JLR No.: 16953-118
Revision: Rev 7

January 31, 2024

Phase 1 Report (Final)

Casselman Water and Wastewater Infrastructure Master Plan

J.L.Richards
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1.0 Introduction

1.1 Background

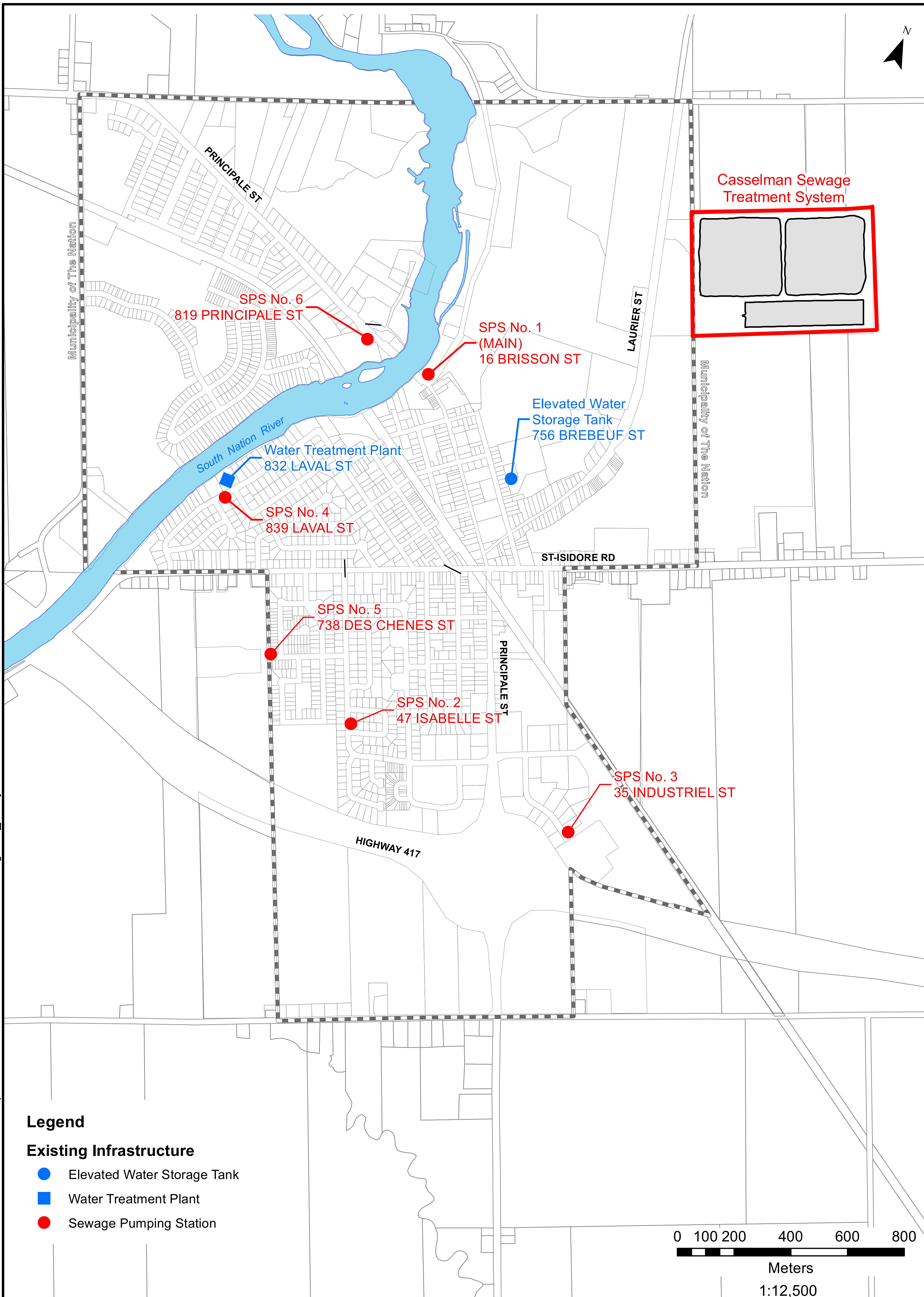
The Municipality of Casselman (the Municipality) initiated a Class Environmental Assessment (Class EA) Study to address treatment, capacity, and condition limitations of its water treatment plant (WTP), elevated water storage tank, water distribution system, wastewater conveyance system, sewage pumping stations and sewage treatment system through the development of a Water and Wastewater Infrastructure Master Plan. This Master Plan is being completed in accordance with the Municipal Engineers Association (MEA) Class EA Approach 1 master planning process. The ultimate objective of the Master Plan is to develop a strategy to accommodate future growth within the Municipality for the next 25 years that can be implemented in a prioritized fashion to improve the overall performance and reliability of the water and wastewater system.

The Municipality is located along Highway 417 on the South Nation River and borders the Municipality of the Nation. The Municipality is serviced by a water distribution system, consisting of the water treatment plant (WTP), elevated water storage tank, and over 22 km of watermains. The Casselman WTP has a rated capacity of 3,182 m^3/day, is owned by the Municipality and operated by the Ontario Clean Water Agency (OCWA). This facility is operated under the Ministry of the Environment, Conservation and Parks (MECP) Drinking Water License Number 173-101 and Drinking Water Works Permit No. 173-201. It provides conventional treatment through an Actiflo ® treatment system, dual media filtration, and disinfection. Additionally, raw water is treated with potassium permanganate during the summer months when influent manganese concentrations are elevated.

The Municipality is serviced by a wastewater collection system consisting of sewage treatment system (STS), six (6) sewage pumping stations (SPS), and over 30 km of sanitary sewers. The Casselman STS has a rated capacity of 2,110 m^3/day and consists of two (2) facultative lagoon cells (Cells ‘A’ and ‘B’), an aerated lagoon cell (Cell ‘C’), an aeration system, a phosphorous removal system, a wetwell and pumping system to convey lagoon effluent to two Moving Bed Biofilm Reactor (MBBR) process trains, a disc filter, and an effluent flow meter. This facility is operated under the MECP Environmental Compliance Approval (ECA) No. 8160-BAHPRF dated April 29, 2019.

Refer to Figure 1 for a location plan and overview of the water and wastewater infrastructure.

J.L. Richards & Associates Limited (JLR) was retained by the Municipality in 2021 to assist in the preparation of the Master Plan. The main purpose of this Phase 1 Report is to summarize the findings from the first phase of the Master Plan process. This includes a comprehensive description of the existing water distribution, wastewater collection and treatment systems. The current conditions associated with these systems are also documented, along with existing and future servicing constraints. This information has been used in the development of a Problem and Opportunity Statement that will form the basis for undertaking Phase 2 of the Master Plan process.



PROJECT:

MUNICIPALITY OF CASSELMAN
WATER AND WASTEWATER MASTERPLAN
MUNICIPALITY OF CASSELMAN, ONTARIO

DRAWING:

STUDY AREA AND OVERVIEW OF KEY INFRASTRUCTURE

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1.2 Summary of Previous and Ongoing Work

The following is a list of recent, previously completed, and ongoing water and wastewater infrastructure works within Casselman:

- Wastewater Annual Reports – completed for 2017 to 2022
- Water Annual Reports – completed for 2017 to 2022
- Lagoon Upgrades – completed in 2021 to include the Moving Bed Biofilm Reactor (MBBR) and disc filtration system
- Extension of Municipal Servicing South of Highway 417 – Water and Wastewater System Projected Servicing Upgrades – completed in 2019 by JLR
- Water and Wastewater CAD/GIS Update – completed in 2021 by JLR
- Highway #417 Watermain Looping – tendered 2022; as-builts 2023 by JLR
- Uncommitted Reserve Capacity Wastewater D-5-1 Calculation – completed in 2023 by JLR
- New Pump Station and Section of Sanitary Sewer located South of Highway 417 – ongoing by JLR
- WTP Upgrades to address THM and Manganese treatment issues – ongoing by JLR
- Development review services – ongoing by JLR
- Development Charge Update – ongoing by Watson in coordination with JLR

1.3 Class Environmental Assessment and Master Planning

The *Ontario Environmental Assessment Act* (EA Act), enacted in 1976, formally recognizes the Municipal Class Environmental Assessment (Class EA) process and outlines requirements for EA approval. The Municipal Class EA process and Master Planning process applies to municipal infrastructure projects, including roads, water, and wastewater projects. To ensure that environmental impacts and effects are considered for each project as per the EA Act, proponents are required to generally follow the planning process set out in the Municipal Class EA Guidelines, prepared by the Municipal Engineers Association (MEA) (2015) (www.municipalclassea.ca). The Class EA process includes the following stages:

- Phase 1: Problem and/or opportunity identification.

- Phase 2: Identification and evaluation of alternative solutions to determine a preferred solution to the problem or opportunity. This Phase also compiles an environmental 'inventory', identifies impacts, and outlines mitigation measures.

- Phase 3: Identification and evaluation of design concepts for the preferred solution. A detailed evaluation of the environmental effects and mitigation measures are addressed during this project Phase.

- Phase 4: Complete and place Environmental Study Report on Public Record. The Report will document Phases 1 through 3 and summarize the consultation undertaken throughout the planning process and is considered valid for a 10-year period.

- Phase 5: Implementation and monitoring.

Since projects may vary in their environmental impact, they are classified in terms of the following schedules:

- Schedule 'A' projects usually have minimal environmental effects and generally include normal or emergency operational and maintenance activities. These projects are pre-approved under the Class EA planning process. Projects within this category are subject to Phases 1 and 5.

- Schedule 'A+' projects are pre-approved projects similar to Schedule 'A', however, the public is to be advised prior to project implementation.

- Schedule 'B' projects have the potential for some adverse environmental impacts and, therefore, the proponent is required to proceed through a screening process, including consultation with affected parties. Generally, these projects include improvements and minor expansions to existing facilities. Projects within this category are subject to Phases 1, 2 and 5.

- Schedule 'C' projects have the potential for greater environmental impacts and are subject to all five Class EA Phases. 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 Casselman Water and Wastewater Infrastructure Master Plan has followed <u>Approach No. 1</u>, which involves the preparation of a Report at the conclusion of Phases 1 and 2. In this case, the Master Plan has been completed at a broad level of assessment thereby requiring more detailed investigations at a project-specific level in order to fulfill the Municipal Class EA documentation requirements for any specific Schedule 'B' and 'C' projects identified within the Master Plan.

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

2.0 Phase 1 Methodology

2.1 Project Initiation Meeting and Site Visits

A project initiation meeting was held on April 19, 2022, with representatives from the Municipality and JLR to confirm roles and responsibilities, project understanding, proposed work plan and schedule and to review current and historical issues associated with the Municipality's water/wastewater systems.

A visual on-site multi-discipline site review was undertaken on May 27, 2022, at the Casselman WTP and six (6) sewage pump stations (SPS), to verify conditions of the existing equipment and infrastructure. The review completed and data obtained were limited to visual observations and discussion with OCWA operators. No special lift devices or ladders were mobilized during the assignment and no destructive or exploratory testing or inspection was carried out. Confined spaces (i.e., wet wells, tanks, etc.) were not included in the scope of the review with the exception of where visual observations could be made outside of the confined space area. The condition assessment was not undertaken at the sewage treatment system (STS) since the facility has undergone major upgrades recently.

2.2 Compilation and Review of Existing Documentation

A comprehensive inventory of historical reports, studies, and drawings related to the water and wastewater treatment and conveyance systems was developed based previous and current works being completed in the Municipality (as noted in Section 1.2). This documentation was reviewed, and a number of key documents are referenced herein. In addition, historical WTP, STS, and SPS operating data were provided by OCWA. The data were reviewed and analysed to establish current operating conditions for each system.

2.3 Consultation Planning and Contact with Stakeholders

A Stakeholder Consultation Plan was developed and reviewed with the Municipality, taking into consideration mandatory requirements and objectives of effective consultation with the public and other potential stakeholders, as outlined in the MEA Class EA document (refer to Appendix 'A' for a copy of the Stakeholder Consultation Plan, dated May 31, 2022). The Plan identifies potential stakeholders, defines the level of consultation, establishes appropriate means of contact, and provides a schedule highlighting the general timing of contact. Consultation includes project notification to the public and potential stakeholders, and one (1) Public Information Centre to be held during Phase 2.

A Project Initiation Notice was posted on the Municipality's website (https://en.casselman.ca/services/water_and_sewer) on June 9, 2022. Project initiation letters were also distributed directly to potential stakeholders, with an invitation to provide comments. Refer to Appendix 'B' for a copy of the Notice and Appendix 'C' for responses received to date and an updated stakeholder tracking list.

2.4 Technical Memoranda

The following technical memoranda (TM) were completed as part of Phase 1 of the Master Plan process:

- TM 1A Water Treatment Plant and Sewage Pumping Stations Condition Assessment, dated November 18, 2022, was prepared to summarize a condition assessment of the WTP and six (6) SPS buildings and process infrastructure (refer to Appendix 'D')
- TM 1B Linear Infrastructure Condition Assessment, dated November 18, 2022, was prepared to summarize a desktop condition assessment of the linear infrastructure (refer to Appendix 'E')
- TM 2 Growth Projections, dated February 2, 2023, was prepared to summarize population and development projections for the Master Plan planning horizon (refer to Appendix 'F')

It should be noted that the above-noted TMs form much of the technical basis for Phase 1 and should be referenced as needed.

2.5 Problem and Opportunity Identification

A problem and opportunity statement was generated from Phase 1 related work and is presented in Section 7.0 of this Report.

2.6 Phase 1 Report

This Phase 1 Report was prepared to summarize the findings from the first phase of the Master Plan process and to use as a basis for the identification and evaluation of alternative options during Phase 2.

The objectives of this Report are:

- To establish 25-year future growth projections.

- To provide a description of existing conditions and constraints associated with the linear infrastructure, WTP, water storage, STS and six SPS within the Municipality, including a summary of historical water/wastewater flows and water/wastewater quality; condition assessment findings of these infrastructure; and updates and findings from the existing water and wastewater models to incorporate more recent development.

- To provide a summary of the D-5-1 calculation (i.e., uncommitted reserve capacity assessment) completed for the STS.

- To provide timing for when rated capacities of the WTP and STS will be reached.

- To establish proposed design basis for future servicing needs.
- To identify land use and planning constraints, and natural environment constraints.
- To establish a Problem/Opportunity Statement.
- To confirm Phase 2 methodology and next steps.

3.0 Design Basis

3.1 Growth Projections (TM 2)

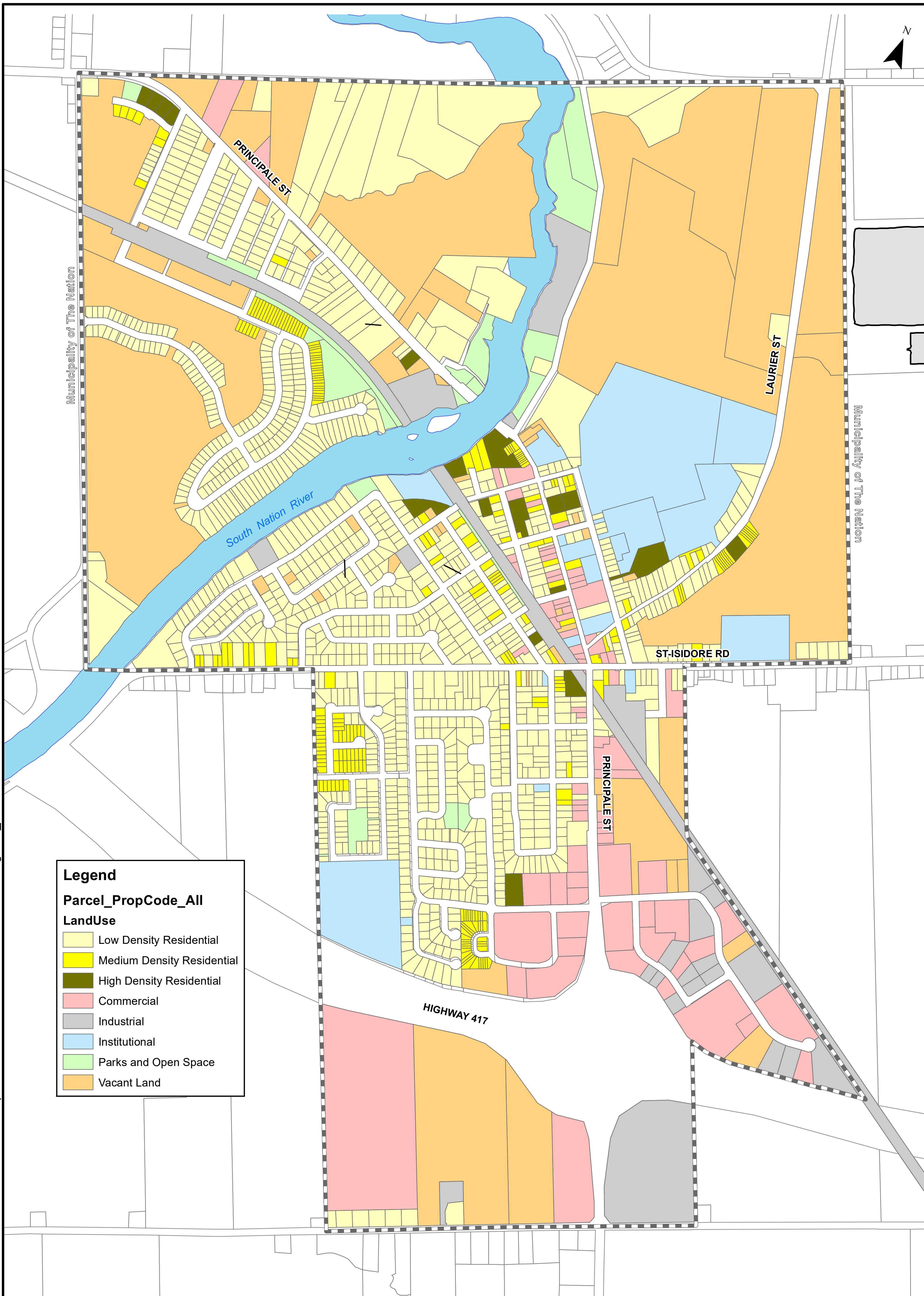
The Casselman Growth Projections Technical Memorandum (TM 2) was prepared in February 2023 for the Municipality to summarize future growth anticipated in Municipality within the master planning timeframe; it is attached in Appendix F. Although TM 2 provides the necessary background information regarding the County Official Plan and growth allocations, it shall be noted that the information regarding future developments, unit counts, existing serviced population and future population provided in this section of the Master Plan supersedes the information presented in TM 2. Information presented in this section of the Master Plan was developed in consultation with the Municipality's Planning Services Department, Buildings Department and Watson & Associates Economics Ltd in mid-2023.

The following key updates have been implemented since TM 2:

- The Municipality is 100% Urban Settlement Area and designated for growth (see Figure 2). The Municipality's Planning Department has requested that a 5% intensification of existing residential units be carried for this Master Plan. This means that approximately 67 units (based on 1,337 units of existing dwellings per 2021 Census) should be accounted for intensification within the established built-up areas of the Municipality via infill, redevelopment, additional residential units, etc.

- The Municipality's growth projection differs from the growth forecast established through the UCPR OP in 2022. The Municipality's Planning Department and Buildings Department has provided information regarding proposed and committed development across Casselman, as illustrated in Figure 3 and Figure 4, and detailed in Section 3.2.

- In addition, as a part of ongoing work, the Municipality has separately retained Watson & Associates Economists Ltd. (Watson) to undertake analysis of existing and future serviced units and population within the Municipality to complete their Development Charges Update. Watson noted a total of 1,695 units and 4,048 people are currently serviced by municipal water and wastewater within the Municipality, excluding the institutional population, at a unit density of 2.39 persons per unit. The existing serviced population, units and density are used as design basis in the Master Plan Phase 1 Report.



PROJECT:

MUNICIPALITY OF CASSELMAN
WATER AND WASTEWATER MASTER PLAN
CASSELMAN, ONTARIO

DRAWING:

LAND USE INVENTORY

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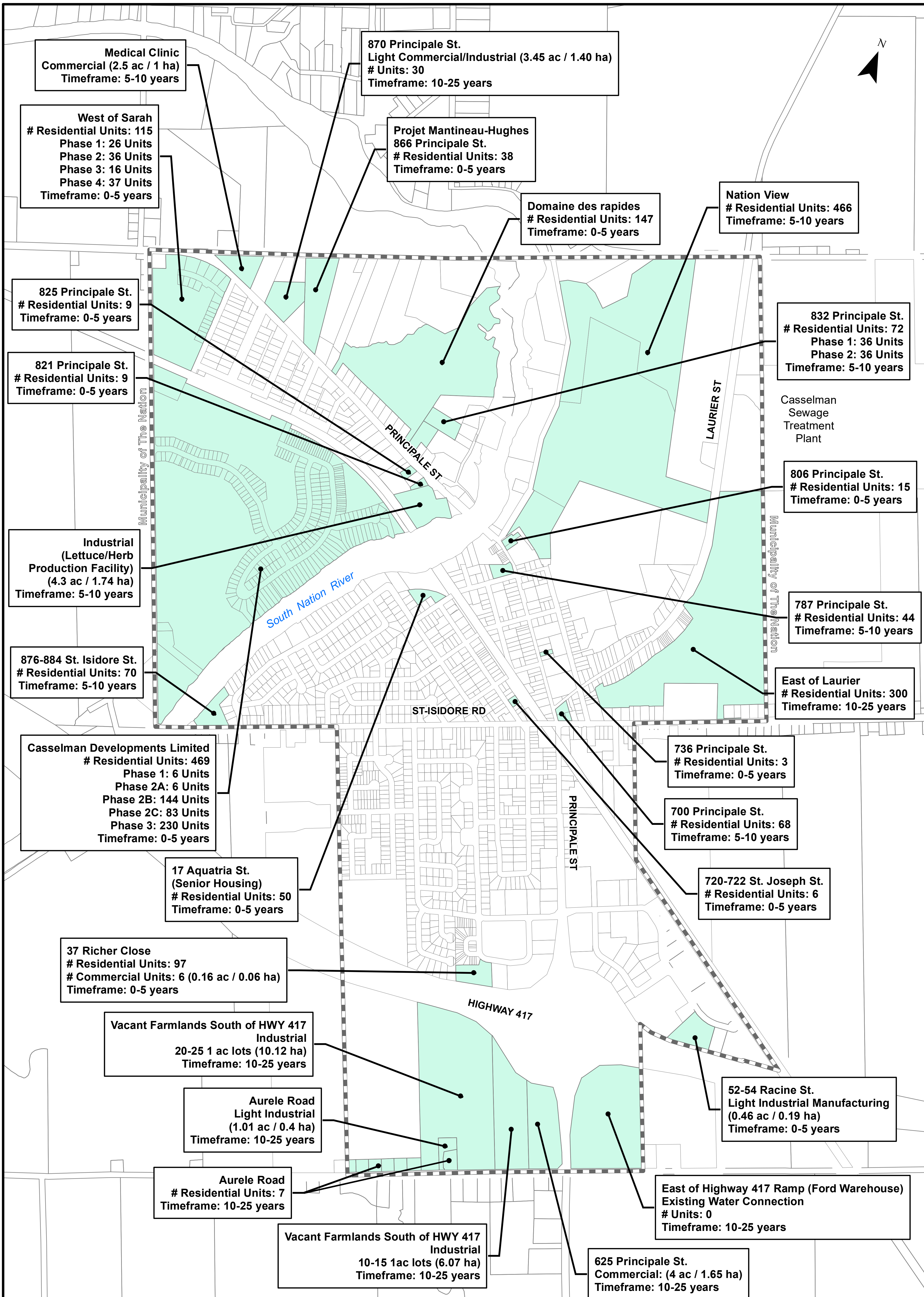

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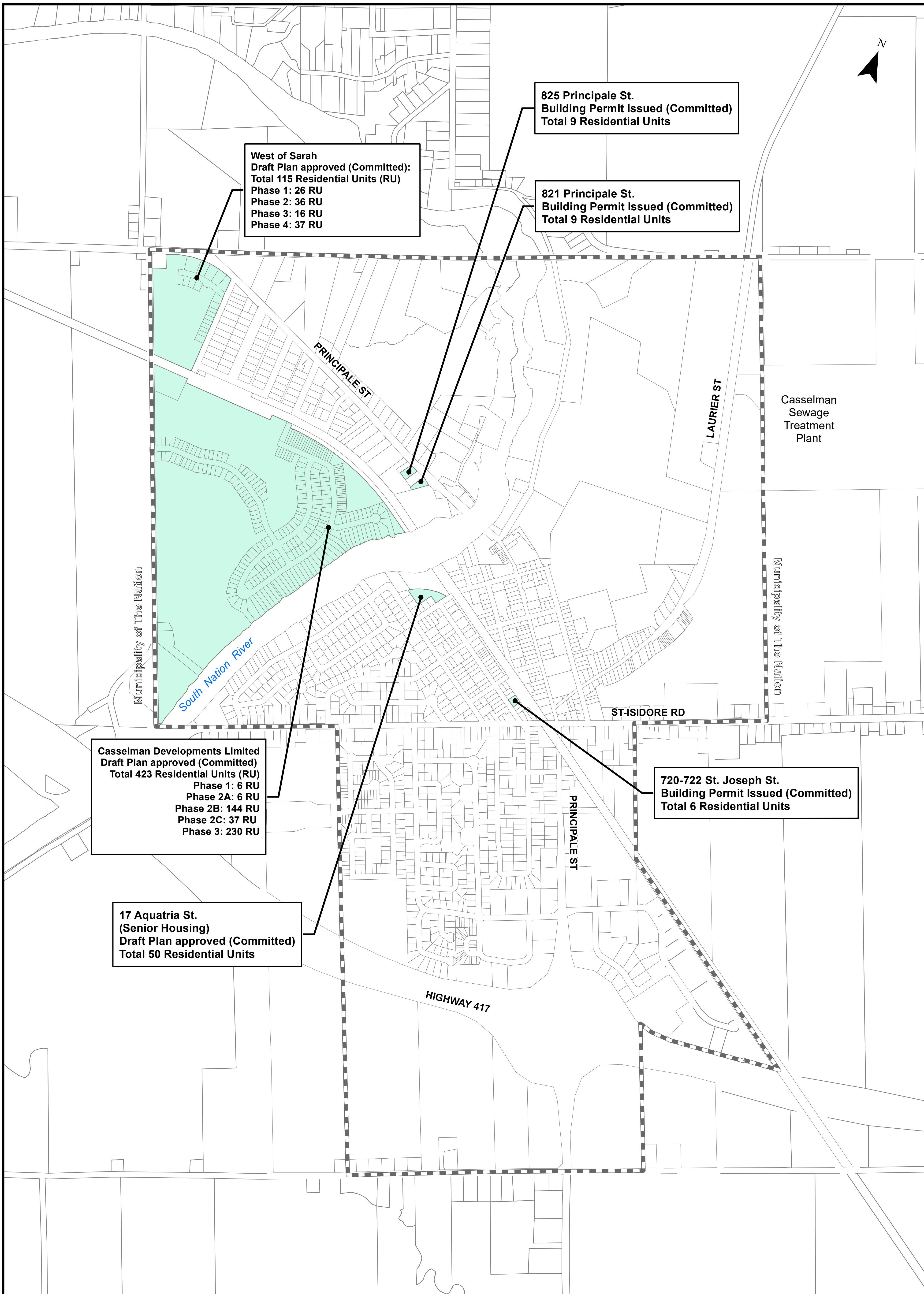

PROJECT: MUNICIPALITY OF CASSELMAN
WATER AND WASTEWATER MASTER PLAN
CASSELMAN, ONTARIO

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3.2 Planning Periods

For the purposes of this Master Plan, population and flow projections and servicing recommendations have been categorized for the near term (2023 to 2027), medium term (2028 to 2032), and long term (2033 to 2047) planning periods. Based on the information presented in the Figures above and consultation with the Municipality, future residential units and population and industrial, commercial, and institutional (ICI) land use projections are summarized by these timeframes in the Table 1 and Table 2. The growth presented in these tables has been used as the design basis for this Master Plan.

Table 1: Future Residential Development Units and Population Projections

Development	Timeframe (1)	Units (2)	Population (3)
West of Sarah Phase 1	0-5 years	26	62
West of Sarah Phase 2	0-5 years	36	86
West of Sarah Phase 3	0-5 years	16	38
West of Sarah Phase 4	0-5 years	37	88
Casselman Developments Ltd. Phase 1	0-5 years	6	14
Casselman Developments Ltd. Phase 2A	0-5 years	6	14
Casselman Developments Ltd. Phase 2B	0-5 years	144	342
Casselman Developments Ltd. Phase 2C	0-5 years	83	197
Casselman Developments Ltd. Phase 3	0-5 years	230	546
Projet Mantineau-Hughes 866 Principale St.	0-5 years	38	90
825 Principale St.	0-5 years	9	21
17 Aquatria St. (Senior Housing) (4)	0-5 years	50	100
37 Richer Close	0-5 years	97	230
720-722 St. Joesph St.	0-5 years	6	14
736 Principale St.	0-5 years	3	7
Domaine des rapides	0-5 years	147	349
806 Principale St.	0-5 years	15	36
821 Principale St.	0-5 years	9	21
Intensification of Existing Units (5)	0-5 years	22	53
TOTAL Short-Term Growth (0-5 Years; 2023-2027)		**980**	**2309**
832 Principale St. Phase 1	5-10 years	36	86
832 Principale St. Phase 2	5-10 years	36	86
700 Principale St.	5-10 years	68	162
787 Principale St.	5-10 years	44	105
Nation View	5-10 years	466	1107
876-884 St. Isidore St.	5-10 years	70	166
Intensification of Existing Units (5)	5-10 years	22	53
TOTAL Mid-Term Growth (5-10 Years; 2028-2032)		**742**	**1763**

Development	Timeframe (1)	Units (2)	Population (3)
East of Laurier	10-25 years	300	713
Aurele Road	10-25 years	7	17
Intensification of Existing Units (5)	10-25 years	22	53
TOTAL Long-Term Growth (10-25 Years; 2033-2047)		**329**	**782**

(1) Timeframes presented herein indicate the anticipated timeline when the development will be connected to the water/wastewater services. This is not an indication of when the development can begin. The actual timing of upgrades will be contingent on the rate of development in each of the contributing areas.
(2) Unit counts provided by the Municipality. For the development areas that are already underway the unit counts represent the unoccupied units as for December 2022.
(3) Assume 2.375 cap/unit for residential units.
(4) Assume 2 cap/unit for Senior Housing.
(5) Assume 5% intensification for existing dwelling units (1,337 units per 2021 Census) divided evenly to each timeline term.

Table 2: Future ICI Development Land Projections

Development	Timeframe	Hectares
52-54 Racine St. - Light Industrial	0-5 years	0.19 (3)
37 Richer Close - Commercial	0-5 years	0.06 (3)
TOTAL Short-Term (0-5 Years; 2023-2027)		**0.25**
Lettuce/Herb Production Facility - Industrial	5-10 years	1.74 (4)
Medical Clinic	5-10 years	1.00 (5)
TOTAL Mid-Term (5-10 Years; 2028-2032)		**2.74**
870 Principale St. - Light Commercial/Industrial	10-25 years	1.40
Vacant Farmlands South of HWY 417 - Industrial	10-25 years	16.19
Aurele Road - Light Industrial	10-25 years	0.40
625 Principale St. - Commercial (1)	10-25 years	1.65
East of Highway 417 Ramp (Ford Warehouse) (2)	10-25 years	N/A
TOTAL Long-Term (10-25 Years; 2033-2047)		**19.64**

(1) Half of the property area for 625 Principale St. has been included within the above projections, development of the other half of the area has been assumed beyond the timeline of the Master Plan.
(2) The Ford Warehouse is already currently serviced with water as of December 2022; future servicing is for wastewater only (17,550 L/day per previous sanitary calculation completed by EMEeng, November 10, 2021).
(3) Footprint presented herein represent the gross floor area (GFA). Development at 37 Richer Close has 6 new commercial space proposed.
(4) Footprint presented herein represent the land parcel area. This development will consist of retrofit of existing building and building expansion.
(5) The medical clinic proposed is a day-time medical centre. There is no overnight care being provided. Footprint presented herein represent the land parcel area.

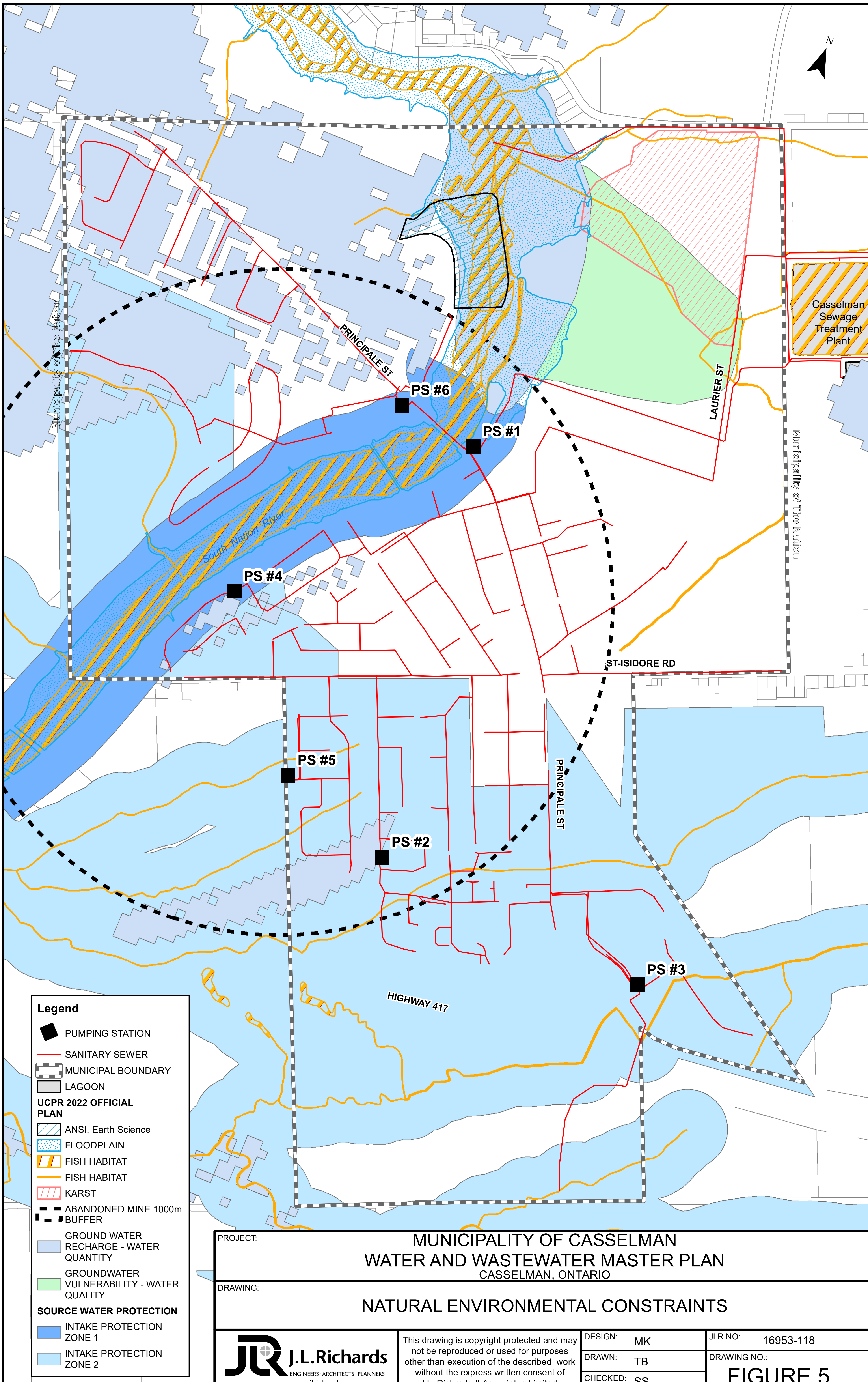
(6) Town Hall relocation to 1 Industrial Street is not accounted for in the future ICI projections since the intent is to occupy existing building footprint.

3.3 Natural Environmental

As illustrated in Figure 5 below, the 2022 UCPR OP has indicated some Areas of Natural and Scientific Interest (ANSI) which represents lands and waters containing natural landscapes or features that are important for natural heritage, protection, appreciation, scientific study and/or education.

Moreover, a section of the South Nation River that runs through Casselman is designated a Source Water Protection Intake Zone 1 and contains areas of fish habitat.

Refer to Figure 5, which identifies other significant landforms, groundwater areas, and source water protection zones located within the study area. Limitations associated with natural environment constraints will be further explored in Phase 2.



PROJECT:

MUNICIPALITY OF CASSELMAN
WATER AND WASTEWATER MASTER PLAN
CASSELMAN, ONTARIO

DRAWING:

NATURAL ENVIRONMENTAL CONSTRAINTS

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4.0 Description of Existing Conditions – Water/Wastewater Facilities

4.1 Water Treatment Plant

The Casselman WTP is located at 832 Laval Street and has a rated capacity of 3,182 m^3/day, as per the Permit to Take Water (PTTW 6067-9EGMS2) and Drinking Water Works Permit (DWWP 173-201, Issue 2). It is owned by the Municipality and operated by the Ontario Clean Water Agency (OCWA). It provides conventional treatment through an Actiflo ® treatment system, dual media filtration, and disinfection (primary using chlorine and UV; secondary using chloramination with ammonium sulphate). Additionally, raw water is treated with potassium permanganate during the summer when influent manganese (Mn) concentrations are exasperated. As previously noted in the list of ongoing work, JLR is currently completing design work at the WTP to lower treated manganese (Mn) and total trihalomethane (THM) concentrations in the distribution system.

4.1.1 Historical Flow Rates

The Casselman WTP treated daily flow data over the past five (5) years (2018 to 2022) was used to determine the current water demands for the water distribution system. Table 3 below summarizes the average day, maximum day and peak hour demands within Casselman.

Table 3: Casselman Water Demands (2018-2022)

Years	Average Day (m^3/day)	Maximum Day (m^3/day)	Peak Hour (m^3/day)
2018	994	2,154	Not available
2019	961	2,051	Not available
2020	1,010	1,744	Not available
2021	1,052	1,864	Not available
2022	1,139	2,029	Not available
5-Year Average Demand (m^3/day)	1,031	1,968	2,953 (1)
5-Year Average Demand (L/s)	12	23	34 (1)
Percent (%) of Rated Capacity Used	Not applicable	62%	Not applicable
(1) Peak hour demand calculated using a theoretical peaking factor of 1.5 times the maximum day demand, MECP Design Guidelines for Drinking Water Systems (2008)			

The average day demand was taken as the average of the treated water flow reported for every day over the past five (5) years, which was calculated to be 1,031 m^3/d (12 L/s). The maximum day demand was taken as the average of the maximum day flow reported for each of the past five (5) years, which was calculated to be 1,968 m^3/d (23 L/s). As the peak hourly data was not specifically recorded, the peak hour demand was estimated using a theoretical peaking factor of 1.5 times the maximum day demand, as recommended in Ministry of the Environment, Conservation, and Parks (MECP) Design Guidelines for Drinking Water Systems (2008) for a community of this size, which resulted in a peak hour demand of 2,953 m^3/d (34 L/s).

4.1.2 Future Water Demands

The design parameters used to calculate the future water demands of the water distribution system are summarized in Table 4.

Table 4: Design Parameters – Future Water Demand

Future Water Flow Projection – Design Parameters		
Parameter	**Residential**	**Industrial / Commercial / Institutional**
Average Day Flow (1)	350 L/cap/day	35,000 L/ha/day (Light Industrial) 45,000 L/ha/day (Typical Industrial) 28,000 L/ha/day (Commercial)
Maximum Day Flow (2)	1.92 x Average Day	1.92 x Average Day
Peak Hour Flow (1)	1.5 x Maximum Day	1.5 x Maximum Day
(1) MECP Design Guidelines for Drinking Water Systems (2008) (2) Peak factor determined from average and maximum day demand data provided in Table 3		

Based on these design parameters, the future growth present in Table 1, the projected short, mid and long-term water demands were calculated and are presented in Table 5.

Table 5: Future Water Demands

Demand Scenario	**Short-Term (2023-2027)**	**Mid-Term (2028-2032)**	**Long-Term (2033-2047)**
Total Serviced Population (1)	6,357	8,120	8,902
ICI Development Area (ha)	0.25	2.74	19.64
Future Average Day (m^3/day)	1,850	2,580	3,690
Future Maximum Day (m^3/day)	3,552	4,954	7,085
Future Peak Hour (m^3/day)	5,328	7,430	10,627
(1) The total serviced population represents residential population only and excludes equivalent institutional households and populations.			

4.1.3 Projected Timing for Casselman WTP Expansion

Based on water demands and growth development timelines a graph representing the projected maximum day water demand from the WTP and anticipated timing to reach 80%, 90%, and 100% of the rated capacity was prepared. Refer to Figure 6, below.

This graph indicates that based on the growth numbers presented in this Master Plan, 80% of the WTP rated capacity will be reached by the end of 2023, 90% WTP rated capacity will be reached by the end of 2024, and the rated capacity of the WTP will be reached by the end of 2025.

The Municipality indicated that based on historical building permit applications, they see 50 units per year. For the purpose of projecting timing for the next expansion, a scenario has been created on Figure 6 to demonstrate the historic trending based on 50 new residential units (excluding ICI development) being brought online per year for the next 25 years. Based on this new scenario, it is anticipated that 80% of the WTP rated capacity will be reached sometime in 2028, 90% WTP rated capacity will be reached sometime in 2032, and the rated capacity of the WTP will be reached sometime in 2035.

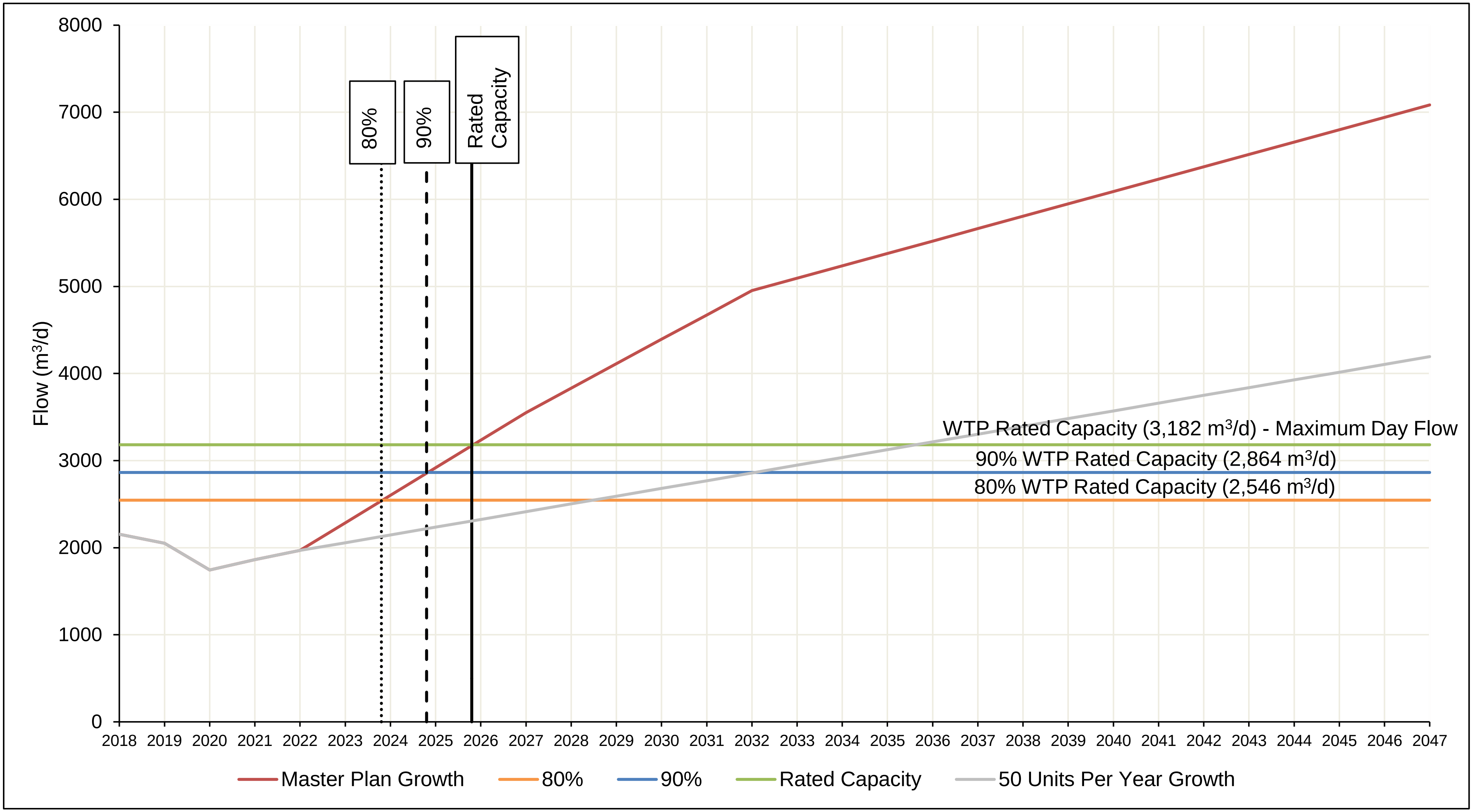


Figure 6: Casselman WTP Flow Projection

4.1.4 Water Quality

A review was completed of the Annual Water Reports for the Casselman WTP from 2018 to 2022. The notable adverse water quality incidents comprised of trihalomethane (THM) exceedances (reported twice (2) in 2018, once (1) in 2019, thrice (3) in 2021) and turbidity exceedances from the Actiflo ® filter effluent (reported thrice (3) in 2019 and twice (2) in 2020). With exception to these water quality issues, it is reported that the system complies with all other regulations for microbiological, chlorine residual, organic and inorganic parameter concentrations in the distribution system.

OCWA provided JLR with water quality parameters of concern in raw water (Table 6) and treated water (Table 7) from 2018 to 2022. It was noted by OCWA that Mn concentrations in raw water sourced from the South Nation River have been elevated, as a result Mn concentrations in treated water from the Casselman WTP have been elevated, as observed in Table 7. A new Maximum Acceptable Concentration (MAC) for Mn of 0.12 mg/L and aesthetic objective (AO) of 0.02 mg/L was recently established in the Guidelines for Canadian Drinking Water Quality and is anticipated to become a near-future requirement in Ontario. As evidenced in Table 7, the WTP is not currently meeting this federal guideline.

In addition, as recently as June/July 2023, the Municipality's water system experienced an event during which the drinking water turned brown. This incident is thought to have been triggered by high influent Mn concentrations compounded with low to no river flow typically experienced in the South Nation River from June to September (per South Nation Conservation data). A water quality advisory was issued at this time by the Eastern Ontario Health Unit (EOHU) as residents experienced brown water in their taps. The EOHU noted, per news articles covering the water advisory, that the water meets Ontario Drinking Water Standards (AO of 0.05 mg/L) and is safe to drink but recommends another source water for babies and infants, who may be more vulnerable to elevated Mn levels.

OCWA also noted that elevated THM concentrations are a persistent issue in finished water, especially during spring and summer operations. THMs are regulated disinfection by-products (DBPs) and are formed when natural organic matter (NOM) present in a source water reacts with chlorine (Cl) used for disinfection. Based on the last five years of data, THM concentrations have approached or exceeded the MAC in finished water, 100 µg/L, as observed in Table 7. Colours have been used in the table to indicate annual average concentrations exceeding the AO or approaching the MAC (yellow) and exceeding the MAC (red). Raw water dissolved organic carbon (DOC) / total organic carbon (TOC) data (Table 6) show that nearly all organic content is dissolved (5-year average of 94% of TOC made up of DOC), which is a probable causation of elevated THM concentrations.

Moreover, it has been noted by OCWA that Actiflo ® filter effluent exceeds turbidity guidelines: 95% of monthly measurements less than <0.3 NTU and no single measurement to exceed 1 NTU; and have had to been reported to the MECP.

Table 6: Casselman Raw Water Quality Annual Averages (2018-2022)

Parameter	2018	2019	2020	2021	2022
Mn (mg/L)	0.24	0.17	0.16	0.13	0.14
Dissolved Organic Carbon (mg/L)	7.59	7.91	6.84	7.08	6.85
Total Organic Carbon (mg/L)	7.83	8.26	7.34	8.44	7.30
Turbidity (NTU)	N/A	N/A	12.73	10.57	12.80

Table 7: Casselman Treated Water Quality Annual Averages (2018-2022)

Parameter	Limit (*Regulation*)	2018	2019	2020	2021	2022
THM (µg/L)	100 *MAC* (1)	97	102	86	121	96
Mn (mg/L)	0.02 *AO* (2) 0.12 *MAC* (2)	0.06	0.09	0.05	0.05	0.06
DOC (mg/L)	5 *AO* (1)	4.65	3.83	3.33	3.38	2.60
TOC (mg/L)	N/A	4.83	4.81	4.15	4.42	3.20
Turbidity (NTU)	1 *MAC* (1)	N/A	0.83	0.50	0.66	0.71

(1) Ontario Drinking Water Standards, Objectives and Guidelines (June 2006)
(2) Guidelines for Canadian Drinking Water Quality – Manganese (May 2019)

4.2 Water Storage

The Casselman Elevated Tank is located at 758 Brebeuf Street and was originally constructed in 1977. The following table summarizes the key parameters of the elevated tank.

Table 8: Casselman Elevated Storage Tank Parameters

Parameter	Value
Physical Characteristics of the Elevated Tank	
Internal Tank Diameter	11.6 m (1)
Overflow Elevation	118 m (2)
Base Elevation of the Elevated Tank	67 m (2) (3)
Operating Characteristics of the Elevated Tank	
Operating Level – High	115.64 m (4)
Operating Level – Low	106.23 m (4)
Top Water Level (Max)	118 m (5)
Low Water Level (Min)	82 m (5)
Total Usable Volume	3,801 m^3 (6)

(1) Obtained from the Inspection Report completed by Landmark Municipal Services 2019.
(2) Obtained from Landmark Structures Co. Casselman Elevated Tank Mixing System Drawings.
(3) High point of the tank arc.
(4) Operating levels provided by OCWA. Low level is 90% of overflow. High level is 98% of overflow.
(5) Obtained from the WaterCAD® Model for existing operating conditions; under maximum day demand plus fire flow gives system minimum pressure 140 kPa (20 psi) when all pumps at the WTP are turned off. Low water level corresponds to level at bottom of C in Figure 7. High water level corresponds to level at top of B in Figure 7.
(6) Usable volume based on overflow elevation and low water level and internal diameter.

Per MECP Design Guidelines for Drinking-Water Systems (2008), total treated water storage within the system should at least amount to the sum of the required equalization storage (B), fire storage (A) and emergency storage (C) allowances, as depicted in Figure 7 below.

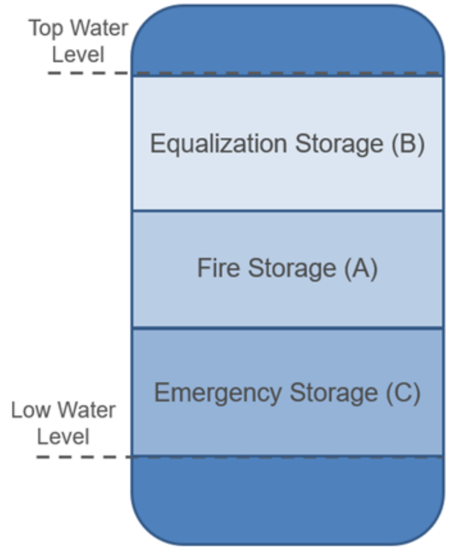


Figure 7: Total Required Treated Water Storage

Based on these Guidelines, Table 9 provides a summary of the estimated existing, short, mid and long-term total storage requirements for the Municipality. Note, the equivalent service population was estimated assuming a 350 L/cap/d average usage which is in line with the domestic water demand recommended by the MECP Design Guidelines (2008).

Based on the information available, the existing treated water storage volume is sufficient for the current and up to the 5-year future demand relative to the MECP requirements. It is anticipated the storage capacity will be insufficient for water demands and system pressure beyond 5-years. Additional modelling will be completed in Phase 2 of the Master Plan to incorporate future development areas and investigate storage and pressure constraints.

Table 9: Water Storage Requirements

Parameter	**Existing (2022)**	**Short-Term (2023-2027)**	**Mid-Term (2028-2032)**	**Long-Term (2033-2047)**
Equivalent Population (1)	2,947	5,286	7,372	10,543
Fire Flow (2) (L/s)	109	148	169	195
Duration (2) (Hours)	2	2	3	3
A – Fire Storage (3) (m^3)	786	1,068	1,828	2,102
B – Equalization Storage (4) (m^3)	492	888	1,238	1,771
C – Emergency Storage (5) (m^3)	320	489	767	968
TOTAL STORAGE REQUIREMENT (m^3)	1,598	2,445	3,833	4,841
EXISTING AVAILABLE STORAGE (m^3)	3,801	3,801	3,801	3,801
SURPLUS (m^3)	2,203	1,357	-32	-1,040

(1) Estimated to be equal to average day demand / per capita usage of 350 L/cap/d. The equivalent population also includes ICI flow contribution.
(2) Values interpolated from Table 8-1 of the MECP Design Guidelines (2008) based on equivalent service population. Fire flow is described as the largest expected fire flow requirement in L/s and duration is length of time fire flow shall be sustained. A sensitivity analysis was completed to compare fire flow by MECP and Fire Underwriters Survey (FUS) methods. Using FUS method, Table 8, exposure distance of less than 3 m for row housing, it generates a fire flow of 9,000 L/min or 150 L/s. The MECP method generates a more conservative estimate for fire flow and is representative of holistic approach for a drinking water distribution system. As such, MECP fire flow numbers are being used for future water storage requirement calculations.
(3) Largest expected fire volume = fire flow x duration
(4) 25% of Maximum Day Demand
(5) 25% of the sum of ‘A’ and ‘B’

4.3 Sewage Treatment System

The Casselman Sewage Treatment System (STS) has a rated capacity of 2,110 m^3/day and consists of two (2) facultative lagoon cells (Cells ‘A’ and ‘B’), an aerated lagoon cell (Cell ‘C’), an aeration system, a phosphorous removal system, a wetwell and pumping system to supply two MBBR process tanks, a disc filter, and an effluent flow meter. The system also includes the main sewage pumping station and a forcemain. This facility is operated under the MECP Environmental Compliance Approval (ECA) No. 2712-6RVNRB from August 24, 2006, until October 2, 2018. On October 3rd, 2018, the ECA was amended, and as a result, this facility was operating under ECA No. 8225-B3HSD4. The ECA was further amended in 2019 to improve the performance of the lagoon sewage treatment system and ECA No. 8160-BAHPRF dated April 29, 2019, was issued by the MECP. ECA No. 8160-BAHPRF came into effect upon completion of the modifications to the sewage treatment system identified within this approval in 2021/2022.

4.3.1 Historical Flow Rates

The average annual daily raw wastewater flows into the Casselman STS for the past five (5) years (2018-2022) were obtained from OCWA. An average day flow was calculated using the average annual daily flows of the past five (5) years (2018-2022), which was calculated to be 1,381 m^3/d (16L/s). The maximum day demand was taken as the average of the maximum day reported for each of the past five (5) years, which was calculated to be 3,206 m^3/d (37 L/s). Refer to Table 10, below.

Table 10: Casselman STS Raw Wastewater Flows (2018-2022)

Years	Average Day (m^3/day)	Maximum Day (m^3/day
2018	1,331	2,772
2019	1,354	2,992
2020	1,468	2,511
2021	1,310	4,457
2022	1,442	3,300
5-Year Average Flow (m^3/d)	1,381	3,206
5-Year Average Flow (L/s)	16	37
Percent (%) of Operating Capacity Used	65%	N/A

4.3.2 Future Wastewater Flow

The design parameters used to calculate the future average day wastewater flows are the same as those previously presented in Table 4, as it is assumed future average daily water demand flows will approximate future average daily wastewater flows. In addition, the Ford Warehouse is currently serviced with water as of December 2022, so future wastewater flows generated by the Ford Warehouse have been added to the long-term future average daily flows, as advised by the Municipality. Future maximum day wastewater flows projections were generated by multiplying the average day flows by a peak factor of 2.34, determined from average and maximum day demand data provided in Table 10 above.

Table 11: Future Wastewater Flow

Demand Scenario	**Short-Term (2023-2027)**	**Mid-Term (2028-2032)**	**Long-Term (2033-2047)**
Total Serviced Population (1)	6,357	8,120	8,902
ICI Development Area (ha)	0.25	2.74	19.64
Future Average Day (m^3/day)	2,200	2,930	4,050 (2)
Future Maximum Day (m^3/day) (3)	5,148	6,856	9,477

(1) The total serviced population represents residential population only and excludes equivalent institutional households and populations.
(2) The Ford Warehouse is already currently serviced with water as of December 2022; so future wastewater flows generated by the Ford Warehouse have been added to the long-term future average daily flows (17,550 L/day per previous sanitary calculation completed by EMEeng, November 10, 2021).
(3) Future maximum day wastewater flows projections were generated by multiplying the average day flows by a peak factor of 2.34, determined from average and maximum day demand data provided in Table 10.

4.3.3 Uncommitted Hydraulic Reserve Capacity Assessment (D-5-1 Calculation)

In conjunction with this Master Plan, the Municipality requested JLR complete an Uncommitted Hydraulic Reserve Capacity Assessment. The results from the assessment are summarized in the sections below, and the report can be found in Appendix G.

The methodology used to determine the Uncommitted Hydraulic Reserve Capacity is based on the MECP document entitled “Procedure D-5-1: Calculating and Reporting Uncommitted Reserve Capacity at Sewage and Water Treatment Plants” (March 1995). The uncommitted reserve capacity is calculated by subtracting the total average daily flow, either the previous 3-year or 5-year average daily flow, whichever is most conservative (in this instance the previous 3-year average of 1,407 m^3/day used as a more conservative raw sewage flow approximation); and the potential daily sewage flow predicted for draft approved developments (committed hydraulic reserve capacity) from the sewage treatment rated capacity. Additionally, a 5% intensification of existing dwellings was included as part of the committed reserve flow calculation based on feedback provided by the Municipality.

4.3.3.1 Hydraulic Reserve Capacity

According to ECA No. 8160-BAHPRF (dated April 29, 2019) the lagoon treatment system has a rated raw sewage influent average daily flow capacity of 2,110 m^3/day. The hydraulic reserve capacity is obtained by subtracting the total average daily flow from the rated capacity. Based on the above, the hydraulic reserve capacity of the Casselman STS as of 2022 is 2,110 m^3/d –1,407 m^3/d = 703 m^3/day.

4.3.3.2 Committed Hydraulic Reserve Capacity

The committed and uncommitted development information used for this calculation is based on information provided by the Municipality. The Municipality indicated 612 units are committed; including 5% intensification and using appropriate unit densities this equates to a committed population increase of 1,593. Assuming an average day per person usage of 350 L/cap/d (MECP

Design Guidelines for Sewer Works 2008), the “committed” hydraulic reserve capacity is calculated as 1,593 persons x 0.35 m^3/d/cap = 558 m^3/d.

4.3.3.3 Uncommitted Hydraulic Reserve Capacity

Based on MECP Procedure D-5-1, the “uncommitted” hydraulic reserve capacity is calculated by subtracting the hydraulic reserve capacity from the “committed” hydraulic reserve capacity. The “uncommitted” hydraulic reserve capacity is 703 m^3/day - 558 m^3/d = 145 m^3/d.

As such, based on MECP Procedure D-5-1 and reported approved/draft approved development information, the Municipality has allocated approximately 93% of the entire hydraulic reserve capacity of the lagoon treatment system. The remaining residual capacity would be available to support an additional 175 residential units above the vacant/draft approved development identified by the Municipality.

4.3.3.4 Projected Timing for Casselman STS Expansion

Based on wastewater demands and growth development timelines, a graph representing the projected average daily wastewater demand of the STS and anticipated timing to reach 80%, 90%, and 100% of the rated capacity was prepared. Refer to Figure 8, below.

This graph indicates that based on the growth numbers presented in this Master Plan, 80% of the STS rated capacity will be reached by the end of 2023, 90% STS rated capacity will be reached sometime in 2025, and the rated capacity of the STS will be reached sometime in 2026.

The Municipality indicated that based on historical building permit applications, they see 50 units per year. For the purpose of projecting timing for the next expansion, a scenario has been created on Figure 8 to demonstrate the historic trending based on 50 new residential units (excluding ICI development) being brought online per year for the next 25 years. Based on this new scenario, it is anticipated that 80% of the STS rated capacity will be reached sometime in 2028, 90% STS rated capacity will be reached in 2033, and the rated capacity of the STS will be reached by the end of 2037.

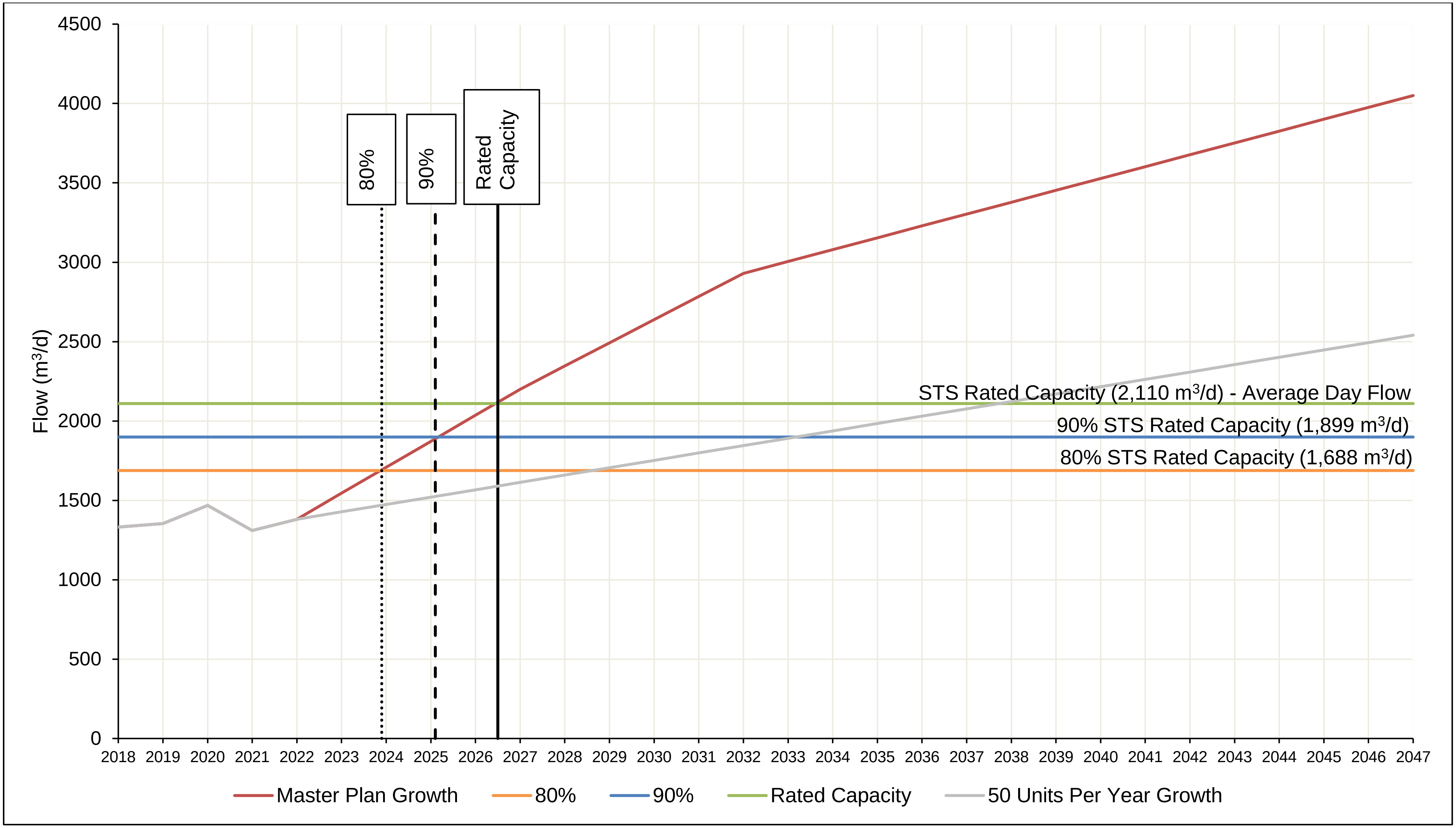


Figure 8: Casselman STS Flow Projection

4.3.4 Influent and Effluent Wastewater Quality

A review was completed of the Annual Wastewater Reports for the Casselman STS from 2018 to 2021. Data were received from OCWA for 2022. Average influent wastewater quality parameters for the past five years are summarized in Table 12 below.

Table 12: Influent Wastewater Quality (2018-2022)

Parameter	2018	2019	2020	2021	2022
$CBOD_5$ (mg/L)	110	88	59	N/A	269
Total Suspended Solids (mg/L)	242	224	235	179	441
Total Phosphorous (mg/L)	5.7	8.0	5.7	7.1	7.4
Total Kjeldahl Nitrogen (mg/L)	44	49	40	60	61

The STS is currently operating under the Amended Environmental Compliance Approval No. 8160 -BAHPRF, issued April 29, 2019. Table 13 below summarizes the effluent characteristics over the past five years; cells in red indicate an ECA Compliance Limit exceedance. Note, the MBBR and disc filter system was installed and began operating in 2021. A process upset was experienced in the same year and trouble shooting the system has been taking place up to spring 2022. Therefore, the information provided in Table 13 is not reflective of the STS treatment performance with the new MBBR and disc filter system.

Table 13: Effluent Wastewater Quality (2018-2022)

Parameter	Discharge Window	New ECA Compliance Limit (1)	2018	2019	2020	2021 (2)	2022 (2)
$CBOD_5$ (mg/L)	Fall (Oct. 1 to Dec. 31)	15	5.8	3.8	3.0	3.2	6.3
	Winter/Spring (Jan. 1 to May 15)	25	8.2	3.2	5.6	3.0	4.9
Total Suspended Solids (mg/L)	Fall (Oct. 1 to Dec. 31)	25	36 (3)	14.8	3.9	9.7	10.6
	Winter/Spring (Jan. 1 to May 15)	25	15.8	10.0	14.0	3.0	13.3
Total Phosphorous (mg/L)	Fall (Oct. 1 to Dec. 31)	1	0.2	0.2	0.1	0.3	0.4
	Winter/Spring (Jan. 1 to May 15)	1	0.3	0.2	0.2	0.2	0.4
Total Ammonia Nitrogen (mg/L)	Fall (Oct.1 to Nov. 30)	5	0.1	5.3	0.1	1.5	1.2
	Fall (Dec.1 to 31)	12	-	-	1.0	4.9	7.7
	Winter (Jan.1 to Mar. 31)	12	-	-	-	-	9.8
	Spring (Apr.1 to May 15)	6	17 (3)	0.6	17	0.1	2.4
Hydrogen Sulphide (mg/L)	Fall (Oct.1 to Dec.31)	Not Detected	0	0	0	0	-
	Winter/Spring (Jan.1 to May 15)	0.1	0	0	0	0	-
pH	Fall (Oct.1 to Dec.31)	6.0-8.0	8.5 (4)	8.2	7.9	7.6	-
	Winter/Spring (Jan.1 to May 15)	6.0-8.0	7.8	7.8	7.8	7.6	-
E. Coli (CFU/100 mL)	Fall (Oct. 1 to Dec. 31)	200	-	-	1.4	28	60
	Winter/Spring (Jan. 1 to May 15)	200	-	-	36	67	126

(1) Per ECA No. 8160-BAHPRF (April 19, 2019)
(2) MBBR and disc filter system was installed and began operating in 2021. It was noted that a process upset was experienced in the same year and trouble shooting the system has been taking place up to spring 2022. The information is not reflective of the STS treatment performance with the new MBBR and disc filter system.
(3) Non-Compliant per ECA No. 8225-B3HSD4 (October 3, 2018) / ECA No. 2712-6RVNRB (August 24, 2006): TSS (fall) =25 mg/L and TAN (spring) =16 mg/L.
(4) Compliant per ECA No. 8225-B3HSD4 (October 3, 2018) / ECA No. 2712-6RVNRB (August 24, 2006): pH limit fall and spring 6.0 to 9.5.

4.4 Sewage Pumping Stations

There are six (6) SPSs in Casselman, owned by the Municipality and operated by OCWA. Table 14 below provides information on each SPS.

Table 14: Sewage Pumping Station Inventory

Station No. (1)	Pumping Station	Pumping Station Capacity (2)	Year of Construction (Major Upgrade) (3)	Address	Operated By
1	Main	236 L/s *(118 L/s each pump)*	1978 (2006)	16 Brisson St.	OCWA
2	Isabelle St.	41 L/s *(20.5 L/s each pump)*	1988(4)	46 Isabelle St.	OCWA
3	Industriel St.	37 L/s *(37 L/s pump)*	1988	35 Industriel St.	OCWA
4	Laval	37 L/s *(18.5 L/s each pump)*	1988	839 Laval St.	OCWA
5	Des Chenes	41 L/s *(20.5 L/s each pump)*	2005	738 Des Chenes St.	OCWA
6	Northwest Quadrant	81 L/s *(40.5 L/s each pump)*	2018	819 Principale St.	OCWA

(1) Details for SPS No. 1 to No. 6 taken from available as-constructed drawings.
(2) ECA 173-W601 (September 29, 2022).
(3) Major upgrade generally includes replacement of pumps and associated electrical updates.
(4) Original construction date unknown.

5.0 Existing Conditions – Linear Infrastructure Model Updates

5.1 Water Model Update

The hydraulic water model for the Municipality of Casselman was previously updated in 2010 and again in 2019. As outlined in the memorandum *Village of Casselman, Extension of Municipal Servicing South of Highway #417 – Water and Wastewater System Projected Servicing Upgrades (JLR, May 21, 2019)*, it was determined at that time that the water model did not require a complete water demand update as the total modelled demands were found to be conservative. For the current water model update for existing conditions, the water demands have been re-adjusted to more accurately represent the flow distribution throughout the Municipality.

5.1.1 Hydraulic Model Update for Existing Conditions

The Casselman WTP treated daily flow data over the past five years (2018-2022) was used for hydraulic modelling purposes, as previously presented in Section 4, Table 3.

The average day demand was taken as the average of the treated water flow reported for every day over the past 5 years, which was calculated to be 1,031 m^3/d (12 L/s). The maximum day demand was taken as the average of the maximum day demand reported for each of the past 5 years, which is 1,968 m^3/d (23 L/s). As there was no peak hourly data specifically recorded, the peak hour demand was estimated using a theoretical peaking factor of 1.5 times the maximum day demand, as recommended by the MECP Design Guidelines for Drinking Water Systems (2008) for a community of any size, which resulted in a peak hour demand of 2,953 m^3/d (34 L/s).

The Municipality has separately retained Watson & Associates Economists Ltd. (Watson) to undertake analysis on the residential growth expected in the area. The study by Watson has provided a breakdown of existing serviced units and population for residential land use within the Municipality. A residential population density of 2.39 persons/unit was applied for existing units based on this study.

To update the water model for existing conditions, the residential parcels throughout the entire system were redistributed among the model junction nodes based on the locations of present water meters which are actively connected. Each actively connected parcel was assigned to the nearest junction node in the model.

Two (2) ‘new’ areas were added to the water model which represent watermain extensions constructed since the previous 2019 model update. Similar to the previously existing areas, the parcels within the ‘new’ areas having actively connected water meters were allocated to the nearest junction node in the model. The following ‘new’ areas were added in the model:

- West of Sarah Street: 9 existing units
- Casselman Developments Limited (Doré Street, Nature Street, Conservation Street, Argile Street, Barrage Street): 104 existing units

For the ‘new’ areas identified above, the watermains were added to the model based on pipe diameters, lengths and materials obtained from the GIS data, junction node elevations obtained from aerial satellite imagery, and roughness coefficients based on current City of Ottawa Design Guidelines.

The existing industrial, commercial and institutional (ICI) water demands were maintained from the 2010 and 2019 water model updates and allocated to the same junction nodes in the model. This included the school at Des Pommiers Street. Refer to Figure 9 for a depiction the overall water model schematic.

To calculate the water demands assigned to each junction node in the model, the existing ICI demands were deducted from the demands identified in Table 3. The total remaining demand for the residential parcels was divided by the total residential population (4,048 people including the ‘new’ areas) to obtain a water consumption rate per person. This consumption rate was then applied to each junction node based on the calculated population. This methodology was used to calculate the average day, maximum day and peak hour demand at each model junction node which was then input into the water model accordingly. The detailed water demand calculations are included in Appendix H.

5.1.2 Water Distribution System Design Criteria and Operating Parameters

For the design criteria under the average day, maximum day and peak hour scenarios, the following guidelines apply based on MECP Design Guidelines for Drinking Water Systems (2008):

- The maximum pressure at any point in the distribution system in unoccupied areas shall not exceed 689 kPa (100 psi), and while in occupied areas, shall not exceed 552 kPa (80 psi).
- Average Day: Pressures shall be within the range of approximately 350 kPa (50 psi) to 480 kPa (70 psi) and not less than 276 kPa (40 psi).
- Maximum Day + Fire Flow: Residual pressures at any point in the distribution system shall not be less than 140 kPa (20 psi).
- Peak Hour: Pressures shall be a minimum of 276 kPa (40 psi).

Fire flow requirements were calculated using Fire Underwriters Survey (FUS) and Ontario Building Code (OBC) requirements. The FUS method was also applied as per the City of Ottawa's Technical Bulletin ISTB-2018-02. It is understood the FUS fire flow is targeted north of Highway 417 and the OBC fire flow is targeted south of Highway 417.

Target fire flow calculations were carried out for various residential areas within the Municipality of Casselman. At least one (1) average size home was selected for each area. Table 15 below lists the representative home(s) selected to calculate the target FUS or OBC fire flow. This is also depicted in Appendix H for clarity.

Table 15: Required Fire Flows per FUS and OBC for Representative Residential Dwellings

Address	FUS Required Fire Flow (L/s)	OBC Required Fire Flow (L/s)
20 Filion St.	100	-
381 Dore St.	100	-
102 Laurier St.	83 - 100	-
106 Laurier St.		
773 Levesque Cres.	100 - 133	-
26 Desnoyers St.		
653 Des Epinettes Pl.	100	-
652 St. Anne		
782 Aurele Rd.	-	45

For existing ICI buildings, the FUS required fire flow is based on several unknown parameters such as construction type, occupancy, and sprinkler system integration. Therefore, a fire flow could not be calculated for these buildings however it is expected that they would require more fire flow than the residential dwellings due to their size.

Following the hydraulic water model update for existing conditions, the model was used to simulate the performance of the current water distribution system under existing flow conditions. The following operating parameters were used in the model simulations:

- The existing average day and peak hour scenarios assume that a single pump (labeled PMP-1 in the model) is operating at the WTP.

- The existing maximum day plus fire flow scenario assumes that two high-lift pumps (labeled PMP-1 and PMP-2 in the model) are operating at the WTP.

- The hydraulic grade line (HGL) of the existing standpipe is 100.52 m (standpipe is 90% full) as provided by OCWA in April 2023 (see email correspondence in Appendix H). This water level represents the normal low operating level before the pumps would be activated at the WTP. The noted HGL was modelled for all demand scenarios.

5.1.3 Water Model Simulation Results

The results of the model simulations are depicted in Figure 10, Figure 11, and Figure 12; and summarized in Table 16 and Table 17, where the percentage of junction nodes within each applicable range is reported.

Table 16: Existing Pressures under Average Day Demand and Peak Hour Demand

Pressure Range			Percentage of Junctions	
Pressure Range (kPa)			Existing Average Day Demand	Existing Peak Hour Demand
	Less than	276	0.0%	0.0%
276	up to	350	54.5%	71.2%
350	up to	400	45.0%	28.3%
400	up to	450	0.5%	0.5%
450	up to	500	0.0%	0.0%
500	up to and incl.	552	0.0%	0.0%
	Greater than	552	0.0%	0.0%

Under the existing average day demand condition, slightly over half of the junction nodes are between 276 kPa and 350 kPa and the remaining nodes are between 350 kPa and 450 kPa. Under peak hour demand conditions, the table above shows that the majority of junction nodes are between 276 kPa and 350 kPa, and a smaller percentage of the junction nodes are between 350 kPa and 450 kPa. Therefore, under both average day and peak hour demand, all of the junction nodes exceed the minimum pressure of 276 kPa (40 psi) as recommended in the MECP design guidelines.

Table 17: Existing Available Fire Flows under Maximum Day Demand

Maximum Day Demand + Fire Flow			Percentage of Junctions
Fire Flow Range (L/s)			Existing Maximum Day Demand
	Less than	30	0.0%
30	up to	45	3.7%
45	up to	67	1.1%
67	up to	83	7.9%
83	up to	100	11.6%
100	up to	117	10.1%
117	up to	150	33.3%
150	up to and incl.	200	14.8%
	Greater than	200	17.5%
	Less than	30	0.0%

The methodology used to calculate the fire flow requirements is outlined in Section 5.1.2. The required fire flow for each area was calculated and compared to the available fire flows computed from the water model. It was found that all areas in Casselman meet the required FUS and OBC fire flows, except at the following three (3) locations:

- Dead end watermain on Laurier Street: The residential houses and elementary school (Sainte-Euphémie Pavillion) on Laurier Street are supplied by a dead end 150 mm diameter watermain. For the residential properties, it was determined that the required fire flow per FUS is between 83 L/s and 100 L/s. For the school, the OBC minimum fire flow requirement for a two-story residential dwelling is 45 L/s and a school of this size would have an FUS fire flow requirement greater than that. The water model shows that the dead end watermain on Laurier Street has available fire flows below 83 L/s, so it does not meet the required fire flow. This is attributed to the length and size of the dead end watermain, which increases head losses along the pipe.
- Northwest area south of Principale Street: The FUS required fire flow was calculated to be 100 L/s based on a representative home on Filion Street. The water model shows that this area does not achieve the required fire flow from the water distribution system. This is attributed to this area being further away from the standpipe and at a higher topographic elevation than the surrounding areas.
- Riviere Nation North Road: It is noted that the water model shows an available fire flow of 47 L/s at the end of the dead end watermain on Riviere Nation North Road, which is below the minimum FUS requirements for that area. This is attributed to the length and size of the dead end watermain, which increases head losses along the pipe. This 150 mm diameter watermain supplies fire flow to a small number of residential houses.

Casselman Water Model
Overall Model Schematic

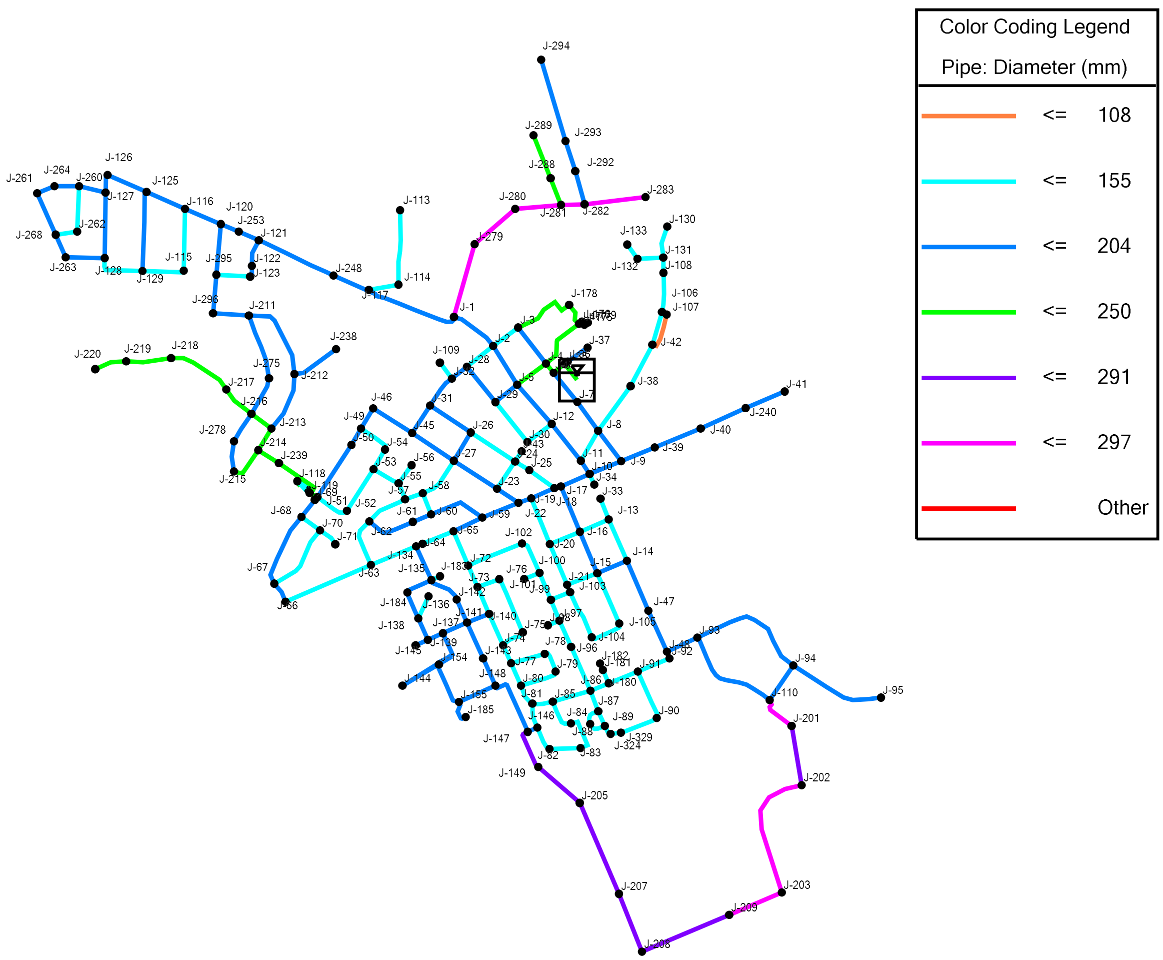


Figure 9: Overall Water Model Schematic

Casselman Water Model
Average Day Demand - Existing
1 Pump on, Standpipe HGL= 100.52 m

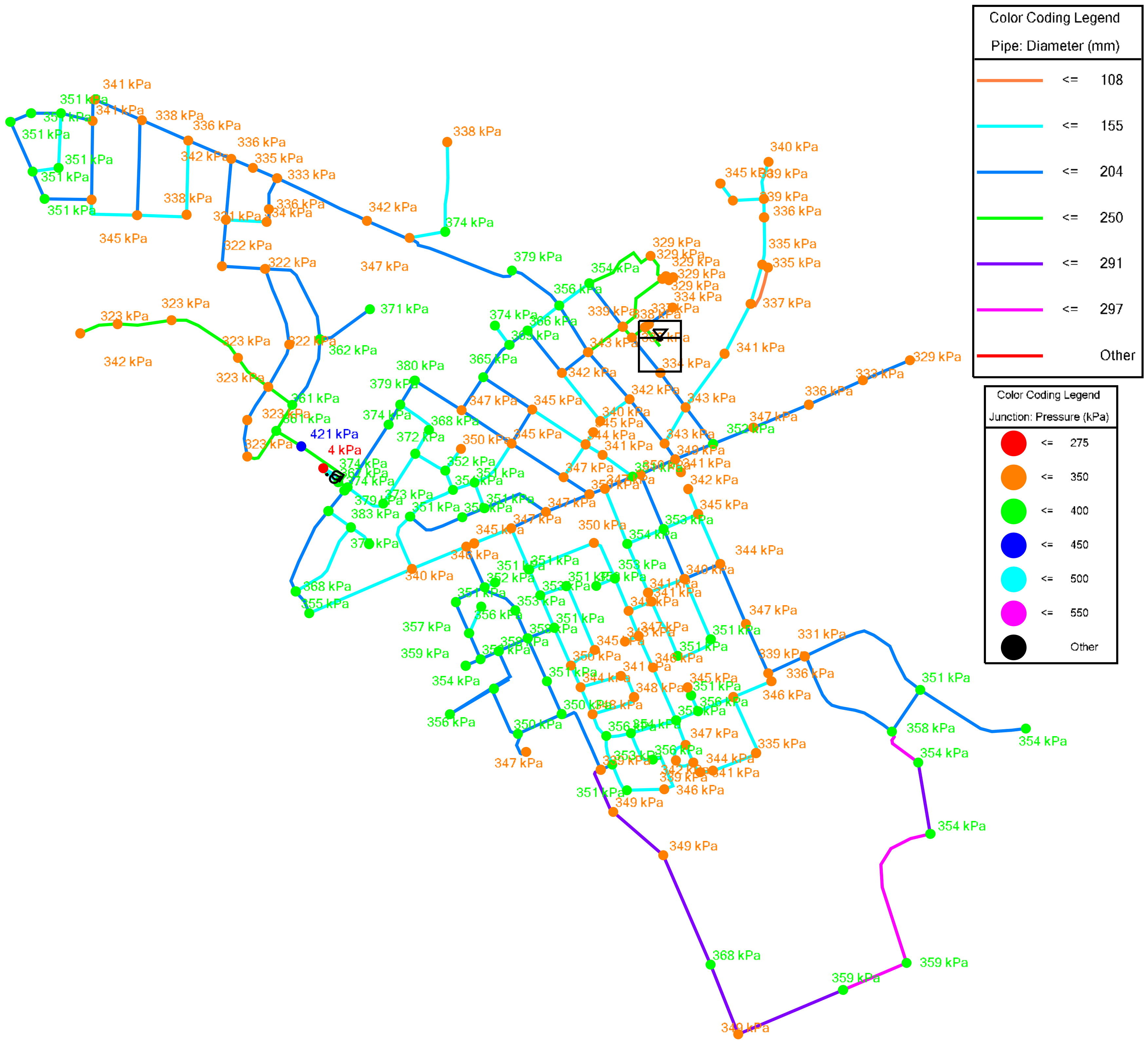


Figure 10: Existing Average Day Demand (1-Pump On)

Casselman Water Model
Peak Hour Demand - Existing
1 Pump on, Standpipe HGL= 100.52 m

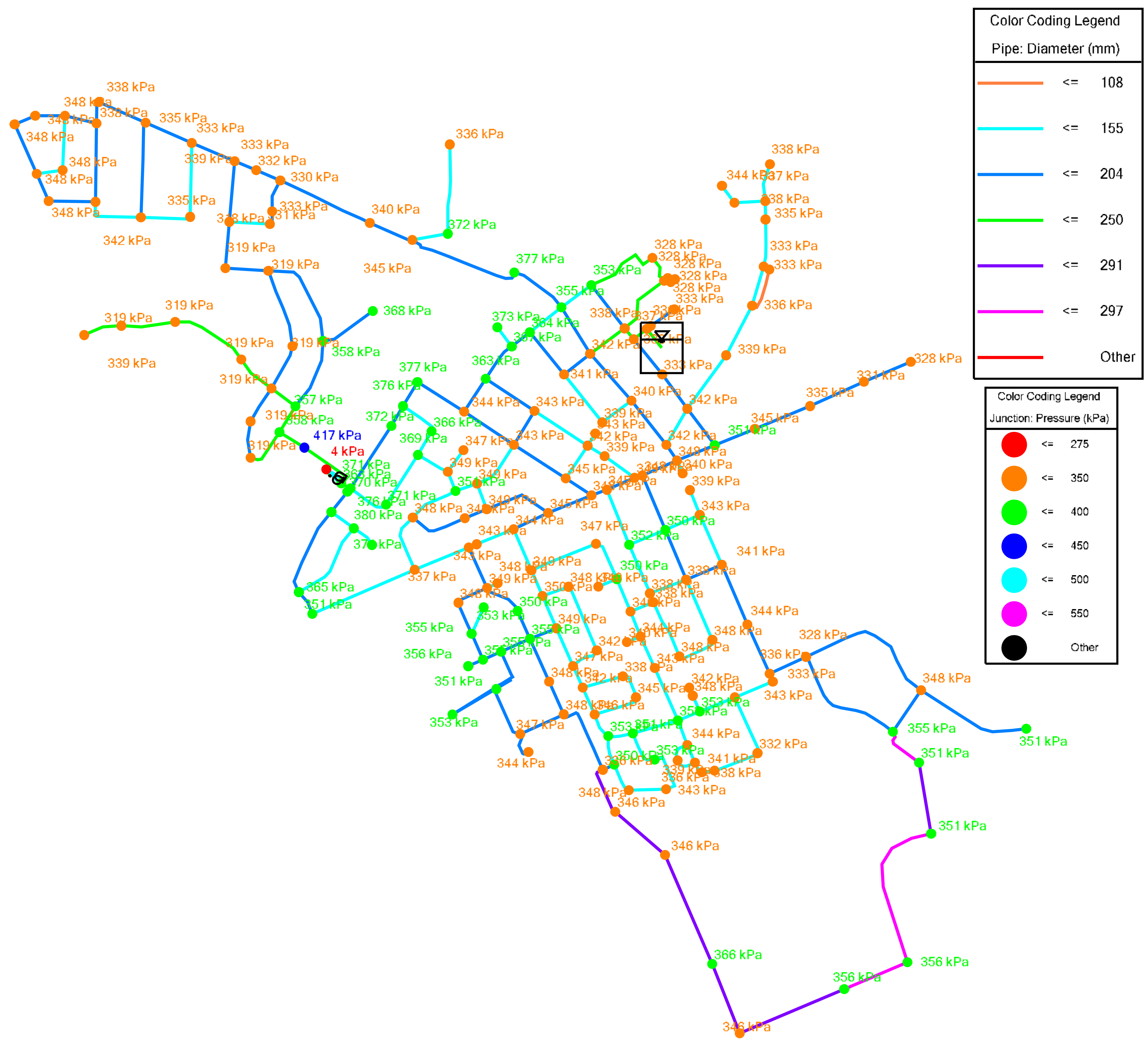


Figure 11: Existing Peak Hour Demand (1-Pump On)

Casselman Water Model
Maximum Day Demand + Fire Flow - Existing
2 Pumps on, Standpipe HGL= 100.52 m

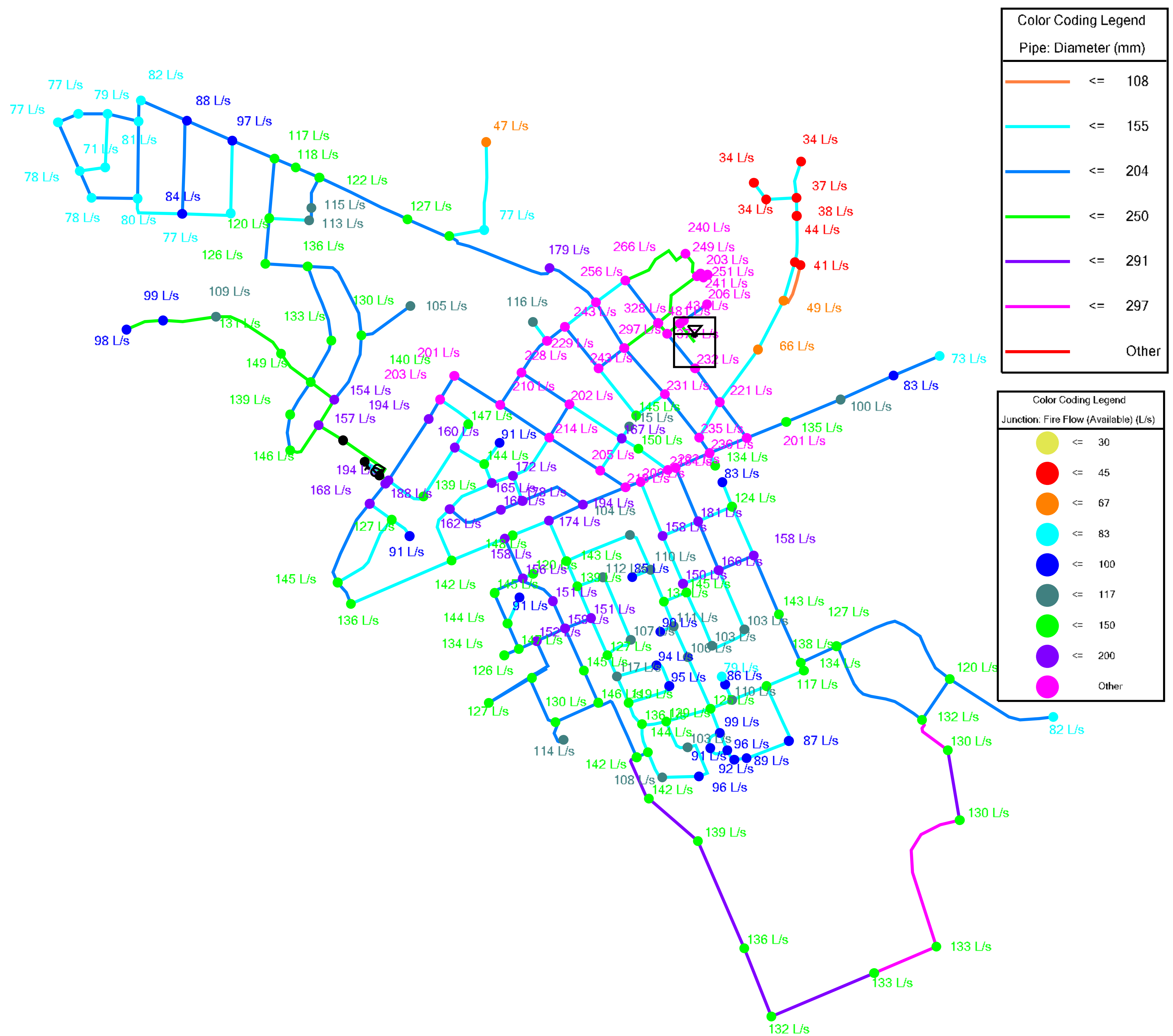


Figure 12: Existing Max Day Demand + Fire Flow (2-Pumps On)

5.2 Wastewater Model Update

5.2.1 Sanitary Sewer Flows

Standard design parameters have been used to develop peak theoretical sanitary sewage flows for the Municipality's sanitary sewer analysis completed in the sanitary sewer design sheet. The design parameters have been used to represent theoretical peak flows that may or may not be reflective of the actual flow being generated within a given sewershed. The actual flow generation will vary with population demographics; type of ICI establishments; ground conditions, groundwater table elevation; construction practices, and other factors.

5.2.1.1 Standard Design Parameters

The standard peak flow design parameters are used for the design of new sewers and pumping stations. They provide a set of conditions that are sufficiently conservative to establish peak sewer design capacities with a factor of safety to account for a certain degree of system degradation over time. Within the Municipality, the City of Ottawa Sewer Design Guidelines have been used to develop parameters for the design flows and are summarized below:

- Residential Average Flow: 350 L/c/day
- Commercial Average Flow: 28,000 L/ha/day
- Institutional Average Flow: 28,000 L/ha/day
- Average Industrial Flow: 35,000 L/ha/day
- Peaking Factor (Residential): Harmon Equation (2.0< P.F.< 4.0)
- Harmon Correction Factor 1.0
- ICI Peak Factor: 1.5

Note: L/c/day = Liters per capita per day
ha = gross hectare

5.2.1.2 Extraneous Flows

Sanitary sewers must be designed to convey waste discharges (the consumption flow), as well as extraneous, non-waste flow components, such as groundwater infiltration and inflow of surface runoff. Excessive extraneous flows can limit the capacity of existing sewer systems to serve expanding growth. They can also result in sewer backups, basement flooding, and increased operation and maintenance costs for pumping and treatment facilities. Conversely, successful control of extraneous flows can increase or maintain the life expectancy of the infrastructure and free available capacity for expansion and development.

The extraneous flow design allowance is added to the peak theoretical consumption flow, described earlier, to yield the total theoretical peak flow that the sewer must be designed to convey. As per the City of Ottawa Sewer Design Guidelines, a general allowance of 0.28 L/s/ha was used for the Municipality to calculate the extraneous flow component of the total flow, irrespective of the land use classification, sewer construction or soil type.

5.2.2 Theoretical Sewage Generation

The Municipality's sanitary sewer system primarily services existing residential development, but also some commercial and institutional developments and industrial areas.

5.2.2.1 Residential Development

To confirm the extent of existing development on the Municipality's sewer system the parcel GIS data was cross referenced with the latest water meter data supplied by the Municipality. It was assumed that where a water meter was present that there was an active connection to the sanitary sewer system.

The Municipality has separately retained Watson & Associates Economists Ltd. (Watson) to undertake analysis on the residential growth expected in the area. The study by Watson has provided a breakdown of existing serviced units and population for residential land use within the Municipality. The count of each unit type was extracted from the Watson data and allocated spatially across the study area on a prorated basis against the zoning information provided by the Municipality. Compared to the zoning information, the numbers provided in the Watson data combined the singles and semis as a single category, the townhouses and duplexes as a single multiple dwellings category, and apartments as a single category. The Watson data had a total of 1,695 units and 4,048 people within the Municipality, excluding the institutional totals, at an average unit density of 2.39 persons per unit.

In developing a design sheet analysis of a sanitary sewer system, it is important that the flows to the system are spatially weighted depending on population. The unit types are identified spatially to each sewershed, however, populations for each of these unit types generally vary and standard unit densities are provided by the City of Ottawa Sewer Design Guidelines and are shown in Table 18. Unit densities were prorated from the provincial guideline values to ensure that the overall population was consistent with the unit breakdown provided by Watson. The resulting population densities based on the unit breakdown in the Watson report are defined in Table 18.

Table 18: Population and Unit Breakdown

<table>
<tr><th>Unit Type</th><th>Zoning Unit Counts</th><th>Standard Unit Density</th><th>Study Counts</th><th>Study Unit Density</th><th>Serviced Population</th></tr>
<tr><td>Singles</td><td>963</td><td>3.4</td><td rowspan="2">1,245</td><td rowspan="2">2.62</td><td rowspan="2">3,261</td></tr>
<tr><td>Semi-Detached</td><td>143</td><td>2.7</td></tr>
<tr><td>Townhouses</td><td>63</td><td>2.7</td><td rowspan="2">240</td><td rowspan="2">2.04</td><td rowspan="2">489</td></tr>
<tr><td>Duplex</td><td>27</td><td>2.3</td></tr>
<tr><td>Apartments</td><td>244</td><td>1.8</td><td>210</td><td>1.42</td><td>298</td></tr>
<tr><td>Average / Total</td><td>1,440</td><td>2.81</td><td>1,695</td><td>2.39</td><td>4,048</td></tr>
</table>

The flow generation parameter applied to these spatially weighted populations for the analysis is 350 L/cap/day. The Harmon peaking equation (adjusted for Operational Parameters, using K = 1.0) was used to estimate peak sewage generation rates, consistent with the provincial guidelines.

5.2.2.2 Industrial, Commercial, and Institutional (ICI) Lands

The revised peak flow generation parameters specify a value of 35,000 L/ha/day to estimate flow generation rates for industrial type developments. This value is generally reserved for new or existing type developments at a Master Plan level of detail rather than specifics depending on the development type, number of employees, number of fixtures, etc. The total area of industrial lands serviced by the municipal sewer system was calculated as 22.24 ha using the zoning information in GIS.

The revised peak flow generation parameters specify a value of 28,000 L/ha/day to estimate flow generation rates for commercial and institutional type developments. This value is generally reserved for new or existing type developments at a Master Plan level of detail rather than specifics depending on the development type, number of employees, number of fixtures, etc. The total area of commercial and institutional lands serviced by the municipal sewer system was calculated as 54.97 ha using the zoning information in GIS.

A commercial and institutional peaking factor of 1.5 (per City of Ottawa Operational Parameters) was used to estimate peak sewage generation rates for both Commercial/Institutional and Industrial lands.

5.2.2.3 Total Theoretical Sewage Generation Rates

The total consumption flow, consisting of the combined commercial/institutional and residential sewage generation rates that are estimated for the site are:

- Total average inflow and infiltration: 65 L/s (=0.28L/s/ha * 233.5 ha)
- Residential average day sewage generation: 16.4 L/s (= 350 L/c/d * 4048 ppl)
- Industrial average day sewage generation: 9 L/s (=35,000 L/ha/day * 22 ha)
- Comm./Inst. average day sewage generation: 17.8 L/s (=28,000 L/ha/day * 55 ha)
- Residential Harmon peaking factor: 3.33
- ICI Harmon peaking factor: 1.5
- Total Peak Sewage Generation: 94.81 L/s (=16.4*3.33+17.8*1.5+9*1.5)

Below are the calculations leading to the Residential Harmon peaking factor, using the equation found in Figure 4.4 of the Ottawa Sewer Design Guidelines:

$$P.F. = 1 + \frac{14}{4 + \left(\frac{P}{1000}\right)^{\frac{1}{2}}} * K$$

where:

- P.F.: Peaking Factor
- K.: Correction Factor = 1.0
- P: Population

$$P.F. = 1 + \frac{14}{4 + \left(\frac{4070}{1000}\right)^{\frac{1}{2}}} * 1$$

$$P.F. = 3.33$$

5.2.3 The Sanitary Sewer Model

A spreadsheet model of the existing sanitary sewer system for the Municipality was developed by updating the existing Pipe by Pipe Design sheet. The extent of the existing network was confirmed by cross referencing parcels with the latest water meter records supplied by the Municipality and assuming that where a water meter is present that there is a connection to the sanitary sewer system, using the information linked to each parcel address found within the scope of work. The parcel addresses shed light on the land usage as well as the number of apartment units within a land parcel. The resulting sanitary sewer spreadsheet model is attached in Appendix I. The model was constructed as described below using the updated Sanitary Sewer Network, as shown in Figure 13 and Figure 14.

Sanitary sewer data such as length, slope and invert elevations were pulled from the GIS data provided by the Municipality. However, some data gaps were identified in the physical attributes of the system. In instances where slopes were missing, a value of 0.35% was assigned to the pipe to remain consistent with the other pipes within the network. The sewer slope is a key parameter in estimating the theoretical capacity of each sewer segment. In areas where invert elevations were missing, it was assumed that the upstream pipe was connected invert to invert, thus, matching the downstream end of the upstream pipe with the upstream end of the pipe for which we are missing information. Sewer sections with assumed data are highlighted in the design sheet. Sewer lengths were computed using QGIS to scale the actual pipe lengths based on the position of upstream and downstream maintenance holes provided by the GIS data.

Land parcel and zoning data were also provided by the Municipality shedding light on land use and number of units.

Sewershed areas were delineated based on lot parcels and proximity of sanitary manholes. Using spatial weighting, each sewershed area was assigned to the upstream sanitary sewer run within the area. This practice is conservative by ensuring that all pipes within the drainage area are of sufficient size to drain the entire area for which it is responsible.

The theoretical sewer capacity and corresponding flow velocity were computed using Mannings Equation. The key variables in Mannings equation are sewer diameter, sewer slope, and Mannings Roughness Coefficient (n). A roughness coefficient of 0.013 was assumed for all sewers in the spreadsheet model.

The residual capacity is defined as the theoretical sewer capacity minus the peak design flow for a given sewer segment. If the residual capacity is positive, then there is sufficient capacity in the existing sewer to accommodate calibrated peak design flow. However, if the residual capacity is negative, the sewer is considered to operate under ‘surcharged’ conditions during peak flow events.

5.2.4 Sanitary Sewer Model Results

Based on the sanitary sewer spreadsheet model the highest peak design flow with pump flow for the Municipality sanitary sewer system is 182 L/s.

The peak design flows in the spreadsheet model only accounts for a smaller 'typical wet weather flow contribution'. More intense 'annual' or 'extreme' storm events could generate higher rainfall induced extraneous flows in the system.

The spreadsheet model indicates that most sewers in the system operate under 19% capacity. The main sanitary sewer system on the south side of the river, on average operates between 2% and 28% capacity, although some sewers operate above 90% and as high as 182% capacity. The sanitary system on the north side of the river, for the most part operates under 9% capacity although some segments operate as high as 35% capacity. The spreadsheet model indicates that eight sewer segments (Table 19) have insufficient capacity to convey the peak design flow and have a negative residual capacity.

Table 19: Sanitary Sewers Over 100% Capacity

Segment	Corresponding Area/ Street	Q_d/Q_{full} (%)
MH535 – MH530	St Isidore Rd between Desnoyers St and St Joseph St	156
MH530 – MH 525	St Isidore Rd between Desnoyers St and St Joseph St	121
MH525 – MH520	St Isidore Rd between Desnoyers St and St Joseph St	163
MH305B – MH300	Intersection of Saint Joseph St and Yvon St	123
MH318 – PS1	At Pump Station 1 (Principale St and Brisson St)	182
MH620 – MH615	Intersection of St Isidore Rd and Isabelle St	116
MH290 – MH255	Intersection of Montcalm St and Sainte Therese St	104
MH255 – MH90	Intersection of Montcalm St and Saint Jean St	104

The Pipe by Pipe Design sheet indicates that an additional three segments of the sanitary sewer system are functioning close to capacity, at between 90% to 100% capacity (Table 20).

Table 20: Sanitary Sewers functioning at 90% to 100% Capacity

Segment	Corresponding Area/ Street	Q_d/Q_{full} (%)	Residual Capacity (L/s)
MH505 – MH500	Intersection of St-Joseph St and Cartier St	94	7.8
MH80 – MH317	Intersection of Brisson St and Principale St	97	11.2
MH515 – MH505	Intersection of St-Joseph St and Cartier St	91	12.7

It is noted that based on the available GIS data, the sewer segments listed in Table 21 have negative slopes and, as such, would not convey the theoretical peak flow without operating under surcharge. Sewer invert elevations are often difficult to measure in the field. For pipe sections with relatively flat slopes, compounded errors in invert measurement at the upstream and downstream maintenance holes can result in an inaccurate assessment of the slope, especially for short pipe lengths.

Table 21: Sanitary Sewers with Negative Slopes

Segment	Corresponding Area/ Street	Slope (%)
MH246 – MH825	Lafleche Blvd	-2.88
MH700 – MH695	Isabelle St between Alice St and Andre St	-0.71
MH310 – MH305B	Saint Joseph St at Yvon St	-0.16
MH295 – MH290	Sainte Therese St	-0.03
MH1500 – MH1490	Principale St near Riviere Nation Rd	-0.28
MH2025 – MH2020	Conservation St	-1.79

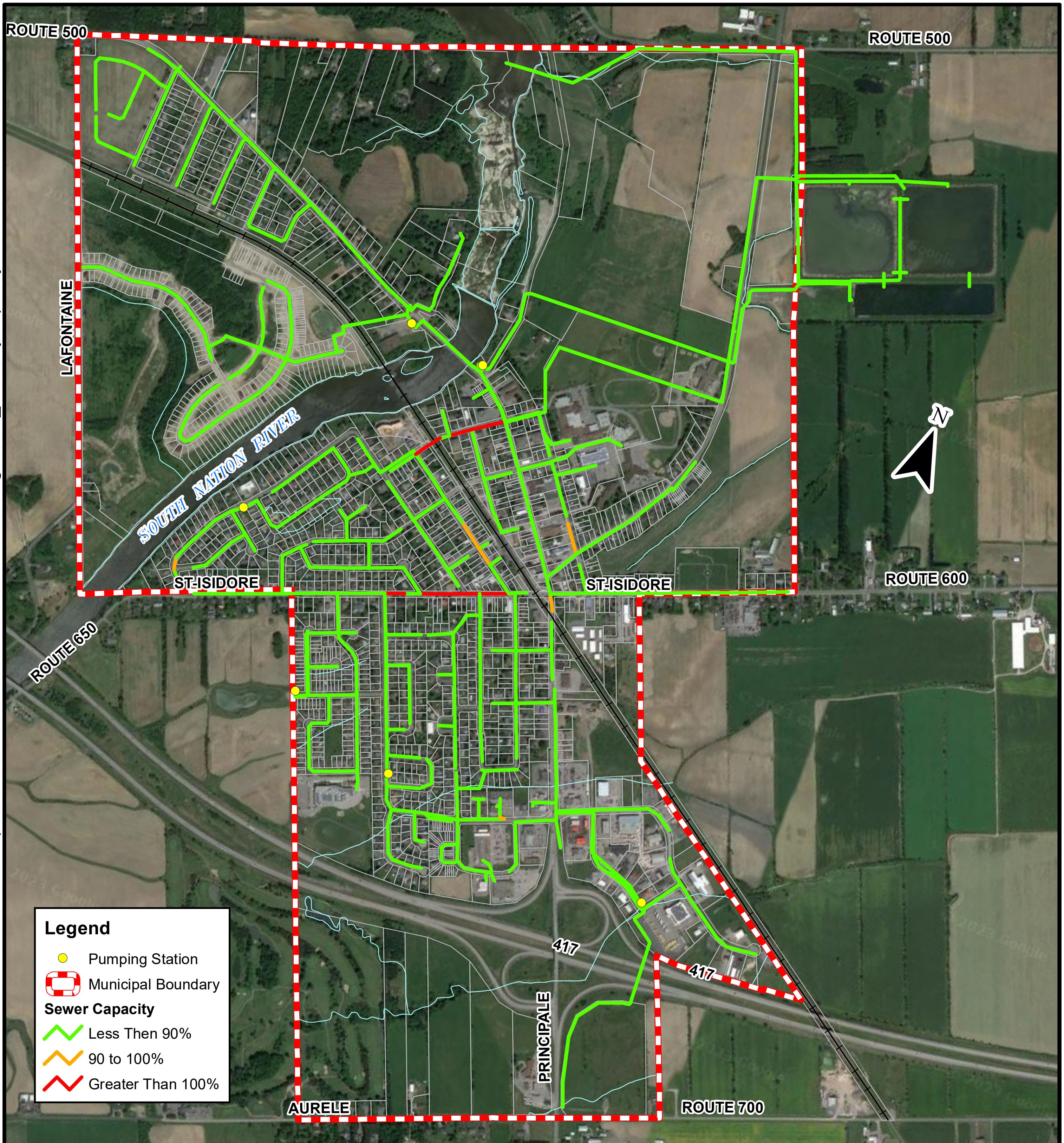
5.2.5 Pump Capacity Assessment

Flows in the design sheet were assessed against the rated and peak capacities at each pump station in the system. Table 22 summarizes the results at each station.

Table 22: SPS Capacity Assessment

SPS No.	SPS Rated Capacity (L/s)	SPS Peak Capacity (L/s)	Modelled Peak Flow (L/s) (1)
1	118	236	185
2	20.5	41	14
3	37	37	14
4	18.5	37	4
5	20.5	41	13
6	40.5	81	28
(1) Modelled peak flow from inlet sewers			

As shown in the above table, all pump stations receive flows below their rated capacity except for SPS No. 1 that receives flows greater than its rated capacity but below its peak capacity.



PROJECT:

CASSELMAN WATER AND WASTEWATER INFRASTRUCTURE MASTER PLAN

CASSELMAN, ONTARIO

DRAWING:

EXISTING SANITARY NETWORK CAPACITY

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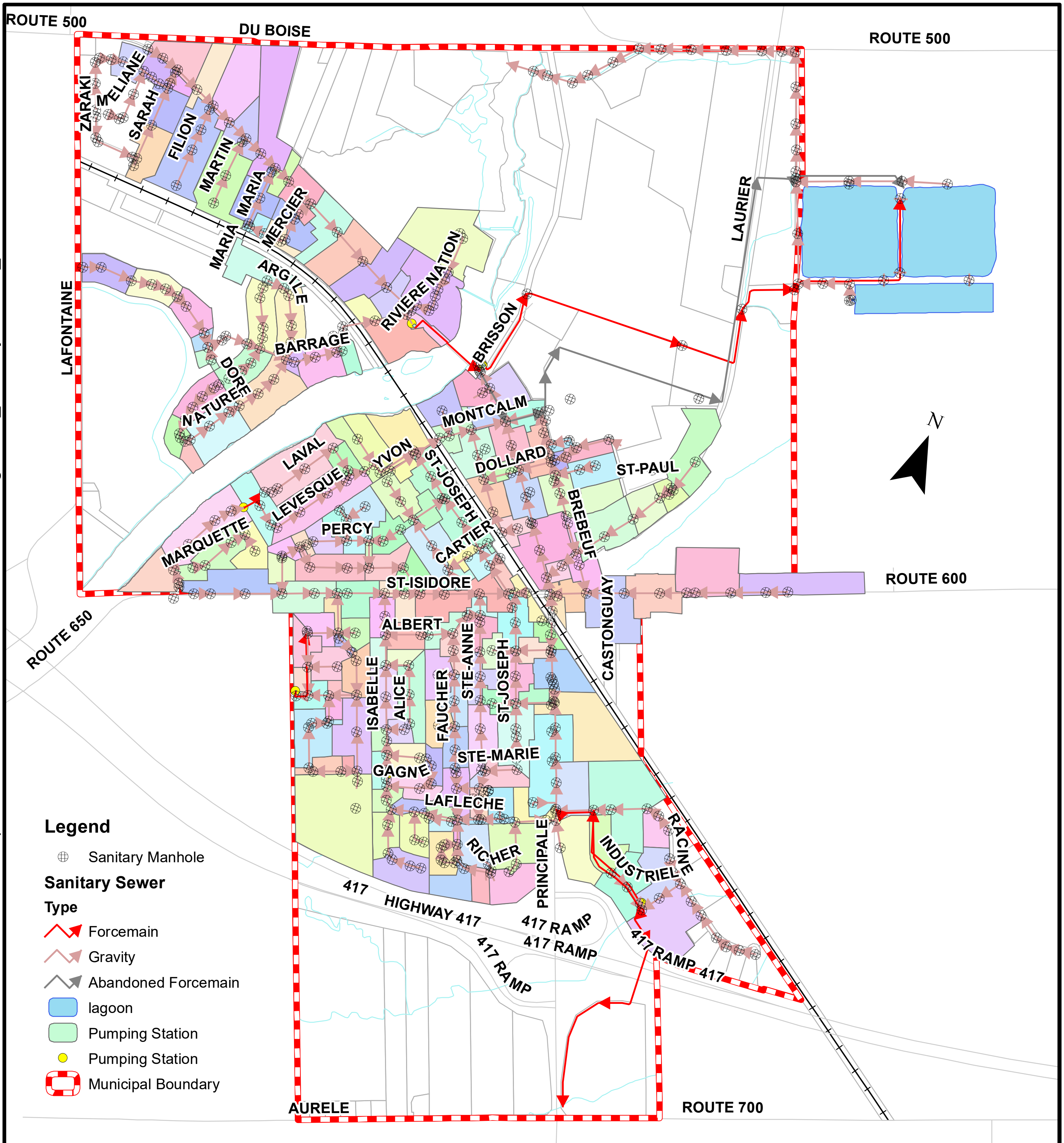
DESIGN:	ML
DRAWN:	TB
CHECKED:	ML/BP
JLR #:	16953-118

DRAWING #:

FIGURE 13

File Location: P:\16000\16953-118 - Casselman Infrastructure Masterplan\3-Production\1-Civil\GIS\16953-118 Figure 13_SanitaryCapacity.mxd

Plot Date: September 25, 2023 1:23:45 PM



PROJECT:

CASSELMAN WATER AND WASTEWATER INFRASTRUCTURE MASTER PLAN

CASSELMAN, ONTARIO

DRAWING:

EXISTING SANITARY NETWORK AND SEWERSHEDS

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DESIGN:	ML
DRAWN:	TB
CHECKED:	ML/BP
JLR #:	16953-118

DRAWING #: FIGURE 14

File Location: P:\16000\16953-118 - Casselman Infrastructure Masterplan\3-Production\1-Civil\GIS\16953-118 Figure 14_SanitaryNetwork_Sewershed.mxd

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6.0 Condition Assessment

6.1 Water Treatment Plant and Sewage Pumping Stations (TM 1A)

A condition assessment was completed of key components of the Casselman WTP and the six (6) SPS on May 27, 2022, in order to establish each facility's existing conditions and identify replacement and/or repair needs. In addition, the Landmark Municipal Services (2019) elevated water tank inspection report which identified required repairs and associated cost estimates was reviewed. The condition assessment report, Technical TM 1A, is attached in Appendix D.

The review completed and data obtained were limited to visual observations and discussions with OCWA operators. No special lift devices or ladders were mobilized during the assignment and no destructive or exploratory testing or inspection was carried out. Confined spaces (i.e., wet wells, tanks, etc.) were not included in the scope of the review with the exception of visual observations outside of the confined space area.

The on-site assessment of the facilities included a confirmation of the key components of each facility and an assignment of a "condition rating" based on the visually observed physical condition. The condition and recommended replacement were assessed on a time basis such that the attributes that are considered "unacceptable" and "poor" conditions are to be upgraded in the short- (year 2022-2027) to mid-term (year 2028-2032); and the attributes that are rated "fair" condition will be recommended for replacement in the long term (year 2033-2047).

Based on the condition assessment, Opinion of Probable Costs were developed for each facility, in 2022-dollar value. Class 'D' OPCs developed for this assignment are expected to be within +/- 30%. The OPCs were developed based on past experience on similar projects, professional judgment, and equipment costs provided by suppliers. The "Opinion of Probable Costs" have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final "Opinion of Probable Costs" of the project will depend on actual labor and material costs, competitive market conditions, final project scope, implementation schedule and other variable factors. As a result, the final "Opinion of Probable Costs" will vary from the "Opinion of Probable Costs" presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding. The "Opinion of Probable Costs" does not include any costs for acquiring the necessary permits or rights-of-way for the above-specified equipment.

6.1.1 WTP

A multidisciplinary review of the WTP was completed, the Class 'D' Opinion of Probable Costs including a 30% engineering and contingency fee for short-, mid- and long-term upgrades are summarized in Table 23.

In the short term, the major items that require upgrades include the following:

- Spalling Brick Veneer
- Garage door finishes and structure
- Actiflo® and Chemical System Mechanical and Structural items (i.e., pumps, sampling system, tank remediation)

- General building mechanical items including ceiling fans, A/C, washroom fixtures
- Electrical and I&C upgrades including new electrical panels and transformers, ACP-01, PLC and HMI Ethernet

In the midterm, the major items that require upgrades include the following:

- Exterior caulking and rusted door frames
- Electrical and I&C items including MCC and FCP-21, -22, and -100
- Additional mechanical items in poor condition including the potassium permanganate chemical dosing and Actiflo® systems

In the long term, the major items that require upgrades include the following:

- Additional electrical and I&C items in fair condition but would require replacement in the long-term such as various pump controllers, indicator transmitters, and a new 250 kVA generator.
- Additional mechanical items that will require replacement in the future including the ammonia and chlorine systems, and raw water, high lift, and transfer pumps.
- Civil items including regrading, fencing, and segments of asphalt replacement.

Table 23: Summary of WTP Short, Mid and Long-Term Upgrades Opinion of Probable Construction Costs

Timeframe	**Short-Term (2022-2027)**	**Mid-Term (2028-2032)**	**Long-Term (2033-2047)**
Facility Costs	$ 880,500	$ 552,600	$1,079,500
Engineering and Contingency (30%)	$264,150	$ 165,780	$323,850
Total (1)	**$1,150,000**	**$720,000**	**$1,400,000**
(1) Class ‘D’ OPC in 2022-dollar value. These costs are based on past experience on similar projects, professional judgment, and equipment costs provided by suppliers and are expected to be within +/- 30%. The final "Opinion of Probable Costs" of the project will depend on actual labor and material costs, competitive market conditions, final project scope, implementation schedule and other variable factors.			

6.1.2 SPSs

In a similar fashion, a multidisciplinary review of each of the Municipality’s six (6) SPSs was completed, the estimated Class ‘D’ Opinion of Probable costs including a 30% engineering and contingency fee for short-, mid-, and long-term upgrades are summarized in Table 24.

In the short term, the major items that require upgrades include the following:

- Roof replacement (SPS No. 1)
- Electrical items such as new PLC (SPS No. 1); new distribution, EYS Seals (SPS No. 2, 3, 4), and junction boxes (SPS No. 2 & 4)
- Boilers and hot water circulators (SPS No. 1)
- Review of the structural building elements (SPS No. 3) and paint touch ups (SPS No. 6)

- Piping, valves, and lighting inside the wet well (SPS No. 5)

In the midterm, the major items that require upgrades include the following:

- Concrete patch repairs (SPS No. 1) and replacement of any rusted elements (SPS No. 2)
- Piping and valves inside the wet well in poor condition (SPS No. 3)
- Electrical items (control panel, programming) needing replacement (SPS No. 4 & 5)

In the long term, the major items that require upgrades include the following:

- Replace electrical panels (SPS No. 1 & 2), distribution, and MCC (SPS No. 1)
- New screening system (SPS No. 1)

Table 24: Summary of SPS No. 1 to 6 Short, Mid and Long-Term Upgrades Opinion of Probable Construction Costs

SPS	Timeframe	**Short-Term (2022-2027)**	**Mid-Term (2028-2032)**	**Long-Term (2033-2047)**
SPS No. 1	Facility Costs	$260,800	$2,500	$565,000
	Engineering and Contingency (30%)	$78,240	$750	$169,500
	Total (1)	**$340,000**	**$3,000**	**$735,000**
SPS No. 2	Facility Costs	$11,500	$2,500	$72,000
	Engineering and Contingency (30%)	$3,450	$750	$21,600
	Total (1)	**$15,000**	**$3,000**	**$94,000**
SPS No. 3	Facility Costs	$89,100	$20,000	$3,000
	Engineering and Contingency (30%)	$26,730	$6,000	$900
	Total (1)	**$116,000**	**$26,000**	**$4,000**
SPS No. 4	Facility Costs	$11,500	$87,500	-
	Engineering and Contingency (30%)	$3,450	$26,250	-
	Total (1)	**$15,000**	**$114,000**	**-**
SPS No. 5	Facility Costs	$24,500	$80,000	-
	Engineering and Contingency (30%)	$7,350	$24,000	-
	Total (1)	**$32,000**	**$104,000**	**-**
SPS No. 6	Facility Costs	$2,500	-	-
	Engineering and Contingency (30%)	$750	-	-
	Total (1)	**$3,000**	**-**	**-**

(1) Class 'D' OPC in 2022-dollar value. These costs are based on past experience on similar projects, professional judgment, and equipment costs provided by suppliers and are expected to be within +/- 30%. The final "Opinion of Probable Costs" of the project will depend on actual labor and material costs, competitive market conditions, final project scope, implementation schedule and other variable factors.

6.1.3 Water Storage

In 2019, OCWA, retained Landmark Municipal Services to complete an inspection of the elevated water storage facility. The inspection consisted of the exterior and interior tank surfaces, completed using a remotely operated vehicle (ROV), and inspection of the tank's protective coatings and linings. The inspection findings set forth several recommendations with associated probable costs. These are summarized in the following Table 25. Note that for the purposes of the condition assessment, the 2019 recommendation costs have been escalated by 30% based on Building Construction Price Index Canada for Non-Residential Building Type in Ottawa-Gatineau Area to be reflective of 2022 costs.

Table 25: Summary of Elevated Water Storage Tank Inspection Upgrades Opinion of Probable Construction Costs

Item	Opinion of Construction Probable Cost (1)
Siteworks	To be determined in Master Plan Phase 2
Security	To be determined in Master Plan Phase 2
Valve Chamber	$ 5,500
Ladder Upgrades	$72,000
Accessories	$ 10,600
Confined Space & Rescue	$ 9,000
Coatings and Linings	$ 53,500
Facility Costs 2019	$ 150,600
Facility Costs 2022 (Escalated 30%)	$ 195,780
Engineering and Contingency (30%)	$ 58,734
Total	**$ 255,000**
(1) Class ‘D’ OPC in 2022-dollar value. These costs are based on past experience on similar projects, professional judgment, and equipment costs provided by suppliers and are expected to be within +/- 30%. The final "Opinion of Probable Costs" of the project will depend on actual labor and material costs, competitive market conditions, final project scope, implementation schedule and other variable factors.	

6.2 Linear Infrastructure (TM 1B)

A desktop condition assessment of water and wastewater conveyance piping infrastructure was undertaken. A piping inventory, including pipe diameter, material, and age, was reviewed and compared to typical industry standards for the desktop piping condition assessment. This condition assessment report is attached in Appendix E.

JLR was previously retained by the Municipality to complete a water/wastewater infrastructure GIS update. As part of the study, a large inventory of historical drawings related to these systems was provided, reviewed, and input into the GIS.

The Municipality’s water network is made up of over 22 km of watermains ranging in diameter from 50 mm to 300 mm. The various watermain materials present in the system include high-density polyethylene (HDPE) and polyvinyl chloride (PVC). The age of the pipe in the system varies from 46 years old to those installed in 2021.

The Municipality’s wastewater collection system is made up of over 30 km of sewer ranging in diameter from 100 mm to 825 mm. The various sewer materials present in the system include asbestos cement (AC), concrete (CONC), corrugated metal, high-density polyethylene (HDPE), and polyvinyl chloride (PVC). The age of the pipe in the system varies from 46 years old to those installed in 2021.

As noted, the oldest pipes within the water and sanitary system are 46 years old (installed in 1976). Based on pipe age alone, none will be approaching or exceeding their typical life span (75 years) within the Master Plan timeframe. However, it should be noted that the actual replacement needs would be based on a variety of factors, such as pipe type, soil and air characteristics and installation method. It is recommended that a visual assessment of the pipes is completed before replacement is considered.

A summary of estimated Opinion of Probable Costs for the long-term replacement (beyond 25 years) of water and sanitary pipes is provided in Table 26. Pricing of various piping by infrastructure type, diameter, and material was based on the City of Ottawa Master Spec Code List published March 3, 2021, and escalated by 30% based on Building Construction Price Index Canada for Non-Residential Building Type in Ottawa-Gatineau Area. As noted above, actual replacement needs would be based on a variety of factors and a visual assessment of pipes should be completed before replacement is considered.

Table 26: Summary of Linear Infrastructure Condition Assessment Long-Term Upgrades Opinion of Probable Construction Costs

Infrastructure	Length of Pipe (km)	Material	Opinion of Probable Cost (1)
Water	22.69	PVC	$ 22,600,000
	Unknown	HDPE	-
			TOTAL = $ 22,600,000
Sanitary	27.14	PVC	$ 18,300,000
	1.58	CONC	$ 1,000,000
	0.27	HDPE	$ 240,000
	0.67	AC	$ 500,000 (2)
	Unknown	Corrugated Metal	-
			TOTAL = $ 20,040,000
			TOTAL REPLACEMENT COST = $ 42,640,000

(1) Class ‘D’ OPC in 2022-dollar value. These costs are based on past experience on similar projects, professional judgment, and equipment costs provided by suppliers and are expected to be within +/- 30%. The final "Opinion of Probable Costs" of the project will depend on actual labor and material costs, competitive market conditions, final project scope, implementation schedule and other variable factors.
(2) Pricing based on Asbestos Cement replaced with PVC piping of equal size.

7.0 Problem and Opportunity Statement

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

The Municipality of Casselman is serviced by communal water and wastewater systems consisting of a water treatment plant, an elevated water storage tank, over 22 km of watermains, a sewage treatment system, six sewage pumping stations, and over 30 km of sanitary sewers. In recent years, the South Nation River, the source water for the Municipality, has presented challenges with respect to raw water quality and quantity. Moreover, the Municipality has been experiencing significant development pressures at present and within the Master Plan timeline.

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 short, mid and long-term planning horizons.

8.0 Phase 2 Methodology and Next Steps

This Report has been developed to summarize the Phase 1 work undertaken as part of the Master Planning process. Phase 1 has been used to identify the problems and opportunities associated with the Municipality's water and wastewater systems and to clearly define the existing conditions and constraints associated with the current system. Phase 2 of the Master Plan process will involve further definition of these systems through the development of hydraulic models and will ultimately include the identification of preferred strategies and actions to address the problems and opportunities identified in Phase 1. Options considered will include new construction, in addition to potential retrofits, upgrades and/or conservation measures to optimize the treatment and efficiency of the existing systems. More specifically, the following are planned for Phase 2:

- Model of the water and wastewater systems for future development.

- Identify and evaluate alternative solutions to address capacity and treatment issues noted in Phase 1. Develop a list of alternatives and their proposed timelines and associated costs.

- A Public Information Centre will be held 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.

- A Master Plan Report will be prepared to summarize Phase 2 findings incorporating public and stakeholder feedback and will be placed on record for a 30-day review period.

This report has been prepared by J.L. Richards & Associates Limited for the Municipality of Casselman'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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Appendix A

Stakeholder Consultation Plan

Appendix B

Notice of Commencement

Appendix C

Stakeholder Responses and Mailing List

Appendix D

TM 1A Water Treatment Plant and Sewage Pumping Stations Condition Assessment (November 18, 2022)

Appendix E

TM 1B Linear Infrastructure Condition Assessment
(November 18, 2022)

Appendix F

TM 2 Growth Projections
(February 2, 2023)

Appendix G

Municipality of Casselman
Sewage Treatment System
Uncommitted Hydraulic
Reserve Capacity – 2022
(September 21, 2023)

Appendix H

Water Model

Appendix I

Wastewater Model

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