP. The system is serviced by five groundwater wells, three below grade reservoirs, three above-grade reservoirs and six booster pumping stations. The groundwater wells are the Alfred Street Well, Kernahan Street Well, Van Buren Street Well, East Quadrant Well, and the Northwest Quadrant Well. There is one below grade reservoir and pumping station at each of the Alfred, Kernahan and Van Buren Street Wells. The above grade storage facilities and remaining pumping stations are located at the eQuinelle development, East Quadrant, and Northwest Quadrant. Figure 1 shows the existing water infrastructure within the Kemptville urban service area.

The Municipality's wastewater system is operated under the Ministry of Environment, Conservation and Parks (MECP) Environmental Compliance Approval Number 9890-CL9RJR. The system consists of four pumping stations, Bridge Street, East Quadrant, Northwest Quadrant, eQuinelle, that connect directly to a wastewater treatment plant (WWTP) located off County Rd 43, also called the Kemptville Water Pollution Control Plant (WPCP). Two other pumping stations, Blackhorse and Kempten Court, are also part of the system, but do not connect directly to the WPCP. The 2019 Environmental Study Report for the WPCP found that the wastewater treatment system average day and maximum day capacities, 4,510 m^3/d 11,370 m^3/d respectively, were insufficient to meet to the projected demand from developments. The Municipality is currently advancing the construction of the recommendations of the ESR which will see an average day capacity increase to 5,250 m^3/d and a maximum day capacity increase to 15,000 m^3/d to service the population growth to the year 2038. Figure 2 shows the existing wastewater infrastructure within the Kemptville urban service area.

2.2 Population Projections

Population projections were established and summarized in the *Existing and Future Population, Employment, and Land Use Implications and Analysis Report*, prepared by JLR on March 13, 2025, for the following planning periods:

- Existing conditions (2025)
- 0 to 5 years (2026 - 2031)
- 5 to 10 years (2031 – 2036)
- 10 to 20 years (2036 – 2046)
- 20+ year buildout (beyond 2046)

The report is available in Appendix A.

Based on the Statistics Canada 2021 Census of Population, the Municipality of North Grenville's population was 17,964 people, while Kemptville population centre had a population of 4,051 people. The Long-term Population, Housing and Employment Study (December 2023) identified the population of Kemptville as approximately 6,000 people in the urban service area. The discrepancy between the two populations is likely because the geographic area for Kemptville population centre does not account for the entirety of the urban serviced area of Kemptville. For the purposes of this Water and Wastewater Servicing Master Plan, the population noted in the Long-term Population, Housing and Employment Study was used as the basis for the existing population.

The 2025 population was estimated by updating the 2021 Census population with the developments that have been constructed and serviced to date, summarized in the table below.

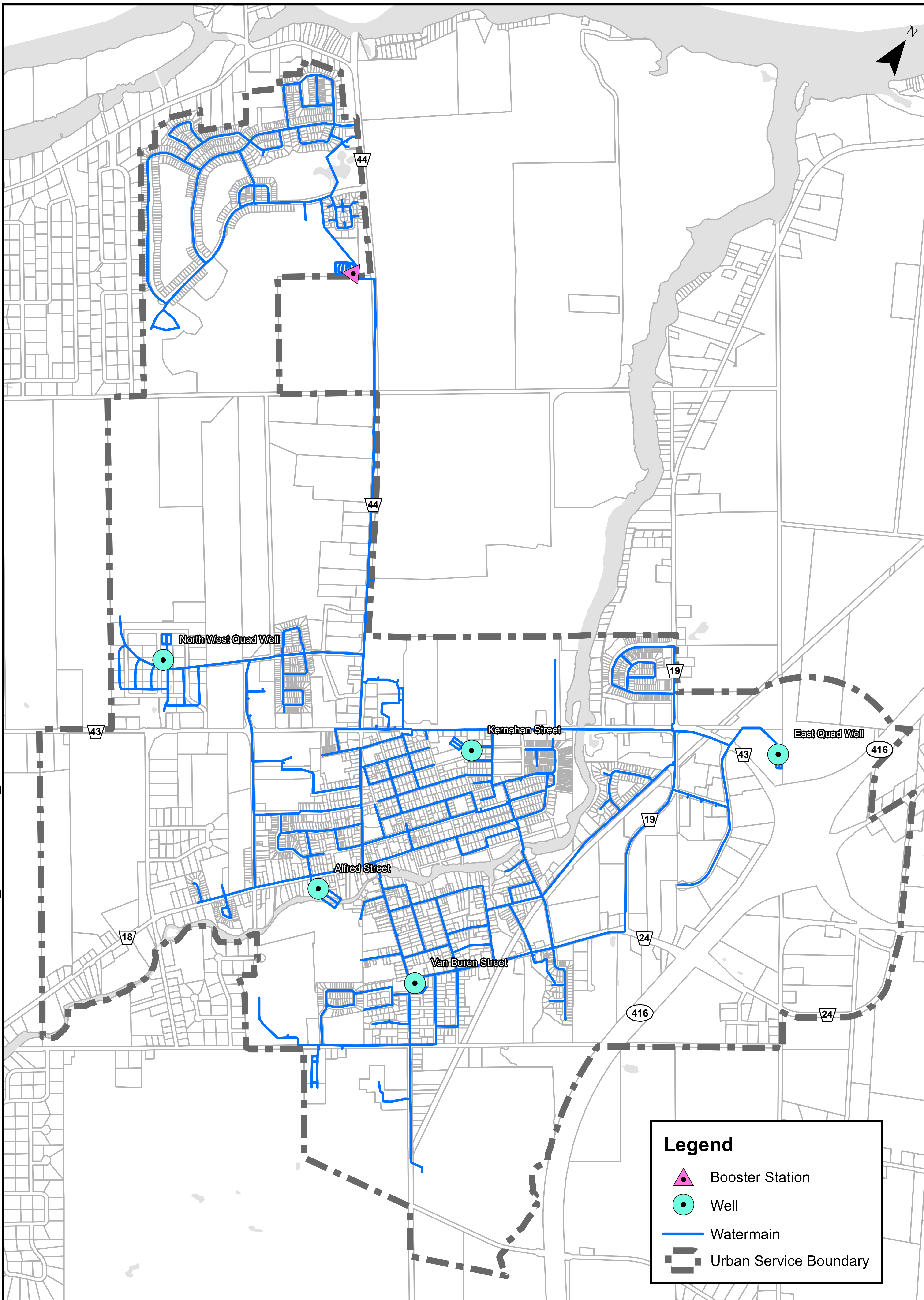
Table 2: Estimation of Existing Population

	Population
Census population – Urban Service Area (2021)	6,000
Development ID #1 (north section) Singles = 45 units Townhomes = 29 units	231
Development ID #3 Singles = 100 units Townhomes = 213 units Apartments = 120 units	1,155
Existing population (2025)	7,386

The estimated future Kemptville population in the urban serviced area was developed for each planning period in the Master Plan through consultation with the Municipality and current development applications. These estimated populations are summarized in the following table. Figure 3 to Figure 6 and corresponding tables show the development areas in each growth period:

Table 3: Estimated Kemptville Urban Serviced Area Population

Year	Kemptville Urban Serviced Area Population
Census (2021)	6,000
Existing (2025)	7,386
0-5 year (2026-2031)	9,366
5-10 year (2031-2036)	11,986
10-20 year (2036-2046)	22,401
Buildout (beyond 2046)	34,764



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North Grenville Water and Sewer Master Plan

Kemptville, Ontario

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Kemptville Urban Service Area - Water Infrastructure

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Figure 1

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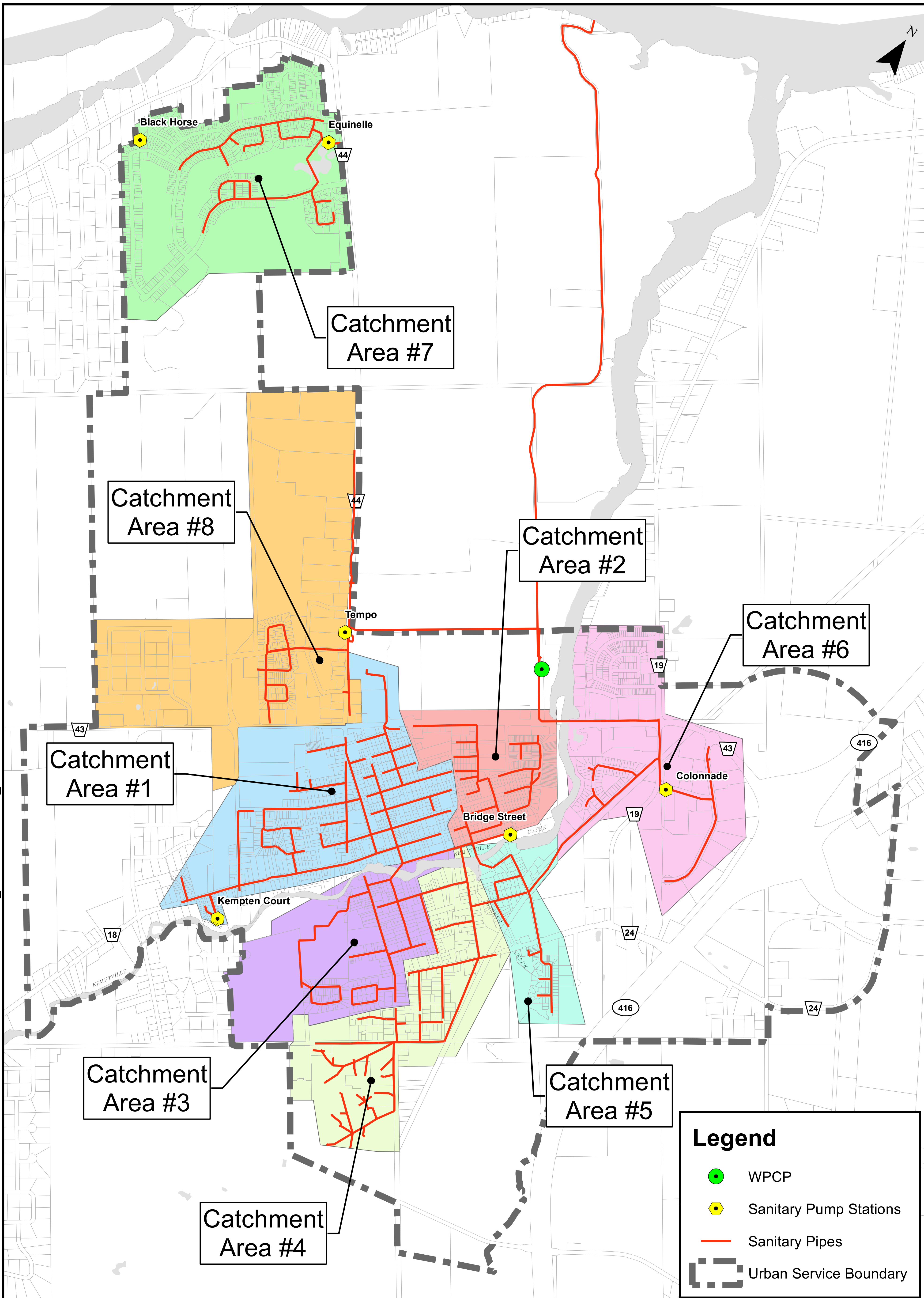

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Kemptville Urban Service Area - Wastewater Infrastructure

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Figure 2

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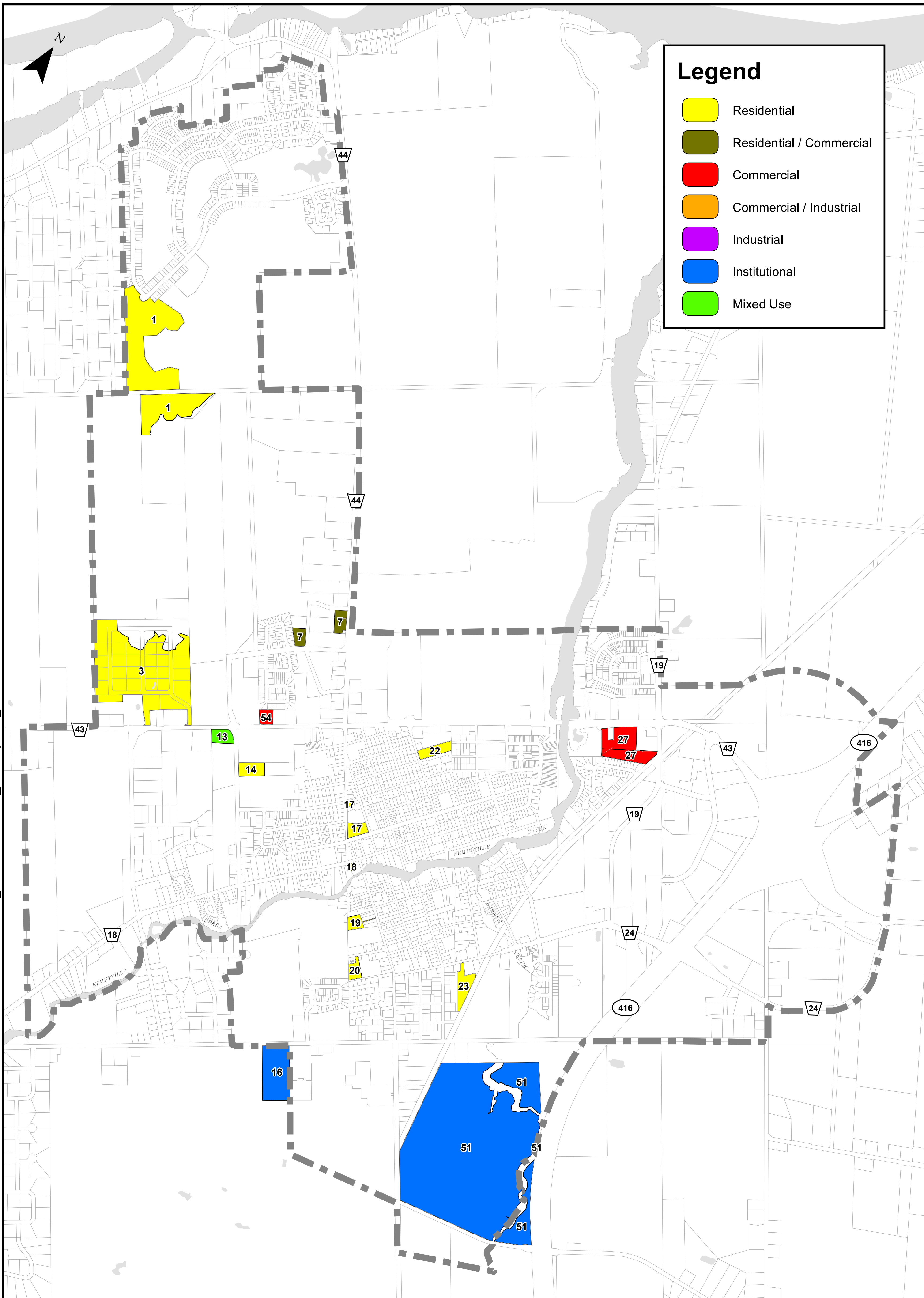

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North Grenville Water and Sewer Master Plan

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New Development - 0 to 5 Years

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Figure 3

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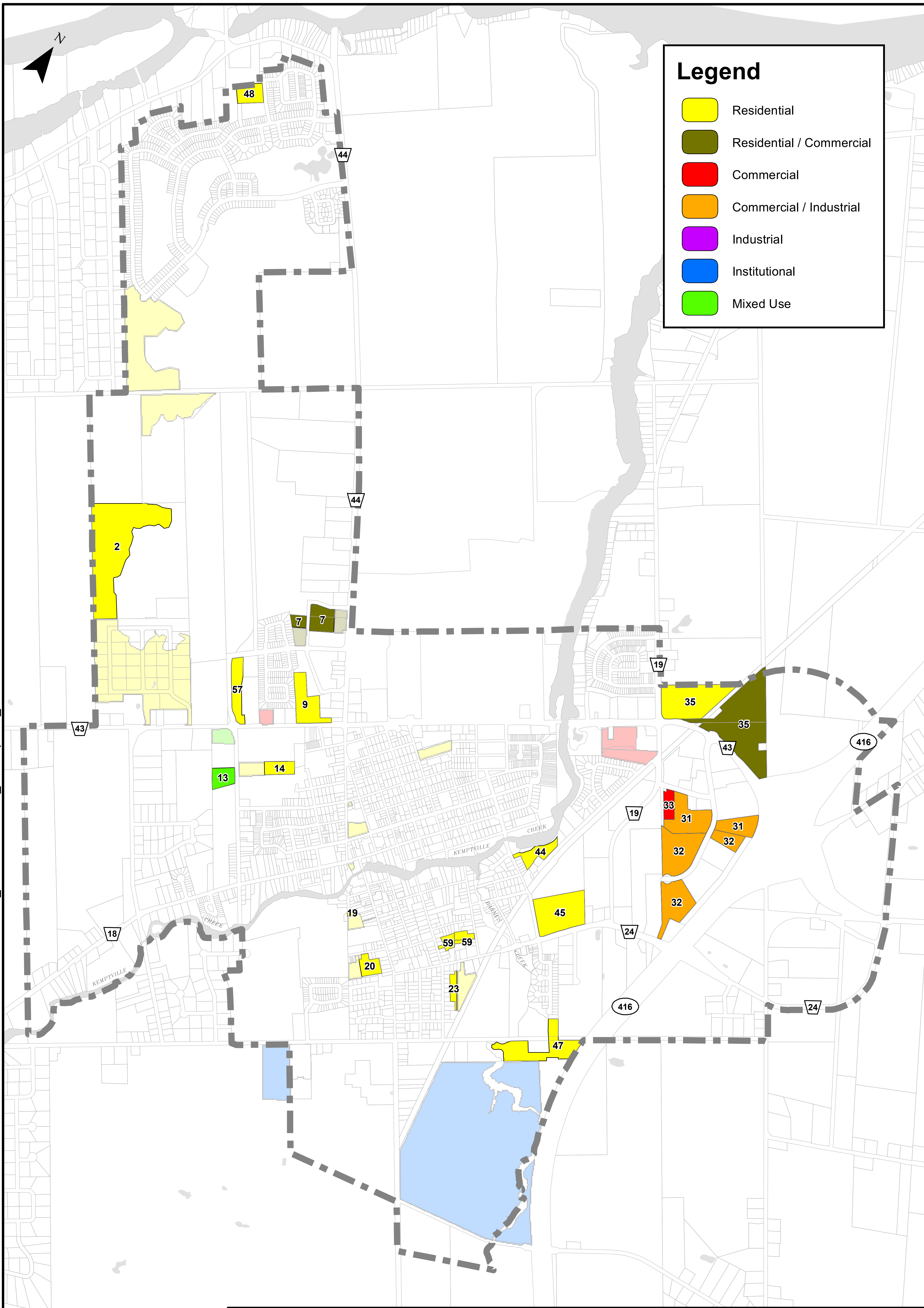
Table 4: New Development - 0 to 5 Years

Map ID	Period	Area (ha)	Type of Development
1	0-5	13.7	Residential
3	0-5	17.3	Residential
7	0-5	1.2	Residential / Commercial
13	0-5	0.8	Mixed Use
14	0-5	0.9	Residential
16	0-5	3.9	Institutional
17	0-5	0.0	Residential
17	0-5	0.6	Residential
18	0-5	0.1	Residential
19	0-5	0.5	Residential
20	0-5	0.6	Residential
22	0-5	0.8	Residential
23	0-5	1.2	Residential
27	0-5	1.4	Commercial
27	0-5	1.8	Commercial
51	0-5	49.9	Institutional
54	0-5	0.5	Commercial



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Kemptville, Ontario

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New Development - 5 to 10 Years

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Figure 4

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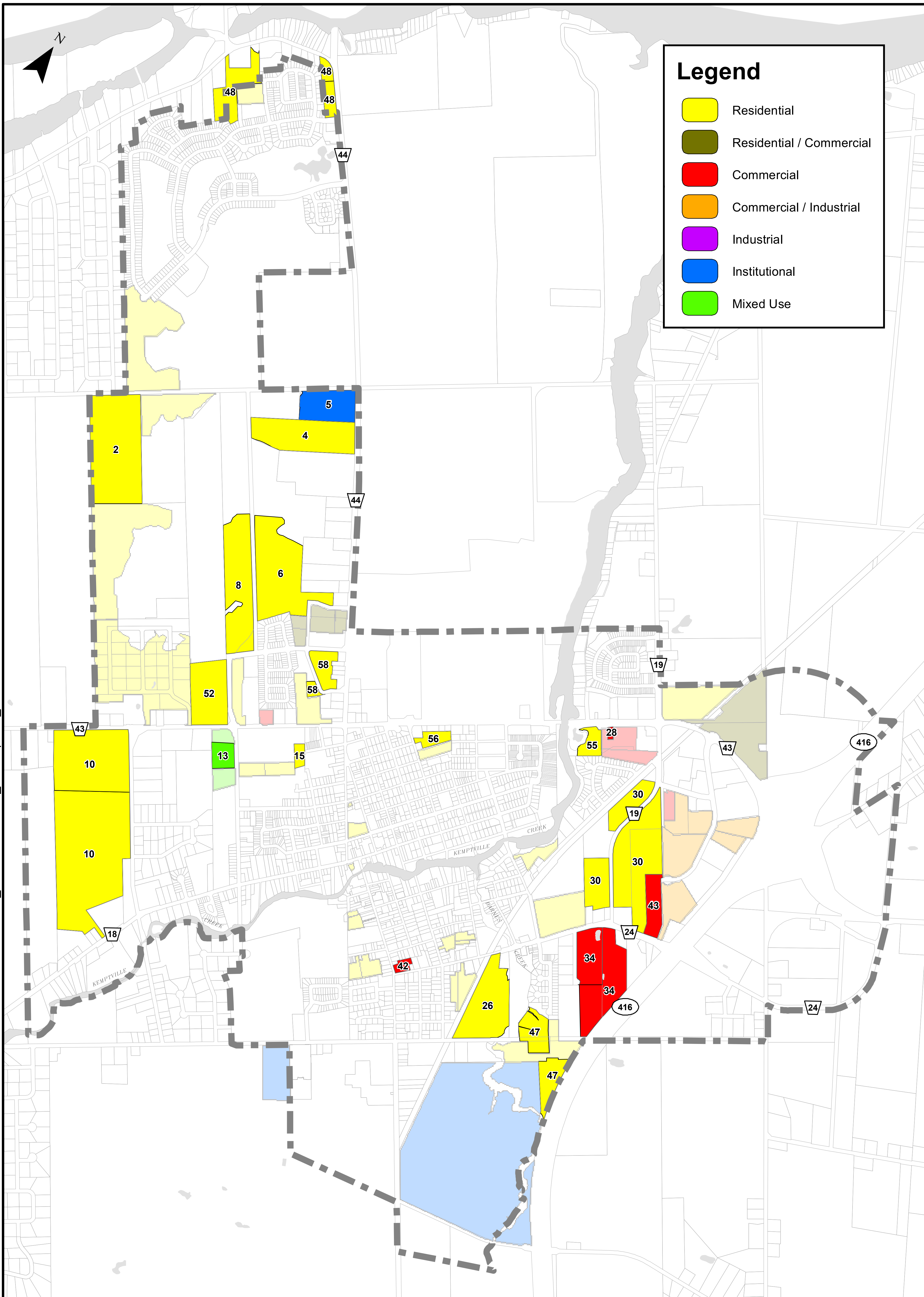
Table 5: New Development - 5 to 10 Years

Map ID	Period	Area (ha)	Type of Development
7	5-10	0.5	Residential / Commercial
7	5-10	1.6	Residential / Commercial
9	5-10	2.6	Residential
13	5-10	1.1	Mixed Use
14	5-10	1.0	Residential
19	5-10	0.1	Residential
20	5-10	1.0	Residential
23	5-10	0.6	Residential
31	5-10	4.8	Commercial / Industrial
32	5-10	7.9	Commercial / Industrial
33	5-10	0.8	Commercial
35	5-10	5.1	Residential
35	5-10	9.5	Residential / Commercial
44	5-10	1.2	Residential
45	5-10	4.6	Residential
47	5-10	3.8	Residential
48	5-10	1.3	Residential
57	5-10	1.8	Residential
59	5-10	0.5	Residential
59	5-10	0.1	Residential
59	5-10	0.4	Residential



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New Development - 10 to 20 Years

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Figure 5

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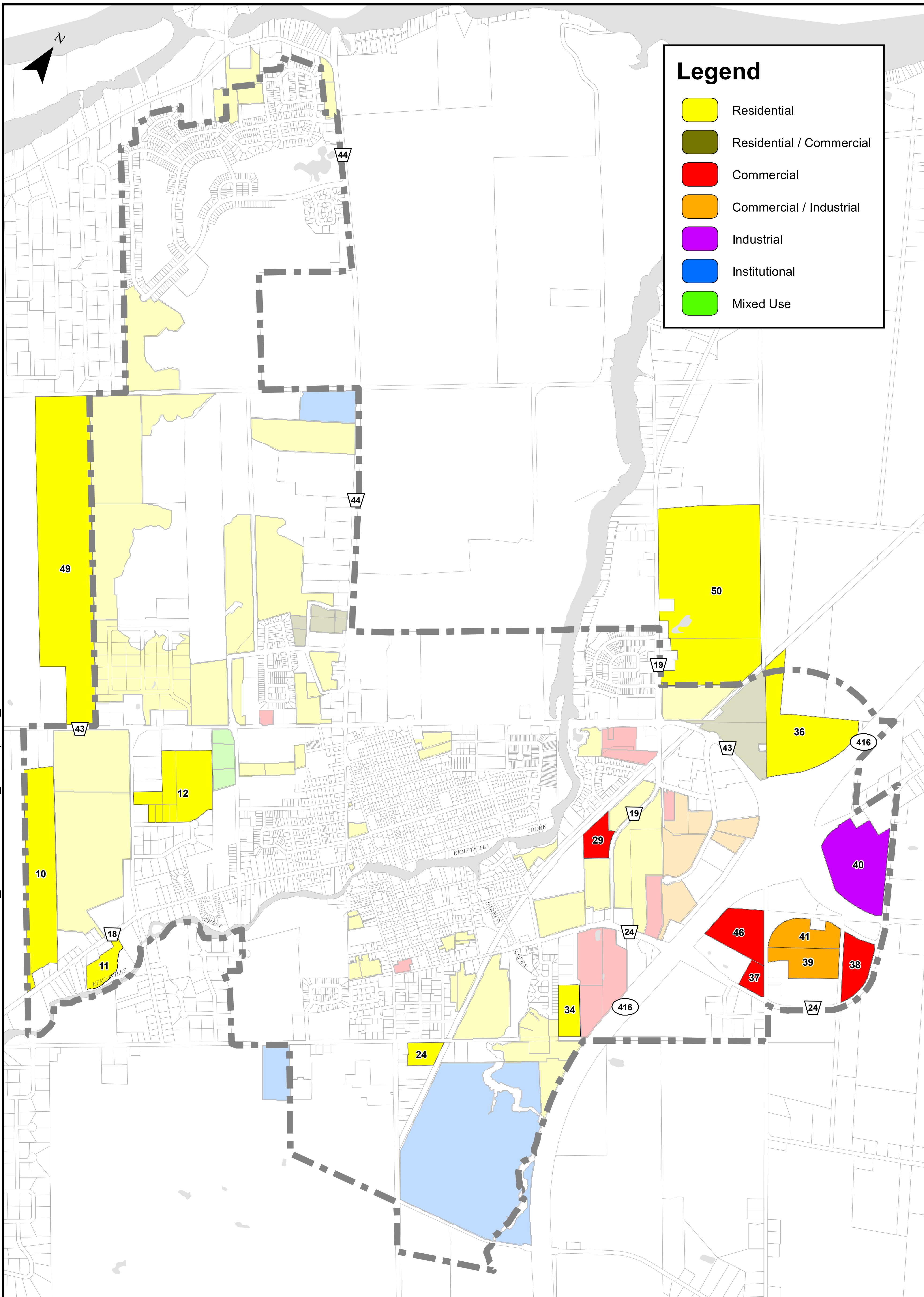
Table 6: New Development - 10 to 20 Years

Map ID	Period	Area (ha)	Type of Development
2	10-20	14.3	Residential
4	10-20	8.0	Residential
5	10-20	4.3	Institutional
6	10-20	11.6	Residential
8	10-20	9.3	Residential
10	10-20	23.3	Residential
10	10-20	12.0	Residential
13	10-20	1.5	Mixed Use
15	10-20	0.6	Residential
26	10-20	7.4	Residential
28	10-20	0.2	Commercial
30	10-20	3.3	Residential
30	10-20	11.2	Residential
30	10-20	2.6	Residential
34	10-20	6.8	Commercial
34	10-20	3.6	Commercial
42	10-20	0.5	Commercial
43	10-20	2.5	Commercial
47	10-20	2.7	Residential
47	10-20	2.5	Residential
48	10-20	4.0	Residential
48	10-20	1.1	Residential
48	10-20	0.6	Residential
52	10-20	6.0	Residential
55	10-20	1.3	Residential
56	10-20	1.1	Residential
58	10-20	2.4	Residential



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New Development - 20+ Years

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Figure 6

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Table 7: New Development - 20+ Years

Map ID	Period	Area (ha)	Type of Development
10	20+	15.9	Residential
11	20+	2.5	Residential
12	20+	10.5	Residential
24	20+	1.8	Residential
29	20+	2.4	Commercial
34	20+	2.9	Residential
36	20+	13.8	Residential
37	20+	1.6	Commercial
38	20+	4.0	Commercial
39	20+	4.7	Commercial / Industrial
40	20+	11.8	Industrial
41	20+	4.3	Commercial / Industrial
46	20+	5.5	Commercial
49	20+	42.4	Residential
50	20+	44.3	Residential

2.3 Natural Environment

Information available from Rideau Valley Conservation Authority (RVCA) shows the Study Area falling within the Kemptville Creek and Lower Rideau River Subwatershed, part of the Rideau Valley Watershed. Refer to the table below for the list of catchment areas found within the Study Area. Kemptville Creek cuts through the Town of Kemptville, travelling north to the Rideau River

Table 8: Watershed and Catchment Areas within Study Area

Watershed	Subwatershed	Catchment Area	Water Quality Rating (1)
Rideau Valley Watershed	Kemptville Creek Subwatershed	Town of Kemptville Catchment Area	Fair (2)
		Barnes Creek Catchment Area	Poor (2)
	Lower Rideau River Subwatershed	Rideau River – Kars Catchment Area	Fair (3)
		Arcand Drain Catchment Area	Fair (3)

Notes:
1) Determined by the Canadian Council of Ministers of the Environment (CCME) Water Quality Index (CCME WQI)
2) Kemptville Creek Subwatershed Report, Rideau Valley Conservation Authority, 2013.
3) Lower Rideau River Subwatershed Report, Rideau Valley Conservation Authority, 2012.

Figure 7 identifies significant natural environment, wetland and floodplain areas within the Study Area. A number of Provincially Significant Wetlands are identified within the Study Area, primarily found north of County Road 43, bounded by County Road 44 and Kemptville Creek. Other unevaluated wetlands are also identified in the Study Area. Available Ministry of Natural Resources (MNRF) mapping notes no areas classified as Areas of Natural or Scientific Interest (ANSI) located within the Study Area.

An environmental site assessment and Species at Risk (SAR) assessment were not undertaken as part of this Master Plan. For all future undertakings identified under the Master Plan where terrestrial or aquatic habitats may be disturbed, it is recommended for an environmental site assessment and SAR assessment to completed to identify areas of environmental concern or other natural environmental constraints.

2.3.1 Geology

Surficial and bedrock geology of the Kemptville area is outlined in the 2019 Groundwater Vulnerability Study prepared by Golder. Refer to the study for more details.

In general, the Study area contains surficial deposits generally consisting of glacial till, offshore marine clay, and near shore fine to medium sand. Overburden thickness is generally 2-10m with local areas up to 20m. Silt and clay deposits are found in areas along Kemptville Creek and Rideau River.

2.3.2 Hydrogeology

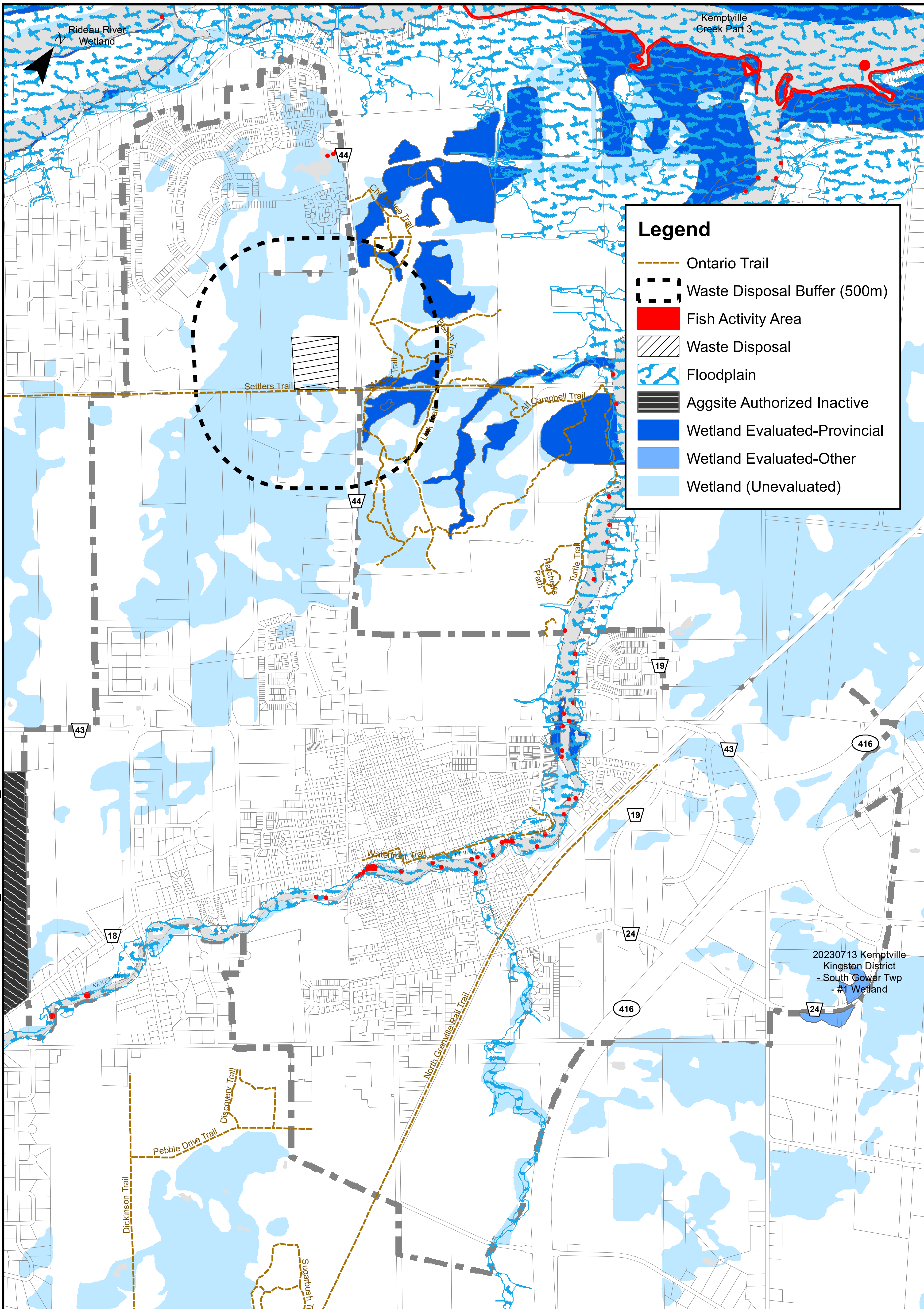
Hydrogeology and groundwater information of the Kemptville area are outlined in the 2019 Groundwater Vulnerability Study prepared by Golder. Refer to the study for more details.

Groundwater supply for drinking water is primarily sourced by bedrock aquifers. Overburden aquifers with sufficient quantities for domestic use are uncommon. The shallow bedrock aquifer is present in the Oxford Formation and is the primary source of water for private supply wells. The deep bedrock aquifer is present in the lower March formation and within the Nepean Formation and is the primary source of water for larger commercial and municipal groundwater supply systems, including Kemptville and Merrickville. The aquifer is generally productive. Groundwater quality is generally good but hard, with localized occurrences of elevated iron, sodium, chloride and hydrogen sulphide.

2.3.3 Source Water Protection

Wellhead Protection Areas (WHPA) are area surrounding a well, where contaminants are reasonably likely to travel though an aquifer towards the well. The innermost wellhead protection area (Zone A) is a 100m circle around the well. Other wellhead protection areas are drawn around the wells based on computer models simulating groundwater movement, depending on the estimated time of travel of contaminants. WHPA Zones B, C, and D indicate the travel times of 2 years, 5 years and 25 years respectively. The RVCA also identified the vulnerability scores within the WHPAs. The score ranges from 0 to 10, where 10 is the most vulnerable. These scores help determine the level of protection needed to safeguard the drinking water source from contamination.

Figure 8 shows the groundwater wellhead protection zones, provided by the Rideau Valley Conservation Authority (RVCA) online mapping tools for Source Water Protection (SWP).
The Study Area generally falls within WHPA Zone B, transitioning to Zone C and D towards the north, with groundwater vulnerability scores of 6, 4 and 2 respectively. The 2019 Groundwater Vulnerability Study prepared by Golder further outlines the modeling undertaken for the WHPA and groundwater vulnerability mapping.



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Plot Date: Friday, February 21, 2025 2:05:49 PM

PROJECT:

North Grenville Water and Sewer Master Plan

Kemptville, Ontario

DRAWING:

Natural Environment and Constraints

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DESIGN:	AG
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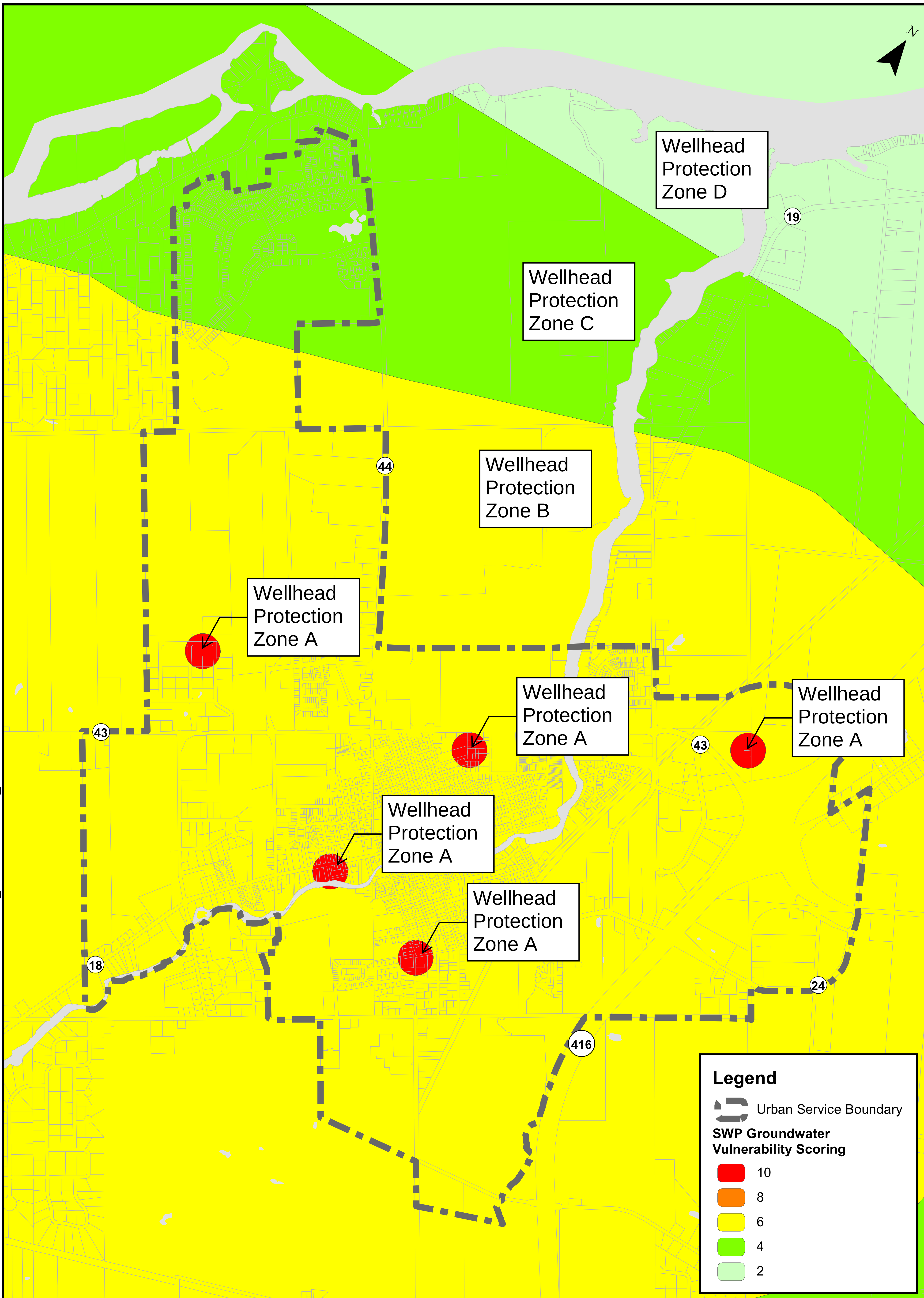
DRAWING #: Figure 7



PROJECT:
North Grenville Water and Sewer Master Plan
Kemptville, Ontario

DRAWING:
Wellhead Protection Areas

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Figure 8

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3.0 Identification and Evaluation of Servicing Strategies

3.1 Evaluation Methodology

Evaluation criteria were developed based on background information, experience on similar assessments, stakeholder comments, and consultation with the Municipality. The criteria fall within five categories: Natural Environment; Climate Change Resiliency; Social & Cultural Heritage Environment; Technical Feasibility; and Financial Considerations. The criteria are described in Table 9 below:

Table 9: Description of Evaluation Criteria

Major	Minor	Description
Natural Environment	Natural areas, terrestrial ecosystems, and wetlands	Impacts on natural areas, including terrestrial ecosystems and wetlands.
	Aquatic and terrestrial species	Impacts on construction and operations on aquatic and terrestrial species & their habitat, including species at risk
	Water quality and quantity	Impacts on water quality and quantity
Climate Change Resiliency	Climate Change Impacts	Impacts of climate change on the project such as elevated levels of precipitation, drought, and extreme weather.
	Ability to Mitigate	Ability of the project to mitigate climate change effects such as its contribution to greenhouse gas production and impacts on carbon sinks.
	Ability to Adapt	Ability of the project to adapt to impacts of climate change on the project, i.e., the resiliency and security of infrastructure.
Social & Cultural Heritage Environment	Cultural Heritage Resources	Impact of project on archeological resources, built heritage resources, and cultural heritage landscapes.
	Air Quality and Noise	Impacts from air quality and noise changes during construction and operation.
	Construction and Operation	Impacts of construction and operation on the public including visual aesthetic and commuting.
	Community	Impacts on local Indigenous communities, lands, and/or way of life; community facilities, institutions, and businesses; and residents.
Technical Feasibility	Constructability	Potential for challenges and constraints during construction.
	Ease of Operation & Operational Flexibility	Ease of operation and operational flexibility of the system.
	Ability to Expand Infrastructure	Ease with which the system can be expanded to accommodate the increase in projected flow.

Major	Minor	Description
Financial Considerations	Capital Costs	Impact of estimated capital costs.
	Operation and Maintenance Costs	Impact of estimated operation and maintenance costs.

The relative level of impact of each potential solution on each criterion was assessed based on the scoring system summarized in Table 10. The option that ranked the highest according to the scoring system was recommended as the preferred solution and presented to stakeholders to solicit input prior to finalization.

Table 10: Detailed Evaluation Impact Levels

Evaluation Impact Level
Strong Positive Impact
Slight Positive Impact
No Anticipated Impact
Slight Negative Impact
Strong Negative Impact

3.2 Opinion of Probable Cost

All opinion of probable costs referred to in this Master Plan are based on a Class ‘D’ estimate class, which is generally defined as follows:

- Work Definition: A description of the intended solutions with such supporting documentation as is available (definition of project typically in the order of 1% to 5%).
- Intended Purpose: To aid in the screening of various options prior to recommending a preferred solution.
- Level of Effort: Limited and expected accuracy could range from -25% to +50%.
- Opinion of Probable Costs: Completed using 2025-dollar value.

Further study will be required to determine development charges (DC) study costs, and estimates for Class EA, design, project management, and construction work for some projects.

As all costs are in 2025 dollars, the Municipality should account for yearly increases in the budgeted cost due to inflation and other factors.

4.0 Potable Water System

4.1 Existing System

The Municipality's drinking water system is serviced by five groundwater wells: the Alfred Street Well, Kernahan Street Well, Van Buren Street Well, East Quadrant Well, and the Northwest Quadrant Well. Each drilled well is protected by a stainless-steel casing and equipped with a submersible well pump. Duty/standby metering pumps inject sodium hypochlorite into the raw water before it enters a storage reservoir for contact time. Duty/standby centrifugal pumps discharge the treated water into the distribution system. The wells are authorized under the Ministry of the Environment, Conservations and Parks (MECP) Permit to Take Water (PTTW) No. 5856-C8ZQ57. The combined PTTW daily water taking limit of all the Municipality's wells is 10,460.24 m^3/d.

The historical raw water demands provided by the Municipality are summarized below:

Table 11: Historical Raw Water Demands (2019 to 2023)

Year	Average Day Demand (m^3/d)	Maximum Day Demand (m^3/d)	Max Day Factor
2019	1967	2944	1.5
2020	1808	2871	1.6
2021	1816	3321	1.8
2022	2090	3446 (1)	1.6
2023	1817	2614	1.4
Overall	1900	3446	1.8

Notes:
(1) Single day max on October 26, 2022 (4,184 m^3/d) removed as an outlier.

As seen in Table 11, the overall average day potable water demand is 1,900 m^3/d, and the maximum day demand is 3,446 m^3/d. This maximum day demand is roughly 33% of the PTTW limit.

The Kemptville Drinking Water System operates under Municipal Drinking Water License (MDWL) No. 159-101 and the Drinking Water Works Permit (DWWP) No. 159-201, with a combined rated capacity of 6,820 m^3/d, with includes the Alfred Street, Van Buren Street, Kernahan Street and East Quadrant subsystems. With the addition of the new Northwest Quadrant system in 2022, the combined rated capacity is 8,823 m^3/d. With the largest subsystem (East Quadrant) out of service, the total system capacity is 6,634 m^3/d. The table below has been updated to flows as noted in the DWWP and supersedes that in the Phase 1 report

Table 12: Drinking Water Treatment Subsystem Rated Capacities

Treatment Subsystem	Rated Capacity (m^3/d)
Alfred Street	1,961
Van Buren Street	1,364
Kernahan Street	1,309

Treatment Subsystem	Rated Capacity (m^3/d)
East Quadrant	2,186
Northwest Quadrant	2,000
Total MDWL Rated Capacity	**8,820**
Total System Capacity (largest subsystem out of service)	**6,634**

The historical treated water demands provided by the Municipality are summarized below:

Table 13: Historical Treated Water Demands (2019 to 2023)

Year	Average Day Demand (m^3/d)	Maximum Day Demand (m^3/d)	Maximum Day Factor
2019	1965	2859	1.5
2020	1815	2749	1.5
2021	1806	2661	1.5
2022	2082	3449 (1)	1.7
2023	1802	2684	1.5
Overall	1894	3449	1.8

Notes:
(1) Single day max on October 26, 2022 (4,205 m^3/d) removed as an outlier.

As seen in Table 13, the overall average day potable water demand is 1,894 m^3/d, and the maximum day demand is 3,449 m^3/d. This results in an overall maximum day factor of 1.82 times the average day demand. This maximum day demand is roughly 39% of the MDWL total rated capacity and roughly 52% of the total system capacity with one well subsystem out of service.

The Kemptville Drinking Water System has six (6) above-grade storage reservoirs, The following table summarizes the available storage at each of these reservoirs. The table has been updated to volumes as noted in the DWWP and supersedes that in the Phase 1 report:

Table 14: Existing Drinking Water Reservoir Storage Volume

Reservoir	Effective Storage Volume (m3)
Alfred	929
Van Buren	929
Kernahan	900
eQuinelle	1073
East Quadrant	1,370
Northwest Quadrant	1,370
Total	**6,571**

4.2 Design Criteria

Table summarizes the water demand rates used to evaluate the Municipality's potable water system.

Table 15: Design Criteria - Water Demand Rates

Land Use	Design Criteria	Maximum Day Factor (1)
Existing Residential (1)	256.4 L/cap/day	1.82
Future Residential (1)	256.4 L/cap/day	1.82
Future Commercial (2)	28,000 L/ha/day	1.82
Future Industrial (3)	35,000 L/ha/day	1.82
Future School (4)	70 L/student/day	1.82
Future Hotel (4)	225 L/bed/day	1.82
Future Retirement Home (5)	256.4 L/bed/day	1.82

Notes
(1) Historical Flow Analysis
(2) MECP Drinking Water Design Guidelines 3.4.3
(3) MECP Drinking Water Design Guidelines 3.4.4
(4) MECP Drinking Water Design Guidelines Table 3-2
(5) Assumed residential ADD

Peak hour factors are based on Table 3-1 of the MECP Drinking Water Design Guidelines, based on population.

4.3 Water Supply Alternatives

An evaluation of potential options for water supply for Kemptville urban serviced area was completed during Phase 2 of this Master Plan. The evaluation considered potential constraints with the existing wells and potential options for increasing the capacity of the system.

The water supply constraints are summarized in Table 16 below.

Table 16: Drinking Water Supply Constraints

Period	Max Day Demand Design Basis (m^3/d)	Deficit (Existing Supply (1)) (m^3/d)
Existing (2025)	3,449	none
Short Term	4,941	none

Period	Max Day Demand Design Basis (m^3/d)	Deficit (Existing Supply [(1)]) (m^3/d)
(2026-2031)		
Mid-Term (2031-2036)	8,188	1,554
Long-Term (2036-2046)	14,053	7,419
Buildout (beyond 2046)	21,726	15,092
Notes: 1) Existing supply defined as the total system capacity with the largest subsystem out of service (6,634 m^3/d).		

It is generally best practice that municipalities investigate and undertake water conservation measures to reduce the demand on the water supply system. Investigating these measures is outside the scope of this Master Plan but as they are beneficial, they are recommended.

4.3.1 Short Term (2026-2031)

As seen in Table 16 above, the short-term demands are within the water supply available for the system. No upgrades to water supply are expected to be required in this period.

4.3.2 Mid-Term (2031-2036), Long-Term (2036-2046), Buildout (beyond 2046)

As seen in Table 16 above, the water supply demands in the mid-term and beyond exceeds the water supply available for the system.

To address this deficit, an initial screening of options was conducted as follows:

4.3.2.1 Option 1: Do Nothing

The 'Do Nothing' approach examines what may occur if none of the alternatives are implemented; it is generally carried forward for detailed review for comparison.

4.3.2.2 Option 2 Expand Existing Well Capacity

This option consists of hydrogeological investigations to check if the existing well sites can operate at a higher capacity. This can include pump tests of the well to confirm yield, extending the well deeper, installing a second well, etc. In all of these options, the investigations will also confirm if the higher capacity is sustainable for the aquifer, and mitigate interferences with other nearby groundwater wells. If the capacity can be increased, the pumping station may need to be upgraded to accommodate the new flows. However, the expansion of existing wells may only yield a small increase in capacity, and is unlikely to be sufficient to address the projected deficits. Other options would need to be explored to increase the water supply. A capacity increase for the existing well sites will require an amendment to the Municipality's PTTW to raise the allowable water taking limit, as well as amendments to the MDWL and DWWP. An amendment to the Source Protection Plan may also be required due to the increased pumping from the well.

Based on the considerations above, this alternative is not recommended to be carried forward for detailed evaluation, but instead can be carried in part with other options.

4.3.2.3 Option 3: Develop New Wells

Developing a new well consists of selecting a well site, undertaking tests to assess the capacity of the proposed site, drilling the new well, and installing the associated treatment system. New watermains will need to be constructed to connect the well to the existing trunk main. The well building or pumphouse would contain treatment systems such as a new sodium hypochlorite feed system, monitoring equipment, chlorine contact chambers, and/or other treatment systems identified in the later phases of the design.

The ability of Kemptville's potable water system to be resilient in the face of future long-term effects of climate change is limited by its reliance on groundwater as a water source. Recent groundwater studies indicate that the Nepean Sandstone formation is a vast regional aquifer that is expected to remain a viable source of supply. It is recommended that well monitoring for changes in supply and the groundwater levels be maintained over the long term.

Based on the background studies for locating other well sites in Kemptville, the average expected yield of candidate sites was about 2,000m^3/d. To meet the projected buildout deficits several new wells would be required over the next 20 years. This is a costly endeavor due to locating enough candidate sites, possible interferences with other wells in close proximity, and a concern with the overall sustainable supply of the aquifer.

This option would require a Schedule 'B' Class EA, PTTW application, amendments to the Drinking Water Works Permit (DWWP) and MDWL, an update to the Source Water Protection Plan, and other studies as required for design or by the MECP. The location of the well should be determined based on separation distances from other wells, sources of contamination, and surface water as part of the Class EA. A test well should be drilled at the proposed location to determine the expected yield. It is recommended that with any new well, an additional well be considered to offer added redundancy and operational flexibility in the event of equipment breakdown and/or scheduled maintenance. The requirement for new additional trunk watermain should also be evaluated.

Based on the considerations above, this alternative is recommended to be carried forward for detailed evaluation.

4.3.2.4 Option 4: New Surface Water Treatment Plant

The construction of a new Water Treatment Plant (WTP) will consist of selecting a site, constructing the treatment plant building along with the intake, and installing watermains to connect the plant to the existing trunk main. The building will house new mechanical and treatment systems. Treatment is typically achieved through coagulation, flocculation, sedimentation, filtration, and disinfection systems such as filters, activated carbon feed, and sodium hypochlorite feed systems. These are supported by various pumps and storage tanks such as those for backwashing filters.

The Rideau River runs along the northern border of North Grenville and would be the preferred surface water source due to its accessibility and size. Further investigations would be required to confirm it will be a sustainable water source and establish the treatment requirements. The WTP intake would need to be located upstream of the WPCP outfall. Several considerations are needed to identify and evaluate potential locations along the Rideau River, such as environmental impacts, property acquisition, physical limitations, establishing an intake protection zone.

As Kemptville is currently serviced by groundwater sources, consideration will need to be given whether the WTP will supplement or completely replace the existing system. The blending of groundwater and surface water sources may pose water quality challenges that require additional treatment and operational measures to overcome. This will need to be reviewed in further detail in future studies and detailed design. The study can look at options such as splitting the water distribution system (e.g. new surface water system in the north, existing groundwater supply in the south), blending surface and groundwater sources, or replacement of groundwater entirely with surface water. Pilot studies can also be conducted to test the feasibility of a blended system and determine treatment requirements.

This option would require a Schedule ‘C’ Class EA, PTTW application, an update to the Source Water Protection Plan, and studies required for design or by the MECP. These studies, as well as the design and construction of the WTP, would be several years away, and may not be ready in time to address the mid-term deficits.

Based on the considerations above, this alternative is recommended to be carried forward for detailed evaluation.

4.3.2.5 Option 5: Hybrid Servicing Strategy

This option consists of a combination of the previous options, to best service Kemptville through the growth of the community. The option consists of the following:

- Initiate investigations to assess feasibility to expand existing well capacities.
- Initiate a Schedule ‘B’ Class EA to install 1-2 new groundwater wells to address mid-term supply deficits.
- Initiate a Schedule ‘C’ Class EA for a new surface water treatment plant along the Rideau River, either to supplement the groundwater system with the remaining deficits, or replace the groundwater sources and service the entire buildout supply demand.

This option addresses near-term water demand needs to continue growth in the community, while allowing for sufficient time to complete the investigations required to consider the construction of a WTP to service long-term needs and beyond.

Based on the considerations above, this alternative is recommended to be carried forward for detailed evaluation

4.3.2.6 Water Supply Alternatives Evaluation

The summary of the evaluation is in the table below. The preferred solution is Option 4 (Hybrid Servicing Strategy.

A Schedule 'B' and Schedule 'C' Class EAs must be undertaken prior to the design and construction process. A water model analysis should also be undertaken to evaluate if any additional upgrades to the water distribution system are required. In addition, the MCM's screening checklists (Criteria for Evaluating Archaeological Potential, Criteria for Evaluating Marine Archaeological Potential, and Criteria for Evaluating Potential for Built Heritage Resources and Cultural Heritage Landscapes) will be required to be completed during the Environmental Assessment process.

For the purposes of this Master Plan and the water model analysis for future growth conditions, it is assumed that two new municipal well sites will be constructed, and the new WTP would supplement the existing water supply system, and be sized at a capacity for the remaining deficits for long term and buildout growth conditions. Assuming each well site has an anticipated yield of 2,000 m^3/d, the capacity of the WTP for buildout would be approximately 11,100 m^3/d.

In discussion with the Municipality, potential locations for the two new well sites and WTP were also proposed for the water model analysis of future growth conditions. For the purposes of the water modeling completed within this Master Plan Study, the proposed location of the WTP is on Municipality-owned land on Honour Way, and the wells sites proposed on Municipality-owned land along Concession Road and County Road 44. Another potential site for a new well site could be on the Municipality-owned land along County Road 44 near Curtis Ave (this location was not included in water model exercise). These locations will need to be reviewed and evaluated against others potential sites at the Class EA stage. The well sites will also require hydrogeological investigations and test wells to confirm a sustainable yield of groundwater. If alternate locations are selected, it is recommended for the water model to be reviewed to confirm potential upgrades to the water distribution and pumping systems. Refer to Figure 12 to Figure 15 for the proposed locations.

Table 17: Water Supply Alternatives Evaluation

Criteria	Option 1: Do Nothing	Option 3: Develop New Wells	Option 3: New Surface Water Treatment Plant	Option 4: Hybrid Servicing Strategy
Natural Environment	No impact on water quality or quantity.	It is expected the local aquifer can support additional water supply from some new well(s) based on the available information, but additional studies are required to assess sustainability for long term or buildout flow demands.	Additional studies required to assess if surface water can support a new WTP.	It is expected the local aquifer can support additional water supply from a new well(s) based on the available information. Additional studies required to assess if surface water can support a new WTP.
Evaluation	No Impact	Slight Negative Impact	Slight Negative Impact	Slight Negative Impact
Climate Change Resiliency	Makes Kemptville's potable water infrastructure vulnerable to impacts of climate change (e.g., drought conditions).	Less infrastructure to develop and maintain water supply, which results in the least GHG emissions of the options. Increases redundancy by developing additional wells. Aquifer is expected to remain a reliable source but reliance on groundwater limits the system's resiliency.	Larger infrastructure produces more GHG emissions from long-term operations and construction. The WTP will allow for more resiliency in the water supply system.	Larger infrastructure produces more GHG emissions from long-term operations and construction. While Groundwater wells are potentially vulnerable to impacts of climate change, the WTP will allow for more resiliency in the water supply system.
Evaluation	Slight Negative Impact	Slight Negative Impact	Slight Positive Impact	Slight Positive Impact
Social, Cultural, Heritage Environment	No impacts on social, cultural, and heritage resources, air quality, or the community. No construction or operation impacts.	Lower individual impacts for each well site on social, cultural, and heritage resources, air quality, or the community. Lower construction or operation impacts for each well site. However, impacts increase as more wells are developed.	Impacts on social, cultural, and heritage resources, air quality, or the community. Possible construction or operation impacts.	Impacts on social, cultural, and heritage resources, air quality, or the community. Possible construction or operation impacts.
Evaluation	No Impact	Slight Negative Impact	Strong Negative Impact	Strong Negative Impact

Criteria	Option 1: Do Nothing	Option 3: Develop New Wells	Option 3: New Surface Water Treatment Plant	Option 4: Hybrid Servicing Strategy
Technical Feasibility	Will not be able to supply water for mid-term growth and beyond.	Several new well sites are required to supply water for long term growth, increasing O&M demands. Easily integrated into existing distribution system, but new wells need to be located to avoid interferences with existing sites.	Will be able to supply water for mid-term growth and beyond. Challenging to integrate WTP into the existing distribution system. A blended system may require additional treatment measures.	Will be able to supply water for mid-term growth and beyond. New wells are easily integrated into the existing distribution system. WTP will be challenging to integrate into the existing distribution system. A blended system may require additional treatment measures.
Evaluation	Strong Negative Impact	Slight Negative Impact	Strong Negative Impact	Slight Negative Impact
Financial Considerations	No capital costs. Inaction may lead to high financial impacts in the future.	Lower initial capital and operational costs, but will increase as more wells are developed.	High capital and operational costs.	Highest capital and operational costs.
Evaluation	Slight Negative Impact	Strong Negative Impact	Strong Negative Impact	Strong Negative Impact
Overall Evaluation	**Not Preferred**	**Not Preferred**	**Not Preferred**	**Preferred**

4.3.3 Potential Future Water Quality Treatment Requirements

The following section provides a summary of future potential water quality treatment requirements for consideration. These requirements could be adopted in Ontario based on emerging issues, Health Canada standards, and United States Environmental Protection Agency (US EPA) standards. It is recommended that the Municipality continue to monitor testing requirements on an as-needed basis.

4.3.3.1 Perfluoroalkylated substances (PFAS)

PFAS are a group of synthetic chemicals, commonly being perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA). According to Health Canada, these chemicals are widespread, typically used in industrial and consumer products (e.g., adhesives, cosmetics, cleaning products), specialized chemical applications (e.g., fire-fighting foams), and various coatings for paper and fabric.

Their carbon-fluoride bond prevents PFAS from breaking down easily, making them persistent in the environment. Health Canada Guidelines require drinking water to meet a maximum allowable concentration (MAC) of 0.2 µg/L PFOA, and 0.6 µg/L PFOS. The sum of PFOS and PFOA concentrations in drinking water, divided by their respective MAC, should not exceed one.

There are currently no specific requirements from the province of Ontario for monitoring PFAS. However, the provincial government may impose regulatory requirements related to PFAS removal, as potential exposure pathways and related health exposure risks are further researched and evaluated.

4.3.3.2 Disinfection By-Products (DBPs), Trihalomethanes (THMs) and Haloactitic Acids (HAAs)

DBPs occur when naturally occurring organic materials in water react with disinfectants, i.e., chlorine. Provincial and Health Canada guidelines require a running annual average of quarterly THM and HAA sampling results to be less than 0.10 mg/L and 0.08 mg/L, respectively.

The 2018 Edition of the Drinking Water Standards and Health Advisories Tables published by the US EPA requires a running annual average THM and HAA limit of 0.08 mg/L and 0.06 mg/L, respectively. Since it is common for Canadian federal and provincial regulations to conform to changes in regulations published by the US EPA, it is possible this more stringent requirement may be adopted in the future.

The Municipality of North Grenville Drinking Water System Annual Water Quality Reports from 2019 to 2023 a running average of quarterly samples taken from the distribution system. The reports indicate the average THM concentrations are below 0.08 mg/L and average HAA concentrations are below 0.06 mg/L.

4.3.3.3 Iron and Manganese

The Ontario Drinking Water Quality Standards (ODWQS) establishes minimum water quality requirements for drinking water in the province of Ontario. The standard identifies Maximum Allowable Concentrations (MAC), Operational Guidelines (OG), and the Aesthetic Objectives (AO) for various elements and compounds. The ODWQS indicates AOs of 0.3 mg/L for iron and 0.05 mg/L for manganese.

Health Canada issued a Technical Document in 2019 “Guidelines for Canadian Drinking Water Quality: Guideline Technical Document–Manganese” that established a stricter AO for manganese of 0.02 mg/L, and a MAC of 0.12 mg/L. The Technical Document further indicates that utilities establish a treated water goal of 0.015 mg/L or less for the design and operation of manganese treatment systems.

While these requirements are not in the ODWQS and remain under evaluation, they are likely to be adopted by the MECP soon.

The Municipality regularly tests the iron and manganese concentrations at each well site in the distribution system. Over the previous few years (2022 to 2025), the average iron concentrations at all well sites were below the ODWQS AO of 0.3 mg/L. The average manganese concentrations at all well sites were below both the ODWQS AO of 0.05 mg/L and the Health Canada AO of 0.02 mg/L.

4.4 Water Storage Strategies

An evaluation of potential options for water storage for the Kemptville Urban Serviced Area was completed during Phase 2 of this Master Plan. The total storage capacity requirements are the sum of the fire storage (‘A’), equalization storage (‘B’), and emergency storage (‘C’) allowances per the Ministry of Environment Conservation and Parks (MECP) Guidelines for Drinking Water Systems (MECP, 2008).

The water storage constraints identified in Phase 1 are summarized in Table 18 below.

Table 18: Water Storage Constraints

Period	Equivalent Population (1)	Volume (m^3)					
		Existing Storage	‘A’	‘B’	‘C’	Required Storage	Deficit
Existing	7,386	**6,571**	1,829	862	673	3,365	None
Short–Term (2026-2031)	10,406	**6,571**	2,087	1,235	830	4,152	None
Mid–Term (2031-2036)	17,361	**6,571**	3,668	2,047	1,429	7,144	573
Long–Term (2036-2046)	29,921	**6,571**	6,337	3,513	2,463	12,313	5,742

Period	Equivalent Population (1)	Volume (m^3)					
		Existing Storage	'A'	'B'	'C'	Required Storage	Deficit
Buildout (beyond 2046)	46,352	**6,571**	10,077	5,431	3,877	19,385	12,814

Notes:
1) Estimated to be equal to average day demand / per capita usage of 256.4 L/cap/d. The equivalent population also includes ICI flow contribution.

4.4.1 Short Term (2026-2031)

No water storage capacity constraints were identified in the short-term period during Phase 1. Therefore, no further assessment of storage strategies was considered for this planning period.

4.4.2 Mid-Term (2031-2036), Long-Term (2036-2046), Buildout (beyond 2046)

In the mid-term planning period and beyond, the storage requirements exceed the available storage in the water system.

To address this deficit, an initial screening was conducted as follows:

4.4.2.1 Option 1: Do Nothing

The 'Do Nothing' approach examines what may occur if none of the alternatives are implemented; it is generally carried forward for detailed review for comparison.

4.4.2.2 Option 2: Expand Storage at Well Sites

This option involves the construction of additional drinking water storage facilities at existing and new well sites.

- Constructing storage at new municipal groundwater well sites
- Additional storage at existing East Quadrant and Northwest Quadrant subsystems

The Municipality has previously expressed their preference for at-grade reservoirs due to the operational and maintenance advantages. Construction of an at grade reservoir are expected to minimal impact on normal operations, since high lift pumps would still be required to maintain a pressure above-grade that is consistent with the existing high lift pumping systems. Emergency operations would also remain unaffected, as fire pumps would still be required to accommodate for fire flow demands. A water model analysis would be recommended to be undertake with the design of these storage reservoirs to confirm system pressures and pump requirements. The size of storage reservoirs at new well sites would also be limited to space constraints within proposed property limits. It is also recommended for candidate well sites to consider room for expansion of storage facilities as needed to accommodate future growth.

Both the East Quadrant and Northwest Quadrant subsystems were designed to accommodate the installation of an additional at-grade storage tank. The new tanks will be a cylindrical, glass-fused-to-steel above-grade reservoir, of the same size as existing (1,370 m^3 of available volume each)

The construction of a new storage tank at the new well sites would require a Schedule ‘B’ Class EA, but can be combined with the EA study for the new municipal well sites. The expansion of storage at the existing East Quadrant and Northwest Quadrant subsystems is currently exempt from an EA.

Based on the considerations above, this alternative is recommended to be carried forward for detailed evaluation.

4.4.2.3 Option 3: New Elevated Tank

This option involves constructing a new elevated tank to fulfill water storage requirements. Elevated tanks are typically coated steel tanks placed on a support structure. The elevated tank water level corresponds to the instantaneous pressure in the system, which means no additional pumping is required beyond any well pumps and pumping stations that fill the elevated tank. An elevated tank has relatively lower operation and maintenance requirements when compared to a continually operating pumping station that has more equipment, valves, and ancillary systems to maintain a pressurized system. Since the elevated tank water level sets the pressure in the system, it does not require sophisticated control systems to ensure safe and reliable water distribution system operation.

However, the current water distribution system maintains its pressures by the control of multiple interconnected pumping stations, and is not set up to readily compatible with an elevated tank. Extensive upgrades to the various pumps and trunk watermains are required to centralize water supply to a single elevated storage location by connecting all well sites dispersed through the urban serviced Kemptville area. This scope of the upgrades requires a dedicated review of the drinking water system in a level of detail beyond the scope of this Master Plan. A Schedule ‘B’ Municipal Class EA is also required prior to installing the elevated storage tank.

Based on the considerations above, this alternative is recommended to be carried forward for detailed evaluation.

4.4.2.4 Option 4: Hybrid Storage Strategy

This option is a combination of Options 2 and 3, consisting of the following:

- Include at-grade storage reservoirs with the construction of each new municipal well sites.
- As required, install the additional at-grade storage reservoir at both the East Quadrant and Northwest Quadrant subsystems, of the same size as existing.
- Initiate a Schedule ‘B’ Class EA to explore a long-term water storage strategy, including further evaluation of an elevated storage tank, to accommodate the requirements for long term and build out conditions.

This option offers the Municipality flexibility to address near-term growth needs while determining overall storage strategy for the future.

Accounting for the expansion of storage at the existing East Quadrant and Northwest Quadrant subsystems (additional 1,370m^3 each), the total additional storage volume is 2,740m^3. To accommodate long-term growth, the total storage volume required at the new well sites would be 3,076m^3 split among the number of proposed sites. For example, if two well sites are installed, each would include a storage volume of 1,538m^3.

Based on the considerations above, this alternative is recommended to be carried forward for detailed evaluation.

4.4.2.5 Water Storage Alternatives Evaluation

The summary of the evaluation is in the table below. The preferred solution is Option 4 (Hybrid Storage Strategy.

A Schedule ‘B’ Class EA must be undertaken prior to the design and construction process. A water model analysis is recommended to evaluate if any additional upgrades to the water distribution system are required. In addition, the MCM’s screening checklists (Criteria for Evaluating Archaeological Potential, Criteria for Evaluating Marine Archaeological Potential, and Criteria for Evaluating Potential for Built Heritage Resources and Cultural Heritage Landscapes) will be required to be completed during the Environmental Assessment process.

Table 19: Water Storage Alternatives Evaluation

Criteria	Option 1: Do Nothing	Option 2: Expand Water Storage	Option 3: New Elevated Tank	Option 4: Hybrid Storage Strategy
Natural Environment	No impact on water quality or quantity.	Some impact due to new construction.	Some impact due to new construction.	Some impact due to new construction.
Evaluation:	No Impact	Slight Negative Impact	Slight Negative Impact	Slight Negative Impact
Climate Change	Leaves Kemptville potable water system vulnerable to impacts of climate change (ex. droughts).	Expanded infrastructure makes community more resilient.	New infrastructure makes community more resilient. Lower GHG emissions from less energy to maintain system pressure	Expanded infrastructure makes community more resilient.
Evaluation:	Strong Negative Impact	Slight Positive Impact	Strong Positive Impact	Strong Positive Impact
Social & Cultural Heritage Environment	No impacts on social, cultural heritage resources, air quality, or the community. No construction or operation impacts.	Some impacts on social, cultural, and heritage resources, air quality, or the community. Some construction impacts.	High impacts on social, cultural, and heritage resources, air quality, or the community. High construction impacts.	Some impacts on social, cultural, and heritage resources, air quality, or the community. Some construction impacts.
Evaluation:	No Impact	Slight Negative Impact	Strong Negative Impact	Slight Negative Impact
Technical Feasibility	Will not be able to support mid-term growth demands.	Improves water distribution system. Size of storage reservoirs may be restricted by property availability. Easy to maintain. Easy to integrate into current water distribution system	Improves water distribution system. Requires extensive modification to integrate existing system to a centralized location. But once established, operation of pumps is simplified.	Improves water distribution system. Offers Municipality flexibility to address near-term needs while determining overall storage strategy for the future.
Evaluation:	Strong Negative Impact	Slight Positive Impact	Slight Negative Impact	Strong Positive Impact

Criteria	Option 1: Do Nothing	Option 2: Expand Water Storage	Option 3: New Elevated Tank	Option 4: Hybrid Storage Strategy
Financial	No capital costs. Inaction may lead to high financial impacts in the future from system failures.	Lower individual capital cost for each storage reservoir installation. Low Operational costs	High capital costs to construct elevated tank and modify existing distribution system. Operational costs are lowest of all options.	High capital cost depending on long-term storage strategy selected.
Evaluation:	Slight Negative Impact	Slight Negative Impact	Strong Negative Impact	Slight Negative Impact
Overall Evaluation:	**Not preferred**	**Not preferred**	**Not preferred**	**Preferred**

4.5 Water Distribution Strategies

To support future growth, new watermains will be installed to:

- Connect upcoming developments to the existing North Grenville potable water distribution system;
- Replace select aging mains;
- Improve supply reliability by increasing system looping.

As a result of the upcoming developments, the network will require pump station upgrades and watermain upgrades to supply the existing and future system, mainly with respect to achieving adequate water pressure and fire flow availability.

The following sections below summarize the system upgrades and new watermains required to achieve sufficient pressure and fire flow requirements under short-term (0-5 years), mid-term (5-10 years), long-term (10-20 years), and build-out (20+ years). Refer to the *North Grenville Water and Wastewater Master Plan Phase 1 Report* (refer to Appendix B) for existing and future water demands, water distribution system design criteria, and modelling results without the system upgrades listed below. The following system upgrades were added based on the summary of preferred watermain condition upgrades provided by the Municipality and model results.

As noted previously, the locations of the new well sites are dependent on field investigations and Class EA to review the suitability of the groundwater source. For the purposes of the Master Plan, locations were selected as outlined below. The Municipality may change the order of well sites to investigate first, or propose alternate locations for investigations. It is recommended for the water model to be reviewed once the locations are selected to confirm any upgrades to the water distribution system.

4.5.1 Short-Term (2026-2031)

Water system upgrades under the short-term growth scenario include condition upgrades of existing watermain infrastructure identified by the Municipality and upgrades to accommodate future growth scenarios (refer to Figure 12 and Appendix C):

<u>Condition-Driven Upgrades:</u>

- 200 mm watermain loop on James Street (from Georgina Street to Dodson Street);
- 200 mm watermain loop on Sanders Street (from Dodson Street to George Street East);
- 300 mm watermain upgrade on Rideau Street (from County Road 43 to Clothier Street West);
- 300 mm watermain upgrade on County Road 44 crossing the Kemptville Creek (from Clothier Street East to Reuben Crescent);
- 200 mm watermain loop on Reuben Crescent (from Riverside Park to the other end of Reuben Crescent);
- 300 mm watermain upgrade on Van Buren Street (from Prescott Street to Jack Street); and

- 300 watermain upgrade on Prescott Street (from Van Buren Street to Concession Road).

Growth-Driven Upgrades

- Various pump upgrades as outlined in Section 4.7.

4.5.2 Mid-Term (2031-2036)

Water system upgrades under the mid-term growth scenario include upgrades to accommodate future growth scenarios (refer to Figure 13 and Appendix C):

Growth-Driven Upgrades

- New Well located east of County Road 44 with a 300 mm diameter watermain connecting to the water distribution system.
- Decommissioning eQuinelle Pumping Station and Reservoir as outlined in Section 4.6.
- A pump upgrade as outlined in Section 4.7.

4.5.3 Long-Term (2036-2046)

Water system upgrades under the long-term growth scenario include condition upgrades of existing watermain infrastructure identified by the Municipality and upgrades to accommodate future growth scenarios (refer to Figure 14 and Appendix C):

Condition-Driven Upgrades

- 200 mm watermain loop on Concession Road (between Dr Gordon Crescent and Hurd Street) and Hurd Street (between Concession Road and Clothier Street West).

Growth-Driven Upgrades

- Surface Water Treatment Plant (WTP) north of Settlers Trail with a 300 mm diameter watermain connecting to the water distribution system.
- New Well located south of Concession Road with a 300 mm diameter watermain connecting to the water distribution system.
- Various pump upgrades as outlined in Section 4.7.

Note: All new junction elevations (nodes J-623 and J-625 in WaterCAD®) were based on Google Earth topography.

4.5.4 Build-Out (beyond 2046)

Water system upgrades under the build-out growth scenario include upgrades to accommodate future growth scenarios (refer to Figure 15 and Appendix C):

Growth-Driven Upgrades

- 200 mm watermain loop between Colonnade Drive near the East Quadrant Well and the new residential development north of Highway 416.
- Two (2) Highway Watermain Crossings as outlined in Section 4.8.

4.6 Decommissioning eQuinelle Pumping Station and Reservoir

The feasibility of decommissioning the eQuinelle Booster Pumping Station (BPS) and Reservoir was evaluated in the mid-term scenario and onwards given that new development can provide a redundant water supply watermain connection to eQuinelle. This would remove the eQuinelle pressure zone and the entire water distribution system would operate as one (1) pressure zone. The benefits of decommissioning eQuinelle pumping station include improving system redundancy and fire flow availability, eliminating the requirement for a pressure reducing valve (PRV) in the mid-term to delineate the two (2) pressure zones, and reduced operation and maintenance at the pumping station and reservoir.

As a result of decommissioning the eQuinelle BPS under mid-term conditions, the 300 mm diameter bypass pipe (P-553 in WaterCAD®) is recommended to establish a connection between the eQuinelle and Kemptville pressure zones.

In addition, the decommissioning of the eQuinelle reservoir will reduce the distribution system's overall storage capacity by 1,073 m^3. This lost volume should be accounted for in the sizing of future storage facilities. The Municipality can consider to defer the decommissioning to retain the storage capacity in the system until additional facilities installed. However, check valves would be required in the mid-term growth period in order to isolate the pressure zone from the rest of the system.

4.7 Pumping Stations and Supply Configuration

The water model was configured to simulate the following scenarios under existing, short-term, mid-term, long-term, and build-out demand conditions:

- Average Day
- Peak Hour
- Maximum Day plus Fire Flow

The pump configurations were adjusted (i.e. which pumps were operating) along with the addition of the new wells (Concession Road Well and County Road 44 Well) and Water Treatment Plant (WTP) to meet the future growth demands. For the purposes of the model, it was assumed the WTP would be sized with the capacity to supplement the remaining supply deficits for long-term and buildout growth. An iterative approach was applied to determine the optimal pump, well supply, and WTP control settings. Due to the nature of the system having multiple pumping stations, certain pumping configurations were not able to converge in the model. To address this modelling issue in all scenarios, a configuration of existing system pumps was explored before introducing new theoretical pumps.

Finalizing the location of Wells and WTP is essential prior to implementing any pumping station upgrades. The total dynamic head (TDH) at the pumping stations can be established during future preliminary design phase, once the supply capacities and storage options have been confirmed. It is recommended that a Schedule 'B' Class EA and groundwater testing requirements for the new wells commence in the short term to ensure they can be implemented into the water distribution system by the mid-term.

Based on feedback provided by the Municipality, two new well locations were proposed. One of the new wells will be added to the system under mid-term conditions, and the second well will be added under long-term conditions. Hydraulic connection of each location was investigated in the Water Model to determine which location should be applied under mid-term conditions. It was found that both locations can hydraulically connect to supply the system with the same pump configuration. The Municipality may therefore select either location to be constructed first (during the mid-term). For the purpose of the Master Plan, it was assumed that the new Well located off County Road 44 will be added under mid-term conditions and the new Well located off Concession Road will be added under long-term conditions.

The optimal pump configurations and supply from the Wells and WTP achieve pressure within the design criteria, where the highest pressure in the system remains below the maximum pressure requirement of 552 kPa (80 psi) per the MECP Design Guidelines. The optimal settings also achieve the required fire flows highlighted in the Phase 1 Report while maintaining system pressures above 140 kPa (20 psi) per the MECP Design Guidelines.

The maximum capacity that can be provided by each of the new wells and the WTP is 23.1 L/s and 128.5 L/s, respectively (refer to Section 4.3). The following pump configurations, well supply, and WTP control settings were found to optimize the system under each demand scenario while all High Lift Pumps (HLP) operated on their curve:

<u>Average Day Demand</u>

Table 20 shows the theoretical operating conditions of the pumps simulated by the water model during average day demand conditions.

Table 20: Operating Conditions under Average Day Demand

Period	Operating Pumps	Concession Road Well (L/s)	County Road 44 Well (L/s)	WTP (L/s)
Short-Term	• Kernahan Duty Pump 1 • Northwest Quad Duty Pump 1 • eQuinelle PMP-2	N/A	N/A	N/A
Mid-Term	• At all pumping stations Duty Pump 1 • eQuinelle PMPs Decommissioned	N/A	16.0	N/A
Long-Term	• Kernahan Duty Pump 1	23.1	23.1	34.0
Build-Out	• Alfred Duty Pump 1 • Kernahan Duty Pump 1	23.1	23.1	73.8

As shown in the table above, HLP upgrades are not anticipated under the average day demand scenario as the system can achieve sufficient pumping capacity for all future growth scenarios. Duty Pump 1 operates at the pumping stations as required to satisfy system demands. It is noted that only 34.0 L/s of supply was required by the future WTP as its full capacity (128.5 L/s at buildout) was not required to accommodate the long-term system demands.

Peak Hour Demand

Table 21 shows the theoretical operating conditions of the pumps simulated by the water model during peak hour demand conditions.

Table 21: Operating Conditions under Peak Hour Demand

Period	Operating Pumps	Concession Road Well (L/s)	County Road 44 Well (L/s)	WTP (L/s)
Short-Term	• Alfred Duty Pump 2 • East Quad Duty Pump 2 • Kernahan High-Capacity Pump • Northwest Quad High-Capacity pump • eQuinelle PMP-2	N/A	N/A	N/A
Mid-Term	• Alfred Duty Pump 2 • Kernahan Duty Pump 2 • Van Buren Duty Pump 2 • Northwest Quad Duty Pump 2 • East Quad High-Capacity Pump • eQuinelle PMPs Decommissioned	N/A	23.1	N/A
Long-Term	• Alfred Duty Pump 1 • Alfred Duty Pump 2 • Kernahan Duty Pump 2 • Van Buren High-Capacity Pump	23.1	23.1	128.5
Build-Out	• Alfred High-Capacity Pump • Van Buren High-Capacity Pump • Kernahan High-Capacity Pump • East Quad High-Capacity Pump	23.1	23.1	128.5

It is noted that high-capacity pumps are required under all future growth scenarios to accommodate the increased peak hour demands. The existing duty pumps and new water supplies, including the Wells and WTP, cannot adequately supply the system on their own. It is recommended that the Municipality upgrades their existing Duty 2 Pumps with sufficient capacity to supply the system under all peak hour demand scenarios given that high-capacity pumps should only be applied under the fire flow scenario.

It is recommended that Kernahan and Northwest Quad Duty Pumps 2 are upgraded under short-term to accommodate all future demands including build-out conditions and eliminate the requirement of two (2) pumps running at the same pumping station and/or high-capacity pumps at any pumping station. It is recommended that East Quad Duty Pump 2 is upgraded under mid-term to satisfy demands under all future conditions to build-out. It is recommended that Van Buren and Alfred Duty Pumps 2 are upgraded under long-term to satisfy demands under long-term and build-out conditions.

Maximum Day Demand plus Fire Flow

Table 22 shows the theoretical operating conditions of the pumps simulated by the water model during maximum day demand plus fire flow conditions.

Table 22: Operating Conditions under Maximum Day Demand plus Fire Flow

Period	Operating Pumps	Concession Road Well (L/s)	County Road 44 Well (L/s)	WTP (L/s)
Short-Term	• Alfred High-Capacity Pump • Van Buren High-Capacity Pump • Kernahan High-Capacity Pump • East Quad High-Capacity Pump • Northwest Quad High-Capacity Pump • eQuinelle PMP-1 • eQuinelle PMP-2 • eQuinelle PMP-3 • eQuinelle PMP-4 • eQuinelle PMP-5	N/A	N/A	N/A
Mid-Term	• Alfred High-Capacity Pump • Kernahan High-Capacity Pump • East Quad High-Capacity Pump • Northwest Quad High-Capacity Pump • eQuinelle PMPs Decommissioned	N/A	23.1	N/A
Long-Term	• Alfred High-Capacity Pump • Kernahan High-Capacity Pump • East Quad High-Capacity Pump • Northwest Quad High-Capacity Pump	23.1	23.1	43.0

Period	Operating Pumps	Concession Road Well (L/s)	County Road 44 Well (L/s)	WTP (L/s)
Build-Out	• Alfred High-Capacity Pump • Kernahan High-Capacity Pump • East Quad High-Capacity Pump • Northwest Quad High-Capacity Pump	23.1	23.1	128.5

It is noted that the WTP cannot contribute its maximum capacity of 128.5 L/s under long-term conditions. Under this growth scenario, the WTP was set to provide an interim system of 43 L/s to address over supply modelling errors that arise if a higher capacity is simulated in the model.

As shown in the table above, pump upgrades are not anticipated under the maximum day plus fire flow scenario as the system can achieve sufficient pumping capacity for all future growth scenarios. The high-capacity pump operates at the pumping stations as required to satisfy system demands. However, it is recommended that the Municipality refines the high-capacity pumps to work in conjunction while Van Buren high-capacity pump is also operating under mid-term to build-out growth scenarios.

4.8 Modelling Results

The WaterCAD® software platform was used to update the existing water distribution system's hydraulic model during Phase 1. For complete details regarding the modelling process, refer to the Phase 1 Report (included in Appendix B).

In the Phase 1 Report, it was advised to obtain confirmation that the Northwest Quad pumping station operates alone, without any contribution from the other pumping stations under average day demand for existing conditions. Upon further investigation and discussions with the Municipality, it was confirmed that the water distribution system operates based on the pump pressure set points which provide the system with sufficient pressure. Two (2) pumping stations turn on automatically under average day demand to achieve the required system pressures. The water model results show that only Northwest Quad Pumping Station (also referred to as Oxford Village pumping station) is operating under the existing average day demand scenario as it was sized to accommodate future flows and high demand scenarios. Thus, its contribution in the model under low demand scenarios results in a higher pressure than that of the other pumping stations. Since the pumping stations cannot meet or operate at this pressure, no flow contribution is expected from the other pumping stations in the model.

As discussed in the Phase 1 Report (refer to Appendix B), the total pump supply capacity is inadequate without modifying the pump operation. In Phase 2, upgraded pump configurations and watermain upgrades were evaluated with the additional water supply from the Wells and WTP to support the water distribution system for each future growth scenario under average day, maximum day, and peak hour demands. Shown below are the results based on the upgraded pump configurations listed in the previous section of this Report.

Refer to Appendix C for more detailed WaterCAD® results and schematics.

In Figure 9, simulation results under average day demand conditions across all projected growth scenarios indicated pressure ranges between 350 kPa and 550 kPa. These values remain within the MECP Design Guidelines' standard operating range of 276 kPa to 552 kPa. Notably, these pressures were attained without requiring any upgrades to the pumping stations, based on the existing pump configuration detailed in Table 20.

In Figure 10, simulated pressures under peak hour demand across all future growth scenarios ranged from 276 kPa to 550 kPa. These values align with the MECP Design Guidelines, which specify a normal operating pressure range of 276 kPa to 552 kPa. The achieved pressures reflect the incorporation of pumping station upgrades, as detailed in the pump configuration presented in Table 21.

In Figure 11, simulated pressured under maximum day demand plus fire flow requirements for future growth scenarios indicate the majority of nodes are projected to provide between 75 L/s and 250 L/s of fire flow. This surpasses the Ontario Building Code (OBC) minimum target of 45 L/s for a typical two-storey residence, and several nodes also meet or exceed the minimum fire flow target of 133 L/s as outlined by the Fire Underwriters Survey (FUS) and established in the Phase 1 Report. These results were achieved based on the pump configuration referenced in Table 22 and the proposed system upgrades detailed below.

While several nodes exhibit available fire flow levels below the FUS target of 133 L/s, each of these locations has demonstrated improvements over existing conditions. Examples of these nodes include eQuinelle zone, the Wastewater Treatment Plant (WWTP) on Honour Way, Concession Road, Hilltop Crescent, Westerra Way, and Dr. Gordon Crescent.

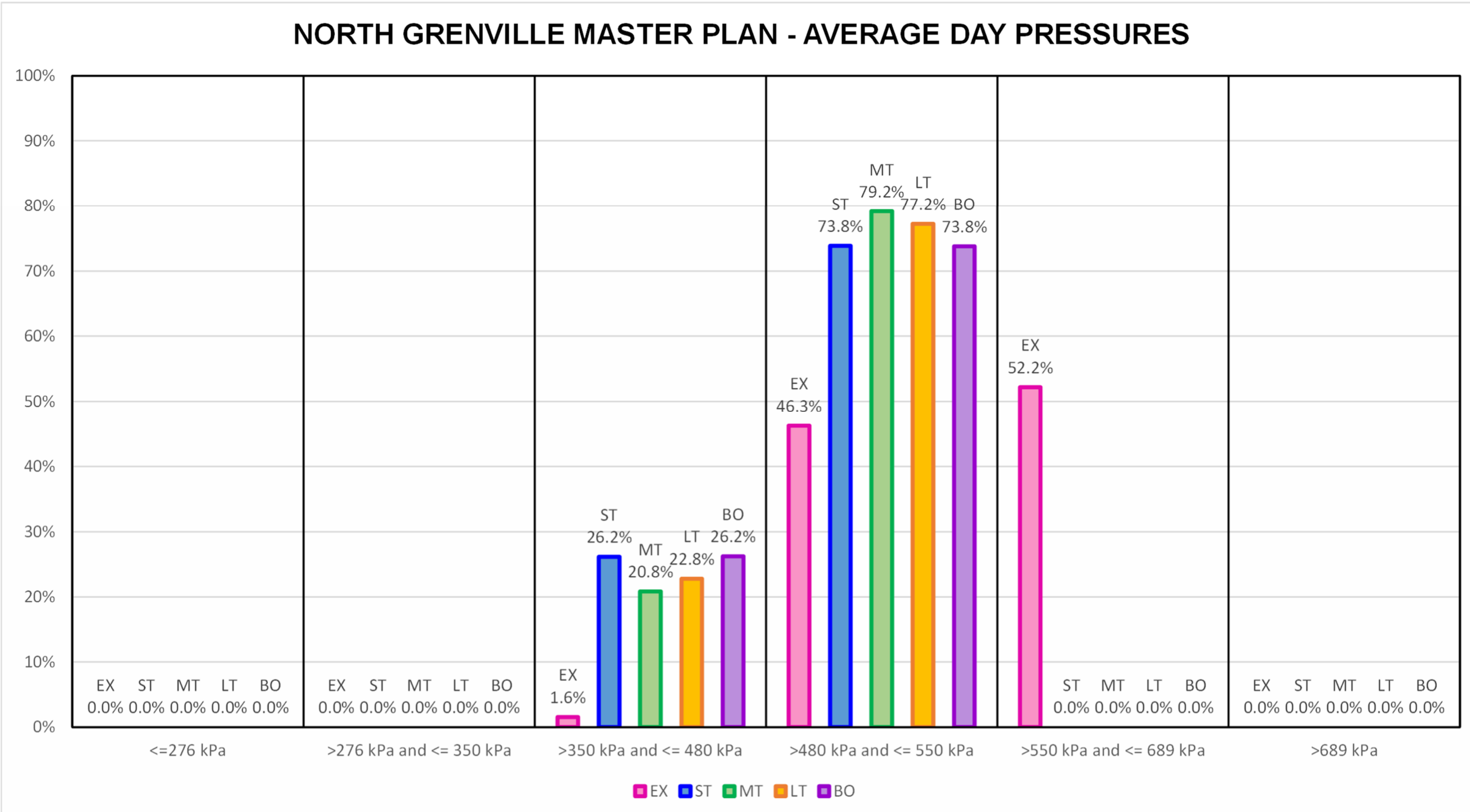


Figure 9: Percentage of Nodes within Listed Pressure Ranges during Average Day Demand

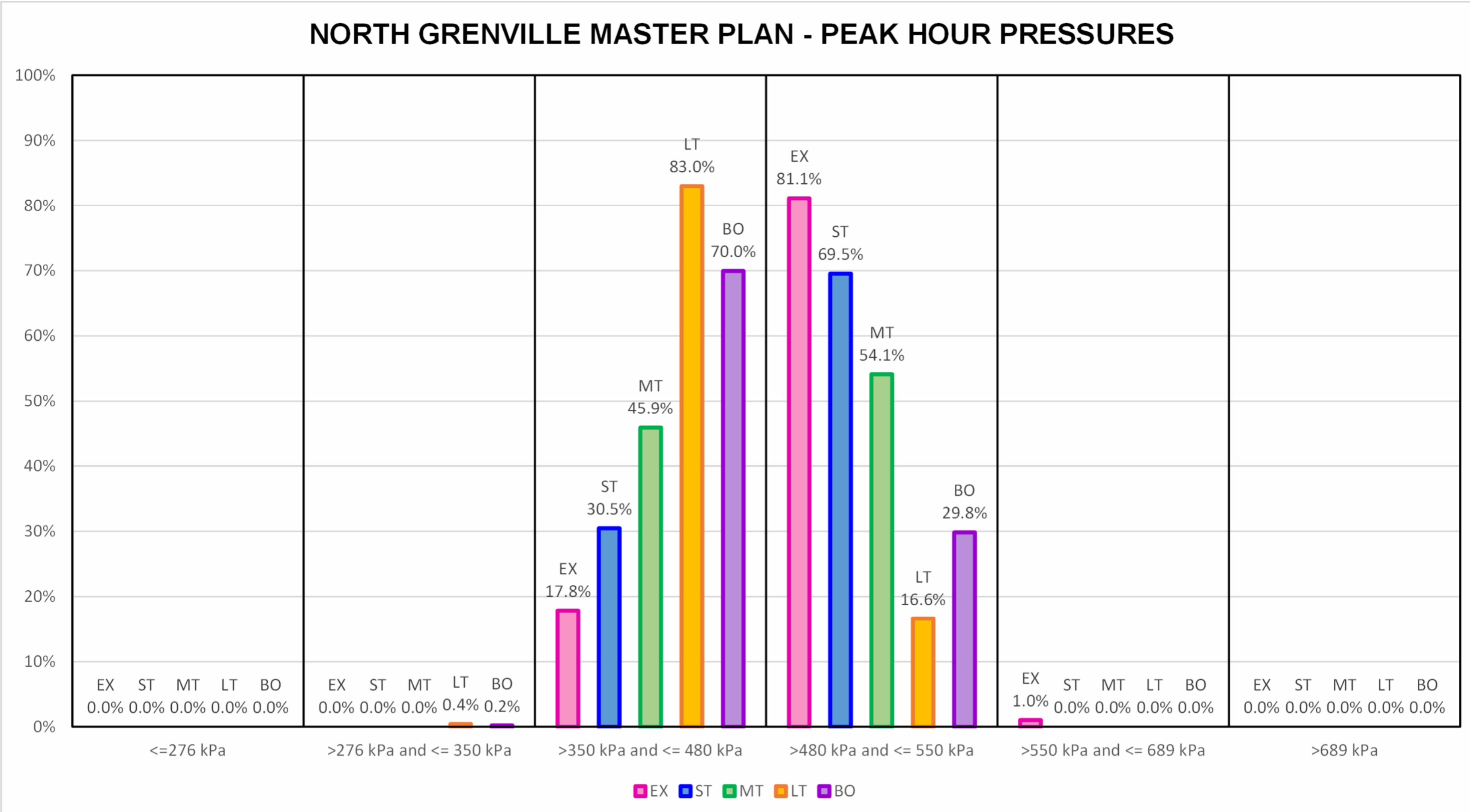


Figure 10: Percentage of Nodes within Listed Pressure Ranges during Peak Hour Demand

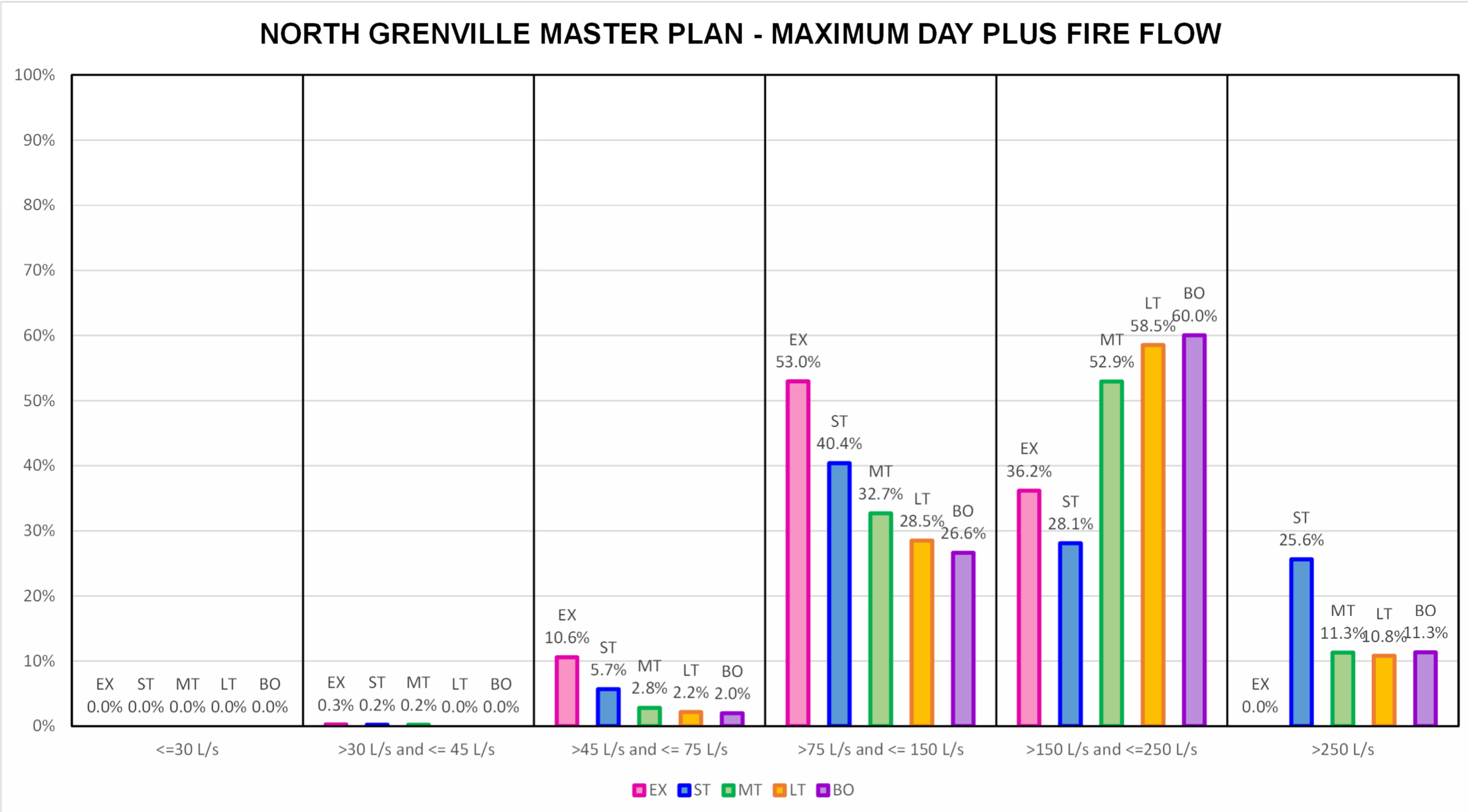


Figure 11: Percentage of Nodes within Listed Fire Flow Ranges during Maximum Day Demand Plus Fire Flow

4.9 Notable Items

The following sections highlight recommended watermain extensions to service the future developments under each growth period.

4.9.1 Short-Term (2026-2031)

Under short-term and mid-term conditions, only one node (H-1 in WaterCAD®) has a fire flow below the minimum Ontario Building Code (OBC) requirement. This node, located on a dead-end service line for the North Grenville District High School, has a modeled fire flow of 43 L/s. No upgrades are recommended given that the hydrant is located on a private service line under existing conditions.

Additionally, the Correctional Facility is shown to have a fire flow of 71 L/s in the water model. However, it is understood this facility will operate its own private system that satisfies its fire protection requirements, which is not represented in the water model (refer to Appendix C). No upgrades are recommended given that the facility consists of a private water system.

4.9.2 Long-Term (2036-2046)

For increased system redundancy, a second watermain can be added from the WTP to the broader network. This can be further investigated at the Detailed Engineering Design stage for the WTP.

4.9.3 Build-out (2046+)

As part of the future watermain looping strategy to support the industrial developments east of Highway 416, an additional highway crossing is proposed. Based on discussions with the Municipality (refer to Appendix C), the target fire flow for industrial developments is 150 L/s in accordance with OBC maximum fire flow. A 300 mm diameter crossing is recommended to connect the area east of Highway 416 with the future residential development adjacent to the East Quad Pumping Station.

The proposed crossing will contribute to system redundancy and ensure adequate fire flow capacity to meet OBC fire flow target. Due to its connection point near the future residential development (J563 in WaterCAD), a ‘Schedule B’ Environmental Assessment (EA) will be required to facilitate land acquisition. A Foundations Report will also be required for the Ministry of Transportation of Ontario (MTO) Approval for the length of watermain beyond the MTO right-of-way.

4.10 Water Model for Future Use

Coordination with the Municipality is required to confirm the water model developed in Phase 2 of the Master Plan is appropriate for use under existing conditions when evaluating new boundary condition requests and conducting studies/assessments. Additionally, it is recommended the existing pump configuration (i.e., which pumps are typically operational) should be verified once updated SCADA data including information from the Northwest Quad Pumping Station becomes available.

4.11 Water Distribution System Costing

The watermain costing excludes watermain looping and extensions to service future developments as it is assumed to be the developer's responsibility. Watermain condition costing was also excluded from the cost estimates as the replacements were not within the scope of the following Master Plan.

4.12 Summary of Potable Water System Strategies

A summary of the preferred solutions and watermain upgrades, including their costs, is included in the table below. Locations of these upgrades are depicted in Figure 12 to Figure 15.

Table 23: Potable Water System Solutions and Costs

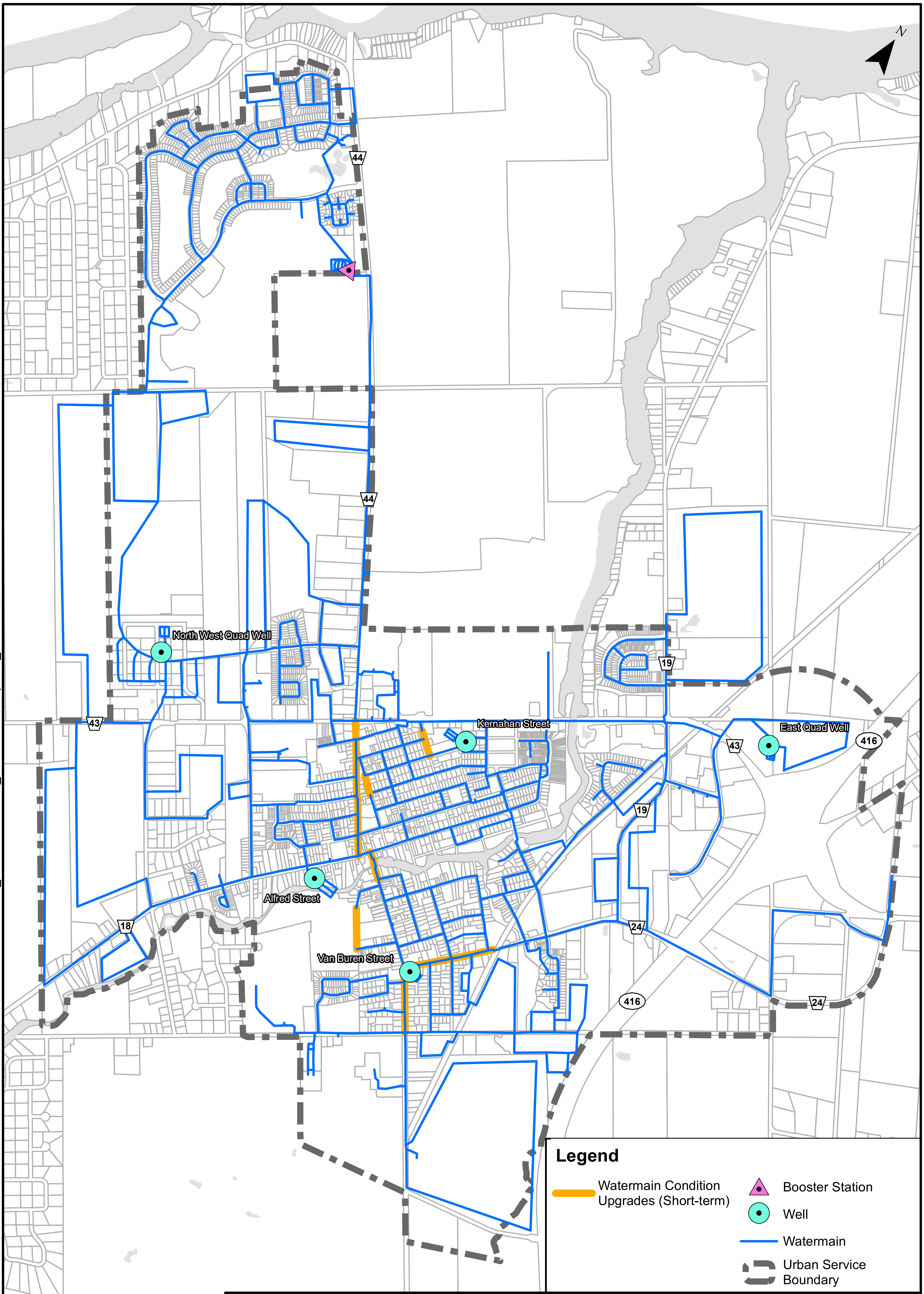
Project Type	Project	Short-Term (0-5 years)	Mid-Term (5-10 years)	Long Term (10-20 years)	Buildout (20+ years)	Details
Water Distribution	Alfred Duty Pump 2 Upgrades	-	-	$1M	-	
	Van Buren Duty Pump 2 Upgrade	-	-	$1M	-	
	East Quad Duty Pump 2 Upgrade		$1M	-	-	
	Northwest Quad Duty Pump 2 Upgrade	$1M	-	-	-	
	Kernahan Duty Pump 2 Upgrade	$1M	-	-	-	
	Decommissioning eQuinelle BPS (including removal, disposal, and demolition)	-	$500,000	-	-	
	Watermain Upgrade (decommissioning eQuinelle BPS)	-	$75,000	-	-	Length: 20 m Diameter: 300 mm
	Highway 416 Crossing (Open Cut Segment)	-	-	-	$2M	Length: 610 m Diameter: 300 mm
	Highway 416 Crossing (Trenchless Segment)	-	-	-	$3M	Length: 90 m Diameter: 300 mm
	Watermain Condition Upgrades	-	-	-	-	Condition upgrades currently planned by Municipality
Water Supply	Test well drilling and pump test – Well site #1	-	$500,000	-	-	
	Test well drilling and pump test – Well site #2	-	-	$500,000	-	
	New Well site #1 installation and expansion	-	$5M	-	-	

Project Type	Project	Short-Term (0-5 years)	Mid-Term (5-10 years)	Long Term (10-20 years)	Buildout (20+ years)	Details
	New Well site #2 installation and expansion	-	-	\$5M	-	
	New Surface Water Treatment Plant and intake pipe from Rideau River	-	-	\$48M *Or* \$75M	-	If supplementing existing groundwater supply (~11 MLD) If supplying entire buildout demand (~22 MLD)
Water Storage	Additional above grade Reservoir at East Quad well site (1,370m^3 storage volume)	-	-	\$1.5M	-	
	Additional above grade Reservoir at Northwest Quad well site (1,370m^3 storage volume)	-	-	\$1.5M	-	
	New above grade reservoir at new well site #1 (approx. storage volume 2,130 m^3)	-	\$2M	-	-	Additional storage from volumes noted in Section 4.4 to account for decommissioning of eQuinelle BPS.
	New above grade reservoir at new well site #2 (approx. storage volume 2,130 m^3)	-	-	\$2M	-	Additional storage from volumes noted in Section 4.4 to account for decommissioning of eQuinelle BPS.
Studies	Exploratory Studies to expand existing Well capacities	\$1M	-	-	-	For all existing well sites, including testing and Source Water Protection update.

Project Type	Project	Short-Term (0-5 years)	Mid-Term (5-10 years)	Long Term (10-20 years)	Buildout (20+ years)	Details
	Schedule ‘B’ Class EA to establish new well locations	$300,000	-	-	-	
	Schedule ‘C’ Class EA to construct a new Surface Water Treatment Plant	-	$400,000	-	-	
	Schedule ‘B’ Class EA to review future water storage strategies	-	$300,000	-	-	
	Geotechnical feasibility study for crossing Highway 416.	-	-	-	$200,000	
	Schedule ‘B’ class EA for crossing Highway 416	-	-	-	$200,000	
	TOTAL	**$ 3.3M**	**$ 9.78M**	**$ 60.5M - $ 87.5M**	**$ 5.4M**	

Notes:

1) Geotechnical, hydrogeological, archaeological and ecological information were not confirmed. Subsurface conditions also remain unknown and are not reflected in the OPC.
2) OPC excludes costs for property acquisition, dewatering, bedrock excavation, and electrical servicing.



Legend

- Watermain Condition Upgrades (Short-term)
- Booster Station
- Well
- Watermain
- Urban Service Boundary

PROJECT:

North Grenville Water and Sewer Master Plan

Kemptville, Ontario

DRAWING:

Water Infrastructure Improvements - Short-Term

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DRAWING #:

Figure 12

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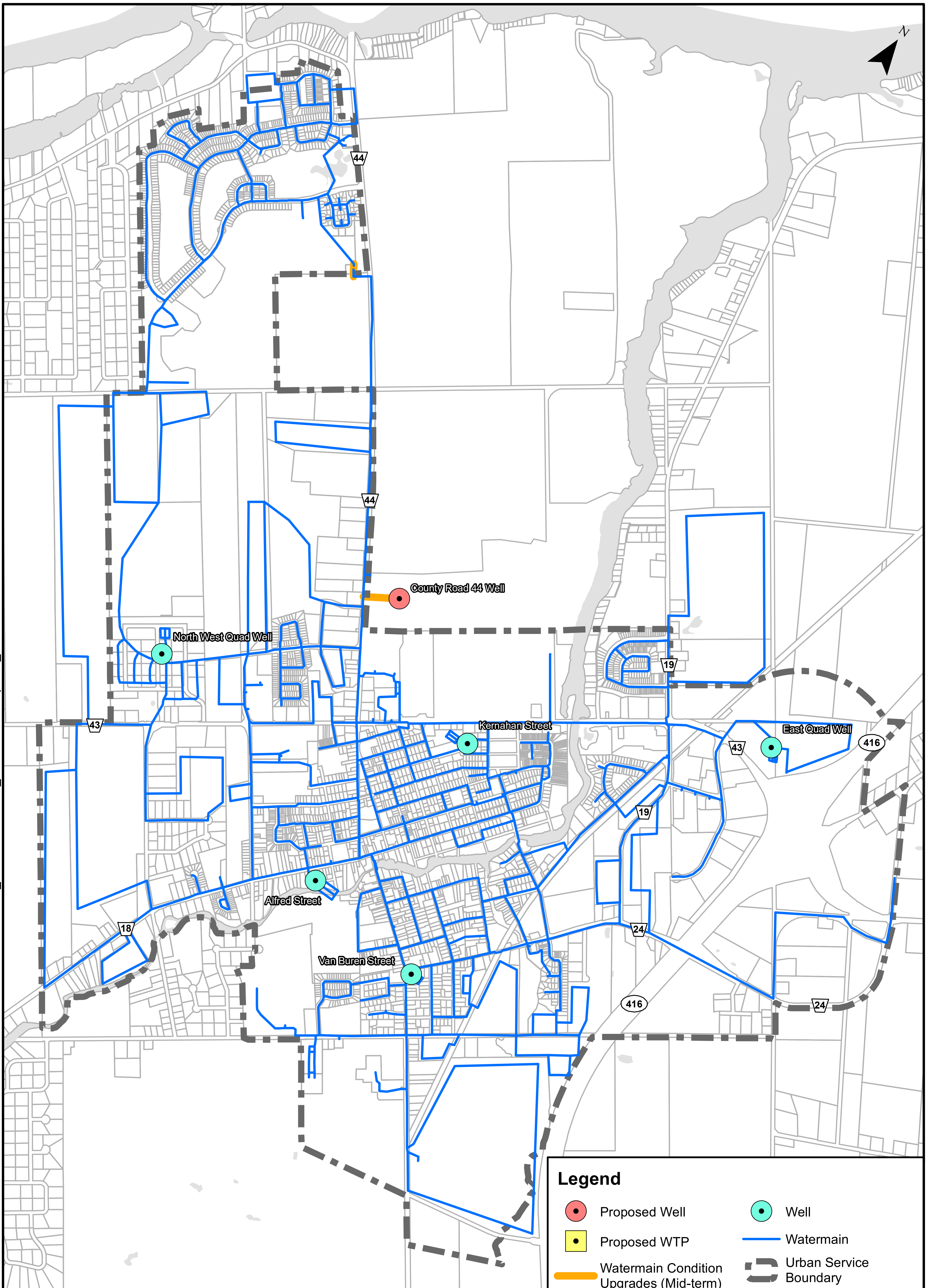

PROJECT:

North Grenville Water and Sewer Master Plan

Kemptville, Ontario

DRAWING:

Water Infrastructure Improvements - Mid-Term

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Figure 13

File Location: P:\33000\33023-000 - North Grenville Water Sewer Master Plan\03-Production\07-Plan\GIS_Schedules\33023_InfrastructureImprove_Mid.mxd

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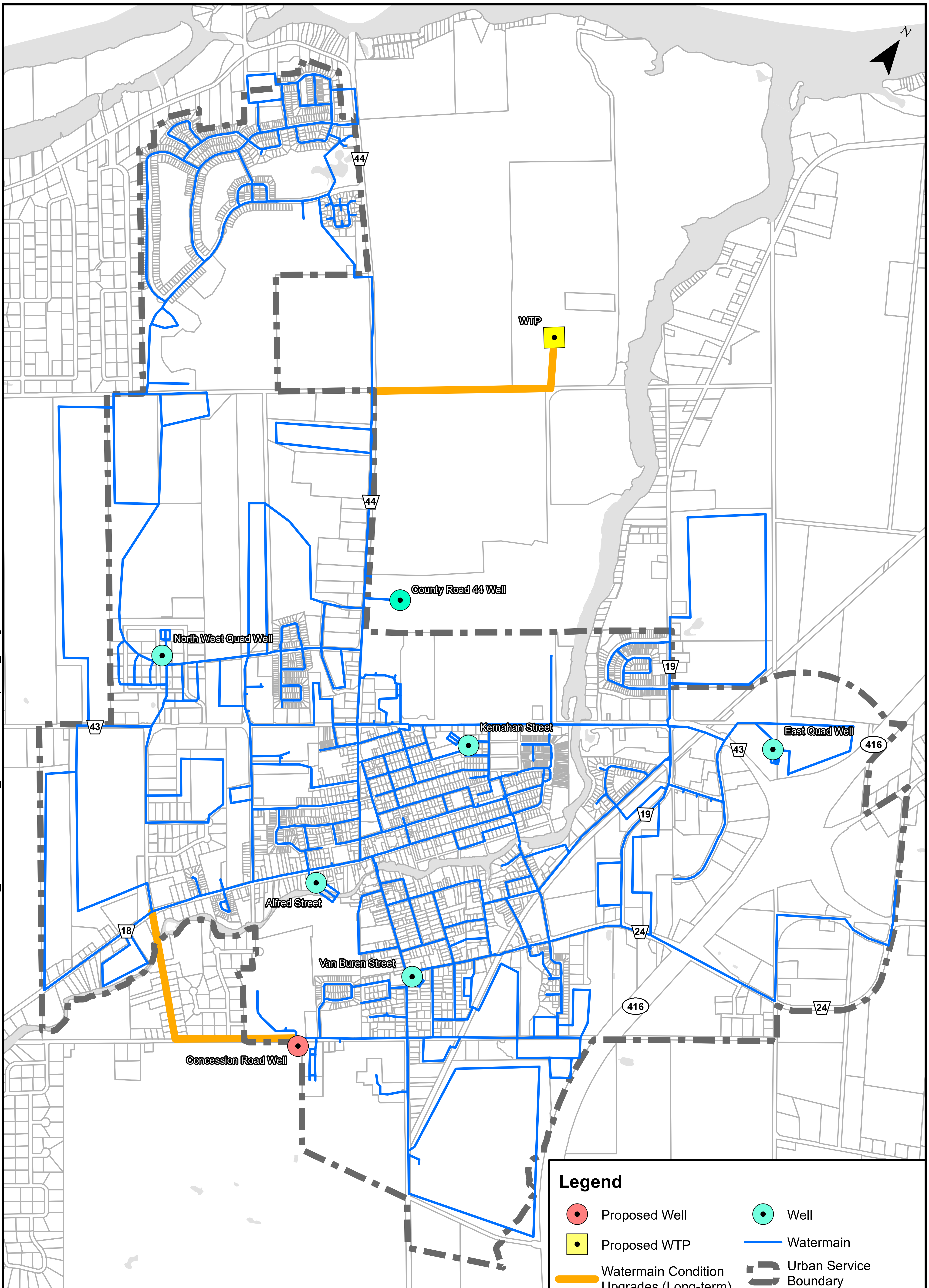

PROJECT:

North Grenville Water and Sewer Master Plan

Kemptville, Ontario

DRAWING:

Water Infrastructure Improvements - Long-Term

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JLR #:	33023

DRAWING #: Figure 14

File Location: P:\33000\33023-000 - North Grenville Water Sewer Master Plan\03-Production\07-Plan\GIS_Schedules\33023_InfrastructureImprove_Long.mxd

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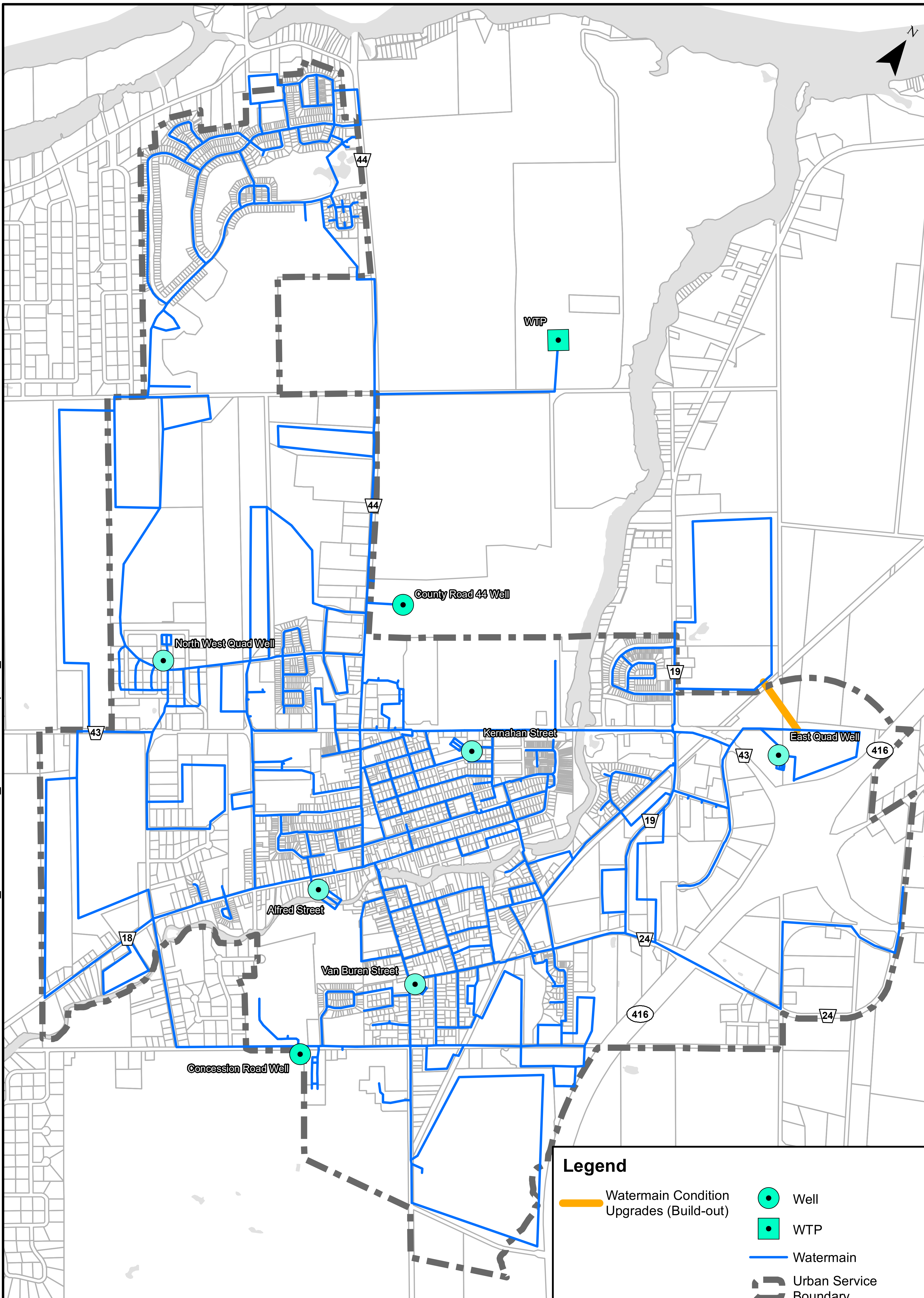

PROJECT:

North Grenville Water and Sewer Master Plan

Kemptville, Ontario

DRAWING:

Water Infrastructure Improvements - Build-Out

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JLR #:	33023

DRAWING #:

Figure 15

File Location: P:\33000\33023-000 - North Grenville Water Sewer Master Plan\03-Production\07-Plan\GIS_Schedules\33023_InfrastructureImprove_Build.mxd

Plot Date: Thursday, August 14, 2025 10:53:48 AM

5.0 Wastewater System

5.1 Existing System

The community of Kemptville is serviced by the Kemptville Water Pollution Control Plant (WPCP), located at 2899 County Road 43, adjacent to Kemptville Creek. The WPCP currently consists of a conventional activated sludge tertiary treatment process, with a rated average and maximum day capacity of 4,510 m^3/d and 11,370 m^3/d, respectively. The WPCP is undergoing expansion and upgrades to increase the rated average and maximum day capacity to 5,250 m^3/d and 15,000 m^3/d respectively. The upgrades have been split into two phases. Construction of Phase A commenced in 2024 and is expected to be completed in 2026. Phase B will start after the completion of Phase A, and is expected to be completed in 2028.

Table 24: Kemptville WPCP Rated Capacity

Parameter	Current WPCP ECA Rated Capacity	Upgraded WPCP ECA Rated Capacity
Average Day Flow (m^3/d)	4,510	5,250
Maximum Day Flow (m^3/d)	11,370	15,000 (1)
Peak Instantaneous Flow (m^3/d) (L/s)	-	32,005 (1) 370

Notes:
1) Peak flows above the maximum day flow are to be attenuated by influent equalization storage to 15,000 m^3/d.

There are no gravity sewers to the WPCP. All influent flow is pumped via forcemains from four (4) sanitary pumping stations. The rated capacities are summarized in the following table:

Table 25: Sanitary Pumping Station Rated Capacities

Sanitary Pumping Station	Rated Capacity (m^3/d)
Bridge Street SPS	8,640 (existing) 11,370 (future) (1)
eQuinelle SPS	4,061
Tempo (Northwest Quadrant) SPS	6,912
Colonnade (East Quadrant) SPS	6,990
Total	**26,602 (existing)** **29,332 (future) (1)**

Notes:
1) Bridge St SPS is currently operating at a lower flow rate due to the existing rated capacity of the WPCP. The 2019 ESR Addendum noted that once WPCP upgrades are completed, the Bridge St SPS can be re-rated to its full rated pump capacity.

5.2 Design Criteria

Table 26 summarizes the wastewater demand rates used to evaluate the Municipality's wastewater system.

Table 26: Design Criteria - Wastewater Demand Rates

Land Use	Design Criteria	Maximum Day Factor
Future Residential (1)	300 L/cap/day	2.85
Future Commercial (2)	28,000 L/ha/day	1.5
Future Industrial (3)	35,000 L/ha/day	1.5
Future School (4)	70 L/student/day	1.5
Future Hotel (4)	225 L/bed/day	1.5
Future Retirement Home (5)	300 L/bed/day	1.5

Notes:
1) Municipality of North Grenville Engineering Standards E1.03.
2) MECP Design Guidelines for Sewage Works 5.5.2.2
3) MECP Drinking Water Design Guidelines 3.4.4
4) MECP Design Guidelines for Sewage Works Table 5-3
5) Assumed residential ADD

5.3 Wastewater Treatment

As noted in the Phase 1 Report, the historical average and max day influent flows are consistently greater than effluent flows. One of the probable causes is that the tertiary filter backwash line enters the WPCP influent upstream of the influent flow meter which could increase flow readings. In addition, the effluent flow is measured by an electronic mag meter and is expected to be much more reliable and accurate than the flow from the proportional flow weir at the influent channel. Although some filtered water is used by the plant, it is expected that this would be minor compared to the backwash returned. Typical operation is only bypassing the tertiary treatment and therefore, actual influent flows should be much closer to effluent flows. It should be noted that the influent flow monitoring will be upgraded during the expansion of the WPCP, which will result in more accurate readings.

The wastewater treatment constraints are summarized in Table 27 below, based on the existing rated capacity of the WPCP, and the increase capacity following the current planned upgrades. A review of constraints for individual unit processes was not completed as it was beyond the scope of this Master Plan.

Table 27: Wastewater Treatment Constraints

Period	Average Day Flow (m^3/d)	Deficit (Existing Capacity) (m^3/d)	Deficit (Upgraded Capacity) (m^3/d)
Existing (2025)	2,296 (1) 2,866 (2)	None	None
Short Term (2026-2031)	3,123 (1) 3,693 (2)	None	None
Mid-Term (2031-2036)	5,020 (1) 5,590 (2)	510 (1) 1,080 (2)	None
Long-Term (2036-2046)	8,703 (1) 9,273 (2)	4,193 (1) 4,763 (2)	3,453 (1) 4,023 (2)
Buildout (beyond 2046)	13,455 (1) 14,025 (2)	8,945 (1) 9,515 (2)	8,205 (1) 8,775 (2)
Note: 1) Based on historical WPCP Effluent flow data 2) Based on historical WPCP Influent flow data			

It is generally best practice that municipalities investigate and undertake inflow and infiltration reduction programs to reduce the peak demands on the wastewater treatment plant. Investigating these measures is outside the scope of this Master Plan but as they are beneficial, they are recommended.

5.3.1 Short Term (2026-2031),

As seen in Table 27 above, the short-term demands are within the wastewater treatment available at the WPCP at its existing rated capacity. While no upgrades are expected to be required in this period, the ongoing expansion of the WPCP is expected to be completed within this period.

5.3.2 Mid-Term (2031-2036)

As seen in Table 27 above, the mid-term demand exceeds the wastewater treatment demands at the WPCP's existing rated capacity. However, the ongoing expansion of the WPCP is expected to be completed, and at the new rated capacity, the mid-term demands are within the wastewater treatment capacity available. No further upgrades are expected to be required in this period.

5.3.3 Long-Term (2036-2046), Buildout (beyond 2046)

As seen in Table 27 above, the wastewater treatment demand exceeds WPCP's rated capacity in the long-term period and beyond.

To address this deficit, an initial screening of options was conducted as follows:

5.3.3.1 Option 1: Do Nothing

The ‘Do Nothing’ approach examines what may occur if none of the alternatives are implemented; it is generally carried forward for detailed review for comparison.

5.3.3.2 Option 2: Optimize WPCP Capacity

This option consists of optimizing the WPCP, by improving operations and maintenance activities to increase the treatment capacity without expanding the plant. Optimization strategies may include, but not limited to, the following:

- Process modelling to determine optimum operating conditions.
- Optimize chemical usage for unit processes.
- Re-rating, which involves the evaluation and testing of unit treatment processes to determine if they can be operated at a higher capacity.

A Schedule ‘B’ Class EA will be required to undertake plant optimization works. However, this will need to be upgraded to a Schedule ‘C’ Class EA if there are any expected works to expand, modify, or retrofit the WPCP or outfall, where there is an increase to the total mass loading to the receiving water body, as outlined in the facility’s Environmental Compliance Approval.

While there are expected to be improvements gained by these strategies, it is unlikely these will be enough to address the wastewater demand deficits due to the scale of the long-term growth.

Based on the considerations above, this alternative is not recommended to be carried forward for detailed evaluation, but instead can be carried in part with other options.

5.3.3.3 Option 3a: Expand Existing WPCP

This option involves the expansion of the existing WPCP to increase the rated capacity to address future demands. This option will start with a Schedule ‘C’ Class EA to define the scope of potential upgrades prior to the design and construction process. A review of unit processes will be required to identify any additional treatment constraints that need to be addressed.

Alternative and innovative technologies (e.g. MBR, MABR, etc.), which can be retrofitted within existing infrastructure, should also be considered as another means to improve treatment performance at higher flows, while reducing the amount of expansion required.

An assimilative capacity assessment will be required to establish new effluent requirements based on the higher flows and current wastewater loadings. Consultation with the MECP will be required to obtain their approval of the new effluent criteria.

Considerations will need to be made to connect any new processes and systems to the existing WPCP. It is recommended for the WPCP upgrades to be constructed to address long-term demands, while considering room for possible expansions for buildout demands. A large area of Municipality-owned land is available immediately adjacent to the WPCP, which could be used for future upgrades.

Based on the considerations above, this alternative is recommended to be carried forward for detailed evaluation.

5.3.3.4 Option 3b: Expand and Optimize Existing WPCP

This option involves optimizing the existing WPCP, as outlined in Option 2, in addition to expanding the plant. Increasing the capacity of unit processes through re-rating could reduce the extent of expansion required to address future flow demands.

Based on the considerations above, this alternative is recommended to be carried forward for detailed evaluation.

5.3.3.5 Option 4a: Additional Treatment Plant in a New Location

This option involves the construction of a new wastewater treatment plant to address future demands above the capacity of the existing WPCP.

A new sewage treatment plant requires a Schedule ‘C’ Class EA. Investigations to evaluate possible sites for the new plant would be needed, in consideration for the protection of source water, sensitive habitats, cultural heritage and archaeological resources, etc. While the Municipality does have owned land, there may be limitations of the availability and suitability of this land where a new treatment plant can be located.

The approach to the conveyance of flows to the new plant should also be considered in the site selection phase. For example, the existing or new catchment areas in the Kemptville urban serviced area can be split between the two treatment plants, allowing for further capacity and growth within these areas, without significant modification or addition to the existing collection system. There may also be opportunities for an existing pumped catchment area to be converted into a gravity sewer to the new plant, reducing the operational efforts by Municipality staff. However, this gain would be offset by operation and maintenance needs for two full wastewater treatment plants in different locations within the community.

A new effluent discharge location will also need to be established, including the effluent criteria for the new plant. An assimilative capacity assessment will be required to establish the effluent requirements, with the consultation and approval of the MECP. An investigation of impacts to aquatic habitats will also need to be considered.

Based on the considerations above, this alternative is recommended to be carried forward for detailed evaluation.

5.3.3.6 Option 4b: Additional Treatment Plant in a New Location, and Optimize Existing WPCP

This option involves the construction of a new wastewater treatment plant to address future wastewater demands. In addition, the existing WPCP can be optimized as outlined in Option 2 to increase the capacity of the existing plant, reducing the size of the new treatment plant.

Based on the considerations above, this alternative is recommended to be carried forward for detailed evaluation.

5.3.3.7 Evaluation of Wastewater Treatment Options

The evaluation of options is summarized in the table below. The preferred alternative is Option 3b. The WPCP upgrades can be staged for both the long-term and buildout periods

A Schedule 'C' Class EA is required to expand the WPCP and to define the scope of upgrades and potential treatment options prior to implementation. It is recommended the MECP be consulted for the confirmation of new wastewater treatment requirements due to the increased flows.

Table 28: Evaluation of Wastewater Treatment Options

Criteria	Option 1: Do Nothing	Option 3a: Expand Existing WWTP	Option 3b: Expand and Optimize Existing WWTP	Option 4a: Additional Treatment Plant in New Location	Option 4a: Additional Treatment Plant in New Location and Optimize Existing WPCP
Natural Environment	Negative impact on environment due to inability to treat high wastewater flows.	Will improve system's ability to treat wastewater flows and limit bypasses. Reduced environmental impact in comparison to other options.	Will improve system's ability to treat wastewater flows and limit bypasses. Optimization to minimize the footprint of WPCP expansion would further reduce environmental impacts.	Will improve system's ability to treat wastewater flows and limit bypasses. Potential environmental impact due to construction for new facility. Requires additional investigations to assess new plant site and discharge location.	Will improve system's ability to treat wastewater flows and limit bypasses. Potential environmental impact due to construction for new facility. Requires additional investigations to assess new plant site and discharge location. Optimization of existing WPCP may reduce footprint of new plant.
Evaluation:	Strong Negative impact	Slight Positive Impact	Strong Positive Impact	Slight Negative impact	Strong Negative impact
Climate Change	Makes Kemptville's wastewater infrastructure vulnerable to impacts of climate change (ex. Floods resulting in bypasses).	Improved infrastructure makes community more resilient. Less GHG production from facility expansions.	Improved infrastructure makes community more resilient. Least GHG production from smaller expansion footprints.	Additional infrastructure makes community more resilient. Some GHG production from new facility.	Additional infrastructure makes community more resilient. Some GHG production from new facility.
Evaluation:	Strong Negative Impact	Slight Negative Impact	Slight Positive Impact	Slight Negative Impact	Slight Negative Impact
Social & Cultural Heritage Environment	Bypasses due to high flows impact the community, air quality, and operation. Limited capacity restricts population growth.	Municipality-owned land adjacent to WCPC available for expansion. Some construction or operation impacts.	Municipality-owned land adjacent to WCPC available for expansion. Some construction or operation impacts.	Higher impacts on social, cultural heritage resources, air quality, or the community. Higher construction or operation impacts.	Higher impacts on social, cultural heritage resources, air quality, or the community. Higher construction or operation impacts.
Evaluation:	Strong Negative Impact	Slight Negative Impact	Slight Negative Impact	Strong Negative Impact	Strong Negative Impact

Criteria	Option 1: Do Nothing	Option 3a: Expand Existing WWTP	Option 3b: Expand and Optimize Existing WWTP	Option 4a: Additional Treatment Plant in New Location	Option 4a: Additional Treatment Plant in New Location and Optimize Existing WPCP
Technical Feasibility	Will not be able to support long-term growth.	Will be able to support long-term growth.	Will be able to support long-term growth. Optimization can reduce extent of expansions required.	Will be able to support long-term growth. Challenging to integrate into the existing wastewater collection system.	Will be able to support long-term growth. Challenging to integrate into the existing wastewater collection system.
Evaluation:	Strong Negative Impact	Slight Positive Impact	Strong Positive Impact	Slight Negative Impact	Slight Negative Impact
Financial	No capital costs. Inaction may lead to high financial impacts in the future.	Higher capital and operational costs.	Higher capital and operational costs. Optimization may reduce cost of new infrastructure.	Highest capital and operational costs.	Highest capital and operational costs. Optimization may reduce cost of new infrastructure
Evaluation:	Slight Negative Impact	Slight Negative Impact	Slight Negative Impact	Strong Negative Impact	Strong Negative Impact
Overall Evaluation:	**Not Preferred**	**Not Preferred**	**Preferred**	**Not Preferred**	**Not Preferred**

5.4 Wastewater Pumping Strategies

An evaluation of potential options for wastewater pumping for the Municipality of North Grenville was completed during Phase 2 of this Master Plan. The wastewater pumping constraints at the Bridge Street, Tempo, eQuinelle, and Colonnade sewage pumping stations (SPS) are summarized in the tables below.

5.4.1 Wastewater Pumping Constraints

The existing peak sanitary flows at Bridge Street, Tempo, eQuinelle, and Colonnade SPS were determined based on the maximum historical sanitary flow between the years of 2022 and 2024. Based on the data, the peak flows under existing conditions at Bridge Street, Tempo, eQuinelle, and Colonnade were found to be 135 L/s (11,618 m3/d), 10 L/s (895.10 m3/d), 14 L/s (1,210 m3/d), and 7 L/s (590 m3/d) respectively.

A design sheet was developed for each of the four (4) SPS to assess their capacity. The peak flows under the future growth were calculated by manually adding the growth projections presented in North Grenville Population Projection NGR Revision 3 Report (JLR, March 13, 2025) (refer to Appendix A). The design parameters used for the growth projections are consistent with the Curry Street assessment in the Phase 1 Report (refer to Appendix B).

Refer to Appendix D for the Sanitary Design Sheets used for the SPS assessments.

5.4.1.1 Bridge Street SPS Constraints

The following table summarises the pumping constraints at the Bridge Street SPS under the future growth conditions.

Table 29: Wastewater Pumping Constraints at Bridge Street SPS

Study Period	Operational Capacity (L/s) (1)	Projected Peak Flows (L/s) (2)	Deficit (L/s)
Existing (2025)	100	135	35
Short–Term (2025-2031)	132	155	23
Mid–Term (2031-2036)	132	170	38
Long–Term (2036-2046)	132	190	58
Build-Out (2046+)	132	195	63

Notes:
1) Firm capacity based on the Water Pollution Control Plant and Sanitary Pump Station Optimization and Expansion Environmental Study Report Addendum (JLR, 2019).

Study Period	Operational Capacity (L/s) (1)	Projected Peak Flows (L/s) (2)	Deficit (L/s)
2) Existing flows were determined based on historical data. Future flows were determined using the planning projections outlined in the North Grenville Population Projection NGR Revision 3 Report (March 13, 2025) and the catchment areas from the QGIS wastewater model.			

The projected peak flows at the Bridge Street SPS are slightly lower than the peak flows calculated in the Curry Street Assessment from the Phase 1 Report as they were determined using two (2) different methods based on the nature of each assessment. As mentioned previously, the flows in the above table were based on historical data, whereas as the flows from the Phase 1 Report were based on theoretical calculations and Design Guideline assumptions developed to assess the capacity of the sanitary sewer on Curry Street. The theoretical approach used in the Phase 1 Report is conservative for sewer sizing.

Under existing conditions, the Bridge Street SPS operates at a capacity of 100 L/s, which is 32 L/s lower than its maximum capacity (132 L/s) due to limitations of the current WPCP. Once the upgrades at the WPCP are complete within the short-term period, the Bridge Street SPS will operate at its full rated pump capacity of 132 L/s. As shown in the table above, the flows into the Bridge Street SPS are beyond the pumping station's rated capacity by approximately 35 – 63 L/s depending on the future growth scenario.

It is recommended that the Bridge Street SPS is upgraded under short-term conditions to address the existing and future pumping deficits. The upgrade may consist of a brand-new pumping station or an upgrade to the existing facility to achieve a rated capacity of 195 L/s to accommodate wastewater flows under all growth scenarios including build-out. If construction of a new pumping station is the preferred option, during construction operations can continue at the existing Bridge Street SPS, mitigating the need for costly construction sequencing measures.

At the buildout flow, the velocity through the existing 300mm forcemain is approximately 2.76 m/s, below the maximum recommended flow velocity of 3 m/s outlined in the MECP Sewer Design Guidelines. While it's likely that no upgrades to the forcemain are anticipated, a more thorough hydraulic analysis of the forcemain should be undertaken at the Class EA and design stages to confirm if any upgrades are required.

A Schedule 'B' Class EA will be required to determine the preferred Bridge Street SPS upgrades. For the following Master Plan, it is assumed that a new pumping station with a rated capacity of 195 L/s will be required to provide a conservative cost estimate.

5.4.1.2 Tempo SPS Constraints

The following table summarises the pumping constraints at the Tempo SPS under the future growth conditions.

Table 30: Wastewater Pumping Constraints at Tempo SPS

Study Period	Operational Capacity (L/s) (1)	Projected Peak Flows (L/s) (2)	Deficit (L/s)
Existing (2025)	80	10	N/A
Short–Term (2025-2031)	80	13	N/A
Mid–Term (2031-2036)	80	22	N/A
Long–Term (2036-2046)	80	56	N/A
Build-Out (2046+)	80	56	N/A

Notes:
1) Firm capacity based on the Northwest Quadrant Pumping Station Preliminary Design Report (Hatch, 2016).
2) Existing flows were determined based on historical data. Future flows were determined using the planning projections outlined in the North Grenville Population Projection NGR Revision 3 Report (March 13, 2025).

As shown in the table above, the projected peak flows at the Tempo SPS are less than the pump's firm capacity under existing conditions and all future growth scenarios. Therefore, no upgrades are recommended for the Tempo SPS.

5.4.1.3 eQuinelle SPS Constraints

The following table summarises the pumping constraints at the eQuinelle SPS under the future growth conditions.

Table 31: Wastewater Pumping Constraints at eQuinelle SPS

Study Period	Operational Capacity (L/s) (1)	Projected Peak Flows (L/s) (2)	Deficit (L/s)
Existing (2025)	47	14	N/A
Short–Term (2025-2031)	47	26	N/A
Mid–Term (2031-2036)	47	28	N/A
Long–Term (2036-2046)	47	34	N/A
Build-Out	47	34	N/A

Study Period	Operational Capacity (L/s) (1)	Projected Peak Flows (L/s) (2)	Deficit (L/s)
(2046+)			

Notes:
1) Firm capacity based on the eQuinelle Subdivision Phase 5 Servicing and Stormwater Management Report (Novatech, 2021).
2) Existing flows were determined based on historical data. Future flows were determined using the planning projections outlined in the North Grenville Population Projection NGR Revision 3 Report (March 13, 2025).

As shown in the table above, the projected peak flows at the eQuinelle SPS are less than the pump's firm capacity under existing conditions and all future growth scenarios. Therefore, no upgrades are recommended for the eQuinelle SPS.

5.4.1.4 Colonnade SPS Constraints

The following table summarises the pumping constraints at the Colonnade SPS under the future growth conditions.

Table 32: Wastewater Pumping Constraints at Colonnade SPS

Study Period	Operational Capacity (L/s) (1)	Projected Peak Flows (L/s) (2)	Deficit (L/s)
Existing (2025)	81	7	N/A
Short–Term (2025-2031)	81	10	N/A
Mid–Term (2031-2036)	81	32	N/A
Long–Term (2036-2046)	81	60	N/A
Build-Out (2046+)	81	151	70

Notes:
1) Firm capacity based on the East Quadrant Sanitary Servicing Functional Design Brief (CH2MHILL, 2008).
2) Existing flows were determined based on historical data. Future flows were determined using the planning projections outlined in the North Grenville Population Projection NGR Revision 3 Report (March 13, 2025).

As shown in the table above, the projected peak flows at the Colonnade SPS are less than the pump's firm capacity under existing conditions and the future growth scenarios until the build-out scenario. However, under build-out conditions, the existing flows are beyond the capacity of the

Colonnade SPS. Therefore, it is recommended that the Colonnade SPS is upgraded under build-out given that the deficit is anticipated to be approximately 70 L/s.

The upgrade may consist of a brand-new pumping station or an upgrade to the existing facility to achieve a rated capacity of 151 L/s to accommodate the wastewater flows under build-out. If construction of a new pumping station is the preferred option, construction operations can continue at Colonnade SPS, mitigating the need for costly construction sequencing measures.

At buildout flow, the velocity through the existing 200mm forcemain is approximately 4.8 m/s, above the maximum recommended flow velocity of 3 m/s outlined in the MECP Sewer Design Guidelines. Forcemain upgrades are anticipated, but a more thorough hydraulic analysis should be undertaken during the Class EA and design stages to confirm any upgrades required.

A Schedule ‘B’ Class EA will be required to determine the preferred Colonnade SPS upgrades. For the following Master Plan, it is assumed that a new pumping station with a rated capacity of 151 L/s and forcemain upgrade will be required to provide a conservative cost estimate.

5.5 Wastewater Collection Strategies

The following section evaluates the syphon redundancy and the recommended sanitary sewer upgrades along Curry Street.

5.5.1 Syphon Capacity Assessment

The following section outlines the benefits and challenges associated with implementing a redundant syphon at each of the following three (3) syphons crossing Kemptville Creek:

1. Water Street to Barnes Street (Catchment Area #3).
2. Jack Street to Curry Street (Catchment Area #4); and
3. Vista Crescent to Curry Street (Catchment Area #5).

Based on recent discussions with the Municipality, it appears that the existing syphons operated at a lower conveyance capacity than the theoretical capacity calculated in the Phase 1 Report (refer to Appendix B). In April 2023, during spring runoff wet weather event the Municipality observed sewer surcharging on both sides of the Kemptville Creek. It is anticipated that the upstream sanitary flow raised the water level in the gravity sewers, thus lowering the available capacity within the syphons. The lower syphon capacity under peak flow conditions (i.e., spring snow melt and wet weather event) likely contributed to observed sewer surcharging on both sides of the Kemptville Creek. The Water Street and Jack Street syphons were originally constructed in 1950, while the Vista Crescent syphon was added in 1964. Based on discussions with the Municipality, it is understood that these syphons are composed of cast iron. Given the age of the syphons, replacements for each existing syphon should be considered in the future during the growth term where the syphon upgrades are recommended.

The table below shows the evaluation matrix for twinning the syphons.

Table 33: Evaluation of Syphon Redundancy

Criteria	Option 1: Do Nothing	Option 2: Twin Syphons
Natural Environment	Negative impact on environment due to inability to treat high wastewater flows.	Will improve system's ability to convey wastewater flows and limit overflows.
Evaluation:	Slight Negative Impact	Strong Positive Impact
Climate Change	Makes Municipality's wastewater system vulnerable to impacts of climate change (ex. increased storm intensity resulting in raw sewer overflows).	Improved infrastructure makes the community more resilient.
Evaluation:	Strong Negative Impact	Strong Positive Impact
Social & Cultural Heritage Environment	Overflows impact the community, air quality, and operation. Increase in bypass frequency of wastewater flow to the Kemptville Creek. Limited capacity restricts population growth.	Some impacts on social, cultural heritage resources, air quality, or the community. Some construction or operation impacts.
Evaluation:	Strong Negative Impact	Slight Negative Impact
Technical Feasibility	Will not be able to support future growth.	Will be able to support future growth and mitigate future surcharge in the system. Redundant syphons will facilitate maintenance activities while keeping the system active.
Evaluation:	Strong Negative Impact	Strong Positive Impact
Financial	No capital costs. Inaction may lead to high financial impacts in the future.	Higher capital and operational costs.
Evaluation:	Slight Negative Impact	Strong Negative Impact
Overall Evaluation:	**Not preferred**	**Preferred**

It is noted that an application for Consolidated Linear Infrastructure Environmental Compliance Approval (CLI-ECA) will be required for each twin syphon. Given that there is an existing syphon at each location, it is assumed the land on each side of the syphon is Municipally owned, therefore, a Schedule B Class EA may not be required. It is recommended that the Municipality conducts additional flow monitoring to better understand the sewer and syphon performance and refine the timing and scope of the syphon twinning.

It is recommended that the three existing syphons are replaced with new twinned syphons to reduce surcharge in the wastewater system and meet the MECP Design Criteria (May 31, 2023) which recommends that there should be at least two (2) redundant syphons with the same pipe diameters and inverts for maintenance purposes. It is recommended for further investigation and assessment of the syphons be undertaken to prioritize the order and timing of their replacement.

5.5.2 Sanitary Sewer Upgrades

The recommended pipe upgrades were based on the assessment of the capacity of the Curry Street sanitary sewer completed in the Phase 1 Report (refer to Appendix A). It is recommended that the Municipality undertakes a capacity assessment of the remaining sanitary sewers within the rest of the system in the future. A trunk sewer model of the existing sanitary sewer system would also be beneficial to assess and identify future upgrades. The following section outlines the recommended sanitary pipe upgrades under each future growth scenario.

5.5.2.1 Short-Term (2025-2031)

It is recommended that the following two (2) sanitary sewers are upgraded under short-term conditions as they were operating at 90% capacity with the existing sanitary infrastructure under mid-term conditions. Although the capacity constraints occur in mid-term, it is recommended that Curry Street is upgraded under short-term conditions to stagger the construction for the sewer and syphon upgrades. The purpose of the pipe upgrades is to provide sufficient capacity to accommodate future sanitary flows from mid-term to build-out conditions.

1. Approximately 63 m of sanitary sewer the along Curry Street, Midway of James Street and Parliament Street (SAMH-10004 to SAMH-10003 per GIS shape file labels), requires an upgrade from a 375 mm to 450 mm diameter pipe. The upgraded pipe operates at a capacity of 55% while maintaining the existing slope. The upgraded pipe has a sanitary flow velocity of 0.96 m/s, which is within the required MECP Design Guidelines range of 0.6 m/s to 3.0 m/s.

2. Approximately 6 m of sanitary sewer along Curry Street, at Parliament Street (SAMH-10003 to SAMH-10002 per GIS shape file labels), requires an upgrade from a 375 mm to 450 mm diameter pipe. The upgraded pipe operates at a capacity of 55% while maintaining the existing slope. The upgraded pipe has a sanitary flow velocity of 1.15 m/s, which is within the required MECP Design Guidelines range of 0.6 m/s to 3.0 m/s.

Refer to Appendix D for the updated Sanitary Design Sheets.

It is also recommended that the existing Jack Street to Curry Street (Catchment Area #4) syphon is replaced and a twin syphon is added under short-term conditions.

. It is recommended that studies be undertaken for the potential of constructing the future Curry Street upgrades and the twin syphons concurrently. Additionally, flow monitoring is advised to be completed within the short-term timeframe to ensure that the required studies are completed in time for all future upgrades.

5.5.2.2 Mid–Term (2031-2036)

It is recommended that the existing Water Street to Barnes Street (Catchment Area #3) syphon is replaced and a twin syphon is added under mid-term conditions.

5.5.2.3 Long–Term (2036-2046)

It is recommended that the existing Vista Crescent to Curry Street (Catchment Area #5) is replaced and a twin syphon is added under long-term conditions It is noted that the two (2) sanitary pipe upgrades in short-term conditions between maintenance holes SAMH-10004 to SAMH-10003 and SAMH-10003 to SAMH-10002 (per GIS shape file labels) operate at 55% and 56% capacity respectively under long-term conditions.

5.5.2.4 Build-Out (2046+)

No upgrades to sanitary sewer are recommended under build-out conditions. It is noted that the two (2) sanitary pipe upgrades in short-term-term conditions between maintenance holes SAMH-10004 to SAMH-10003 and SAMH-10003 to SAMH-10002 (per GIS shape file labels) operate at 55% and 56% capacity respectively under build-out conditions.

A Schedule 'B' Class Environmental Assessment (EA) will be required to facilitate land acquisition as the highway crossing connected to a future residential subdivision. A Foundations Report will also be required for the Ministry of Transportation of Ontario (MTO) for the length of sanitary sewer beyond the MTO right-of-way.

A preliminary evaluation of the forcemains connecting the SPS to the WPCP was conducted under Build-Out conditions. Based on current findings:

- <u>Bridge Street, Tempo, and eQuinelle SPS:</u> No upgrades are anticipated for the associated forcemains.

- <u>Colonnade SPS:</u> It is anticipated that the forcemain will require an upgrade as the velocity exceeds the maximum allowable threshold of 3 m/s, as defined in the MECP Design Guidelines dated May 31, 2023.

It is recommended that the SPS forcemain assessments be further refined during future preliminary design, with the consideration of material rating to accommodate surge pressures.

5.5.3 Sanitary Servicing East of Highway 416

The sanitary servicing east of Highway 416 was evaluated under build-out conditions given the industrial, commercial, and institutional growth projections within this area. The existing sanitary distribution system terminates west of Highway 416. Thus, a highway crossing was evaluated to convey sanitary flows from the new developments east of the highway to the existing system. However, due to the distance required and the existing topography of the area, it is not feasible to service east of the highway by gravity. Therefore, a new sanitary pumping station would be required to convey flows to the across the highway. Sanitary demands for existing developments are not known, so the required capacity of the SPS cannot be confirmed. For the purposes of this Master Plan, a capacity range of 25-45 L/s was assumed to estimate costs. As no Municipality-owned land is available east of the highway, property acquisition is likely required for the SPS. Based on the available existing topography of the area, a possible candidate location for the SPS to consider can one of the vacant lots along Kingdom Rd. This location would need to be confirmed based on the layout of the future sanitary servicing in the area and availability of property.

For the purposes of the Master Plan, it is assumed the new forcemain would be installed along the road right of way, crossing Highway 416 along Van Buren St. A trenchless crossing of the forcemain across the highway is anticipated be required. It is understood that there are plans for an extension of the gravity sewer south along County Road 19. If this is constructed, the forcemain could connect to the south end of this sewer to travel the rest of the way by gravity to the SPS. A review of sizing of this new sewer extension during the design stages is recommended to consider available capacity to convey flows from developments east of the highway.

A Schedule ‘B’ Class EA will be required to undertake this work and confirm the size and location of the SPS and forcemain.

5.6 Summary of Wastewater System Strategies

A summary of the preferred solutions and wastewater upgrades, including their costs, is included in the table below.

Table 34: Wastewater System Solutions and Costs

Project Type	Project	Short-Term (0-5 years)	Mid-Term (5-10 years)	Long Term (10-20 years)	Buildout (20+ years)	Details
Wastewater Treatment	WPCP Optimization and Expansion – Long Term	-	-	$130M	-	Capacity increase from 5,250m^3/d to ~9,000m^3/d
	WPCP Optimization and Expansion – Buildout	-	-	-	$175M	Capacity increase from 9,000m^3/d to ~14,000m^3/d
Wastewater Pumping	Bridge Street SPS (new SPS)	$16M	-	-	-	Rated capacity of 195L/s
	Colonnade SPS (new SPS)	-	-	-	$12.5M	Rated capacity of 151L/s
	New SPS – East of Highway 416	-	-	-	$3M	Assumed capacity 40L/s
Wastewater Collection	Curry Street Sewer - Midway of James Street and Parliament Street (SAMH-10004 to SAMH-10003 and SAMH-10003 to SAMH-10002) (1)	$250,000	-	-	-	Length: 70 m Diameter: 450 mm
	New Forcemain from New SPS to County Road 19 (Open Cut Segment)	-	-	-	$6M	Length: 2 km Diameter: 200 mm
	New Forcemain from New SPS to County Road 19 (Trenchless Segment crossing Highway 416)	-	-	-	$3M	Length: 90 m Diameter: 200 mm
	New Forcemain – Colonnade SPS to WPCP	-	-	-	$4.5M	Length: 1,300 m Diameter: 300 mm
	Replacement and Twinning Syphon - Water Street to Barnes Street (Catchment Area #3) (4)	-	$7M	-	-	Length: 105 m (2) (2 syphons, total length = 210m) Diameter: 150 mm (3)
	Replacement and Twinning Syphon - Vista Crescent to Curry Street (Catchment Area #5) (4)	-	-	$14M	-	Length: 175 m (2 syphons, total length = 350m) Diameter: 250 mm (3)

Project Type	Project	Short-Term (0-5 years)	Mid-Term (5-10 years)	Long Term (10-20 years)	Buildout (20+ years)	Details
	Replacement and Twinning Syphon - Jack Street to Curry Street (Catchment Area #4) (4)	$9.8M	-	-	-	Length: 120 m (2 syphons, total length = 240m) Diameter: 300 mm (3)
Studies	Flow Monitoring Program - Curry Street and Syphons	$100,000				
	Trunk Sewer Model Development	$150,000				Model Development only; Data collection scope to be defined
	Schedule ‘B’ Class EA for New SPS and Forcemain Crossing of Highway 416	-	-	-	$250,000	
	Geotechnical feasibility study for crossing Highway 416.	-	-	-	$200,000	
	Schedule ‘C’ Class EA for WPCP Expansion	-	$350,000	$350,000	-	
	Schedule ‘B’ Class EA for Bridge St SPS Expansion	$250,000	-	-	-	
	Schedule ‘B’ Class EA for Colonnade SPS Expansion	-	-	-	$250,000	
TOTAL		**$26.55M**	**$7.35M**	**$144.35M**	**$204.7M**	

Notes:

1) Maintenance hole labels based on QGIS model provided by Municipality (refer to Appendix D)
2) Length of the Water Street to Barnes Street (Catchment Area #3) Syphon was based on the QGIS model.
3) Diameter of all three (3) syphons and the lengths of the Vista Crescent and Jack Street Syphons were obtained from drawings and markups based on field work provided by the Municipality per the Phase 1 Report (refer to Appendix B).
4) Catchment Area numbering is based on QGIS model provided by Municipality (refer to Appendix D).
5) Geotechnical, hydrogeological, archaeological and ecological information were not confirmed. Subsurface conditions also remain unknown and are not reflected in the OPC.
6) OPC excludes costs for property acquisition dewatering, bedrock excavation, and electrical servicing.

6.0 Considerations and Mitigation Measures

Construction and operation of the works proposed in this Master Plan can have environmental impacts. Table 35 summarizes these potential impacts, identified by the MECP, and provides measures to mitigate these impacts. It is recommended that impacts and mitigation measures be further reviewed and updated during project-specific Class EA planning and design stages.

Table 35: Summary of Environmental Impacts and Mitigation Measures

Impact	Mitigation Measure
Source Water Protection	In general, consultation with the Rideau Valley Conservation Authority should be completed during Class EA and mitigation measures should be embedded in the design and implemented during project construction. The recommended projects in this Master Plan are intended to improve the performance and reliability of the drinking water systems in the 20+ year planning horizon.
Air Quality, Dust and Noise	Increased dust and noise can be anticipated from the various construction works of the proposed projects; impacts to air quality may occur during proposed upgrades projects. The potential for impacts related to air quality, dust, and noise will be assessed during the Class EA and/or design phase for the proposed works. Dust and noise control mitigation measures (e.g. the MECP recommends non-chloride dust-suppressants) should be addressed and included in the construction plans to ensure that nearby residential and other sensitive land uses within the projects area are not adversely affected during construction activities.
Ecosystem Protection and Restoration	Generally, construction activities should avoid impacting ecosystem form and function. In general, site-specific environmental site assessments should be completed during the projects Class EA and mitigation measures should be embedded in the design and implemented during project construction. Consultation with the Ministry of the Environment, Conservation and Parks (MECP), Ministry of Natural Resources and Forestry (MNRF), Fisheries and Oceans Canada (DFO), and local conservation authorities should be completed during the Class EA projects to determine if special measures or additional studies will be needed to preserve and protect sensitive features within the area.
Species at Risk	In general, investigation of species at risk should be completed during the projects Class EA and mitigation measures should be embedded in the design and implemented during project construction. The proponent/consultant retained to complete the proposed Class EA projects should review the “Client’s Guide to Preliminary Screening for Species at Risk” (MECP, May 2019).
Surface Water	The planning and design process should include measures to ensure that any impacts to watercourses from construction or operational activities (e.g., spills, erosion, pollution) are mitigated as part of the proposed undertakings.
Groundwater	The potential for impacts related to groundwater conditions will be assessed through geotechnical/ hydrogeological studies during the design phase for the proposed works.

Impact	Mitigation Measure
Excess Material Management	Projects involving the management of excess soil should be completed in accordance with O. Reg. 406/19 and the MECP's current guidance document titled "*Management of Excess Soil–A Guide for Best Management Practices*" (2014). All waste generated during construction must be disposed of in accordance with Ministry requirements and Municipality policy.
Contaminated Sites	Additional studies to identify waste disposal sites, contaminated sites and underground storage tanks and excess material management may be required as part of specific Class EAs or during project design.
Servicing, Utilities and Facilities	Hydro One and the Ministry of Transportation should be consulted on individual projects during the Class EA and/or during design.
Mitigation and Monitoring	Design/construction reports for the proposed projects should center the protection of the existing environment, and opportunities for rehabilitation and enhancement of any impacted areas. A list of proposed mitigation and monitoring measures should be developed during the project's Class EA and/or design.
Permits and Approvals	The projects identified in this Master Plan may require specific permits and approvals which will be identified and obtained during the project's Class EA and/or design. These may include: • Environmental Compliance Approval (ECA) • Drinking Water Works Permit (DWWP) Amendment • Municipal Drinking Water License (MDWL) Amendment • Permit to Take Water (PTTW) • Environmental Activity and Sector Registry (EASR) • Species at risk permits • MTO permits. • Building Permit • Site Plan Approval • Approvals under the Impact Assessment Act, 2019. • Department of Fisheries and Oceans • Navigation Protection Program • Rideau Valley Conservation Authority permits
Cultural Heritage Resources	For all future undertakings identified under the Master Plan, the Ministry of Citizenship and Multiculturalism (MCM)'s Criteria for Evaluating Archaeological Potential screening checklist, the Criteria for Evaluating Marine Archaeological Potential screening checklist (if shoreline or in-water works are proposed) should be completed to determine whether an archaeological assessment is needed. Similarly, the MCM's Criteria for Evaluating Potential for Built Heritage Resources and Cultural Heritage Landscapes screening checklist should be completed for these projects to determine whether a Cultural Heritage Evaluation Report (CHER) and Heritage Impact Assessment (HIA) are needed. If a project area exhibits archaeological potential, then an archaeological assessment shall be completed by a licensed archaeologist under the Ontario Heritage Act. Archaeological assessment reports are to be submitted to MCM for review as early as possible during the planning phase and prior to any ground disturbing activities. If a project area exhibits potential for BHRs and/or CHLs, then a CHER shall be completed. If the CHER concludes that the property/project area has cultural heritage value or

Impact	Mitigation Measure
	interest, then an HIA will also be completed. The CHER (and HIA, if required) will be completed by a qualified person(s) and submitted for review and comment to MCM, Indigenous communities, and other interested parties, as early as possible during the planning phase and prior to any ground disturbing activities. Should previously undocumented archaeological resources be discovered, they may be a new archaeological site and therefore subject to Section 48(1) of the Ontario Heritage Act. The proponent or person discovering the archaeological resources must cease alteration of the site immediately and engage a licensed consultant archaeologist to carry out an archaeological assessment, in compliance with Section 48(1) of the Ontario Heritage Act. The Funeral, Burial and Cremation Services Act, 2002, S.O. 2002, c.33 requires that any person discovering human remains must cease all activities immediately and notify the police or coroner. If the coroner does not suspect foul play in the disposition of the remains, in accordance with Ontario Regulation 30/11 the coroner shall notify the Registrar, Ontario Ministry of Public and Business Service Delivery, which administers provisions of that Act related to burial sites. In situations where human remains are associated with archaeological resources, the MCM should also be notified (at archaeology@ontario.ca) to ensure that the archaeological site is not subject to unlicensed alterations which would be a contravention of the Ontario Heritage Act.”
Climate Change–Mitigation	New construction may contribute to climate change through the production of greenhouse gas (GHG) emissions such as those from heavy vehicles during construction. They may also include negatively impacting the landscape’s ability to remove and store atmospheric carbon through the removal of trees and other carbon capturing species. Operations can also contribute to climate change through GHG production from biological waste produced by the WPCP facility or electricity usage. Further review and consideration for greenhouse gas emissions, impacts on carbon sinks, and resilience or vulnerability is requried for the proposed undertakings during their respective Class EA.
Climate Change–Adaptation	Impacts of climate change on municipal water and wastewater projects include property-specific concerns such as flooding and system-wide impacts on water demand and electricity consumption. WPCPs and wells may typically experience negative impacts to functionality and reliability due to changing climatic conditions such as drought, flooding, and ice storm damage. The recommended projects presented will enhance the Municipality’s climate resiliency by improving servicing quantity, quality, and reliability.

7.0 Public and Agency Consultation

Effective consultation is key to successful environmental assessment planning. Through an effective consultation program, the proponent can generate meaningful dialogue between project planners and stakeholders/rights holders, including, but not limited to, the public, stakeholder agencies and interest groups. Refer to Appendix E for documented consultation activities for this Master Planning process.

At the beginning of this Master Planning process, a Notice of Project Initiation was published in the local newspaper, on the Municipality's website and distributed to potential stakeholders. A project mailing list was developed identifying stakeholders, and the list was updated throughout the process to reflect any changes.

Public Information Centres (PICs) regarding this Master Plan was held on October 27, 2025. The PICs included informal discussions and viewing of information boards on the project. In advance of the PICs, notices were placed in the local newspaper and on the project website. Emails were also sent to stakeholders on the project mailing list.

Table 36 below provides a summary of public comments received regarding this Class EA. Refer to Appendix E for written correspondence received from the public.

Table 36: Public Stakeholder Comments

Stakeholder	Comment	Action
No comments from public as of present date.		

Table 37 provides a summary of agency and developer comments received regarding this Master Plan. Refer to Appendix E for written correspondence from these groups.

Table 37: Review Agency and Developer Comments

Stakeholder	Comment	Action
Ministry of Environment, Conservation, and Parks (MECP)	Provided guidance in letter dated August 16, 2024	Noted.
Ministry of Citizenship and Multiculturalism (MCM)	Provided guidance in letter dated September 10, 2024	Noted.
Ministry of Natural Resources (MNR)	Provided guidance in letter dated August 8, 2024	Noted.
Infrastructure Ontario	Noted the planning of the future correctional facility in the study area.	Noted.

Table 38 provides a summary of comments received from Indigenous groups regarding this Master Plan. Refer to Appendix E for written correspondence from these groups.

Table 38: Indigenous Comments and Consultation

Stakeholder	Comment	Action
No comments from Indigenous groups as of present date.		

8.0 Limitations

This report has been prepared by J.L. Richards & Associates Limited for Municipality of North Grenville's exclusive use. Its discussions and conclusions are summary in nature and cannot properly be used, interpreted or extended to other purposes without a detailed understanding and discussions with the client as to its mandated purpose, scope and limitations. This report is based on information, drawings, data, or reports provided by the named client, its agents, and certain other suppliers or third parties, as applicable, and relies upon the accuracy and completeness of such information. Any inaccuracy or omissions in information provided, or changes to applications, designs, or materials may have a significant impact on the accuracy, reliability, findings, or conclusions of this report.

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J.L. RICHARDS & ASSOCIATES LIMITED

Prepared by:

Matthew Marcuccio, P.Eng.
Senior Environmental Engineer

Tatyana Roumie, EIT
Civil Engineering Graduate

Reviewed by:

Mark Buchanan, P.Eng.
Practice Lead, Environmental Infrastructure

Annie Williams, P.Eng.
Senior Civil Engineer

Ottawa
343 Preston Street
Tower II, Suite 1000
Ottawa ON Canada
K1S 1N4
613-728-3571
ottawa@jlrichards.ca

Kingston
203-863 Princess Street
Kingston ON Canada
K7L 5N4
613-544-1424
kingston@jlrichards.ca

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS

Sudbury
314 Countryside Drive
Sudbury ON Canada
P3E 6G2
705-522-8174
sudbury@jlrichards.ca

Timmins
834 Mountjoy Street South
Timmins ON Canada
P4N 7C5
705-360-1899
timmins@jlrichards.ca

North Bay
122 Main Street West, Suite 3
North Bay ON Canada
P1B 2T5
705-495-7597
northbay@jlrichards.ca

Guelph
107-450 Speedvale Avenue West
Guelph ON Canada
N1H 7Y6
519-763-0713
guelph@jlrichards.ca

London
380 Wellington Street
Tower B, 6th Floor
London ON Canada
N6A 5B5
226-700-5127
london@jlrichards.ca

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