



East Hants – Servicing Capacity Study

Technical Memorandum # 7 – State of Infrastructure Assessment Final

**Prepared for:
The Municipality of East Hants**

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RVA 226421

July 4, 2023

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July 4, 2023

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 - Final Technical Memorandum #7 - State of Infrastructure Assessment

As part of the East Hants Servicing Capacity Study, R. V. Anderson Associates (RVA) has been tasked with completing a desktop analysis of the Municipality's water and wastewater linear infrastructure to estimate its current state of repair. The goal of the study is to use the results of the state of infrastructure assessment to develop a 25-year financial forecast.

Please find enclosed the Final Technical Memorandum # 7 – State of Infrastructure Assessment for the Municipality's review and consideration. RVA has completed an internal QA review of the document and made appropriate changes based on the review. Should the Municipality have any questions, please don't hesitate to contact the undersigned.

Yours very truly,

R.V. Anderson Associates Limited



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



Alex Mason, P.Eng., ENV SP
Project Manager

TECHNICAL MEMORANDUM – STATE OF INFRASTRUCTURE ASSESSMENT

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1.0 Introduction

1.1 Background

R.V. Anderson Associates (RVA) were retained by the Municipality of East Hants (East Hants) to undertake a servicing capacity study with the goal of reviewing the Municipality’s water, wastewater, and stormwater infrastructure to determine upgrades required to accommodate the projected population growth within the populated areas along Highway 2. As one of Nova Scotia’s fastest growing communities, East Hants needs an accurate long-term plan to manage its infrastructure requirements. The scope of work for the overall servicing capacity study project began in June of 2022 and is still ongoing.

1.2 Purpose

As part of this project, RVA is tasked with completing a “desktop” review or state of infrastructure assessment of existing water and wastewater linear assets. The goal of this exercise is to understand the estimated current condition of assets and develop a 25-year financial forecast to determine the annual estimated expenditures required to maintain current levels of service. The assessment will focus on water and wastewater linear infrastructure (i.e. gravity sewers, sanitary forcemains, watermains, etc.) and exclude vertical infrastructure (i.e. pump stations, wastewater treatment plants, etc.). The following sections outline RVA’s methodology, assumptions, results, and 25-year financial forecast.

2.0 METHODOLOGY AND ASSUMPTIONS

2.1 Inventory

An accurate representation of the Municipality’s infrastructure is essential in subsequent steps as it contains asset specific information required to estimate current replacement values such as material, diameter, length, age, and condition. For the purposes of this assessment, the inventory was based on the Geographic Information System (GIS) datasets provided by the Municipality for water and wastewater linear infrastructure. Specifically, RVA included the following “Feature Codes” in the analysis:

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

Feature codes is an attribute field contained in the GIS inventory which defines the infrastructure type of the asset. 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 made 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.

2.2 Valuation

The Current Replacement Value (CRV) of infrastructure represents the total cost to replace each asset under current conditions. CRVs are often used to better understand the size and scope of a community’s infrastructure and forecast potential long-term investment needs. The CRV of the Municipality’s infrastructure were calculated using estimated unit replacement costs and asset information contained in the GIS inventory. 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 CRVs represent a conservative average across all material types found in the municipality’s asset inventory.

Table 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

Diameter (inch / mm)	Estimated Unit Replacement Cost (\$/m)
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.

2.3 Condition

The condition rating of each asset is an important indicator used by municipalities to help identify infrastructure which likely require immediate repair or renewal. Condition ratings can be estimated many ways but are always most reliable when based on field observations. For this project, RVA utilized an industry standard technique to estimate current condition of infrastructure using age-based estimates as an alternative to up-to-date field inspections.

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. Based on the date of installation and an asset’s estimated useful life, RVA can predict the percent of life remaining and estimate when the asset needs to be replaced. Age-based condition ratings and corresponding percent of life remaining are presented in the following Figure 1. Assumed estimated useful lives for each asset are presented in Table 2.

Condition ratings and corresponding percent life remaining were defined by RVA based on past experience and reviewed with the Municipality for any potential changes considering local conditions. Estimated useful life assumptions were established from review of public asset management plans.

Figure 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%

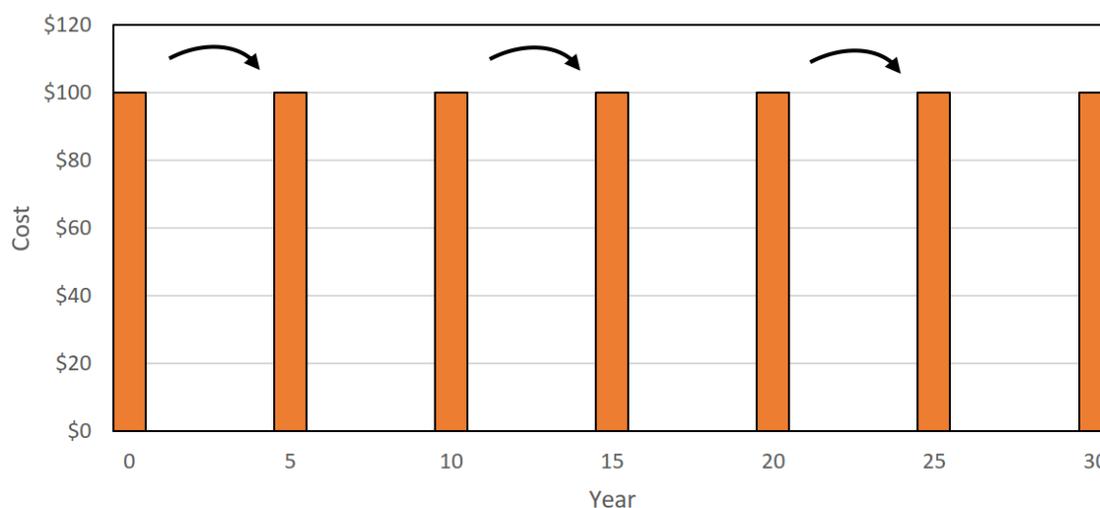
Table 2 - Estimated Useful Life Assumptions

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

2.4 Long-term Financial Forecast

A detailed 25-year capital forecast is used to estimate the anticipated annual investments required to maintain services for infrastructure included in this study. The capital forecast assumes each asset is replaced “like-for-like” at the end of its useful life. The model leverages the age-based conditions ratings assigned during the condition analysis to determine when an asset needs to be replaced. The asset’s CRV “rolls over” each year until it is assumed to reach the end of its service life. Forecasted replacement costs are expressed in 2023 nominal year dollars. This is done for each asset type individually. The forecasting model used for this report is shown conceptually in Figure 2.

Figure 2 - Long-term Financial Forecast Graphical Representation



3.0 RESULTS

3.1 Inventory

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

Table 3 - Quantity Breakdown of Water and Sewer Linear Infrastructure

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

3.2 Valuation

The results of the inventory valuation of the Municipality’s water and wastewater linear infrastructure are presented in the following table. Based on the valuation results the combined current replacement value of the Municipality’s water and wastewater linear infrastructure is estimated to be \$167.5 million.

Table 4 - Asset Inventory Valuation Breakdown

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

3.3 Condition

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

Table 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 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

3.4 Long-term Financial Forecast

A 25-year capital forecast has been generated for the Municipality’s sanitary and storm linear infrastructure and is presented in Figure 3 for water lines and Figure 4 for sewer lines. The forecast is generated by summing the total CRV for all assets due for replacement in a given year. The 25-year average annual capital cost to replace sewer lines at the end of their assumed lives is approximately \$532,809 per year. The 25-year average annual capital cost to replace water lines at the end of their assumed lives is approximately \$456,275 per year. A complete summary of the 25-year capital forecast is provided in the Appendix.

Figure 3 - Water Lines Long-term Forecast

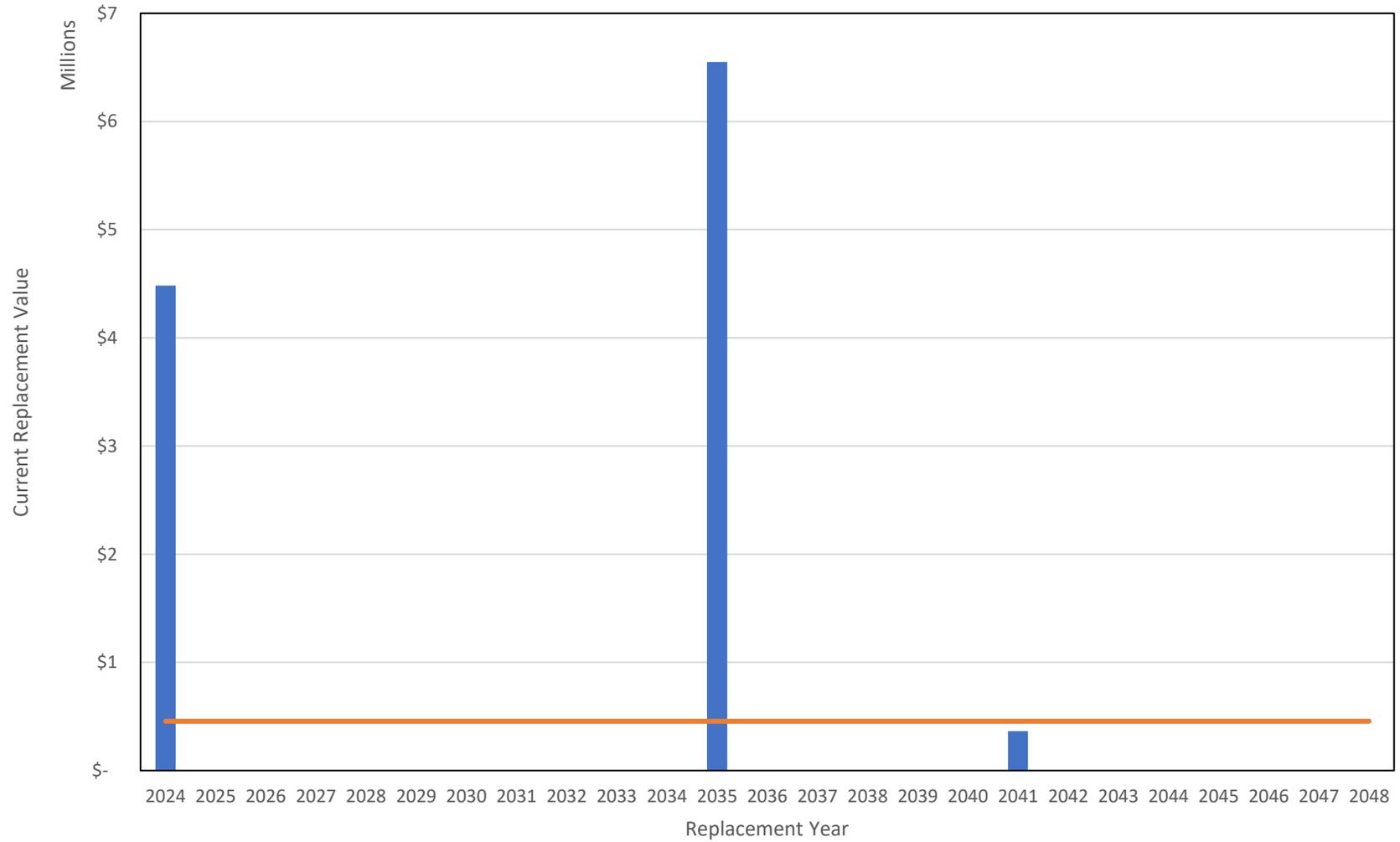
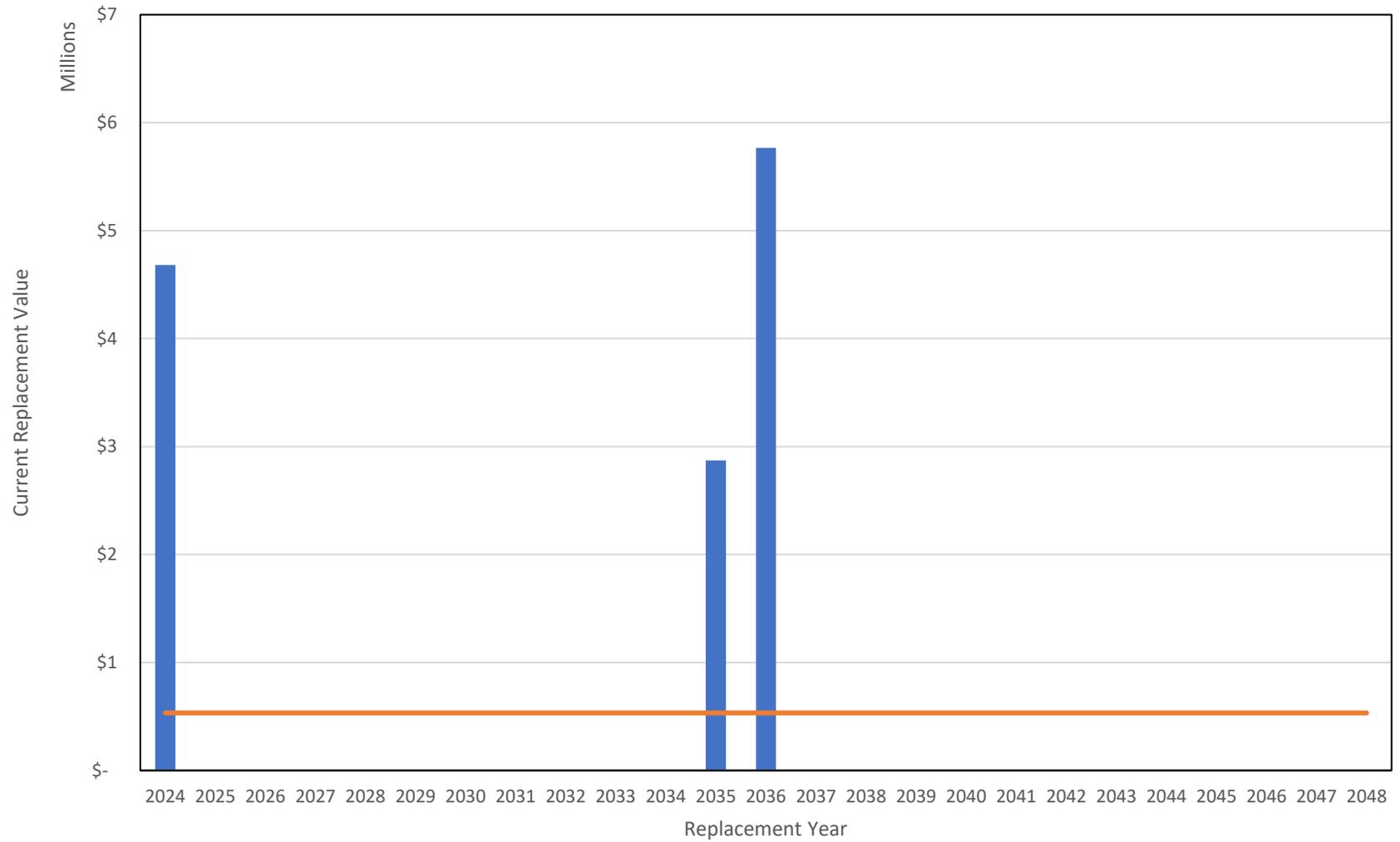


Figure 4 - Sewer Lines Long-term Forecast



4.0 RECOMMENDATIONS

Upon completion of thesis study and review of the results, RVA has made the following recommendations for the Municipality's consideration to leverage the work completed and continue to mature their asset management capabilities:

- It is recommended the Municipality develop a comprehensive data model and asset hierarchy representing the framework in which asset data is collected, stored, and managed. Data models help facilitate field data collection, ensure information is collected/stored in a consistent manner and the data collected meets the needs of the organization. While the Municipality has a detailed asset database, asset information is missing or incomplete in areas and the meaning of some attribute codes is unclear (i.e. feature codes). Through this exercise, the Municipality may also consider removing some attribute fields which do not need to be managed in a GIS setting. Furthermore, it is strongly recommended the Municipality implement an inventory wide unique identifier system to facilitate effective reporting at the asset level. The data dictionary and inventory model should be a living document, continuously adjusted to meet current needs.
- The Municipality should continue to address existing data gaps (i.e., asset dimensions, install years, condition, IDs, etc.) in the asset inventory and validate the information through inspections, record drawings or interviews with operational staff. Minor data gaps were identified during this study which required assumptions to overcome. It would be prudent for the Municipality to validate information contained in the asset inventory to ensure they have an accurate representation of infrastructure to facilitate financial reporting. As an example, based on the existing asset inventory, some of the Municipality's inventory is well passed its service life. Should the install year recorded be found to be inaccurate, it will significantly impact the 25-year forecast which predicts large infrastructure investments in the immediate time horizon (i.e. 2024).
- The Municipality may consider expanding on the current capital forecast model to include actual asset renewal and maintenance schedules. Move beyond the current like-for like replacement assumption and assign realistic long-term renewal strategies. Realistically, the Municipality will not be replacing all linear assets at the same time as identified by this financial forecast. In reality, replacement schedules will be informed based on CCTV inspections, rehabilitation considerations, spot repair, etc., for sanitary sewers and water main breaks, hydrant flow test results, capacity requirements, water quality, etc., for water lines.

5.0 CONCLUSION

In summary, RVA successfully carried out an inventory valuation and condition analysis for the Municipality's water and wastewater linear infrastructure. The results of the analyses were used to generate a 25-year financial forecast to communicate capital investment requirements. The following provides a summary of the inventory analysis results:

- 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.
- The sewer lines long-term financial forecast estimates that approximately 4.6 million of infrastructure investments are required in 2024; however, the annual average investment over the 25-year time horizon is estimated to be \$532,809.
- The sewer lines long-term financial forecast estimates that approximately 4.4 million of infrastructure investments are required in 2024; however, the annual average investment over the 25-year time horizon is estimated to be \$456,275.

APPENDIX 1

Water and Sewer Lines Long-term Financial
Forecast

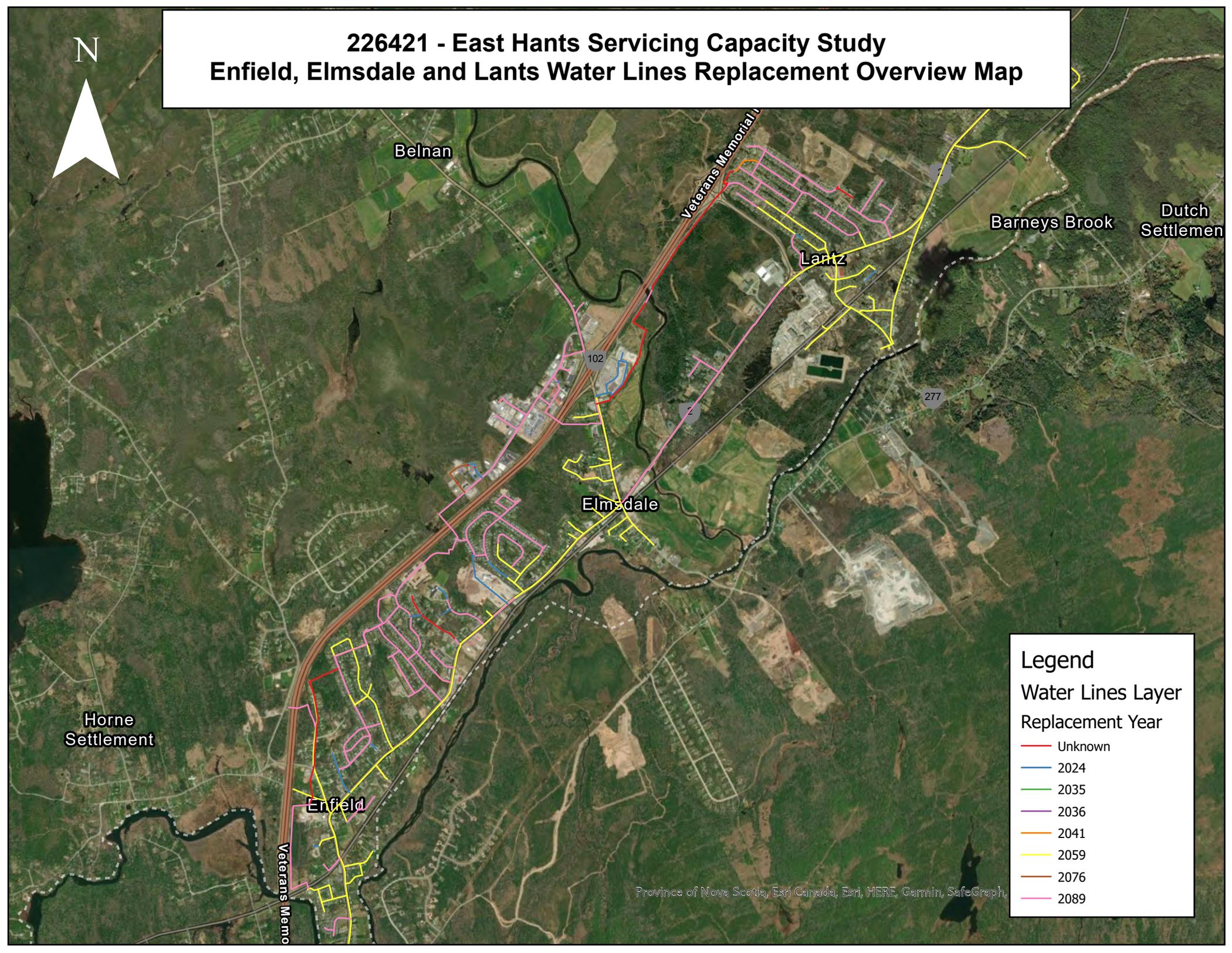


APPENDIX 2

Water and Sewer Lines Estimated Replacement Year Overview Mapping



226421 - East Hants Servicing Capacity Study Enfield, Elmsdale and Lantz Water Lines Replacement Overview Map

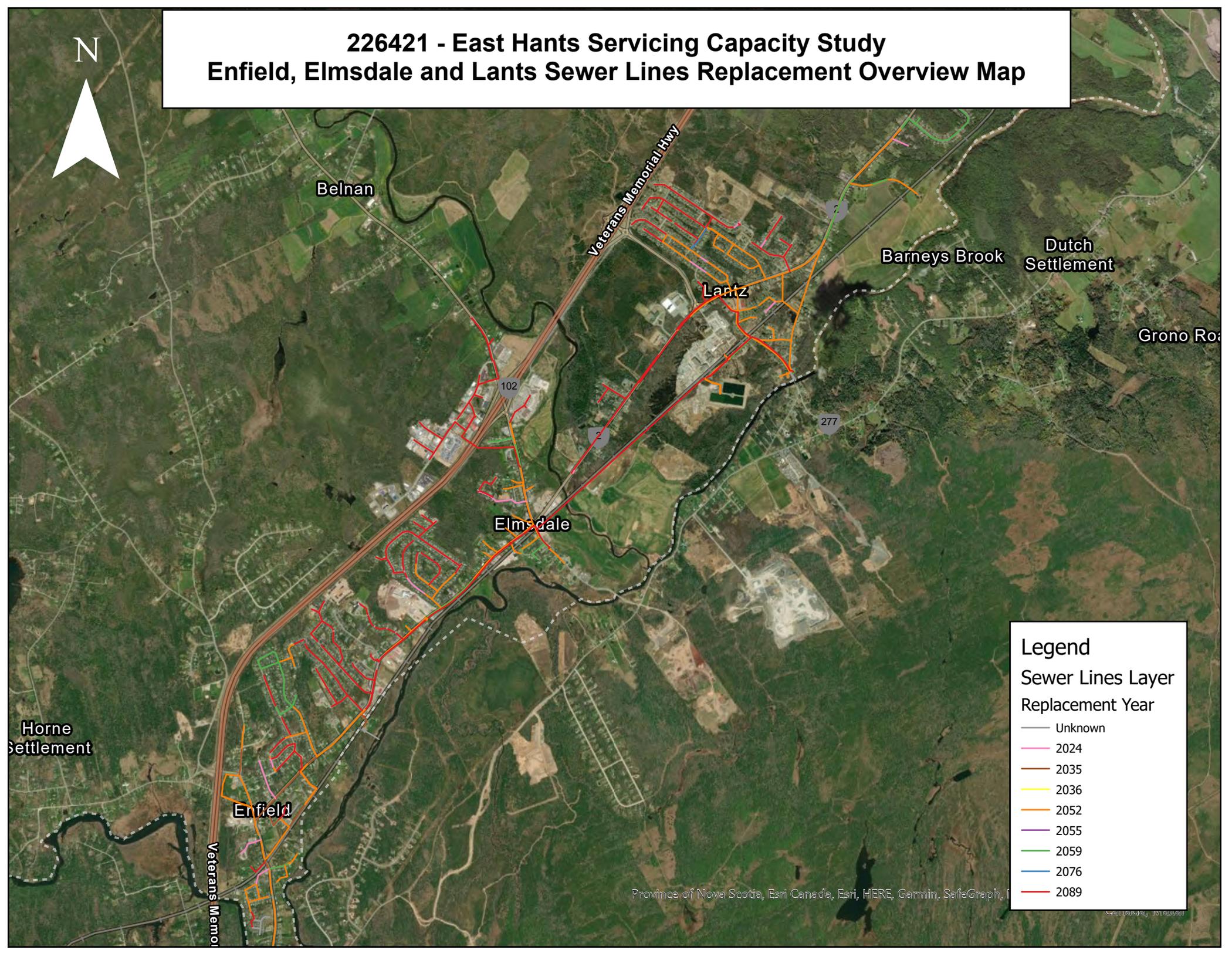


Legend
Water Lines Layer
Replacement Year

- Unknown
- 2024
- 2035
- 2036
- 2041
- 2059
- 2076
- 2089

226421 - East Hants Servicing Capacity Study Enfield, Elmsdale and Lantz Sewer Lines Replacement Overview Map

N



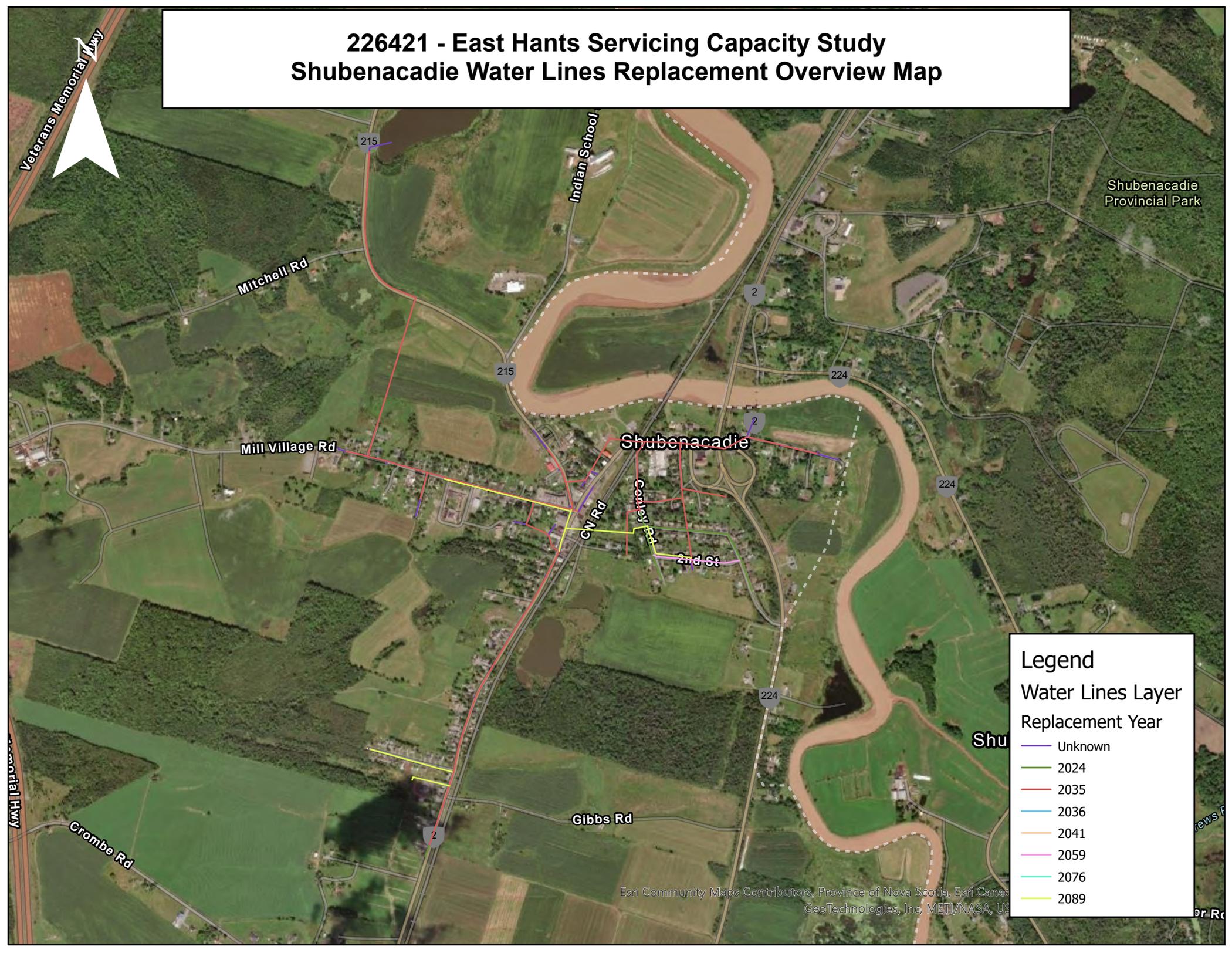
Legend

Sewer Lines Layer

Replacement Year

- Unknown
- 2024
- 2035
- 2036
- 2052
- 2055
- 2059
- 2076
- 2089

226421 - East Hants Servicing Capacity Study Shubenacadie Water Lines Replacement Overview Map



Legend

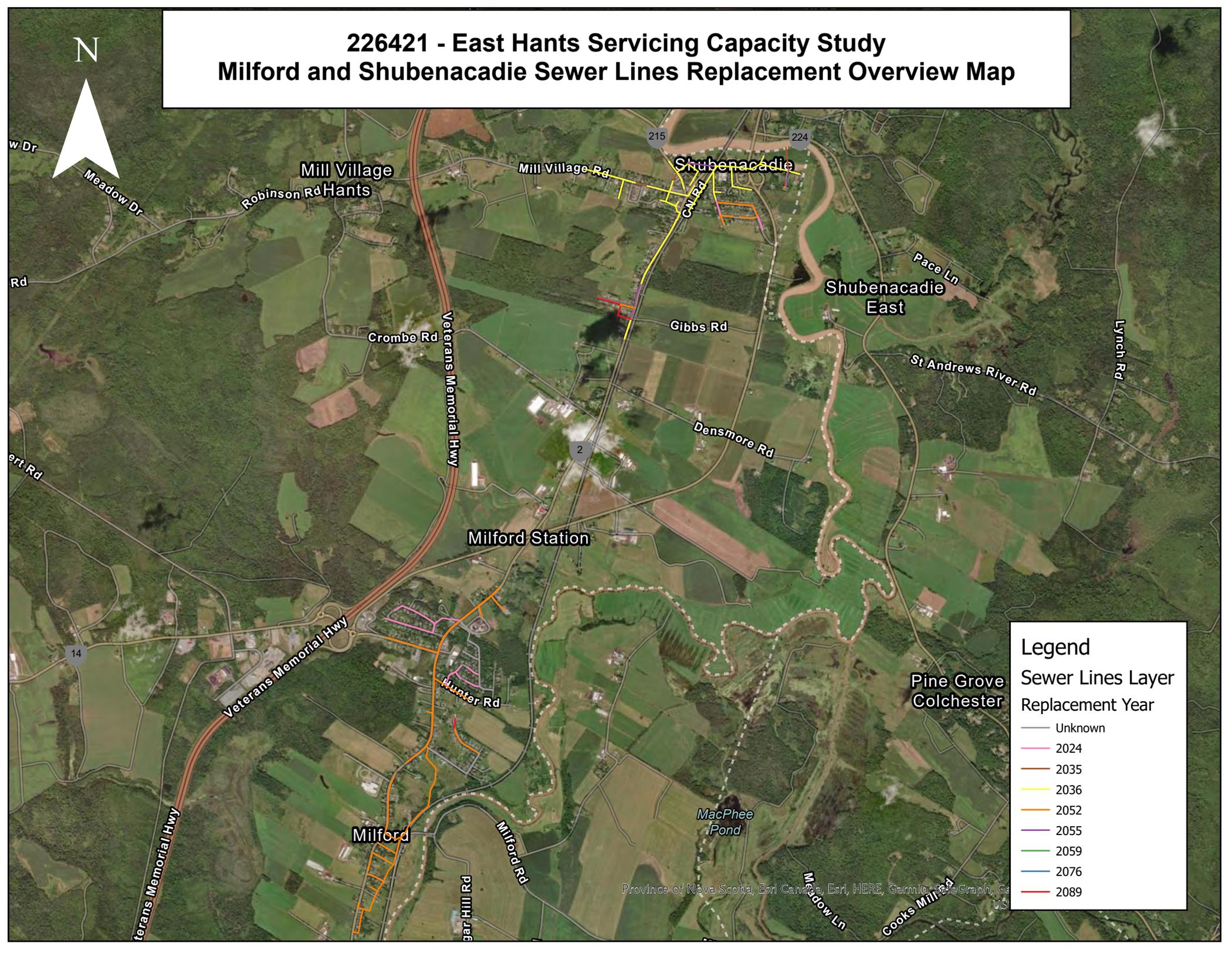
Water Lines Layer

Replacement Year

- Unknown
- 2024
- 2035
- 2036
- 2041
- 2059
- 2076
- 2089

226421 - East Hants Servicing Capacity Study Milford and Shubenacadie Sewer Lines Replacement Overview Map

N



Legend

Sewer Lines Layer Replacement Year

- Unknown
- 2024
- 2035
- 2036
- 2052
- 2055
- 2059
- 2076
- 2089

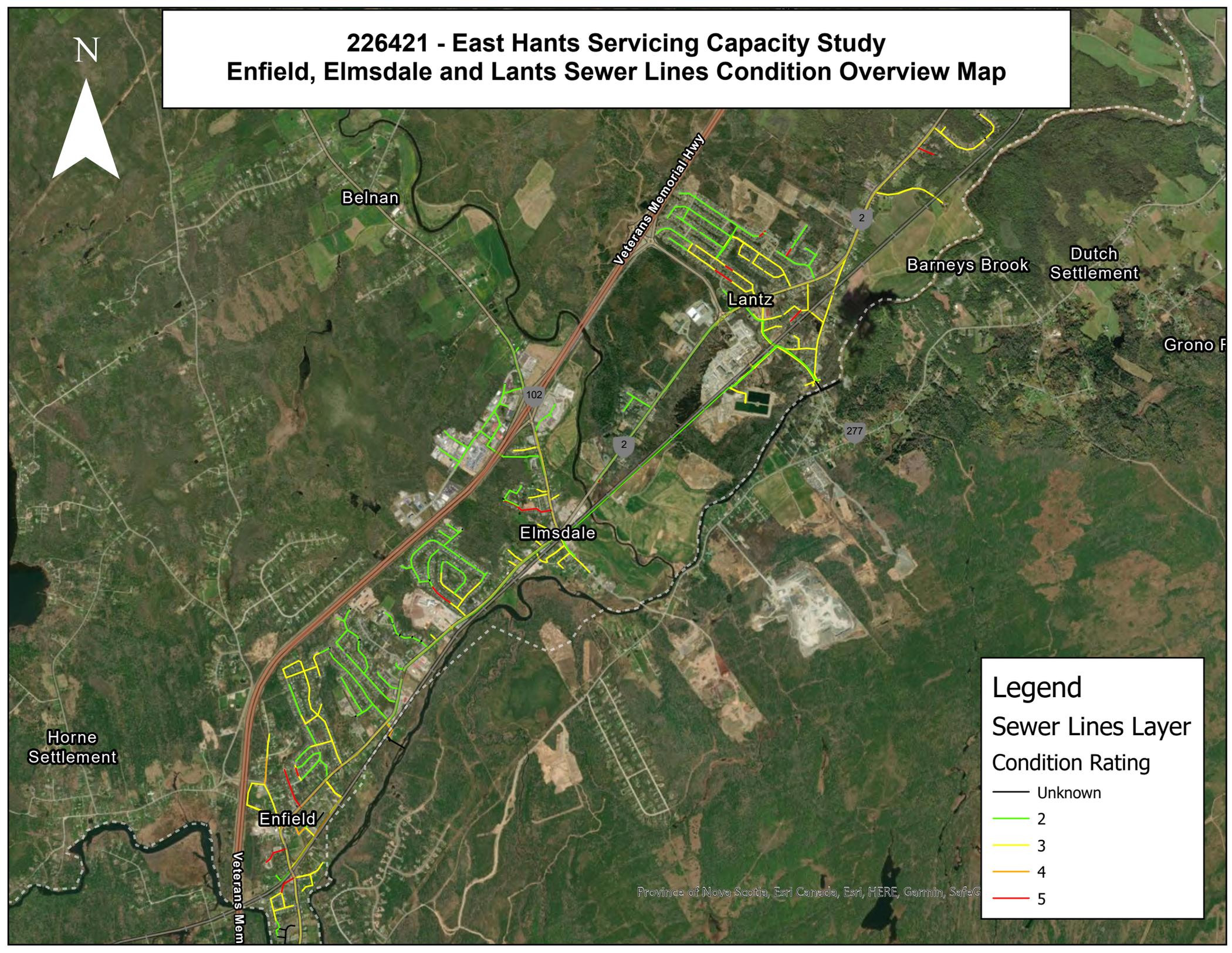
APPENDIX 3

Water and Sewer Lines Estimated Condition Rating Overview Mapping



226421 - East Hants Servicing Capacity Study

Enfield, Elmsdale and Lantz Sewer Lines Condition Overview Map



Legend

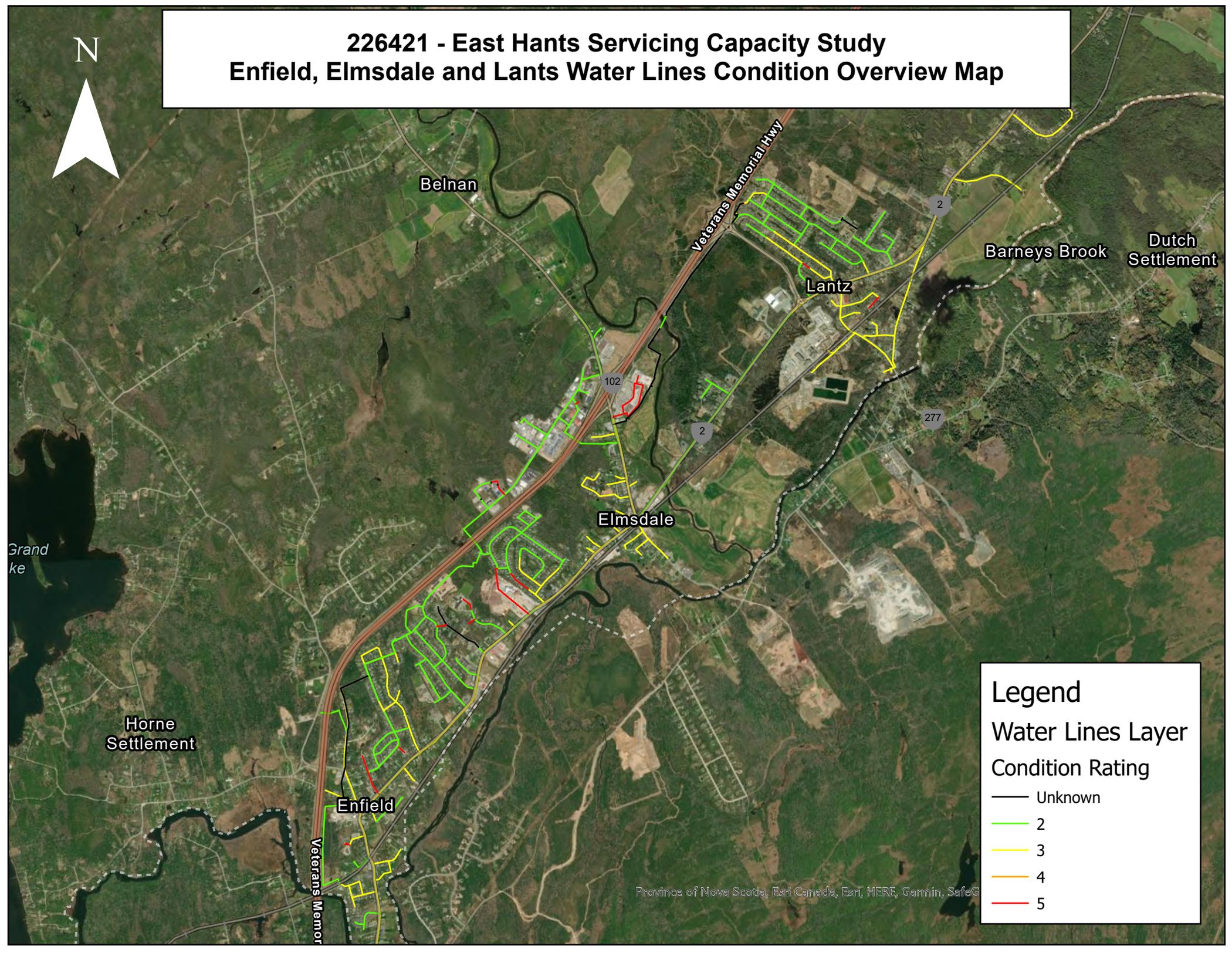
Sewer Lines Layer

Condition Rating

- Unknown
- 2
- 3
- 4
- 5

226421 - East Hants Servicing Capacity Study

Enfield, Elmsdale and Lantz Water Lines Condition Overview Map



Legend

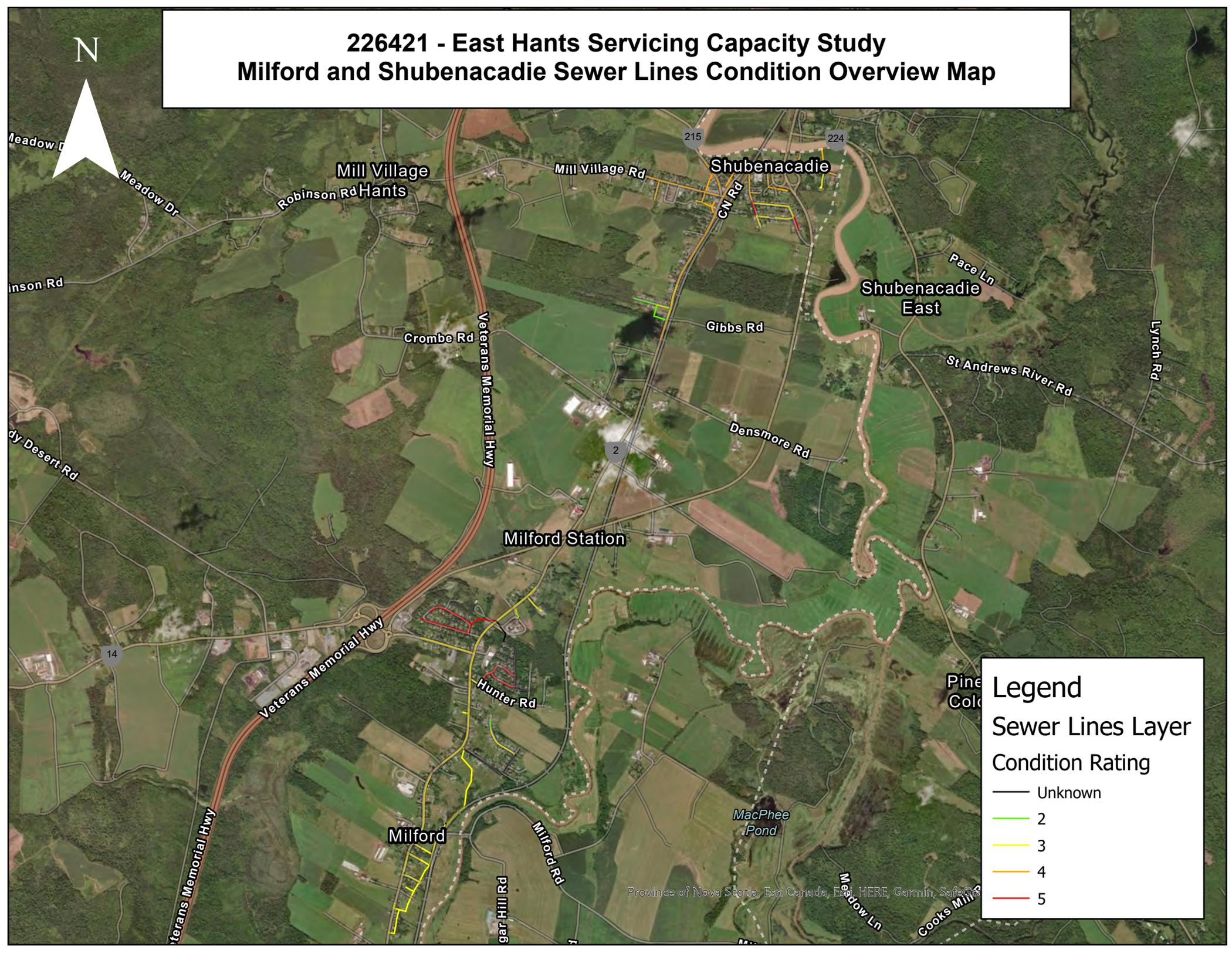
Water Lines Layer

Condition Rating

- Unknown
- 2
- 3
- 4
- 5

226421 - East Hants Servicing Capacity Study Milford and Shubenacadie Sewer Lines Condition Overview Map

N



Legend

Sewer Lines Layer

Condition Rating

- Unknown
- 2
- 3
- 4
- 5

