East Hants Servicing Capacity Study

Revised Final Report

February 22, 2024

Prepared for:

EAST HANTS
We live it!

R.V. Anderson Associates Limited
230 Brownlow Avenue, Suite 240
Dartmouth NS B3B 0G5 Canada
T 902 468 1806 F 855 833 4022
rvanderson.com

RVA

RVA 226421

February 22, 2024

The Municipality of East Hants
Municipal Office
Lloyd E. Matheson Centre
15 Commerce Court
Elmsdale, NS B2S 3K5

Attention: Mr. Derek Normanton, P.Eng., Project Engineer

Dear Mr. Normanton:

Re: East Hants Servicing Capacity Study – Revised Final Report

RVA received comments on February 21, 2024, this is a revised final report which includes revisions to address the comments provided. The revisions occur in Water Distribution System Capacity Assessment costs section and Appendix H Costs and Recommendations. As part of the East Hants Servicing Capacity Study, R. V. Anderson Associates (RVA) has been tasked with completing a final report summarizing a total of 7 technical memorandums. The goal of this report is to gather key findings and reporting with a 25-year financial forecast of each section.

Please find enclosed the Final Report for the Municipality's review and consideration. RVA has completed an internal QA review of all seven TMs and have incorporated the necessary comments from the QA reviewers as well as comments from the Municipality. This document includes the Technical Memorandums as appendices for reference when reviewing the key findings as presented herein. Should the Municipality have any questions, please don't hesitate to contact the undersigned.

Yours very truly,

R.V. ANDERSON ASSOCIATES LIMITED

Tariq Karaballi, B. Eng., EIT
Project Designer

Jason Angel, M.Sc., P.Eng. PMP
Senior Project Manager

Encls.

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East Hants Servicing Capacity Study
Final Report

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EXECUTIVE SUMMARY

The Municipality of East Hants is planning for future growth and development and the supporting works to maintain servicing capacity in the Sanitary Sewers, Pump Stations, Milford Wastewater Treatment Plant (MWWTP), Shubenacadie Water Treatment Plant, Regional Water Distribution, Stormwater conveyance systems for the next 25 years. Each section consisted of existing capacity and/or infrastructure conditions followed by an anticipated future demands the system will need to maintain. The existing/future capacity and infrastructure conditions was determined using the appropriate methods: onsite inspections, modelling and calibrations, population growth predictions and review of datasets provided by the Municipality. It was determined upgrades, replacements, and repairs are necessary in the system to withstand the upcoming servicing capacities. The following sections are summaries of the Technical Memorandums issued to East Hants that provide reporting and findings followed by infrastructure upgrade cost estimates and the associated implementation timelines.

A. General Introduction

This general introduction provides a description of existing infrastructure at specific locations within the study area and the overall objectives of the study as it related to the specific infrastructure. Following this introduction, individual sections 1-7 provide summaries of the findings of each of the Technical Memorandums as issued to East Hants including consideration of comments provided by the Municipality on each submission. Section 8 provides recommendations and cost estimates for infrastructure improvements across the systems and their identified timeframe for implementations over the next 25 years.

A.1 Sanitary Sewer Pump Stations

Sanitary lift stations are essential for the municipality's wastewater collection system designed to move the wastewater sewage from low to high elevation where gravity can take over to the treatment plant. There are 28 sanitary lift stations within the municipality and part of the field inspection process RVA analyzed key elements of each lift station (motors, pumps, wet-well structure, instrumentation, and controls etc.) utilizing developed condition ratings to confirm if infrastructure can withstand the projected population growth for the next 25 years.

A.2 Milford Wastewater Treatment Plant (MWWTP)

The Milford Wastewater Treatment Plant is a class II facility with sequencing batch reactor (SBR) facility and is equipped with grit removal, influent grinding, equalization, UV disinfection and aerobic sludge digestion. The wastewater treatment plant is designed to remove influent contaminants and meet municipal effluent regulations to release to the environment and properly dispose of waste sludge.

The wastewater plant was initially designed for the following flows outlined in Table A.1 below:

Table A.1 – MWWTP Design Flows

Parameter	Value
Average Daily Flow	998 m^3/d
Peak Daily Flow	2,500 m^3/d
Peak Hourly Flow	232 m^3/hr (5,568 m^3/d)

Notes:
Adapted from the MWWTP Operations manual – Milford Wastewater Treatment Plant (2012) prepared by ABL Environmental Consultants Ltd. (ABL Environmental Consultants Ltd., 2012)

RVA performed an assessment on the MWWTP to determine the plant's ability to treat the community's wastewater for the next 25 years.

The objectives of this assessment were to:

- Calculate the plant's current capacity.
- Calculate the anticipated wastewater flows to the MWWTP based on estimated population growth out to 2050.
- Provide estimated asset costs and Timelines for Replacement for major assets.
- Provide recommendations of any upgrades required to meet the 2050 wastewater treatment requirements.

A.3 Shubenacadie Water Treatment Plant

The Shubenacadie Water Treatment Plant initially operated with two groundwater wells PW-1 and PW-2; however, PW-1 has been decommissioned due to failure of internal components. The plant is equipped with Sand Media Filters, Carbon Filters, Water Softeners, Corrosion Control System, UV Disinfection with Secondary Chlorine Disinfection. The plant is designed to remove contaminants, particulates, iron and manganese, and hydrogen sulfide to improve water quality and aesthetics and meet drinking water regulations.

RVA performed an assessment on the Shubenacadie Water Treatment Plant to determine the plant's ability to meet 25-year water demands.

The objectives of this assessment were to:

- Calculate the plant's current capacity.
- Review the 25-year anticipated population.
- Calculate the 25-year anticipated water demand for the Shubenacadie Water Treatment Plant.
- Provide estimated asset costs and timelines for replacement in the immediate term (0-5 years) and after 25 years.
- Perform site review assessment of the general condition of the water treatment plant and associated infrastructure.
- Provide recommendations for any upgrades required to meet the 25-year water demands.

A.4 Water Distribution Capacity

The Municipality of East Hants has two separate water distribution systems: The Regional Water Distribution System and the Shubenacadie Water Distribution System. The Regional Water Distribution System services the community of Enfield, Elmsdale and Lantz, whereas the Shubenacadie Water Distribution System services the community of Shubenacadie. The distribution systems are designed to maintain the minimum pressure required during Peak Hour Demand with sufficient storage capacity to maintain Maximum Day Demand + Fire Flow event.

RVA performed hydraulic and capacity assessments of the water distribution systems through computer modeling to reflect current (2022) conditions and future (2047) conditions.

The objectives of this assessment were to:

- Develop water distribution models of the Municipality’s water distribution systems.
- Calibrate water distribution models based on field test results.
- Identify existing and future systems constraints and opportunities to improve the water network’s system performance.
- Provide recommendations for any system upgrades required to meet the 25-year servicing requirements.

A.5 Sanitary Collection System Capacity

The Municipality is currently divided into three (3) sanitary sewer systems which include Milford, Shubenacadie, and Regional Collection Systems (Enfield, Elmsdale and Lantz).

It is important to maintain a reliable and accurate wastewater hydraulic model to assist the Municipality with planning for wastewater servicing requirements that are directly attributed to the growth in population. The existing wastewater hydraulic model was updated and calibrated to assess the performance of the systems capacity under existing and future conditions, and to determine the impacts of planned developments, future growth and future sewer flows on the current infrastructure. The analysis has resulted in recommendations pertaining to necessary future infrastructure upgrades, and operational improvements for optimal operations of the systems. Cost estimates for sanitary works are summarized in Section 8 which provides overall recommendations for all systems with associated cost estimates for implementation of infrastructure upgrades.

A.6 Stormwater Culvert Capacity

The Municipality of East Hants (Municipality) has multiple watersheds which flow into the Shubenacadie River. In order for the flow to reach the river, it must flow through developed areas in Enfield, Elmsdale and Lantz, under Nova Scotia Highway 2 and the adjacent CN Railway, before continuing towards the river. Along Highway 2, there are culverts and piped stormwater systems which allow flow to pass under the road. During and after heavy rainfall events, the municipality experiences minor flooding on the North side (upstream) of Highway 2. The municipality requested as part of the capacity study that RVA undertake an assessment of specific culverts to understand condition and conveyance capacity. As such, RVA completed the following activities in support of the assessment on the stormwater culverts:

- Visual inspection of the culverts along Highway 2 – Includes taking measurements of culverts to determine conveyance capacity.
- Measured water level in culverts
- Observed the culverts and the upstream/downstream channels including, sediment, vegetation, and debris.
- Completed GPS survey, including inlet and outlet elevations of each culvert to accurately calculate the length and slope.

Once site investigations were complete, all data gathered was assembled and used in the desktop exercise to calculate conveyance capacity under the 1-5 year and 1–100-year events.

A.7 State of Infrastructure Assessment – Linear Works

A desktop review or state of infrastructure assessment of the existing water and wastewater linear assets was conducted to develop a 25-year financial forecast to determine the annual estimated expenditures required to maintain current levels of service. The assessment was focused on the water and wastewater linear infrastructure (i.e. gravity sewers, sanitary forcemains, watermains, etc.) and excludes vertical infrastructure (i.e. pump stations, wastewater treatment plants, etc.).

1.0 Sanitary Sewer Pump Stations Assessment & Conditions

Tech Memo #1 was issued to East Hants to provide the methodology to complete Lift Station Investigations, reporting and findings, and identification of Total Repair/Replacement Costs on the Sanitary Sewer Pump Stations. The following sections summarize highlights of this Technical Memorandum.

1.1 Lift Station Investigations – Methodology

The condition rating of each pump station asset represents the current state of physical repair and is often used as an indicator for the relative time until corrective action (rehabilitation or replacement) is required. The table below identifies a rating, a description of the condition attached to the rating and what is the expected life of the asset when given a rating. Descriptions of each condition rating (from 1 to 5) and expected service life are provided in Table 1.1 below.

Table 1.1 – Condition Rating Matrix

Condition Rating	Physical Condition	Expected Service Life
1 - Very Good	Excellent working condition. No signs of deterioration.	Like new.
2 – Good	Minor signs of deterioration.	At or beyond mid-stage of life.
3 – Fair	Some elements exhibiting major deficiencies.	Approaching end of life.
4 - Poor	Significant deterioration with localized areas of failure.	Needs to be replaced/ repaired in the short-term.
5 - Very Poor	Asset is beyond repair and, generally, has completely failed.	Needs to be replaced/ repaired immediately.
0 - Unknown	Insufficient information exists to estimate asset condition.	

Through access to the GIS files, RVA was able to create effective and efficient methods to conduct the field study for each lift station. When developing a condition rating, the age and usage of certain elements such as pumps, was taken into consideration to understand if they were at or nearing the end of their operating life, if they should be considered for a performance review, and if they can withstand the projected population growth for the next 25 years. The use of iPad technology was most efficient to upload field notes and photos during each lift station assessment to ensure all notes are retained from the field. The municipal operators provided detailed information during each lift station inspection where the operator was aware of recurring issues. Information was documented by RVA staff for consideration in establishing the overall rating.

1.2 Reporting and Findings - Sanitary Sewer Pump Stations

The following conclusions were made on the pump station infrastructure for the Municipality of East Hants:

- The Municipality owns and operates 28 lift stations between Enfield and Shubenacadie.
- The total current 2023 repair/replacement value of lift stations upgrades are estimated at $508,900.
- Overall, the municipalities lift station infrastructure is in good condition, however some deficiencies exist, including:
    - 6 pumps are past the typical 20-year operating life.
    - 5 lift stations are in fair condition.
    - 5 lift stations have wet-well chambers which are prone to run-off from adjacent roadway surfaces.
    - 10 pedestals require repair or replacement.
    - 13 lift stations should have EYS fittings installed as per Canada Explosion Proofing Guidelines.
- Seven (7) lift stations require immediate repair within the next 0-2 years. Peter Horne, Elmsdale Fire Hall, Old Elmsdale School, Old Public Works Shed, Barney Brook, Ross' Hill, and Main Office stations should receive upgrades or be replaced before 2025.
- Fifteen (15) lift stations will require upgrades or replacement within the next 7-12 years. Horne Settlement, Locks Road, Curley Portables, Mill (Elmsdale Lumber), Medical Centre, Pine Grove, Industrial Park, Carmies Daycare, Elmsdale Legion, Lantz Cemetery, Sportsplex, Poplar Drive, Paley Road, Havenwood Drive and Maitland Road stations should receive upgrades or be replaced by 2035.
- Two (2) lift stations will require upgrades or repairs in the next 20-25 years. Donaldson Avenue and Burgess Road stations should receive upgrades or repairs by 2040.

- Three (3) lift stations will require upgrades or repairs in the next 25+ years. Sherwood Park, Park Road Extension and Isenor Road stations should receive upgrades or repairs by 2050.

1.3 Total Repair/Replacement Costs

RVA developed a spreadsheet according to each lift station and data collected from the field to determine total repair/replacement cost estimates. Xylem manufacturing company pricing was used in the cost estimates and costs were distinguished by the pump replacement cost, Wet-Well Hardware Replacement cost, Control Panel replacement cost, and Misc. replacement cost. The East Hants Lift Station Replacement Costs are also incorporated in Section 8.0 below.

The total replacement cost is estimated at $508,900.00 as shown in Table 1.2 below. It should be noted that these replacement costs are for the current fiscal year (2023) and in the next 25 years all of the pumps will surpass the pump life of 20-25 years and will require to be replaced.

Table 1.2 – Sanitary Lift Station Replacement Costs

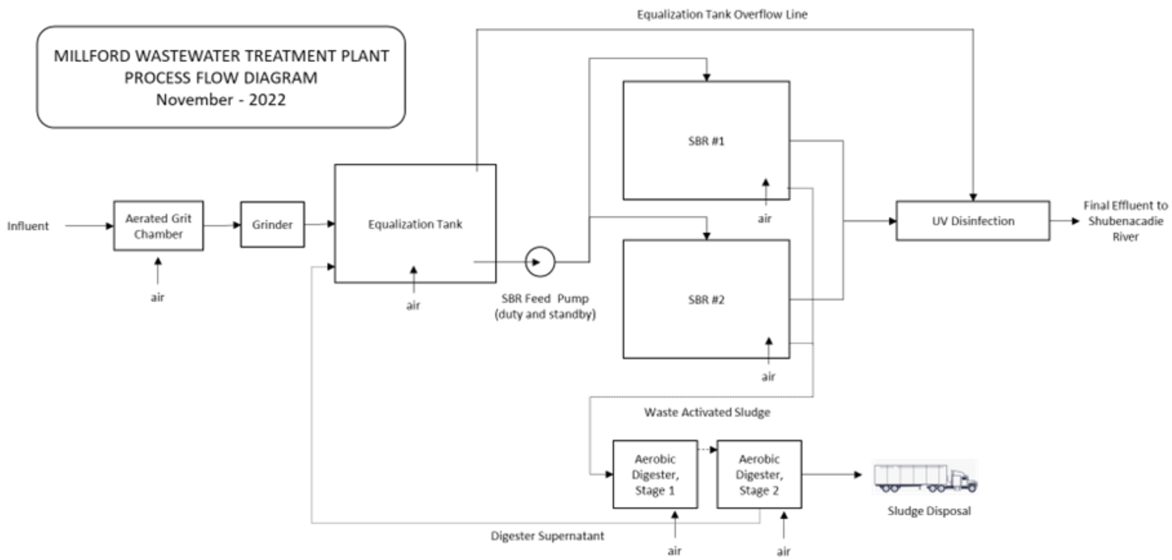
Asset	Replacement Cost[1]
Pumps	$156,150.00
Wet-Well Hardware	$150,750.00
Control Panel	$40,000.00
Miscellaneous	$62,000.00
Total	$508,900.00

Notes:
[1]Costs are provided in Canadian dollars and not adjusted for future inflation. Equipment and installation costs are included in these estimates.
Miscellaneous costs are listed for maintenance or repairs required per lift station. (Pedestal, security bar, hinge covers etc.)

2.0 Milford Wastewater Treatment Plant

Tech Memo #2 provides a detailed review of the plant conditions, capacity, operations, and performance. Key information is provided below. A process flow diagram at is provided in Figure 2.1.

Figure 2.1 – MWWTP Process Flow Diagram



2.1 Current Process Capacity

To determine the plant's ability to treat the community's wastewater for the next 25 years, RVA assessed the current treatment and flow capacity with respect to the projected treatment and flow capacity. Using SCADA flow data analysis, it was determined the current average flow at the plant to be 361 m3/d with absolute peak daily flow observed of 2,304 m3/d. The current Municipal Wastewater Treatment Plant is designed to meet effluent limits which are provided in **Table 2.1.** Treated effluent is discharged to the Shubenacadie River.

Table 2.1 – MWWTP Treated Effluent Limits

Parameter	Limit	Sampling Frequency	Sampling Location
BOD_5	20 mg/L	5 / month	Treated Effluent Discharge
Suspended Solids	20 mg/L	5 / month	Treated Effluent Discharge
Fecal Coliform	200 counts / 100 mL	5 / month	Treated Effluent Discharge
pH	6.5 – 9.0	Continuously or daily grab	Treated Effluent Discharge
Plant Volumes	-	Continuously	Entering and Leaving Plant
Fish Toxicity	-	As requested by NSE	Treated Effluent Discharge

Notes:
The facility shall be considered to be in compliance as long as:
1 - 80% of the samples meet the limits, and
2 - No single result is greater than two (2) times the limit

2.2 Future Wastewater Flow and WWTP Capacity

To assess anticipated future treatment and flow demands, the municipality provided RVA with population growth projections extending to 2050 for low, mid, and high growth scenarios in the Milford Growth Management Area (GMA). For this analysis, RVA utilized the "mid growth" projections for 2022 through 2050 using the following assumptions:

- The Milford GMA has an estimated current population (as of December 31, 2021) of 948.
- Development rates were based on those typical over the past 5 – 10 years.
- An average of 2.5 people per dwelling as per the combined Corridor/Indian Brook aggregate dissemination area (ADA) from the 2021 census.

The Atlantic Canada Water and Wastewater Association (ACWWA) guideline value of 380 L person per day, when combined with the current population, closely predicts the current average daily sewage flows observed (see **Table 2.2**) and will be used to predict the increase in flow associated with population growth.

Table 2.2 – MWWTP Flow Projection Check

Parameter	Unit	Value	Source
Estimated Current Population	Residents	948	Municipality of East Hants
Design Residential Wastewater Flow	L/Cap*d	380	ACWWA Guidelines
Estimated Average Daily Wastewater Flow	m3/d	360	Calculated from ACWWA Guidelines
Average Daily Flow	m3/d	361	2019 – 2021 Historical Data

The peak and average daily flows estimated to occur in 2050 are presented alongside the capacities of the MWWTP's various unit processes in Table 2.3. The analysis indicated that the plant would have the capacity to manage the estimated future average and peak daily flows.

Table 2.3 – MWWTP Unit Process Capacity Summary

Unit Process	Average Daily Flow (m^3/d)		Peak Daily Flow (m^3/d)	
	2050	Capacity	2050	Capacity
Preliminary Treatment	452	1,044(1)	1900	5,743
SBR Pump		3,370		4,493
SBRs		975		2,250
Disinfection		1,256(2)		5,400
Sludge Digestion		998		N/A

2.3 WWTP Assets Replacement Timeline

Upon review of historical data provided for the municipal wastewater treatment plant (MWWTP), it was determined the plant was 100% in compliance with the Nova Scotia Environment (NSE) guidelines as outlined in Table 2.4 below:

Table 2.4 – 2019 – 2021 MWWTP Treated Effluent Results

Parameter	Limit	Average	Compliance
BOD_5	20 mg/L	3 mg/L	100%
Suspended Solids	20 mg/L	5 mg/L	100%
Ammonia (as Nitrogen)	N/A	0.09 mg/L	N/A
Fecal Coliform	200 counts / 100 mL	9 CFU/100 mL	100%
pH	6.5 – 9.0	7.13	100%

Although the capacity of the plant has shown to meet the projected 2050 wastewater flows, almost all of the plant's assets, with the exception of the tanks will require replacement or rehabilitation before this time. The major replacement timeline Table 2.5 is presented below:

Table 2.5 – Major Asset Replacement Timeline

Asset	Installed/ Constructed	Normal Service Life	Expected Replacement
Grinder	2021	25	2046
SBR Pumps	2021	25	2046
Blowers	2011	20	2031
UV system	2011	25	2036
SCADA System	2011	20	2031
Building Electrical and Mechanical System	2011	20	2031
Tanks	2011	50	2061[(1)]

Notes: Adapted from (WSP Canada Inc., 2015)
[1]Tanks would likely be rehabilitated instead of replaced.

The Peaking Factor Analysis shows that the plant will have capacity to manage the future average daily flows, but the estimated peak daily flow may approach the SBR's design capacity.

2.4 Total Repair/Replacement Costs

The total costs for replacement are shown in Table 2.6 below:

Table 2.6 – Major Asset Replacement Cost Estimates

Asset	Expected Replacement	Installation	Construction Contingency	Replacement Cost (1)
Grinder	2046	20%	15%	$110,000
SBR Pumps	2046	20%	15%	$175,000
Blowers	2031	30%	15%	$180,000
UV system	2036	30%	15%	$165,000
SCADA System(2)	2031	Included in Equipment Cost	15%	$230,000
Building Electrical (MCC) (3)	2031		25%	$450,000
Building Mechanical System (4)	2031	50%	50%	$100,000

Notes:
1 Costs are provided in Canadian dollars and adjusted for 2% inflation to the year of expected replacement. Equipment and installation costs are included in these estimates.
2 Costs for SCADA system replacement include a new panel, HMI station, programming, installation, startup and testing.
3 Costs for Building Electrical Systems include replacement of the motor control cabinet (MCC – 1).
4 Costs for Building Mechanical Systems include replacement of HVAC equipment (fans, HRV, heaters) and plumbing equipment (water heater, pressure tank, water softener.

3.0 Shubenacadie Water Treatment Plant Assessment

Tech Memo #3 provides a detailed review of the Shubenacadie water treatment plant. The content below is a summary of approach and findings of the capacity assessment at this facility.

3.1 Current Treatment Plant Capacity

The Shubenacadie Water Treatment Plant currently runs off two groundwater wells, PW-2 (installed in 2007) and PW-2019 (installed in 2019). When the plant was first commissioned, it was supplied by wells PW-1 and PW-2; however, PW-1 has since been decommissioned because the internal components of the well failed. Each pump has a rated capacity of 9.5 L/s @ 76 m head (150 USGPM @ 250 ft head) with the typical output of the plant is 7.6 L/s @ 58 m head (100 IGPM @ 82 psi). Raw water flows through one of the two sand media filters, each rated at 12.6 L/s capacity to remove contaminant particulates improving the water quality. Portion of the water (60%) then flows through one of the two water softeners rated at 9.8 L/S removing excess iron and manganese improving water aesthetics and the other portion (40%) bypasses the softeners to reduce the hardness from 261 mg/L to 100 mg/L. Hydrogen Sulfide is then removed by granular activated carbon filter (GAC) rated at 12.6 L/S. Chlorine injection is then applied as the final stage of the treatment to provide primary/secondary disinfection. Well water is used to backwash the sand filters, water softeners and GAC filter.

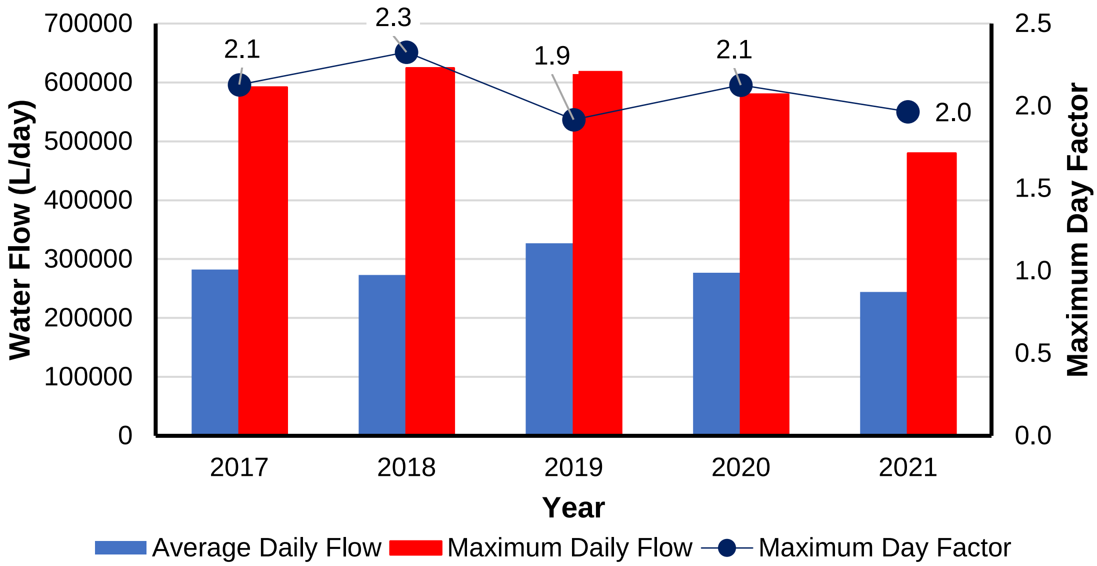
The municipality has noted operational challenges with the backwashing of the treatment plant. Currently the plant is using well water to backwash the sand filters, water softeners and GAC filter. At minimum a volume of 8,000 L of backwash supply storage tank is determined to be suitable however, a greater volume is recommended to ensure adequate functional volume is available. The system has identified it would require backwash storage tank, duty/standby pumps, controls, and electrical system upgrades to accommodate for adequate treatment capacity. Napier Reid has provided quotes for external tank options inside the existing building or buried outside the building. This information is provided in sections below.

3.2 Future Growth and Supply Capacity

The Municipality of East Hants provided RVA with low, mid, and high-range population estimates from 2022 – 2047 for this assessment. RVA was instructed to use the mid-range population projection for this study. Based on this mid-range projection, the estimated population in 2047 is 1033. RVA used Census data and linear interpolation to determine the approximate population between 2016 – 2021 using the municipality's data from 2022-2047.

Figure 3.1 presents a summary of key water usage parameters in Shubenacadie between 2017 and 2021. The average day demands in Shubenacadie varied between 244,000 and 327,000 L/d, with an overall average daily demand of 281,000 L/d. The maximum daily demand varied between 480,000 and 625,000 L/d, while the maximum day factor averaged 2.1.

Figure 3.1 – Historical Water Use in Shubenacadie



3.3 WTP Asset Upgrades/Replacement Costs

The limiting factor for the future will be the withdrawal rate from the underground well. Provisions for a second well may be considered to provide additional redundancy to the water supply since well PW-1 failed in the recent years. The municipality may need to investigate the cause of the backwash system deficiencies, evaluate options, and design an improved backwash supply system, potentially including a backwash supply tank and pumping system. Refer to **Table 3.1** for upgrades/replacements recommended based on asset life span in the immediate term 0-5 years (red), within the next 6-25 years (yellow), and within >25 years (green) as well as their estimated replacement costs.

Table 3.1 – Approximate Asset Costs and Timelines for Replacement

Asset	Cost (2022 values in CAD, excluding tax)	Life Span (years)	Year of Installation
Well PW-2	$110,000	25-35	2007
Well PW-2019	$110,000	25-35	2019
Well Pump PW-2	$18,000	10-15	2011
Well Pump PW-2019	$18,000	10-15	2019
Sand Filters	$400,000	15-25	2011
Softening System	$400,000	15-25	2011
GAC Filter	$400,000	15-25	2011
Chlorine Treatment System	$180,000	15	2011
Corrosion Control	$20,000	15	2013
Future UV System	$170,000	15	2023*
SCADA System	$110,000	15	2011
Emergency Power	$250,000	15	2011
Backwash System	$280,000	30-60	2023**
Building and property	0%-7% of building replacement value per year***	30 to 90, depending on the asset	2011

**Note: will be required if water is ever deemed GUDI. Cost assumes 1 duty plus 1 standby unit and a UVT sensor and analyzer.*

***Recommended to install. Requires additional design. Refer to appended quotes received for an internal tank-based system. Quotes have also been received for an external tank. Many of the items required for the internal tank system would also be required for the external tank system (with the exception of the internal tank and piping costs).*

****General building and property are difficult to estimate due to the variety of factors involved. The National Research Council Study "Expenditures for the operation and maintenance of buildings" indicated that a range can be used based on the replacement costs of the building that can vary from 0 – 7% per year, with 0.5% per year as a 6-year average. Deferred maintenance costs would accumulate.*

4.0 Water Distribution System Capacity Assessment

Tech Memo #4 provides a detailed report of the water distribution system assessment on the Shubenacadie and Regional systems including model development, hydrant testing, calibration, and flow demand predictions. The content below provides a summary of Tech Memo #4 findings and cost estimates. Please refer to Tech Memo #4 for mapping and graphics that show in detail system findings.

4.1 Current Distribution Capacity

RVA evaluated the two water distribution systems (Regional & Shubenacadie) using the model InfoWater (Innovyze) under various scenarios and planning horizons. To guide the municipality with the provision of safe and reliable water for both water systems, the hydraulic models considered factors such as node evaluation, pipe roughness, water sources, high lift pumps, water storage, hydrant flow tests, and current demand estimates.

To ensure the accuracy of the hydraulic model, several steady-state fire flow tests were completed using NFPA 291 standards. The results of the tests were utilized to calibrate the model. Model adjustments were revised in a trial-and-error manner until the variances within the tolerance reached the observed and simulated conditions. Once the model adjustment of mainly pipe roughness were inputted to the hydraulic model, all flow variances in the post calibration between field and model conditions were inside the tolerable range of 10%.

Steady-state scenarios were simulated in both the Regional and Shubenacadie water distribution systems for the present-day conditions which illustrated performance of the distribution for Pressure under existing Peak Hour Demand and available fire flow under existing Max Day Demand.

4.2 Future Growth and Distribution System Capacity

RVA used the same boundary condition in the existing model to simulate the future condition for a lateral comparison using the mid-range future development study. The proposed development for the Shubenacadie System is currently unknown and estimated demands based on the projected growth were evenly distributed and allocated to each junction in the hydraulic model. Estimated demands from the proposed developments were allocated to the closest existing water system junctions in the hydraulic model. For the System Pressure under Future Peak Hour Demand conditions, Darcy's equation was used to determine the total head loss increase throughout the systems. The fire flow under future Max Day Demand conditions were observed by the pressure and fire flow availability.

The Atlantic Canada Guidelines was referenced to confirm Treated Water Storage requirements for unexpected shutdowns, watermain breaks or power outage at the WTP. Lidar survey provided by Nova Scotia DataLocator from 2020 was referenced when determining the location for the new water storage facility expansion.

4.3 Water Distribution Systems Findings

The northern side of the Regional Distribution System had the largest expected growth and is currently experiencing service issues due to low pressure in the system. The low pressure in the Regional Distribution system appeared in the current steady-state simulation and has significantly increased in the future simulation in both the Peak Hour Demand and the available fire flow under Max Day Demand. It was determined the addition of a New Water Storage Facility (NWSF) with storage capacity of 5,000 m^3 is required to satisfy future needs as shown in table Table 4.1 below. The location of the NWSF is recommended to be constructed at the highest ground elevation at the northern side of the system where most anticipated growth is located and where the hydrostatic pressure can be driven by gravity throughout the service area. A new 450mm transmission watermain providing bidirectional flow can reduce head loss inside the pipeline to meet future conditions with an estimated cost of six million dollars. In addition, existing watermain on Highway 2 from Earls Court to Mader Street need to upsize to 400mm diameter to improve supply redundancy between the NWSF and the rest of the water system. The estimated cost of this upgrade would be one and a half million dollars.

Table 4.1 – System Storage Capacities

System	Condition	Fire Storage & Emergency Storage (m^3)	Equalization Storage (m^3)	Total Storage (m^3)
Regional	Current Required	2,792	962	3,753
	2047 Required	7,867	2,850	10,717
	Existing Capacity	5,366	1,271	6,096
	2047 Surplus/Deficit	-2,502	-1,579	-4,621
Shubenacadie	Current Required	611	141	752
	2047 Required	758	190	948
	Existing Capacity	1,151	497	1,648
	2047 Surplus/Deficit	393	307	700

The existing Shubenacadie System can accommodate the projected population growth. However, it is recommended to address the high-pressure issue on the northern and western side of the system with pressure reducing valves.

4.4 Total Expansion Costs

RVA developed tables for the Regional and Shubenacadie Distribution Systems to determine total upgrade costs. The total estimated costs for the Regional System are $15.5-16.5M and the total estimated costs for the Shubenacadie System is $2.2M as presented in the tables below.

Table 4.2 – Recommended Upgrades in Regional System

Upgrades	Items	Estimated Costs* 2023 $
New Water Facility	Option 1: Standpipe Option 2: Elevated Tank	8.0 M 8.0 ~ 9.0 M
New Transmission Watermain	450mm diameter, 4 km in length	6.0 M
Watermain Upsize	400mm diameter, 1 km length	1.5 M
	Total Cost	15.5 ~ 16.5 M

** k presents hundred thousand dollars; M presents million dollars.*
** Costs are based on inhouse knowledge for similar sized tanks, not considering site constraints and local market changes.*

Table 4.3 – Recommended Upgrades in Shubenacadie System

Upgrades	Items	Estimated Costs* 2023 $
Separate the System into Two Pressure Zones	300mm Diameter Dedicated Watermain from WTP to Standpipe, estimated length of 1.7 km Two PRV chambers	2.0 M 0.2 M
	Total Cost	2.2 M

** k presents hundred thousand dollars; M presents million dollars.*
** Costs are based RVA's knowledge for similar sized tanks, not considering site constraints and local market changes.*

5.0 Sanitary Collection Capacity Assessment

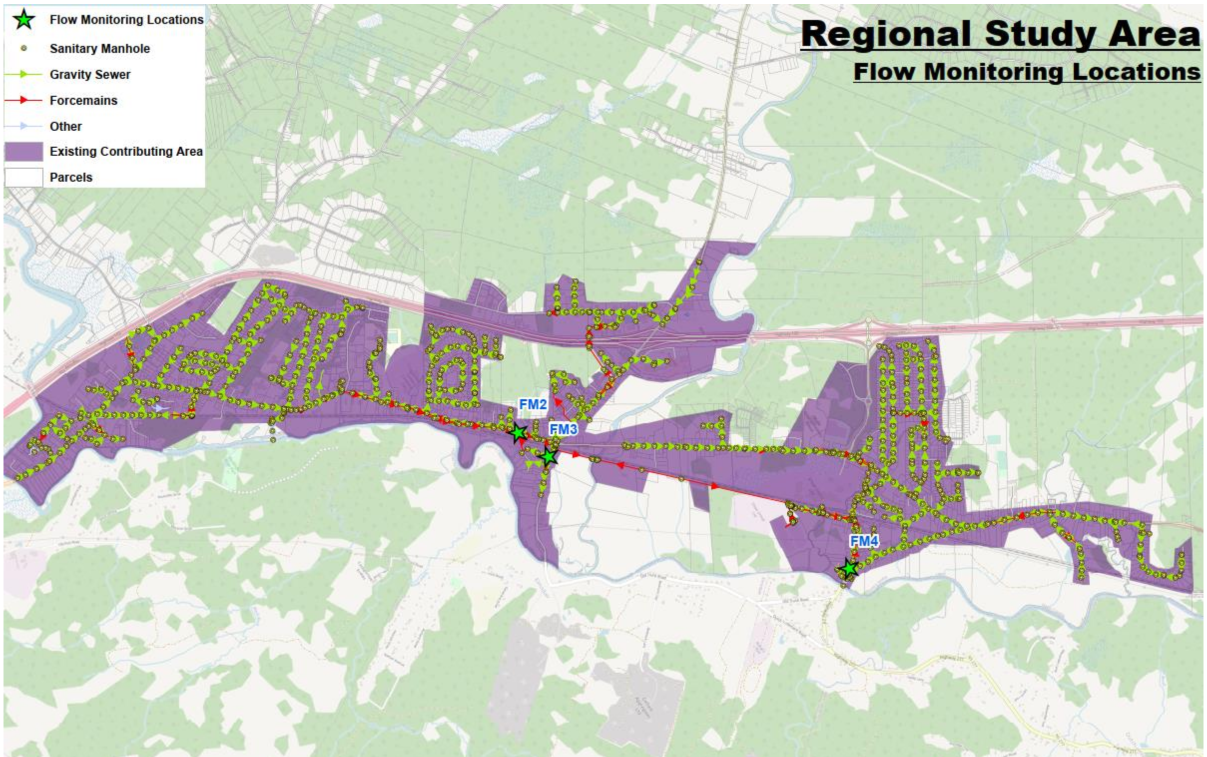
Tech Memo #5 provides a detailed report on the assessment of Wastewater Collection System (sewers and pump stations) and identifies capacity constraints and Capital Planning within the Milford, Shubenacadie and the Regional servicing areas. The content below provides a summary of Tech Memo #5 findings and cost estimates. Please refer to this document for mapping which shows specific on findings on the modelling analysis.

5.1 Current Conveyance Capacity

As part of the Servicing Capacity Study, the Municipality provided a copy of the previous 2015 hydraulic model completed by another consultant developed in SewerGEMS modelling platform. A total of 139 additional pipes that were not present in the existing model were reviewed in detail prior to adding to the model. Pipes that were present in the existing model and GIS database were reviewed for diameter and invert elevations and compared between the model and the latest GIS database. Manhole data included rim elevations, manhole depth and invert elevations. Pump curves was assigned to each pump within each station in the model. Wet well area, operating range, and pump curves for duty and standby pumps were reviewed and compared against the information provided by the Municipality for Regional (22 pump stations), Shubenacadie (3 pump stations) and Milford (1 pump station) systems.

A flow monitoring program was undertaken by Biomaxx Environmental and consisted of the installation of three (3) temporary flow monitors for over a three-month period. As part of the study, the rainfall data was obtained from the weather station located at the Halifax Stanfield International Airport, which is on average from the flow monitoring stations approximately sixteen (16) km away from the study area. Figure 5.1 below shows the flow monitoring locations.

Figure 5.1 – Flow Monitoring Locations - Regional System

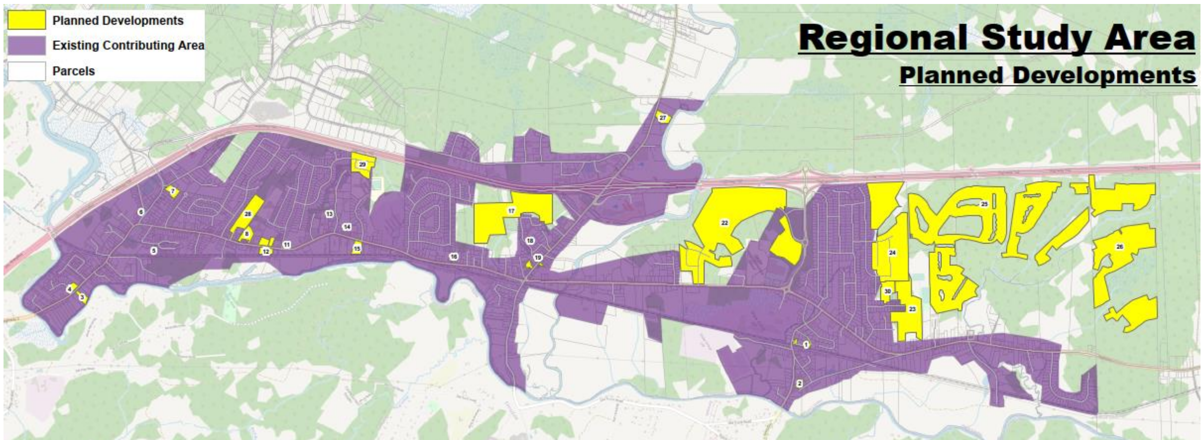


To verify and calibrate the average dry weather flows (ADWF) for each of the three (3) WWTP's, influent data from the Milford WWTP and effluent data from the Shubenacadie WWTP and the Regional WWTP was reviewed by RVA. It should be noted that the effluent data is not ideal for data analysis as the data does not provide an accurate representation of the upstream flows discharged to the plant.

As part of the information gathering process, RVA also reviewed plan and profile drawings that were provided for the proposed and approved developments that will directly impact the sanitary collection capacity in the near future. As per the information provided by the Municipality, all developments were planned in the Regional system of the Municipality, and no developments are planned in either the Milford or Shubenacadie system at this time.

The figure below provides a summary of the planned developments within the regional system:

Figure 5.2 – Planned Developments – Regional System



ID	Address	No. of Units	Area (Ha)	Total Population
1	Melody Lane, Lantz	40	0.64	100
2	161 Highway 277, Lantz	16	0.51	40
3	159 Highway 2, Enfield	72	0.66	180
4	Sherwood Park, Enfield	64	0.51	160
5	John Murray Drive, Enfield	10	0.29	25
6	Old Enfield and Old Hornse Dev	10	0.20	34
7	Bakery Lane	72	0.93	180
8	410 Highway 2, Enfield	70	1.31	175
9	428 Highway 2, Enfield	62	0.61	155
10	432 Highway 2, Enfield	40	0.34	100
11	450 Highway 2, Enfield	126	0.45	315
12	429 Highway 2, Enfield	84	0.74	210
13	Kali Lane, Elmsdale	16	0.39	40
14	532 Highway 2, Elmsdale	42	0.18	105
15	553 Highway 2, Elmsdale	58	0.97	145
16	Highway 2, Elmsdale	16	0.15	40
17	Pinehill/Elmwood, Elmsdale	660	19.2	1650
18	Pine Hill Drive, Elmsdale	12	0.08	30
19	166 Highway 214, Elmsdale	12	0.14	30
20	163 Highway 214, Elmsdale	11	0.12	28
21	TOLSON-Highway 214, Elmsdale	36	0.32	90
22	Lantz-The Shaw Group	1500	46.9	3750
23	Mariah Drive, Lantz	148	10.8	370
24	Mariah Drive, Lantz	104	26.6	260
25	Lantz - ARMCo	2205	71.8	5513
26	Milford Development	1400	42.1	3500
27	Highway 214, Elmsdale	94	1.26	235
28	Dorey Lane-1, Enfield	74	4.44	185
29	Tyler Street Extension, Elmsdale	88	3.96	220
30	Acorn Ave, Lantz	81	2.26	203

5.2 Future Growth and Supply Capacity

The existing SewerGEMS model was updated to reflect the latest addition to the infrastructure prompted by the planned developments that will be completed in the near future. Planned developments that are to be constructed in already developed areas are assigned to the nearest sanitary sewer that is part of the existing system. It is important to note that no new pipes and manholes were added to the sanitary sewer model for Milford and Shubenacadie study area. No model update summary was required for Milford and Shubenacadie systems, as for the Regional System, the model update summary is presented below:

Table 5.1 – System Model Update Summary – Regional System

Model Feature	Updated Model*	Comment
No. of Pipes	901	# new pipes added = 139
No. of Manholes	802	# new manholes added = 133
No. of Pump Stations	24	# pump stations added = 2

***Based on plan and profile drawings and other pertinent data provided by the Municipality**

Two (2) new pump stations were added to the model to service a future development located in Lantz, Nova Scotia. The planned development will consist of 2205 units of varying unit types and is set to be completed by the year 2045.

The total flows allocated to the existing manholes were compared to the flows discharged to the respective WWTP to confirm if the flows allocated for the existing conditions were still valid or needed to be updated before proceeding to a future condition analysis. Table 5.2 below provides details pertaining to the sanitary flows used in the existing conditions.

Table 5.2 – Existing Condition Flows – All Systems

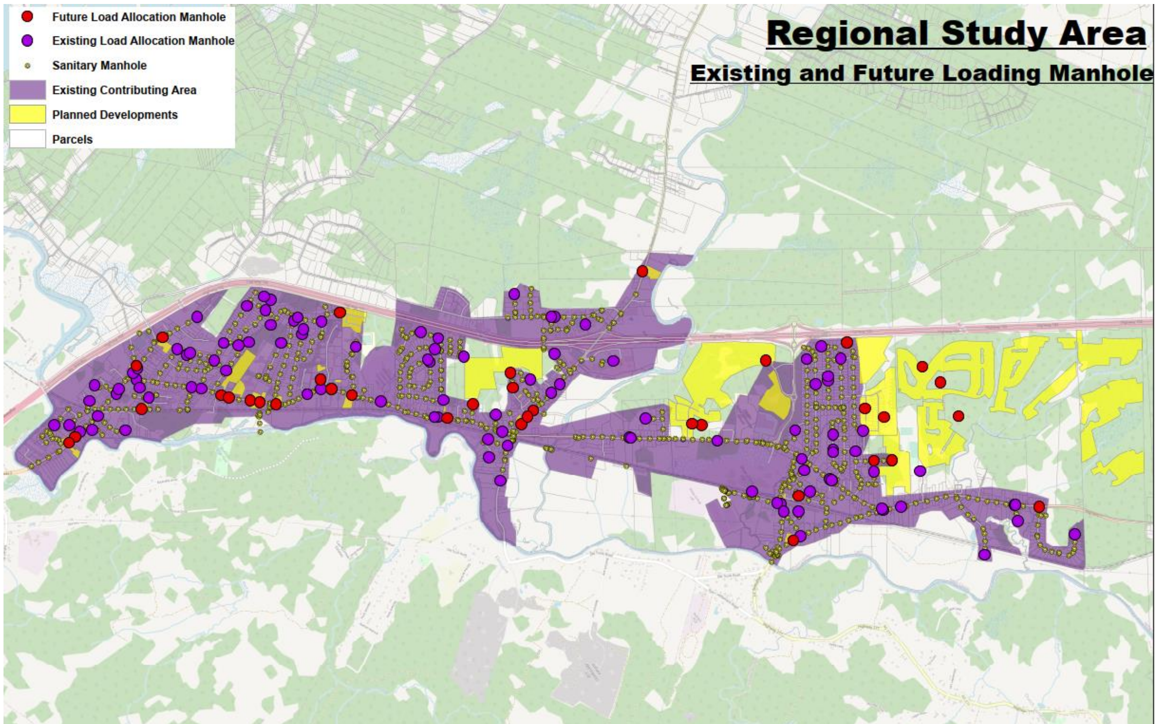
Existing Conditions (WSP Load Allocation)				
Item	Milford	Shubenacadie	Regional	Comment
Existing Peak Residential Flows (L/s)	21.25	15	144.38	From the WSP model
Existing Peak ICI Flows (L/s)	2.77	-	29.1	From the WSP model
Population	1000	785	9040	
Harmon Peaking Factor	3.8	3.87	3	
Existing Residential Average Dry Weather Flow (L/s)	5.59	3.88	48.16	
Existing Per Capita Consumption (L/Cap/d)	483	427	460	Higher than Municipal design standard of 340 L/Cap/d and need to be adjusted

Once the existing condition flows were calibrated, the additional flows that were directly attributed from the future developments were calculated and added to the model to develop future conditions by assigning the flows to the nearest existing manhole or a newly digitized manhole provided by the municipality. The flows for the planned developments were calculated using the Municipality’s guidelines and they are as follows:

- Average Dry Weather Flows: 340 liters per person per day
- Design Peak Flows: 1,490 liters per person per day
- Inflow and Infiltration Flows: 25, 920 liters per hectare per day

Figure 5.3 shows the updated locations of the loading manholes for the future conditions.

Figure 5.3 – Existing and Future Loading Manholes



Dry weather flows were calibrated to match the values recorded at the WWTP. Milford was reduced by 46%, Shubenacadie by 60% and Regional by 53%.

5.3 Reporting and Findings

It was determined for the Milford Wastewater System no immediate concerns with the existing infrastructure, however a singular location where a pipe upgrade is recommended as shown in Table 5.3 below:

Table 5.3 – Proposed Sanitary Sewer Upgrades - Milford System

Location	Length (m)	Current Diameter (mm)	Proposed Diameter (mm)	To be installed by
Influent to WWTP	10	250	300	Immediately

The Shubenacadie Wastewater System pumps at Mainland Road Pumping Station (PS23) were determined to be downsized with a design capacity of 20 L/s at 10 meters of total dynamic head. Pipes experiencing capacity constraints and recommended for upgrade are listed in the Table 5.4 below:

Table 5.4 – Proposed Sanitary Sewer Upgrades - Shubenacadie System

Pipe ID	Length (m)	Current Diameter (mm)	Proposed Diameter (mm)	To be installed by
MH43 to MH66	610	200	250	Immediately
MH69 to MH68	275	200	300	Immediately

The Regional system demonstrated capacity constraints with gravity sewers, forcemains and pump stations. The upgrades are shown in the tables below:

Table 5.5 – Proposed Sanitary (Gravity) Sewer Upgrades - Regional System

Location ID	Length (m)	Current Diameter (mm)	Proposed Diameter (mm)	To be installed by
EH_R1	850	200	250	Immediate
EH_R2	885	200	250	2031/2045
EH_R3	452	200	250	2031/2045
EH_R4	333	200	300	Immediate
EH_R5	574	250	300	2031/2045
EH_R6	786	200	300	2031/2045
EH_R7-A	724	200	525	Immediate
EH_R7-B	253	250	525	Immediate
EH_R9	505	200	375	2031/2045
EH_R8	301	300	525	2031/2045
EH_R10	110	200	375	2031/2045
EH_R11	164	200	300	Immediate

Table 5.6 – Proposed Sanitary (Forcemains) Sewer Upgrades - Regional System

Location ID	Length (m)	Current Diameter (mm)	Proposed Diameter (mm)	To be installed by
EH_F1	189	75	100	Immediate
EH_F2	205	150	250	Immediate
EH_F3	296	100	150	Immediate
EH_F4	275	75	100	Immediate
EH_F5	1308	300	350	2031/2045
EH_F6	596	150	250	2031/2045
EH_F7	121	150	200	2031/2045

Table 5.7 – Proposed Pump Upgrades - Regional System

Pump Station	Flow (L/s)	Head (m)	Horsepower (Hp)	To be installed by
PS03	17	24	10	Immediate
PS07	182	90	300**	Immediate
PS10	96	15	30	Immediate
PS11A	45	40	35	Immediate
PS16	12.5	12	3	Immediate
PS17	100	18	35	Immediate
PS17*	250	50	250**	2031/2045
PS18	115	40	90	2031/2045
PS20	85	5	10	2031/2045

*Requires another upgrade to accommodate 2031/2045 flows

**Estimated horsepower for each pump station is the total horsepower required to convey the design flow and head condition. For simplicity, it is assumed that one duly pump will convey the design flow and head conditions. It is assumed that the number of duty pumps (1, 2 or 3) will be determined at the design stage. Accordingly, the horsepower of individual pumps can be estimated.

5.4 Total Upgrade Costs

The tables below provide probable costs for the proposed upgrades in the Shubenacadie system.

Table 5.8 – Proposed Costs for Sanitary Sewer Upgrades - Shubenacadie System

Location	Length (m)	Prop Diameter (mm)	Cost	Cost (Millions)
MH43 to MH66	610.00	250.00	$ 721,630.00	$ 0.72
MH69 to MH68	275.00	300.00	$ 357,500.00	$ 0.36

Table 5.9 – Proposed Costs for Pump Upgrade - Shubenacadie System

Pump Station	Flow (L/s)	Head (m)	Horsepower (Hp)	Cost*
PS23	20	10	4	$ 67,500.00

The tables below provide probable costs for the proposed upgrades in the Regional system.

Table 5.10 – Proposed Costs for Sanitary (Gravity) Sewer Upgrades - Regional System

Location	Length (m)	Prop Diameter (mm)	Cost	Cost (Millions)
EH_R1	850	250	$ 1,005,550.00	$ 1.01
EH_R4	333	300	$ 432,900.00	$ 0.43
EH_R7-A	724	525	$ 993,328.00	$ 0.99
EH_R7-B	253	525	$ 347,116.00	$ 0.35
EH_R11	164	300	$ 213,200.00	$ 0.21
EH_R8	301	525	$ 412,972.00	$ 0.41
EH_R2	885	250	$ 1,046,955.00	$ 1.05
EH_R3	452	250	$ 534,716.00	$ 0.53
EH_R5	574	300	$ 746,200.00	$ 0.75
EH_R6	786	300	$ 1,021,800.00	$ 1.02
EH_R9	505	375	$ 656,500.00	$ 0.66
EH_R10	110	375	$ 143,000.00	$ 0.14

Table 5.11 – Proposed Costs for Sanitary (Forcemains) Sewer Upgrades – Regional System

Location ID	Length (m)	Proposed Diameter (mm)	Cost	Cost (Millon)
EH_F1	189	100	$206,388.00	$0.21
EH_F2	205	250	$242,515.00	$0.24
EH_F3	296	150	$327,080.00	$0.33
EH_F4	275	100	$300,300.00	$0.30
EH_F5	1308	350	$1,700,400.00	$1.70
EH_F6	596	250	$705,068.00	$0.71
EH_F7	121	200	$133,705.00	$0.13

Table 5.12 – Proposed Costs for Pump Upgrade - Regional System

Pump Station	Flow (L/s)	Head (m)	Horsepower (Hp)	Cost*
PS03	17	24	10	$77,200
PS07	182	90	300	$496,200
PS10	96	15	30	$113,500.00
PS11A	45	40	35	$146,950.00
PS16	12.5	12	3	$67,550.00
PS17	100	18	35	$146,950.00
PS17*	250	50	250	$496,200
PS18	115	40	90	$165,400
PS20	85	5	10	$77,200

*Includes Control panel replacement and wet well hardware replacement costs

5.5 Response to Comments Received from Municipality

In response to comments received on October 27, 2023, it should be noted that the model provided by the Municipality included 250mm forcemain from PS18, which was later determined it should have been a twinned 150mm forcemain. The difference between 250mm forcemain and 150mm twinned forcemain is hydraulically comparable. The model provided by the Municipality did not include a 200mm forcemain installed along Highway 2 which has been tied into the existing 350mm forcemain into the configuration. Any such information, if not included in the latest GIS, as provided by the Municipality, was not included in the updated model. We recommend the Municipality to regularly update their GIS database based on any ongoing infrastructure modifications so the update-do-date data set can be used in the next model update.

6.0 Stormwater Culvert Capacity Assessment

Tech Memo #6 provides a detailed report on the assessment of culverts along highway 2 within the Regional Servicing Area. The content below provides a summary of Tech Memo #6 findings and cost estimates. Please refer to the Tech Memo for mapping that shows catchment and culvert locations and the Appendices for specifics on the field inspections.

6.1 Existing Conditions

6.1.1 Existing Conditions

Visual inspections were conducted during site investigations to capture culvert water level and diameters, upstream/downstream obstructions, and record inlet/outlet elevations using GPS survey equipment. Inspection forms in the field were completed, with attached photos supporting the culvert inspections. Reference to the Master Drainage Plan (1998) was used to locate the culverts. Most culverts along the Highway 2 have been identified as concrete pipe with some being Concrete Box and Galvanized Steel culverts. The culverts on Highway 2 are in good condition with the exception of some corrugated steel culverts that should be considered for replacement. Vegetation growth has shown disruption in the downstream flow of the channels. Built up debris near or around the outlets are causing water to pool and reducing the capacity of the culvert. Most channels in the upstream segments were clear of any obstructions.

Although not in the project scope, while in the field, RVA located and visually inspected three culverts (CN22, CN23 and CN24) along the CN railway which were downstream from Highway 2. The overall rating of the CN railway culverts was a good condition status.

6.1.2 Hydrological Capacity Analysis

Hydrology composite runoff coefficients were determined for each catchment area of the identified culverts which were then used in comparison to the 1998 Dillon Master Drainage Plan. The peak runoff from each catchment was determined using the Rational method, which only considered the predictions of servicing catchments with less than 80 hectares from this study. The Hathaway equation was used to average the slope of composite roughness for the catchment area to determine the time of concentration along the principal watercourse. Peak

Flow culvert capacity was determined using the peak runoff flows for the 1 in 100-year and 1 in 5-year storm events.

The Manning's equation was used to determine the capacity of each of the identified culverts. Each culvert was treated as a single pipe with uniform cross-sectional area through its full length although some pipes had a difference in size with the inlet/outlet, the smaller size was used for its full length. All culverts were considered to have uniform slope from the inlet/outlet, changes in slope were not considered. The slopes for the culverts under Highway 2 were obtained through field inspections, all the culverts under the CN railway were assumed to have a uniform slope of 2.0%.

6.2 Findings

Modelling for Highway 2 culverts indicated that many culverts were of adequate size to convey surface flows from 1 in 100-year event towards the Shubenacadie River. Some culverts were partially or fully blocked with debris and material around the drainage channel and inside the culverts, which has the potential to reduce the capacity of some culverts. Two out of the three CN culverts that were assessed were in poor condition due to gravel and debris build up and corrosion at the bottom of the culvert. Most of the Highway 2 culverts are able to accommodate the 1 in 5 – year flow event if debris and blockages are removed, however for 1 in 100 – year event, some of the culverts under Highway 2 and CN Railway do not have the capacity and surcharging of those culverts is likely.

7.0 State of Infrastructure Assessment

Tech Memo #7 provides a detailed report on the assessment of existing water and wastewater linear assets. The content below provides a summary of Tech Memo #7 findings and cost estimates.

7.1 Reporting

For the purposes of this assessment, the inventory was based on the Geographic Information System (GIS) datasets provided by the Municipality for water wastewater linear infrastructure. Specifically, RVA included the following "Feature Codes" in the analysis:

- SPIPE – Sanitary Pipe
- SFM – Sanitary Forcemain
- WPIPE – Watermain

RVA reviewed the GIS datasets provided by the Municipality and noted many data gaps which would impact the results of the assessment. RVA communicated the data gaps to the Municipality and where possible corrected issues within the asset inventory. Where data gaps remained (i.e., date of installation, material type, etc.), RVA used the following assumptions to facilitate the analysis based on engineering experience:

- For assets with unknown material types, RVA assumed a conservative estimated useful life of 80 years.
- For assets with unknown or inaccurate install dates (i.e. 1900), RVA did not want to adjust the inventory without evidence and assumed the install years to be true which results in very poor (5) condition ratings.

Asset unit replacement costs were established based on historical cost estimates and construction cost estimating guides. Unit replacement costs presented in the following table include open cut install, labour, materials, road restoration and pipe appurtenances as well as engineering (15%) and contingency allowances (15%). The following unit replacement costs used to calculate Current Replacement Value (CRV) represent a conservative average across all material types found in the municipality's asset inventory.

Table 7-1 - Unit Replacement Costs

Diameter (inch / mm)	Estimated Unit Replacement Cost ($/m)
2 inch – 50 mm	$1,157
3 inch – 75 mm	$1,047
4 inch – 100 mm	$1,066
6 inch – 150 mm	$1,084
8 inch – 200 mm	$1,120
10 inch – 255 mm	$1,157
12 inch – 300 mm	$1,194
14 inch – 355 mm	$1,230
15 inch – 380 mm	$1,267
16 inch – 405 mm	$1,285
18 inch – 457 mm	$1,303
21 inch – 530 mm	$1,340
26 inch – 660 mm	$1,395

CRVs should be used with caution as their accuracy and level of detail is only sufficient to support benchmarking, financial reporting, and long-term financial planning. The estimates should not be relied on for short-term capital budgeting or as an engineer's estimate. Influencing factors such as local conditions, market trends, and system capacity assessments should be considered to ensure budgeting cost estimates reflect the true cost of replacement and/or upgrade.

RVA assessed age-based condition ratings (i.e. theoretical condition) assuming an asset deteriorates at a standard rate from the time it is constructed until it fails. RVA predicted the assets estimated useful life based on the date of installation. Age-based condition ratings and corresponding percent of life remaining are presented in the following Figure 7-1. Assumed estimated useful lives for each asset are presented in Table 7-2.

Figure 7-1 - Condition Rating Summary

Condition Rating	Percent of Life Remaining
(1) Very Good	100%
(2) Good	65%
(3) Fair	35%
(4) Poor	15%
(5) Very Poor	0%

Table 7-2 - Estimated Useful Life Assumptions

Pipe Material Type	Estimated Useful Life (Years)
Concrete	80
PVC	100
Asbsetos Cement	75
Cast Iron	90
Ductile Iron	50
HDPE	100
PE	100
Other	80

7.2 Findings

7.2.1 Condition

The results of the inventory assessment of the Municipality's water and wastewater linear infrastructure are presented in the table below.

Table 7-3 - Quantity Breakdown of Water and Sewer Linear Infrastructure

Asset Type	Quantity (m)
Water Lines (WPIPE)	64,808
Sewer Lines (SPIPE & SFM)	78,566

The replacement value of the Municipality's water and wastewater linear infrastructure is estimated to be $167.5 million as presented in the following table.

Table 7-4 - Asset Inventory Valuation Breakdown

Asset Type	Value (2023 CAD)
Water Lines	$75,923,118
Sewer Lines	$91,618,171

The results of the inventory condition analysis of the Municipality's water and wastewater linear infrastructure are presented in the following table.

Table 7-5 - Condition Distribution Represented as Asset Length (m)

Asset Type	Condition Rating (m)				
	1	2	3	4	5
Water Lines	0	29,760	25,404	5,758	3,885
Sewer Lines	0	28,917	38,120	7,375	4,083

Table 7-6 - Condition Distribution Represented as Asset Current Replacement Value (2023 $)

Asset Type	Condition Rating (CRV)				
	1	2	3	4	5
Water Lines	-	$35,617,805	$29,262,563	$6,558,377	$4,484,373
Sewer Lines	-	$34,222,967	$43,992,008	$8,638,435	$4,681,789

7.2.2 Total Linear Infrastructure Replacement Costs

A 25-year capital forecast was generated for both the sewer and water lines summing the total CRV for all assets due for replacement in a given year. The Sewer lines average cost was approximately $532,809 per year and the water lines average cost was approximately $456,275 per year. The estimated CRV of the Municipality's water line and sewer (i.e. gravity and Forcemain) inventory is approximately $75.9 million and $91.6 million, respectively. The condition analysis estimated approximately $24.4 million of all infrastructure evaluated is in a Very Poor (5) or Poor (4) condition.

Figure 7-2 - Water Lines Long-term Forecast

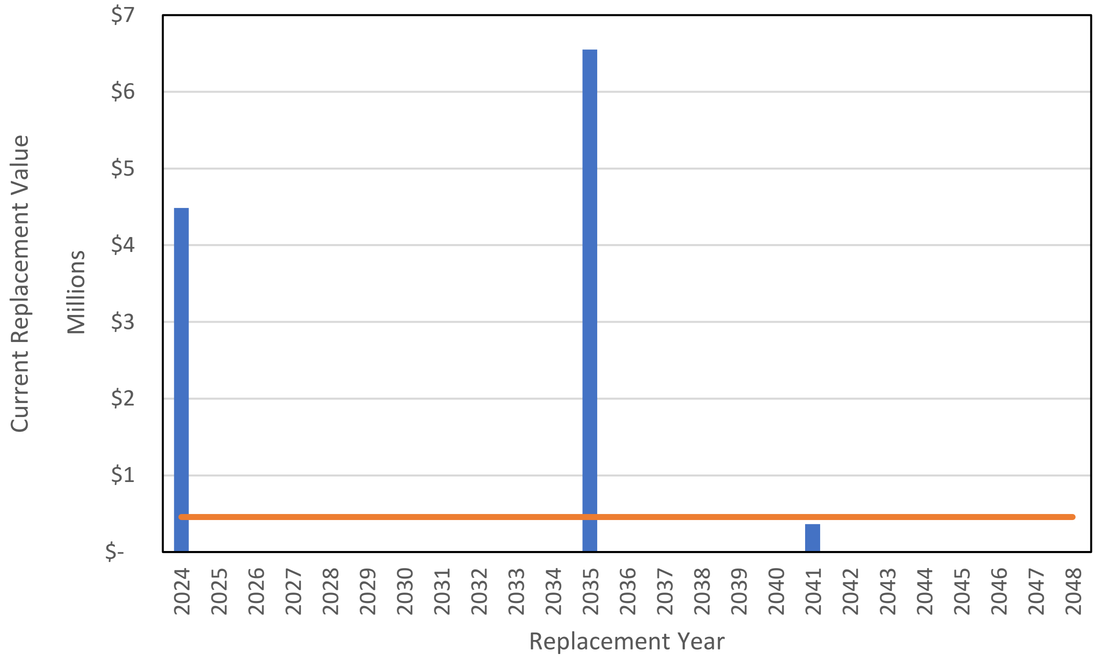
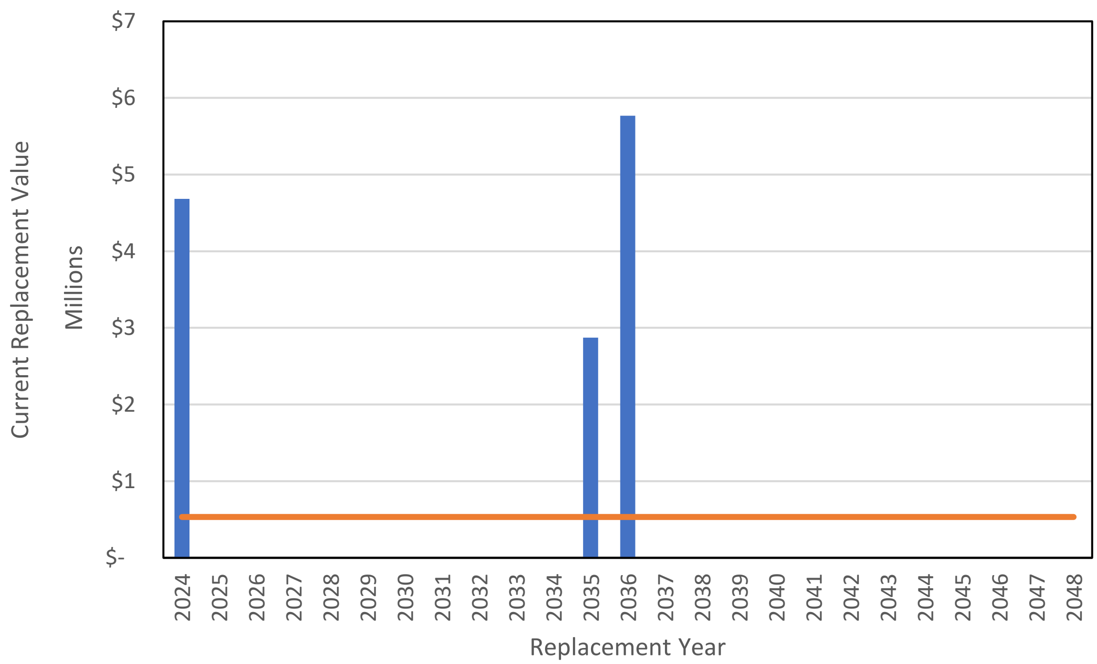


Figure 7-3- Sewer Lines Long-term Forecast



8.0 Implementation and Costs for Infrastructure Upgrades

The content below provides a detailed cost summary for all infrastructure upgrades.

8.1 Total Costs

A summary of the total costs from each Technical Memorandum was developed in a capital plan spreadsheet which includes consolidated costs for each given year from 2023 to 2050. The total costs from each section were then broken out by their given category as follows:

- Sanitary Sewer Pump Stations
- Milford Sewers
- Shubenacadie Sewers
- Regional Sewers
- Regional Sanitary Forcemains
- Milford Wastewater Treatment Plant
- Shubenacadie Water Treatment Plant
- Water Distribution Systems
- Transmission Mains
- Reservoir

Of note each section identifies costing for the works based on the activity which was undertaken. The total costs from each section were subsequently reviewed to ensure duplicate costing is not applied in the overall summary table. For example, the same sewer upgrades from section 5 sanitary collection system were identified to be installed prior to the proposed upgrades in section 7 State of Infrastructure sanitary sewer upgrades. Dates for implementation and estimates of works have been reconciled in Table 8-1.

Table 8-1 below provides and the overall summary of costs to be considered when planning for infrastructure upgrades. We identify what type of infrastructure is required in the time period in which it should be installed and the cost for the item based on 2023 dollars. We note these costs are high level estimates and are not to be considered as expected costs for construction. They are adequate for planning and budgeting purposes only. Detailed design would further refine the cost estimates as would the identification of market conditions at the expected time of installation. The total costs for infrastructure upgrades are shown in Table 8-1 below with a total value of $49,666,641 in 2023 dollars.

Table 8-1 – Estimated Future infrastructure Upgrade Costs

226421 - East Hants Servicing Capacity Total Replacement Costs	Sanitary Sewer Pump Stations	Milford Sewers	Shubenacadie Sewers	Regional Sewers	Regional Sanitary Forcemains	Milford Wastewater Treatment Plant	Shubenacadie Water Treatment Plant	Water Distribution Systems	Transmission Mains	Reservoir	TOTAL
2023	$ 1,167,950		$ 1,079,130	$ 2,992,094	$ 1,076,283	$ -	$ 450,000	$ 200,000	$ 9,500,000	$ 9,000,000	$ 25,465,457
2024	$ -	$ 1,823,825	$ 259,957	$ 43,049		$ -	$ -	$ 4,484,373			$ 6,611,203
2025	$ 121,750					$ -	$ -				$ 121,750
2026	$ -					$ -	$ 378,000				$ 378,000
2027	$ -					$ -	$ 180,000				$ 180,000
2028	$ -					$ -	$ 20,000				$ 20,000
2030	$ 302,250					$ -	$ -				$ 302,250
2031	$ 738,800			$ 1,994,643	$ 2,539,173	$ 960,000	$ -				$ 6,232,616
2035	$ 11,300		$ 397,218	$ 42,309		$ -	$ -	$ 6,550,597			$ 7,001,424
2036	$ -		$ 1,072,544	$ -		$ 165,000	$ 1,200,000	$ 7,780			$ 2,445,324
2041	$ -					$ -	$ -	$ 364,117			$ 364,117
2042	$ -					$ -	$ 110,000				$ 110,000
2046	$ -					$ 285,000	$ -				$ 285,000
2050	$ 21,500					$ -	$ 128,000				$ 149,500
Total	$ 2,363,550	$ 1,823,825	$ 2,808,848	$ 5,072,095	$ 3,615,456	$ 1,410,000	$ 2,466,000	$ 11,606,867	$ 9,500,000	$ 9,000,000	$ 49,666,641

9.0 References

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APPENDIX A

Tech Memo #1 - Sanitary Sewer Pump Stations Assessment & Conditions

APPENDIX B

Tech Memo #2 - Milford Wastewater Treatment Plant Assessment

APPENDIX C

Tech Memo #3 - Shubenacadie Water Treatment Plant

APPENDIX D

Tech Memo #4 - Water Distribution Capacity Assessment

APPENDIX E

Tech Memo #5 - Sanitary Collection Capacity

APPENDIX F

Tech Memo #6 - Stormwater Culverts Assessment

APPENDIX G

Tech Memo #7 - State of Infrastructure

APPENDIX H

Costs & Recommendations