Halifax Water

# 2019 INTEGRATED RESOURCE PLAN

Report

Prepared by GM BluePlan Engineering

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# GLOSSARY OF TERMS AND ACRONYMS

The following table provides a summary of terms and acronyms that are commonly used throughout the report.

| Term or Acronym | Definition |
|---|---|
| AMI | Advanced Metering Infrastructure |
| AMPs | Asset Management Plans |
| AO's | Aesthetic Objectives |
| CCME | Canadian Council of Ministers of the Environment |
| CEF | Cost Estimation Framework |
| CSMMW | Canada-wide Strategy for the Management of Municipal Wastewater Effluent |
| CSO | Combined Sewer Overflows |
| DFO | Department of Fisheries and Oceans |
| DSM | Demand Side Management |
| ECCC | Environment and Climate Change Canada |
| EPA | Environmental Protection Agency |
| ERM | Enterprise Risk Management |
| GIS | Geographic Information System |
| HC | Health Canada |
| HHSP | Halifax Harbour Solutions Project |
| HRM | Halifax Regional Municipality |
| HRWC | Halifax Regional Water Commission |
| I/I | Inflow and Infiltration |
| IRP | Integrated Resource Plan |
| IT | Information Technology |
| KPIs | Key Performance Indicators |
| LID | Low Impact Development |
| LoWSCA | Regional Centre Local Wastewater Servicing Capacity Analysis |
| LTCP | Long-Term Capital Plan |
| LTPF | Long-Term Planning Framework |
| MAC's | Maximum Acceptable Concentrations |
| MDD | Maximum Day Demand |
| MHD | Minimum Hour Demand |
| MPIR | Ministry of Public Infrastructure Renewal |
| NSE | Nova Scotia Environment |
| NSUARB | Nova Scotia Utility and Review Board |
| PHD | Peak Hour Demand |
| RDC | Regional Development Charge |
| RDII | Rainfall Derived Inflow and Infiltration |
| RWWFP | Regional Wastewater Functional Plan |
| SSM | Supply Side Management |
| SSO | Sanitary Sewer Overflows |
| WQMP | Water Quality Master Plan Update |
| WRWIP | West Region Wastewater Infrastructure Plan |
| WSER | Wastewater System Effluent Regulations |
| WSP | Water Supply Plants |
| WWMP | Wet Weather Management Program |
| WWTF | Wastewater Treatment Facilities |

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# 1.0 INTEGRATED RESOURCE PLANNING

## 1.1 OVERVIEW

The Halifax Regional Water Commission (HRWC), also known as Halifax Water, was the first regulated and publicly owned water, wastewater and stormwater utility in Canada. With a long history dating back to the 1940s, Halifax Water is the water, wastewater and stormwater utility servicing residents of the Halifax Regional Municipality (HRM).

As part of its mandate and services, Halifax Water continuously undertakes initiatives and programs to maintain and operate its systems while striving to provide world class service to its customers and environment. These initiatives and programs require integration into a single capital program that identifies the long-term resource needs and financial expenditures.

The long-term program is consolidated into a comprehensive document: The Integrated Resource Plan (IRP) for Halifax Water. As part of the IRP approach, it is intended to complete IRP updates at regular intervals to ensure the consolidated long-term program remains current. Halifax Water retained GM BluePlan Engineering Limited (GM BluePlan) to complete the IRP Update. This IRP update is a critical project that brings together projects, initiatives and programs from separate studies, into a singular integrated capital plan. This study applies the considerations of compliance, asset renewal and growth, to ensure the integrated recommendations achieve the desired service delivery goals, as well as identify any additional gaps and programs required in the long-term plan.

The IRP update is a key component of Halifax Water's iterative planning process as shown in ***Figure 1***. The process was initiated in 2012 with the preparation of the first IRP. The 2012 IRP highlighted existing data gaps, outlined assumptions made in its preparation and recommended next steps, kick starting a cycle of continuous improvement that has fed into the preparation of the foundation documents: **Infrastructure Master Plan, Compliance Plan and Asset Management Plans, and ultimately the 2019 IRP Update**. This iterative planning approach will ensure an ever-stronger base to prepare the next iteration of plans and programs and improve confidence in recommendations and project delivery.

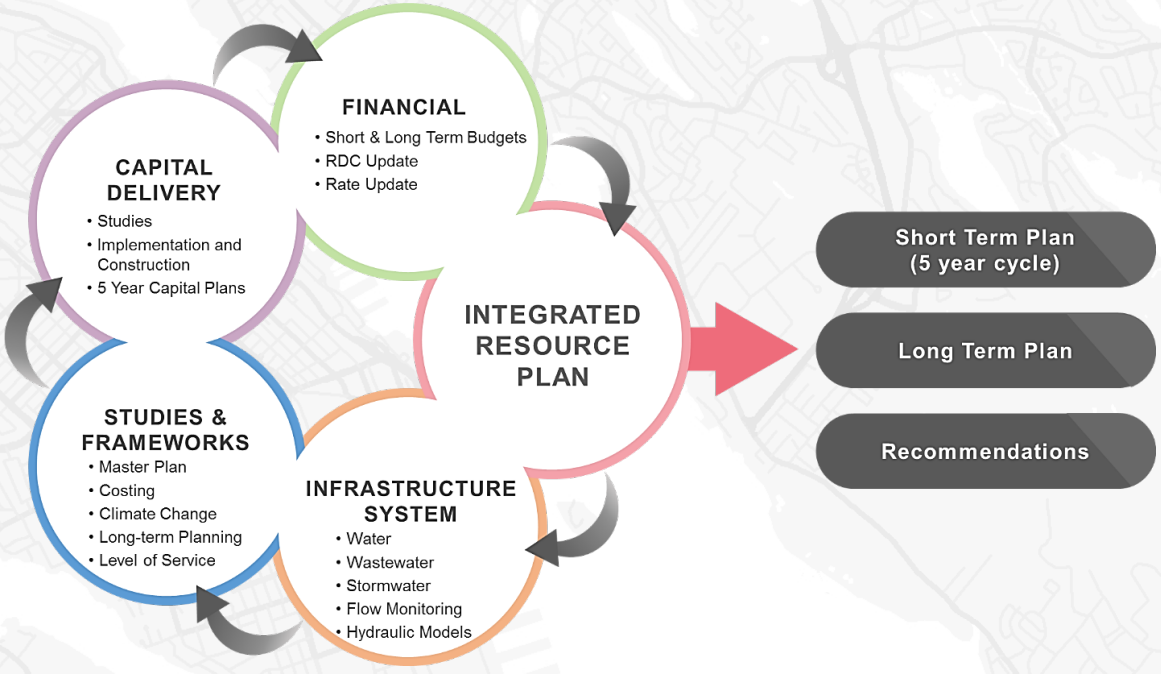



*Figure 1 – IRP Iterative Planning Process*

Since the 2012 IRP, Halifax Water has improved its understanding of the existing infrastructure systems and developed supporting studies and frameworks. Elements such as increased wastewater flow monitoring data collection and analysis, development / update of comprehensive and calibrated water and wastewater hydraulic models and improved understanding of existing assets condition, has vastly supported the preparation of the servicing strategies in the 2019 IRP's foundational documents.

The results of these strategies are then transformed into capital and implementation plans that feed into Halifax Water capital budgets, regional development charges and rate structure. The process repeats itself in a typical 5-year cycle with the development of the Integrated Resource Plan Update which provides a path for the next 5 years.

The 2019 IRP Update is built on the foundation of the 2012 IRP and provides Halifax Water with the required programs and resources for a 30-year period covering each of the three drivers: **Compliance, Asset renewal and Growth.** This update will feed directly into Halifax Water's Business Plans, Capital and Operating Budgets and future rate applications. However, the 2019 IRP Update is not intended to provide analysis of capital program impacts on the operating budget, debt, depreciation, rates and affordability as part of the development of the long-term capital program and implementation.

***Figure 2*** shows graphically how the various key individual studies and plans feed into the Integrated Resource Plan process and output Halifax Water business planning and Regional Development Charge deliverables.

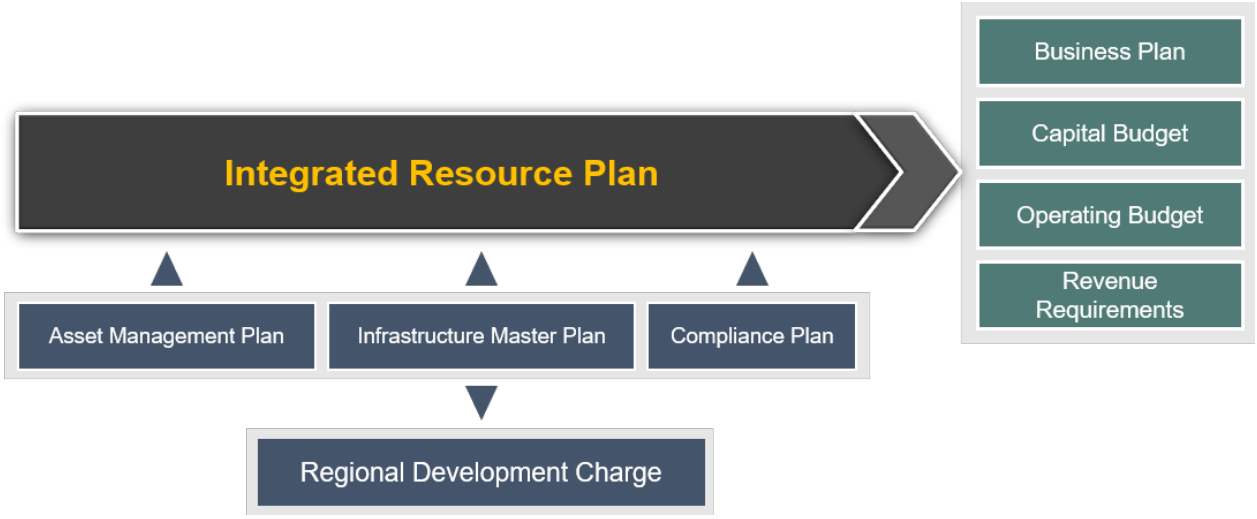



***Figure 2 – Relationship of the Integrated Resource Plan to other initiatives***

## 1.2 GOALS AND OBJECTIVES

The 2019 IRP Update is a critical component of Halifax Water's financial and resource planning. The primary goal of the 2019 IRP Update is to combine the outputs from the foundational studies and programs (Infrastructure Master Plan, Compliance Plan, Asset Management Plan) to create one holistic project and study program that will inform Halifax Water activities for the next 5 years and provide a guide for the next 30 years.

In order to achieve this goal, the following key objectives were completed:

- Complete a baseline understanding from previous studies.
- Complete detailed review of Supply Side Management (SSM) and Demand Side Management (DSM) options.
- Coordinate and align needs identified in the Infrastructure Master Plan, Compliance Plan and Asset Management Plans.
- Identify the projects and driver splits that meet the three drivers of Compliance, Asset Renewal and Growth.
- Provide the preliminary preferred long-term capital infrastructure program as an input into financial models.
- Provide recommendations for future initiatives and improvements.
- Create a foundation for ongoing capital budgeting processes.

## 1.3 INTEGRATED RESOURCE PLAN VISION

The vision for the 2019 IRP is to be an integrated forward-looking document based on the following principles:

- Build on the foundation and structure of the 2012 IRP
- Layer multiple infrastructure inputs and recommendations to establish an integrated long-term capital plan
- Strategic planning for the long-term
- Real steps in the short-term
- Tactical level document
- Integrated capital program and strategy
- Supported collectively

## 1.4 DRIVERS AND OBJECTIVES

The 2019 IRP Update focuses on three drivers: **Compliance, Asset Renewal and Growth**. In support of the three drivers, fourteen objectives based on Halifax Water's level of service, compliance requirements (existing and future), asset renewal requirements, as well as other important considerations such as adaptation to climate change, system reliability and servicing growth were further identified.

The fourteen objectives were first developed under the 2012 IRP and further reviewed and refined through this update process. The objectives reflect a greater level of granularity and specific criteria related to the current and anticipated compliance requirements for the three infrastructure systems, optimal asset renewal requirements and growth. Many of the 2012 objectives remain valid and have not changed while others required context update or changes to the main driver to better reflect the current and planned Halifax Water planning and delivery program.

The IRP Update does not focus on Enterprise Risk Management (ERM) as a specific objective, however the risk lens is applied through consideration of objectives such as adaptation to climate change and system reliability. The IRP Update commenced prior to Halifax Water implementing a formalized ERM. The outcomes of the ERM will be considered for future updates to the IRP and in the implementation of the IRP capital program.

## 1.4 DRIVERS AND OBJECTIVES CONTINUED

The 2019 IRP Update objectives are summarized in ***Table 1***. Changes between the 2012 and 2019 objectives are highlighted in blue.

***Table 1 – IRP Drivers and Objectives***

| Driver | | Infrastructure System | | Objective |
|---|---|---|---|---|
| Compliance | Regulatory | Wastewater | 1 | Meet current Nova Scotia Environment WWTF Permit to Operate Requirements |
| | | Water | 2 | Meet or exceed current Nova Scotia Environment WSP Permit to Operate |
| | | Wastewater Stormwater | 3 | Meet Current Overflow Compliance (Monitor and Report) |
| | | Wastewater | 4 | Meet or exceed Future WWTF Compliance |
| | | Water | 5 | Meet or exceed future drinking water compliance |
| | Level of Service | Wastewater Stormwater | 6 | Meet future overflow compliance |
| | | Water Wastewater Stormwater | 7 | Endeavour to provide existing systems that are adequately sized to meet Halifax Water Level of Service |
| | | Stormwater | 8 | Meet Future Stormwater Quality Compliance |
| | | Water Wastewater Stormwater | 9 | Ensure planning and sizing of infrastructure considers the impact of climate change |
| Asset Renewal | | Water Wastewater Stormwater | 10 | Implement optimal level of asset re-investment |
| | | Water Wastewater Stormwater | 11 | Enhance the reliability, redundancy and security of the water, wastewater and stormwater systems with attention to high risk and critical areas |
| | | Water Wastewater | 12 | Reduce energy consumption, operating costs and GHG contributions |
| Growth | | Water Wastewater Stormwater | 13 | Provide regional water, wastewater and stormwater infrastructure needed to support planned growth |
| | | Water Wastewater | 14 | Manage flow and demand to maximize capacity for growth and minimize the need for new hard infrastructure |

Further details on the IRP drivers and objectives are provided in ***Section 2.6.1*** of this report.

# 2.0 BACKGROUND AND PLANNING FRAMEWORK

## 2.1 BACKGROUND

### 2.1.1 2012 IRP

The Integrated Resource Plan (IRP) was developed in 2012, in collaboration with the Nova Scotia Utility and Review Board (NSUARB), to identify required programs and resources for the next thirty years (2013-2042) covering each of the three drivers: growth, compliance and asset renewal. The IRP served as the first step in an on-going and evolving process of continuous improvement.

The purpose of the IRP was to guide Halifax Water's financial planning by focusing on the following:

- Providing a framework for Halifax Water to evaluate alternative planning scenarios for its water, wastewater and stormwater services
- Help to identify and achieve Halifax Water service goals while considering environmental requirements
- Provide long term direction for Halifax Water and be a platform for assessing investment options
- Serve as a basis under which more detailed, facility or program-specific capital investment analyses can take place
- Identify and plan for the management of risks
- Provide the board with information to make fully informed decisions about proposed future capital investments, revenue, requirements and rates

Preparation of the IRP resulted in various next steps and recommendations including an evaluation of the adequacy of the existing institutional capacity of Halifax Water required for successful implementation of the IRP components including programs and projects identified. Recommendations for the water, wastewater and stormwater systems included, but were not limited to:

- Implementing various wastewater programs and plans including an I/I Pilot program, Wet Weather System Plan, assessment of eight wastewater treatment facilities, and a Wastewater Master Plan
- Development of a Water Master Plan applying water use trends and design criteria
- Assessment of stormwater quality compliance requirements and clarification of the role of Halifax Water in stormwater planning and management
- Assessment of Climate Change impacts on all systems which will require an update of design standards and operational practices

The proposed 30-year expenditures for the recommended 2012 IRP is presented in ***Figure 3***.

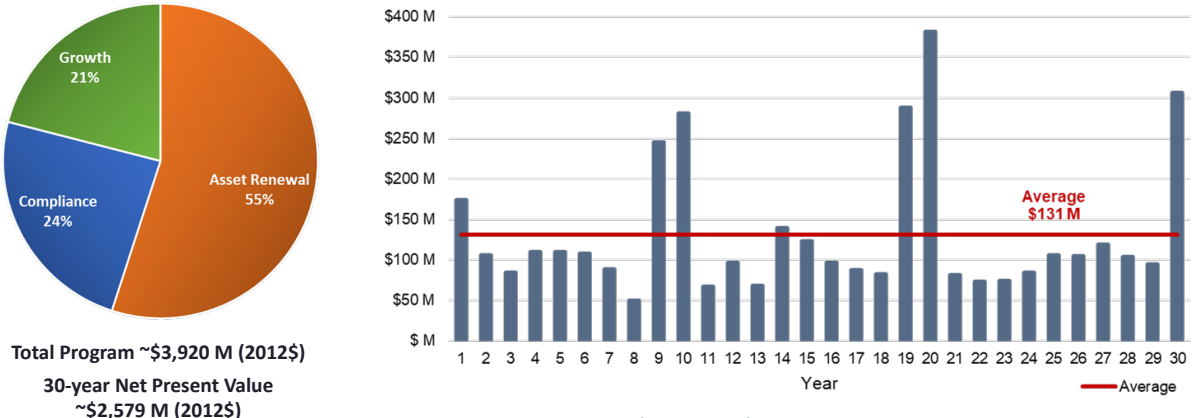



*Figure 3 – 2012 Integrated Resource Plan*

### 2.1.2 RELEVANT STUDIES, FRAMEWORKS AND INITIATIVES

Halifax Water has been very active in implementing recommendations from the 2012 IRP as well as other initiatives to inform the decision-making and long-term planning process. Several studies, frameworks and initiatives have provided Halifax Water with a much-enhanced understanding of Halifax Water's existing infrastructure and better planning approaches to meet future needs. ***Table 2*** presents some of the main relevant studies, frameworks and initiatives in the IRP Update context.

***Table 2 – Studies, Frameworks and Initiatives***

| Studies and Initiatives |
|---|
| **Regional Development Charge (RDC) —** Approved in 2014. Provides a justifiable and transparent framework to implement an RDC incorporating 20 years of the proposed capital program and scenarios to assess potential impacts of varying RDC assumptions. |
| **Regional Centre Local Wastewater Servicing Capacity Analysis (LoWSCA) —** Completed in 2016 for HRM. Provides an understanding of local wastewater collection system capacity constraints within six target intensification areas. |
| **Water Quality Master Plan Update (WQMP) —** Completed in 2017. Guides Halifax Water's work and ongoing research on water quality related to understanding and adapting to lake recovery, maintaining distribution system water quality and water quality data mining. |
| **West Region Wastewater Infrastructure Plan (WRWIP) —** Completed in 2017. The foundation of policies for the West Region of Halifax regarding regional infrastructure planning, preferred servicing solutions and preliminary designs for wastewater infrastructure servicing needs. |
| **Wet Weather Management Program (WWMP) —** Initiated in 2013 and ongoing. Program that guides how to effectively manage wet weather flows within the sanitary wastewater systems including monitoring and separating combined sewer systems when possible and in the most cost-effective way. |
| **Five-year Business Plans —** Most recent plan completed for the 2018/19 to 2022/23 period. Developed to provide Halifax Water with a comprehensive financial plan related to the impact of current and imminent capital projects as well as future capital demands. |
| **Asset Management Plans (AMPs) —** Provides an annual summary of Halifax Water's asset inventory and outlines how the Utility manages its assets, the state of regional infrastructure, the level of service provided by assets, and associated costs. |
| **Infrastructure Master Plan —** Completed in 2019. Focuses on producing optimal servicing strategies for the water and wastewater networks within Halifax. |
| **Compliance Plan —** Completed in 2019. Plans to establish current and future federal, provincial and municipal level compliance regulations to create a path forward for Halifax Water to maintain and achieve compliance over the next 30 years. |
| **Integrated Stormwater Management Policy —** Ongoing policy development with HRM. Developed to implement policies that guide municipal utility operations and governance while delivering stormwater management services within both legislative requirements and community expectations. |

### 2.1.2 RELEVANT STUDIES, FRAMEWORKS AND INITIATIVES CONTINUED

*Table 2 – Studies, Frameworks and Initiatives (continued)*

| Frameworks |
|---|
| **Climate Change Management Framework —** Developed in 2018. Created in the form of a simple flow diagram to represent how infrastructure systems of individual assets progress from being assessed against climate change to having a mitigation strategy implemented. |
| **Cost Estimation Framework (CEF) —** Developed in 2017. Provides a consistent, transparent and audit-able approach to costing capital projects both internally and externally. |
| **Long-Term Planning Framework (LTPF) —** Developed in 2017. Provides Halifax Water with direction for holistic long-term infrastructure planning activities considering all drivers of infrastructure management. |

| Initiatives to Close Data Gaps |
|---|
| **Sewer Inspection and Survey Program —** Provides Halifax Water with information regarding the condition and performance of sewers in order to identify defects requiring rehabilitation or replacement. |
| **Condition Assessments by Asset Class —** Formal condition assessments used to inform the development of Asset Management Plans for various asset classes using available asset attribute data. |
| **Flow Monitoring Program —** Initiated in 2016 and implemented in phases from Spring 2016 to Spring 2018. Developed to monitor and inform wet weather analysis and includes permanent flow monitors, short term flow monitors which are used for the WWMP and temporary monitors which are used to inform capital projects. |
| **Wet Weather Management Program and I/I Reduction Pilot Area Assessments —** Addition to the WWMP. Identification of five high inflow and infiltration (I/I) areas to enable Halifax Water to validate the Rainfall Derived I/I reduction that can be accomplished through various I/I reduction strategies. |
| **GIS Update —** Information Technology Strategic plan developed in 2017. Provides a structured approach for implementing technological investment strategies including new ways to update and integrate GIS in Halifax Water operations. |
| **Water and Wastewater Hydraulic Models —** Built and calibrated for Halifax Water to assess the water and wastewater distribution and collection systems in terms of operational strategies and to inform capital project needs. |
| **Lead Service Replacement Program —** Approved in 2017. Program is intended to remove all lead service lines in an effort to limit the opportunity for lead to come in contact with drinking water. |
| **Advanced Metering Infrastructure (AMI) & Customer Connect Program —** Launched in 2017. The program's efforts are aimed at replacing all water meters with Advanced Metering Infrastructure Technology to enable two-way digital communication between Halifax Water and its customers and allow them to effectively manage their usage and footprint. |

***Appendix A.1*** provides a summary of the studies, frameworks and initiatives that Halifax Water is currently undertaking or has completed since the 2012 IRP. For detailed information of the past studies and initiatives that support the work undertaken for the IRP Update, refer to the Infrastructure Master Plan Background Review.

## 2.2 GOVERNANCE

### 2.2.1 HALIFAX REGIONAL MUNICIPALITY (HRM)

Halifax Regional Municipality (HRM) was established in 1996 when the City of Halifax, the City of Dartmouth, the Town of Bedford and Halifax County were united to form one municipal unit. HRM is comprised of an estimated population density of 71.1 per km², spanning across a total of 5,490 km², or 10% of Nova Scotia's total land area. However, the majority of the HRM population is situated around the Urban Core centered on and around the Halifax Harbour. Outside the Urban Core, the majority of residents are concentrated in a number of rural communities.

Halifax Water is an autonomous, self-financed utility owned by HRM. The role of HRM is to maintain and oversee overall planning authority and provide the specific direction for the nature and location of future growth.

### 2.2.2 HALIFAX WATER

Halifax Water is the water, wastewater and stormwater utility servicing residents of HRM. Halifax Water, previously known as the Public Service Commission, was created in 1945 to maintain and operate the water supply system for the City of Halifax. When the City of Halifax amalgamated with the City of Dartmouth, Town of Bedford, and Halifax County in 1996, Halifax Water merged with the water utilities of those former municipalities. In 2007, Halifax Water further expanded its mandate with the transfer of all wastewater and stormwater assets from HRM.

Halifax Water owns, operates and maintains the water and wastewater systems within HRM, as well as the stormwater infrastructure located within the road right-of-way or easements owned by the utility. Halifax Water builds and maintains infrastructure to treat, deliver and move water and wastewater across the region while servicing over 109,000 customers and employing approximately 500 people.

#### 2.2.2.1 Mission and Vision

Halifax Water Mission and Vision statements are as follows:

### 2.2.3 HALIFAX WATER BOARD OF COMMISSIONERS WATER BOARD OF COMMISSIONERS

Halifax is governed by the Halifax Board of Commissioners which includes four members of Halifax Regional Council appointed by Council, three residents of HRM appointed by council and the Chief Administration Officer of HRM, or a Halifax municipal employee appointed by the Chief Administrative Officer.

The roles and functions of the Halifax Water Board of Commissioners are to uphold a policy of openness and transparency, balanced with its roles in representing the interests of Halifax Water, its customers and other stakeholders.

Two provincial bodies have responsibility for oversight of Halifax Water: Nova Scotia Utility and Review Board (NSUARB) and Nova Scotia Environment (NSE).

### 2.2.4 NOVA SCOTIA UTILITY AND REVIEW BOARD

The NSUARB is an independent body with both regulatory and adjudicative jurisdiction. The NSUARB provides general supervision over all public water utilities within the province, including involvement in rate setting, approval of large capital expenditure projects and reviewing complaints. The NSUARB ensures projects meet the requirements of the public utilities act. When approving capital expenditures, the NSUARB assesses, among other things, the need for the proposed project, the reasonableness of the expenditure, and the financial impact on the Utility and its customers.

### 2.2.5 NOVA SCOTIA ENVIRONMENT

NSE is the provincial government department that acts as environmental regulator ensuring public health and environmental quality. NSE oversees wastewater and water supply standards, issues approvals and audits compliance with standards. NSE specifically regulates drinking water quality as well as municipal and industrial discharges from wastewater treatment facilities and other sources such as overflows.

In addition to the NSUARB and NSE, federal departments including Department of Fisheries and Oceans (DFO), Environment and Climate Change Canada (ECCC) and Health Canada (HC) may also play an oversight role for specific projects and activities.

## 2.3 STUDY AREA

HRM is comprised of 18 community planning areas, spanning 5,500 km², with an approximate population of 411,014 people (2016 census estimate). The boundary of the 2019 IRP Update includes the existing and planned Central, East and West service areas for water and wastewater in HRM, as well as the stormwater service boundary.

The study area of the 2019 IRP Update is provided in ***Figure 4***.

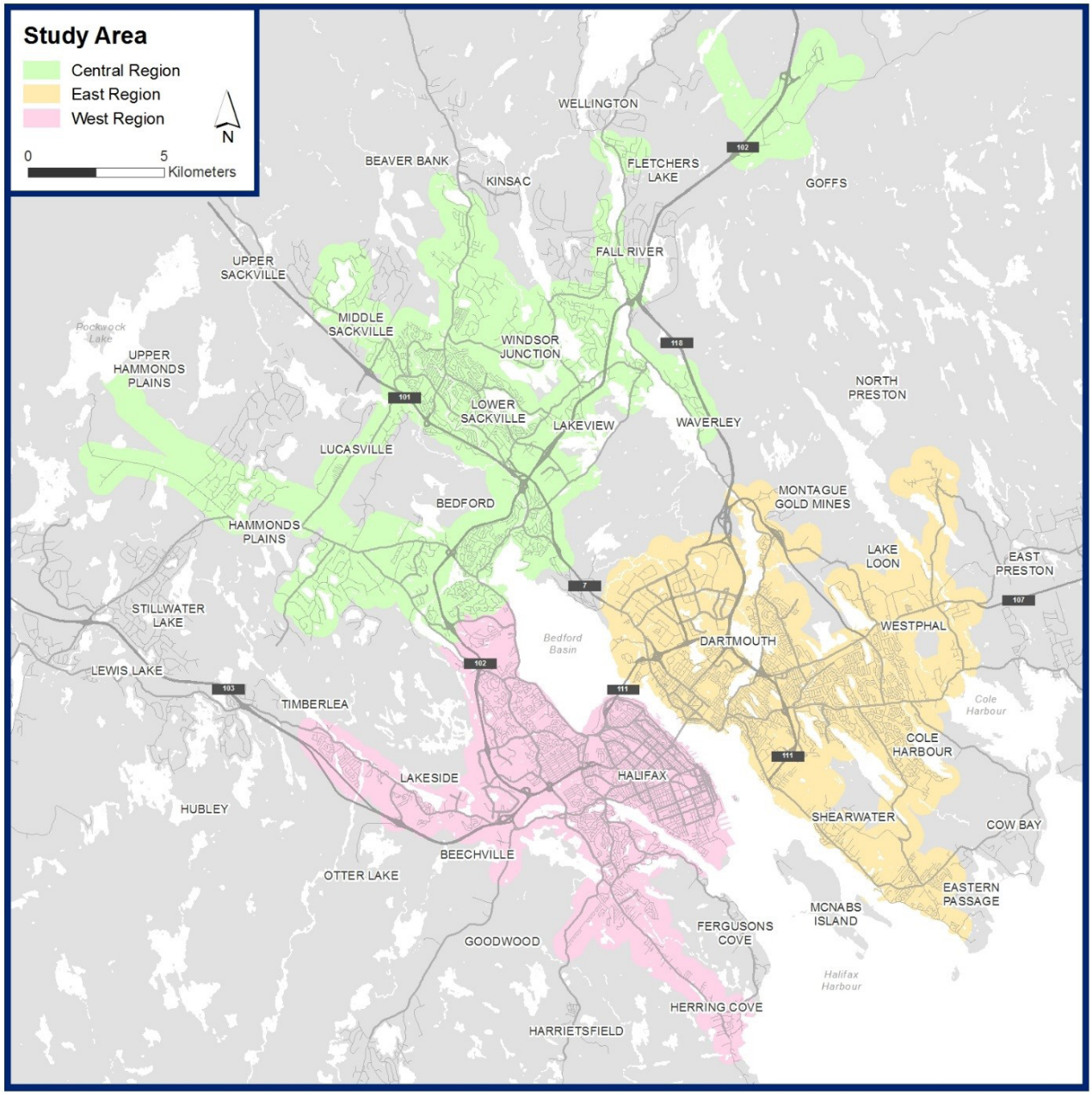



*Figure 4 – Study Area*

Halifax Water owns and operates the water distribution system and the wastewater collection system. It also owns and operates the stormwater collection system within the right-of-way inside the Halifax Water stormwater service boundary.

The following section, details Halifax Water's existing water, wastewater and stormwater infrastructure.

## 2.4 HALIFAX WATER INFRASTRUCTURE

### 2.4.1 WATER SYSTEM

Halifax Water provides drinking water and fire protection services to approximately 370,000 people. The water distribution system is made up of 1,558 km of watermains (including transmission and distribution mains), eight water supply plants (WSP), two back-up water supplies, six water supply dams, 21 booster stations and 143 chambers. An overview of the water supply system is illustrated in ***Figure 5.***

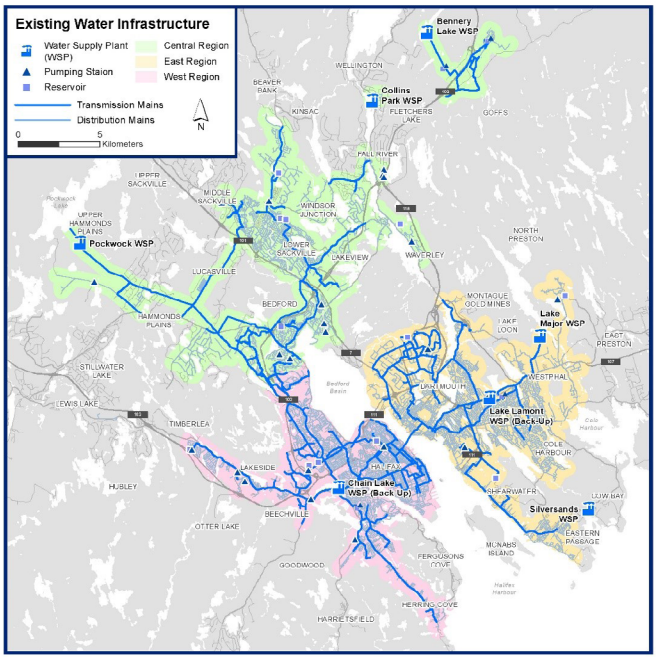



*Figure 5 – Overview of the Existing Water System*

Halifax has three main water supply plants; J.D Kline WSP, Lake Major WSP and Bennery Lake WSP. In addition, Halifax Water services five smaller community supply plants that service rural / suburban areas. Each WSP has a water withdrawal permit and meets the Canadian Drinking Water Standards.

J.D. Kline WSP services the West and Central Region including the greater urban core of Halifax, Bedford, Sackville, Fall River, Waverley, Herring Cove and Timberlea. The plant uses a direct duel media filtration process to treat water from the Pockwock Lake.

Lake Major WSP services the East Region including Dartmouth, Eastern Passage, Shearwater, North Preston and Forrest Hills / Colby Village. The plant uses a sedimentation and multi-media filtration process to treat water from Lake Major.

Bennery Lake WSP services the Halifax Stanfield International Airport and Aerotech Business Park. The plant uses a direct filtration process to treat water from Bennery Lake.

### 2.4.2 WASTEWATER SYSTEM

The wastewater collection system is made up of 1,424 km of sewers (including forcemains and gravity sewers), 14 treatment facilities, one biosolids processing facility and 166 pumping stations.

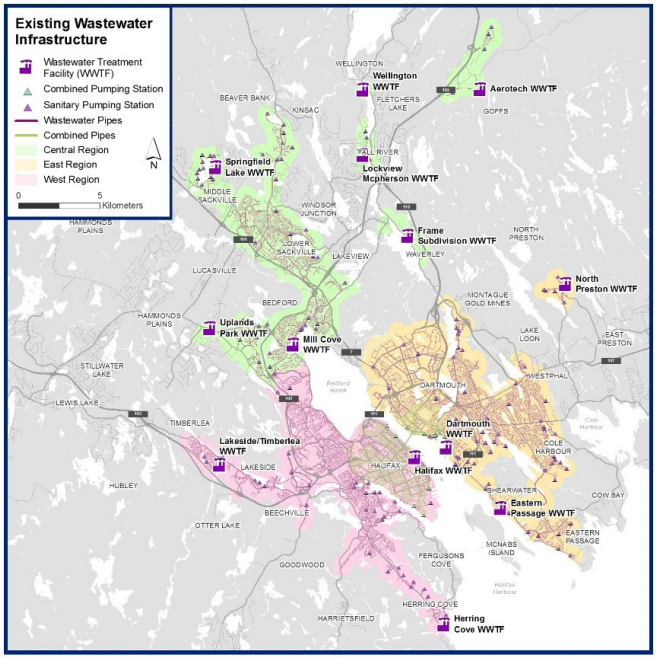



*Figure 6 – Overview of the Existing Wastewater System*

Halifax Water currently owns and operates five major wastewater treatment facilities (WWTF), Halifax, Dartmouth, Herring Cove, Mill Cove and Eastern Passage and nine smaller WWTF that service rural / suburban areas providing a level of treatment from primary to tertiary. Five of the WWTFs discharge to salt water bodies and nine discharge to small freshwater bodies. ***Figure 6*** provides an overview of the wastewater network.

### 2.4.2 WASTEWATER SYSTEM CONTINUED

The major wastewater collection system for each of the regions is as follows:

The West Region is comprised of the urban areas of the Halifax Peninsula and mainland serviced by the Halifax WWTF, and outlying suburbs including Beechville, Lakeside and Timberlea are serviced by the BLT WWTF and the trunk sewer which conveys flow to Halifax sewershed, while the outer regions of Spryfield and Herring Cove are serviced by the Herring Cove WWTF.

The East Region is comprised of the Dartmouth area which includes combined and separated sewers tributary to the Dartmouth WWTF. The Dartmouth catchment is particularly complex with separated networks entering combined networks, high Inflow and Infiltration (I&I) levels and several flow splits which create complexity when characterizing flow paths and defining catchment areas. The outlying suburbs of Cole Harbour, Shearwater and Eastern Passage are tributary to the Eastern Passage WWTF.

The Central Region comprises of Bedford and Sackville which are tributary to the Mill Cove WWTF. A large portion of the Central Region is not serviced by the municipal wastewater system, relying on on-site sewage disposal.

### 2.4.3 STORMWATER SYSTEM

The stormwater collection system is made up of 878 km of storm sewers, 2,337 cross culverts, approximately 16,000 driveway culverts, and 40 stormwater management structures.

The stormwater system is multi-jurisdictional, with the provincial and municipal governments, Halifax Water and private owners having distinct roles and responsibilities within the stormwater cycle.

***Figure 7*** on the right provides an overview of Halifax Water's stormwater service boundary.

***Table 3*** below presents the stormwater system jurisdiction and roles and responsibilities for each entity.

***Table 4*** below presents the inventory of Halifax Water's infrastructure and the associated replacement cost.

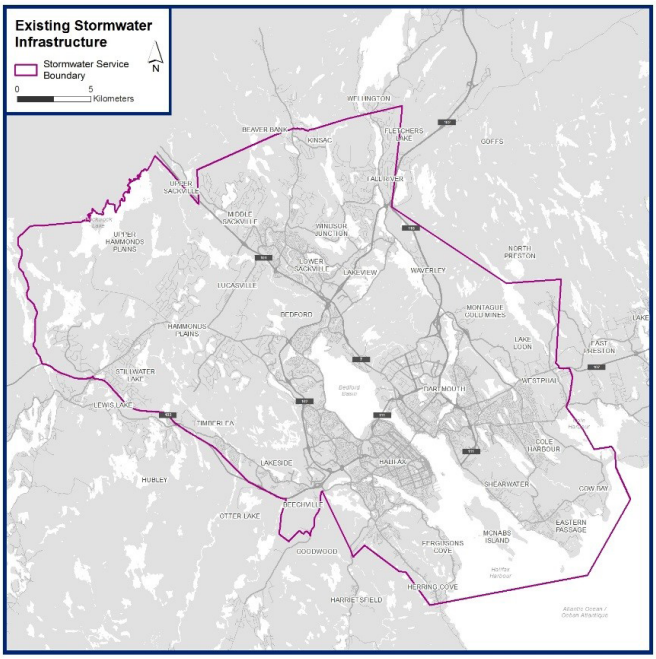



*Figure 7 – Halifax Water Stormwater Service Boundary*

*Table 3 – Stormwater System Jurisdiction*

| Entity | Roles and Responsibilities |
|---|---|
| Province of Nova Scotia | • Protection of water resources including natural watercourses (stream, rivers, lakes)<br>• Issues a Permit to Construct for the installation of a public stormwater system |
| Halifax Water | • Municipal water, wastewater and stormwater utility serving HRM residents<br>• Authority to own and operate stormwater systems within a defined service boundary which comprises of catch basins, pipes, manholes, roadside, ditches, swales, culverts, stormwater holding tanks, ponds, and dams |

## 2.4.3 STORMWATER SYSTEM CONTINUED

*Table 3 – Stormwater System Jurisdiction (continued)*

| Entity | Roles and Responsibilities |
|---|---|
| Halifax Regional Municipality | • Regulation of land development activities including siting of buildings, grading of land, and assessment of impacts of overland flow resulting from development of land and stormwater systems<br>• Owns and maintains minor drainage system elements including pipes, ditches, culverts, etc. that fall outside of Halifax Water's service boundary<br>• Owns and maintains public street system |
| Private Property Owners | • Stormwater flow across individual properties, across adjacent property boundaries and stormwater management systems located on individual property<br>• Private stormwater systems include rainwater leads, footing drains, private community systems, and slope protection within privately-owned property<br>• Maintain drainage corridors and privately-owned drainage infrastructure free of vegetation and debris |

*Table 4 – Infrastructure Inventory and Replacement Costs*

| Asset Group | Asset* | Number / Length | Replacement Costs ($2019 Millions) |
|---|---|---|---|
| **Water** | Water Distribution Mains | 1235 km | $1,384 |
| | Water Transmission Mains | 323 km | $690 |
| | Water Pumping Stations | 21 | $17 |
| | Chambers and PRV | 143 | $50 |
| | Water Reservoirs | 16 | $95 |
| | Dams | 6 | $44 |
| | Water Supply Plants | 10** | $306 |
| | **Water System Sub-Total** | | **$2,586** |
| **Wastewater** | Sewers | 1296 km | $1,714 |
| | Forcemains | 129 km | $275 |
| | Pumping Stations | 166 | $561 |
| | Holding Tanks | 5 | $12 |
| | Treatment Facilities | 14 | $652 |
| | **Wastewater System Sub-Total** | | **$3,214** |
| **Stormwater** | Pipes | 878 km | $1,369 |
| | Cross Culverts | 2,337 | $268 |
| | Driveway Culverts | 16,000 | $56 |
| | Structures | 40*** | $3 |
| | **Stormwater System Sub-Total** | | **$1,696** |
| | **All Systems Total** | | $7,496 |

*There are other categories of assets funded through the capital program that are not represented above (e.g. Information systems and other corporate programs)
**Includes back up supply plants
***Excludes Sullivans Pond and Ellenvale Run

## 2.5 PLANNING DATA AND POPULATION PROJECTIONS

As part of the Infrastructure Master Plan process, Halifax Water's project team including HRM staff collaborated to define the planning projection dataset, required to develop the Infrastructure Master Plan. HRM confirmed the starting baseline populations, the ultimate planning projection approach and growth rate over a 30-year horizon, from 2016 to 2046. The resulting planning estimates were the basis for the water demand and wastewater flow projections for the Infrastructure Master Plan. ***Table 5*** summarizes the HRM planning estimates as developed in the Infrastructure Master Plan and ***Figure 8*** presents the location of projected growth in the study area.

*Table 5 – Halifax Regional Municipality Planning Estimates*

| Sub-boundary | Employment Growth (2016 - 2046) | Population Growth (2016 - 2046) | Total Growth (2016 - 2046) |
|---|---|---|---|
| **Regional Centre** | 42,123 | 53,507 | 95,630 |
| **Suburban** | 36,963 | 77,706 | 114,669 |
| **Rural** | 6,877 | 17,000 | 23,877 |
| **Total** | **85,963** | **148,213** | **234,176** |
| **Service Area*** | **79,086** | **131,213** | **210,299** |

*Excludes rural planning projections.

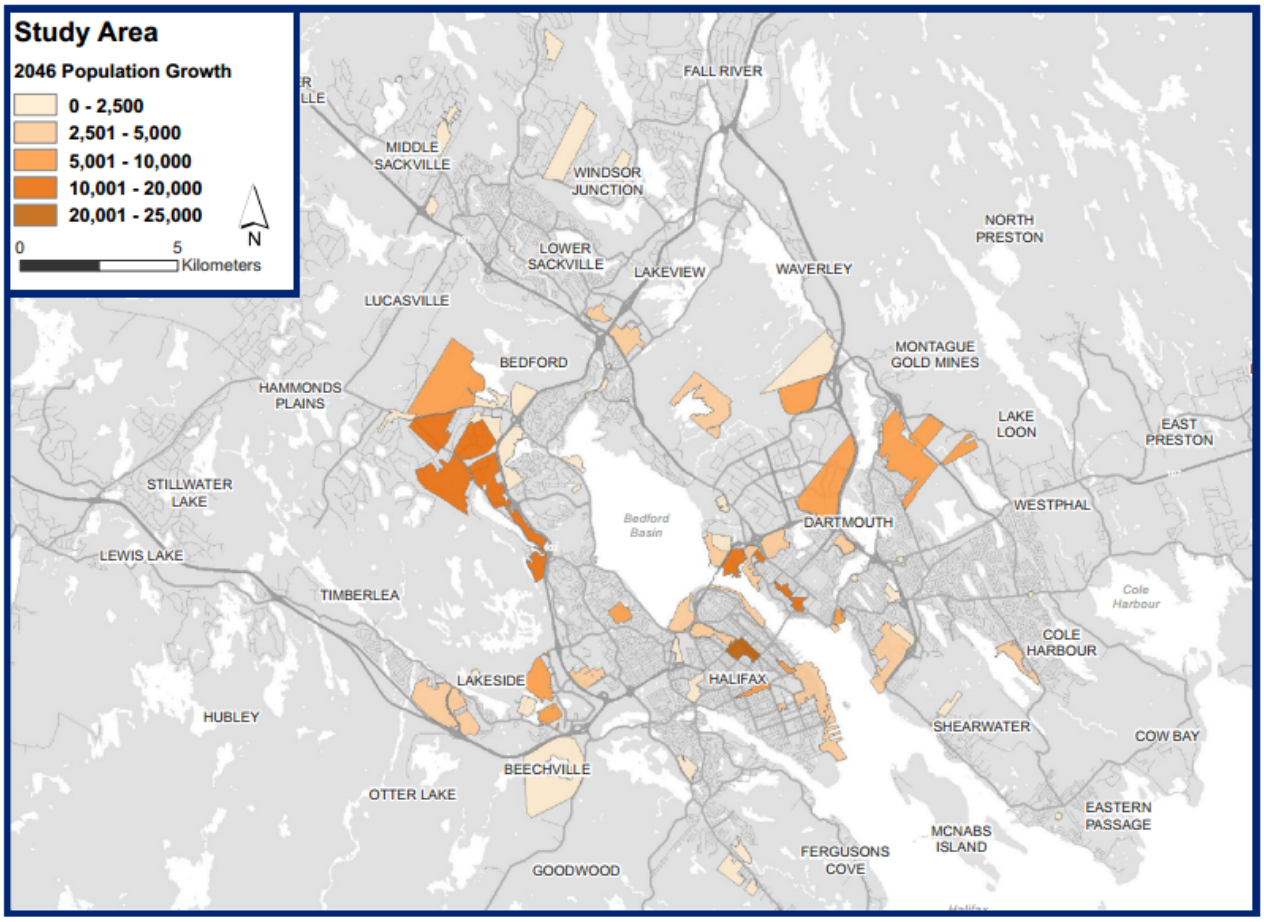



*Figure 8 – Population Growth Allocation*

## 2.6 DESIGN CRITERIA AND LEVEL OF SERVICE

### 2.6.1 DESIGN CRITERIA

A comprehensive review of Halifax Water's existing design criteria for water supply and wastewater collection systems was completed as part of the WRWIP and Infrastructure Master Plan. In addition to the review, trend analyses and a summary of industry best practice were used to validate the appropriateness of the criteria.

Key design criteria for wastewater collection system:

- Per capita sanitary flow = 300 L/cap/day
- I/I allowance rate = 0.28 L/s/ha

Key design criteria for water supply system:

- Per capita average day demand = 375 L/cap/day
- Peaking factors summarized in ***Table 6***

***Table 6 – Peaking Factors for Infrastructure Planning***

| Category | MDD | PHD |
|---|---|---|
| System Supply | 1.40 | 2.10 |
| Storage | 1.90 | 2.85 |
| Pumping and PRVs (Zones > 10,000 people) | 1.90 | 2.85 |
| Pumping and PRVs (Zones < 10,000 people) | 2.20 | 3.30 |

### 2.6.2 LEVEL OF SERVICE

A comprehensive review of Halifax Water's level of service for water supply and wastewater collection systems was completed as part of the Infrastructure Master Plan. The level of service recommended as part of the Infrastructure Master Plan includes:

#### Wastewater collection systems

- A 1 in 5-year design event is to be used to assess peak flows and infrastructure capacity.
- Ensure that new development does not increase the frequency and/or volume of CSOs or SSOs, or impact on the water quality.
- In recognition of the high amenity value of the Northwest Arm, a more stringent limit of 10 overflow events per year is to be applied at each individual CSO along the Northwest Arm.

#### Water supply systems

- Pressures between 40-100 psi under Minimum Hour Demand (MHD) and Peak Hour Demand (PHD) scenarios.
- Pressures above 22 psi during a fire under a Maximum Day Demand (MDD) scenario.
- Available storage capacity in accordance with the Atlantic Canada Guidelines.

# 3.0 INTEGRATED RESOURCE PLAN DRIVERS AND OBJECTIVES

The 2019 IRP purpose is to develop an integrated 30-year capital infrastructure plan covering all systems (water, wastewater, stormwater) and drivers (growth, compliance, asset renewal). In support of the three drivers, fourteen objectives based on Halifax Water's level of service, compliance requirements (existing and future), asset renewal requirements, as well as other important considerations such as adaptation to climate change, system reliability and servicing growth were further identified.


*Figure 9 – Integrated Resource Plan Drivers*

## 3.1 COMPLIANCE

For the 2019 IRP Update the compliance driver has been divided into two main categories: Regulatory Compliance and Level of Service Compliance. Regulatory compliance is based on Halifax Water's goal to ensure, through their efforts, that appropriate measures are taken to be in conformity with current policies and regulations. The level of service component of compliance is based on Halifax Water aspiring to provide customers with high quality water, wastewater and stormwater services, in accordance with the Halifax Water's vision.

### 3.1.1 WATER SYSTEM

**Regulatory Compliance —** Nova Scotia Environment (NSE) is the department of the provincial government responsible for overseeing drinking water with emphasis on water works approvals, facility classification and operator certification, drinking water quality, as well as monitoring and reporting. Compliance for drinking water treatment and delivery is regulated by NSE through approvals issued under the Environment Act. These approvals are issued for a period of 10 years and provide the terms and conditions for the operation of the water supply plants.

Health Canada publishes the Guidelines for Canadian Drinking Water Quality. These guidelines provide direction on the acceptable levels of microbiological, chemical and radiological contaminants in drinking water and on the physical characteristics of drinking water (e.g. odour, taste). The guidelines can be published as either Maximum Acceptable Concentrations (MAC's) which are health related parameters; Aesthetic Objectives (AO's) and Operational Objectives. Drinking Water Approvals in Nova Scotia require that all MAC's must be achieved. While achievement of AO's in not required, many of them must be monitored and reported on. Any new or revised MAC's published during the life of an Approval is deemed to form part of the Approval by NSE.

### 3.1.1 WATER SYSTEM CONTINUED

Regulatory requirements related to the operation of the water transmission and distribution system include the following:

- Free chlorine residual of 0.20 mg/L at all locations in the distribution system at all times.
- Distribution system turbidity of < 5 NTU.
- Total Trihalomethanes < 100 ug/L based on a locational running annual average (LRAA).
- Haloacetic Acids (5), < 80 ug/L based on LRAA.
- Continuous chlorine residual monitoring on the outlet of all storage facilities.
- Provide water that is not corrosive to lead.

Through the Compliance Plan, water facilities and distribution system were reviewed to determine Halifax Water's current state of compliance with regulations, and recommendations were then incorporated into the IRP Update.

**Level of Service Compliance —** Level of service compliance for the water system focuses on meeting Halifax Water's level of service for system pressures and available storage capacity (as described in ***Section 2.6.2***) and ensuring that climate change considerations are taken into account when planning and sizing water infrastructure.

### 3.1.2 WASTEWATER SYSTEM

**Regulatory Compliance —** Wastewater management in Canada is governed federally, provincially and at the municipal level. Legislation is issued federally to stipulate minimum standards for wastewater effluent, while provincial governments are responsible for issuing permits or licenses to wastewater treatment facilities to construct and operate under their regulatory framework. Permits are typically site specific and may require increased stringency based on provincial legislation to improve human health and ensure environmental protection based on population density and assimilative capacity of the receiving waters.

Halifax Water has been consistently working toward achieving the provincial level of wastewater treatment as stipulated by Nova Scotia Environment (NSE) permits and Federal Wastewater System Effluent Regulations (WSER). Historically, NSE has set compliance standards for each wastewater treatment facility (WWTF) issuing Approval for Operation which sets the effluent limits, and the Canada-wide Strategy for the Management of Municipal Wastewater Effluent (CSMMW) provided national standards for combined sewer overflows (CSO) and sanitary sewer overflows (SSO). In June of 2012, the WSER was enacted which set national standards for WWTF effluent discharge and CSO and SSO monitoring. The NSE, CSMMW and WSER requirements are detailed in the following sections.

**Nova Scotia Environment:** Nova Scotia Environment has local jurisdiction to implement additional or more stringent requirements pertaining to wastewater effluent. In 1992, NSE developed provincial regulatory direction on wastewater effluent requirements. This direction was amended and incorporated in to the Atlantic Provinces approach; the "Atlantic Canada Wastewater Guidance Manual for Collection, Treatment and Disposal". Based upon wastewater assimilation studies, the Atlantic Canada Guideline provides a procedure for determining effluent quality requirements for new or upgraded wastewater treatment plants. Each municipal wastewater treatment facility is required to obtain an Approval to Operate that outlines how the facility shall be managed and operated to achieve effluent requirements specific to the receiving waters.

### 3.1.2 WASTEWATER SYSTEM CONTINUED

**Canada-wide Strategy for the Management of Municipal Wastewater Effluent (CSMMW):** Prior to the WSER, the most significant policy / regulation related to Halifax Water's long-term wastewater planning objectives was the Canada-wide Strategy for the Management of Municipal Wastewater Effluent (CSMMW), which is endorsed by the Canadian Council of Ministers of the Environment (CCME). The objective of the CCME was to achieve regulatory clarity in managing municipal wastewater effluent under a harmonized framework that is protective of human health and the environment. Since the establishment of the CCME guidelines, the WSER (2012) became law.

**Wastewater System Effluent Regulations (WSER):** The WSER were enacted in June 2012 and amended January 2015. The WSER were implemented by the federal government and became both the provincial and federal wastewater standards for compliance. The WSER regulations are intended to phase out the release of under-treated wastewater effluent and improve the understanding on CSO and SSO spills through monitoring. The WSER define the following as deleterious substances, and set national standards for their discharge:

- Carbonaceous Biochemical Oxygen Demand (CBOD): 25 mg/L
- Suspended Solids (TSS): 25 mg/L
- Total Residual Chlorine (TRC) for facilities using chlorine disinfection: 0.02 mg/L
- Un-ionized Ammonia as N at 15°C ± 1°C: 1.25 mg/L

WWTFs are authorized to discharge these substances at levels below the defined limits, provided that the effluent is not acutely lethal to trout as determined by standard toxicity testing. Facilities not in compliance must apply for a Transitional Authorization (TA) to deposit effluent exceeding those limits. The Authorization will be valid for a period of 10, 20 or 30 years, depending on the risk level associated with the effluent, as determined by a defined risk-ranking system in the WSER.

Through the Compliance Plan, wastewater facilities and collection system were reviewed to determine Halifax Water's current state of compliance with regulations, and recommendations were then incorporated into the IRP Update.

### 3.1.3 WASTEWATER OVERFLOWS

**Regulatory Compliance —** Halifax Water records the volume and frequency (# of events and # of days active) of overflows associated with the combined sewer overflows (CSOs) and reports this information annually to Nova Scotia Environment and Environment Canada. There is currently no effluent quality monitoring or reporting requirements for overflows from CSOs.

A number of regulations and guidelines speak to combined sewer overflows (CSOs) however, there is little concrete direction concerning SSOs. In the Canadian Council of Ministers for the Environment (CCME) Guideline the recommended national standard for SSOs is, "sanitary sewer overflow frequencies will not increase due to development or redevelopment". However, this standard was not adopted into the WSER.

**Level of Service Compliance —** Since the development of the Regional Wastewater Functional Plan (RWWFP) in 2012, Halifax Water has taken a proactive approach to managing the impacts of growth on the wastewater system. The RWWFP states "Therefore, Halifax Water intends to manage the system such that planned serviced growth impacts will not increase the frequency and volume of CSOs and SSOs." This approach was carried forward in the WRWIP which further states "In general, it is recommended that the CCME national standard guidelines for CSOs and SSOs continue to be followed and infrastructure solutions be identified so that, in light of growth, current LOS be maintained, particularly overflow frequency and volume performance."

Level of service compliance for wastewater overflows focuses on meeting Halifax Water's level of service recommended as part of the Infrastructure Master Plan further discussed in ***Section 2.6.2*** of this report.

### 3.1.4 STORMWATER SYSTEM

Currently, there are no regulatory compliance requirements with respect to the stormwater system. However, it is expected that future regulation could potentially look into mitigating and/or avoiding negative impacts of stormwater on receiving water quality, as well as the effects of flooding and erosion.

### 3.1.5 COMPLIANCE OBJECTIVES

There are nine specific IRP objectives covering the compliance driver. Objectives 1 to 5 are directly associated with meeting or exceeding current and future regulatory compliance. Objectives 6 to 9 are associated with Halifax Water's desired level of service including meeting future compliance requirements for overflows, stormwater quality and adaption to climate change.

***Table 7*** below present the IRP objectives associated with Regulatory and Level of Service Compliance.

***Table 7 – Compliance Objectives***

| Driver | | Infrastructure System | | Objective |
|---|---|---|---|---|
| Compliance | Regulatory | Wastewater | 1 | Meet or exceed current Nova Scotia Environment WWTF Permit to Operate Requirements |
| | | Water | 2 | Meet or exceed current Nova Scotia Environment WSP Permit to Operate |
| | | Wastewater Stormwater | 3 | Meet Current Overflow Compliance (Monitor and Report) |
| | | Wastewater | 4 | Meet or exceed Future WWTF Compliance |
| | | Water | 5 | Meet or exceed future drinking water compliance |
| | Level of Service | Wastewater Stormwater | 6 | Meet future overflow compliance |
| | | Water Wastewater Stormwater | 7 | Endeavour to provide existing systems that are adequately sized to meet Halifax Water Level of Service |
| | | Stormwater | 8 | Meet Future Stormwater Quality Compliance |
| | | Water Wastewater Stormwater | 9 | Ensure planning and sizing of infrastructure considers the impact of climate change |

## 3.2 ASSET RENEWAL

Asset renewal encompasses the replacement or rehabilitation of an existing asset with a new asset capable of delivering the same or improved level of service. Asset renewal was the major strategic driver identified in the 2012 IRP and will continue as the main driver for the foreseeable future, all with the intention to elevate the level of service to customers and protect the environment.

Managing infrastructure assets now and in the future ensures that as assets continuously age and deteriorate, they will deliver the desired level of service into the long term and that appropriate financial planning is in place for timely asset renewal implementation. To guarantee effective asset management practices, Halifax Water currently develops annual Asset Management Plans (AMPs) that provide a summary of asset inventory and state of Halifax Water's infrastructure, level of service the assets provide to the customers, infrastructure replacement and maintenance strategies, and associated costs and expenditures. The level of detail in each of the AMPs varies among asset classes, but all the recommendations are incorporated into the IRP Update.

### 3.2.1 ASSET DATA GAPS

Effective asset renewal is based on solid understanding of the asset inventory and current asset condition. However, during the development of the 2012 IRP, asset data gaps were identified as major challenges for the development of the asset renewal program. The following are some of the data gaps identified in the 2012 IRP:

- Water, wastewater and stormwater assets were missing from GIS datasets.
- Linear asset information such as material, diameter and age were missing at some extent for water, wastewater and stormwater linear asset classes.
- Breakdown of assets to equipment / component level was not available for pumping stations and treatment plants.
- Significant limitations on asset condition data.
- Historical capital expenditure was not available for all asset classes.
- Limited renewal/rehabilitation data.

Since the development of the 2012 IRP, Halifax Water has proactively established programs, undertaken assessments and collected information to close data gaps. Halifax Water has focused efforts on gathering missing data on asset attributes such as size, material, age, and condition which has supported the establishment and preparation of formal annual AMPs.

Through the completion of the Wastewater Treatment Facility Condition Assessment, Wastewater Pumping Station Condition Assessment, Stormwater Culvert Inventory and Condition Assessment, and Sewer Condition Assessments, the level of existing asset information has greatly improved the baseline understanding and provided data needed to complete the AMPs for those asset classes. For remaining asset classes, best available information was used to theoretically establish condition with the understanding that future AMPs will be refined as new information is collected.

Other initiatives and programs to close data gaps include:

- Corporate Flow Monitoring Program
- Wet Weather Management Program
- I/I Reduction Pilot Area Assessments
- GIS Update
- Customer Connect Program
- Water and Wastewater Hydraulic Models Build and Calibration
- Lead Service Replacement Program
- Advanced Metering Infrastructure (AMI)

For more details on asset data gaps, assumptions and initiatives to close data gaps, please refer to ***Appendix A.1, Section 3***.

### 3.2.2 ASSET RENEWAL OBJECTIVES

There are three specific IRP objectives covering the asset renewal driver. Asset renewal objectives are not only related to the replacement and/or rehabilitation of existing assets, but also with enhancing the existing system for reliability, redundancy, security of supply and reduction of energy, GHG emissions and operating costs.

***Table 8*** below present the IRP objectives associated with Asset Renewal.

***Table 8 – Asset Renewal Objectives***

| Driver | Infrastructure System | | Objective |
|---|---|---|---|
| Asset Renewal | Water<br>Wastewater<br>Stormwater | 10 | Implement optimal level of asset re-investment |
| | Water<br>Wastewater<br>Stormwater | 11 | Enhance the reliability, redundancy and security of the water, wastewater and stormwater systems with attention to high risk and critical areas |
| | Water<br>Wastewater | 12 | Reduce energy consumption, operating costs and GHG contributions |

## 3.3 GROWTH

Projected growth within greenfield and intensification areas is a fundamental component for the long-term infrastructure planning of the water, wastewater and stormwater systems. The 2012 IRP utilized high level growth estimates that were generated by HRM in collaboration with Halifax Water during the RWWFP. The planning numbers were a key input into the creation of the infrastructure requirements in the RWWFP, but they were not subject to additional analysis during the development of the 2012 IRP.

Since the 2012 IRP, the Halifax Water project teams including HRM staff collaborated to define the planning projections dataset required to complete the Infrastructure Master Plan. Planning data and growth projections formed the baseline and growth demands on the systems, spanning the period from 2016-2046 (a 30-year planning horizon).

The growth projections defined under the Infrastructure Master Plan, reflect Census growth trends, known developments and planning guidelines, as outlined in the HRM Centre Plan and Integrated Mobility Plan. The growth projections for HRM service area are:

- Population Growth (2016-2046) = 131,213
- Employment Growth (2016-2046) = 79,086
- Total Growth (2016-2046) = 210,299

These growth numbers cover Halifax Water service areas (e.g. exclude rural planning projections). The Infrastructure Master Plan growth projections are presented in more detail in ***Section 2.5*** of this report.

### 3.3.1 IMPACT OF GROWTH ON THE EXISTING SYSTEMS

Significant growth is planned for the Halifax Water service area. The location of this growth will put additional stress on infrastructure systems that are in places already at capacity, particularly as it relates to wastewater infrastructure. In line with HRM growth projections, a significant amount of growth is expected to occur through intensification within the Regional Centre. Downtown Halifax and Dartmouth are key areas where intensification is planned and where existing infrastructure systems are sensitive to growth. In both locations, the presence of combined sewer systems and some of the oldest infrastructure present significant challenges without infrastructure improvements/solutions. In these areas, growth will increase the amount of CSO discharge occurring and exacerbate capacity issues that are known to exist.

Suburban growth on the edge of the existing urban boundary will stress regional infrastructure. For the East water system, Lake Major supply is not adequate to service the planned growth on its own and the Pockwock transmission main and requirement for full back up supply become more critical with a larger population. For the East wastewater system, the Eastern Passage gravity pressure sewer is under capacity with planned growth. For the wastewater system, sewer separation and I/I reduction have great potential to recapture capacity for growth.

More detailed information of growth impacts on Halifax Water systems are provided in ***Appendix B.1 – Infrastructure Master Plan Executive Summary***.

### 3.3.2 GROWTH OBJECTIVES

There are two specific IRP objectives covering the growth driver. The first objective is directly related to providing the system with new infrastructure to support growth. The second objective is related to managing the existing water demands and sanitary flows to maximize the use of the existing systems and free up capacity to minimize the need for new infrastructure to service growth.

***Table 9*** below present the IRP objectives associated with Growth.

***Table 9 – Growth Objectives***

| Driver | Infrastructure System | | Objective |
|---|---|---|---|
| **Growth** | Water<br>Wastewater<br>Stormwater | 13 | Provide regional water, wastewater and stormwater infrastructure needed to support planned growth |
| | Water<br>Wastewater | 14 | Manage flow and demand to maximize capacity for growth and minimize the need for new hard infrastructure |

## 3.4 CHALLENGES, OPPORTUNITIES AND RISKS

Identifying the primary Integrated Resource Plan constraints and opportunities will provide an understanding of the risk associated with the individual projects that form the final capital program. The opportunities, challenges and risks identified in the 2012 IRP are largely still relevant and as such the following section provides an update.

The IRP provides an opportunity to integrate the drivers of compliance, renewal and growth across the water, wastewater and stormwater systems. This integration will provide efficiencies in project delivery and ensure that the IRP objectives are met in the most cost-effective way. The challenge related to this integration is to ensure that the approach is repeatable and becomes an embedded process that Halifax Water can continue to update throughout the program implementation.

### 3.4.1 COMPLIANCE – WATER

The water system is currently compliant with all regulatory requirements and the risk of unknown future, more stringent, compliance requirements are negligible. However, there are challenges with regard to the water system and maintenance of compliance and level of service in light of growth. The Infrastructure Master Plan, for the first time, provided a comprehensive review of the water system considering existing conditions and growth. The outcome identified two key needs that relate to Halifax Water's ability to maintain compliance into the future: the safe yield study of the two primary supply sources, Lake Pockwock and Lake Major, and the transmission main risk assessment. In addition to these risks, climate change is ever present and Halifax Water's intent to progress the implementation of water supply plant vulnerability assessments will be critical to manage the risks posed by climate change into the future.

### 3.4.2 COMPLIANCE - WASTEWATER

WWTF compliance is currently not consistently attained across all facilitates. With the potential need for upgrades to meet WSER requirements at Halifax Water's Halifax and Dartmouth Halifax Harbour Solutions Project (HHSP) facilities there are opportunities for Halifax Water to consider alternative technologies and enhanced treatment to ensure compliance of all WSER requirements.

At present, the WSER regulations require monitoring and reporting of CSO and SSO discharges. It is anticipated that within the 30-year horizon of the IRP there will be more stringent requirements on discharges, likely with annual limits applied, consistent with the majority of other comparable international jurisdictions. The IRP program includes CSO and SSO management plan projects to assess the needs to achieve future reductions. This work presents opportunities for Halifax Water to integrate these needs with those of renewal, growth and climate change mitigation to ensure that they are obtained in the most cost-effective approaches building on the rainfall derived inflow and infiltration (RDII) and sewer separation programs currently recommended.

### 3.4.3 COMPLIANCE - STORMWATER

Potential future compliance relating to stormwater quality remains the greatest risk to maintaining stormwater compliance. Halifax Water has made good progress collecting inventory data of the stormwater network, particularly of culverts, and has implemented a stormwater charge. This creates opportunities to sustainably manage stormwater assets. The Infrastructure Master Plan identifies sewer separation projects that will impact stormwater and building on the Wet Weather Management Study opportunity exists to explore low impact development (LID) applications to enhance the system. These approaches should be explored as part of ongoing climate change assessments and as an opportunity to work with HRM.

### 3.4.4 ASSET RENEWAL

The advancement of the Halifax Water Asset Management Plans is testament to the progress Halifax Water has made with regard to asset renewal planning. Many data improvements have been made especially to pumping stations and sewers. Water main condition assessment, particularly transmission mains continue to be a challenge. The primary challenge across all asset classes relates to estimated life versus condition-based renewal planning. As further data is collected, a decision support tool that can leverage the condition data to inform renewal decisions is a key priority and will significantly enhance the understanding of actual needs and infrastructure deficit assessments.

### 3.4.5 GROWTH

The completion of the Infrastructure Master Plan, for the first time, brings together all systems and serviced areas into one comprehensive long-term plan to accommodate growth. There is a clear opportunity for Halifax Water to build on this enhanced planning momentum to ensure that 5-year updates are funded and implemented and that collaborative processes with HRM regarding growth projections are developed in the interim. The projections of growth used in the Infrastructure Master Plan were derived from the best planning estimates published by HRM. The challenge is to ensure that growth is monitored and compared to the planning estimates used. This will mitigate the risk of the actual versus planned growth deviating and ultimately impacting the validity of the Infrastructure Master Plan preferred strategy.

## 4.0 2019 INTEGRATED RESOURCE PLAN DEVELOPMENT

The IRP was a multi-step and iterative process. The key tasks and activities are represented graphically in ***Figure 10***. The main approach to the development of the plan included the completion of the following tasks:

- Build on the foundation of the 2012 IRP and the projects, studies and work completed through its recommendations.
- Complete a baseline understanding from previous studies
  - Review opportunities and constraints for the water, wastewater and stormwater systems
  - Review underlying assumptions related to project triggers and servicing requirements
  - Identify data gaps
  - Consolidate recommendations from previous studies and identify potential conflicts and uncertainties
- Complete detailed review of Supply Side Management (SSM) and Demand Side Management (DSM) options.
  - Review completed and ongoing initiatives
  - Review opportunities and constraints related to implementing public and private-side initiatives
  - Develop a range of short and long term potential initiatives
- Coordinate and align needs identified in the Infrastructure Master Plan, Compliance Plan and Asset Management Plans.
  - Consolidate full range of recommendations
  - Identify opportunities for alignment and integration
  - Identify opportunities for merging projects or programs
- Utilize data and tools to help close gaps through data linkage and apply spatial allocation, prioritization and decision-making tools to review project integration opportunities.
- Identify the projects and splits that meet the three drivers of Compliance, Asset Renewal and Growth
  - Complete a project-by-project analysis of the project triggers and objectives
- Provide the preliminary preferred long-term capital infrastructure program as an input into financial models
  - Work iteratively and collaboratively with Halifax Water team to support the development of a long-term capital infrastructure plan based on the capital investment requirements for the three drivers
- Recommend a forward-looking long-term infrastructure plan that is traceable, defendable and implementable.
- Provide recommendations for future initiatives and improvements
  - Recognizing the process for future updates, identify opportunities for additional work, data and other updates that would benefit and enhance value for the future IRP Update
- Create a foundation for ongoing capital budgeting processes
  - Provide the deliverables in a format to be easily leveraged into Halifax Water processes and other analyses for capital delivery including budgeting
- Prepare a report that documents the development of the IRP Update.

# HALIFAX WATER INTEGRATED RESOURCE PLAN UPDATE PROCESS FLOW DIAGRAM

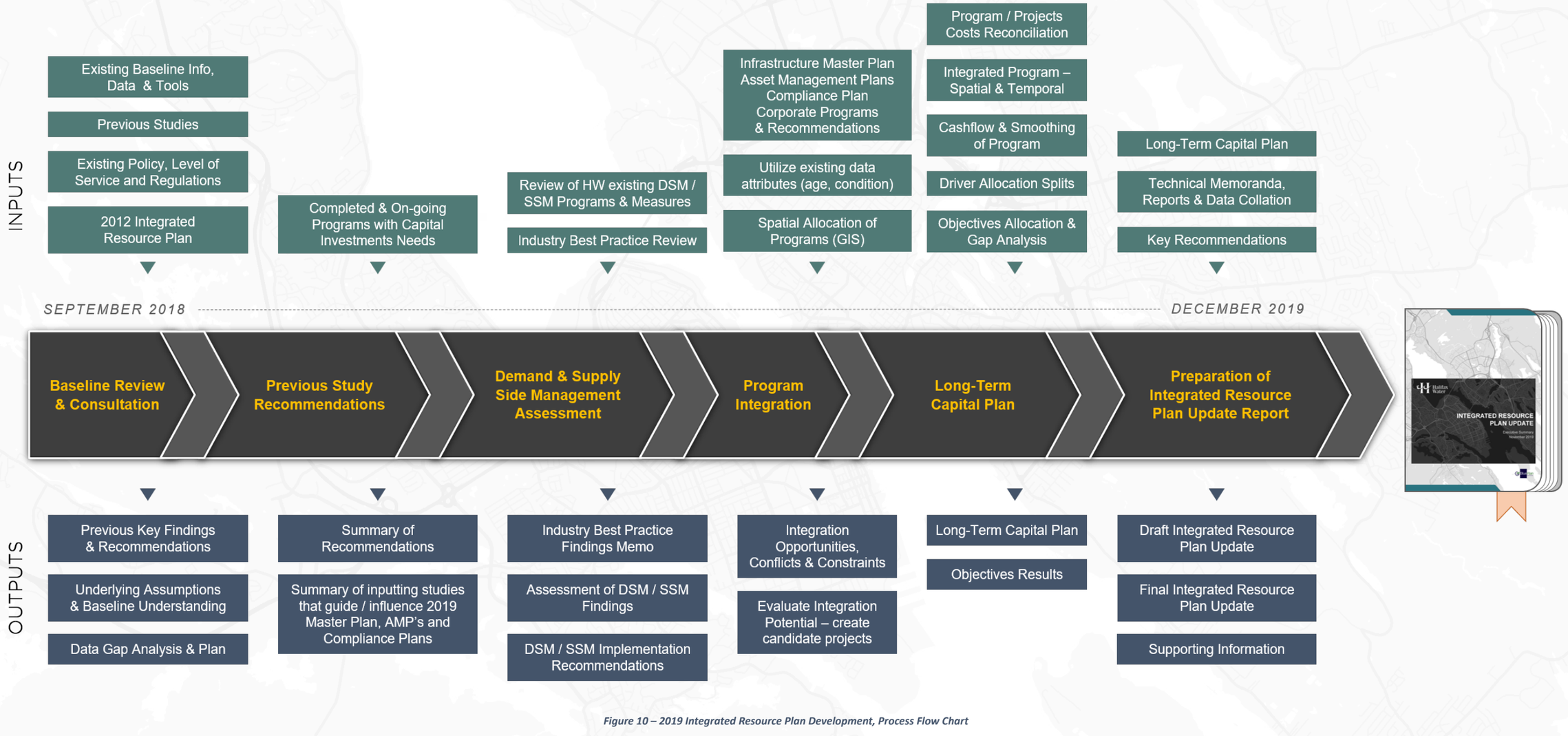



*Figure 10 – 2019 Integrated Resource Plan Development, Process Flow Chart*

## 4.1 FOUNDATIONAL STUDIES

There are three major foundational studies that served as the main inputs for the 2019 IRP Update: The Infrastructure Master Plan, Compliance Plan and Asset Management Plans (AMPs).

As mentioned in ***Section 2.1.2***, since the 2012 IRP Halifax Water has been very active in implementing programs and initiatives to inform the decision-making process and the development of the foundational studies of the IRP Update. ***Figure 11*** presents a list of studies, frameworks and initiatives in the context of each of the foundational studies of the 2019 IRP Update.


***Figure 11 – IRP Foundational Studies***

### 4.1.1 INFRASTRUCTURE MASTER PLAN

The Infrastructure Master Plan focuses on the servicing strategies and management of infrastructure in the Halifax Region, to produce an optimal servicing strategy for the wastewater collection and water supply networks to meet growth. The Infrastructure Master Plan is built off previous completed studies such as the West Region Wastewater Infrastructure Plan (WRWIP) and Regional Centre Local Wastewater Servicing Capacity Analysis (LoWSCA). The Infrastructure Master Plan incorporates the WRWIP and provides servicing strategies for the rest of the wastewater system servicing the Central and East Regions. The Infrastructure Master Plan then follows a similar approach for the water network, by formalizing the foundational policies of regional infrastructure planning in water infrastructure and forming a servicing strategy that covers the regional water network for Halifax Water.

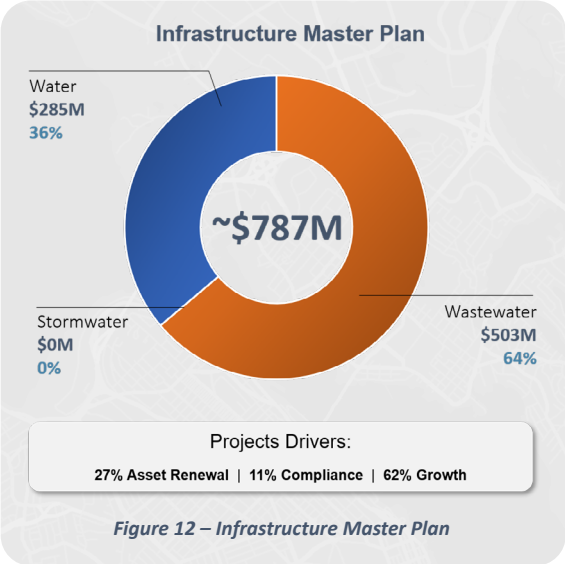



*Figure 12 – Infrastructure Master Plan*

The Infrastructure Master Plan is a key component of long-term planning, providing project costing and phasing. It included development / update of wastewater and water hydraulic models, conceptual designs for priority projects, and forms a work plan for adapting to climate change. ***Figure 12*** presents the total program and percentage split of water, wastewater and stormwater projects as an input into the 2019 IRP Update. The following key inputs were provided by the Infrastructure Master Plan to the 2019 IRP update:

- Planning projections and growth areas.
- Water and wastewater capital projects to 2046 including timing, cost estimates and spatial allocation.
- Wet Weather Management Study – priority areas, best areas with potential for sewer separation, Rainfall derived inflow and infiltration (RDII) reduction, low impact development (LID) and CSO discharge reduction.
- Climate Change Vulnerability Assessment Framework

#### Major components of the Infrastructure Master Plan include:

**Wastewater**

- Mill Cove WWTF Capacity Upgrade
- Dartmouth WWTF Capacity Upgrade and Flow Diversion to Eastern Passage
- Halifax WWTF Capacity Upgrade
- Fairview Cove Tunnel
- BLT Diversion to Halifax Peninsula
- Eastern Passage new Gravity Pressure Sewer upgrade
- Rainfall derived inflow and infiltration (RDII) reduction program across all regions
- Sewer Separation in Halifax and Dartmouth Areas

**Water**

- Pockwock Transmission Twinning (60″) and (54″)
- Bedford – Burnside Lake Major and Pockwock system interconnection
- Water system extension to Bennery Lake
- Robie Transmission Main

### 4.1.1 INFRASTRUCTURE MASTER PLAN CONTINUED

Wastewater projects make 64% of the total cost of the Infrastructure Master Plan component in the IRP Update. 73% of the projected wastewater projects cost are associated with growth, while 17% are associated with compliance and 9% with asset renewal needs.

Water projects make the remaining 36% of the total cost of the Infrastructure Master Plan component in the IRP Update. 60% of the projected water projects cost are associated with asset renewal, system optimization, redundancy and security of supply; while 40% are associated with growth.

There are no stormwater projects in the Infrastructure Master Plan.

Further detailed information can be reviewed in ***Appendix B.1***.

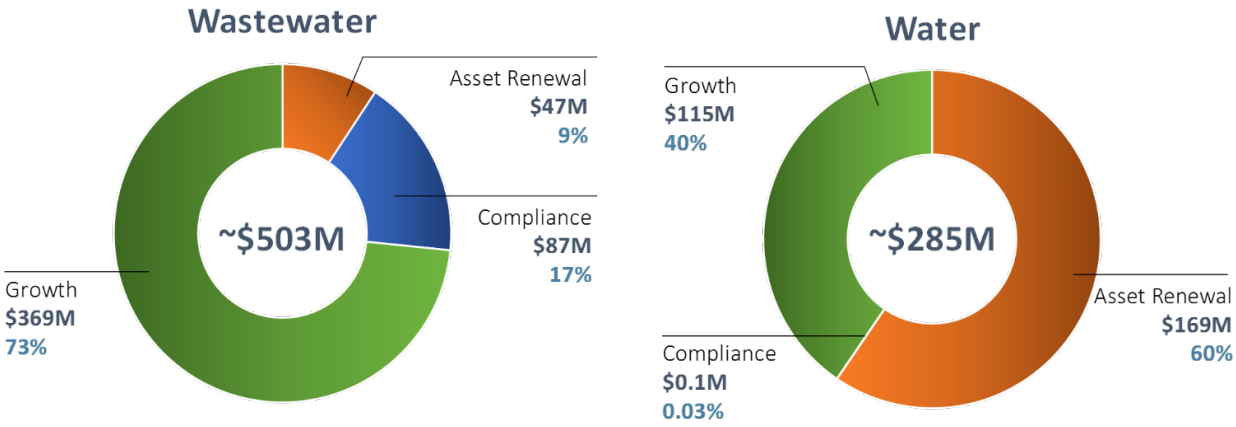



*Figure 13 – Infrastructure Master Plan Wastewater and Water Components*

### 4.1.2 COMPLIANCE PLAN

The Compliance Plan provides a review of the current state of compliance of Halifax Water's infrastructure with federal, provincial and municipal level compliance requirements. The main goal of the compliance plan is to document the long-term (30 years) infrastructure needs related to compliance and to ensure continued compliance requirements are met for wastewater, water and stormwater systems.

The plan discusses and examines wastewater treatment facilities, wastewater collection systems, sanitary and combined sewer overflows, water supply plants, and water distribution systems including water storage reservoirs. ***Figure 14*** presents the total program and percentage split of water, wastewater and stormwater projects from the as an input into the 2019 IRP Update.

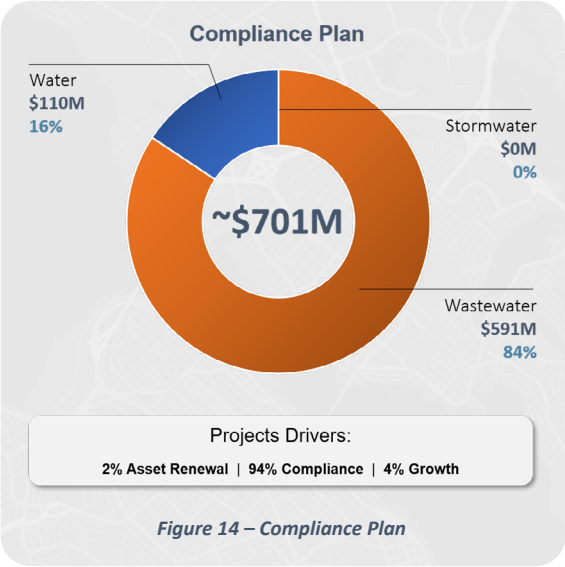



*Figure 14 – Compliance Plan*

The following key inputs were provided by the Compliance Plan to the 2019 IRP Update:

- Current and future regulatory compliance requirements.
- Detailed treatment compliance assessment for WWTFs and WSPs.
- Capital program including timing, cost estimates and location.

### 4.1.2 COMPLIANCE PLAN CONTINUED

**Major project from the Compliance Plan include:**

- Halifax WWTF Upgrade to meet Wastewater Systems Effluent Regulations
- Dartmouth WWTF Upgrade to meet Wastewater Systems Effluent Regulations
- Herring Cove WWTF Upgrade to meet Wastewater Systems Effluent Regulations
- Corporate Flow Monitoring Program and Overflow Monitoring Program
- Wet Weather Management Program
- Lake Major and J.D. Kline WSP upgrades

Wastewater projects make 84% of the total cost of the Compliance Plan component in the IRP Update. 93% of the projected wastewater projects cost are compliance related, while 5% have a growth component and 2% are associated with asset renewal needs.

Water projects make the remaining 16% of the total cost of the Compliance Plan component in the IRP Update. All water projects costs are compliance related, and there are no water projects with asset renewal or growth components.

There are no stormwater projects in the Compliance Plan.

Further detailed information can be reviewed in ***Appendix B.2***.

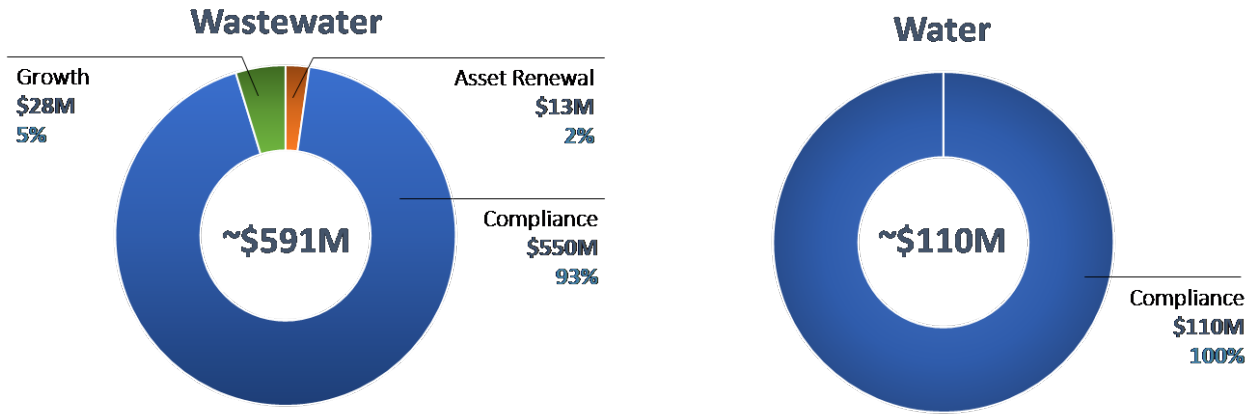



*Figure 15 – Compliance Plan Wastewater and Water Components*

### 4.1.3 ASSET MANAGEMENT PLANS

The Asset Management Plans (AMPs) provide a summary of asset inventory and state of Halifax Water's infrastructure, level of service the assets provide to the customers, infrastructure replacement and maintenance strategies, and associated costs and expenditures.

Halifax Water currently updates the AMPs on an annual basis. The 2019 IRP Update focuses on the 2018 / 2019 AMPs which are expected to be published in Spring of 2020.

The AMPs main document structure consists of an "Overall Main Sections" component followed by individuals AMPs covering 14 different asset class as listed:

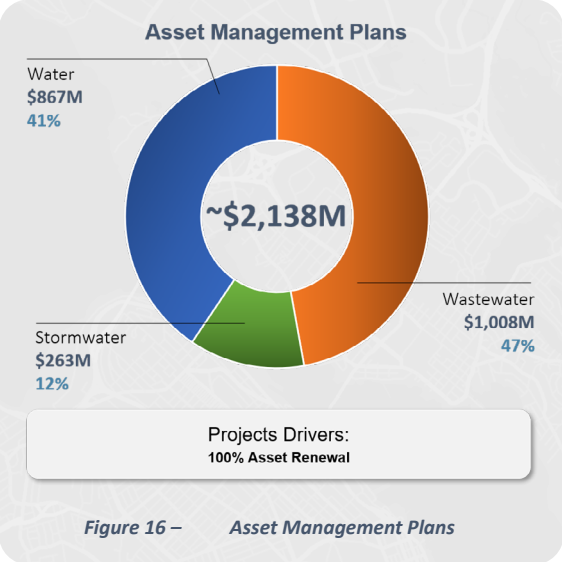



*Figure 16 – Asset Management Plans*

**Water**

- Supply Plants
- Supply Dams
- Chambers & Booster Stations
- Transmission Mains
- Distribution Mains
- Service Reservoirs

**Wastewater**

- Treatment Facilities
- Pumping Stations
- Gravity Sewers
- Forcemains

**Stormwater**

- Management Structures
- Gravity Sewers
- Cross Culverts
- Driveway Culverts and Ditches

The AMPs provide the following key inputs to the 2019 IRP Update:

- Asset inventory and replacement costs for each asset class.
- Asset condition based on age/estimated service life, condition assessments, site inspections, staff knowledge and discussions, depending on the available information for each asset class.
- Recommended 5-year detailed capital expenditures and a 30+ year average forecast for most asset classes.

***Figure 16*** presents the total program and percentage split of water, wastewater and stormwater projects from the Asset Management Plans as an input into the 2019 IRP Update.

All wastewater, stormwater and water projects from the AMPs are associated with asset renewal needs, and there are no projects within the plans with growth or compliance components.

Further detailed information can be reviewed in ***Appendix B.3***.

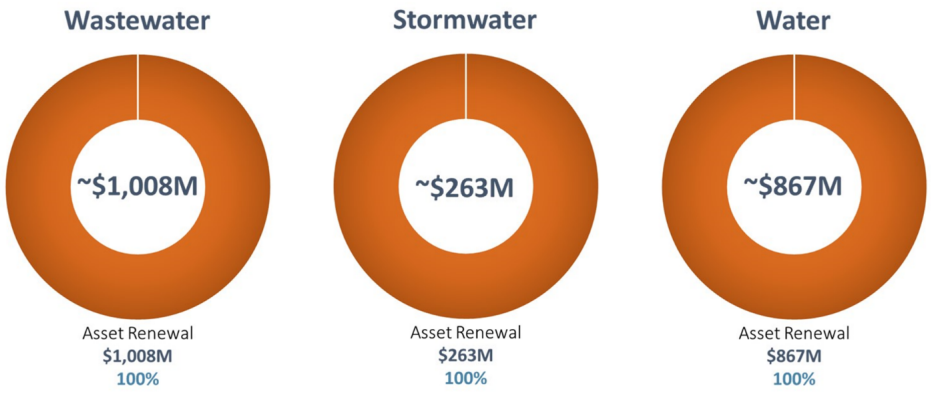



*Figure 17 – AMPs Wastewater, Stormwater and Water Components*

### 4.1.4 CORPORATE PROJECTS

Halifax Water Corporate Projects serve a variety of purposes such as maintaining/updating information systems, building capital improvements, improving customer experience with Halifax Water, among others. Corporate Projects can be classified into seven categories:

- Information Technology (IT)
- Geographic Information System (GIS)
- Asset Management
- Facility
- SCADA & Other Equipment
- Fleet
- Studies, Programs & Initiatives

***Figure 18*** presents the total program and percentage split of water, wastewater and stormwater corporate projects in the 2019 IRP Update.

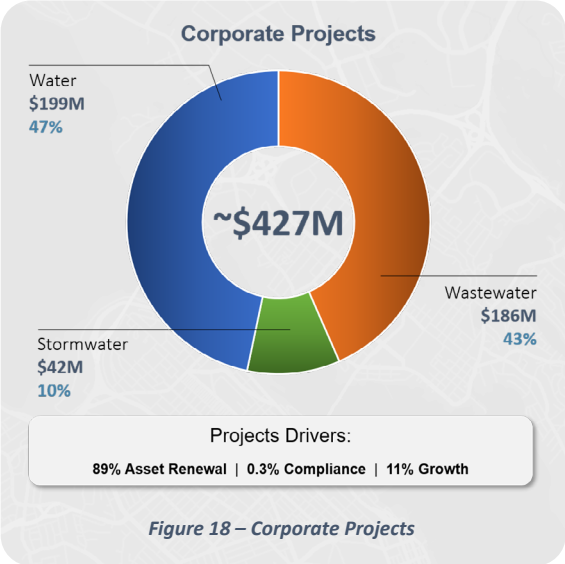



*Figure 18 – Corporate Projects*

The majority of the corporate projects are associated to asset renewal needs with 85%, 89% and 93% for the wastewater, stormwater and water systems respectively. The growth component of the corporate projects for the three systems varies from 6% to 15%, while the compliance component remains the lowest percentage varying from 0.3% to 1%.

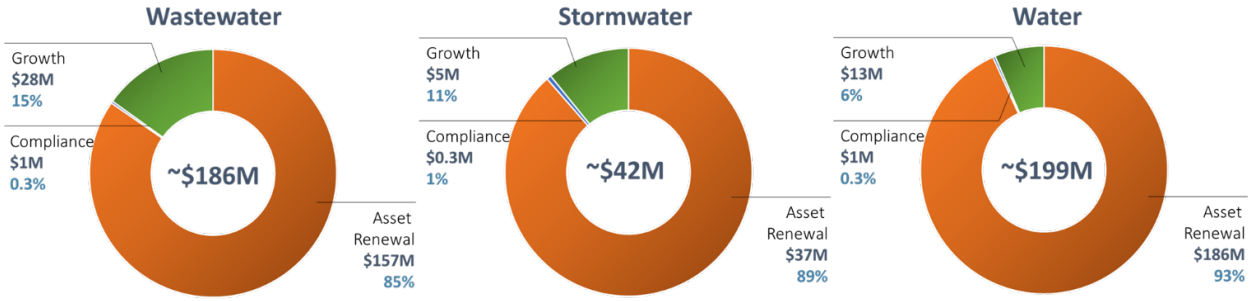



*Figure 19 – Corporate Projects Wastewater, Stormwater and Water Components*

## 4.2 DEMAND SIDE MANAGEMENT AND SUPPLY SIDE MANAGEMENT REVIEW

As part of the 2019 IRP Update process a review of demand side management (DSM) and supply side management (SSM) practices and measures was undertaken. The purpose of the DSM/SSM exercise was to review and evaluate DSM and SSM measures currently in place by Halifax Water, and consider additional measures implemented by other utility companies and municipalities. Through collaboration with Halifax Water staff, each identified measure was reviewed and evaluated to provide recommendations for improvements and select new measures for potential future implementation.

Demand side management (DSM) relates to the management of water, wastewater and stormwater at the point of use, that affects customer usage and education, utility rates, regulations and private property connections. DSM activities are those that occur on the customer side of the property boundary. DSM measures are guided and supported by Halifax Water (in some cases in association with HRM), however, the rate of success is determined by the level of customer involvement. Challenges for DSM are mostly related to implementation costs and inconvenience to customers.

Supply side management (SSM) relates to the management of water, wastewater and stormwater infrastructure to meet or exceed customer demands including system optimization, upgrades, and infrastructure repair and replacement. SSM activities are those that occur at Halifax Water facilities or within the public right-of-way. SSM measures are implemented by Halifax Water (in some cases in association with HRM), therefore, the rate of success is determined by the planning, design and operation of the infrastructure. Challenges for SSM are mostly related to infrastructure and energy costs.

The DSM/SSM measures review process involved the following steps:

1. Review of existing measures currently planned or implemented by Halifax Water.
2. Review of best practices from other utilities/municipalities within and outside Canada.
3. Evaluating the long list of DSM/SSM measures in collaboration with Halifax Water.
4. Identification of potential new measures and/or enhancement opportunities.

The review demonstrated that Halifax Water is currently implementing a wide range of measures across all DSM/SSM categories covering all systems (water, wastewater, stormwater) and driver type (growth, asset renewal, compliance).

Potential enhancement opportunities and recommendations to current DSM/SSM measures were discussed during the review process. The following enhancement opportunities and recommendations resulted from the DSM/SSM review and discussion:

- Development of key performance indicators (KPIs) and targets in accordance with Halifax Water's goals and objectives, drivers and level of service.
- Further enhancement of public education including tailoring initiatives for specific area needs, keeping the public informed, and promoting collaborative work with government and organizations.
- Continuing the collection of data that support DSM/SSM measures.
- Improving integration between organizations/jurisdictions, programs/initiatives, data and processes.
- Explore revisions to the Rules and Regulations to allow more flexibility to undertake private side works to meet the goals of RDII reduction.

More detailed information about the DSM/SSM review process, findings and recommendations can be found in Appendix A.2.

## 4.3 DATA / GIS LINKAGE AND GEOSPATIAL INTEGRATION

Early in the 2019 IRP update process, it was identified that Data / GIS linkage and Geospatial Integration presented opportunities for improvement and enhancement of the program integration process. Since the 2012 IRP, Halifax Water has taken steps to update their GIS on a continual basis as new information is available. Halifax Water updates their asset management plans on an annual basis incorporating any new data available such as asset condition based on best available information (age / estimated service life, conditions assessments, site inspections, staff knowledge and discussions).During the development of the IRP Update a Data / GIS Linkage exercise was undertaken which consisted of:

1. Compilation of GIS layers for each asset class (e.g. watermains, sewers, facilities)
2. Extraction of asset condition data from AMPs (e.g. age, condition, replacement year)
3. Pairing of condition data to each asset in GIS layers based on Asset ID or spatial location

***Table 10*** below provides a summary of the GIS features and data from the AMPs that was used in the Data / GIS linkage exercise. The table outlines the names of the files used, as well as the fields used in the pairing process.

***Table 10 – Data / GIS Linkage Report***

| System | GIS Shapefiles | | | AMP Excel Files | | |
|---|---|---|---|---|---|---|
| | **Featureclass Name** | **# Records** | **Field used to Pair** | **AMP File Name** | **Condition Tab** | **Field used to Pair** |
| **Water** | TranMainCond AST_water_pipe (Transmission) | 566 | TMCID | AMP A4 2018-19- Water Transmission Mains | TMC Data | • TMCID<br>• Spatial Intersection |
| | AST_water_pipe (Distribution and Transmission) | 15262 | Pipekey | AMP A5 2018-19- Water Distribution Mains | Data for AMP | • Pipe Key<br>• Spatial Intersection |
| | AST_water_ structure_point | 372 | NAME | AMP A3 2018-19- Water Chambers and Booster Stations | AMP Data | NAME |
| | | | NAME | AMP A6 2018-19- Water Reservoirs | A5- Reservoirs | MASTER-ID/OBJECTID |
| | | | MASTERID | AMP A1 2018-19- Water Supply Plants | AMP Data | MASTER-ID/OBJECTID |
| **Collection System** | HWCS_pipe | 82192 | CS_PipeID | AMP B3 2018-19- Wastewater Gravity Sewers 20June2019 | Data for AMP | Pipe ID |
| | | | | AMP B4 2018-19- Forcemains_16 May | GIS data HW Pipes | |
| | | | | AMP C2 2018-19- Stormwater Gravity Sewers Revised 17 May | Pipe Data | |
| | | | | AMP C3 2018-19- Stormwater Cross Culverts | Merged Data | |
| | HWCS_storm_ mgmt_structure | 92 | CS_ SWM STRUCTURE ID | AMP C1 2018-19- Storm-water Management Structures | 2018 19 AMP | Stormwater Mgmt Structure ID |
| | HWCS_ treatment_ facility | 18 | CS_ TREATMENT FACILITYID | AMP B1 2018-19- Wastewater Treatment Facilities | - | Data for IRP |

The data / GIS linkage exercise resulted in a new GIS data set of Halifax Water systems that contains information from GIS and AMPs. This new data set was used to develop a Geospatial Integration Tool to support the program integration process.

### 4.3.1 GEOSPATIAL INTEGRATION TOOL

The geospatial integration tool was built using QGIS to combine multiples sources of GIS layers and datasets into one GIS interface with all relevant information.

***Figure 20*** depicts a sample of the interface of the geospatial integration tool.

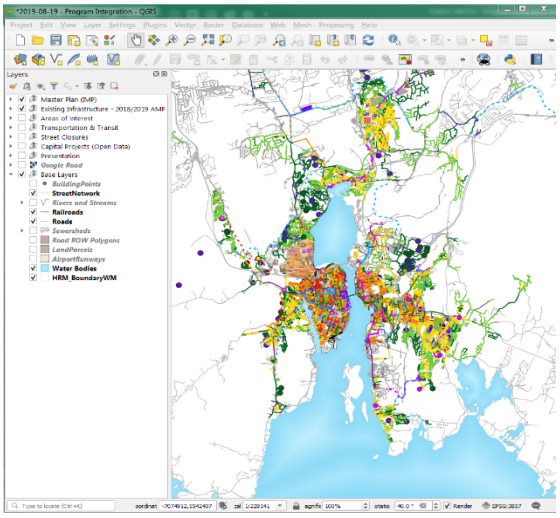


*Figure 20 – Geospatial Integration Tool*

A sample of the datasets that were used in the development of the geospatial integration tool include:

- Master Plan capital projects – linear and vertical water and wastewater projects.
- RDII Reduction Areas – as outlined in the Infrastructure Master Plan.
- Existing infrastructure – asset inventory and condition resulted from the data / GIS linkage exercise.
- Areas of interest – growth areas, LoWSCA areas, WWMP areas, HRM Flood study sites, etc.
- Transportation and Transit – Location of transit and transportation features and planned projects.
- Street closures – Location of planned street closures that might affect project implementation.
- HRM Capital Projects – location of HRM capital projects (2019).
- Base layers – Base layers that provide context of the natural environment, municipal boundaries, land parcels, etc.

The geospatial integration tool was used to determine areas with potential for integration. These areas were determined spatially by visually inspecting different zones in Halifax Water systems with planned capital projects and existing infrastructure in poor condition. The GIS interface allowed for easy review of projects, asset condition, extent, location, among other details; and to identify any opportunities for project bundling or coordination. ***Figure 21*** below provides an example of use of the geospatial integration tool to identify integration opportunities.

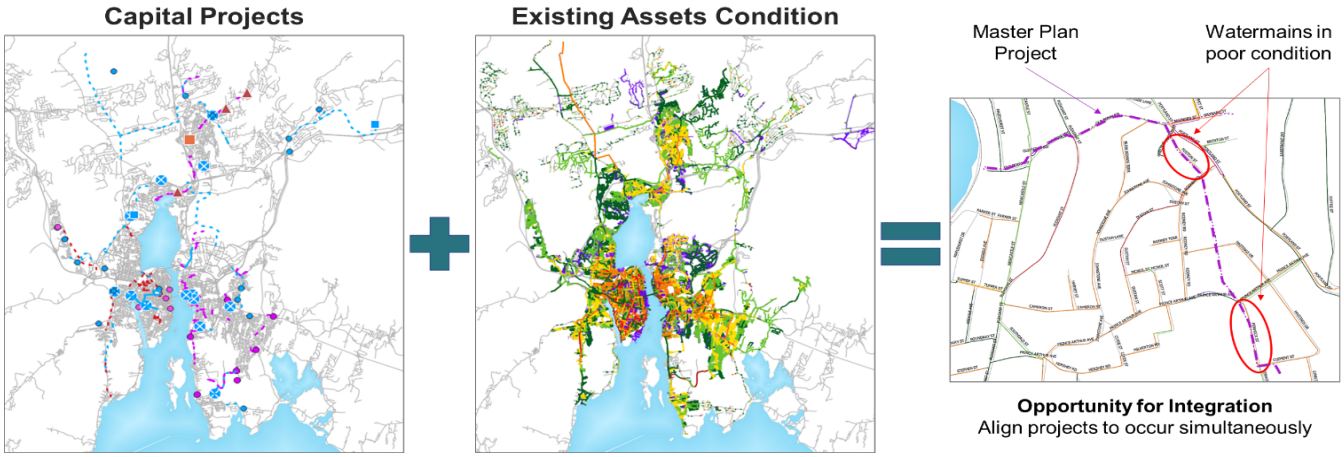



*Figure 21 – Geospatial Integration Opportunity Example*

## 4.4 EXPENDITURE ANALYSIS AND COSTING REVIEW

For the 2019 IRP update, the AMPs were used to determine the majority of the asset renewal expenditure needs for the existing water, wastewater and stormwater systems. A review of the level of detail of the data contained in the AMPs for each asset class was completed, particularly regarding: condition source, replacement costs and granularity of the data.

The results from the asset renewal expenditure needs analysis identified an opportunity to review, refine, update and integrate base unit costing for the three foundational studies (Infrastructure Master Plan, Compliance Plan and AMPs). Cost estimation practices have an impact on capital costing, new infrastructure costs, target reinvestments rates, RDC rates and assumptions incorporated into the capital programs. Therefore, it was considered vital that the cost estimating assumptions for asset renewal, growth and compliance driven projects were aligned.

All AMPs for each asset class were reviewed to establish confidence in the data sources. Through discussions with the Halifax Water team, the following five asset classes were identified to have low confidence in replacement costs and could benefit from further assessment: Water Supply Plants, Wastewater Treatment Facilities, Wastewater Pumping Stations, Wastewater Forcemains, Stormwater Management Structures.

The goals and objectives for the costing analysis were:

- Improve the asset classes with low confidence in their replacement cost estimate;
- Check the alignment between Halifax Water Infrastructure Master Plan and Asset Management Plans costing approaches;
- Provide recommendations for unit costs and replacement cost adjustments if necessary.
- Provide confidence, transparency and traceability to support funding streams.

The costing analysis consisted of a high-level desktop exercise completed to compare multiple sources of costing data / information. The analysis approach can be summarized in the following seven steps:

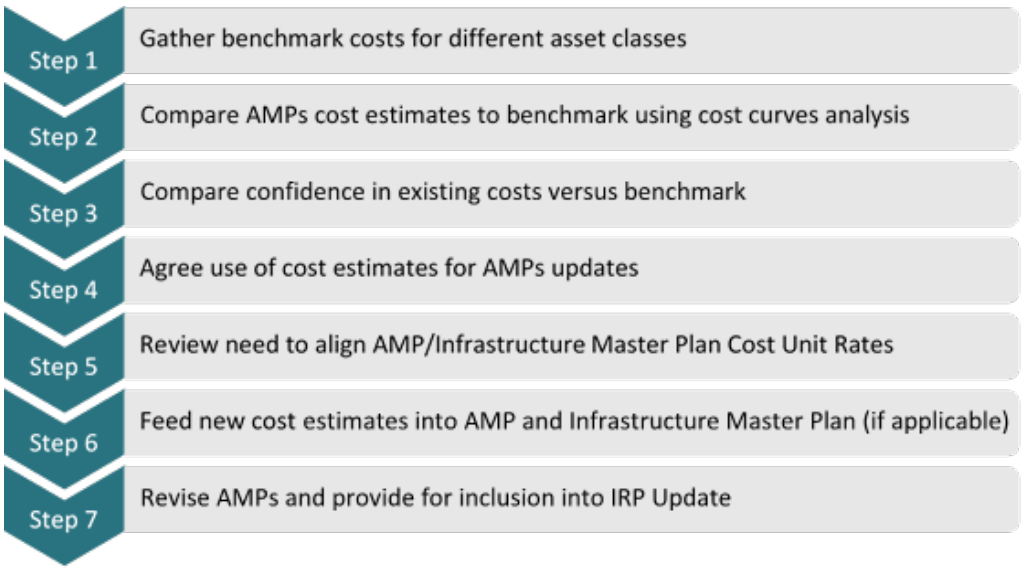



*Figure 22 – Costing Analysis Approach*

## 4.4 EXPENDITURE ANALYSIS AND COSTING REVIEW CONTINUED

The following sources of information were used in the costing analysis are presented below in ***Table 11***.

***Table 11 – Costing Analysis Sources***

| Source | Description |
|---|---|
| Halifax Water AMP | Replacement costs and unit costs provided in the AMPs are described in the Expenditure Needs Analysis workbook provided in Appendix A.3 |
| Halifax Water Infrastructure Master Plan | The MP Rates were established in the preparation of the Functional Plan and WRWIP, and further updated during the Master Plan development process. |
| Modeling the Cost of Infrastructure Environmental Protection Agency (EPA) | United States EPA completed an update to a previous study in 1999 to estimate the 20-year capital investment needs of public water systems by developing cost curves for various water and wastewater assets. |
| Water and Wastewater Asset Cost Study- Ministry of Public Infrastructure Renewal (MPIR) | The Ontario MPIR completed a study in 2005 to provide life cycle costing information to assist in determining investment needs in the water and wastewater sector. |
| Various Municipal Replacement Cost and Unit Cost Data | GMBP leveraged their knowledge base of information from past projects and experiences. This included Ontario municipalities of populations ranging from less than 25 thousand to over 2 million. Data sources were collected from AMPs, MP, State of Infrastructure re-ports, etc. Further descriptions were included in the IRP Cost Comparison provided in ***Appendix A.3***. |

The costing analysis was carried out as a collaborative effort with Halifax Water's asset management team which used the information to update the 2018/2019 AMPs. In addition, the Infrastructure Master Plan also benefited from this exercise with the adjustment of cost unit rates to be aligned with the AMPs.

The AMPs expenditure analysis costing analysis ultimately resulted in the following recommendations:

- Annual review of all unit rates (linear and vertical)
- Enhance cost estimating approach for vertical facilities (e.g. pumping stations, storage facilities, treatment plants)
- Develop a more detailed approach for complex facilities that may include unit rates for subcomponents
- Continue benchmarking construction projects

More detailed information on the AMPs expenditure analysis and costing review exercise is provided in Appendix A.3.

## 4.5 PROGRAM INTEGRATION

The Long-Term Capital Plan (LTCP) was developed based on a six-step approach for program integration as shown below in ***Figure 23***.

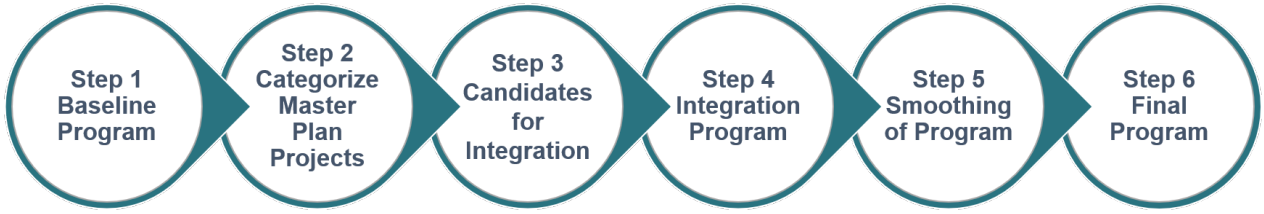



***Figure 23 – LTCP: Program Integration Approach***

**Step 1:** The first step was the development of the **Baseline Program** by compiling all individual projects from the study inputs into one comprehensive table including project specific information such as cost, year, drivers, driver splits, objectives.

**Step 2:** The second step was to **Categorize Infrastructure Master Plan Projects** based on critically and timing to identify which projects could be advanced, delayed or have a fixed timing.

**Step 3:** The third step was to identify **Candidates for Integration**. At this stage the objective was to identify projects that were happening at the same time and could be coordinated / bundled together, have critical timing, could align with state of good repair program, and/or require coordination with external influences. The Geospatial integration tool presented in ***Section 4.3*** was used in this step to identify candidate projects for integration.

**Step 4:** The fourth step was the **Program Integration**. This step involved workshops with Halifax Water project team to review candidate projects for integration, provide an update on the process and confirm the integration program and approach.

**Step 5:** The fifth step was the **Smoothing of the Program**. Once the program was reviewed and integration opportunities were confirmed, a smoothing process was completed to bring a realistic aspect to the program for implementation. This process is presented in more detail in ***Section 4.5.2***.

**Step 6:** The last step of the program integration process was the development of the **Final Program** and recommendations. The final program was provided to Halifax Water for inclusion in their financial model for debt, rate structure and affordability analysis.

### 4.5.1 DECISION MAKING TREES

During the development of the 2019 IRP Update various Decision Trees were developed to guide the program integration process. The first decision tree was developed and used as part of **Step 2** to categorize each individual Infrastructure Master Plan project based on criticality of timing. The result of this process was a comprehensive list of Master Plan projects categorized based on the four project types:

**Type A –** Flexible Timing

**Type B –** Project can be delayed but not advanced

**Type C –** Project can be advanced but not delayed

**Type D –** Fixed timing as per Master Plan

Each project was individually reviewed and categorized and comments about timing, critical paths, relationship with other projects, among others; were added to inform the integration and smoothing process, but also for future use for Halifax Water in their financial modelling and analysis.


*Figure 24 – Decision Making Tree (Step 2)*

For each type of project (A,B,C,D) an additional decision tree was created as part of **Step 3**. The decision tree was used with support of the geospatial integration tool (***Section 4.3***) to identify potential candidate projects for integration. A sample decision tree for **Step 3** is presented further in ***Figure 25***.

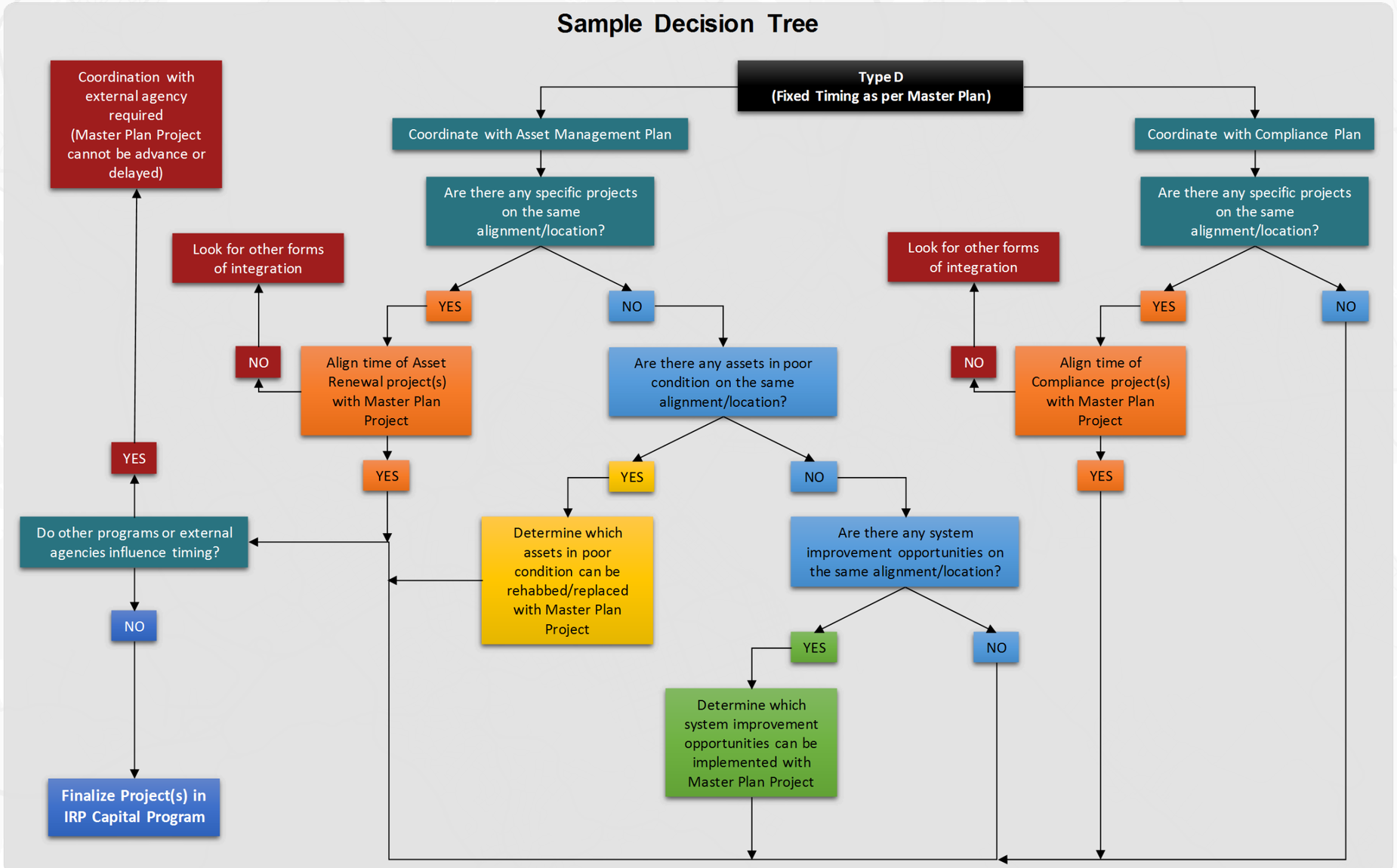



*Figure 25 – Sample Decision Making Tree (Step 3)*

### 4.5.1 DECISION MAKING TREES CONTINUED

This process aimed to:

- Identify projects that were happening at the same time in order to coordinate or bundle together
- Identify related projects that have critical path timing
- Identify projects that could align with the state of good repair programs, but that are not currently identified as individual projects
- Identify projects which timing could be moved to better align with other initiatives / projects
- Identify projects that require coordination / tracking with external influences

The Geospatial integration tool presented in ***Section 4.3*** was used in this step to identify candidate projects for integration.

The result of this process was a capital program that contained proposed new timing for specific projects as well as a list of new candidate projects from the state of good repair program that can be better aligned. This program was then further refined through **Steps 4 to 6** of the program integration process.

### 4.5.2 PROGRAM SMOOTHING

The smoothing of the IRP Capital Program is one of the last steps of the program integration process. The smoothing exercise cash flows the projects to better represent how the capital program will be delivered.

The program smoothing process consisted of flattening the cost expenditure peaks in the program by adding projects splits for multiple year expenditures to account for projects phases such as preliminary design, detailed design and construction over two years. This process was applied to projects greater than $1 million dollars that were not already smoothed or programmed for multiple years.

The smoothing process followed a set of rules defined by Halifax Water and further refined through the development of the 2019 IRP Update. The process uses a ranking system for the application of the rules and every decision has been flagged and documented to be traceable and defendable.

***Figure 26*** presents the 2019 IRP program before and after the smoothing exercise was completed.

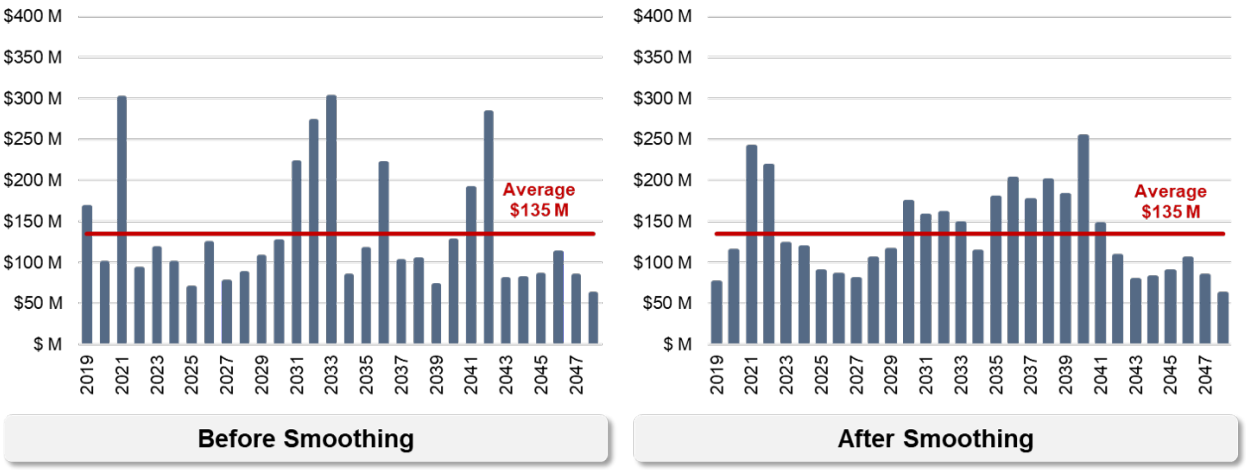



*Figure 26 – IRP Capital Program Before and After Smoothing*

### 4.5.3 2019 IRP UPDATE CONSULTATION

During the development of the 2019 IRP Update, stakeholder involvement and input was an important aspect of the consultation process. The main consultation teams involved members of Halifax Water project team, Halifax Water Directors, Halifax Water Board, and NSUARB Consultants. GM BluePlan acted as a liaison with the consultation teams to confirm key aspects in the development of the IRP update such as data gaps, regulatory requirements, study inputs content and limitations, ongoing and future planned work, among others.

As part of the consultation process, key meetings were held throughout the duration of the project to agree on key subjects such as the IRP vision and scope of the update, and also to inform parties on progress and decisions as they were made. The overall consultation process is covered in this section.

#### 4.5.3.1 Halifax Water Staff & Directors

The GM BluePlan team worked closely with Halifax Water to ensure proper execution of this project. It was the Project team's intent to be in regular contact with Halifax Water throughout the duration of the project and ensure that other parties were consulted and updated appropriately. For this purpose, weekly meetings were set up to ensure Halifax Water team was kept informed on progress and directly involved in all decisions. In addition, to share documents between those involved in the project, Halifax Water created an IRP Update Project Site on SharePoint enabling concurrent access to key project documentation.

The Halifax Water project team has been involved in all meetings and workshops with Halifax Water Board and NSUARB Consultants. During the project meetings and workshops, it was GM BluePlan's role to present study findings and solicit technical input.

To support the communication and consultation process, GM BluePlan issued the following documents to Halifax Water:

- Project Charter – Outlining project purpose, business objectives, scope, deliverables and the governance structure.
- Project Management Plan – Outlining the project background, project management objectives, schedule budget, quality assurance, health & safety, risk management and the communication & information management approach.
- Revised Project Schedule, as required.

#### 4.5.3.2 Halifax Water Board

As discussed in section 2.2.3, Halifax is governed by the Halifax Board of Commissioners. Several meetings with the Halifax Water Board were held during the development of the 2019 IRP update. At the outset of the project a kick-off meeting was held to introduce the project. Subsequent meetings provided updates of the process and presented the outcome of the IRP Update including the long-term capital plan and recommendations.

#### 4.5.3.3 Nova Scotia Utility and Review Board (NSUARB)

NSUARB is an independent body with both regulatory and adjudicative jurisdiction. The NSUARB provides general supervision over all public water utilities within the Province, including involvement in rate setting, approval of large capital expenditure projects and reviewing complaints.

Consultant representatives of the NSUARB have been involved in several other Halifax Water studies and initiatives such as the Infrastructure Master Plan and Compliance Plan. In the context of the IRP Update, to keep NSUARB informed several meetings occurred throughout the project. During the meetings progress updates were presented, responses to previous questions from NSUARB were provided and recommendations from the NSUARB representatives were discussed and incorporated into the overall project.

# 5.0 LONG-TERM CAPITAL PLAN

## 5.1 2019 IRP UPDATE CAPITAL PROGRAM

The long-term capital plan generated through the completion of the 2019 IRP update amounts to a 30-year program of $4,054 million. This represents a net present value (NPV) of $2,691 million and a yearly average of approximately $135 million for the next 30 years.

The timing of projected expenditures (in $2019 dollars) is presented in ***Table 12*** and ***Figure 27*** which shows significant expenditures above the yearly average at key points in the next 30 years related to the following projects:

- Mill Cove Wastewater Treatment Plant Capacity Upgrade (2020-2022)
- Lake Major and J.D. Kline WSP upgrades (2020-2030)
- Pockwock Transmission Twinning – 60″ (2028-2031)
- Future Enhanced Overflow Program (2033-2042)
- Dartmouth WWTF Upgrade to meet Wastewater Systems Effluent Regulations (2035-2038)
- Herring Cove WWTF Upgrade to meet Wastewater Systems Effluent Regulations (2036-2039)
- Halifax WWTF Upgrade to meet Wastewater Systems Effluent Regulations (2037-2040)

***Table 12 – 2019 IRP Recommended Expenditure (30-Year)***

| System | 2019-2028 | 2029-2038 | 2039-2048 | Total |
|---|---|---|---|---|
| Wastewater | $652 M | $948 M | $687 M | $2287 M |
| Stormwater | $63 M | $134 M | $108 M | $306 M |
| Water | $530 M | $539 M | $391 M | $1461 M |
| **Total** | **$1245 M** | **$1621 M** | **$1187 M** | **$4054 M** |
| **30-year Average** | **$135 M** | | | |

The projected expenditures by driver and system are shown in ***Figure 28***. Approximately 68% of the projected expenditures are associated with asset renewal and the remainder split between 14% for growth and 18% for compliance. 56% of the projected expenditures are associated with the wastewater system, while 36% are associated with the water system and 8% with the stormwater system.

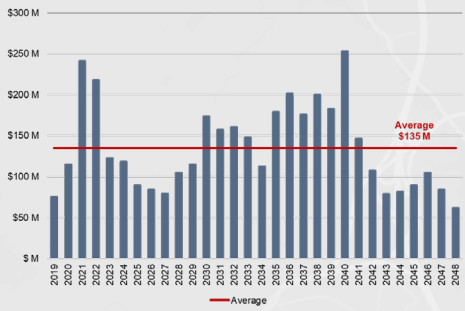



***Figure 27 – 2019 IRP Recommended Expenditure by Year***

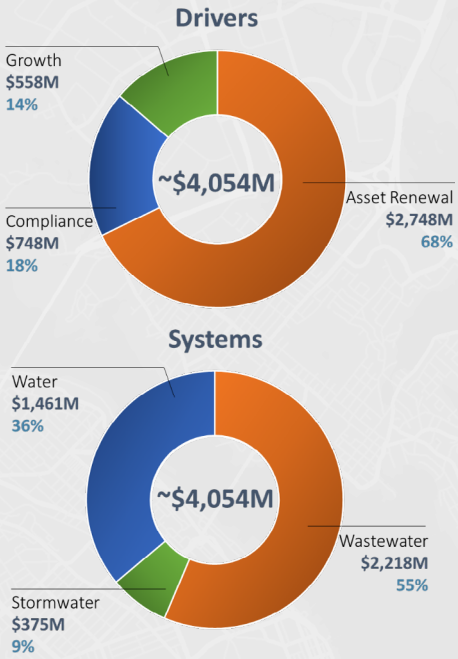



***Figure 28 – 2019 IRP Recommended Expenditure by Driver***

## 5.1 2019 IRP UPDATE CAPITAL PROGRAM CONTINUED

The timing of projected expenditures by driver (in $2019 dollars) is presented in ***Figure 29*** which shows the fluctuation of asset renewal requirements across the 30-year period. Growth projects are more concentrated in the first 4 years mainly related to Infrastructure Master Plan projects including the Eastern Passage new gravity pressure sewer, Mill Cove WWTF capacity upgrade, Fairview Cove tunnel and BLT diversion projects. Compliance projects are mostly concentrated between 2035 and 2040, mainly related to the WWTF upgrades to WSER requirements and the Enhanced Overflow Program.

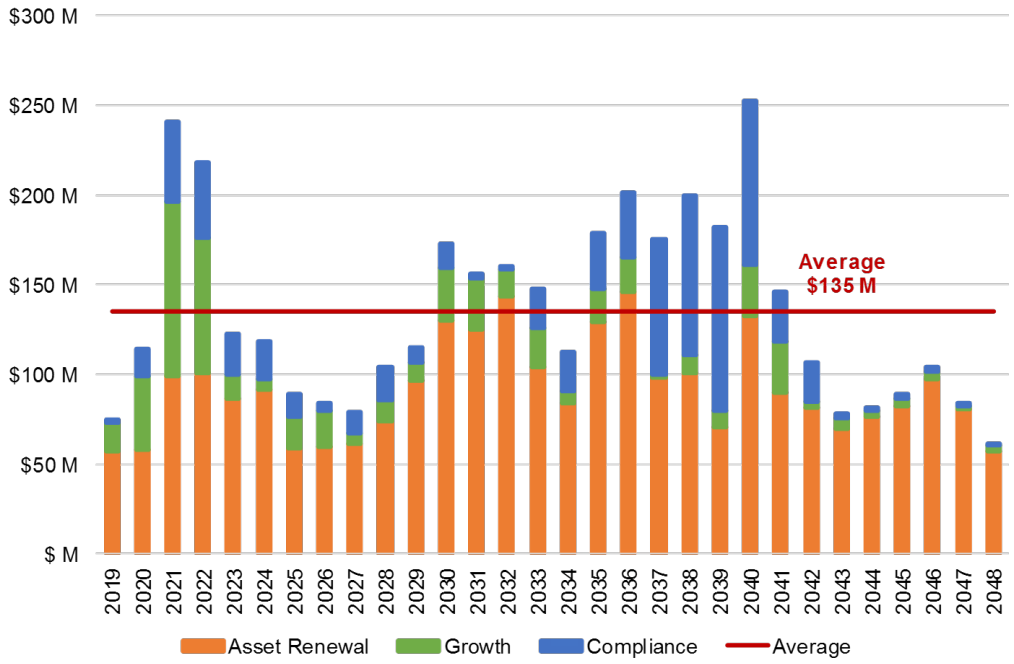



*Figure 29 – 2019 IRP Recommended Expenditure by Year*

The timing of projected expenditures for the wastewater, stormwater and water systems (in $2019 dollars) is presented in ***Figure 30*** which shows the fluctuation of expenditures requirements across the 30-year period.

The wastewater system presents an average expenditure need of $76 million over the 30-year period. This is the highest average among all three systems due the significant large projects such as the Mill Cove WWTF Capacity Upgrade and various WWTF upgrades to meet WSER.

The stormwater average expenditure need remains pretty steady around $10 million with no major fluctuations across the 30-year period.

## 5.1 2019 IRP UPDATE CAPITAL PROGRAM CONTINUED

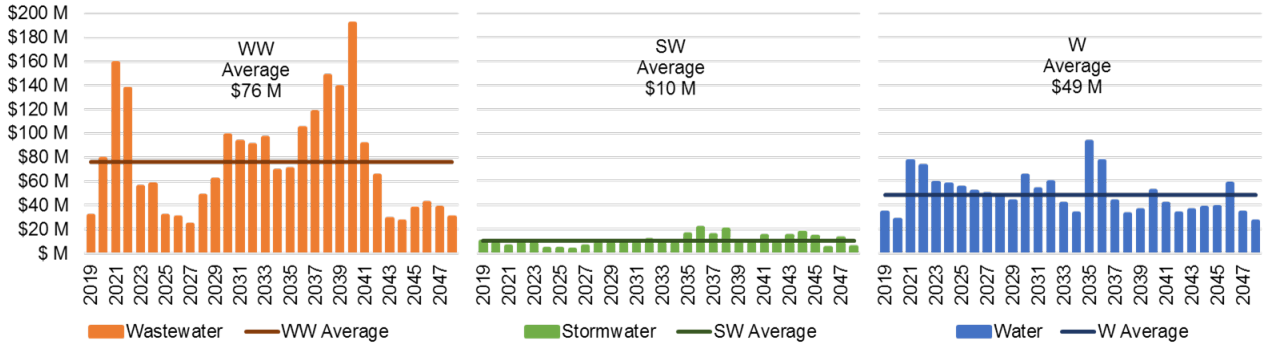



*Figure 30 – 2019 IRP Recommended Expenditure by System*

The water system presents an average expenditure need of approximately $49 million with some high peak fluctuations around 2035-2036 related to Pockwock Transmission main twinning, Bedford-Burnside System Interconnection phases 1 & 2, and some high asset renewal requirements for water distribution and transmission mains.

### 5.1.1 2019 IRP UPDATE 5-YEAR EXPENDITURE NEEDS

The short-term capital plan generated through the completion of the 2019 IRP update amounts to a 5-year program of $771 million. This represents a yearly average of approximately $155 million for the next 5 years which is approximately $20 million higher than the 30-year average of $135 million identified for the total program to 2048.

The timing of projected expenditures (in $2019 dollars) is presented in ***Table 13*** and ***Figure 31*** which shows significant expenditures above the yearly average at key points in the next 5 years.

*Table 13 – 2019 IRP Recommended Expenditure (5-Year)*

| System | Y1 2019 | Y2 2020 | Y3 2021 | Y4 2022 | Y5 2023 |
|---|---|---|---|---|---|
| Wastewater | $31 M | $79 M | $158 M | $137 M | $55 M |
| Stormwater | $10 M | $8 M | $5 M | $8 M | $9 M |
| Water | $34 M | $28 M | $77 M | $72 M | $59 M |
| **Total** | **$75 M** | **$114 M** | **$241 M** | **$218 M** | **$123 M** |
| **5-year Average** | **$154 M** | | | | |

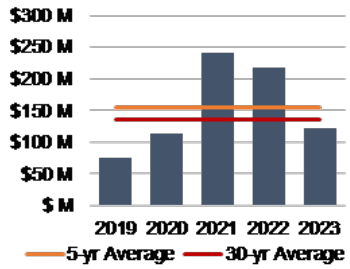



*Figure 31 – 2019 IRP Recommended Expenditure (5-Year)*

### 5.1.2 2019 IRP COMPARISON WITH THE 2012 IRP

Since the 2012 IRP Halifax Water has actively implemented programs and initiatives that have better informed the decision-making process and the development of the foundational studies of the 2019 IRP. The result of closing many of the gaps and assumptions made in the 2012 IRP has resulted in fundamental changes in the 2019 IRP. This makes a straight comparison of the two plans difficult. The following section summarizes a high-level fiscal comparison and then outlines the factors that have impacted the resulting differences.

In order to compare the 2012 IRP and 2019 IRP programs, the 2012 IRP program was inflated to 2019 dollars using an annual 2 percent inflation rate per year from 2012 to 2019.

***Figure 32*** and ***Figure 33*** present the comparison of the 2012 and 2019 Integrated Resource Plans in 2019 dollars.

| Integrated Resource Plan (2019 $) | 2012 | 2019 |
|---|---|---|
| Total Program | ~ $4,506 M | ~ $4,054 M |
| 30-year Net Present Value | ~ $2,901 M | ~ $2,691 M |
| 30-year Average | ~ $150 M | ~ $135 M |

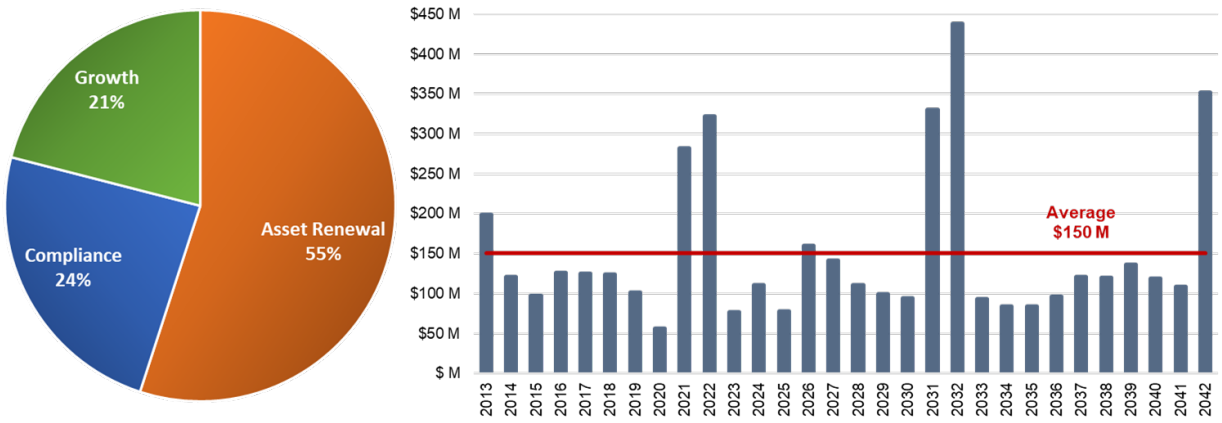



*Figure 32 – 2012 Integrated Resource Plan*

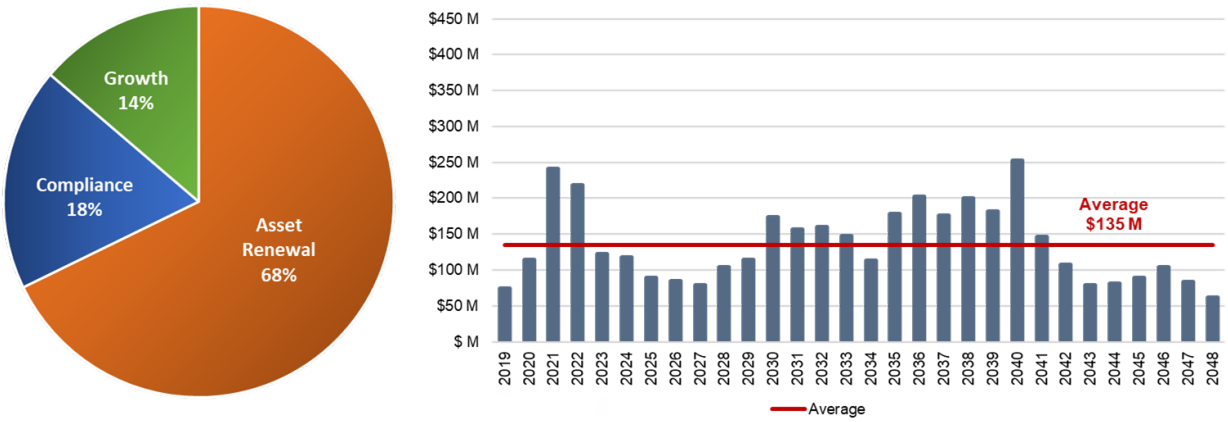



*Figure 33 – 2019 Integrated Resource Plan*

### 5.1.3 2019 IRP COMPARISON WITH THE 2012 IRP CONTINUED

The effect of comparing the 2019 IRP to the 2012 in 2019 dollars results in approximately a 10% reduction in overall expenditure. The percent split between drivers for the 2019 IRP when compared to the 2012 IRP resulted in a 13% increase related to asset renewal, 7% decrease in growth and a 6% decrease in compliance.

The main factors for differences in the two programs are:

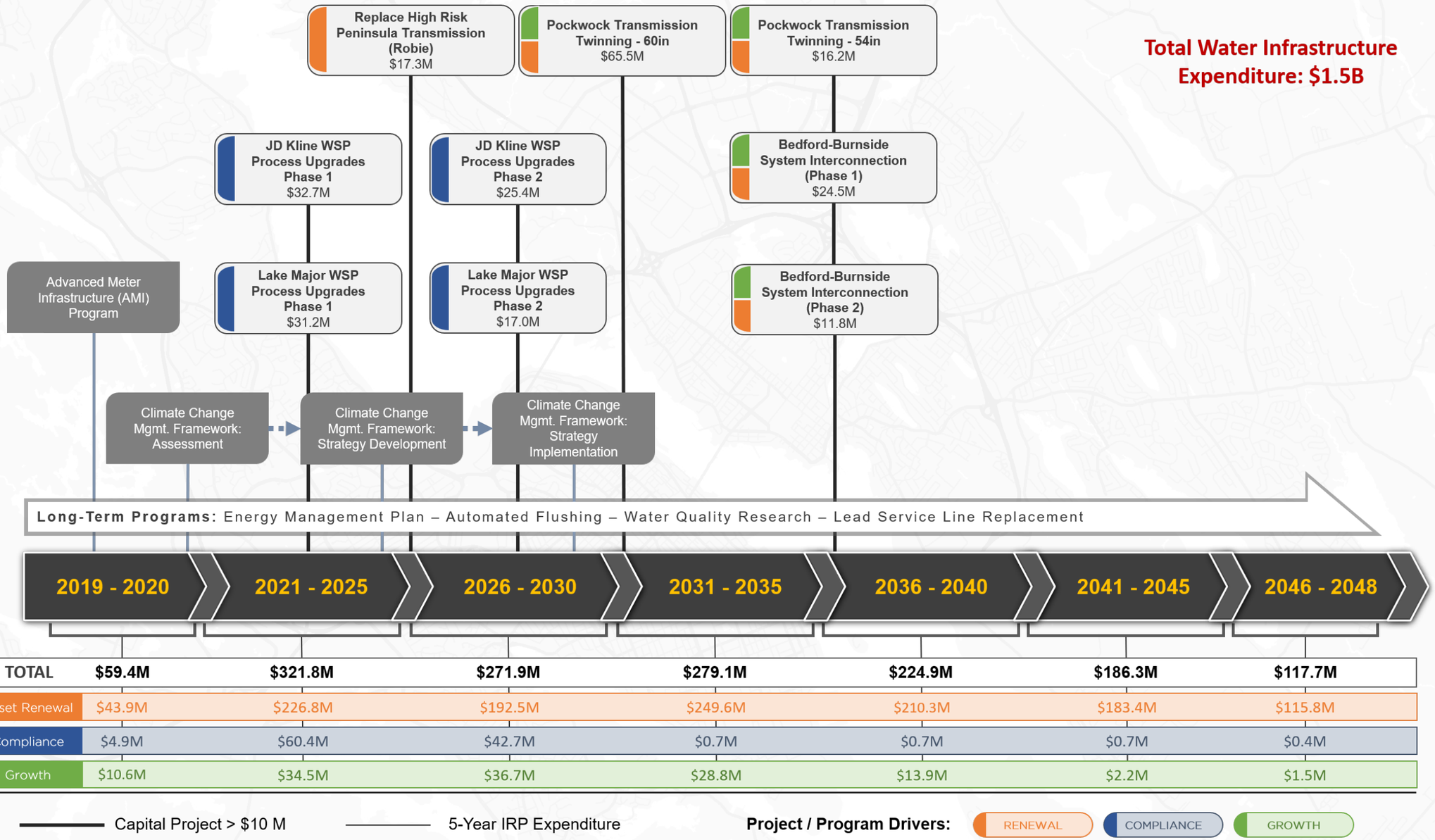
- The 2012 IRP was predicated on broad assumptions due to the extent of data gaps at the time. The 2019 IRP's foundational studies and inputs are new, having filled many of the previous gaps of the 2012 IRP. This has generated a fundamentally different plan.
- The 2012 IRP inputs included the Regional Wastewater Functional Plan (RWWFP) and Halifax Water Capital Budget. At that time, no formal Asset Management Plans, Compliance Plan, or Water Master Plan were in place. The 2019 IRP has benefited from the work Halifax Water has completed to close data gaps identified in 2012 which translated to improved study inputs: Water and Wastewater Infrastructure Master Plan, Compliance Plan, and Asset Management Plans.
- The results of the driver allocation splits between the 2019 and 2012 programs are considerably different. This can be attributed to the detailed programs and analysis completed in the inputting studies and plans. The subsequent infrastructure strategies, programs and projects have resulted in a much more integrated program that can often benefit more than one driver. The improved level of detail available for the 2019 IRP has also enabled a more informed driver allocation compared to the 2012 IRP.
- The 2012 IRP program has significant peaks in expenditure related to WWTF and enhanced overflow program, among other projects. While the 2019 IRP Update program contains the same projects, the program has been smoothed to provide more realistic timing that accounts for project implementation phases such as preliminary design, detailed design and construction.
- Both the 2012 IRP and 2019 IRP propose long-term capital programs with 30-year horizons. However, the time period/horizon have changed and the 2019 IRP looks further than the previous IRP.
- The 2012 IRP program included Operation and Maintenance (O&M) components, while the 2019 IRP program does not include O&M components in the capital program.

The 2019 IRP demonstrates the value of master planning as a part of Halifax Water's continuous improvement and adaptive planning process. Further, these variations support the value that the efforts undertaken in the intervening years have contributed to this iteration of the IRP and creates a model for the supporting inputs to future IRP updates.

### 5.1.3 2019 IRP UPDATE TIMELINE OF KEY PROJECTS AND PROGRAMS

***Figure 34*** and ***Figure 35*** present a timeline to provide an overview of the total IRP program and highlights the key water, wastewater and stormwater infrastructure projects, studies and programs that are recommended for the next 30 years.

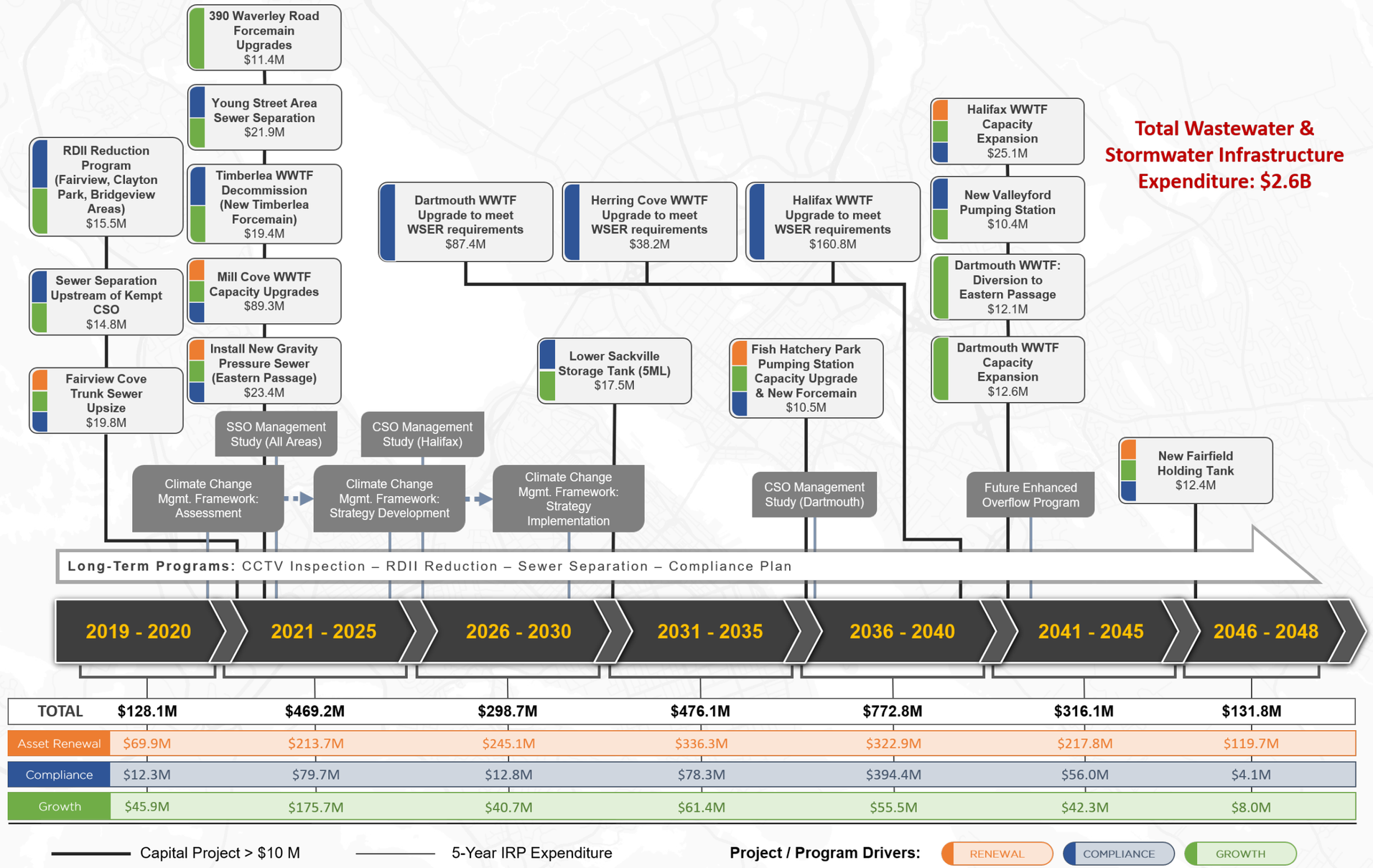
# WATER INFRASTRUCTURE INTEGRATED RESOURCE PLAN TIMELINE 2019-2048




**Total Water Infrastructure Expenditure: $1.5B**

*Figure 34 – Water Infrastructure IRP Timeline 2019-2048*

# WASTEWATER & STORMWATER INFRASTRUCTURE INTEGRATED RESOURCE PLAN TIMELINE 2019-2048




**Total Wastewater & Stormwater Infrastructure Expenditure: $2.6B**

| | 2019 - 2020 | 2021 - 2025 | 2026 - 2030 | 2031 - 2035 | 2036 - 2040 | 2041 - 2045 | 2046 - 2048 |
|---|---|---|---|---|---|---|---|
| TOTAL | $128.1M | $469.2M | $298.7M | $476.1M | $772.8M | $316.1M | $131.8M |
| Asset Renewal | $69.9M | $213.7M | $245.1M | $336.3M | $322.9M | $217.8M | $119.7M |
| Compliance | $12.3M | $79.7M | $12.8M | $78.3M | $394.4M | $56.0M | $4.1M |
| Growth | $45.9M | $175.7M | $40.7M | $61.4M | $55.5M | $42.3M | $8.0M |

Capital Project > $10 M — 5-Year IRP Expenditure

**Project / Program Drivers:** RENEWAL COMPLIANCE GROWTH

*Figure 35 – Wastewater & Stormwater Infrastructure IRP Timeline 2019-2048*

### 5.1.4 2019 IRP LONG-TERM CAPITAL PLAN TABLES

The 2019 IRP Long-Term Capital Plan is presented in detail in ***Appendix C***. The LTCP contains project descriptions, estimated total cost, proposed year in service, source of project / program, drivers, driver split allocation and objectives.

### 5.1.5 INTEGRATED RESOURCE PLAN STRATEGY TO ACHIEVE OBJECTIVES

The projects and studies that form the Integrated Resource Plan program evidence the intent of Halifax Water to achieve each of the 14 Integrated Resource Plan objectives (***Section 3.0***).

Every project and study contained in the Integrated Resource Plan program table has been assessed to identify which objective(s) the project or study helps to achieve. Where a project addresses multiple objectives, the association was ranked to identify the primary, secondary and tertiary objective to which the project applies.

The analysis was completed to support the identification of strengths and weaknesses in the program, helping to identify additional recommendations to achieve progress towards the objectives. The ring chart below (***Figure 36***) shows graphically the projects that address each objective. The colours show which objective group (compliance, renewal, growth) the specific objectives belong to.

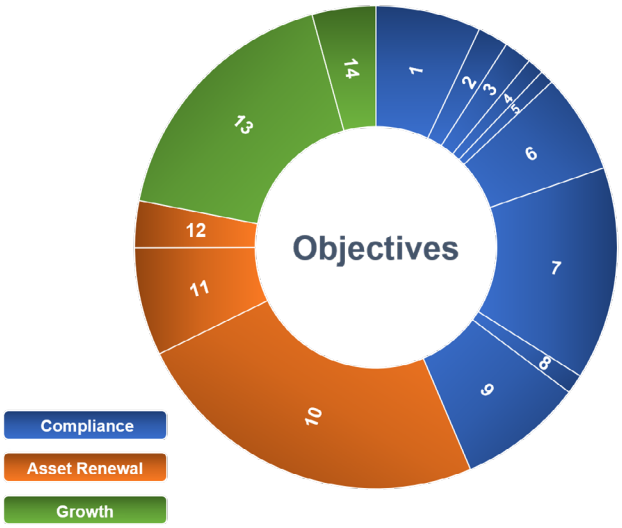



*Figure 36 – Projects and Studies that Address the Integrated Resource Plan Objectives.*

The results of the analysis can be summarized as follows:

- The three drivers of Growth, Renewal and Compliance are all adequately addressed by the Integrated Resource Plan Program.
- Objectives 7, 10 and 13 have the most projects directly or indirectly aimed at meeting or addressing each of the three main drivers of Compliance (Objective 7), Asset Renewal (Objective 10) and Growth (Objective 13).
- Objectives 2,3 4, 5, 8 have few projects aimed at addressing them and all are related to the Compliance driver.
    - Objective 2,3,4,5 all relate to regulatory compliance which is generally achieved and successfully maintained by Halifax Water. These objectives do not require numerous projects to address them.
    - Objective 8 relates to meeting future stormwater compliance. This could be attained with a review of future compliance needs for stormwater systems which could be part of the next iteration of the compliance plan.

***Table 14*** outlines the approach to meet each of the 14 objectives, highlighting only the key actions required.

### 5.1.5 IRP STRATEGY TO ACHIEVE OBJECTIVES CONTINUED

*Table 14 – Integrated Resource Plan Key Actions to Achieve Objectives*

| Objective | | Key Integrated Resource Plan Components |
|---|---|---|
| 1 | Meet or exceed current Nova Scotia Environment WWTF Permit to Operate Requirements | • Implement Compliance Plan and Infrastructure Master Plan Project recommendations. |
| 2 | Meet or exceed current Nova Scotia Environment WSP Permit to Operate | • Fully compliant. Continue review through the Compliance Plan, Water Quality Master Plan and Infrastructure Master Plan updates. |
| 3 | Meet Current Overflow Compliance (Monitor and Report) | • Fully compliant with current requirements. Maintain up to date hydraulic model with 5 year Infrastructure Master Plan updates<br>• Implement CSO flow monitoring program. |
| 4 | Meet or exceed Future WWTF Compliance | • Implement Infrastructure Master Plan WWTF expansion projects (Dartmouth, Halifax and Mill Cove).<br>• Implement compliance plan projects to ensure compliance with future WSER requirements. |
| 5 | Meet or exceed future drinking water compliance | • Implement Infrastructure Master Plan and Compliance Plan projects. Complete review of future scenarios. |
| 6 | Meet future overflow compliance | • Complete Infrastructure Master Plan CSO and SSO Management Plan studies and identify discharge frequency and volume targets for CSO's.<br>• Implement Infrastructure Master Plan I/I reduction projects considering pre and post CSO discharge impact assessment. |
| 7 | Endeavour to provide existing systems that are adequately sized to meet Halifax Water Level of Service | • Update water hydraulic model in 2020 and update/recalibrate water and wastewater models every 5 years.<br>• Complete Stormwater Capacity Evaluation. |
| 8 | Meet Future Stormwater Quality Compliance | • Complete study to review potential future regulatory scenarios. |
| 9 | Ensure planning and sizing of infrastructure considers the impact of climate change | • Implement Climate Change framework. |
| 10 | Implement optimal level of asset re-investment | • Complete condition assessment of water mains, sewers, and vertical facilities to enable condition-based renewal planning. |
| 11 | Enhance the reliability, redundancy and security of the water, wastewater and stormwater systems with attention to high risk and critical areas | • Implement Water Infrastructure Master Plan preferred strategy, specifically transmission twinning, system interconnections, safe yield and back up supply studies. |
| 12 | Reduce energy consumption, operating costs and GHG contributions | • Update Energy Management Strategy including the assessment of current GHG generation and establish targets for reduction. |
| 13 | Provide regional water, wastewater and stormwater infrastructure needed to support planned growth | • Implement Infrastructure Master Plan preferred servicing strategy.<br>• Ensure 5-year updates to re-align strategy with updated planning and development information. |
| 14 | Manage flow and demand to maximize capacity for growth and minimize the need for new hard infrastructure | • Implement I/I and Sewer Separation projects from Infrastructure Master Plan preferred servicing strategy.<br>• Enhance public education campaigns on water usage and savings. |

#### 5.1.5.1 Climate Change

Climate change is a prominent consideration for Halifax Water. Through the Infrastructure Master Plan, a Climate Change Assessment Framework was developed to provide a consistent approach of assessing the threats of climate change on water, wastewater and stormwater infrastructure.

The Infrastructure Master Plan considered climate change throughout the development of the projects and studies that form the preferred servicing alternative. Every infrastructure project was assessed using a design rainfall event that makes an allowance for the predicted increased rainfall intensities.

It is important for Halifax Water to build on these initiatives and begin implementing the framework. The following provides an outline of the recommended implementation plan.

- Climate Change Infrastructure Assessments on Asset Groups – 2020-2023 (4 years)
    1. Water Supply Plants and Dams (AMP A1 and A2)
    2. Wastewater Treatment Facilities (AMP B1), Wastewater Pumping Stations (AMP B2) and Water Chambers and Booster Stations (AMP A3).
    3. Water Reservoirs (AMP A6) and Stormwater Management Structures (AMP C1)
    4. Water Transmission Mains (AMP A4), Distribution Mains (AMP A5), Wastewater Gravity Mains (AMP B3), Wastewater Forcemains (AMP B4), Stormwater Gravity Sewers (AMP C2), Stormwater Cross Culverts (AMP C3)
- Develop Climate Change Action Plans following sequence above – 2024-2027 (4 years)
- Implement Action Plan on Priority Basis – 2028+

It is important to note that Halifax Water takes climate change into consideration on a project by project basis. For instance, projects submitted for funding consideration under the current Investing in Canada Infrastructure Federal Provincial Program require a formal audited review under the “Climate Lens” for Climate change adaptation and mitigation.

# 6.0 INTEGRATED RESOURCE PLAN IMPLEMENTATION

## 6.1 IMPLEMENTATION PLAN

The 2019 IRP Update has established a 30-year capital program. The total capital program is approximately $4,054 million equating to $135 million per year average. This substantially exceeds the five-year average of the approved capital budget of approximately $73.6 million (***Table 15***). Similar to the 2012 IRP, this presents challenges with regard to impact on rates, the availability of other funding sources, and the availability of Halifax Water's institutional capacity to manage this increase in capital delivery volume.

**Successful implementation of the 2019 IRP Update recommendations will require the following key steps:**

- Elevate critical projects to ensure priorities across all three drivers are addressed
- Utilize the 2019 IRP Update capital program as the foundation for yearly capital and operating budgets for Halifax Water
- Undertake additional cash flow analysis for projects to ensure costs and effort are apportioned across the appropriate time period
- Continually increase capital project delivery year over year while at the same time continually increase the Halifax Water project team resources including staff and project management/delivery tools
- Engage the consulting and construction industry in order to support the level of construction needed to meet the infrastructure needs
- Review procurement and project delivery models to ensure allocation of resources is not delayed

The next step in implementation will be to examine the fiscal and practical impacts of the recommended 2019 IRP Update, evaluate opportunities for external infrastructure funding, and assess the capital delivery resource needs.

### 6.1.1 RESOURCE NEEDS

The 2019 IRP Update has identified that an average of $135M per year is required to address all asset renewal, compliance and growth needs. The capital program requirement not only requires financial capacity, but also resource capacity from the Halifax Water staff, consulting engineering firms, and construction firms.

***Table 15*** summarizes the annual approved capital budget over the past 5 years and the corresponding number of Halifax Water capital delivery staff and consultant fees that have been required to deliver the program. The five-year average Capital Budget of $73,560,240 has required an average of 39 staff and an average of $9,952,365 of supporting consultant fees. Based on the capital program average of $135 M per year, Halifax Water would need to significantly increase project delivery capacity through both staff increases and project delivery method improvements.

***Table 15 – Historical Approved Capital Budget and Capital Delivery Resources***

| Year | Annual Approved Capital Budget | HW Capital Delivery Total Staff # | Consultant Fees | % of Cap Consultant Fees |
|---|---|---|---|---|
| 2014/15 | $60,845,200 | 37 | $6,317,175 | 10% |
| 2015/16 | $57,222,000 | 41 | $9,246,243 | 16% |
| 2016/17 | $66,778,000 | 39 | $14,884,721 | 22% |
| 2017/18 | $109,508,000 | 39 | $8,658,023 | 8% |
| 2018/19 | $73,448,000 | 40 | $10,655,665 | 15% |
| **Avg.** | **$73,560,240** | **39** | **$9,952,365** | **14%** |

The 2012 IRP recommended the evaluation of the adequacy of Halifax Water's existing institutional capacity and staffing to implement the programs and projects identified in the 2012 IRP. In 2014 an Institutional Capacity Assessment was completed by Opus International Consultants which recommended a staff increase of 24-42 full time equivalent staff. A key recommendation of the 2019 IRP Update is to update the Institutional Capacity Study to align with the preferred 2019 IRP program.

### 6.1.2 LONG-TERM PLANNING STUDY SCHEDULE

Halifax Water continuously undertakes initiatives and programs to maintain, operate and expand its systems while striving to provide world class service to its customers and environment. Halifax Water has taken considerable positive steps since the preparation of the 2012 IRP to the benefit of much more robust and informed 2019 IRP Update. Integral to continued success is to maintain this momentum and cycle of continuous improvement.

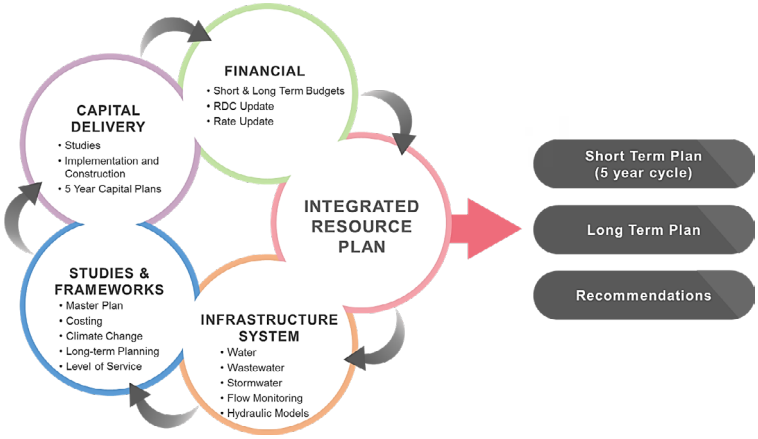



*Figure 37 – IRP Iterative Planning Process*

The iterative planning approach outlined in ***Section 1.1*** will ensure an ever-stronger base to prepare the next iteration of plans and programs and improve confidence in future recommendations and project delivery.

### 6.1.2 LONG-TERM PLANNING STUDY SCHEDULE CONTINUED

In order to ensure future updates of the Integrated Resource Plan continue in an efficient manner it is recommended that the various supporting studies be planned and coordinated so that outputs can be integrated together. ***Figure 38*** provides a study schedule that identifies the critical studies and outlines timing of each to ensure continuity, and efficient and timely delivery of outputs. Key components that direct the timing of the studies are as follows:

- Halifax Water commitment to update the Regional Development Charge every 5 years
- Commitment to RDC stakeholders that project need, costing, design criteria impact are periodically reviewed
- Infrastructure Master Plan Update is required to drive the Regional Development Charge update
- Population planning estimates are required to feed into hydraulic models
- Hydraulic models used in Infrastructure Master Plan updates
- Infrastructure Master Plan updates required to capture/recalibrate starting point and projections and review project need, triggers and phasing
- Key supporting studies are needed to inform the core studies
- Infrastructure planning is not static but dynamic with changing variables and requires iterative updates
- Studies provide exceptional value when they are a tool to better inform how, when and where to spend billions of dollars

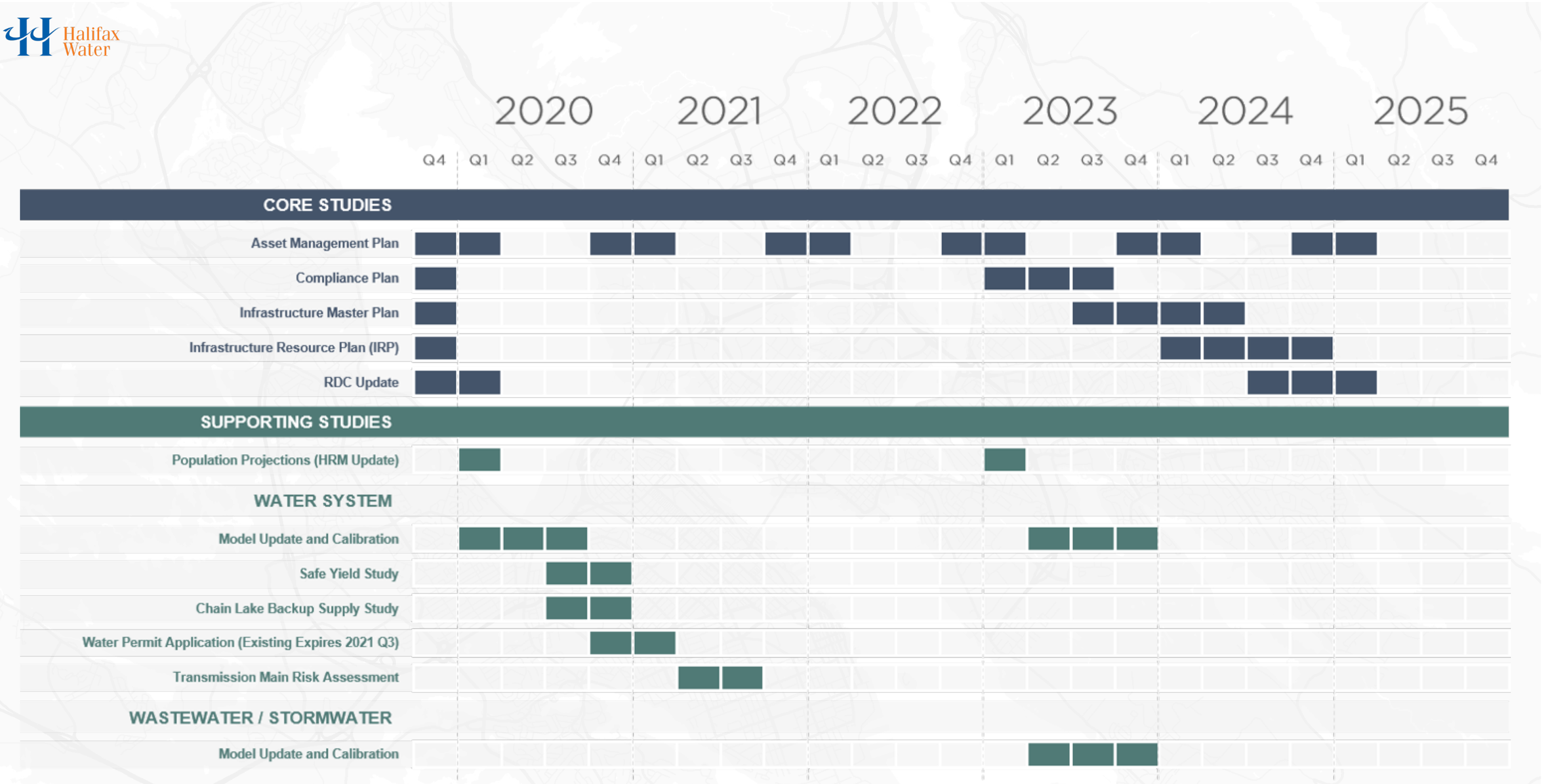



*Figure 38 – 5-year Studies Schedule*

## 6.2 RECOMMENDATIONS

Based on the analysis carried out during the development of the 2019 IRP Update, the following recommendations are presented:

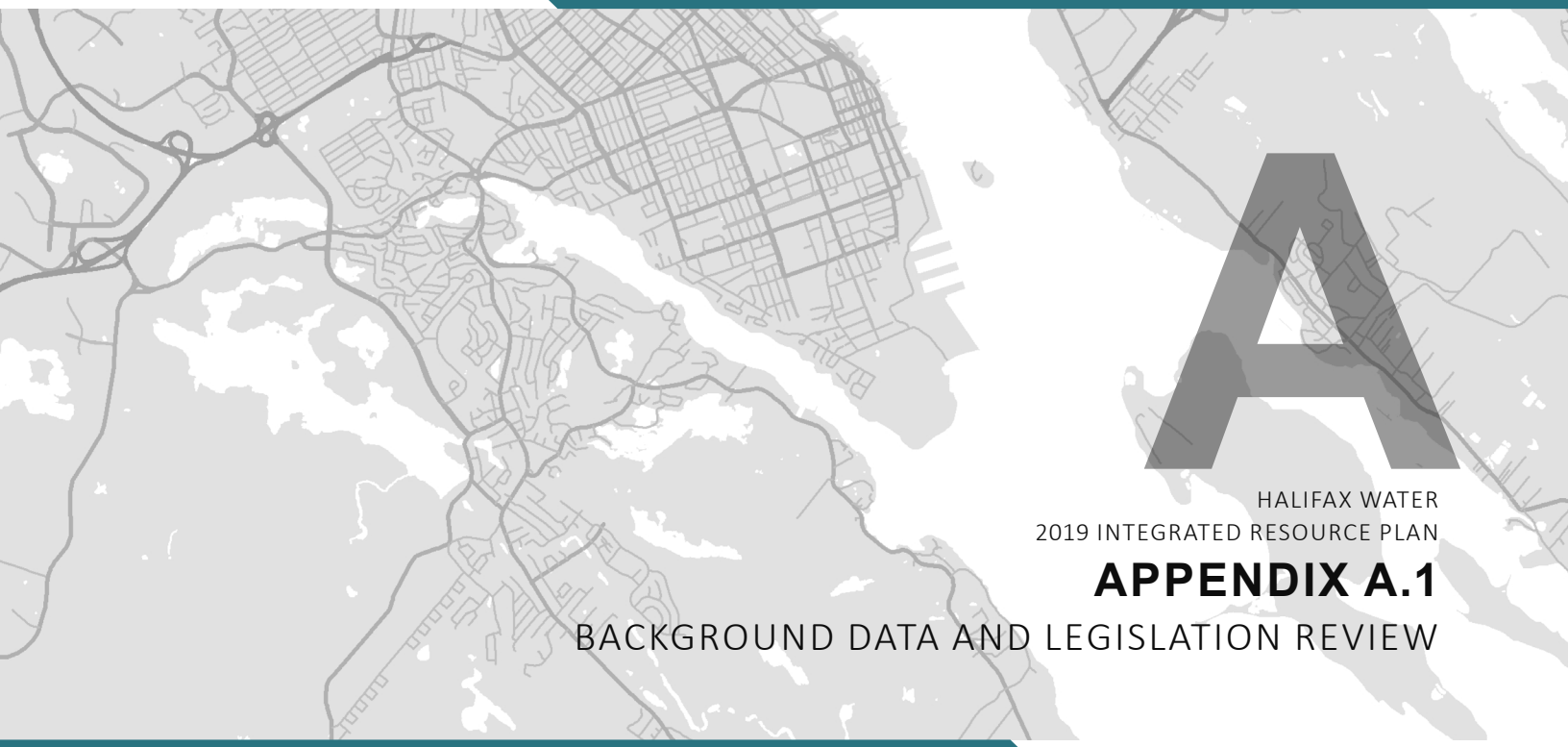
*Table 16 – 2019 IRP Recommendations*

| | |
|---|---|
| **Stakeholder Outreach and Education** | |
| 1 | Continue and enhance public outreach with stakeholders and public to market Halifax Water's objectives, educate customers and target efficiencies related to water, wastewater and stormwater servicing |
| 2 | Enhanced communication with NSE to ensure current compliance and appropriate future planning of regulatory issues |
| **Implementation Programs** | |
| 3 | Implement IRP Capital Program- (Water and Wastewater Infrastructure Master Plan, Asset Management Plans and Compliance Plan) |
| 4 | Utilize IRP program and undertake financial modelling, select preferred program and implement |
| 5 | Continue implementing Wet Weather Management Program |
| 6 | Integrate private-side I/I with wet weather management program starting 2020 |
| **Data Collection and Tools** | |
| 7 | Continue on-going GIS system build out and data management |
| 8 | Improve asset knowledge base and accuracy through asset management condition assessments and performance<br>• Expand pumping station performance assessments for the top 50 largest facilities<br>• Use CCTV information to support the development of a sewer predicted condition model<br>• Use condition and break history to support the development of a watermain predicted condition model |
| 9 | Maintain and update 2019 IRP integrated GIS program tool |
| 10 | Maintain and update water and wastewater hydraulic model development, calibration and build-out<br>• Water model calibration<br>• Water and Wastewater model update |
| 11 | 2022 Implement CSO and SSO flow monitoring program and analysis |
| 12 | Use established Level of Service and asset performance to prioritize data collection |
| **Studies** | |
| 13 | Complete CSO and SSO Management Study |
| 14 | Complete Water and Wastewater Master Plan Update within 5 years |
| 15 | Complete Asset Management Plan Data Updates annually with full written plans updated on 5 year cycle<br>Establish renewal program based on condition and performance data rather than age<br>Prepare project specific AMPs for large vertical infrastructure e.g. WWTFs |
| 16 | Complete Compliance Plan Update within 5 years |
| 17 | Complete study of potential future regulatory scenarios for water, wastewater and stormwater and feed into the Compliance Plan |
| 18 | Update the Energy Management Strategy including the assessment of current GHG generation and establish targets for reduction |
| 19 | Update Institutional Capacity Study to align with preferred 2019 IRP program |

## 6.2 RECOMMENDATIONS CONTINUED

*Table 16 – 2019 IRP Recommendations (continued)*

| | |
|---|---|
| **Cost Estimation** | |
| 20 | Undertake an annual review of all unit rates (linear and vertical) |
| 21 | Enhance cost estimating approach for vertical facilities (e.g. pumping stations, storage facilities, treatment plants) |
| 22 | Develop a more detailed approach for complex facilities that include unit rates for subcomponents |
| 23 | Continue benchmarking construction projects |
| **Enhanced HW and HRM Coordination** | |
| 24 | Coordinate periodic planning projection updates to establish “best planning estimates” for use in studies to support timing, phasing and allocation decisions for water, wastewater and stormwater infrastructure |
| 25 | Establish predictable timetable to update projections to enable coordinated timing of studies and tool updates |
| 26 | Enhance sharing of data and planned project information to enable updating, building and use of the GIS integration tool |
| 27 | Enhance coordinated capital project planning improve ability to align projects (ideally both within HW and with HRM) |
| 28 | Joint study to explore required steps, viability and impact of enhanced private side I/I reduction and Low Impact Development (LID) |
| 29 | Enhance joint educational/marketing to target efficiencies related to water, wastewater and stormwater servicing |
| **Scheduling/Timing** | |
| 30 | Ensure scheduled alignment of integrated studies to better inform and enable review of integrated planning opportunities (e.g. AMP prepared in advance of Master Plans) |
| 31 | Ensure Population projections, hydraulic models, Infrastructure Master Plan and Compliance Plan are updated by 2025 |



A

HALIFAX WATER

2019 INTEGRATED RESOURCE PLAN

# APPENDIX A.1

## BACKGROUND DATA AND LEGISLATION REVIEW

# Halifax Water

# 2019 Integrated Resource Plan

## *Technical Memorandum #1:*

*Background Data and Legislation Review*

Project No.: 718032

**Prepared by: GM BluePlan Engineering**

**For: Halifax Water**

**March 2020**

## Document Revisions

The following is a record of the changes/updates that have been made to the final document:

| Version | Changes / Updates | Author | Reviewed | Date |
|---|---|---|---|---|
| DRAFT | 1st Draft for Review | Sandy Naime | Chris Campbell | March 4th, 2019 |
| DRAFT | 2nd Draft for Review | Sandy Naime | Chris Campbell<br>James Jorgensen | May 11th 2019 |
| DRAFT | 3rd Draft for Review | Sandy Naime | Chris Campbell | May 14th 2019 |
| FINAL DRAFT | Final Draft Report | Sandy Naime | Chris Campbell | Dec 16th, 2019 |
| FINAL | Final Report | Sandy Naime | Chris Campbell | March 13, 2020 |

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## Appendices

# 1 Introduction

The Halifax Regional Water Commission (HRWC), also known as Halifax Water, was the first regulated and publicly owned water, wastewater and stormwater utility in Canada. With a long history dating back to the 1940s, Halifax Water is the water, wastewater and stormwater utility servicing residents of the Halifax Regional Municipality (HRM).

As part of its mandate and services, Halifax Water continuously undertakes initiatives and programs to maintain and operate its systems while striving to provide world class service to its customers and environment. These initiatives and programs require integration into a single capital program that identifies the long-term resource needs and financial expenditures.

Halifax Water retained GM BluePlan Engineering Limited (GM BluePlan) to complete the Integrated Resource Plan (IRP) Update. The IRP Update is a critical project that brings together various initiatives, and programs from separate studies, into a singular integrated capital and financial plan. This study applies the considerations of growth, regulatory compliance and asset renewal to ensure the integrated recommendations achieve the desired service delivery goals, as well as identify any additional gaps and programs required in the long-term plan.

The IRP Update will build on the foundation of the 2012 IRP. The 2012 IRP was developed to identify required programs and resources for a 30-year period covering each of the three drivers: growth, regulatory compliance and asset renewal. The 2012 IRP focused on capital, operation and maintenance costs to meet program and project requirements, developed a planning framework including Halifax Water's business processes, and provided recommendations including the IRP periodical update.

This technical memorandum will review key information provided in the 2012 IRP and any subsequent studies which will set out the foundation for the IRP Update. In addition, it will outline the vision and process for the IRP update, identify recent information to be included and summarize the primary IRP study inputs: Infrastructure Master Plan, Compliance Plan and Asset Management Plan.

## 1.1 Aim

The aim of the Background Data and Legislation Review Tech Memo is to review the background information available and form the understanding required to successfully complete the IRP Update.

## 1.2 Objectives

In order to meet the Aim, the following objectives were completed:

- Undertake a review and summary of the previous 2012 IRP including the purpose, drivers and objectives, applicable regulations and policies, available information and data gaps, study assumption and recommendations.
- Describe the progress since the previous IRP such as the studies that have been completed or are currently ongoing, and the frameworks and initiatives that have been implemented.
- Overview of the current scope of the IRP Update to confirm the vision, drivers and objectives, changes in regulations, study area, planning numbers, design criteria, level of service and study inputs.
- Identify key areas for review and update based on the analysis done to date and based on the scope of work for the IRP Update.

# 2 Background Information

## 2.1 The 2012 IRP

### 2.1.1 Overview and Aims

The Integrated Resource Plan (IRP) was developed in 2012, in collaboration with the Nova Scotia Utility and Review Board (NSUARB), to identify required programs and resources for the next thirty years (2013-2043) covering each of the three drivers: growth, compliance and asset renewal. The purpose of the IRP, as defined in the 2012 IRP, is to:

1. Provide the framework for Halifax Water to comprehensively evaluate alternative planning scenarios for its water, wastewater and stormwater services in an integrated fashion and identify the most efficient means of achieving its service goals while meeting all environmental requirements.
2. Provide long-term direction for HRWC and be a platform for comprehensively assessing alternative generic facility and programmatic investment options.
3. Serve as an umbrella under which more detailed, facility or program specific capital investment analyses can take place.
4. Explicitly identify and plan for the management of risks facing HRWC.
5. Provide the Board with the information and context it needs to make fully informed decisions about proposed future capital investments, revenue requirements and rates.

### 2.1.2 Drivers and Objectives

The IRP focused on three drivers: Growth, Regulatory Compliance and Asset Renewal. **Table 1** presents the three drivers and fourteen objectives that were developed as part of the 2012 IRP. The objectives were based on Halifax Water's level of service, compliance requirements (existing and future), asset renewal requirements, as well as other important considerations such as adaptation to climate change, system reliability and servicing growth.

**Table 1 – 2012 IRP Drivers and Objectives**

| Driver | System | Objective |
|---|---|---|
| Compliance | Wastewater | 1. Meet current Nova Scotia Environment WWTF Permit to Operate |
| | Water | 2. Meet current Nova Scotia Environment WSP Permit to Operate |
| | Wastewater | 3. Meet current overflow compliance |
| | Wastewater | 4. Meet future WWTF compliance |
| | Water | 5. Meet future drinking water compliance |
| | Wastewater | 6. Meet future overflow compliance |
| | Stormwater | 7. Meet future stormwater quality compliance |
| Asset Renewal | Water, Wastewater, Stormwater | 8. Implement optimal level of asset renewal |
| | Water, Wastewater | 9. Enhance the reliability of critical water and wastewater assets |
| | Stormwater | 10. Ensure existing stormwater system is adequately sized for minor storm conveyance |

| Driver | System | Objective |
|---|---|---|
| | Water, Wastewater, Stormwater | 11. Adapt to future climate change |
| | Water, Wastewater | 12. Reduce energy consumption, operating costs and GHG contributions |
| Growth | Water, Wastewater, Stormwater | 13. Provide regional water, wastewater and stormwater infrastructure needed to support planned growth |
| | Water, Wastewater | 14. Manage flow capacity allocations |

### 2.1.3 Regulations, Policy and Legislation

During the 2012 IRP, two provincial bodies were responsible for overseeing Halifax Water: Nova Scotia Utility and Review Board (NSUARB) and Nova Scotia Environment (NSE).

- NSUARB is responsible for approving business plans, significant projects and water/wastewater/stormwater rates.
- NSE is a provincial environmental regulator responsible for public health and environmental safety including drinking water quality and wastewater discharges and overflows.

Certain projects would require additional oversight from Federal departments including Department of Fisheries and Oceans (DFO), Environment Canada (EC) and Health Canada (HC).

The following is a review of key regulations, policies and legislation at the time of the 2012 IRP.

#### *2.1.3.1 Water*

In 2012, Nova Scotia Environment (NSE) was the department of the provincial government responsible for overseeing drinking water with emphasis on water works approvals, facility classification and operator certification, drinking water quality, as well as monitoring and reporting.

The following guidelines for water quality were identified in the 2012 IRP:

- Guidelines for Canadian Drinking Water Quality: provides guidance on the physical characteristics of drinking water (e.g. odour, taste) and the acceptable levels of microbiological, chemical and radiological contaminants in drinking water.

At the time of the 2012 IRP, Halifax Water was in accordance with the compliance requirements for all water distribution and treatment facilities.

The 2012 IRP also identified potential changes to guidelines and regulations that were expected to occur in the future:[1]

- Canada's Federal-Provincial-Territorial Committee on Drinking Water undertook numerous consultations since 2010 regarding acceptable levels of Dichloromethane and N-nitrosodimethylamine (NDMA) in drinking water. In 2012, the maximum acceptable level for dichloromethane was 0.05 mg/L with a proposed change by Health Canada to 0.015 mg/L. At the time, NDMA did not have "current guidelines" but a guideline of 0.04 µg/L was proposed by Health Canada.

[1] Integrated Resource Plan (Section 4.3), Halifax Water, October 2012

- Reduction of chlorine-based and bromine-based disinfection by-products including Trihalomethanes (THMs) and Haloacetic acids (HAAs). Disinfection by-product precursor removal targets were expected to increase, following similar developments in the US.
- New parameters and lower Maximum Acceptable Concentrations (MACs) by the Federal-Provincial-Territorial Committee on Drinking Water based on new scientific information.

#### *2.1.3.2 Wastewater*

In 2012, Halifax Water's wastewater systems required to be in conformity with NSE compliance requirements. The majority (10 out of 14) of Halifax Water's Wastewater Treatment Facilities (WWTFs) were not compliant with NSE Permit to Operate, therefore required upgrades to obtain full compliance.

The 2012 IRP also recognized that WWTFs upgrades would be required to meet the recently promulgated Canadian Wastewater System Effluent Regulations (WSER). The WSER were enacted in June 2012, with the intention to phase out untreated and undertreated wastewater released to water bodies. The regulations apply to systems that treat an average daily volume of at least 100 cubic meters per day. The WSER proposed national performance standards that wastewater systems were expected to meet are shown in Table 2. These performance standards are typically achievable with secondary level of treatment at plants.

**Table 2 – WSER National Performance Standards (NPS)[1]**

| Parameter | Concentration |
|---|---|
| Carbonaceous Biochemical Oxygen Demand (CBOD) | Average ≤ 25 mg/L |
| Suspended Solids (TSS) | Average ≤ 25 mg/L |
| Total Residual Chlorine (TRC) | Average ≤ 0.02 mg/L |
| Un-ionized ammonia as N at 15˚C ± 1˚C | Maximum < 1.25 mg/L |

At the time of the development of the 2012 IRP, the WSER were not legislation. The Province of Nova Scotia indicated that it will implement WSER requirements under its jurisdiction through conditions attached to approvals issued by NSE. However, strong guidelines for the management of wastewater were available through the Canadian Council of the Ministers of the Environment (CCME) Strategy for the Management of Municipal Wastewater Effluent. These guidelines were used to inform Halifax Water's adopted level of service for planning studies at that time, in particular the Regional Wastewater Functional Plan (RWWFP).

In addition, the 2012 IRP identified the future regulations for wastewater systems such as the limit of technology (LOT) effluent limits. Advanced nitrogen and/or phosphorus removal potentially to the LOT could be required for wastewater treatment facilities that discharge to receiving waters with limited assimilative capacity. The following are the projected effluents requirements for nitrogen and phosphorous:

- Monthly Total Nitrogen (TN) limit of 5 mg/L as N, based on accepted LOT.
- Monthly Total Phosphorous (TP) limit of 0.1 mg/L as P based on the range of proposed LOT and full-scale plant performance at other WWTFs.

Advanced TN and/or TP removal potentially to the LOT effluent limits will possibly be required for the following WWTFs in the future:[2]

- Lockview/MacPherson (Fall River)
- Middle Musquodoboit
- North Preston
- Uplands Park
- Wellington
- Frame
- Mill Cove
- Aerotech

#### *2.1.3.3 Wastewater Overflows*

In 2012 Halifax Water was required by NSE to monitor and report on Combined Sewer Overflows (CSOs) and Sanitary Sewer Overflows (SSOs). There was no legislative requirement to limit combined or sanitary overflow discharges. However, through the RWWFP study Halifax Water adopted a key level of service to ensure that overflows would not increase in frequency or volume as a result of growth.

The IRP recommended an Enhanced Overflow Control Program to address future overflow control needs.

#### *2.1.3.4 Stormwater*

In 2012, there were no regulatory compliance issues for stormwater systems. The IRP noted that the Regional Municipal Planning Strategy commits HRM to preparing a Regional Stormwater Functional Plan (RSWFP) to set out stormwater management strategies to reduce stormwater flows, environmental impacts, groundwater contamination, sediments and contaminant discharge, and inflow/infiltration. It also looks at emerging technologies to improve stormwater management systems and establish best management practices and criteria for both quantity and quality of stormwater discharge. Through the RSWFP, existing roles and jurisdiction of Halifax Water, HRM, NSE and other regulators would also be examined in relation to stormwater management and stormwater system regulations.

It was anticipated that recommendations from the RSWFP would be incorporated into HRM's regulations, policies and programs, which would directly impact how Halifax Water's deliver stormwater services.

### 2.1.4 Available Information and Data Gaps

The following presents a review of available information and data gaps that were identified from the 2012 IRP.

#### *2.1.4.1 Planning Estimates*

The 2012 IRP utilized high level growth estimates that were generated by HRM in collaboration with Halifax Water during the RWWFP. The planning numbers were a key input into creation of the infrastructure requirements in the RWWFP, they were not subject to additional analysis during the 2012 IRP.

- Residential Growth to 2046 = 159,140 persons
- Employment area growth to 2046 = 698.1 ha

[2] Integrated Resource Plan (Section 4.3), Halifax Water, October 2012

#### *2.1.4.2 Flow Monitoring Data*

During the 2012 IRP the Corporate Flow Monitoring Program had not yet been established. At the time, it was identified that more accurate flow monitoring and observed data was required for further development and calibration of wastewater hydraulic models, to better assess sizing and capacity needs of the systems, and to inform other programs such as the inflow/infiltration (I/I) reduction pilot program.

#### *2.1.4.3 Water and Wastewater Model*

For the 2012 IRP, a skeletal model of the water distribution network was utilized to assess overall system capacity. The model included primarily the transmission watermains and facilities covering the operating regions serviced by the J.D Kline (Pockwock), Bennery Lake and Lake Major Water Supply Plants (WSP). The model was also utilized to identify the size of transmission main projects required to service future growth or for security of supply. The IRP recognized that the integrated water network model would require continuous refinement and further calibration to support future projects such as the recommended Water System Master Plan.

A skeletal wastewater collection system model was available for analysis of the wastewater system. There were limitations observed with the model, such as limited flow monitoring data for model calibration, limited representation of local infrastructure, and uncertainties regarding the operations of some facilities. As with most hydraulic models, Halifax Water's is an evolving tool, which will improve as more data becomes available. The 2012 IRP identified a series of updates to the model to better inform the analysis and effectiveness of the I/I pilot program.

#### *2.1.4.4 Asset Information*

Based on the review of available asset data undertaken in the 2012 IRP, the following asset data gaps were reported: [3]

- Water, wastewater and stormwater assets were missing from GIS datasets creating spatial gaps in the system. Missing assets in GIS was more significant on the water system with 50% of the watermains missing from GIS, while 18% of sewers and 24% of stormwater pipes were not digitized in GIS. In addition, there was limited stormwater culverts data available on GIS (8km recorded).
- Linear asset information such as material, diameter and age were missing at some extent for water, wastewater and stormwater linear asset classes.
- Breakdown of assets to equipment/component level was not available for pumping stations and treatment plants.
- Significant limitations on asset condition data. Water system linear assets had the most recorded information, while wastewater and stormwater linear assets had little or no recorded condition data. Condition data was not available for vertical infrastructure.
- Historical capital expenditure was not available for all asset classes.
- Limited renewal/rehabilitation data

[3] Integrated Resource Plan (Section 4.4.2, Volume 3 Appendix D), Halifax Water, October 2012

### 2.1.5 Study Assumptions

There were certain assumptions made for the 2012 IRP due to time constraints, data availability and other analysis limitations. The 2012 IRP identified assumptions within each of the following study aspects:

- Compliance – future regulatory compliance.
- Asset Renewal Modelling – assets information such as material, diameter, age, service life estimates, asset renewal capital expenditures and discount rates, etc.
- Demand Reduction Assessment – reduction of sanitary flows and I/I flows, costs for demand reduction activities.
- End-of-Period Value Analysis – assets value, depreciation, asset renewal analysis.
- Enhanced Overflow Control Program Analysis– size of storage, pumping and treatment requirements, cost estimation.
- Financial Modelling – discount rates, project costs and incidental cost and contingency multiplier, capital expenditures, O&M costs, allocation of costs among IRP objectives, etc.

Details on the assumptions for each of the above aspects are included in **Appendix A** of this report.

### 2.1.6 Recommendations

The 2012 IRP proposed the following 17 recommendations:

1. Implement the IRP components and timing.
2. Finalize the overall integrated planning approach and future schedule (i.e. HRM Regional Plan updates, master plans and Asset Management Assessment, and financial planning) within the IRP framework.
3. Evaluate the adequacy of Halifax Water's existing institutional capacity and staffing to implement the programs and projects identified in the IRP.
4. Continue IRP public outreach with stakeholders and the public at large.
5. Update the IRP periodically, as needed.

<u>Wastewater System</u>

6. Implement I/I Pilot Program and integrate results into Wet Weather System Plan and Wastewater Master Plan.
7. Develop Wet Weather System Plan through integrating RWWFP, Enhanced Overflow, I/I Pilot program and other wet weather-related wastewater projects/programs.
8. Undertake remaining ERAs for WWTFs requiring nutrient control and confirm effluent and technology requirements.
9. Develop Wastewater Master Plan.

<u>Water System</u>

10. Develop Water Master Plan.
11. Apply water use trends to water and wastewater design criteria and integrate into Water and Wastewater Master Plans.

Stormwater System

12. Assess stormwater quality compliance requirements.
13. Clarify role and mandate of Halifax Water in stormwater planning and management.

All Systems

14. Assess impacts of climate change on all systems, update design standards, update operational practices, and integrate findings into Water and Wastewater Master Plans and Wet Weather System Plan.

Corporate Balanced Scorecard and Level of Service

15. Implement recommendations for LOS update/expansion and update CBS.
16. Develop monitoring, analysis and reporting framework to support the updated/expanded LOS.
17. Identify needed resources to support updated/expanded LOS program.

# 3 Progress since the 2012 IRP

Halifax Water has been very active in implementing recommendations from the 2012 IRP as well as other initiatives to inform the decision-making and long-term planning process. The following sections summarize the programs, studies, frameworks and initiatives that Halifax Water is currently undertaking or has completed since the 2012 IRP.

## 3.1 Previous and Ongoing Studies and Initiatives

Since the 2012 IRP, Halifax Water has undertaken several water, wastewater and stormwater studies and initiatives. These studies have provided Halifax Water with a much enhanced understanding of Halifax Water's existing infrastructure and better planning approaches to meet future needs.

### 3.1.1 Past Studies and Initiatives

#### *3.1.1.1 Regional Development Charges Development and Application*

The Regional Development Charge (RDC) Review was completed in July 2013 to provide a justifiable and transparent framework to implement a RDC. The preferred option encompassed the first 20 years of the capital program proposed by the RWWFP, as well as alternative scenarios generated to assess potential impacts of adjusting or refining the assumptions of the RDC.

#### *3.1.1.2 Regional Centre Local Wastewater Servicing Capacity Analysis*

The Regional Centre Local Wastewater Servicing Capacity Analysis (LoWSCA) was completed in 2016 with the purpose of understanding the local wastewater system capacity constraints within six target intensification areas, four in Halifax Peninsula and two in downtown Dartmouth. Each area was analyzed in detail resulting in a recommended capital plan of the preferred solutions for each area.

#### *3.1.1.3 Water Quality Master Plan Update*

The Water Quality Master Plan Update (WQMP) was completed in 2017 and approved by the Halifax Water Board. The WQMP is a key study that guides Halifax Water's work and ongoing research on water quality. The WQMP concentrates its efforts in four themes: understanding lake recovery, adapting to lake recovery, maintaining distribution system water quality, and water quality data mining.

#### *3.1.1.4 West Region Wastewater Infrastructure Plan*

The West Region Wastewater Infrastructure Plan (WRWIP) was completed in 2017 to formalize the foundation policies of regional infrastructure planning, identify the preferred servicing solution and prepare preliminary designs of the wastewater infrastructure needed to service the West Region. The WRWIP builds on the 2012 IRP, the RWWFP and the LoWSCA studies to progress Halifax Water's wastewater servicing strategy.

#### *3.1.1.5 Wet Weather Management Program*

The Wet Weather Management Program (WWMP) was initiated in 2013 following the recommendations from the RWWFP and the 2012 IRP to effectively manage wet weather flows within the sanitary wastewater system. The WWMP developed a strategy to efficiently manage the impacts of wet weather flows in the sanitary system, including monitoring and separating combined sewer systems when possible. The program outlines short and long-term objectives and is being implemented in phases. The WWMP is currently in Phase III where pilot programs are used to gather information for the cost of various wet weather management techniques and the potential benefits. This will support Phase IV in developing the most cost-effective strategies to wet weather flows.

#### *3.1.1.6 Five-Year Business Plans*

Five-year Business Plans have been developed to provide a comprehensive financial plan for Halifax Water. The Business Plan includes the Five-year Capital Plan, which defines the specific projects and programs prepared by Halifax Water and approved (first year) by the NSUARB. The Business Plan also describes challenges and opportunities moving forward, including: the impact of significant current and imminent capital projects, future capital demands to better align with rates, enhanced customer service and expectations, increasing energy and chemical costs, wastewater research to meet current regulations, the wet weather management program and lead line replacement program. The latest Business Plan for the period from 2018/19 to 2022/23 was developed to replace the previous five-year Business Plan (2015/16 to 2019/20).

For detailed information of the past studies and initiatives that support the work undertaken for the IRP Update, refer to the Infrastructure Master Plan Background Review.

### 3.1.2 Ongoing Studies and Initiatives

#### *3.1.2.1 Asset Management Plans*

Halifax Water prepares Asset Management Plans (AMP) on an annual basis to outline how the utility manages its assets and to provide a summary of asset inventory, state of Halifax Water's infrastructure, level of service the assets provide to the customers, infrastructure replacement and maintenance strategies, and associated costs and expenditures. The latest version of the AMPs is the 2017/18 which was prepared by the utility on October 2018. Halifax Water is currently working towards the development of the 2018/2019 AMP.

The Asset Management Plan is one of the key inputs to the IRP Update. For more information refer to section 4.6.3

#### *3.1.2.2 Integrated Stormwater Management Policy (ongoing)*

The Integrated Stormwater Management Policy is an ongoing initiative, its main objective is developing policies that guide municipal and utility operations and governance when delivering stormwater management services in a manner that meets both legislative requirements and community expectations relating to public safety and environmental stewardship. The Integrated Policy will be structured around four main issues or themes: a capital investment strategy for stormwater infrastructure, ownership and maintenance of stormwater systems, land development practices, and drainage on private properties.

#### *3.1.2.3 Infrastructure Master Plan (ongoing)*

The Infrastructure Master Plan focuses on the servicing strategies and management of infrastructure in the Halifax Region, to produce an optimal servicing strategy for the wastewater and water supply networks. The Infrastructure Master Plan is ongoing and will become a key component of long term planning for Halifax Water.

The Infrastructure Master Plan is one of the key inputs to the IRP Update. For more information please refer to section 4.6.1

#### *3.1.2.4 Compliance Plan (ongoing)*

The Compliance Plan is currently underway. It will establish the current and future (5-year and 30-year planning horizon) federal, provincial and municipal level compliance regulations related to Halifax Water's water distribution system and wastewater and stormwater collection system. The main goal of

the compliance plan is to create a path forward for Halifax Water to achieve compliance for the next 30 years.

The Compliance Plan is one of the key inputs to the IRP Update. For more information please refer to section 4.6.2

## 3.2 Frameworks

The following frameworks and guidelines have been completed since the 2012 IRP. These guidelines provide a consistent and transparent approach for internal and external stakeholders.

### 3.2.1 Climate Change Management Framework

The Climate Change Management Framework was developed in 2018 to show how infrastructure systems of individual assets progress from the stage of being assessed against the impacts of climate change to the point where a mitigation strategy is implemented. The Climate Change Management Framework has been developed based on a review of best practices and the existing body of knowledge. The Framework is presented in the flow diagram below:

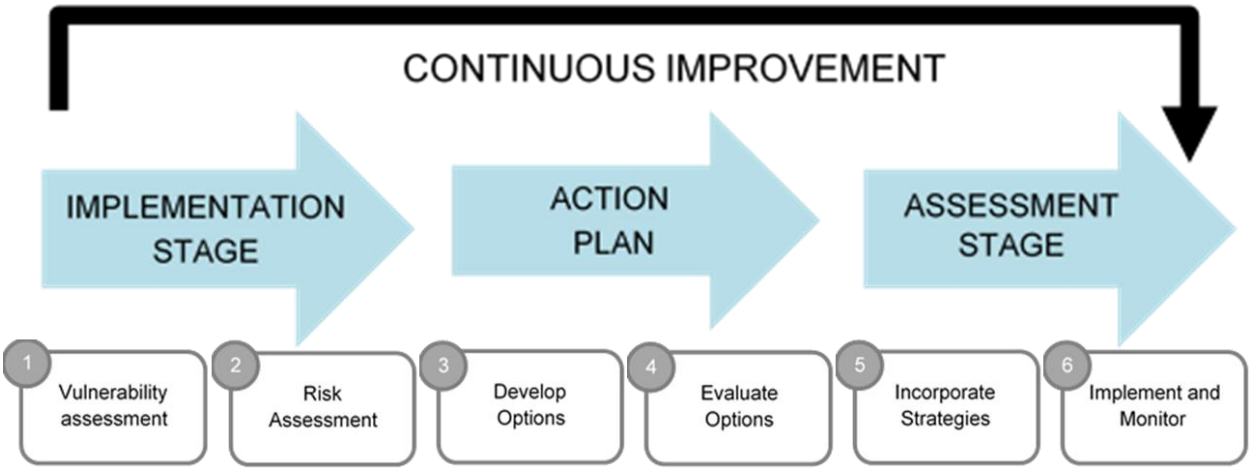



**Figure 1 – Climate Change Management Framework**

### 3.2.2 Cost Estimation Framework

As part of the West Region Wastewater Infrastructure Plan (WRWIP), Halifax Water formalized a cost estimation framework (CEF) with the purpose of providing a consistent, transparent, and auditable approach to costing capital projects both internally and externally. The CEF was developed using the knowledge gained through a review of Halifax Water's existing costing practices and unique organizational structure, in addition to a thorough industry best practice review.

The CEF approach uses a classification system to categorize diverse cost estimate classes. These classes represent different phases of planning and design, and subsequently various methods of cost estimation and levels of accuracy.

The CEF is a living document that provides opportunities for updates as required. As such, subsequent work under the Infrastructure Master Plan updated the unit rates to be used with the framework. The cost estimation framework is expected to be used moving forward for all Halifax Water's capital projects, and it will be used throughout the IRP Update.

Figure 2 present key features of Halifax Water Cost Estimation Framework.

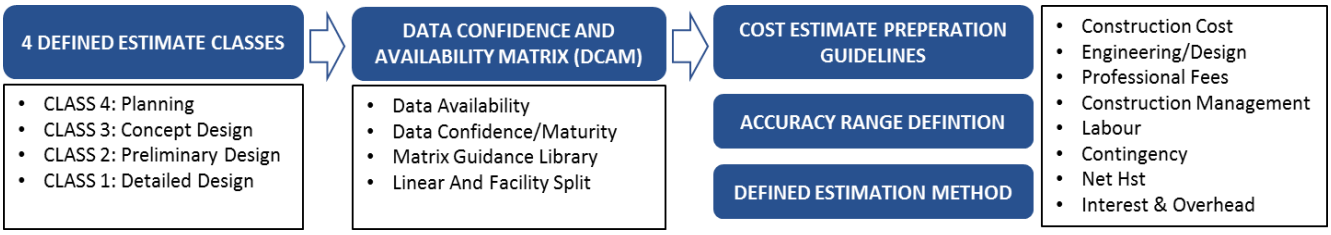



**Figure 2 – Key Cost Estimation Framework Features**

### 3.2.3 Long-term Planning Framework

The Long-Term Planning Framework (LTPF) was developed in 2017 to provide Halifax Water with direction for long-term infrastructure planning activities. The LTPF considers all drivers of infrastructure management including growth, asset renewal, regulatory compliance, and operability. The framework provides a basis to plan for infrastructure needs in a holistic approach that integrates and considers infrastructure types together.

The LTPF proposes that Halifax Water elect to complete a unified water-wastewater-stormwater master plan, which is common within industry best practice for master planning. This approach is consistent with Halifax Water's 2012 IRP and allows for project coordination and improved long-term planning across all systems.

## 3.3 Initiatives to Close Data Gaps

Several programs and assessments were initiated by Halifax Water to close data gaps identified in the 2012 IRP. Some of these programs include the following:

### 3.3.1 Sewer Inspection and Survey Program

The sewer inspection and survey program is an annual program for determining condition information about the sewer systems. The program involves both manhole inspection using zoom camera technology, and conventional CCTV inspection for the mainline sewers and laterals. The advantage of using the zoom technology is that it allows an initial look at the pipes connected to each manhole with sufficient information to determine if mainline cleaning is needed or if full CCTV inspection is warranted. Additionally, zoom inspection is considerably less expensive than CCTV inspection. However, while zoom camera technology provides excellent information of the structures, it cannot capture detail on locations of defects in the mainline sewers.

The sewer inspections and survey program provide Halifax Water with information regarding the condition and performance of the sewers and can identify defects requiring rehabilitation or repair. These inspections are critical for decision making related to near term integrated project priorities and the wet weather program. As part of this program, Halifax Water staff has placed emphasis on the usability and accessibility of the information collected using available tools to make results simpler to view. Figure 3 below presents a snapshot of the Zoom Inspection Dashboard that shows an interface with inspection data and results.


**Figure 3 – Zoom Inspection Dashboard**

### 3.3.2 Condition Assessments by Asset Class

Halifax Water's Asset Management team have directed significant efforts on gathering data on asset attributes (size, material, age, and condition information as a minimum), and preparing the Asset Management Plans for all asset classes. Data refinements benefited from the completion of the following projects:

- Wastewater Treatment Facility Condition Assessment
- Wastewater Pumping Station Condition Assessment
- Stormwater Culvert Inventory and Condition Assessment
- Sewer Condition Assessments (Sewer Inspection and Survey Program)

The formal condition assessments provided data needed to inform the development of the AMPs for those asset classes. For the remaining asset classes, Halifax Water staff relied on best available information with the understanding that future AMPs will be refined as better information is collected.

### 3.3.3 Flow Monitoring Program

In 2016, Halifax Water initiated a corporate flow monitoring program, which was implemented in three phases; Spring 2016, Fall 2016 and Spring 2018. In addition to flow monitors, permanent rain gauges were installed to inform wet weather analysis. The program is comprised of three types of monitoring:

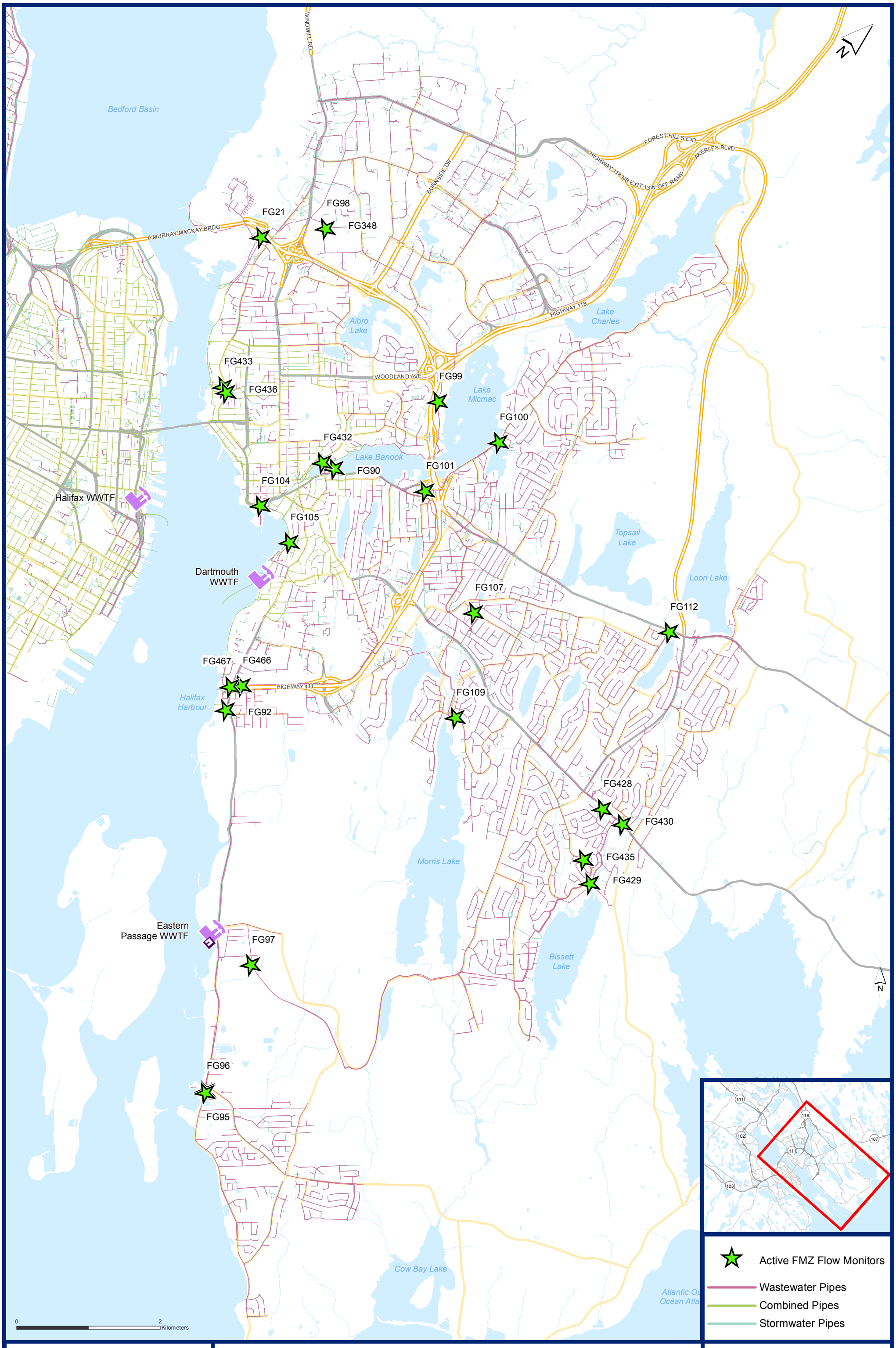
- Permanent flow monitors, referred to as the Flow Monitoring Zones (FMZ);
- Short-term flow monitors, used for the Wet Weather Management Program (WWMP); and,
- Temporary flow monitors, used to inform capital projects such as facility upgrades, sewer separation, etc.

#### *3.3.3.1 Permanent Flow Monitors*

The objectives of the FMZ monitors are:

- Provide continuous monitoring of sufficiently sized catchments (not too big, not too small) to provide the most valuable information. Areas of interest include upstream of CSOs, pumping stations, at major flow splits, and other key areas of the systems.
- Provide insight on system inputs and how they change over time, including changes in sanitary flow rates (e.g. growth, water conservation), wet weather response (inflow, infiltration), and impacts of climate change (e.g. sea level rise, storm intensity).
- Provide readily available data for hydraulic model updates and capital project studies.
- Use the data to supplement the WWMP flow monitors to meet the Wet Weather Management Program objectives.

The flow monitoring program currently includes 81 active FMZ flow monitors installed throughout the West, Central, and East Regions of HRM. **Figure 4, Figure 5** and **Figure 6** are overview maps of the FMZ monitors.




Halifax Water

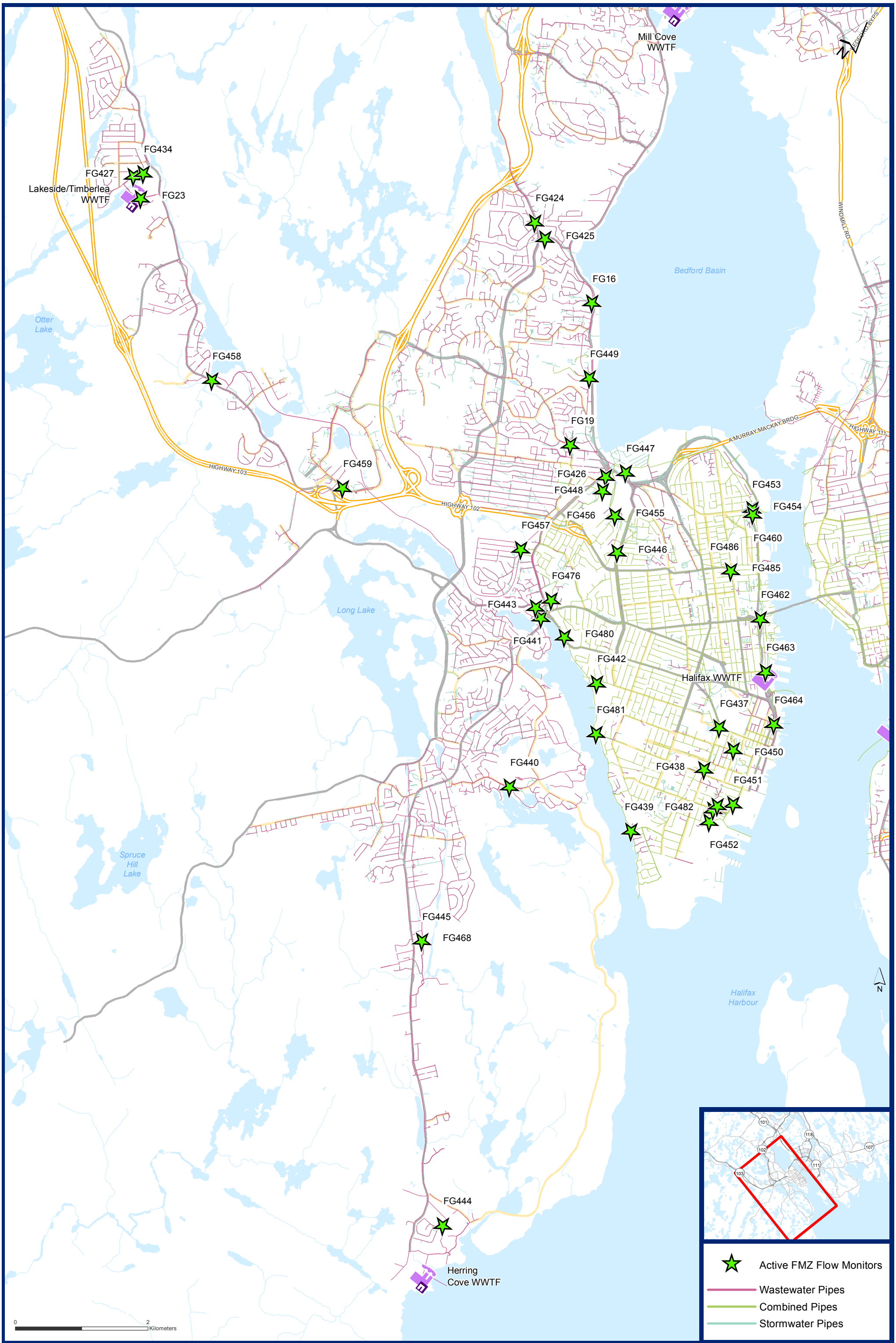
**Integrated Resource Plan**

Figure 4

**FMZ Program Flow Monitors (East Region)**

BluePlan ENGINEERING

May, 2019
718032-WW-001
NAD 1983 UTM Zone 20N




Halifax Water

**Integrated Resource Plan**

Figure 5

**FMZ Program Flow Monitors (West Region)**

BluePlan ENGINEERING

May, 2019
718032-WW-002
NAD 1983 UTM Zone 20N

Springfield Lake WWTF

Uplands Park WWTF

Mill Cove WWTF

FG94
FG13
FG12
FG89
FG11
FG14
FG10
FG9
FG15
FG7
FG8
FG6

Square Lake
Fenerty Lake
Drain Lake
Tucker Lake
McCabe Lake
Kinsac Lake
First Lake
Second Lake
Third Lake
Sandy Lake
Rocky Lake
Powder Mill Lake
Anderson Lake
Bedford Basin

HIGHWAY 101
HIGHWAY 102
BEDFORD BYPS
WINDMILL RD

0 2 Kilometers

N

Active FMZ Flow Monitors
Wastewater Pipes
Combined Pipes
Stormwater Pipes

Halifax Water
Integrated Resource Plan

Figure 6
**FMZ Program Flow Monitors (Central Region)**

BluePlan ENGINEERING
May, 2019
718032-WW-003
NAD 1983 UTM Zone 20N

#### *3.3.3.2 Short-term Flow and Temporary Monitors*

The following lists the various uses for the short-term and temporary flow monitors:

- **Wet Weather Management Program (WWMP)**: identify and quantify sources of inflow and infiltration. The WWMP currently has 19 active flow monitors. The Program is based on a three-phase approach: monitor the identified priority area, perform remediation works to alleviate identified issues, and continue monitoring to identify the beneficial impact (e.g. cost-benefit analysis).
- **Regional Development Charges (RDC)**: assess the performance of new development.
- **Capital Projects (CP)**: used by Halifax Water staff to gain better understanding of existing infrastructure in specific areas.
- **Hydraulic Models**: these monitors are used to fill in the system coverage gaps in preparation for model development and calibration.

### 3.3.4 Wet Weather Management Program and I/I Reduction Pilot Area Assessments

As part of the WWMP, Halifax Water has five pilot projects in areas identified as having high inflow and infiltration. These areas include Stuart Harris Sewershed, Cow Bay Rd, Leiblin Park, North Preston, and Crescent Ave. These pilot areas were chosen strategically to enable Halifax Water to validate what Rainfall Derived Inflow and Infiltration (RDII) reduction can be accomplished via various I/I reduction strategies on both the private and public side. Using flow monitoring data for the pilot areas, Halifax Water expects to validate the notion that comprehensive rehabilitation will be required to significantly reduce I/I.

Additionally, as mentioned in section 3.1.1.5, the WWMP is currently in Phase III where the pilot projects are used to gather information for the cost of various wet weather management techniques and potential benefits. This will support Phase IV of the WWMP in developing cost-effective strategies to manage wet weather flows throughout the entire service boundary.

### 3.3.5 GIS Update

In 2017, Halifax Water developed an Information Technology Strategic Plan to provide a structured program approach for implementing technological investment strategies, including Geographic Information Systems (GIS). Halifax Water has been using GIS for a number of years and has taken steps to update their GIS on an annual basis or when new information is available. Through the Strategic Plan, new ways of integrating GIS into Halifax Water operations will be developed. The Plan includes the following future strategic milestones related to GIS:

| Theme – Information Integration with Location | Fiscal Year |
|---|---|
| GIS core system upgraded | 2018/2019 |
| All assets linked to GIS | 2019/2020 |
| GIS linked to customer records, asset records and work activity | 2022/2023 |
| Key GIS data is up to date and maintained | 2022/2023 |

### 3.3.6 Water and Wastewater Hydraulic Models

#### *3.3.6.1 Wastewater Model*

The West Region Wastewater Infrastructure Plan (WRWIP) involved the wastewater model update for Halifax Water's existing west region sanitary and combined collection system models. The process produced two model scenarios: existing and growth.

The Infrastructure Master Plan is currently underway and involves new build and calibration of all-pipe wastewater models for Halifax's three main sewersheds: Central Region (Mill Cove WWTF and Springfield Lake WWTF), East Region (Eastern Passage WWTF and Dartmouth WWTF), and West Region (Halifax WWTF, Herring Cove WWTF, and Timberlea WWTF).

The new Infrastructure Master Plan wastewater models were developed using InfoWorks ICM and built primarily using a combination of data from corporate GIS geodatabases, as-built drawings, and field surveys. Calibration was completed in accordance with the CIWEM Urban Drainage Group Code of Practice using flow and precipitation data recorded at monitoring locations across all catchment areas.

Combined sewer overflow (CSO) and sanitary sewer overflow (SSO) discharges are of particular interest to the Infrastructure Master Plan; the model is used as a predictive tool to evaluate the impacts of population growth and climate change on the volume and frequency of CSO and SSO discharges. The current level of service for CSO and regional SSO evaluation is to ensure that there are no net increases to overflow volumes or frequencies as a result of growth.

#### *3.3.6.2 Water Model*

The water distribution hydraulic model, based in Bentley's WaterCAD software, was built, calibrated, and is currently maintained by Halifax Water. It is used to assess the distribution system in terms of operational strategies and to inform capital project needs.

The model is currently a steady-state model representative of trunk infrastructure, with pockets of local watermains. Originally, there were four separate models that represented the different systems and regions, including:

- Central (Bedford and Sackville)
- East (Dartmouth and Eastern Passage)
- West (Peninsula, BLT, Herring Cove)
- Bennery (Airport)

A water model update was completed as part of the Infrastructure Master Plan project so that it could be used to assess system opportunities and constraints, and to inform the development of the overall distribution system servicing strategy. The objective of the model update was to create a single integrated WaterCAD model of the Halifax Regional Municipality.

The individual models were reviewed to identify data gaps and prepare for the integration process. Once integrated, the water network was updated to include all facilities and watermains ≥ 300mm, to provide a skeletal model for master planning objectives. System demands were updated, using 2016 billing data, facility production data, and SCADA data at pressure zone boundaries. The roughness coefficients assigned to the pipes were not updated, Halifax Water staff deemed them appropriate and valid at the time of the Infrastructure Master Plan. The intention of the modelling exercise was to ensure that the state of the hydraulic model was sufficient to assess the trunk infrastructure, including:

- Source of supply,
- Storage and pumping facilities, and
- System transmission.

Following the model build and update, the baseline scenario simulation was used to complete an audit and validation.

### 3.3.7 Lead Service Replacement Program

One of Halifax Water top priorities is to remove lead service laterals from the water system. Prolonged exposure to lead can cause adverse effects on human's health, specially for infants, young children, pregnant women and breastfeeding children. For homes with lead service lines, the potential for high levels of lead in drinking water is a significant concern.

In 2016, Halifax Water Board approved a comprehensive plan for the lead service line replacement program. In 2017, the program was approved in an effort to replace all lead that comes in contact with drinking water, including service lines. The same year, the NSUARB approved a rebate program proposed by Halifax Water to provide financial assistance to encourage residents to remove lead service lines located on private property.

The lead service replacement program intends to remove all lead service lines by 2050, consistent with the recommendation made to the US Environmental Protection Agency (USEPA) by the National Drinking Water Advisory Council (NDWAC). The program has the following five pillars:

1. Replace all lead service lines by 2050
2. Inventory
3. Customer communication
4. Continuation of customer sampling programs
5. Corrosion control

### 3.3.8 Advanced Metering Infrastructure & Customer Connect Program

The customer connect program was launched in 2017 to replace all water meters with Advanced Metering Infrastructure (AMI) technology. This will allow two-way digital communication between Halifax Water and its customers. Some of the features of the implementation of the AMI includes:

- Ability to offer monthly billing to residential and small commercial customers thus making it easier for customers to manage cash flows and automated payments.
- Billing errors will be reduced, and estimated meter readings will be eliminated.
- Halifax water will be able to alert customers to high consumption due to things like plumbing leaks, almost as they happen, reducing billing disputes and high bill amounts.
- Customers will have the ability, through a web link, to mange their water consumption, and see the effect of any conservation measures they take.

The AMI and Customer Connect Program will give customers the ability to manage their usage more effectively and reduce Halifax Water's environmental footprint by reducing fuel costs and site visits currently required for meter reading. It would also provide Halifax Water with better information on water consumption that would inform the decision-making process for short and long-term planning of infrastructure.

### 3.3.9 Update Planning Projections and Growth Allocations (completed by HRM)

The planning projections and growth allocation have been updated as part of the current Infrastructure Master Plan and are provided in **Section 4.2**.

# 4 The 2019 Integrated Resource Update

The 2019 Integrated Resource Plan will be the main outcome of the IRP update process which was initiated in September 2018. At the outset of the project, key meetings were held with members of the Halifax Water project team, Halifax Water Directors, Halifax Water Board, and NSUARB Consultants. The following sections summarize the material presented at these meetings. The purpose of these meetings was to introduce the project and agree on key subjects such as the IRP vision, scope of the IRP Update, study inputs and next steps.

## 4.1 Overview

The IRP is a key component of Halifax Water's iterative planning process. The process was initiated in 2012 with the first IRP and continued with the development and further understanding of the infrastructure systems. Elements such as flow monitoring, hydraulic models and conditions assessments are developed at this stage to better understand and inform the decision-making process. In the same vein, studies and frameworks such as Master Plans and Climate Change Framework are implemented to determine the best servicing strategies for Halifax Water's systems. The results of these strategies are then transformed into capital and implementation plans that feed into Halifax Water capital budgets, regional development charges and rate updates. The process repeats itself in a typical 5-year cycle with the development of the Integrated Resource Plan Update which provides a path for the next 5 years.

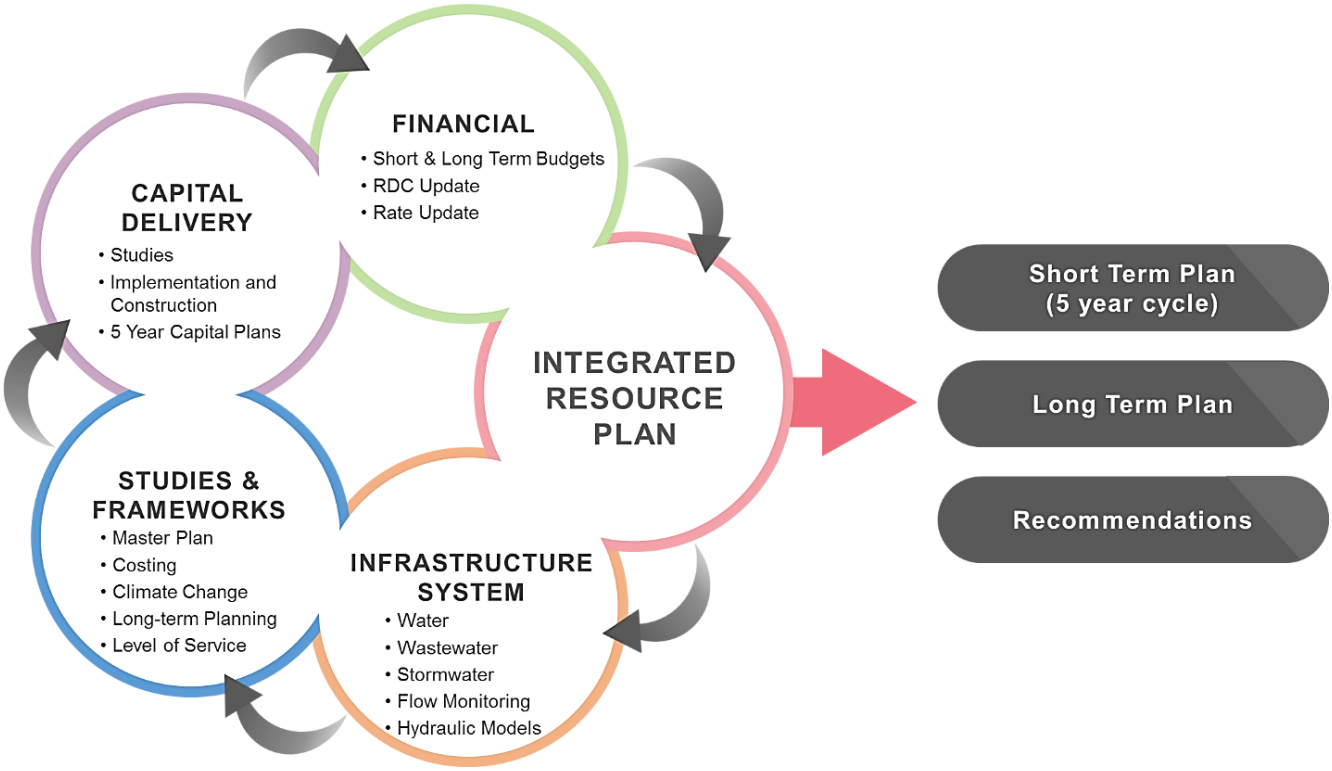



**Figure 7 – IRP Iterative Planning Process**

The main purpose of the 2019 IRP is to develop an integrated 30-year capital infrastructure plan covering all systems (water, wastewater, stormwater) and drivers (growth, compliance, asset renewal). In order to do so, the following objectives were defined:

- Compile, organize and summarize best available information
- Identify and assess current Halifax Water and industry leading demand and supply side management measures (DSM/SSM)
- Recommend preferred integration opportunities
- Inform Halifax Water's long-term financial model to understand the financial requirements for the infrastructure needs
- Develop a forward looking long-term infrastructure plan that is traceable, defendable and implementable

### 4.1.1 IRP Vision

The 2019 IRP vision is to be an integrated forward-looking document based on the following principles:

- Build on the foundation and structure of the 2012 IRP
- Layer multiple infrastructure inputs and recommendations to establish an integrated long-term capital plan
- Strategic planning for the long-term
- Real steps in the short-term
- Tactical level document
- Integrated capital program and strategy
- Supported collectively

### 4.1.2 Drivers and Objectives

The 2019 IRP drivers and objectives remain unchanged from the 2012 IRP as shown in section 2.1.2 and Table 1. The 2019 IRP focuses on the three drivers: Growth, Regulatory Compliance and Asset Renewal; and fourteen objectives based on Halifax Water's level of service, compliance requirements (existing and future), asset renewal requirements, as well as other important considerations such as adaptation to climate change, system reliability and servicing growth.

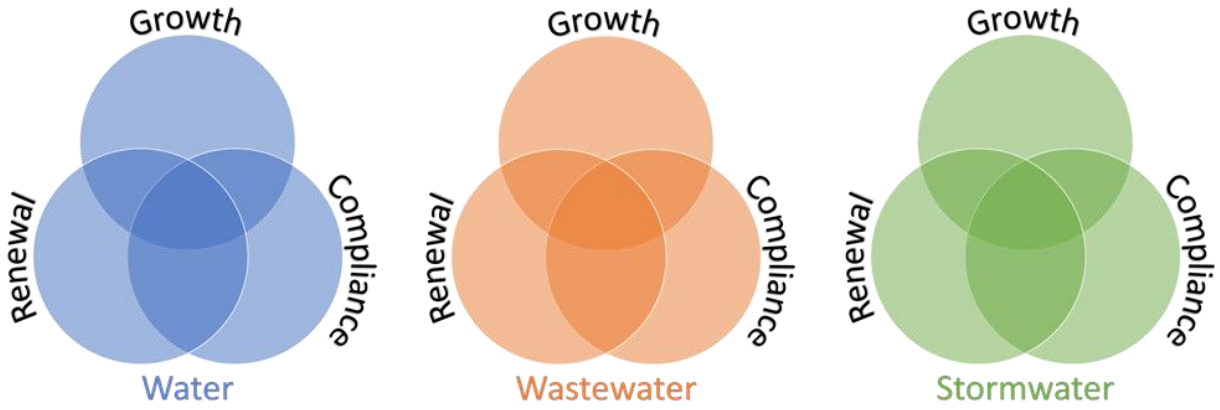



**Figure 8 – 2019 IRP Drivers**

### 4.1.3 Regulation, Policy and Legislation Review

Review of applicable new and future regulation not included in the 2012 IRP.

#### *4.1.3.1 Water System*

One of the overall objectives of the Water Quality Master Plan is full compliance with "Guidelines for Canadian Drinking Water Quality". These guidelines provide the acceptable levels of microbiological, chemical and radiological contaminants in drinking water. It also provides acceptable physical characteristics including taste and odour. The guidelines can be published as either Maximum Acceptable Concentrations (MAC's) which are health related parameters; Aesthetic Objectives (AO's) and Operational Objectives. Drinking Water Approvals in Nova Scotia require that all MAC's must be achieved.

Table 3 summarizes the changes made to the guidelines after 2012. These Guidelines are established and updated based on published scientific research on the health and aesthetic effects associated with a contaminant.

**Table 3 – Changes to the Guidelines for Canadian Drinking Water Quality**

| Parameter (approval, reaffirmation) | MAC (mg/L) |
|---|---|
| Ammonia (2013) | None required |
| Benzo[*a*]pyrene (2016) | 0.000 04 |
| 1,2-Dichloroethane (2014) | 0.005 |
| Ethylbenzene (2014) | 0.14 |
| Nitrate (2013) | 45 as nitrate; 10 as nitrate-nitrogen |
| Nitrite (2013) | 3 as nitrite; 1 as nitrite-nitrogen |
| pH (2015) | None |
| Selenium (2014) | 0.05 |
| Tetrachloroethylene (2015) | 0.01 |
| Toluene (2014) | 0.06 |
| Vinyl chloride (2013) | 0.002 ALARA |
| Xylenes (total) (2014) | 0.09 |

The Federal-Provincial-Territorial Committee on Drinking Water is continuously reviewing Maximum Acceptable Concentrations (MACs) due to new scientific information and studies on adverse effects of certain substances. Most recently, the Federal-Provincial-Territorial Committee on Drinking Water has established a MAC of 0.005 mg/L (5 µg/L) for total lead in drinking water, based on a sample of water taken at the consumer's tap, using the appropriate protocol for the type of building being sampled. As this value exceeds the drinking water concentration associated with neurodevelopmental effects in children, every effort should be made to maintain lead levels in drinking water as low as reasonably achievable (or ALARA). Additionally, Health Canada has announced an expected changed in the MAC for manganese in April 2019. The expected MAC for manganese will be 0.12 mg/L.

The Federal-Provincial-Territorial Committee has released additional guidance documents since 2012 including:

- Issuing and Rescinding Boil Water Advisories in Canadian Drinking Water Supplies (2015): Summary of factors for responsible authorities to consider when a boil water advisory is issued or rescinded.
- Use of Microbiological Drinking Water Guidelines (2013): Overview of considerations for microbiological parameters to ensure drinking water quality.
- Waterbourne Bacterial Pathogens (2013): Information on pathogens that originate from human or animal faeces or naturally occurring in the environment and their treatment options.

In addition to the "Guidelines for Canadian Drinking Water Quality", there is also the Atlantic Canada Guidelines for the Supply, Treatment, Storage, Distribution and Operation of Drinking Water Supply System. These guidelines provide guidance for the development of water supply projects in Atlantic Canada.

Through the Compliance Plan, water and wastewater facilities will be reviewed to achieve compliance with regulations, and the recommendations will be incorporated into the IRP Update.

#### *4.1.3.2 Wastewater System*

The Wastewater System Effluent Regulations (WSER), were enacted in June 2012 and amended January 2015. The WSER were implemented by the federal government and became both provincial and federal wastewater standards for compliance.

The WSER define the following as deleterious substances, and set national standards for their discharge:

- Carbonaceous Biochemical Oxygen Demand (CBOD): 25 mg/L
- Suspended Solids (TSS): 25 mg/L
- Total Residual Chlorine (TRC) for facilities using chlorine disinfection: 0.02 mg/L
- Un-ionized Ammonia as N at 15°C ± 1°C: 1.25 mg/L

WWTFs are authorized to discharge these substances at levels below the defined limits, provided that the effluent is not acutely lethal to trout as determined by standard toxicity testing. Facilities not in compliance must apply for a Transitional Authorization (TA) to deposit effluent exceeding those limits. The Authorization will be valid for a period of 10, 20 or 30 years, depending on the risk level associated with the effluent, as determined by a defined risk-ranking system in the WSER.

#### *4.1.3.3 Wastewater Overflows*

Completed in 2012, the Level of Service (LOS) targets, developed as part of the RWWFP, were based on the draft Canada-wide Strategy for the Management of Municipal Wastewater Effluent guidelines developed by the Canadian Council of Ministers of Environment (CCME). An anticipated component of the guidelines was to target no increase in frequency and/or volume of combined sewer overflows (CSOs) and/or sanitary sewer overflows (SSOs) as a result of new development.

In 2017, The WRWIP level of service review was undertaken to inform strategic planning of Halifax Water's wastewater systems. The recommended LOS of no increase in spill frequency or volume for combined sewer overflows (CSOs) and separated sewer overflows (SSOs) from the RWWFP were recommended to remain as is; the recommendation was adopted in the ongoing Infrastructure Master Plan.

#### *4.1.3.4 Stormwater*

HRM is currently developing a Stormwater Management and Erosion Control By-law to control lot grading and therefore address stormwater quality issues.

## 4.2 2019 IRP Study Area

HRM is comprised of 18 community planning areas, spanning 5,500 km$^2$, with an approximate population of 411,014 people (2016 census estimate). The boundary of the 2019 IRP Update includes the existing and planned Central, East and West service areas for water and wastewater in HRM, as well as the stormwater service boundary.

The study area of the IRP is provided in Figure 9 below.

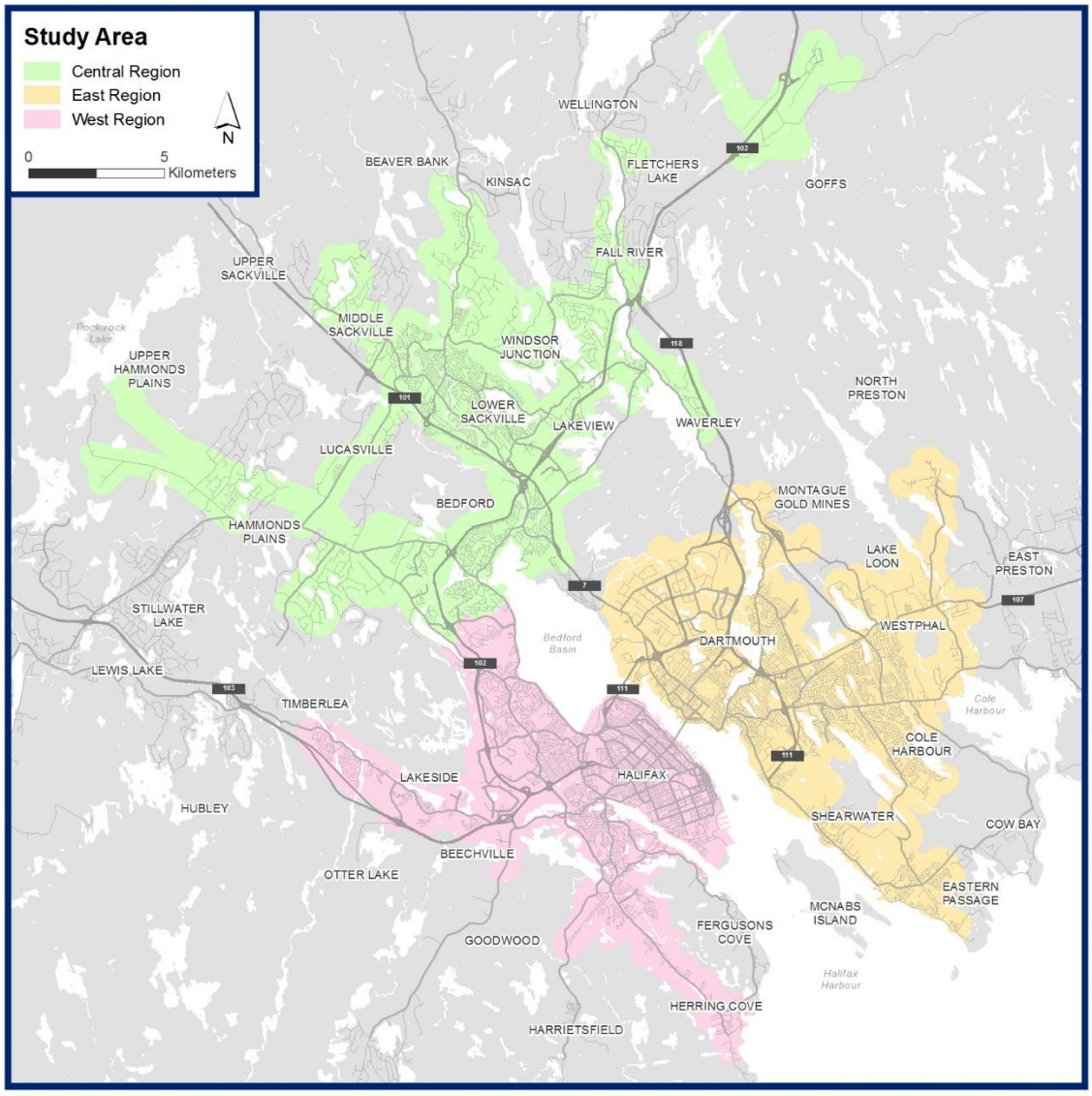



**Figure 9 – Study Area**

Halifax Water owns and operates the water distribution system and the wastewater collection system. It also owns and operates the stormwater collection system within the right-of-way inside the Halifax Water stormwater service boundary.

The following section, details Halifax Water's existing water, wastewater and stormwater infrastructure.

## 4.3 Existing Infrastructure

### 4.3.1 Water System

Halifax Water provides drinking water and fire protection services to approximately 370,000 people. The water distribution system is made up of 1,558 km of watermains (including transmission and distribution mains), eight water supply plants (WSP), two back-up water supplies, six water supply dams, 21 booster stations and 143 chambers.

Halifax has three main water supply plants; J.D Kline WSP, Lake Major WSP and Bennery Lake WSP. In addition, Halifax Water services five smaller community supply plants that service rural/suburban areas. Each WSP has a water withdrawal permits and meets the Canadian Drinking Water Standards.

J.D. Kline WSP services the West and Central Region including the greater urban core of Halifax, Bedford, Sackville, Fall River, Waverley and Timberlea. The plant uses a direct duel media filtration process to treat water from the Pockwock Lake.

Lake Major WSP services the East Region including Dartmouth, Eastern Passage, Shearwater and Forrest Hills/Colby Village. The plant uses a sedimentation and multi-media filtration process to treat water from Lake Major.

Bennery Lake WSP services the Halifax Stanfield International Airport and Aerotech Business Park. The plant uses a direct filtration process to treat water from Bennery Lake.

An overview of the water supply system is illustrated in Figure 10. Showing the location of the WSPs, the pumping stations and reservoirs.

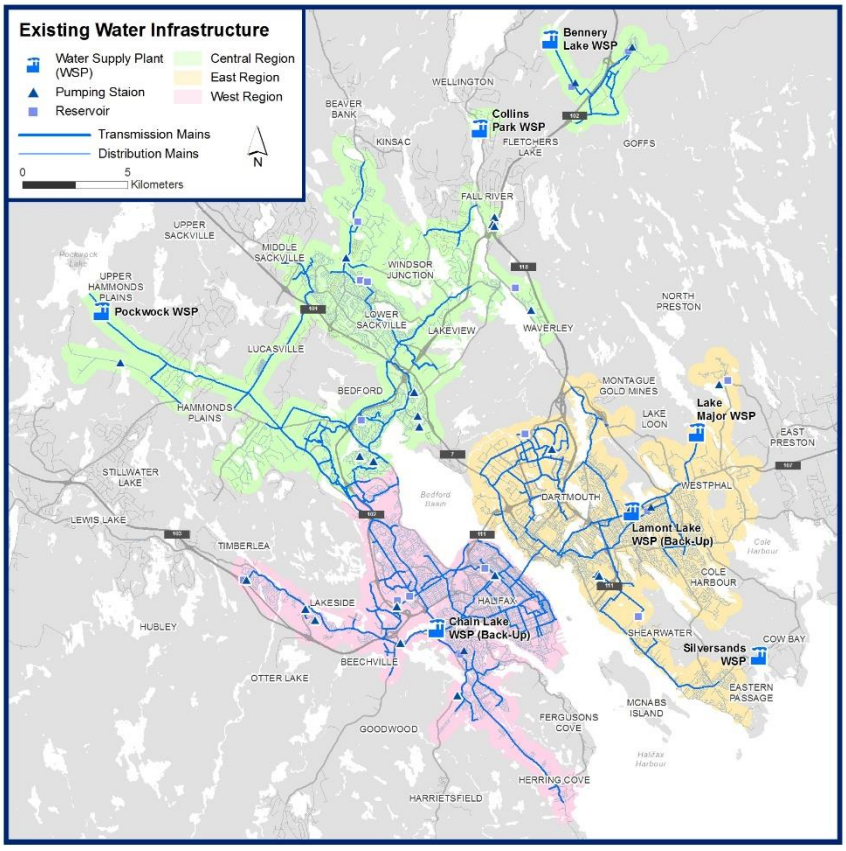



**Figure 10 – Overview of the Existing Water System**

### 4.3.2 Wastewater System

The wastewater collection system is made up of 1,424 km of sewers (including forcemains and gravity sewers), 14 treatment plants, one biosolids processing facility and 166 pumping stations. Halifax Water currently owns and operates five major wastewater treatment facilities (WWTF), Halifax, Dartmouth, Herring Cove, Mill Cove and Eastern Passage and nine smaller WWTF that service rural/suburban areas providing a level of treatment from primary to tertiary. Five of the WWTFs discharge to salt water bodies and nine discharge to small freshwater bodies.

The major wastewater collection system for each of the regions is as follows:

The West Region is comprised of the urban areas of the Halifax Peninsula and mainland serviced by the Halifax WWTF, and outlying suburbs including Beechville, Lakeside and Timberlea are serviced by the BLT WWTF and the trunk sewer which conveys flow to Halifax sewershed, while the outer regions of Spryfield and Herring Cove drain to the Herring Cove WWTF.

The East Region is comprised of the Dartmouth area which includes combined and separated sewers tributary to the Dartmouth WWTF. The Dartmouth catchment is particularly complex with separated networks entering combined networks, high I&I levels and a number of cross connections making defining catchments and flows more complex. The outlying suburbs of Cole Harbour, Shearwater and Eastern Passage are tributary to the Eastern Passage WWTF.

The Central Region comprises of Bedford and Sackville which are tributary to the Mill Cove WWTF. A large portion of the Central Region is not serviced by the municipal wastewater system, relaying on on-site sewage disposal.

Figure 11 provides an overview of the wastewater network. It illustrates the location of the WWTFs, pumping stations and sanitary and combined sewer network.

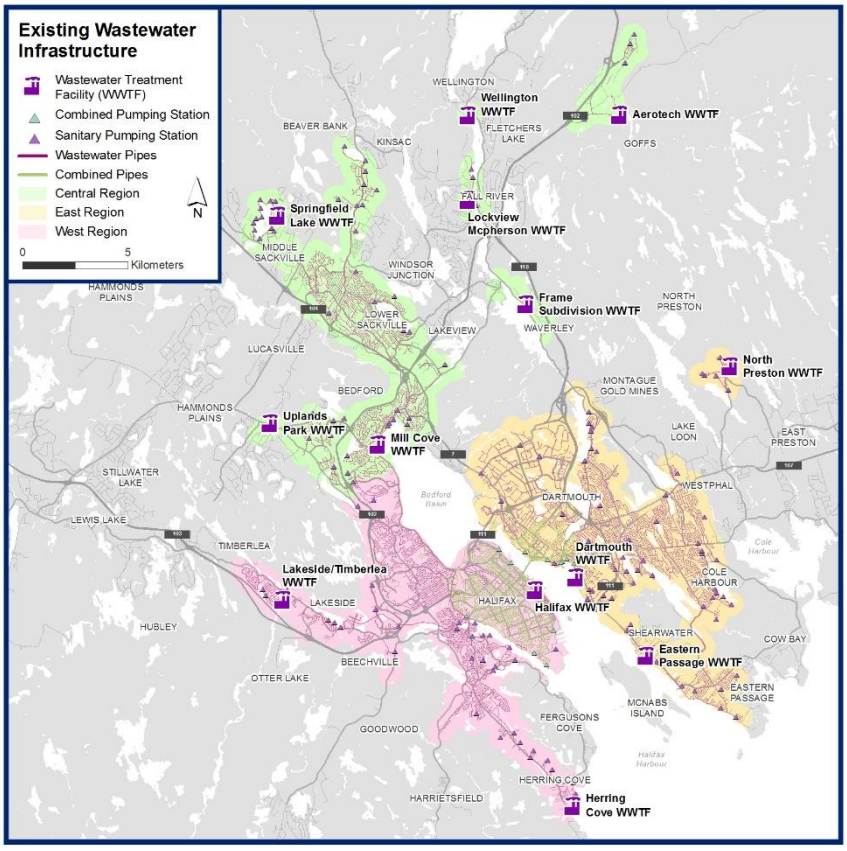



**Figure 11 – Overview of the Existing Wastewater System**

### 4.3.3 Stormwater System

The stormwater collection system is made up of 878 km of storm sewers, 2,337 cross culverts, approximately 16,000 driveway culverts, and 40 stormwater management structures. The stormwater system is multi-jurisdictional, with the provincial and municipal governments, Halifax Water and private owners having distinct roles and responsibilities within the stormwater cycle. Table 4 presents the stormwater system jurisdiction and roles and responsibilities for each entity.

**Table 4 – Stormwater System Jurisdiction**

| Entity | Roles and Responsibilities |
|---|---|
| Province of Nova Scotia | • Protection of water resources including natural watercourses (stream, rivers, lakes)<br>• Issues a Permit to Construct for the installation of a public stormwater system |
| Halifax Water | • Municipal water, wastewater and stormwater utility serving HRM residents<br>• Authority to own and operate stormwater systems within a defined service boundary which comprises of catch basins, pipes, manholes, roadside, ditches, swales, culverts, stormwater holding tanks, ponds, and dams |
| Halifax Regional Municipality | • Regulation of land development activities including siting of buildings, grading of land, and assessment of impacts of overland flow resulting from development of land ad stormwater systems<br>• Owns and maintains minor drainage system elements including pipes, ditches, culverts, etc.) that fall outside of Halifax Water's service boundary<br>• Owns and maintains public street system |
| Private Property Owners | • Stormwater flow across individual properties, across adjacent property boundaries and stormwater management systems located on individual property<br>• Private stormwater systems include rainwater leads, footing drains, private community systems, and slope protection within privately-owned property<br>• Maintain drainage corridors and privately-owned drainage infrastructure free of vegetation and debris |

Figure 1 provides an overview of Halifax Water's stormwater service boundary.

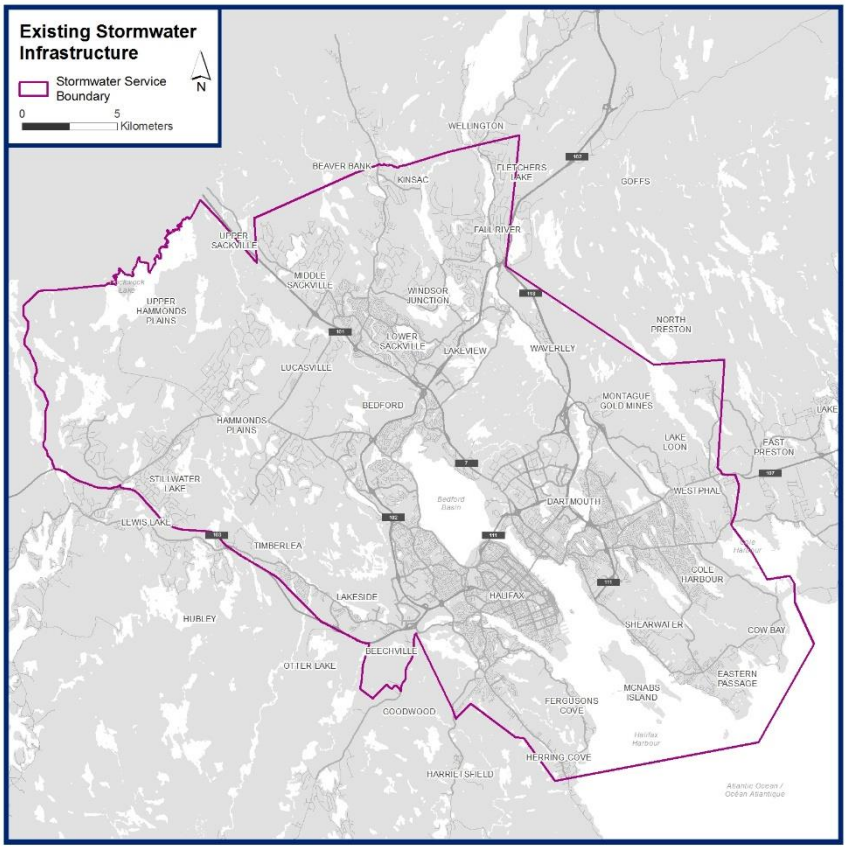



**Figure 12 – Halifax Water Stormwater Service Boundary**

## 4.4 Planning Data and Population Projections

As part of the Infrastructure Master Plan process, Halifax Water project teams including HRM staff collaborated to define the planning projection dataset, required to develop the Infrastructure Master Plan. HRM confirmed the starting baseline populations, the ultimate planning projection approach and growth rate over a 30-year horizon, from 2016 to 2046. The resulting planning estimates were the basis for the water demand and wastewater flow projections for the Master Plan. Table 5 summarizes the HRM planning estimates as developed in the Infrastructure Master Plan.

**Table 5 – Halifax Regional Municipality Planning Estimates**

| Sub-boundary | Employment Growth (2016-2046) | Population Growth (2016-2046) | Total Growth (2016-2046) |
|---|---|---|---|
| Regional Centre | 42,123 | 53,507 | 95,630 |
| Suburban | 36,963 | 77,706 | 114,669 |
| Rural | 6,877 | 17,000 | 23,877 |
| **Total** | **85,963** | **148,213** | **234,176** |
| **Service Area*** | **79,086** | **131,213** | **210,299** |

*Excludes rural planning projections.

## 4.5 Design Criteria, Level of Service and Cost Estimation Review

### 4.5.1 Design Criteria

A comprehensive review of Halifax Water's existing design criteria for water supply and wastewater collection systems was completed as part of the WRWIP and Infrastructure Master Plan. In addition to the review, trend analyses and a summary of industry best practice were used to validate the appropriateness of the criteria.

Key design criteria for wastewater collection system:

- Per capita sanitary flow = 300 L/cap/day
- I/I allowance rate = 0.28 L/s/ha

Key design criteria for water supply system:

- Per capita average day demand = 375 L/cap/day
- Peaking factors summarized in Table 6.

**Table 6 – Peaking Factors for Infrastructure Planning**

| Category | MDD | PHD |
|---|---|---|
| System Supply | 1.40 | 2.10 |
| Storage | 1.90 | 2.85 |
| Pumping and PRVs (Zones > 10,000 people) | 1.90 | 2.85 |
| Pumping and PRVs (Zones < 10,000 people) | 2.20 | 3.30 |

### 4.5.2 Level of Service

A comprehensive review of Halifax Water's level of service for water supply and wastewater collection systems was completed as part of the Infrastructure Master Plan. The level of service recommended as part of the Infrastructure Master Plan includes:

Wastewater collection systems

- A 1 in 5-year design event is to be used to assess peak flows and infrastructure capacity.
- Ensure that new development does not increase the frequency and/or volume of CSOs or SSOs, or impact on the water quality.
- In recognition of the high amenity value of the Northwest Arm, a more stringent limit of 10 overflow events per year is to be applied at each individual CSO along the Northwest Arm.

Water supply systems

- Pressures between 40-100 psi under Minimum Hour Demand (MHD) and Peak Hour Demand (PHD) scenarios.
- Pressures above 22 psi during a fire under a Maximum Day Demand (MDD) scenario.
- Available storage capacity in accordance with the Atlantic Canada Guidelines.

## 4.6 IRP Update Study Inputs

There are three documents that will serve as the main study inputs for IRP Update:

- Infrastructure Master Plan (ongoing)
- Compliance Plan (ongoing)
- Asset Management Plan (ongoing)

### 4.6.1 Infrastructure Master Plan

The Infrastructure Master Plan focuses on the servicing strategies and management of infrastructure in the Halifax Region, to produce an optimal servicing strategy for the wastewater and water supply networks. The Infrastructure Master Plan is ongoing and builds off previous completed studies such as the WRWIP and LoWSCA. The strategic plan of the Master Plan is intended to accommodate growth, regulatory compliance, asset renewal and optimization of assets for the next 30 years. The Master Plan will become a key component of long term planning, providing costing and timeframes. It includes development of wastewater and water hydraulic models, conceptual designs for projects in the first 10 years, and forms a work plan for adapting to climate change, similar to the WRWIP.

Through the Master Plan, the following have been completed and/or used in the development of the servicing strategies:

- Climate Change Framework
- Wet Weather Management Study
- Cost Estimation Framework
- Design Criteria and Level of Service Review
- Planning Data and Population Analysis
- Water Model Build and Calibration
- Wastewater Model Build and Calibration

The Infrastructure Master Plan will provide key inputs to the IRP Update, including:

- Growth Areas – Halifax's projected growth areas covering extents and timing.
- Capital Program – water and wastewater capital projects to 2041 including timing, cost estimates and spatial allocation.
- Wet Weather Management Study – priority areas, best areas with potential for sewer separation, I/I reduction, low impact development (LID) and CSO discharge reduction.

### 4.6.2 Compliance Plan

Halifax Water's Compliance Plan is currently underway. It will establish the current and future (5-year and 30-year planning horizon) federal, provincial and municipal level compliance requirements related to Halifax Water's water distribution system and wastewater and stormwater collection systems. The Compliance Plan will provide a path for Halifax Water moving forward to achieve full compliance in all its systems.

Compliance requirements for the following infrastructure will be included:

- Wastewater treatment facilities and effluent, as well as wastewater compliance within the collection system (SSOs and CSOs).
- Water supply plants, transmission and distribution system, water chambers, booster stations, water supply dams and reservoirs.

The Compliance Plan will provide key inputs to the IRP Update, including:

- Current and future regulatory compliance requirements.
- Detailed treatment compliance assessment for WWTFs and WSPs.
- Capital program including timing, cost estimates and location.

### 4.6.3 Asset Management Plan

The Asset Management Plan (AMP) is last of three key inputs to the IRP Update. The AMP provides a summary of asset inventory and state of Halifax Water's infrastructure, level of service the assets provide to the customers, infrastructure replacement and maintenance strategies, and associated costs and expenditures. Halifax Water currently updates the AMP on an annual basis. The latest version of the AMP is the 2017/18 which was prepared by the utility on October 2018. Halifax Water is currently working towards the development of the 2018/2019 AMP.

The AMP document structure consists of an "Overall Main Sections" component followed by individuals AMPs covering 14 different asset class as follow:

<u>Water</u>

- Supply Plants
- Supply Dams
- Chambers & Booster Stations
- Transmission Mains
- Distribution Mains
- Service Reservoirs

<u>Wastewater</u>

- Treatment Facilities
- Pumping Stations
- Gravity Sewers
- Forcemains

<u>Stormwater</u>

- Management Structures
- Gravity Sewers
- Cross Culverts
- Driveway Culverts and Ditches

For each of the asset class AMPs, background documentation (spreadsheet, shapefiles, etc.) has been provided with the purpose to inform the IRP Update and support the integration process.

The AMP provides the following key inputs to the IRP Update:

- Asset inventory and replacement costs for each asset class.
- Asset condition based on age/estimated service life, conditions assessments, site inspections, staff knowledge and discussions, depending on the available information for each asset class.
- Recommended 5-year detailed capital expenditures and a 30+ year average forecast for most asset classes.

It is expected that the Master Plan will contain projects and initiatives that will present an overlap with some of the recommendations from the Compliance Plan and Asset Management Plan. The IRP will navigate through all the recommendations from the plans to find areas for integration in order to develop Halifax Water's Long-Term Infrastructure Planning Capital Plan.

# 5 Conclusions and Recommendations

Halifax Water is responsible for the operation and management of the water and wastewater systems, and the operation and maintenance of the existing stormwater infrastructure located within the road right-of-way or easements owned by the utility. As part of its mandate and services, Halifax Water continuously undertakes initiatives and programs to maintain, operate and expand its systems while providing an appropriate level of service to its customers.

The Integrated Resource Plan Update is a critical project that brings together Halifax Water's various initiatives and programs into a singular integrated capital and financial plan. This study applies the considerations of growth, regulatory compliance and asset renewal to ensure the integrated recommendations achieve the desired service delivery goals as well as identify any additional gaps and programs required in the long-term plan.

The 2019 IRP Update will be built on the foundation of the 2012 IRP, as well as other studies and initiatives completed since, or that are currently underway. The main inputs to the IRP Update include the Infrastructure Master Plan, the Compliance Plan and Asset Management Plans.

As part of the IRP Update, a background data and legislation review was undertaken. The purpose of the review was to go through the background information available and form the understanding required to successfully complete the IRP Update.

The background data and legislation review provide the following recommendations for areas of improvement and next steps:

- Understand Halifax Water's current DSM/SSM measures, document what strategies are being planned and recommended through the study inputs, identify industry leading DSM/SSM strategies, and provide recommendations for potential implementation of new measures.
- Review AMPs inventory, replacement costs and projected asset renewal expenditures. A Costing Review analysis will be carried out to undergo an industry review and cross-reference of sources of unit rates, replacement values, costing methodology and assumptions for water, wastewater and stormwater infrastructure.
- Assess potential integration opportunities for projects and programs recommended in the study inputs for the water, wastewater and stormwater systems. The integration process purpose is to ensure that projects and programs are aligned in terms of geography and spatial allocation, drivers (growth, compliance, asset renewal), priorities, timing and phasing, life cycle cost, resources and financial sustainability.
- Ensure consistency among deliverables and outputs of the IRP Update with the study inputs and other published documents including appropriate sourcing of information.

# Appendix A - 2012 IRP Assumptions

**Appendix A: 2012 IRP Assumptions**

| Study Aspect | Assumption |
|---|---|
| Compliance[1] | • For purposes of the IRP, development of a conservative assumption was made that each wastewater facility except BLT, which is already being upgraded, would need to meet limit of technology (LOT) effluent limits. The term "limit of technology" has been used to describe the lowest, consistently achievable effluent concentration for total phosphorus (TP) and total nitrogen (TN) utilizing existing technology. In Chesapeake Bay, a program has been in place since 1992, which implemented the concept of LOT utilizing biological nutrient removal (BNR) technologies. |
| Asset Renewal Modelling[2] | • Due to GIS data gaps, asset information for the water distribution and wastewater collection systems were assumed including material, diameter, and age profile<br>• The asset service life estimates were based on best industry practice. For complex assets like pump stations and treatment facilities separate service life estimates were made for various system components. Civil (structural) elements had a 50-year life, mechanical-electrical (M&E) components had a 20-year life and instrumentation and control (IC) had a 10-year life. A fraction of the total asset value was assigned to each component e.g. structural represents 60% of total asset value. The asset life data and fractional values are contained in the costing procedures technical memorandum, which is presented in Volume 3 Appendix C of the IRP final report.<br>• For purposes of the asset renewal modelling the civil-structural components of complex assets such as pump stations and treatment plants were considered to be presently in new condition. Considering the 50-year life of the components they did not figure in the asset renewal requirements over the 30-year IRP planning period. Halifax Water staff reviewed the status of the M&E and IC systems of major water and wastewater treatment facilities and provided specific estimates of current asset age. These were used as the starting point for the modelling of these assets.<br>• A discount rate of 3% was applied to all asset renewal capital expenditures. The discount rates were calculated as the difference between the current municipal borrowing rate of 5% and an inflation rate of 2% for capital projects estimated from an analysis of ENRCCI index changes for municipal construction projects.<br>• The current annual expenditure as a percentage of the asset value was based on the asset renewal expenditures provided in the Five-Year Capital for 2012 to 2017. It was assumed that the budgeted amounts are indicative of current asset renewal expenditures.<br>• Some special assets with significant site-specific conditions affecting renewal costs such as reservoirs or dams were not modelled but rather subjected to individual analysis to estimate required renewal over the 30-year period. These were high-level estimates. Specific detailed evaluations should be made for each of these structures to establish current condition and replacement requirements. |

[1] Integrated Resource Plan (Section 4.3.2), Halifax Water, October 2012
[2] Integrated Resource Plan (Volume 1, Appendix F), Halifax Water, October 2012

| Study Aspect | Assumption |
|---|---|
| Demand Reduction Assessment[3] | For the purpose of the demand reduction assessment the following assumptions have been made:<br>• A conservative reduction of 10% in existing sanitary flows through water demand reduction. This reduction is based on retrofit of existing homes and purchase of new water efficient appliances.<br>• A 30% reduction in sanitary flows through future water demand reduction.<br>• A 30% I/I reduction in existing I/I flows, consistent with the targets set for King County Washington<br>• Current design allowance for future I/I<br>In order to assess the potential benefit to cost relationship associated with the demand reduction activity the following assumptions were made:<br>• The bulk of the cost of the 30% future water/wastewater demand reduction would be incorporated into the cost of the new dwellings and buildings (through low-flow appliances and fixtures) and would not impact on the IRP capital requirements.<br>• Low cost for the demand reduction for existing water/wastewater usage, largely achieved through existing public education programs<br>• The cost of the I/I program could not be determined precisely due to the absence of Halifax data. Instead a high-level analysis approach was based on the large scale, well resourced, multi-year program in King County, Washington. |
| End-of-period Value Analysis[4] | • The starting value of the assets was determined from their replacement value, age profile (i.e. year of installation), and nominal service life. Straight-line depreciation was then used to estimate the current asset value.<br>• The 30-year asset renewal analysis was carried out for four cases: A, B, C and composite levels and includes the renewal of assets added through the IRP capital program over the 30-year period.<br>• The capital expenditures over the 30-year period were based on the Recommended IRP.<br>• Straight-line depreciation was used throughout. |
| Enhanced Overflow Control Program Analysis[5] | • Additional overflow control used a technology based on storage coupled to pumping and secondary treatment for purposes of estimating capital costs.<br>• Storage was sized to capture all but 25, 15 and 5 overflow events per average year<br>• Pumping and secondary treatment requirements were sized to empty full storage in 48 hours<br>• Costs were estimated using the same procedures as throughout the IRP |

[3] Integrated Resource Plan (Section 6.3.2), Halifax Water, October 2012
[4] Integrated Resource Plan (Section 6.3.3), Halifax Water, October 2012
[5] Integrated Resource Plan (Volume 1, Appendix F), Halifax Water, October 2012

| Study Aspect | Assumption |
|---|---|
| Financial Modelling[6] | • A discount rate of 3% was applied to all capital expenditures and a discount rate of 1% was applied for all additional O&M costs. The discount rates were calculated as the difference between the current municipal borrowing rate of 5% and an inflation rate of 2% for capital projects estimated from an analysis of ENRCC index changes for municipal construction projects and 4% inflation rate for O&M<br>• Only years 2-5 of the Halifax Water Five-Year Capital Plan were incorporated in the financial models. The initial year 2012-2013 was considered already in process and was not included. Year 1 of the IRP financial analysis is 2013-2014.<br>• The expenditures associated with projects identified in the years beyond the Five-year Capital Plan were distributed through the financial model through discussions with Halifax Water staff on priorities and programming<br>• All capital projects where variations were considered in timing were allocated to the single year indicated in the variation.<br>• All capital expenditures developed during the IRP are stated as project costs and include a 1.6 multiplier to account for engineering, construction management, other incidental costs and a 25% estimating contingency. The details of the unit rates (e.g. cost per meter of pipe) and other aspects of the project costing procedures are presented in Volume 3 Appendix C. All capital costs presented for the RWWFP have been harmonized with regard to costing procedure used by the IRP. All capital costs are presented in $2012 using an ENRCC Index value of 9200.<br>• Additional (change in) O&M costs were developed using the procedures described in Volume 3 Appendices B and C. The costs account for labour, energy, and chemicals as well as such consumables as UV bulbs and membrane filter cartridges. Additional O&M costs for upgrade/expansion projects were started the year after the project was implemented<br>• All programs/projects and O&M costs were allocated to one or more IRP objectives. The cost split among objectives was based on best professional judgment. The splits are recorded in the financial models presented in Volume 3 Appendix F.<br>• The Enhanced Overflow Control Program was allocated in total to Objective 6. The asset renewal costs arising from the asset renewal modeling were allocated to Objective 8. These program costs incorporated the Halifax Water Five-Year Capital Plan specific asset renewal projects. The RWWFP costs were allocated primarily to Objective 13 reflecting the need to offset the impacts of growth on the existing wastewater system. Some RWWFP costs were however allocated to Objectives 6 and 14. |

[6] Integrated Resource Plan (Section 5.6), Halifax Water, October 2012

A

HALIFAX WATER

2019 INTEGRATED RESOURCE PLAN

# APPENDIX A.2

## DSM / SSM MEASURES

# Halifax Water

# 2019 Integrated Resource Plan

***Technical Memorandum #2:***

*Demand Side Management &*

*Supply Side Management*

*Measures*

Project No.: 718032

**Prepared by: GM BluePlan Engineering**

**For: Halifax Water**

**March 2020**

## Document Revisions

The following is a record of the changes/updates that have been made to the final document:

| Version | Changes / Updates | Author | Reviewed | Date |
|---|---|---|---|---|
| DRAFT | 1st Draft for Review | Sandy Naime | James Jorgensen | Dec 6th 2019 |
| DRAFT | 2nd Draft for Review | Sandy Naime | Chris Campbell | Dec 12th 2019 |
| FINAL DRAFT | Final Draft Report | Sandy Naime | James Jorgensen | March 9th, 2020 |
| FINAL | Final Report | Sandy Naime | James Jorgensen | March 27th, 2020 |

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## Appendices

# 1 Introduction

The Halifax Regional Water Commission (HRWC), also known as Halifax Water, was the first regulated and publicly owned water, wastewater and stormwater utility in Canada. With a long history dating back to the 1940s, Halifax Water is the water, wastewater and stormwater utility servicing residents of the Halifax Regional Municipality (HRM).

As part of its mandate, Halifax Water continuously undertakes initiatives and programs to maintain and operate its systems while striving to provide world class service to its customers and environment. These initiatives and programs require integration into a single capital program that identifies the long-term resource needs and financial expenditures.

The long-term program is consolidated into a comprehensive document: the Integrated Resource Plan (IRP) for Halifax Water. As part of the IRP approach, it is intended to complete IRP updates at regular intervals to ensure the consolidated long-term program is current. This IRP update is a critical project that brings together projects, initiatives and programs from separate studies, into a singular integrated capital plan. This study applies the drivers of compliance, asset renewal and growth, to ensure the integrated recommendations achieve the desired service delivery goals, as well as identify any additional gaps and programs required in the long-term plan.

The IRP approach is a key component of Halifax Water's iterative planning process. The process was initiated in 2012 with the first IRP and continued with further understanding of the infrastructure systems and development of studies and frameworks, capital delivery and financial planning. The 2019 IRP Update is built on the foundation of the 2012 IRP and provides Halifax Water with the required programs and resources for a 30-year period covering each of the three drivers: Compliance, Asset Renewal and Growth.

As part of the 2019 IRP Update process, a review of Demand Side Management (DSM) and Supply Side Management (SSM) practices and measures was undertaken. The review included identifying and reviewing all the activities that Halifax Water currently employ as well as an evaluation of those implemented throughout the water industry. Through collaboration with Halifax Water staff, each identified measure was reviewed and evaluated to provide recommendations for improvements and select new measures for potential future implementation.

This technical memorandum summarizes the review of industry trends, reviews measures currently in place at Halifax Water, evaluates effectiveness of different measures and considers potential additional measures that could be implemented.

## 1.1 Aim

The aim of the DSM/SSM Measures Technical Memo is to provide guidance on which existing and new activities and measures are likely most effective for Halifax Water.

## 1.2 Objectives

In order to meet the Aim, the following objectives were completed:

- Identify and review DSM/SSM measures currently being planned or already implemented by Halifax Water.
- Identify and review DSM/SSM best practices from other utility companies or municipalities within and outside Canada.
- Evaluate DSM/SSM measures and provide recommendations for improvements or potential new measures for future implementation.

# 2 DSM/SSM Definitions and Review Process

## 2.1 Definitions

**Demand Side Management (DSM)** - relates to the management of water, wastewater and stormwater at the point of use. Demand Side Management effects customer usage and education, utility rates, regulations and private property connections.

Demand Side Management activities are those that occur on the customers side of the property boundary.

DSM measures are guided and supported by Halifax Water (in some cases in association with HRM) however, the rate of success is determined by the level of customer involvement. Challenges for DSM are mostly related to implementation costs and inconvenience to customers.

**Supply Side Management (SSM)** - relates to the management of water, wastewater and stormwater infrastructure to meet or exceed customer demands including system optimization, upgrades, and infrastructure repair and replacement.

Supply Side Management activities are those that occur at Halifax Water facilities or within the public right-of-way.

SSM measures are implemented by Halifax Water (in some cases in association with HRM), therefore, the rate of success is determined by the planning, design and operation of the infrastructure. Challenges for SSM are mostly related to infrastructure and energy costs.

## 2.2 DSM/SSM Review Process

The DSM/SSM measures review process involved the following steps:

1. Review of existing measures currently planned or implemented by Halifax Water.
2. Review of best practices from other utilities/municipalities within and outside Canada.
3. Evaluating the long list of DSM/SSM measures in collaboration with Halifax Water.
4. Identification of potential new measures and/or enhancement opportunities for Halifax Water.

## 2.3 DSM/SSM Categories

As detailed above, the review process started with forming a long list of DSM/SSM measures by reviewing existing measures currently planned or implemented by Halifax Water and undertaking a best practice review of other utilities/municipalities within and outside Canada.

After the long list of measures was formed, the DSM/SSM measures were first categorized based on system (water, wastewater, stormwater) and driver type (growth, compliance, asset renewal). Each measure was then further classified by DSM and SSM categories shown in **Table 1**. These categories were chosen based on their overall impact on the customer (DSM) and impact on the planning and/or design of infrastructure (SSM).

**Table 1 - DSM/SSM Categories**

| DSM Categories | SSM Categories |
|---|---|
| Customer Education | Design Criteria |
| Customer Usage | Financial Incentives |
| Financial Incentives | Infrastructure Management |
| Regulation | Infrastructure Replacement / Repair |
| Utility Rates | System Optimization |
| Water Loss Control | System Extension / Upgrades |

## 2.4 DSM/SSM Measures Evaluation

To compare and assess the long list of DSM/SSM measures a range of factors were applied and ranked. The main goals of the DSM/SSM long list evaluation process were:

For the DSM/SSM planned or implemented measures:

- Assess the measures of success and benefits to Halifax Water, the public and the environment.
- Identify challenges and issues Halifax Water is facing.
- Provide recommendations for improvements, if applicable.

For the additional/new DSM/SSM measures:

- Compile a comprehensive list of industry best practice DSM/SSM measures.
- Identify opportunities and challenges in the context of Halifax Water.
- Assess which additional measures could be further considered for future implementation.

The factors included in the evaluation process and the indicators are detailed in **Table 2**.

**Table 2 – Long List Evaluation Criteria**

| Factor | Indicator |
|---|---|
| Strategy Control | The entity who has control of the strategy |
| Technical Feasibility | Includes compatibility with existing and future infrastructure, capacity for future growth, system security, technical viability, traffic management, existing utilities and operation & maintenance |
| Financial / Cost / Affordability | Includes capital cost, lifecycle cost, net present value and institutional capacity (budget availability) |
| Legal / Jurisdictional | Includes property acquisition, permitting requirements, board approvals, compliance with applicable planning policies, by-law changes, jurisdiction |
| Environmental | Includes long term effects on environmentally sensitive features, soil/land contamination, water features/resources/source water, geology, hydrogeology and air quality |

| Factor | Indicator |
|---|---|
| Social / Cultural | Includes community impacts, effects on existing road infrastructure, noise, vibration, dust and odour impacts, cultural heritage/archaeology impacts, agricultural impacts, financial impact to customer |
| Probability of Success | By implementing the strategy, what is the probability of successfully - reducing flows/increasing capacity and sustaining that impact |
| Implementation / Timing | Includes phasing, schedule/timing risk, resource availability |
| Project Integration | Can the strategy be integrated with current and/or future projects? |
| Cost-Benefit Analysis | Comparison of the success of the strategy versus the cost of the project - considerations include the ability to monitor the results of the strategy to determine its success |

GM BluePlan, in collaboration with Halifax Water, developed a ranking system to classify each measure from least suitable to most suitable. Using the evaluation criteria provided in **Table 2,** a score of either 1 (low benefit - red), 2 (medium benefit – yellow) or 3 (high benefit - green) was given to each factor in the evaluation criteria, to provide an overall score for each measure in the long list. The overall score allowed the measures to be ranked from most suitable strategies to least.

## 3 Halifax Water's DSM/SSM Measures

A review was conducted to gather information on DSM/SSM measures Halifax Water is currently implementing or is planning to implement in the future. This information included: data collection process and use, issues/challenges, potential enhancements to existing initiatives/programs, and integration opportunities, among others. Discussions with Halifax Water were conducted throughout the process to ensure sufficient detail was gathered on these measures.

A total of 40 DSM/SSM measures were identified through this process. The DSM/SSM measures currently being undertaken by Halifax Water are provided in **Figure 1.**


**Figure 1 – Halifax Water's Existing DSM/SSM Measures**

Halifax Water's current DSM/SSM measures were evaluated against the evaluation criteria presented in **Table 2**. The DSM/SSM review and evaluation process demonstrated that Halifax Water is currently implementing a wide range of measures across all DSM/SSM categories covering all systems and drivers. The long lists of DSM/SSM measures are provided in **Appendix A**.

The following is a summary of the findings:

- Water measures scored high in the DSM/SSM measures evaluation due to the innovative work Halifax Water is currently doing on their water system. An example of this work is the Infrastructure Leakage Index (ILI). Halifax Water is a leader in North America for actively using ILI to help reduce water loss in the system. Other measures that target water leak identification and control include: night time flow analysis, active leak detection using sonic detection, leak notification program, corrosion control, and pressure management, among others.
- Some of the challenges identified for water DSM/SSM measures were for financial incentives such as rebate/retrofit programs which might require significant amount of funding and/or loss of revenue, and local improvement charges which are currently administered by HRM.

- Similar to the water DSM/SSM measures, Halifax Water has invested significant resources and effort on DSM/SSM measures that target the wastewater and combined systems. Some measures, such as the corporate flow monitoring program, support the implementation and performance indicators of other initiatives such as the inflow and infiltration reduction program, design criteria review and sewer separation.

- Some of the challenges identified for wastewater DSM/SSM measures, were related to the data collection, capital and O&M costs required to support the implementation of these measures. For instance, RDII reduction measures require great amount of data collection to support implementation. Any measure related to implementation of new infrastructure requires capital cost and O&M costs, such as the implementation of a new pumping station.

- Private side RDII reduction is currently being addressed by Halifax Water with a dedicated team. The work focusses on known issue areas and provides enforcement to ensure illegal connections etc. are rectified. There are several challenges with Private side works, such as foundation drain disconnections, may be challenging in areas where existing stormwater sewers are too shallow or do not exist. Downspout and foundation drain disconnections also involve residents, which often requires significant collaboration with HRM and public consultation, and/or incentive programs. Halifax Water has been progressing their Wet Weather Management Program, which includes detailed cost-benefit analyses of different RDII reduction strategies and actively seek effective private side RDII reduction.

- Private-side RDII reduction require significant increased coordination with HRM, the public, and other stakeholders. Halifax Water promotes and ensures private side RDII reduction through educational and enforcement activities. The implementation of these measures is challenging due to multiple jurisdictions, governing and funding sources. It is likely that to be effective new by-laws and approval from the Nova Scotia Utility and Review Board will be required to allow Halifax Water to subsidize or fund work on private property.

- Another outcome of the DSM/SSM review and evaluation was the need for measuring the performance and cost benefit of implementing DSM/SSM measures. Some activities are currently measured though the corporate balance scorecard, such as the water loss control reduction and I/I reduction program. However, further refinement of measurement approach should focus on relating the program to cost to benefit. Performance management of DSM/SSM measures will further support Halifax Water in aligning their resources and systems to meet their strategic objectives. It also has the potential to provide early warning of potential issues or problems that can be mitigated or resolved in a timely manner.

- The current Halifax Water DSM/SSM measures, as listed in **Figure 1**, have an impact on the long-term planning of infrastructure and therefore on the current 2019 IRP Update. **Table 3** provides a list of potential impacts that DSM/SSM measures could have on the IRP Update depending if the measures are related to data collection, education and standards, or hard infrastructure.

**Table 3 – Halifax Water DSM/SSM Measures Impact on IRP Update**

| Type of DSM/SSM Measure | Potential Impact on the 2019 Integrated Resource Plan Update |
|---|---|
| Data Collection | • Informs operations<br>• Prioritizes areas for RDII reduction<br>• Informs Design & Construction Standard Specifications revisions<br>• Provides evidence of effectiveness of initiatives and programs<br>• Informs the decision-making process |
| Education and Standards | • Affects how flow and demands are projected in the future<br>• Aims to reduce demand on the systems<br>• Intent to change user's behaviour<br>• Influences public perception on Halifax Water, services and their role as stewardship of the environment and natural resources |
| Infrastructure | • Sizing of new infrastructure or capacity upgrades<br>• Timing and allocation of resources<br>• Add or free up capacity in the systems<br>• Manage existing and projected demands<br>• Aim to extend lifecycle of assets and better use of resources<br>• Support growth and future developments<br>• Improve overall system performance and reliability |

# 4 Additional DSM/SSM Measures

After identifying the DSM/SSM measures from the long list that are already implemented by Halifax Water, there remained a list of DSM/SSM measures identified during the best practice review, that are not currently implemented by Halifax Water.

The purpose of this step of the DSM/SSM study was to understand what other utility companies and municipalities were currently implementing that are not already in place at Halifax Water. Then to determine if those measures should be considered for future implementation by Halifax Water.

The desktop review of DSM/SSM measures included: information provided on municipality and relevant association websites, infrastructure planning and design guidelines and reports, industry leading standards, published articles and university studies, among others. In addition, GM BluePlan leveraged the knowledge obtained through various projects to further refine the information contained in the DSM/SSM measures review.

**Figure 2** presents a summary of the additional measures identified through this process. Additional information can be found in **Appendix A**.

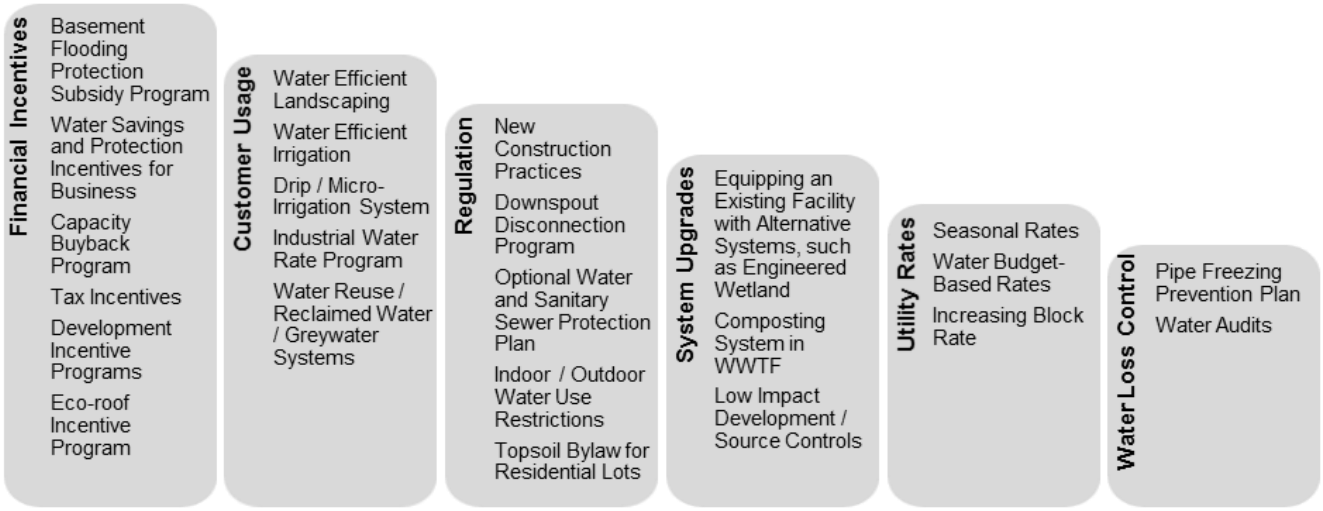



**Figure 2 – Additional DSM/SSM Measures**

The additional DSM/SSM measures were evaluated against the same evaluation criteria as the current Halifax Water's measures, as presented in **Table 2**. The following is a summary of the findings:

- Financial incentives and utility rates are popular measures in other utilities/municipalities. The purpose of these incentives is to encourage users to implement measures that promote water conservation and protection. Both financial incentives and utility rates may require a significant amount of funding and/or loss of revenue and require a strong business case to gain approval and support for their implementation. It is difficult to measure the direct effectiveness of incentives and also to prioritize spatially where such measures would be most effective in relation to specific infrastructure needs.
- Customer usage measures are intended to change user behaviour. The probability of success for these measures are in the low range since it depends entirely on the users but has the potential to increase when they are combined with financial incentives or regulation restrictions. Halifax's

climate may not support water reduction measures for irrigation as the area receives a lot of precipitation. This would have to be considered prior to pursuing some of these measures.

- Regulation measures can be challenging to implement as they may have legal and jurisdictional implications, such as requiring approvals from Nova Scotia Utility and Review Board (NSUARB) and HRM.
- System upgrades involve the implementation of new infrastructure and/or the use of new technology. These measures can be difficult to get approval or implement due to their technical feasibility and associated high cost, among other factors.
- Halifax Water has a comprehensive approach to water loss and has made many improvements and water loss reduction. As a result, additional measures that target water loss may see diminishing return on investments as the most cost-effective measures have already been implemented.

Additional DSM/SSM measures have shown to be successful in other municipalities and jurisdictions, but due to the above reasons, they were not carried forward as specific standalone solutions for implementation by Halifax Water at this time. However, it is recognized that a combination of existing and new DSM/SSM measures targeting RDII reduction will be required for the successful implementation of the Infrastructure Master Plan wastewater servicing strategy.

# 5 Halifax Water Collaboration

## 5.1 Collaboration Process

Throughout the DSM/SSM measures review and evaluation process, Halifax Water have been a key contributor. Halifax Water reviewed and confirmed information provided is correct and up to date and identified any measures that did not adhere to Halifax Water's current objectives and level of service.

Once the long list of measures was developed, Halifax Water reviewed the list and added comments for consideration in the evaluation process. Halifax Water staff input included, but was not limited to:

- Measures currently implemented
- Measures currently planned for implementation
- Issues, barriers or constraints in the planning, funding or implementation process
- Cost/benefit insights on some of the current measures
- Organizational challenges, cost and resources availability
- Legal and jurisdictional considerations

## 5.2 Summary of Discussions with Halifax Water and NSUARB Consultants

As part of the IRP Update process, several points of contact were held for discussion, feedback and input with Halifax Water's project team and Directors, as well as the consultants retained by the NSUARB to oversee the IRP Update process.

The following presents a summary of some of the discussions throughout the IRP Update in regard to DSM/SSM measures:

**October 16th, 2018 – Kick-off Meeting**
At the outset of the project, the first kick-off meeting was held with Halifax Water's project team and NSUARB consultants to formally initialize the IRP Update. Following the kick-off meeting, additional meetings have covered the programs and studies that were currently dealing with or impacting DSM/SSM measures, as well as a brief introduction of the IRP study approach for DSM/SSM.

**December 12th, 2018 - NSUARB Consultants Workshop**
The workshop was held with Halifax Water's project team and the NSUARB consultants to discuss: the DSM/SSM IRP study approach, achieve consensus on key principles heading into the IRP detailed workplan and outline next steps.

**March 5th, 2019 – Steering Group Meeting**
The meeting was held with Halifax Water's Executive Team and Operations Directors to discuss the DSM/SSM measures, evaluation process and outcomes.

# 6 Analysis Discussion

Throughout the IRP Update process, it was recognized that DSM and SSM are key aspects for sustainable long-term planning of infrastructure and system optimization, to meet customer demands and maintain an appropriate level of service. In collaboration with Halifax Water's staff, a review of DSM/SSM measures was undertaken to identify what is working for Halifax Water, what could be done to improve or enhance existing measures, and identify from an industry best practice review if other measures could be further considered for future implementation.

The review demonstrated that Halifax Water is currently implementing a wide range of measures across all DSM/SSM categories covering all systems (water, wastewater, stormwater) and drivers (growth, asset renewal, compliance). The review also provided an opportunity to identify recommendations and enhancement opportunities to current DSM/SSM measures. In general, the recommendations resulting from the discussions are centered on continuing the collection of data that support DSM/SS measures, improving integration between programs/initiatives, data and processes. Specific recommendations relate to key performance indicators, public and organizational education and awareness and legislative review to enable private side I/I work in the future.

The review of additional DSM/SSM measures resulted in a list of measures implemented by other utilities/municipalities that are not currently in place by Halifax Water. Most of the additional measures target water demands and water conservation. As discussed in previous sections, Halifax Water currently implements water measures that have proven effective in reducing water demands, promoting water conservation and reducing water loss in the system. Therefore, additional water measures were not recommended.

In regard to wastewater, some of the additional measures that were identified target changes in regulation or financial incentives aimed to reduce rainfall derived inflow and infiltration (RDII) into the wastewater system by for instance implementing new construction practices, downspout disconnection, basement flooding protection practices, among others. While specific measures related to RDII reduction are not directly recommended through this analysis, the IRP recognizes the importance of RDII reduction as an overarching DSM/SSM measure for the management of the wastewater system and for the successful implementation of the Infrastructure Master Plan wastewater servicing strategy.

## 6.1 Enhancement Opportunities and Recommendations

The following enhancement opportunities and recommendations resulted from the DSM/SSM review and discussion:

Performance Indicators

Through the DSM/SSM review, it became evident that most initiatives/programs would benefit from performance measurement to evaluate their success and effectiveness. The simple principle of "what gets measured, gets done" can be applied to most DSM/SSM measures implemented by Halifax Water. In order to do so, key performance indicators (KPIs) and targets should be developed in accordance with Halifax Water's goals and objectives, drivers and level of service.

Table 4 provide a sample of suggested key performance indicators and targets that can be used to assess the effectiveness of existing DSM/SMM measures. If considered for implementation, these indicators should be reconciled with Halifax Water existing KPI to ensure consistency.

**Table 4 – Sample Key Performance Indicators for Existing DSM/SSM Measures**

| Measure Type | System | Measure | KPI |
|---|---|---|---|
| SSM | Water | Active Leak Detection:<br>% of leaks proactively detected (prior to reported customer issue or billing enquiry) versus total leakage incidents | >95% |
| SSM | Water | Infrastructure Leakage Index and total losses per service connection.<br>Total leakage measures the sum of distribution losses and supply pipe losses in megalitres per day (Ml/d). It includes any uncontrolled losses between the treatment works and the customer's stop tap. | Leakage index Target <3.0<br>Losses <200 litres/connection |
| SSM | Water<br>Wastewater | Per Capita Water & Wastewater Allocation derived from water billing and wastewater flow monitor and treatment flow analysis.<br>Measure actual water usage and wastewater generation | Water: (70% of Design Criteria) < 260 Litres per person per day (L/p/d)<br>Wastewater: (80% of water usage) 210 Litres per person per day (L/p/d) |
| SSM | Water | Night Flow Analysis to assess possible leakage or unwanted customer internal plumbing losses: Average Nightime Litres per residential service connection (L/service). | <50 litres/service connection |
| SSM | Water<br>Wastewater<br>Stormwater | Design Criteria Manual Updates:<br>Complete annual review | Yes/No |
| SSM | Stormwater | Culvert Replacement<br>Metres replaced/year (m/yr)<br>% of culverts in poor condition | <15% in poor condition |
| SSM | Water | Transmission Main Upgrades<br>Metres replaced/year (m/yr)<br>% of mains in poor condition | <5% in poor condition |
| SSM | Wastewater | Flow Monitoring: % of system monitored | >90% system monitored |
| SSM | Water | Pressure Management for leakage control<br>Megalitres per year saved (Ml/yr) | Implement Measure to inform savings KPI definition |
| SSM | Water | Corrosion Control:<br>% of at risk metallic pipe protected | Implement Measure to inform KPI definition |
| DSM | Water | Watermain Lining Programs<br>Metres lined/year (m/yr)<br>% of unlined metalic watermains | Implement Measure to inform KPI definition |
| DSM | Water | Water Efficiency Program<br>5 year rolling average of per capita residential consumption reduction | 2% per year reduction in 5 year rolling average of actual water consumption |
| SSM | Wastewater | Optimize Power Requirements<br>Kwh per customer service connection | Implement Measure to inform reduction KPI definition |
| SSM | Wastewater<br>Stormwater | Sewer Separation:<br>% reduction of combined system.<br># of sewer separation projects completed per year | >1%/year<br>>1 project per year |
| DSM | Wastewater | Lateral Repairs<br>Number of customers using lateral loan | Implement Measure to inform KPI definition |

| Measure Type | System | Measure | KPI |
|---|---|---|---|
| DSM | Water | AMI (Advanced Metering Infrastructure) / Smart Metering<br>% of leaks proactively detected (prior to reported customer issue or billing enquiry) versus total leakage incidents | >95% |
| DSM | Water<br>Wastewater<br>Stormwater | Public and Customer Education Programs<br>Temporal measurement of number # of website visits | >4x increase in visits following campaign |
| SSM | Water<br>Wastewater<br>Stormwater | Infrastructure Replacement / Repair.<br># of pipe failures per 100km | <2 failures/100km |
| DSM | Wastewater | Sewer Surcharge Rebate Program<br>Volume diverted from sewer | Implement Measure to inform KPI definition |
| DSM | Water | Water Usage Data<br>% of customers accessing water usage data | >10% |
| DSM | Water | Leak Notification Program.<br>Number of notices issued | Implement Measure to inform KPI definition |
| SSM | Wastewater<br>Stormwater | CSO / SSO management<br>Frequency and volume of CSO/SSO discharges | All CSOs: <30/year<br>CSOs on NWA: <10/year<br>All SSOs <10/year |
| DSM | Water | Rebate & Retrofit Programs<br># of participants | Implement Measure to inform KPI definition |
| SSM | Water<br>Wastewater<br>Stormwater | Vulnerability to Climate Change Management Framework<br>Number of assets and asset classes assessed | 1 asset class/year |
| SSM | Wastewater | Optimize Number & Configuration of Pumping Stations<br>Number of pumping station per person | <2500 people/pumping station |
| DSM | Stormwater | Flood Reduction Program<br>Number of customers flooded by stormwater | Implement Measure to inform KPI definition |

Public Education and Organizational Awareness

Public education offers a great opportunity to enhance existing DSM/SSM measures. Public education efforts that are coordinated and integrated with other programs/initiatives have the potential to improve the relationship between Halifax Water and the public and increase customer engagement and participation. This is particularly important for measures such as private RDII reduction or lateral repair programs, where public participation is required for successful implementation. It is also important to ensure that there is a consistent organizational understanding. This relates to Halifax Water, HRM and the NSUARB. The level of understanding required for each organization and the public is different and thus the format and detail of materials should be customized appropriately.

Of paramount importance for public education programs is to ensure that there is prior assessment of approaches to understand costs, benefits and returns on investments. It is recommended that this take the form of a best practice review and organizational and public survey with results used to define appropriate approaches to public education and organizational awareness approaches. Public education approaches should be designed with a general understanding of the DSM/SSM measures that will likely be implemented.

Halifax Water's current public education program includes various distribution forms such as website, pamphlets, surveys and twitter, among others. It also includes some mobile and creative initiates such

as the “The Shed” which is usually present at popular events and locations throughout the community, so people can stop in and learn more about Halifax Water and what they do.

Halifax Water’s public education can be further enhanced by tailoring some initiatives to the unique needs of specific areas. For instance, in areas identified as high priority for RDII reduction, public engagement can be tailored to not only inform the public about the problem and solutions provided by Halifax Water, but also to inform the customers about how they can participate, what are the benefits of measures such as downspout disconnection, available incentives or rebates programs, as well as by-law enforcement or mandatory participation if applicable. The goal is to keep the public informed and promote collaborative work with government and organizations, in implementing solutions to their issues.

A suggested task list approach to implement this recommendation is as follows:

- Approach to public education best practice review
- Organizational and public survey to baseline current understanding
- Identification of key subject areas in relation to infrastructure needs and future programs
- Evaluation of approaches and selection of preferred
- Creation of materials and implementation of preferred educational programs

It is recommended that a pilot study approach be adopted to test various methods and be able to assess the effectiveness of various approaches. Different methods could be implemented in various locations of similar characteristics with the intent to measure the effectiveness.

Data Collection

Data collection is a critical step in supporting the development and implementation of DSM/SSM measures. For this reason, it is recommended that Halifax Water continue collecting data about their systems through programs such as the Flow Monitoring and Advance Metering Infrastructure (AMI) programs.

For instance, the information collected through the flow monitoring program is valuable for better understanding Halifax Water’s sanitary and combined systems, to identify RDII issues, and is particularly important for future hydraulic model updates and validations. The flow monitoring program supports other initiatives including the Wet Weather Management Program and several Capital Projects, and the data collected can provide evidence of the efficiency of the implementation of RDII reduction strategies.

In addition, the AMI program which is currently in the implementation phase, is expected to increase public education and engagement, and in turn public education programs need to spread awareness of the customer benefits of the AMI program. The data collected has the potential to serve multiple purposes such as advanced rate options, enhanced leak detection, enhance usage analysis feeding into design criteria review, model calibration and water demand projections, among others.

GIS Integration

Management and use of the data collected also plays an important role in long-term planning of infrastructure. As such, it is recommended to improve the linkage and integration between GIS datasets and other programs such as the Asset Management Plans, Conditions Assessments, Capital Budget, Wet Weather Management Program, among others. GIS integration will help to better understand the geographical context of Halifax Water’s assets and systems and to bring efficiencies across the organization while supporting the decision-making process.

Enhanced HRM Integration

It is recommended to continue DSM/SSM coordination with HRM to support finding efficiencies and better ways to integrate projects and programs between the two organizations. Due the nature of the existing shared jurisdiction of the stormwater system, involvement of both Halifax Water and HRM is key for implementation of DSM/SSM measures that require changes in policies, by-laws, and/or the implementation and maintenance of infrastructure such as Low Impact Developments (LID) facilities.

Another area of integration is the coordination between HRM's Roads Program and Halifax Water's linear projects. The main goal is to align projects that have common factors such as location, alignment, timing and resources; and identify potential conflict and/or limitations that could impact project implementation.

It is also recommended that Halifax Water continue to work with HRM in the development and update of population projections, including: baseline population, growth rate and distribution, as they form the foundation of many studies and initiatives including the future updates of the Infrastructure Master Plan and Integrated Resource Plan.

Private-side RDII Reduction

Considering the importance of RDII reduction for Halifax Water's wastewater servicing strategy, it is recommended that Halifax Water and HRM progress work to establish a policy and process to be able to undertake private side RDII works. This will require collaboration with HRM as they update their stormwater/lot grading bylaws and approval for the NSUARB to establish a policy, by-law and revisions to the Rules and Regulations whereby Halifax Water would have more flexibility to undertake works required on private property to meet the goals of RDII reduction in cases where the benefit of the private side work is not directly realized by the property owner (e.g. improvements to system capacity providing for growth). This could leverage the approach taken by Halifax Water on the lead pipe replacement program, where work can now be performed on the privately-owned pipe sections to support the removal of lead from drinking water.

It is important to identify the general preferred approach to private side I/I reduction so that new policy and legislation is supportive and complementary. There are several key areas to decide on an approach to private side I/I reduction, as shown below **(Figure 3**).

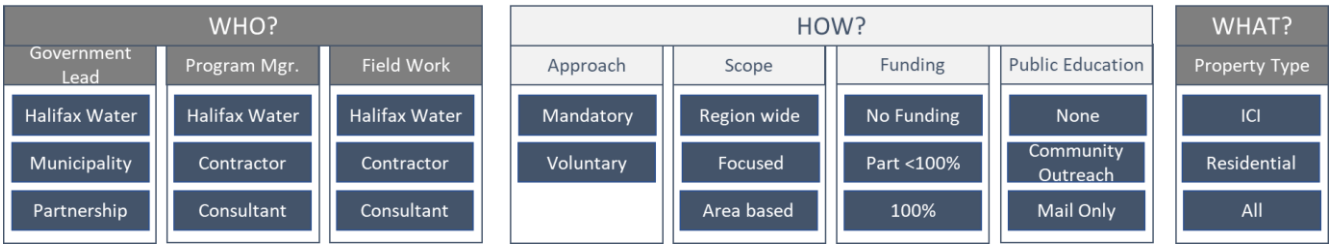



**Figure 3 - Considerations for Private Side I/I Program Reduction**

The following approach is suggested to progress this important precursory step prior to being able to effectively establish a proactive private side I/I reduction program.

- Best practice review of Private side I/I reduction programs and associated legislative and enforcement approaches.
- High level evaluation and identification of preferred private side I/I reduction approach
- Review of existing legislation and policies
- Identification of legislative opportunities and constraints
- Detailed evaluation and identification of preferred policy and legislative framework approach
- Implementation of policy and legislation with HRM and NSUARB

# 7 Summary and Conclusions

As part of the 2019 IRP Update process a review of demand side management (DSM) and supply side management (SSM) practices and measures was undertaken. The purpose of the DSM/SSM exercise was to review and evaluate DSM and SSM measures currently in place by Halifax Water, and consider additional measures implemented by other utility companies and municipalities. Through collaboration with Halifax Water staff, each identified measure was reviewed and evaluated to provide recommendations for improvements and select new measures for potential future implementation.

The review demonstrated that Halifax Water is currently implementing a wide range of measures across all DSM/SSM categories covering all systems (water, wastewater, stormwater) and driver type (growth, asset renewal, compliance).

- Potential enhancement opportunities and recommendations to current DSM/SSM measures were discussed during the review process. The following enhancement opportunities and recommendations resulted from the DSM/SSM review and discussion:
- Development of key performance indicators (KPIs) and targets in accordance with Halifax Water's goals and objectives, drivers and level of service.
- Further enhancement of public education including tailoring initiatives for specific area needs, keeping the public informed, and promoting collaborative work with government and organizations.
- Continuing the collection of data that support DSM/SSM measures.
- Improving integration between organizations/jurisdictions, programs/initiatives, data and processes.
- Explore revisions to the Rules and Regulations to allow more flexibility to undertake private side works to meet the goals of RDII reduction.

# Appendix A - Long Lists of DSM/SSM measures

**Long Lists of DSM/SSM measures - Initiatives currently in place by Halifax Water**

| Measure Type | Strategy Type | System | IRP Driver | Measure | Description | Who has strategy control? | Technical Feasibility | Cost / Affordability | Legal / Jurisdiction | Environmental | Social / Cultural | Probability of Success | Implementation Timing | Integration Potential | Cost-Benefit Analysis | Overall Score |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SSM | Infrastructure Management | Water | Asset Renewal | Infrastructure Leakage Index | Infrastructure leakage index is a ratio between the current annual real losses and unavoidable annual real losses in a system. The lower the infrastructure leakage index value, the closer the system is to its unavoidable annual real losses value, i.e., there is less water loss in the system. | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| SSM | Design Criteria | Water Wastewater | Growth | Per Capita Water and Wastewater Allocation Adjustment to Optimal Levels in New Designs | Review and update (if necessary) of HW's water and wastewater design criteria for projecting demands/flows in the systems. Usually undertaken during regular master planning cycle. | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 30 |
| SSM | Infrastructure Management | Water | Asset Renewal | Flow Monitoring - Night Flow Analysis | Night time flow analysis involves calculating leakage based on the measured flow of water into the DMA at night and subtracting the legitimate consumption of water within the DMA during that time. The result provides the real losses in the system at night | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| SSM | Design Criteria | Water Wastewater Stormwater | Growth | Design Criteria Manual | Design and construction specifications for water, wastewater and stormwater systems to provide consistency and standardize materials, design criteria and method of construction among developers, consultants and contractors throughout the municipality | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 29 |
| SSM | Infrastructure Replacement / Repair | Stormwater | Asset Renewal Growth | Culvert Replacement | Replacement of culverts due to deterioration causing obstructions in flow | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 29 |
| SSM | System Upgrades | Water | Asset Renewal Growth | Transmission main upgrades | Upgrades to increase capacity to meet water demands | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 28 |
| SSM | Infrastructure Management | Wastewater | Asset Renewal | Flow Monitoring | Monitoring wastewater sewers for inflow/infiltration issues, model calibration, etc. | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 28 |
| SSM | Infrastructure Management | Water | Asset Renewal | Pressure Management | Decreasing pressure within watermains using pressure reducing valves and monitoring points within the distribution system | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 28 |
| SSM | Infrastructure Management | Water | Asset Renewal Compliance | Corrosion control | Using materials such as cathodic protection of metallic pipes or addition of minerals in water to reduce corrosion | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 28 |
| DSM | Water Loss Control | Water | Asset Renewal | Watermain Lining Programs | Watermain re-lining, replacing valves, hydrants, appurtenances | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 28 |
| DSM | Customer Education | Water | Asset Renewal Growth | Water Efficiency Program | Water efficiency and conservation efforts—by residents, businesses, HW and the municipality to protect water sources (lake, groundwater, etc.) | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 28 |
| SSM | System Optimization | Wastewater | Asset Renewal | Optimize power requirements | Pump timing, configuration pumps, optimize operation | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 27 |
| SSM | System Optimization | Wastewater Stormwater | Asset Renewal Growth | Sewer Separation | Separation of combined sewers has the objective of reducing wet weather flows in the sewage system and to Wastewater Treatment Plants. Constructing new storm sewers so that the combined sewer can be converted to sanitary. Full Sewer Separation or Partial Sewer Separation | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 27 |
| SSM | Infrastructure Management | Water | Asset Renewal | Active Leak Detection | Using sonic detection to locate leaks in the water distribution system based on sound propagation | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 27 |
| DSM | Water Loss Control | Wastewater | Asset Renewal | Lateral Repairs | Laterals can become damaged and cause sewer back up and basement flooding | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 26 |
| DSM | Water Loss Control | Water | Asset Renewal | AMI (Advanced Metering Infrastructure) / Smart Metering | Provides "real time" information on water use activities and conservation efforts, and helps customers detect leaks more immediately. Able to notify customers when demand patterns are indicative of potential leakage | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 26 |

**Long Lists of DSM/SSM measures - Initiatives currently in place by Halifax Water**

| Measure Type | Strategy Type | System | IRP Driver | Measure | Description | Who has strategy control? | Technical Feasibility | Cost / Affordability | Legal / Jurisdiction | Environmental | Social / Cultural | Probability of Success | Implementation Timing | Integration Potential | Cost-Benefit Analysis | Overall Score |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DSM | Customer Education | Water<br>Wastewater<br>Stormwater | Asset Renewal<br>Growth<br>Compliance | Public and Customer Education Programs | Improved awareness of efficient water use and its effect on billing in communities through door to door visits, mailed newsletters, information on the municipality's website, school education programs, social marketing campaigns | 3 | 3 | 2 | 3 | 3 | 2 | 1 | 3 | 3 | 2 | 25 |
| SSM | Infrastructure Replacement / Repair | Water<br>Wastewater<br>Stormwater | Asset Renewal | Main replacement / infrastructure repairs / infrastructure renewal | Replacement of old infrastructure mains to avoid breaks and leaks. E.g. replacement of old watermains to avoid watermain breaks and water loss | 3 | 2 | 1 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 25 |
| DSM | Financial Incentives | Wastewater | Asset Renewal<br>Growth | Sewer Surcharge Rebate Program | Open to industrial, commercial and institutional water customers, the Program offers a rebate on water not discharged into the sanitary sewer system. | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 3 | 2 | 25 |
| DSM | Customer Usage | Water | Asset Renewal<br>Growth | Water Usage Data | Customers have the ability to login to view their water usage per day. This can help customers find ways of reducing the amount of water they use to save money | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 25 |
| DSM | Water Loss Control | Water | Asset Renewal | Leak Notification Program | Municipality alerts customers if there are spikes in water usage for a certain number of consecutive days. This program is currently being undertaken by New York City | 3 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 25 |
| SSM | System Extension | Water<br>Wastewater<br>Stormwater | Growth | Design/ construction of Greenfield water, wastewater and stormwater infrastructure. | New greenfield infrastructure to service new growth areas. For example, dams, transfer schemes and associated infrastructure, as solutions to meet growing water requirements. | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 2 | 25 |
| SSM | Infrastructure Management | Wastewater | Asset Renewal | Inflow/Infiltration Identification and Reduction Program (public side) | I/I identification and reduction program. Might include some of the following: Flow Monitoring , Sanitary Sewer Condition Assessment, Cross Connection Identification | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 26 |
| DSM | Regulation | Stormwater | Compliance | Grading Requirements | Provides erosion protection during construction phase (water quality issues). Grading requirements are needed to improve drainage design and compliance with approved plans | 1 | 2 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 25 |
| DSM | Regulation | Wastewater | Compliance | Source Control / Protection | Reducing the amount of contaminants being sent via the sanitary sewer system to WWTF | 1 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 24 |
| SSM | Infrastructure Management | Wastewater<br>Stormwater | Asset Renewal<br>Growth<br>Compliance | CSO/SSO management | Implementation of effective preventive maintenance programs to significantly reduce the frequency and volume of untreated sewage discharges. Management can ensure SSO treatment is prioritized due to the higher concentrations of raw sewage | 3 | 2 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 24 |
| DSM | Financial Incentives | Water | Asset Renewal<br>Growth | Rebate & Retrofit Programs | Transitioning to high-efficiency fixtures and appliance (e.g. toilet rebate programs, solar hot water incentive programs, showerhead and washing machine rebate programs)<br>Fixture/Appliance Replacement Programs (e.g. showerheads, washing machines, dishwashers) | 3 | 3 | 1 | 2 | 3 | 3 | 2 | 2 | 3 | 2 | 24 |
| SSM | Infrastructure Management | Water<br>Wastewater<br>Stormwater | Asset Renewal | Vulnerability to Climate Change Management Framework | Takes into account the effects of the changing climate on infrastructure (e.g. capacity, demand, etc.) | 3 | 2 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 24 |
| SSM | System Optimization | Water | Asset Renewal<br>Growth | Enhanced redundancy and optimization routing | Construct new infrastructure to meet demands - supply security | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 2 | 24 |
| SSM | System Upgrades | Wastewater | Asset Renewal<br>Growth | Over-sizing pipes / storage | Increase capacity of pipes and storage to meet system demands | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 24 |
| DSM | Utility Rates | Stormwater | Growth | Stormwater rate structure | A fixed rate structure to applicable properties | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 2 | 3 | 2 | 24 |
| SSM | System Optimization | Water | Asset Renewal<br>Growth | Bulk Water Strategy | Involves restricting hydrant use by introducing bulk water stations with swipe card system | 3 | 2 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 24 |
| SSM | System Upgrades | Water<br>Wastewater | Asset Renewal<br>Growth | Additional treatment capacity or upgrades | New treatment processes, new treatment plant, new technology (same footprint), rehabilitation of existing facility | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 24 |

**Long Lists of DSM/SSM measures - Initiatives currently in place by Halifax Water**

| Measure Type | Strategy Type | System | IRP Driver | Measure | Description | Who has strategy control? | Technical Feasibility | Cost / Affordability | Legal / Jurisdiction | Environmental | Social / Cultural | Probability of Success | Implementation Timing | Integration Potential | Cost-Benefit Analysis | Overall Score |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SSM | System Optimization | Wastewater | Asset Renewal Growth | Optimize number and configuration of pumping stations | Decrease the need for pumping stations | 3 | 1 | 1 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | **23** |
| SSM | System Upgrades | Stormwater | Asset Renewal Growth | Stormwater Management Ponds | Surface water management is the process of collecting, monitoring and treating surface water to help prevent flooding and pollution. | 1 | 2 | 2 | 2 | 3 | 2 | 3 | 2 | 3 | 2 | **22** |
| DSM | Infrastructure Management | Wastewater | Asset Renewal | Inflow/Infiltration Identification and Reduction Program (Private Side) | I/I reduce the capacity of the sewage system leaving less for existing residents and future growth. It also makes sewage treatment less efficient as the sewage is diluted by water. Increase the cost to residents because sewage treatment plants are required to treat a higher volume of flow. May cause sewage | 1 | 2 | 2 | 1 | 3 | 3 | 3 | 2 | 3 | 2 | **22** |
| SSM | Financial Incentives | Water Stormwater | Asset Renewal Growth | Local Improvement Charges | Fees imposed by the municipality on those property owners in the specific vicinity that benefit from the local improvement | 1 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | **21** |
| DSM | Regulation | Stormwater | Compliance | Sediment / Erosion Management | Sediment and erosion control policies and procedures aimed at preventing contamination of watercourses | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | **21** |
| DSM | Customer Education | Stormwater | Asset Renewal | Flood Reduction Program | Steps to reduce flooding damage within the municipality and outlines the short term activities required | 1 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | **20** |
| DSM | Regulation | Stormwater | Compliance | Comprehensive Controlled Drainage Management | Controlled drainage management to prevent water damage to foundations and basements. Houses, streets and buildings in urban areas depend heavily on surface and subsurface drainage systems for protection. These generally are a combination of plastic or metal gutters, concrete curb and gutter, and concrete pipes or channels. | 1 | 2 | 2 | 2 | 3 | 2 | 1 | 1 | 1 | 2 | **17** |

**Long Lists of DSM/SSM measures - Additional measures for consideration**

| Measure Type | Strategy Type | System | IRP Driver | Measure | Description | Who has strategy control? | Technical Feasibility | Cost / Affordability | Legal / Jurisdiction | Environmental | Social / Cultural | Probability of Success | Implementation Timing | Integration Potential | Cost-Benefit Analysis | Overall Score |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DSM | Regulation | Water / Wastewater / Stormwater | Compliance | New Construction Practices | Water efficiency requirements and standards for new construction projects. Emphasis also needs to be on construction standards, construction inspection certification, and enforcement of non-compliance to HW standards | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 27 |
| DSM | Water Loss Control | Water | Asset Renewal | Pipe Freezing Prevention Plan | Information available to the public to prevent the water pipes from freezing during the winter months | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 2 | 27 |
| DSM | Customer Usage | Water | Asset Renewal Growth | Water Efficient Irrigation | Rain and moisture sensors to adjust irrigation schedules based on the local weather (e.g. Low Pressure Center Pivot Sprinkler Irrigation Systems) | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 3 | 3 | 2 | 26 |
| DSM | Customer Usage | Water | Asset Renewal Growth | Drip/Micro-Irrigation System | Small diameter tubing with regular openings, immediately above or below ground level to minimize traveling time to rooting zone. This increases water efficiency and reduced energy costs | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 3 | 3 | 2 | 26 |
| DSM | Customer Usage | Water | Asset Renewal Growth | Water Efficient Landscaping | Water-efficient landscape to reduce customer demands (e.g. native vegetation suited to the area's climate) | 3 | 2 | 3 | 3 | 3 | 2 | 1 | 3 | 3 | 2 | 25 |
| DSM | Utility Rates | Water | Growth | Seasonal Rates | The higher rates promote water conservation during these high peak periods. E.g. water use during the summer months has a higher rate due to the higher demand in water supply. | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 25 |
| DSM | Regulation | Wastewater | Compliance | Downspout Disconnection Program | Residents who have downspout disconnection can apply for the City to subsidize the disconnection. This will reduce the amount of rainwater entering the wastewater system. | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 2 | 3 | 3 | 25 |
| DSM | Regulation | Water / Wastewater | Compliance | Optional Water and Sanitary Sewer Protection Plan | Help educate residential property owners about their responsibilities for the maintaining, repairing and replacing of their private side (from inside their homes to the property line) water and sanitary sewer pipes. Help reduce expenses to property owners and the utility because the plans encourage residents to report water and sewer leaks in a timely manner. Timely water pipe repairs conserve water and reduce water loss for the utility. Timely sewer pipe repairs minimize wastewater pollution helping the environment. | 2 | 3 | 3 | 1 | 3 | 2 | 2 | 3 | 3 | 2 | 24 |
| DSM | Financial Incentives | Wastewater / Stormwater | Asset Renewal Growth | Basement Flooding Protection Subsidy Program | Offering residents a financial subsidy to install a sump pump with sump pump overflow and/or backwater valve(s) and/or disconnect foundation drains from the floor drain. | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 2 | 3 | 2 | 24 |
| DSM | Financial Incentives | Water | Asset Renewal Growth | Water Savings and Protection Incentives for Business | Financial incentives for businesses participating in water protection/conservation | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 24 |
| DSM | Customer Usage | Water | Asset Renewal Growth | Industrial Water Rate Program | Open to industrial water customers, the Industrial Water Rate offers a discounted water rate to manufacturers that implement a water conservation plan. | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 2 | 3 | 2 | 24 |
| DSM | Water Loss Control | Water | Asset Renewal | Water Audits | Helps municipalities and utilities companies detect water loss within their system. Water audit methodology developed by the AWWA and International Water Association | 3 | 3 | 2 | 3 | 3 | 3 | 1 | 2 | 3 | 1 | 24 |

**Long Lists of DSM/SSM measures - Additional measures for consideration**

| Measure Type | Strategy Type | System | IRP Driver | Measure | Description | Who has strategy control? | Technical Feasibility | Cost / Affordability | Legal / Jurisdiction | Environmental | Social / Cultural | Probability of Success | Implementation Timing | Integration Potential | Cost-Benefit Analysis | Overall Score |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DSM | Customer Usage | Water | Asset Renewal Growth | Water Reuse / Reclaimed Water / Greywater Systems | Reclamation of rainwater for irrigation purposes - may have some cost and health & safety concerns. Reclaimed water is wastewater that has gone through various treatment processes to meet specific water quality criteria with the intent of being used again in a beneficial manner (i.e. irrigation and industrial uses). | 3 | 2 | 3 | 3 | 2 | 1 | 1 | 3 | 3 | 2 | 23 |
| DSM | Regulation | Water | Asset Renewal Growth | Indoor/Outdoor Water Use Restrictions | Outdoor Water use restrictions dependent on season and time of day (more expensive during peak periods). Indoor use restriction by issuing plumbing or building permits on new development/renovation projects. | 2 | 3 | 3 | 2 | 3 | 2 | 1 | 2 | 3 | 2 | 23 |
| DSM | Utility Rates | Water | Growth | Water Budget-Based Rates | Rate structure based on anticipated needs of household by number of people or property size. If customer go over their "budget", higher water rate applies | 3 | 2 | 2 | 2 | 3 | 2 | 1 | 2 | 3 | 2 | 22 |
| DSM | Utility Rates | Water | Growth | Increasing Block Rate | Unit price of each succeeding block of usage is charged at a higher unit rate than the previous block | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 2 | 3 | 2 | 22 |
| DSM | Financial Incentives | Water | Asset Renewal Growth | Capacity Buyback Program/ Rebate Program | Open to commercial and institutional organizations, the program offers a free water audit and one-time cash rebate. | 3 | 3 | 1 | 1 | 3 | 2 | 2 | 2 | 3 | 1 | 21 |
| DSM | Regulation | Wastewater | Compliance | Topsoil Bylaw for Residential Lots | Landscaped area to have a minimum of 12-inch topsoil to ensure greater water retention | 1 | 2 | 3 | 1 | 3 | 2 | 2 | 2 | 3 | 2 | 21 |
| SSM | System Upgrades | Wastewater | Asset Renewal | Equipping an existing facility with alternative systems, such as an engineered wetland | Federation of Canadian Municipalities provides funding for wastewater system projects that demonstrate new solutions or approaches to wastewater systems | 3 | 1 | 3 | 2 | 3 | 3 | 1 | 1 | 2 | 2 | 21 |
| DSM | Financial Incentives | Water | Asset Renewal Growth | Tax Incentives | Tax incentive to help mitigate the difference in costs between a non water-efficient fixture vs. a water-efficient fixture - for existing and new construction | 1 | 2 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | 1 | 20 |
| DSM | Financial Incentives | Water / Wastewater / Stormwater | Asset Renewal Growth | Development Incentive Programs | Incentive for new developments for water conservation | 1 | 2 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | 1 | 20 |
| DSM | Financial Incentives | Stormwater | Asset Renewal Growth | Eco-roof Incentive Program / Green roof bylaw | Green roofs support the growth of vegetation and consists of a waterproofing membrane, drainage layer, organic growing medium (soil), and vegetation. | 1 | 2 | 2 | 2 | 3 | 2 | 1 | 2 | 3 | 2 | 20 |
| SSM | System Upgrades | Stormwater | Asset Renewal Growth | Low Impact Development / Source Controls | The design of land to manage stormwater runoff as part of green infrastructure. LID emphasizes conservation and use of on-site natural features. | 1 | 2 | 2 | 1 | 3 | 3 | 2 | 2 | 2 | 2 | 20 |
| SSM | System Upgrades | Wastewater | Asset Renewal Growth | Composting System in WWTF | Wastewater treatment facility with a composting system that eliminates sludge from the treatment process and returns high quality effluent to water body | 3 | 1 | 1 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 19 |

A

HALIFAX WATER

2019 INTEGRATED RESOURCE PLAN

# APPENDIX A.3

## COSTING AND EXPENDITURE ANALYSIS

# Halifax Water

# 2019 Integrated Resource Plan

## *Technical Memorandum #3:*

*Expenditure Summary and Costing Review*

Project No.: 718032

**Prepared by: GM BluePlan Engineering**

**For: Halifax Water**

**March 2020**

## Document Revisions

The following is a record of the changes/updates that have been made to the final document:

| Version | Changes / Updates | Author | Reviewed | Date |
|---|---|---|---|---|
| DRAFT | 1st Draft for Review | Sandy Naime | Chris Campbell<br>James Jorgensen | Jan 31st 2020 |
| FINAL | Final Report | Sandy Naime | Chris Campbell | March 13, 2020 |

## Table of Contents



## Appendices

# 1 Introduction

The Halifax Regional Water Commission (HRWC), also known as Halifax Water, was the first regulated and publicly owned water, wastewater and stormwater utility in Canada. With a long history dating back to the 1940s, Halifax Water is the water, wastewater and stormwater utility servicing residents of the Halifax Regional Municipality (HRM).

As part of its mandate and services, Halifax Water continuously undertakes initiatives and programs to maintain and operate its systems while striving to provide world class service to its customers and environment. These initiatives and programs require integration into a single capital program that identifies the long-term resource needs and financial expenditures.

Halifax Water retained GM BluePlan Engineering Limited (GM BluePlan) to complete the Integrated Resource Plan (IRP) Update. The IRP Update is a study to consolidate various initiatives and programs from separate studies into a singular integrated capital and financial plan. This study applies the considerations of growth, regulatory compliance, and asset renewal to ensure the integrated recommendations achieve the desired service delivery goals, as well as identify any additional gaps and programs required in the long-term plan.

The IRP Update will build on the foundation of the 2012 IRP. The 2012 IRP focused on capital program and project requirements, developed a planning framework including Halifax Water's business processes, and provided recommendations including the periodical update of the IRP.

## 1.1 Aim

The aim of the Expenditure Summary and Costing Review is to first outline and summarize Halifax Water’s projected expenditures prior to program and project integration and then summarize the costing review exercise undertaken as part of the 2019 IRP Update.

## 1.2 Objectives

The goals and objectives for the expenditure summary and costing review are:

- Gain understanding of projected expenditures from the corporate projects and the three foundational studies: Asset Management Plans, Infrastructure Master Plan and Compliance Plan.
- Review all asset categories/classes covered in the Asset Management Plans and improve the replacement cost estimates for asset classes with low confidence.
- Review the alignment between Halifax Water Infrastructure Master Plan, Compliance Plan and Asset Management Plans costing approaches.
- Provide recommendations for unit costs and replacement cost adjustments to update into foundational studies if necessary.
- Describe Halifax Water’s cost estimating approach and unit rates for linear and vertical infrastructure, as well as RDII reduction projects.

Completing these objectives will provide confidence, transparency and traceability to support the funding streams.

# 2 Expenditure Summary

The approach taken in the expenditure summary identifies the magnitude of the total and average annual expenditures required to meet level of service objectives in each of the foundational studies and corporate projects:

1. Infrastructure Master Plan
2. Compliance Plan
3. Asset Management Plans (AMPs)
4. Corporate Projects

The expenditure summary below presents projected expenditure needs prior to any project/program integration as part of the 2019 IRP Update. The objective of the expenditure summary is to provide a high-level overview of the input capital programs that served as the starting point for the 2019 IRP Long-Term Capital Plan.

## 2.1 Infrastructure Master Plan

The Infrastructure Master Plan focuses on the servicing strategies and management of infrastructure in the Halifax Region, to produce an optimal servicing strategy for the wastewater collection and water supply networks to meet growth. The Infrastructure Master Plan provided key inputs to the 2019 IRP Update including planning projections and growth areas, and water and wastewater capital projects to 2046 including timing, cost estimates and spatial allocation.

Expenditure needs as identified through the Infrastructure Master Plan until the end of the planning horizon in 2046 are summarised in Table 1 below. The full capital program is presented in more detail in Appendix A.

**Table 1 – Infrastructure Master Plan Projected Expenditure Need**

| System | Project Category | Total Capital Cost (2019$M) |
|---|---|---|
| Water | Pockwock - Peninsula | $39.4 |
| | Pockwock - Other | $61.7 |
| | Lake Major | $32.8 |
| | System Interconnections | $150.1 |
| | Studies | $0.7 |
| Wastewater | Dartmouth Servicing | $104.4 |
| | Eastern Passage | $49.5 |
| | Mill Cove | $163.5 |
| | West Region | $186.3 |
| **Total*** | | **$788.3** |
| Infrastructure Master Plan Average Annual Expenditure Need (2019-2046) | | 29.2 |

*Projected expenditure needs as per the Infrastructure Master Plan prior to program integration for the IRP Update.

## 2.2 Compliance Plan

The Compliance Plan provides a review of the current state of Halifax Water's infrastructure compliance requirements. The main goal of the compliance plan is to document the long term (30 years) infrastructure needs related to compliance and to ensure continued compliance requirements are met for Halifax Water's wastewater, water and stormwater systems. The plan examines Wastewater Treatment Facilities (WWTF), wastewater collection systems, sanitary and combined sewer overflows, Water Supply Plants (WSP), and water distribution systems including water storage reservoirs.

The Compliance Plan provided key inputs to the 2019 IRP Update including detailed treatment compliance assessment for WWTFs and WSPs, and capital program including timing, cost estimates and location.

Major projects from the Compliance Plan include:

- Lake Major and J.D. Kline WSP upgrades
- WWTFs upgrades to meet Wastewater Systems Effluent Regulations
- Corporate Flow Monitoring Program
- Wet Weather Management Program

A summary of the Compliance Plan capital program is presented in Table 2 below. The Compliance Plan capital program is presented in more detail in Appendix B.

**Table 2 – Compliance Plan Projected Expenditure Need**

| System | Project Category | Total Capital Cost (2019$M) |
|---|---|---|
| Water | Water Treatment | $109.2 |
| | Water Distribution | $0.6 |
| Wastewater | Wastewater Treatment | $388.1 |
| | Wastewater Collection | $272.9 |
| **Total*** | | **$770.8** |
| Compliance Plan Average Annual Expenditure Need (2019-2048) | | $25.7 |

*Projected expenditure needs as per the Compliance Plan prior to program integration for the IRP Update.

## 2.3 Asset Management Plans (AMPs)

The Asset Management Plans (AMPs) provide a summary of asset inventory and state of Halifax Water's infrastructure, level of service the assets provide to the customers, infrastructure replacement and maintenance strategies, and associated costs and expenditures. Halifax Water currently updates the AMPs on an annual basis.

The AMPs structure consists of individuals AMPs covering 14 different asset class as follows:

Water
- Supply Plants
- Supply Dams
- Chambers & Booster Stations
- Transmission Mains
- Distribution Mains
- Service Reservoirs

Wastewater
- Treatment Facilities
- Pumping Stations
- Gravity Sewers
- Forcemains

Stormwater
- Management Structures
- Gravity Sewers
- Cross Culverts
- Driveway Culverts and Ditches

The 2017-2018 Asset Management Plan was used to determine the asset renewal needs for the existing water, wastewater and stormwater system. A review of the level of detail of the data for each asset class was completed, particularly regarding: condition source, replacement costs and granularity of the data. A reassessment of replacement costs was also completed and discussed in Section 3 of this report.

The expenditure needs determined for the different asset classes are provided in  The Asset Management Plans are presented in more detail in Appendix C.

Table 3. The Asset Management Plans are presented in more detail in Appendix C.

**Table 3 – 2017/2018 AMPs Projected Expenditure Need**

| System | Asset Group | AMP 30-year Average Annual Expenditure Need (2019$M) | 2017-2018 AMP Replacement Cost (2019$M) | Annual Reinvestment Rate |
|---|---|---|---|---|
| Water | Supply Plant | $11.2 | $312 | 3.6% |
| | Supply Dam | $0.2 | $44 | 0.4% |
| | Booster Station | $0.2 | $18 | 1.0% |
| | Reservoir | $1.0 | $96 | 1.0% |
| | Chambers | $0.3 | $16 | 2.1% |
| | Transmission Main | $6.6 | $660 | 1.0% |
| | Distribution Main | $12.0 | $1,619 | 0.7% |
| Wastewater | Treatment Facility | $12.5 | $652 | 1.9% |
| | Pumping Station | $12.5 | $305 | 4.1% |
| | Gravity Sewer | $4.9 | $1,728 | 0.3% |
| | Force Main | $4.0 | $300 | 1.3% |
| Stormwater | Management Structure | $0.0 | $0 | 0.0% |
| | Gravity Sewer | $7.0 | $1,677 | 0.4% |
| | Cross Culvert | $2.2 | $293 | 0.8% |
| | Driveway Culvert | $0.7 | $66 | 1.1% |
| | Ditches | $0.0 | $0 | 0.0% |
| **Total*** | | **$75** | **$7,785** | **1.0%** |

*Projected expenditure needs as per the 2017-2018 AMPs prior to replacement costs update for the 2018-2019 AMPs and subsequent program integration for the IRP Update.

A more detailed review of the 2017-2018 AMPs was documented in the Expenditure Needs workbook is provided in Appendix D.

## 2.4 Corporate Projects

Halifax Water Corporate Projects serve a variety of purposes such as maintaining/updating information systems, building capital improvements, improving customer experience with Halifax Water, among others. Corporate Projects can be classified into seven categories:

- Information Technology (IT)
- Geographic Information System (GIS)
- Asset Management
- Facility
- SCADA & Other Equipment
- Fleet
- Studies, Programs & Initiatives

A summary of the Corporate Projects is presented in Table 2 below.

**Table 4 – Corporate Projects Projected Expenditure Need**

| System | Total Capital Cost (2019$M) |
|---|---|
| Water | $199 |
| Wastewater | $186 |
| Stormwater | $42 |
| **Total*** | **$427** |
| Corporate Projects Average Annual Expenditure Need (2019-2048) | $14.2 |

*Projected expenditure needs for Corporate Projects prior to program integration for the IRP Update.

# 3 Costing Analysis

The results from the expenditure needs summary identified an opportunity to review, refine, update and integrate base unit costing for the three foundational studies (Infrastructure Master Plan, Compliance Plan and AMPs). Cost estimation practices have an impact on capital costing, new infrastructure costs, target reinvestments rates, RDC rates and assumptions incorporated into the capital programs. Therefore, it was considered vital that the base cost estimating assumptions for asset renewal, growth and compliance driven projects were aligned.

All AMPs for each asset class were reviewed to establish confidence in the data sources. Through discussions with the Halifax Water team, the following 5 asset classes were identified to have low confidence in replacement costs and could benefit from further assessment: Water Supply Plants, Wastewater Treatment Facilities, Wastewater Pumping Stations, Wastewater Forcemains, Stormwater Management Structures.

The goals and objectives for the costing analysis were:

- Improve the replacement cost estimates for asset classes with low confidence;
- Review the alignment between Halifax Water Infrastructure Master Plan and Asset Management Plans costing approaches;
- Provide recommendations for unit costs and replacement cost adjustments if necessary.
- Provide confidence, transparency and traceability to support funding streams.

## 3.1 Analysis Approach

The costing analysis consisted of a desktop exercise completed to compare multiple sources of costing data/information. The analysis approach can be summarized in the following seven steps:

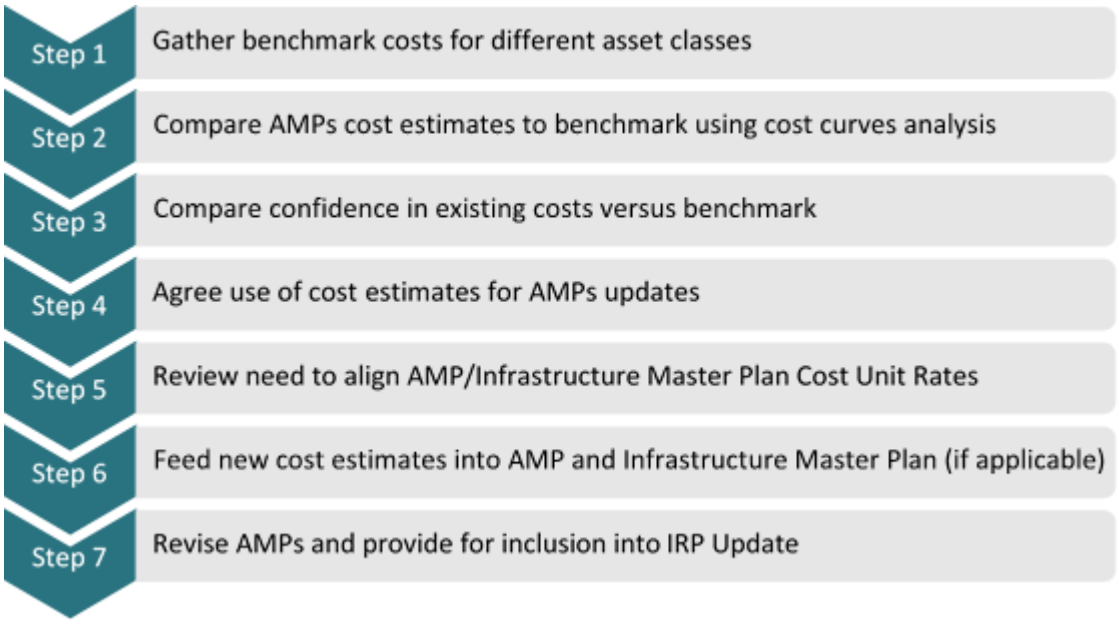



**Figure 1 – Costing Analysis Approach**

### 3.2 Assumptions and Considerations

It was important that the replacement costs and unit costs were compared on a like-for-like basis, therefore the following assumptions and considerations were used in the analysis:

- For vertical assets, all-in replacement costs were analyzed and compared. All-in replacement costs are inclusive of project design and construction costs.
- For linear assets, there were varying levels of uncertainty which resulted in different assumptions to all-in replacement costs. Therefore, the base unit rates for all linear assets were used in the analysis. Base unit rates do not account for other costs such as engineering and design, contingency, etc.
- When required, costs were inflated to 2019 dollars using an inflation rate of 2%, informed through a forecast of Non-Residential Buildings Construction Price Index collected by Statistics Canada.

**Step 1 - Gather benchmark costs for different asset classes**

Benchmark replacement costs from various data sources were compiled for most asset classes. The main sources of information for this analysis are described in Table 5 below.

**Table 5 – Replacement Cost Analysis Sources**

| Source | Description |
|---|---|
| Halifax Water AMP (2017-2018) | Replacement costs and unit costs provided in the AMP are described the Expenditure Needs Analysis workbook provided in Appendix D. |
| Halifax Water Infrastructure Master Plan (2019) | The Infrastructure Master Plan rates were established in the preparation of the Functional Plan and WRWIP, and further updated during the Master Plan development process. |
| Modelling the Cost of Infrastructure Environmental Protection Agency (EPA) (2003) | United States EPA completed an update to a previous study in 1999 to estimate the 20-year capital investment needs of public water systems by developing cost curves for various water and wastewater assets. |
| Water and Wastewater Asset Cost Study Ministry of Public Infrastructure Renewal (MPIR) (2005) | The Ontario MPIR completed a study in 2005 to provide life cycle costing information to assist in determining investment needs in the water and wastewater sector. |
| Various Municipal Replacement Cost and Unit Cost Data | GMBP leveraged their knowledge base of information from past projects and experiences. This included Ontario municipalities of populations ranging from less than 25 thousand to over 2 million. Data sources were collected from AMPs, Infrastructure Master Plan, State of Infrastructure reports, etc. Further descriptions are included in the Cost Comparison provided in Appendix E. |

**Step 2 - Compare AMPs cost estimates to benchmark using cost curves analysis**

As part of the costing analysis, cost comparison charts were developed for each asset class as follow:

- For vertical infrastructure, the capacity of the facilities was plotted against the total facility replacement cost.
- For linear infrastructure, base unit costs were plotted against the size/diameter of the linear assets (e.g. watermains, sewers, forcemains).

The figures below present a sample of the cost comparison charts for the asset classes identified with low confidence in their replacement cost. It should be noted that out of the five asset classes identified, stormwater management structures did not have enough available information to develop a comparison chart. The remaining asset classes are provided in the Cost Comparison workbook in Appendix E.

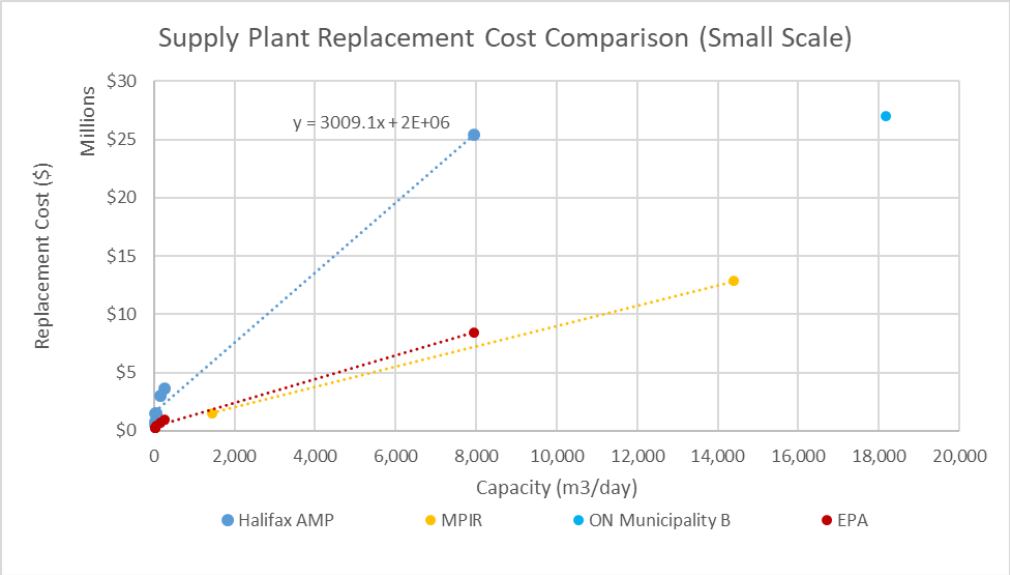



**Figure 2 – Water Supply Plant (<20,000 m3/day) Comparison Chart**

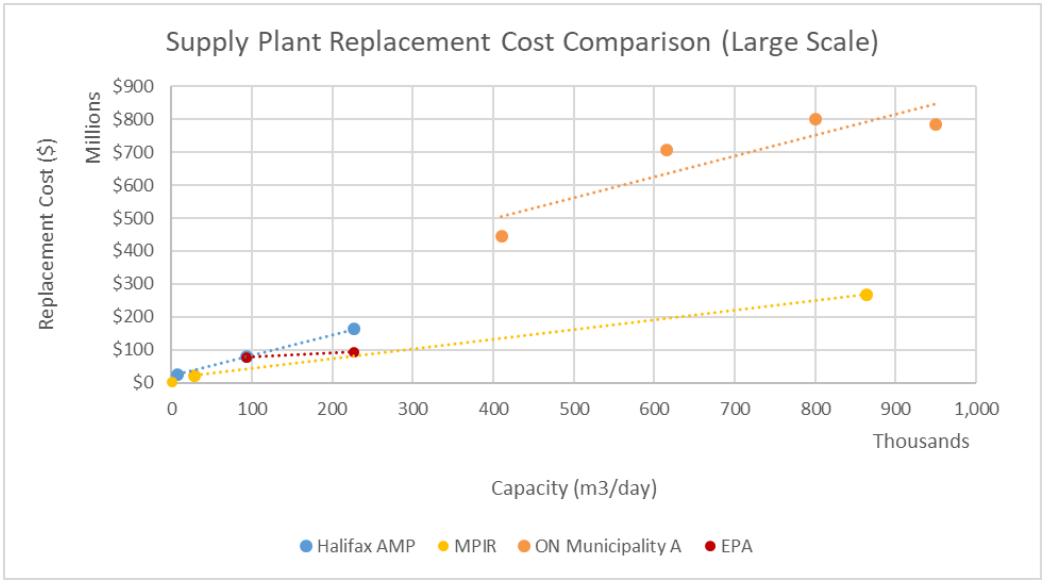



**Figure 3 – Water Supply Plant (>=20,000 m3/day) Comparison Chart**

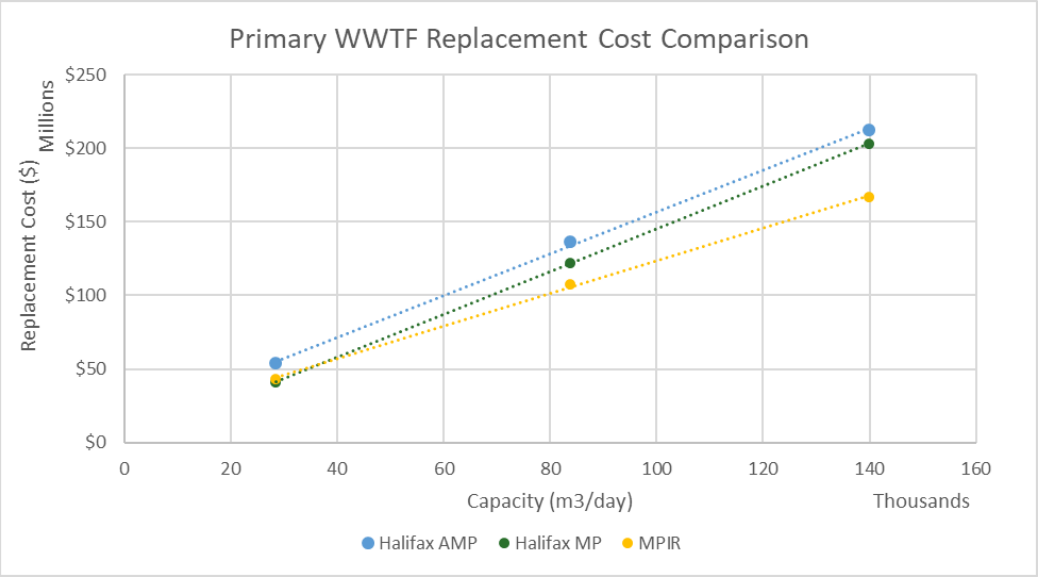



**Figure 4 – Primary Wastewater Treatment Facility Comparison Chart**

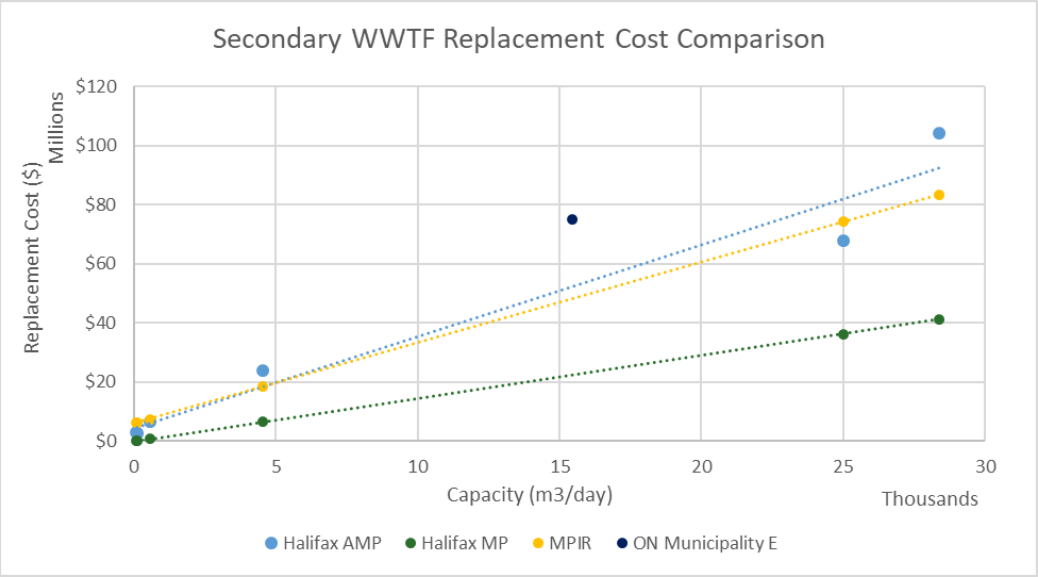



**Figure 5 – Secondary Wastewater Treatment Facility Comparison Chart**

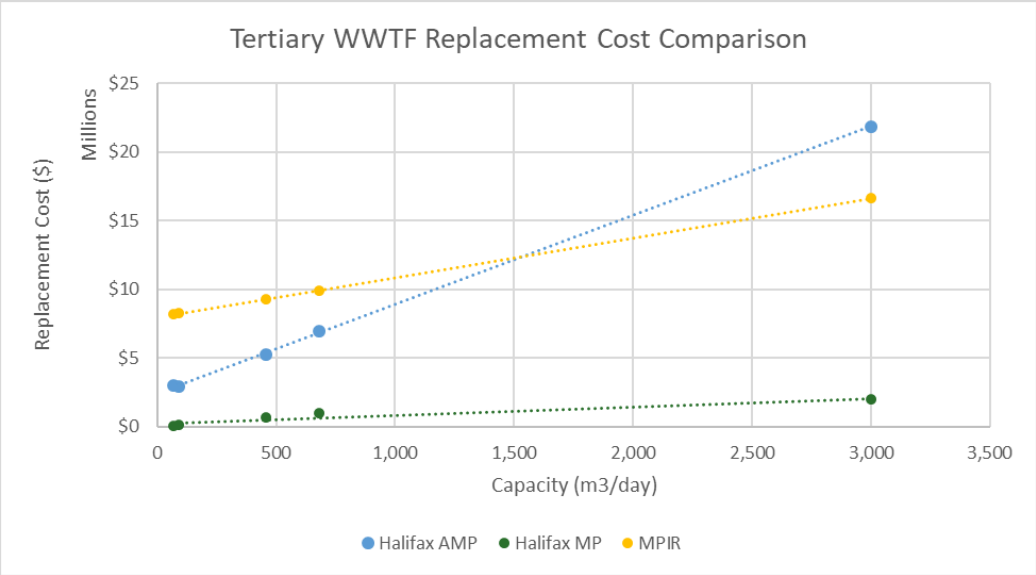



**Figure 6 – Tertiary Wastewater Treatment Facility Comparison Chart**

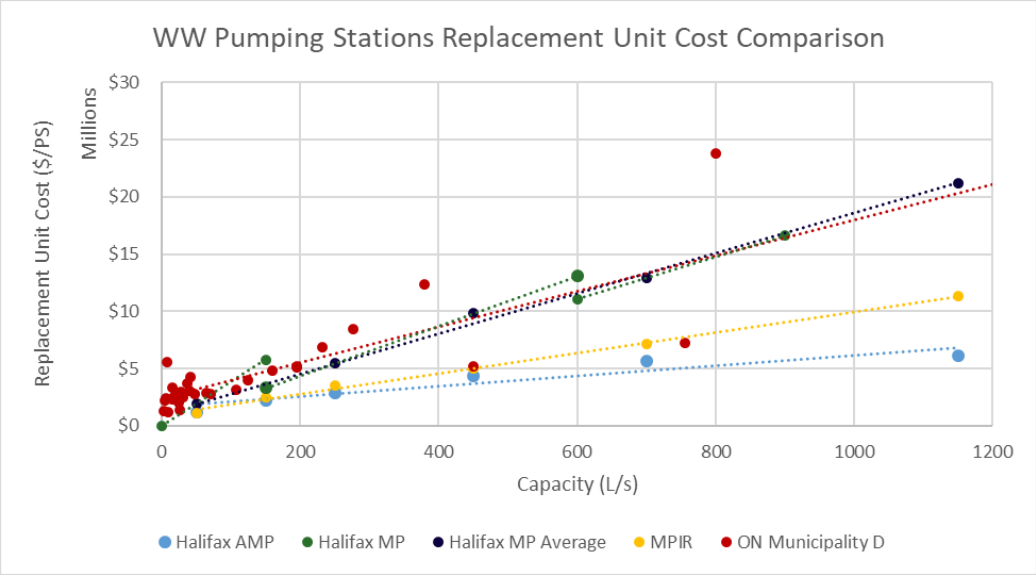



**Figure 7 – Wastewater Pumping Station Comparison Chart**

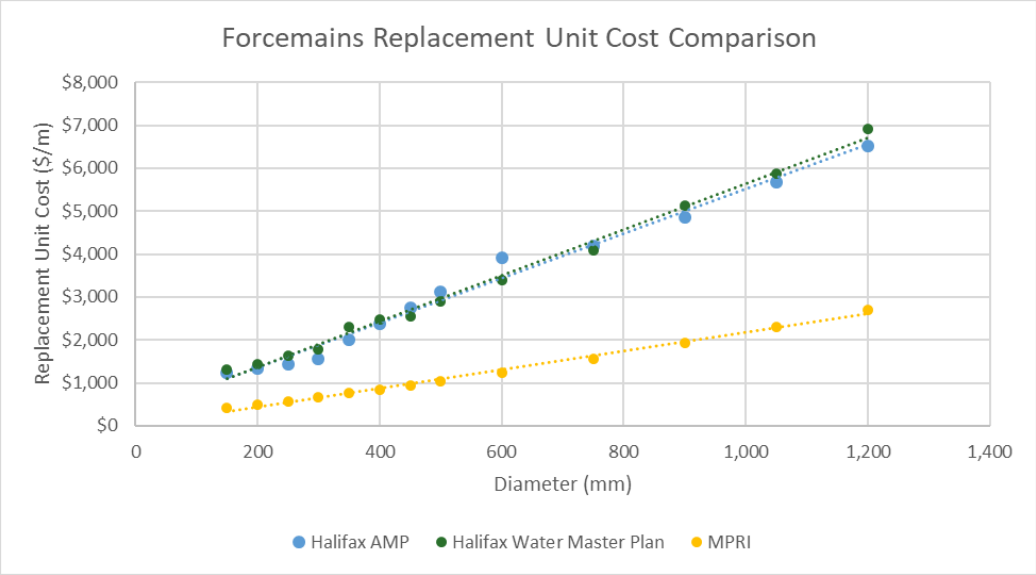



**Figure 8 – Wastewater Forcemain Comparison Chart**

### Step 3 - Compare confidence in existing costs versus benchmark

The confidence of the data sources was assigned using Table 4.

**Table 6 – Confidence Sale**

| Letter Rating | Description |
|---|---|
| **A** | High confidence; no major assumptions; reliable source; completed for asset management purposes; no data gaps. |
| **B** | Moderate confidence; no major assumptions; data moderately reliable; no data gaps; may be out of date. |
| **C** | Low confidence; lack of details around values; some data gaps; major assumption used (out of date inventory or study, anecdotal, etc.) |
| **D** | Very low confidence; uncertainty on how values were determined; significant data gaps; unsure of assets included; unsure of what is included in the cost. |

### Step 4 - Agree use of cost estimates for AMPs updates

### Step 5 - Review need to align AMP/Infrastructure Master Plan Cost Unit Rates

Steps 4 & 5 were completed simultaneously. Several meetings were held with Halifax Water's Asset Management team to discuss the results of the benchmark cost comparison and provide recommendations for replacement adjustment and alignment among the plans.

The following recommendations were carried forward for inclusion in the 2018-2019 AMPs update:

- Adjust Replacement Cost for Vertical Infrastructure:
  - Water Supply Plants – except for backup plans
  - Water Booster Stations
  - Water Reservoirs
  - Wastewater Pumping Stations

- Adjust Base Unit Cost for Linear Infrastructure:
  - Transmission and Distribution Mains
  - Wastewater Gravity Sewers
  - Forcemains
  - Stormwater Gravity Sewers

The following recommendations were carried forward for inclusion in the Infrastructure Master Plan:

- Adjust Base Unit Cost for:
  - Water Supply Plants
  - Water Booster Stations
  - Water Reservoirs

### Step 6 - Feed new cost estimates into AMP and Infrastructure Master Plan (if applicable)

Replacement and base unit cost recommendations were incorporated into the 2018-2019 AMPs and the final capital program of the Infrastructure Master Plan.

### Step 7 - Revise AMPs and provide for inclusion into IRP Update

Revised 2018-2019 AMPs were provided for inclusion in the 2019 IRP update prior to the beginning of integration process. The following table presents the update AMPs projected expenditure needs.

**Table 7 – 2018-2019 AMPs Projected Expenditure Need**

| System | Asset Group | AMP 30-year Average Annual Expenditure Need (2019$M) | 2017-2018 AMP Replacement Cost (2019$M) | Annual Reinvestment Rate |
|---|---|---|---|---|
| Water | Supply Plant | $10.3 | $306 | 3.4% |
| | Supply Dam | $0.3 | $44 | 0.6% |
| | Booster Station | $0.2 | $17 | 1.0% |
| | Reservoir | $1.1 | $95 | 1.2% |
| | Chambers | $0.4 | $51 | 0.7% |
| | Transmission Main | $9.1 | $691 | 1.3% |
| | Distribution Main | $10.3 | $1,384 | 0.7% |
| Wastewater | Treatment Facility | $13.2 | $652 | 2.0% |
| | Pumping Station | $11.6 | $573 | 2.0% |
| | Gravity Sewer | $5.5 | $1,714 | 0.3% |
| | Force Main | $1.6 | $275 | 0.6% |
| Stormwater | Management Structure | $0.4 | $42 | 0.8% |
| | Gravity Sewer | $5.4 | $1,369 | 0.4% |
| | Cross Culvert | $2.2 | $268 | 0.8% |
| | Driveway Culvert | $0.7 | $66 | 1.1% |
| | Ditches | $0.9 | $56 | 1.5% |
| **Total*** | | **$73** | **$7,602** | **1.0%** |

*Projected expenditure needs as per the 2018-2019 AMPS prior to program integration for the IRP Update.

# 4 Cost Estimating Approach

This section outlines Halifax Water's established approach to cost estimation of capital projects through the application of the Cost Estimation Framework (CEF). Halifax Water's CEF was developed as part of the West Region Wastewater Infrastructure Plan (WRWIP) and most recently updated through the Infrastructure Master Plan with knowledge gained through an industry best practice review. This framework has been tailored to Halifax Water's needs and provides a uniform and consistent approach to estimating project costs, ultimately narrowing the gap between cost estimates and final project budgets.

## 4.1 Unit Costing Template

The unit costing template was originally developed as part of the WRWIP and was updated in 2019 during the completion of the Infrastructure Master Plan. Updates included revised unit rates based on new information, new costing components especially for water infrastructure, and overall adjustments for inflation.

The key unit rate categories that form the basis of the master planning costing template are as follows:

- Linear infrastructure is costed per metre of pipe based on type (sewer, forcemain, watermain, tunnel), diameter, and depth. Additional unit costs are applied as required for creek, road, and utility crossings. An uplift is used for construction in certain areas known to have higher costs, such as on the urban peninsula.
- Vertical infrastructure costing varies depending on the facility type; pumping stations are costed per litre capacity and storage costed per cubic metre useable volume.
- A range of unit costs for water and wastewater treatment capacity were developed based on previous Integrated Resource Plan 2012 study and discussions with Halifax Water.

### Other Construction Costs

Construction costs associated with Engineering and Design, Geotechnical, Hydrogeological, and Professional Fees, Construction Management and Contract Administration, and Property Requirements are assigned as percentage rates.

### Contingency Costs

The accuracy of capital project cost estimates varies depending on a given phase of planning and design. The Cost Estimation Framework contains a classification system to categorize these different phases, each with a varying level of costing accuracy depending on the current stage of project development:

- **Class 4: Planning Cost Estimate**
  - High-level concept screening
  - Justification for project funding
  - Lowest accuracy, highest contingency
- **Class 3: Concept Design Cost Estimate**
  - Basis for budgeting and approvals
- **Class 2: Preliminary Design Cost Estimate**
  - Basis for project cost control during detailed design
  - Initial detailed cost estimate

- **Class 1: Detailed Design Cost Estimate**
  - Final cost review before construction
  - Ready for tender
  - Highest accuracy, lowest contingency

An contingency rate is applied to the construction costs depending on the Class Estimate Type (e.g. 10% contingency for Class 1 up to 30% contingency for Class 4). It should be noted that due the preliminary nature of the study, all capital projects identified in the Infrastructure Master Plan are categorized as Class 4, with 30% contingency costs.

**Peer Review**

The unit costing tables developed for the Infrastructure Master Plan were peer-reviewed by DesignPoint Engineering & Surveying Limited and Halifax Water staff, who provided valuable local expertise and insight on material, construction, and contingency costs. DesignPoint assisted in identifying uncommon pipe sizes for omission from the costing template, classifying the most common material choice for pipes based on diameter, and revising individual unit rates for watermains and forcemains based on pipe depth, material, and installation date.

The unit cost tables used to develop the capital programs for the preferred infrastructure servicing strategies are provided in Appendix F. An example of a detailed costing sheet developed for a key wastewater capital project through the Infrastructure Master Plan is provided in Appendix G.

## 4.2 RDII Reduction Cost Estimation

Rainfall-derived inflow and infiltration (RDII) reduction was an integral component of the overall Infrastructure Master Plan wastewater strategies. A RDII Costing Template was developed to provide consistency for these difficult to estimate capital needs. This template incorporates a costing methodology that takes into consideration specific catchment parameters such as area, land use, number of manholes, and length of sewer pipe. Preliminary unit costing rates were based on GM BluePlan's previous project experience and cross referenced with multiple case studies from the USA and Canada.

As part of the development of the RDII Costing Template, an industry review was undertaken on case studies from several United States municipalities. The industry review provided historic information for different RDII reduction programs including total program cost as well as a range of unit costs including cost per manhole, cost per unit length of sewer, cost per individual property connection, and cost per unit area. Age and condition of infrastructure, physical catchment characteristics, and presence of direct stormwater network connections like downspouts and foundation drains can vary substantially depending on location, often within the same municipality. It is important to note that depending on the scale and success of each program, the final program cost may differ significantly from an original cost estimate. As a result, program costs were highly variable for case study. The unit rates used in the RDII Costing Template generally agreed with the unit rates derived from the industry review.

An example of a RDII reduction costing sheet used to estimate the cost for extraneous flow removal in a targeted area is provided in Appendix H.

## 5 Conclusions and Recommendations

As part of the 2019 IPR Update process, an expenditure analysis was undertaken to identify the magnitude of annual expenditures required to meet the drivers of growth, compliance and asset renewal. The results from the expenditure needs analysis identified an opportunity to review, refine, update and integrate base unit costing for the three foundational studies though a high-level desktop costing analysis. The costing analysis compared multiple sources of costing data/information and resulted in the following recommendations:

- Annual review of all unit rates (linear and vertical).
- Enhance cost estimating approach for vertical facilities (e.g. pumping stations, storage facilities, treatment plants).
    - By updating the cost estimation approach on an ongoing basis for vertical infrastructure, their unit rates can be broken down into sub-categories, like different sizing costs for linear infrastructure.
    - For example, costing for new pumping stations would not be limited to a unit cost per litre of pumped sewage; this cost could also account for approximate land requirements, wet/dry well depth, number of pumps, etc.
- Develop a more detailed approach for complex facilities that may include unit rates for subcomponents.
- Continue benchmarking construction projects.

Additional recommendations with respect to the Infrastructure Master Plan and RDII reduction are:

- Enhance RDII reduction unit costing methodology in future Infrastructure Master Plan updates by expanding the industry review for more recent program costing in other North American municipalities.
- Future updates to RDII reduction costing should account for pre-implementation program cost estimates in Halifax Water's target areas and compare with actual post-implementation costs and success rates. This data will be used to provide additional justification for future RDII reduction and improve the accuracy of cost estimation based not only on other North American municipalities' RDII reduction programs, but from efforts within the Halifax area itself.
- Track separate implementation costs and efficacy of both public and private side RDII reduction, as these metrics may vary significantly between different areas within the same sewershed.

# Appendix A – Infrastructure Master Plan Program

## Executive Summary Table 3: Wastewater Capital Program Summary

| | Project Category | Project ID | Project Name | Project Description | Start Year | Planning Period | Total Capital Cost (2019$) |
|---|---|---|---|---|---|---|---|
| West Region: Halifax | Peninsula Halifax | WR1 | WRWIP: Spring Garden Area Sewer Separation | *Full separation of Spring Garden LoWSCA pocket - 5 individual projects* | 2018-2023 | 2016-2021 | $ 7,281,000 |
| | | WR2 | WRWIP: Young Street Area Sewer Separation | *Full separation of Young Street LoWSCA pocket - 18 individual projects* | 2018-2023 | 2016-2021 | $ 21,879,000 |
| | | WR3 | WRWIP: Sewer Separation Upstream of Kempt CSO | *Full separation of a portion of the Kempt CSO sewershed - 17 individual projects* | 2018-2025 | 2016-2021 | $ 14,752,000 |
| | | WR4 | WRWIP: Linear Upsize - Quinpool Road | *525mm ø combined sewer upsize along Quinpool Road (from Preston to Oxford)* | 2020 | 2016-2021 | $ 437,000 |
| | | WR5 | WRWIP: Linear Upsize - Gottingen & Cogswell Area | *750mm ø combined sewer upsize along Portland Place (from Saunders to Brunswick) + 900mm ø combined sewer upsize along Brunswick Street* | 2020 | 2016-2021 | $ 221,000 |
| | | WR6 | WRWIP: Gottingen Street and North Street Intersection Flow Split | *Lower the invert of the combined sewer along Gottingen, on the south side of North Street* | 2020 | 2016-2021 | $ 500,000 |
| | | WR7 | WRWIP: Young Pumping Station Upgrade | *New 300mm diameter alignment + Installation of new pumps to increase the station capacity from 114L/s to 250L/s* | 2027 | 2026-2031 | $ 2,169,000 |
| | | WR8 | WRWIP: New Fairfield Holding Tank | *New 3,700 cubic metre holding tank at the existing Fairfield Holding Tank site* | 2046 | 2041-2046 | $ 12,403,000 |
| | | WR9 | WRWIP: Replace Armdale Pumping Station Forcemains | *Upsize the existing 300mm ø Armdale Pumping Station forcemains with new twinned 400mm ø forcemains* | 2020 | 2016-2021 | $ 3,850,000 |
| | **Halifax Inflow and Infiltration** | **WR13** | WRWIP: RDII Reduction Program | *Implement an Inflow and Infiltration Reduction Program within the Fairview, Clayton Park, and Bridgeview areas (CCTV, Smoke/Dye Testing, Property Disconnections, Sewer Lining)* | 2020 | 2016-2021 | $ 15,491,589 |
| | **Halifax Fairview Cove Tunnel** | **WR19** | WRWIP: Fairview Cove Linear Upsize | *Upsize existing 1050mm ø tunnel to 1800mm ø* | 2019 | 2016-2021 | $ 19,781,000 |
| | **Wastewater Treatment Facility** | **WR20** | WRWIP: Halifax Treatment Plant Capacity Upgrade | *Increase the rated capacity of Halifax WWTF from 134 MLD to 140 MLD* | 2041 | 2036-2041 | $ 25,142,000 |
| | **Halifax Greenfield** | **WR21** | WRWIP: Linear Upgrades within the Kearney Lake Road Area | *Sanitary sewer upgrades downstream of the Kearney Lake Road Pumping Station* | 2033 | 2031-2036 | $ 2,997,000 |
| | **Halfax Flow Optimization** | **WR22** | Infrastructure Master Plan: CSO Management Study | *Monitor and assess CSO facilities to mitigate discharges (16 facilities). Costed at $14,000/monitor and $15,000/CSO for assessment.* | 2026 | 2016-2021 | $ 965,000 |
| | | **WR23** | Infrastructure Master Plan: SSO Management Study | *Monitor and assess SSO facilities to mitigate discharges (6 facilities). Costed at $14,000/monitor and $15,000/SSO for assessment.* | 2021 | 2016-2021 | $ 415,000 |
| | **HALIFAX Total Wastewater Servicing Strategy Cost** | | | | | | **$ 128,283,589** |

## Executive Summary Table 3: Wastewater Capital Program Summary (continued)

| | Project Category | Project ID | Project Name | Project Description | Start Year | Planning Period | Total Capital Cost (2019$) |
|---|---|---|---|---|---|---|---|
| West Region: BLT | BLT WWTF Decommission | WR10 | WRWIP: BLT WWTF Decommission - New Timberlea PS | *New 247L/s Timberlea Pumping Station at existing BLT WWTF site* | 2020 | 2016-2021 | $ 5,928,000 |
| | | WR11 | WRWIP: BLT WWTF Decommission - New Timberlea Forcemain | *New 450mm ø forcemain from new Timberlea Pumping Station to gravity sewer start near Bayers Lake* | | | $ 19,436,000 |
| | | WR12 | WRWIP: BLT WWTF Decommission | *Decommissioning of BLT WWTF and site recovery* | | | $ 500,000 |
| | BLT Diversion to Herring Cove | WR14 | WRWIP: BLT Flow Diversion to Herring Cove - New Crown Drive Pumping Station | *Construct new 370L/s pumping station to divert all of BLT flow to Herring Cove* | 2033 | 2031-2036 | $ 8,063,000 |
| | | WR15 | WRWIP: BLT Flow Diversion to Herring Cove - New Crown Drive Forcemain | *Construct new twinned 450mm ø forcemain along Northwest Arm Drive from new proposed Crown Drive Pumping Station to Cowie Hill* | | | $ 9,026,000 |
| | | WR16 | WRWIP: BLT Flow Diversion to Herring Cove - New Gravity Sewer | *Construct new 600mm ø gravity sewer along Northwest Arm Drive from Cowie Hill to Herring Cove Road south of Levis Street* | | | $ 4,319,000 |
| | | WR17 | WRWIP: BLT Flow Diversion to Herring Cove - New Gravity Sewer | *Construct new 1050mm ø gravity sewer from COLTA sewer to new Crown Drive Pumping Station* | | | $ 3,266,000 |
| | **BLT Total Wastewater Servicing Strategy Cost** | | | | | | **$ 50,538,000** |
| Herring Cove | **Herring Cove Linear Upsizing** | **WR18** | WRWIP: Herring Cove Road - Gravity Sewer Upsize | *Upsize sanitary sewers (to 900mm ø) downstream of Roaches Pond Pumping Station* | 2033 | 2031-2036 | $ 7,439,000 |
| | **HERRING COVE Total Wastewater Servicing Strategy Cost** | | | | | | **$ 7,439,000** |
| | **WEST REGION Total Wastewater Servicing Strategy Cost** | | | | | | **$ 186,260,589** |

## Executive Summary Table 3: Wastewater Capital Program Summary (continued)

| | Project Category | Project ID | Project Name | Project Description | Start Year | Planning Period | Total Capital Cost (2019$) |
|---|---|---|---|---|---|---|---|
| Central Region: Mill Cove and Springfiled Lake | Trunk Upgrades | MC1 | Trunk Sewer Upgrades | *Sackville Trunk Upgrades to 1200mm diameter* | 2036 | 2036-2041 | $ 5,101,000 |
| | | MC2 | Trunk Sewer Upgrades | *Sackville Trunk Upgrades to 1050mm diameter* | 2036 | 2036-2041 | $ 8,246,000 |
| | | MC3 | Trunk Sewer Upgrades | *Sackville Trunk Upgrades to 1500mm diameter* | 2036 | 2036-2041 | $ 144,000 |
| | Storage tank Upgrades | MC4 | Storage Tank | *Offline storage tank near Sackville Goodlife Fitness Centre (5ML)* | 2031 | 2031-2036 | $ 17,469,000 |
| | Upgrades to Pumping Stations | MC5 | Fish Hatchery Park Pumping Station Upgrade | *Upsize existing 450mm forcemain from Fish Hatchery Park PS to 675mm diameter and increase pumping capacity to 1500 L/s with an addition of 100 L/s capacity* | 2036 | 2031-2036 | $ 10,529,000 |
| | | MC6 | Pumping Station (Beaver Bank #3 PS and Majestic Avenue PS) | *Increase pumping capacity at Beaver Bank #3 PS from 55 L/s to 100 L/s, and increase pumping capacity of Majestic Avenue PS from 82 L/s to 165 L/s to eliminate growth-impacted SSO discharge* | 2036 | 2036-2041 | $ 1,090,000 |
| | Wastewater Treatment Facility | MC7 | Mill Cove Wastewater Treatment Plant Capacity Upgrade | *WWTF Upgrade* | 2021 | 2021-2026 | $ 89,256,000 |
| | Inflow and Infiltration | MC8 | RDII Reduction Program FMZ07, FMZ10, & FMZ40 | *Implement an Inflow and Infiltration Reduction Program within the Lower Sackville areas FMZ07, FMZ10, & FMZ40 (CCTV, Smoke/Dye Testing, Property Disconnections, Sewer Lining)* | 2020 | 2016-2021 | $ 9,288,248 |
| | | MC9 | RDII Reduction Program FMZ02 & FMZ03 | *Implement an Inflow and Infiltration Reduction Program within Bedford areas FMZ02 & FMZ03 (CCTV, Smoke/Dye Testing, Property Disconnections, Sewer Lining)* | 2031 | 2031-2036 | $ 8,023,065 |
| | Local New Networks and Upgrades | MC10 | Local network upgrades on Beaver Bank Rd. North of Glendale Dr. | *Upsize from 200mm to 450mm diameter gravity sewer along Beaver Bank Rd.* | 2021 | 2021-2026 | $ 2,086,000 |
| | | MC11 | Local network upgrades on Beaver Bank Rd. at Galloway Dr. | *Upsize from 300mm to 450mm diameter gravity sewer along Beaver Bank Rd.* | 2021 | 2021-2026 | $ 1,490,000 |
| | | MC12 | Local network upgrades on Beaver Bank Rd by Windgate Drive | *Upsize from 300mm to 375mm diameter gravity sewer along Beaver Bank Rd.* | 2021 | 2021-2026 | $ 1,667,000 |
| | | MC13 | Local network upgrades on Old Sackville Road south of Harvest Hwy | *Upsize from 200mm to 375mm diameter gravity sewer along Old Sackville Road* | 2036 | 2036-2041 | $ 845,000 |
| | | MC14 | Local network upgrades on on Hallmark Ave. | *Upsize from 200mm to 375mm diameter gravity sewer on Hallmark Ave.* | 2036 | 2036-2041 | $ 437,000 |
| | | MC15 | Local Sewer Upgrades on Waterfront Drive | *375 mm Sewer Upgrade on Waterfront Drive* | 2036 | 2036-2041 | $ 500,000 |
| | Springfield Lake | MC16 | Springfield Lake Connection to Sackville | *Decommission Springfield Lake WWTF, divert all flow to Mill Cove WWTF via new pumping station and gravity sewer to connect at top of Sackville trunk sewer.* | 2043 | 2041-2046 | $ 6,226,000 |
| | Flow Optimization | MC17 | SSO Management Study | *Monitor and assess SSO facilities to mitigate discharges (18 facilities). Costed at $14,000/monitor and $15,000/SSO for assessment.* | 2021 | 2021-2026 | $ 1,086,000 |
| | **CENTRAL REGION Total Wastewater Servicing Strategy Cost** | | | | | | **$ 163,483,313** |

## Executive Summary Table 3: Wastewater Capital Program Summary (continued)

| | Project Category | Project ID | Project Name | Project Description | Start Year | Planning Period | Total Capital Cost (2019$) |
|---|---|---|---|---|---|---|---|
| East Region Eastern Passage | Gravity Pressure Sewer | EP1 | Install new Gravity Pressure Sewer | *Install new 450 and 825mm Ø gravity pressure sewer* | 2021 | 2021-2026 | $ 23,372,000 |
| | | EP2 | Connect Beaver Crescent and Caldwell Forcemains to new 450mm gravity pressure sewer | *Connect Beaver Crescent and Caldwell Forcemains to new gravity pressure sewer* | 2026 | 2026-2031 | $ 78,000 |
| | | EP3 | Install new pump out stations | *Install 4 new pump out stations in the low point of the gravity pressure sewer* | 2026 | 2026-2031 | $ 1,676,000 |
| | | EP4 | Install gate valves at surge tank | *Optimize flows at the surge tank through gate valves* | 2026 | 2026-2031 | $ 420,000 |
| | | EP5 | Decommission existing 450mm gravity pressure sewer | *Grout fill the 450mm Ø asbestos gravity pressure sewer* | 2043 | 2041-2046 | $ 559,000 |
| | Upgrades to Pumping Stations | EP6 | Upgrade Quigley Corner Pumping Station | *Increase pumping capacity at Quigley to 570l/s with an addition of 343l/s* | 2021 | 2021-2026 | $ 2,875,000 |
| | | EP7 | Optimize Quigley's Corner PS | *Forcemain optimization and SLR assessment* | 2021 | 2021-2026 | $ 336,000 |
| | | EP8 | Upgrade Memorial Drive Pumping Station | *Increase pumping capacity at Memorial Drive PS with an addition of 65l/s. Install new dual 300mm ø forcemain* | 2031 | 2031-2036 | $ 2,633,000 |
| | | EP9 | Upgrade Beaver Crescent Pumping Station | *Increase pumping capacity at Beaver Crescent PS with an addition of 20l/s* | 2036 | 2036-2041 | $ 168,000 |
| | | EP10 | Upgrade Bissett Lake Pumping Station | *Increase pumping capacity at Bissett Lake PS with an addition of 350l/s* | 2041 | 2036-2041 | $ 2,934,000 |
| | | EP11 | Upgrade Caldwell Road Pumping Station | *Increase pumping capacity at Caldwell Road PS with an addition of 70l/s. Install new dual 200mm ø forcemains* | 2039 | 2036-2041 | $ 631,000 |
| | Inflow and Infiltration | EP12 | RDII Reduction Program FMZ23 | *Implement an Inflow and Infiltration Reduction Program within the Cole Harbour areas (CCTV, Smoke/Dye Testing, Property Disconnections, Sewer Lining) - FMZ23* | 2031 | 2031-2036 | $ 3,204,580 |
| | | EP13 | RDII Reduction Program FMZ24 | *Implement an Inflow and Infiltration Reduction Program within the Loon Lake areas (CCTV, Smoke/Dye Testing, Property Disconnections, Sewer Lining)- FMZ24* | 2020 | 2016-2021 | $ 1,570,040 |
| | | EP14 | RDII Reduction Program FMZ37 | *Implement an Inflow and Infiltration Reduction Program within the Eastern Passage areas (CCTV, Smoke/Dye Testing, Property Disconnections, Sewer Lining)- FMZ37* | 2020 | 2016-2021 | $ 2,479,704 |
| | Local New Networks and Upgrades | EP15 | Local network upgrades on Caldwell Road | *Upsize from 200 to 300mm ø gravity sewer along Caldwell Road* | 2036 | 2036-2041 | $ 607,000 |
| | | EP16 | Local network upgrades on Colby Drive | *Upsize from 200 to 300mm ø gravity sewer along Colby Drive* | 2031 | 2031-2036 | $ 1,176,000 |
| | | EP17 | Local network upgrades on Forest Hill Parkway | *Construct new 450mm ø gravity sewer along Forest Hill Parkway connect to pipeline on Nestor Crescent* | 2041 | 2041-2046 | $ 4,275,000 |
| | Flow Optimization | EP18 | SSO Management Study | *Monitor and assess SSO facilities to mitigate discharges (8 facilities). Costed at $14,000/monitor and $15,000/SSO for assessment.* | 2021 | 2021-2026 | $ 484,000 |
| | **EASTERN PASSAGE Total Wastewater Servicing Strategy Cost** | | | | | | **$ 49,478,324** |

## Executive Summary Table 3: Wastewater Capital Program Summary (continued)

| | Project Category | Project ID | Project Name | Project Description | Start Year | Planning Period | Total Capital Cost (2019$) |
|---|---|---|---|---|---|---|---|
| East Region : Dartmouth | Lakes and Sewer Separation | D1 | LoWSCA: Canal Street Separation | *Full separation of Canal Street LoWSCA pocket - 1 individual project. Install new stormwater pipelines, separate 35 properties and reconnect 8 catchbasins.* | 2020 | 2016-2021 | $ 1,842,000 |
| | | D2 | LoWSCA: Wyse Road Separation | *Full separation of Wyse Road LoWSCA pocket - 3 individual project, two phases.*<br>*Phase 1 - Install new stormwater pipelines along Albro Lake Road and Windmill Road, separate 43 properties and reconnect 18 catchbasins (Area A).*<br>*Phase 2 - Install new stormwater pipelines along Wyse Road, connecting to Albro Lake stormwater pipe, separate 111 properties and reconnect 4 catchbasins (Area B).*<br>*Install new sewer diversion from Lyle St Catchment to Jamieson(Area C).* | 2020 | 2016-2021 | $ 3,860,000 |
| | | | | | 2021 | 2021-2026 | $ 2,802,000 |
| | | D3 | Additional Stormwater Separation on Wyse Street | *450mm ø stormwater pipe connecting to Park Ave CSO, separate 6 properties and reconnect 1 catchbasin.* | 2031 | 2026-2031 | $ 1,912,000 |
| | | D5 | Albro Lakes Watershed Separation | *Full separation of Albro Lakes Watershed, install new stormwater trunk line, connecting to Jamieson Street CSO outfall.* | 2021 | 2021-2026 | $ 8,111,000 |
| | | D6 | Maynard Lake and Clement Street Wetland Separation | *Full separation of Maynard Lake and the Clement Street Wetland - 4 phases*<br>*Phase 1 - Install 1050mm pipeline in Old Ferry Rd, connection to CSO outfall, connect stormwater pipeline from Hazlehurst Street and catchbasins en route*<br>*Phase 2 - Install 750mm pipeline working upstream to the Wetland, continue to connect to catchbasin en route*<br>*Phase 3 - Install 600mm pipeline connecting Maynard Lake to the pipeline*<br>*Phase 4 - Connect to stormwater network for DSM and Fenwick Drive properties and separate North Woodside - Southdale Elementary and surrounding businesses* | 2031 | 2026-2031 | $ 642,000 |
| | | | | | 2031 | 2031-2036 | $ 4,540,000 |
| | | | | | 2033 | 2031-2036 | $ 1,155,000 |
| | | | | | 2036 | 2031-2036 | $ 453,000 |
| | Upgrades to Pumping Stations | D7 | New Valleyford Pumping Station | *Install new pumping station by the Valleyford Holding Tank to a capacity of 300l/s. Install new forcemain down Raymond Street and Maple Drive, to connect to the trunk sewer* | 2041 | 2036-2041 | $ 10,446,000 |
| | | D8 | 390 Waverley Road Upgrades | *Install new dual 500mm ø forcemain following existing path with a diversion to the North Dartmouth Trunk Sewer, by Highway 118* | 2021 | 2021-2026 | $ 11,361,000 |
| | | D9 | Anderson Pumping Station Upgrades | *Install new 300mm ø forcemain following existing path. Alter flow path from holding tank to PS by adjusting pipe grades between infrastructure* | 2031 | 2031-2036 | $ 340,000 |
| | Dartmouth WWTF Upgrades | D10 | Upgrades to Dartmouth WWTF | *Upgrade Dartmouth WWTF to meet demand at end of Project Horizon* | 2043 | 2036-2041 | $ 12,572,000 |
| | Inflow and Infiltration | D11 | RDII Reduction Program | *Implement an Inflow and Infiltration Reduction Program within the Ellenvale areas (CCTV, Smoke/Dye Testing, Property Disconnections, Sewer Lining)* | 2021 | 2021-2026 | $ 5,941,076 |
| | | D12 | RDII Reduction Program | *Implement an Inflow and Infiltration Reduction Program within the Woodside areas (CCTV, Smoke/Dye Testing, Property Disconnections, Sewer Lining)* | 2031 | 2031-2036 | $ 1,120,232 |
| | | D13 | Additional flow monitoring | *Flow monitoring through the catchment to assess areas in model showing flooding* | 2020 | 2016-2021 | $ 252,000 |

## Executive Summary Table 3: Wastewater Capital Program Summary (continued)

| | Project Category | Project ID | Project Name | Project Description | Start Year | Planning Period | Total Capital Cost (2019$) |
|---|---|---|---|---|---|---|---|
| East Region : Dartmouth | Local New Networks and Upgrades | D15 | Green St Upsize | *Common project - Upsize from 375 to 750mm ø gravity sewer along Green Street* | 2041 | 2041-2046 | $ 513,000 |
| | | D16 | Pinecrest Dr Upgrade | *Common project - Upsize from 200 to 375mm ø gravity sewer along Pinecrest Drive* | 2031 | 2031-2036 | $ 1,013,000 |
| | | D17 | Peddars Way Upgrade | *Common project - Upsize from 300 to 375mm ø gravity sewer along Peddars Way* | 2031 | 2031-2036 | $ 555,000 |
| | | D18 | Atlantic Street Upgrade | *Common project - Upsize from 250 to 450mm ø gravity sewer along Atlantic St* | 2021 | 2021-2026 | $ 3,831,000 |
| | | D19 | Akerley Blvd and Railway Alignment Upgrade | *Strategy project - Upsize from 250 to 600mm ø gravity sewer along Akerley Blvd and Railway easement towards Ferguson Road CSO* | 2041 | 2036-2041 | $ 4,814,000 |
| | | D20 | Pleasant Street Upgrade | *Strategy project - Upsize from 200 to 450mm ø gravity sewer along Pleasant St, and towards Cuisack Street CSO* | 2021 | 2021-2026 | $ 767,000 |
| | | D21 | Princess Margaret Blvd. Upgrade | *Strategy project - Upsize from 450 to 600mm ø gravity sewer along Princess Margaret Blvd.* | 2031 | 2031-2036 | $ 3,106,000 |
| | | D22 | Anderson Lake Development Connection | *Strategy project - Construct new 450mm ø gravity sewer to connect Anderson Lake development to Akerley Blvd* | 2036 | 2036-2041 | $ 7,609,000 |
| | | D23 | Marvin Connection | *Strategy project - Construct new 450mm ø gravity sewer in Marvin Street and connect to connect Cuisack Street CSO* | 2026 | 2026-2031 | $ 1,380,000 |
| | Flow Diversion | D24 | King Street Diversion | *Common Project - 450mm ø sewer diversion to NDTS* | 2026 | 2026-2031 | $ 78,000 |
| | | D25 | Diversion to Eastern Passage | *Install new pumping station at Melva St CSO. Install new dual 600mm ø forcemain following Pleasant Street and connecting to existing gravity pipe in Eastern Passage network. Upgrade existing gravity pipe from a 200 to 600mm ø.* | 2036 | 2036-2041 | $ 12,113,000 |
| | Flow Optimization | D14 | CSO Flow Management Study | Monitor and assess CSO facilities to mitigate discharges (11 facilities). Costed at $14,000/monitor and $15,000/CSO for assessment. | 2036 | 2036-2041 | $ 675,000 |
| | | D26 | SSO Flow Management Study | Monitor and assess SSO facilities to mitigate discharges (9 facilities). Costed at $14,000/monitor and $15,000/SSO for assessment. | 2021 | 2016-2021 | $ 555,000 |
| | **DARTMOUTH Total Wastewater Servicing Strategy Cost** | | | | | | **$ 104,358,308** |
| | **EAST REGION Total Wastewater Servicing Strategy Cost** | | | | | | **$ 153,836,631** |
| | **ALL REGIONS Total Wastewater Servicing Strategy Cost** | | | | | | **$ 563,082,533** |

**Executive Summary Table 4: Water Capital Program Summary**

| Project Category | Project Name | Project ID | Project Task | Start Year | Planning Period | Total Capital Cost (2019$) |
|---|---|---|---|---|---|---|
| Pockwock - Peninsula | Peninsula Transmission Upgrades (Chain Control) | W06.1 | Chain Control Transmission - Existing Peninsula Low Upsize | 2021 | 2021-2026 | $ 3,841,000 |
| | | W06.2 | Chain Control Transmission - Existing Peninsula Intermediate Upsize | 2021 | 2021-2026 | $ 2,650,000 |
| | | W06.3 | Pepperell Transmission | 2036 | 2036-2041 | $ 2,702,000 |
| | | W06.4 | Chain Control Transmission - Existing Peninsula Low Lining | 2036 | 2036-2041 | $ 2,916,000 |
| | | W06.5 | Chain Control Transmission - Valve Chambers | 2036 | 2036-2041 | $ 1,258,000 |
| | Twinning of Peninsula Transmission (Robie) | W07 | Replace High Risk Peninsula Transmission (Robie) | 2026 | 2026-2031 | $ 17,312,000 |
| | Quinpool to Young Connection | W08 | Peninsula Intermediate Looping - Quinpool Rd to Young St | 2021 | 2021-2026 | $ 4,319,000 |
| | Young Street Pocket Upgrades | W10.1 | Young St Upsize | 2026 | 2026-2031 | $ 1,315,000 |
| | | W10.2 | Robie St Upsize | 2026 | 2026-2031 | $ 956,000 |
| | | W10.3 | Almon St Upsize | 2026 | 2026-2031 | $ 1,168,000 |
| | | W10.4 | Windsor St Upsize | 2026 | 2026-2031 | $ 1,004,000 |
| Pockwock - Other | Lakeside Projects | W01.1 | Geizer 158 to Lakeside High Looping | 2021 | 2021-2026 | $ 2,249,000 |
| | | W01.2 | Gravity Supply to Brunello | 2041 | 2041-2046 | $ 2,328,000 |
| | | W01.3 | Dominion Cres Upsize | 2041 | 2041-2046 | $ 447,000 |
| | | W01.4 | Brunello Booster Pump Upgrades | 2021 | 2021-2026 | $ 236,000 |
| | Lively, Geizer Hill, and Leiblin Booster Pump Upgrades | W03 | Geizer Hill Booster Pump Upgrades | 2021 | 2021-2026 | $ 277,000 |
| | | W04 | Leiblin Booster Fire Pump | 2019 | 2016-2021 | $ 395,000 |
| | | W15 | Lively Booster Pump Upgrades | 2036 | 2036-2041 | $ 38,000 |
| | Herring Cover Upgrades | W05.1 | Herring Cove Rd Twinning | 2020 | 2016-2021 | $ 3,585,000 |
| | | W05.2 | St Michaels Ave Upsize | 2041 | 2041-2046 | $ 502,000 |
| | | W05.3 | Herring Cove Rd Looping - McIntosh St | 2021 | 2021-2026 | $ 2,272,000 |
| | Lucasville Road Twinning | W12.1 | Lucasville Rd Twinning (Phase 1) | 2019 | 2016-2021 | $ 8,117,000 |
| | | W12.2 | Lucasville Rd Twinning (Phase 2) | 2026 | 2026-2031 | $ 8,956,000 |
| | New Primary Sackville High and Beaver Bank Supply | W13.1 | New Primary Feed to Sackville High | 2026 | 2026-2031 | $ 4,953,000 |
| | | W13.2 | New Sackville Beaver Bank Valve Chamber | 2026 | 2026-2031 | $ 839,000 |
| | | W13.3 | Reconfiguration of Beaver Bank Booster | 2026 | 2026-2031 | $ 100,000 |
| | | W13.4 | New Sackville High PRV | 2026 | 2026-2031 | $ 420,000 |
| | Second Supply to Windsor Junction | W14.1 | Cobequid High Looping | 2026 | 2026-2031 | $ 2,233,000 |
| | | W14.2 | Windgate Dr Upsize | 2026 | 2026-2031 | $ 882,000 |
| | New Hemlock Tank | W16 | New Hemlock Elevated Tank | 2020 | 2016-2021 | $ 6,209,000 |
| | Pockwock Transmission Looping | W17 | Pockwock Transmission Loop through Bedford | 2021 | 2021-2026 | $ 5,069,000 |
| | Second Geizer 158 Feed and Lacewood Drive Loop | W02 | Geizer 158 Looping - Lacewood Dr | 2041 | 2041-2046 | $ 2,002,000 |
| | | W20 | Second Geizer 158 Feed | 2041 | 2041-2046 | $ 9,612,000 |

**Executive Summary Table 4: Water Capital Program Summary (continued)**

| Project Category | Project Name | Project ID | Project Task | Start Year | Planning Period | Total Capital Cost (2019$) |
|---|---|---|---|---|---|---|
| Lake Major | New Transmission from Topsail to Burnside | W22.1 | New Main Street to Caledonia Road Connection | 2021 | 2021-2026 | $ 3,072,000 |
| | | W22.2 | Caledonia Rd Twinning | 2021 | 2021-2026 | $ 3,429,000 |
| | | W22.3 | New Breeze Dr Watermain | 2021 | 2021-2026 | $ 5,801,000 |
| | | W28 | Tacoma PRV Chamber | 2021 | 2021-2026 | $ 420,000 |
| | Highway 118 Crossing | W23 | Highway 118 Crossing - Shubie Park to Dartmouth Crossing | 2021 | 2021-2026 | $ 6,063,000 |
| | Windmill Road Upgrade | W24 | Windmill Rd Upsize | 2026 | 2026-2031 | $ 6,104,000 |
| | New Woodside Industrial Park Feed | W25 | New Woodside Industrial Park Feed | 2021 | 2021-2026 | $ 1,649,000 |
| | Willowdale-Eastern Passage Connection | W26 | Willowdale to Eastern Passage Connection | 2036 | 2036-2041 | $ 6,290,000 |
| System Interconnections Pockwock Transmission WTP Decommissioning | Pockwock Transmission Twinning | W19.1 | Pockwock Transmission Twinning - 60in | 2031 | 2031-2036 | $ 65,516,000 |
| | | W19.2 | Pockwock Transmission Twinning - 54in | 2036 | 2036-2041 | $ 16,228,000 |
| | Extension to Springfield Lake | W21 | Extension to Springfield Lake | 2041 | 2041-2046 | $ 3,043,000 |
| | Bedford-Burnside Interconnection | W29.1 | Bedford-Burnside System Interconnection (Phase 1) | 2036 | 2036-2041 | $ 24,499,000 |
| | | W29.2 | Bedford-Burnside System Interconnection (Phase 2) | 2036 | 2036-2041 | $ 11,779,000 |
| | Dartmouth-Peninsula Interconnection | W30.1 | Lyle Emergency Booster | 2026 | 2026-2031 | $ 1,045,000 |
| | | W30.2 | Valving for Central Intermediate Boundary Change | 2026 | 2026-2031 | $ 629,000 |
| | Pockwock-Bennery Interconnection | W31.1 | Extension of Fall River to Bennery Lake (Phase 1) | 2026 | 2026-2031 | $ 8,067,000 |
| | | W31.2 | Extension of Fall River to Bennery Lake (Phase 2) | 2026 | 2026-2031 | $ 9,156,000 |
| | | W31.3 | Extension of Fall River to Bennery Lake (PS) | 2026 | 2026-2031 | $ 1,310,000 |
| | WSP Decommissioning | W32.1 | Decommission Miller Lake WSP - Linear | 2019 | 2016-2021 | $ 628,000 |
| | | W32.2 | Decommission Miller Lake WSP | 2019 | 2016-2021 | $ 61,000 |
| | | W33.1 | Decommission Collins Park WSP - Linear | 2041 | 2041-2046 | $ 1,086,000 |
| | | W33.2 | Decommission Collins Park WSP | 2041 | 2041-2046 | $ 168,000 |
| | | W34.1 | Decommission Silversands WSP - Linear | 2041 | 2041-2046 | $ 1,931,000 |
| | | W34.2 | Decommission Silversands WSP | 2041 | 2041-2046 | $ 168,000 |
| | Aerotech Storage | W40 | Aerotech Storage | 2021 | 2021-2026 | $ 4,752,000 |
| Studies | Studies | W18 | Chain Lake Backup Supply Study | 2020 | 2016-2021 | $ 50,000 |
| | | W27 | Mt Edward Booster Fire Pump | 2019 | 2016-2021 | $ 50,000 |
| | | W29.3 | New Orchard Control Chamber | 2021 | 2021-2026 | $ 50,000 |
| | | W30.3 | Robie Emergency Booster | 2021 | 2021-2026 | $ 50,000 |
| | | W35 | Safe Yield Study | 2020 | 2016-2021 | $ 100,000 |
| | | W36 | New Hydraulic Water Model (InfoWater) | 2020 | 2016-2021 | $ 200,000 |
| | | W37 | Comprehensive PRV Study | 2019 | 2016-2021 | $ 50,000 |
| | | W38 | Transmission Main Risk Assessment and Prioritization Framework | 2020 | 2016-2021 | $ 50,000 |
| | | W39 | Tomahawk Lake Supply Study | 2036 | 2036-2041 | $ 50,000 |
| **Total Water Servicing Strategy Cost** | | | | | | **$ 284,706,000** |

# Appendix B – Compliance Plan Program

**Compliance Plan Program**

| Project Category | Project Name | Project Description | NPV Costing Year | Start Year | Planning Period | Total Capital Cost (2019$) | Total Life Cycle Cost | Life Cycle Cost (NPV) - 2019 |
|---|---|---|---|---|---|---|---|---|
| Halifax Wastewater Treatment Facility | Preliminary Treatment | Improved screening capture rates by replacing three (3) existing bar screens with newer technology | 2019 | 2021 | 2016-2021 | $1,950,000 | $1,950,000 | $1,950,000 |
| | Coagulant Dosing System | Replace existing Alum dosing pumps with PD pumps to match plant flows, includes pumps, valves and appurtenances | 2019 | 2020 | 2016-2021 | $135,000 | $135,000 | $135,000 |
| | Polymer Dosing System | Replace existing polymer dosing pumps with PD pumps to match plant flows, includes pumps, valves and appurtenances (4 duty, 1 standby) | 2019 | 2020 | 2016-2021 | $39,500 | $39,500 | $39,500 |
| | Hydraulic Balancing Improvements | CFD Analysis, flow division baffles, and implementation of flow monitoring devices to improve hydraulic flow distribution and loading to the Densadeg reactors | 2019 | 2019 | 2016-2021 | $395,000 | $608,300 | $539,784 |
| | Disinfection Upgrades | Add 9 additional UV models to per bank (8 banks, 72 total models), power distribution center and system control center (PLC) | 2019 | 2022 | 2022-2027 | $850,000 | $1,309,000 | $1,161,560 |
| | UV System Level Controls | Replace four (4) existing hydraulic level control weir gate with motorized weir gates with electrical actuators to ensure lamps remain submerged under all flow conditions | 2019 | 2022 | 2022-2027 | $385,000 | $592,900 | $526,118 |
| | Solids Handling | Improve dewatering to increase capacity | 2019 | 2021 | 2016-2021 | $935,000 | $1,439,900 | $1,277,715 |
| | Odour Control - Activated Carbon Reactors | Replacement of activated carbon canisters on dry scrubber | 2019 | 2020 | 2016-2021 | $275,000 | $275,000 | $275,000 |
| | Ballasted Flocculation Upgrades | Retrofit existing Densadeg system with ballasted floc treatment technology for optimal TSS and BOD removal efficiencies, replace tube settlers | 2029 | 2029 | 2026-2031 | $4,070,000 | $5,453,800 | $3,825,924 |
| | Upgrades to meet WSER | | | 2040 | | $160,750,000 | | |
| **Total Halifax WWTF Compliance Cost** | | | | | | **$169,784,500** | | **$9,730,601** |

| Project Category | Project Name | Project Description | NPV Costing Year | Start Year | Planning Period | Total Capital Cost (2019$) | Total Life Cycle Cost | Life Cycle Cost (NPV) - 2019 |
|---|---|---|---|---|---|---|---|---|
| Dartmouth Wastewater Treatment Facility | Preliminary Treatment | Improved screening capture rates by replacing three (3) existing bar screens with newer technology | 2019 | 2020 | 2016-2021 | $1,785,000 | $1,785,000 | $1,785,000 |
| | Coagulant Dosing System | Replace existing Alum dosing pumps with PD pumps to match plant flows, includes pumps, valves and appurtenances | 2019 | 2020 | 2016-2021 | $120,000 | $120,000 | $120,000 |
| | Polymer Dosing System | Replace existing polymer dosing pumps with PD pumps to match plant flows, includes pumps, valves and appurtenances (4 duty, 1 standby) | 2019 | 2020 | 2016-2021 | $25,000 | $25,000 | $25,000 |
| | Hydraulic Balancing Improvements | CFD Analysis, flow division baffles, and implementation of flow monitoring devices to improve hydraulic flow distribution and loading to the Densadeg reactors | 2019 | 2020 | 2016-2021 | $335,000 | $502,500 | $457,791 |
| | Disinfection Upgrades | Add 8 additional UV models to per bank (8 banks, 64 total models), power distribution center and system control center (PLC) | 2019 | 2021 | 2016-2021 | $775,000 | $1,162,500 | $1,059,069 |
| | UV System Level Controls | Replace four (4) existing hydraulic level control weir gate with motorized weir gates with electrical actuators to ensure lamps remain submerged under all flow conditions | 2019 | 2021 | 2016-2021 | $325,000 | $487,500 | $444,126 |
| | Solids Handling | Improve dewatering to increase capacity | 2023 | 2022 | 2021-2026 | $735,000 | $1,102,500 | $867,804 |
| | Ballasted Flocculation Upgrades | Retrofit existing Densadeg system with ballasted floc treatment technology for optimal TSS and BOD removal efficiencies, replace tube settlers | 2029 | 2029 | 2026-2031 | $3,800,000 | $5,700,000 | $3,572,116 |
| | Upgrades to meet WSER | | | 2038 | | $87,400,000 | | |
| **Total Dartmouth WWTF Compliance Cost** | | | | | | **$95,300,000** | | **$8,330,906** |

**Compliance Plan Program**

| Project Category | Project Name | Project Description | NPV Costing Year | Start Year | Planning Period | Total Capital Cost (2019$) | Total Life Cycle Cost | Life Cycle Cost (NPV) - 2019 |
|---|---|---|---|---|---|---|---|---|
| Herring Cove Wastewater Treatment Facility | Preliminary Treatment | Improved screening capture rates by replacing three (3) existing bar screens with newer technology | 2019 | 2022 | 2021-2026 | $1,020,000 | $1,020,000 | $1,059,035 |
| | UV System Level Controls | Replace four (4) existing hydraulic level control weir gate with motorized weir gates with electrical actuators to ensure lamps remain submerged under all flow conditions | 2019 | 2022 | 2021-2026 | $300,000 | $462,000 | $409,962 |
| | Odour Control - Activated Carbon Reactors | Replacement of 144 activated carbon canisters on dry scrubber | 2019 | 2020 | 2016-2021 | $165,000 | $165,000 | $225,479 |
| | Ballasted Flocculation Upgrades | Retrofit existing Densadeg system with ballasted floc treatment technology for optimal TSS and BOD removal efficiencies, replace tube settlers | 2023 | 2023 | 2021-2026 | $3,265,000 | $4,766,900 | $3,854,939 |
| | Upgrades to meet WSER | | | 2039 | | $38,200,000 | | |
| **Total Herring Cove WWTF Compliance Cost** | | | | | | **$42,950,000** | | **$5,549,415** |

| Project Category | Project Name | Project Description | NPV Costing Year | Start Year | Planning Period | Total Capital Cost (2019$) | Total Life Cycle Cost | Life Cycle Cost (NPV) - 2019 |
|---|---|---|---|---|---|---|---|---|
| Lakeside-Timberlea Wastewater Treatment Facility | Improve Plant Hydraulics | Flow splitter box to allow for equal flow distribution and increased alum dosing for TP reduction | 2019 | 2020 | 2016-2021 | $25,000 | $38,500 | $34,164 |
| **Total Lakeside-Timberlea WWTF Compliance Cost** | | | | | | **$25,000** | | **$34,164** |

| Project Category | Project Name | Project Description | NPV Costing Year | Start Year | Planning Period | Total Capital Cost (2019$) | Total Life Cycle Cost | Life Cycle Cost (NPV) - 2019 |
|---|---|---|---|---|---|---|---|---|
| Mill Cove Wastewater Treatment Facility | Mill Cove Wastewater Treatment Plant Capacity Upgrade | WWTF Upgrade | 2019 | 2020 | 2016-2021 | $70,000,000 | $107,800,000 | $95,657,844 |
| **Total Mill Cove WWTF Compliance Cost** | | | | | | **$70,000,000** | | **$95,657,844** |

| Project Category | Project Name | Project Description | NPV Costing Year | Start Year | Planning Period | Total Capital Cost (2019$) | Total Life Cycle Cost | Life Cycle Cost (NPV) - 2019 |
|---|---|---|---|---|---|---|---|---|
| Corporate Programs | Wet Weather Management Program | Wet weather Management program - Annual cost of $250,000 | NA | 2020 | 2020-2048 | $7,250,000 | | |
| | I&I Reduction Program | Capital Costs related to the purchase of equipement (flow monitors, etc.) for the private side I&I Reduction Program | | 2019 | 2019-2048 | $750,000 | | |
| | Corporate Flow Monitoring Program | Annual cost for program | | 2019 | 2019-2048 | $51,060,000 | | |
| | Bio-Solids Facility Upgrades | Bio-Solids Facility Upgrades | | 2023 | | $10,000,000 | | |
| **Total Corportate Programs Compliance Cost** | | | | | | **$69,060,000** | | **$0** |

| Project Category | Project Name | Project Description | NPV Costing Year | Start Year | Planning Period | Total Capital Cost (2019$) | Total Life Cycle Cost | Life Cycle Cost (NPV) - 2019 |
|---|---|---|---|---|---|---|---|---|
| | Armdale CSO Screening | | 2025 | 2025 | 2021-2026 | $3,000,000 | | |
| | Quinpool Road CSO Screening | | 2025 | 2025 | 2021-2026 | $3,000,000 | | |
| | Coburg Road CSO Screening | | 2025 | 2025 | 2021-2026 | $3,000,000 | | |
| | South Street CSO Screening | | 2025 | 2025 | 2021-2026 | $3,000,000 | | |
| | Beaufort CSO Screening | | 2025 | 2025 | 2021-2026 | $3,000,000 | | |
| | Future Overflow Program | | | 2042 | | $198,889,474 | | |
| **Total Collection System Compliance Cost** | | | | | | **$213,889,474** | | |

Water

| Project Category | Project Name | Project Description | NPV Costing Year | Start Year | Planning Period | Total Capital Cost (2019$) | Total Life Cycle Cost | Life Cycle Cost (NPV) - 2019 |
|---|---|---|---|---|---|---|---|---|
| General | Watershed Land Acquistion | Annual program of $100K per year | | 2020 | 2019-2048 | $3,000,000 | | |
| | Automated Flushing Program | Annual program $20K per year | | 2020 | 2020-2048 | $580,000 | | |
| JD Kline | JD Kline WSP – Phase 1 | | | 2025 | | $32,660,000 | | |
| | JD Kline WSP – Phase 2 | | | 2025 | | $25,440,000 | | |
| Lake Major WSP | Lake Major WSP – Phase 1 | | | | | $31,163,000 | | |
| | Lake Major WSP – Phase 2 | | | | | $16,960,000 | | |
| **Total Water System Compliance Cost** | | | | | | **$109,803,000** | | |

# Appendix C – Asset Management Plan Program

## Halifax Water 2018/2019 AMPs

**A1 Water Supply Plants**

| Year | Planned Expenditure | |
|---|---|---|
| 2019 | $7,211 | $7.21 |
| 2020 | $7,554 | $7.55 |
| 2021 | $15,682 | $15.68 |
| 2022 | $59,033 | $59.03 |
| 2023 | $38,625 | $38.63 |
| 2024 | $6,483 | $6.48 |
| 2025 | $6,483 | $6.48 |
| 2026 | $6,483 | $6.48 |
| 2027 | $6,483 | $6.48 |
| 2028 | $6,483 | $6.48 |
| 2029 | $11,483 | $11.48 |
| 2030 | $11,483 | $11.48 |
| 2031 | $6,483 | $6.48 |
| 2032 | $6,483 | $6.48 |
| 2033 | $6,483 | $6.48 |
| 2034 | $6,483 | $6.48 |
| 2035 | $6,483 | $6.48 |
| 2036 | $6,483 | $6.48 |
| 2037 | $6,483 | $6.48 |
| 2038 | $8,483 | $8.48 |
| 2039 | $8,483 | $8.48 |
| 2040 | $8,483 | $8.48 |
| 2041 | $8,483 | $8.48 |
| 2042 | $8,483 | $8.48 |
| 2043 | $6,483 | $6.48 |
| 2044 | $6,483 | $6.48 |
| 2045 | $6,483 | $6.48 |
| 2046 | $6,483 | $6.48 |
| 2047 | $6,483 | $6.48 |
| 2048 | $6,483 | $6.48 |
| **Total** | **$310,180** | **$310** |
| 30-Year Average | | $10.3 |

**A2 Water Supply Dams**

| Year | Planned Expenditure | |
|---|---|---|
| 2019 | $420,000 | $0.42 |
| 2020 | $725,000 | $0.73 |
| 2021 | $0 | $0.00 |
| 2022 | $0 | $0.00 |
| 2023 | $0 | $0.00 |
| 2024 | $3,000,000 | $3.00 |
| 2025 | $0 | $0.00 |
| 2026 | $300,000 | $0.30 |
| 2027 | $1,000,000 | $1.00 |
| 2028 | $0 | $0.00 |
| 2029 | $0 | $0.00 |
| 2030 | $0 | $0.00 |
| 2031 | $0 | $0.00 |
| 2032 | $0 | $0.00 |
| 2033 | $300,000 | $0.30 |
| 2034 | $1,000,000 | $1.00 |
| 2035 | $0 | $0.00 |
| 2036 | $0 | $0.00 |
| 2037 | $0 | $0.00 |
| 2038 | $0 | $0.00 |
| 2039 | $0 | $0.00 |
| 2040 | $300,000 | $0.30 |
| 2041 | $0 | $0.00 |
| 2042 | $1,000,000 | $1.00 |
| 2043 | $0 | $0.00 |
| 2044 | $0 | $0.00 |
| 2045 | $0 | $0.00 |
| 2046 | $0 | $0.00 |
| 2047 | $300,000 | $0.30 |
| 2048 | $0 | $0.00 |
| **Total** | **$8,345,000** | **$8** |
| 30-Year | $278,166.7 | $0.3 |

## Halifax Water 2018/2019 AMPs

### A3 Water Chambers and Booster Stations

| Year | Planned Expenditure | |
|---|---|---|
| 2019 | $971,526 | $0.97 |
| 2020 | $680,000 | $0.68 |
| 2021 | $1,056,006 | $1.06 |
| 2022 | $1,816,330 | $1.82 |
| 2023 | $680,000 | $0.68 |
| 2024 | $1,056,006 | $1.06 |
| 2025 | $680,000 | $0.68 |
| 2026 | $680,000 | $0.68 |
| 2027 | $2,808,976 | $2.81 |
| 2028 | $1,562,889 | $1.56 |
| 2029 | $680,000 | $0.68 |
| 2030 | $680,000 | $0.68 |
| 2031 | $680,000 | $0.68 |
| 2032 | $680,000 | $0.68 |
| 2033 | $680,000 | $0.68 |
| 2034 | $680,000 | $0.68 |
| 2035 | $680,000 | $0.68 |
| 2036 | $680,000 | $0.68 |
| 2037 | $1,900,811 | $1.90 |
| 2038 | $680,000 | $0.68 |
| 2039 | $1,056,006 | $1.06 |
| 2040 | $680,000 | $0.68 |
| 2041 | $680,000 | $0.68 |
| 2042 | $680,000 | $0.68 |
| 2043 | $680,000 | $0.68 |
| 2044 | $680,000 | $0.68 |
| 2045 | $680,000 | $0.68 |
| 2046 | $1,763,530 | $1.76 |
| 2047 | $680,000 | $0.68 |
| 2048 | $680,000 | $0.68 |
| **Total** | **$28,272,080** | **$28** |
| 30-Year Average | $942,402.7 | $0.9 |

### A4 Water Transmission Mains

| Year | Planned Expenditure | |
|---|---|---|
| 2019 | $3,158,412 | $3.16 |
| 2020 | $2,195,809 | $2.20 |
| 2021 | $3,700,733 | $3.70 |
| 2022 | $578,572 | $0.58 |
| 2023 | $1,233,573 | $1.23 |
| 2024 | $888,995 | $0.89 |
| 2025 | $2,914,110 | $2.91 |
| 2026 | $1,438,971 | $1.44 |
| 2027 | $14,499,962 | $14.50 |
| 2028 | $2,818,305 | $2.82 |
| 2029 | $6,390,313 | $6.39 |
| 2030 | $17,452,387 | $17.45 |
| 2031 | $8,989,294 | $8.99 |
| 2032 | $41,620,036 | $41.62 |
| 2033 | $9,093,502 | $9.09 |
| 2034 | $3,724,250 | $3.72 |
| 2035 | $45,778,540 | $45.78 |
| 2036 | $5,035,175 | $5.04 |
| 2037 | $19,536,934 | $19.54 |
| 2038 | $1,595,668 | $1.60 |
| 2039 | $5,803,733 | $5.80 |
| 2040 | $16,656,700 | $16.66 |
| 2041 | $6,867,538 | $6.87 |
| 2042 | $7,859,107 | $7.86 |
| 2043 | $7,196,873 | $7.20 |
| 2044 | $7,439,048 | $7.44 |
| 2045 | $7,657,123 | $7.66 |
| 2046 | $10,748,340 | $10.75 |
| 2047 | $4,911,723 | $4.91 |
| 2048 | $4,617,192 | $4.62 |
| **Total** | **$272,400,917** | **$272** |
| 30-Year Average | $9,080,030.6 | $9.1 |

## Halifax Water 2018/2019 AMPs

**A5 Water Distribution Mains**

| Year | Planned Expenditure | |
|---|---|---|
| 2019 | $9,339,533 | $9.34 |
| 2020 | $2,263,652 | $2.26 |
| 2021 | $8,950,247 | $8.95 |
| 2022 | $7,165,140 | $7.17 |
| 2023 | $6,279,950 | $6.28 |
| 2024 | $2,319,408 | $2.32 |
| 2025 | $2,077,175 | $2.08 |
| 2026 | $8,007,113 | $8.01 |
| 2027 | $6,931,906 | $6.93 |
| 2028 | $6,637,547 | $6.64 |
| 2029 | $9,615,798 | $9.62 |
| 2030 | $7,657,841 | $7.66 |
| 2031 | $5,955,757 | $5.96 |
| 2032 | $4,938,520 | $4.94 |
| 2033 | $7,585,205 | $7.59 |
| 2034 | $8,720,320 | $8.72 |
| 2035 | $8,122,103 | $8.12 |
| 2036 | $17,236,887 | $17.24 |
| 2037 | $9,774,710 | $9.77 |
| 2038 | $15,538,535 | $15.54 |
| 2039 | $13,167,851 | $13.17 |
| 2040 | $14,636,149 | $14.64 |
| 2041 | $11,121,269 | $11.12 |
| 2042 | $10,280,888 | $10.28 |
| 2043 | $13,675,211 | $13.68 |
| 2044 | $17,135,886 | $17.14 |
| 2045 | $18,061,416 | $18.06 |
| 2046 | $30,307,174 | $30.31 |
| 2047 | $15,612,285 | $15.61 |
| 2048 | $8,475,887 | $8.48 |
| **Total** | **$307,591,367** | **$308** |
| 30-Year Average | $10,253,045.6 | $10.3 |

**A6 Water Reservoirs**

| Year | Planned Expenditure | |
|---|---|---|
| 2019 | $0 | $0.00 |
| 2020 | $0 | $0.00 |
| 2021 | $2,703,375 | $2.70 |
| 2022 | $7,146,015 | $7.15 |
| 2023 | $2,112,012 | $2.11 |
| 2024 | $2,615,566 | $2.62 |
| 2025 | $1,879,478 | $1.88 |
| 2026 | $1,584,009 | $1.58 |
| 2027 | $0 | $0.00 |
| 2028 | $1,584,009 | $1.58 |
| 2029 | $0 | $0.00 |
| 2030 | $2,061,032 | $2.06 |
| 2031 | $1,015,555 | $1.02 |
| 2032 | $0 | $0.00 |
| 2033 | $1,814,874 | $1.81 |
| 2034 | $0 | $0.00 |
| 2035 | $1,584,009 | $1.58 |
| 2036 | $0 | $0.00 |
| 2037 | $0 | $0.00 |
| 2038 | $0 | $0.00 |
| 2039 | $1,421,503 | $1.42 |
| 2040 | $0 | $0.00 |
| 2041 | $2,112,012 | $2.11 |
| 2042 | $0 | $0.00 |
| 2043 | $0 | $0.00 |
| 2044 | $0 | $0.00 |
| 2045 | $0 | $0.00 |
| 2046 | $2,615,566 | $2.62 |
| 2047 | $0 | $0.00 |
| 2048 | $0 | $0.00 |
| **Total** | **$32,249,015** | **$32** |
| 30-Year Average | $1,074,967.2 | $1.1 |

## Halifax Water 2018/2019 AMPs

**B1 Wastewater Treatment Facilities**

| Year | Planned Expenditure | |
|---|---|---|
| 2019 | $3,245,000 | $3.25 |
| 2020 | $5,300,000 | $5.30 |
| 2021 | $5,125,000 | $5.13 |
| 2022 | $3,730,000 | $3.73 |
| 2023 | $3,415,000 | $3.42 |
| 2024 | $7,252,981 | $7.25 |
| 2025 | $3,828,889 | $3.83 |
| 2026 | $4,768,599 | $4.77 |
| 2027 | $6,260,084 | $6.26 |
| 2028 | $5,352,447 | $5.35 |
| 2029 | $25,458,640 | $25.46 |
| 2030 | $23,887,870 | $23.89 |
| 2031 | $42,461,251 | $42.46 |
| 2032 | $21,252,760 | $21.25 |
| 2033 | $24,073,154 | $24.07 |
| 2034 | $13,619,813 | $13.62 |
| 2035 | $10,214,913 | $10.21 |
| 2036 | $33,209,862 | $33.21 |
| 2037 | $14,776,389 | $14.78 |
| 2038 | $29,710,471 | $29.71 |
| 2039 | $1,430,073 | $1.43 |
| 2040 | $6,815,963 | $6.82 |
| 2041 | $11,755,859 | $11.76 |
| 2042 | $23,658,867 | $23.66 |
| 2043 | $6,851,578 | $6.85 |
| 2044 | $5,806,788 | $5.81 |
| 2045 | $13,202,394 | $13.20 |
| 2046 | $13,202,394 | $13.20 |
| 2047 | $13,202,394 | $13.20 |
| 2048 | $13,202,394 | $13.20 |
| **Total** | **$396,071,828** | **$396** |
| 30-Year Average | $13,202,394.3 | $13.2 |

**B2 Wastewater Pumping Stations**

| Year | Planned Expenditure | |
|---|---|---|
| 2019 | $1,475,000 | $1.48 |
| 2020 | $7,230,000 | $7.23 |
| 2021 | $9,550,000 | $9.55 |
| 2022 | $12,390,000 | $12.39 |
| 2023 | $10,150,000 | $10.15 |
| 2024 | $27,588,744 | $27.59 |
| 2025 | $3,387,113 | $3.39 |
| 2026 | $4,644,683 | $4.64 |
| 2027 | $1,663,669 | $1.66 |
| 2028 | $20,209,244 | $20.21 |
| 2029 | $7,711,131 | $7.71 |
| 2030 | $35,941,502 | $35.94 |
| 2031 | $11,645,360 | $11.65 |
| 2032 | $33,865,684 | $33.87 |
| 2033 | $16,138,756 | $16.14 |
| 2034 | $5,573,572 | $5.57 |
| 2035 | $4,409,507 | $4.41 |
| 2036 | $8,933,333 | $8.93 |
| 2037 | $4,918,501 | $4.92 |
| 2038 | $3,784,214 | $3.78 |
| 2039 | $15,680,210 | $15.68 |
| 2040 | $53,059,590 | $53.06 |
| 2041 | $9,734,411 | $9.73 |
| 2042 | $6,377,050 | $6.38 |
| 2043 | $3,252,683 | $3.25 |
| 2044 | $1,938,986 | $1.94 |
| 2045 | $4,582,932 | $4.58 |
| 2046 | $9,513,268 | $9.51 |
| 2047 | $11,970,205 | $11.97 |
| 2048 | $596,216 | $0.60 |
| **Total** | **$347,915,562** | **$348** |
| 30-Year Average | $11,597,185.4 | $11.6 |

## Halifax Water 2018/2019 AMPs

**B3 Wastewater Gravity Sewers**

| Year | Planned Expenditure | |
|---|---|---|
| 2019 | $4,073,232 | $4.07 |
| 2020 | $4,073,232 | $4.07 |
| 2021 | $4,073,232 | $4.07 |
| 2022 | $4,073,232 | $4.07 |
| 2023 | $4,073,232 | $4.07 |
| 2024 | $4,073,232 | $4.07 |
| 2025 | $4,073,232 | $4.07 |
| 2026 | $4,073,232 | $4.07 |
| 2027 | $4,073,232 | $4.07 |
| 2028 | $4,073,232 | $4.07 |
| 2029 | $8,309,589 | $8.31 |
| 2030 | $8,309,589 | $8.31 |
| 2031 | $8,309,589 | $8.31 |
| 2032 | $8,309,589 | $8.31 |
| 2033 | $8,309,589 | $8.31 |
| 2034 | $8,309,589 | $8.31 |
| 2035 | $8,309,589 | $8.31 |
| 2036 | $8,309,589 | $8.31 |
| 2037 | $8,309,589 | $8.31 |
| 2038 | $8,309,589 | $8.31 |
| 2039 | $4,203,226 | $4.20 |
| 2040 | $4,203,226 | $4.20 |
| 2041 | $4,203,226 | $4.20 |
| 2042 | $4,203,226 | $4.20 |
| 2043 | $4,203,226 | $4.20 |
| 2044 | $4,203,226 | $4.20 |
| 2045 | $4,203,226 | $4.20 |
| 2046 | $4,203,226 | $4.20 |
| 2047 | $4,203,226 | $4.20 |
| 2048 | $4,203,226 | $4.20 |
| **Total** | **$165,860,471** | **$166** |
| 30-Year Average | $5,528,682.4 | $5.5 |

**B4 Wastewater Forcemains**

| Year | Planned Expenditure | |
|---|---|---|
| 2019 | $4,580,806 | $4.58 |
| 2020 | $2,120,072 | $2.12 |
| 2021 | $0 | $0.00 |
| 2022 | $0 | $0.00 |
| 2023 | $2,654,954 | $2.65 |
| 2024 | $480,588 | $0.48 |
| 2025 | $1,019,438 | $1.02 |
| 2026 | $2,120,072 | $2.12 |
| 2027 | $0 | $0.00 |
| 2028 | $0 | $0.00 |
| 2029 | $2,389,950 | $2.39 |
| 2030 | $650,182 | $0.65 |
| 2031 | $147,729 | $0.15 |
| 2032 | $2,626,163 | $2.63 |
| 2033 | $705,967 | $0.71 |
| 2034 | $8,682,673 | $8.68 |
| 2035 | $581,010 | $0.58 |
| 2036 | $0 | $0.00 |
| 2037 | $4,771,410 | $4.77 |
| 2038 | $174,320 | $0.17 |
| 2039 | $0 | $0.00 |
| 2040 | $0 | $0.00 |
| 2041 | $1,693,929 | $1.69 |
| 2042 | $180,201 | $0.18 |
| 2043 | $814,014 | $0.81 |
| 2044 | $4,757,793 | $4.76 |
| 2045 | $1,956,197 | $1.96 |
| 2046 | $1,768,911 | $1.77 |
| 2047 | $72,249 | $0.07 |
| 2048 | $3,190,451 | $3.19 |
| **Total** | **$48,139,079** | **$48** |
| 30-Year Average | $1,604,636.0 | $1.6 |

## Halifax Water 2018/2019 AMPs

**C1 Stormwater Management Structures**

| Year | Planned Expenditure | |
|---|---|---|
| 2019 | $4,350,137 | $4.35 |
| 2020 | $2,615,289 | $2.62 |
| 2021 | $0 | $0.00 |
| 2022 | $2,000,000 | $2.00 |
| 2023 | $1,090,289 | $1.09 |
| 2024 | $0 | $0.00 |
| 2025 | $0 | $0.00 |
| 2026 | $0 | $0.00 |
| 2027 | $0 | $0.00 |
| 2028 | $0 | $0.00 |
| 2029 | $0 | $0.00 |
| 2030 | $0 | $0.00 |
| 2031 | $0 | $0.00 |
| 2032 | $0 | $0.00 |
| 2033 | $66,528 | $0.07 |
| 2034 | $0 | $0.00 |
| 2035 | $0 | $0.00 |
| 2036 | $0 | $0.00 |
| 2037 | $0 | $0.00 |
| 2038 | $0 | $0.00 |
| 2039 | $0 | $0.00 |
| 2040 | $0 | $0.00 |
| 2041 | $0 | $0.00 |
| 2042 | $0 | $0.00 |
| 2043 | $0 | $0.00 |
| 2044 | $0 | $0.00 |
| 2045 | $0 | $0.00 |
| 2046 | $0 | $0.00 |
| 2047 | $0 | $0.00 |
| 2048 | $416,160 | $0.42 |
| **Total** | **$10,538,402** | **$11** |
| 30-Year Average | $351,280.1 | $0.4 |

**C2 Stormwater Gravity Sewers**

| Year | Planned Expenditure | |
|---|---|---|
| 2019 | $1,351,339 | $1.35 |
| 2020 | $1,158,911 | $1.16 |
| 2021 | $1,152,335 | $1.15 |
| 2022 | $1,596,322 | $1.60 |
| 2023 | $1,423,623 | $1.42 |
| 2024 | $1,152,335 | $1.15 |
| 2025 | $1,152,335 | $1.15 |
| 2026 | $1,152,335 | $1.15 |
| 2027 | $1,152,335 | $1.15 |
| 2028 | $1,152,335 | $1.15 |
| 2029 | $8,188,156 | $8.19 |
| 2030 | $8,135,100 | $8.14 |
| 2031 | $7,957,884 | $7.96 |
| 2032 | $8,736,299 | $8.74 |
| 2033 | $7,957,884 | $7.96 |
| 2034 | $8,031,699 | $8.03 |
| 2035 | $8,594,173 | $8.59 |
| 2036 | $9,226,997 | $9.23 |
| 2037 | $12,912,742 | $12.91 |
| 2038 | $8,388,758 | $8.39 |
| 2039 | $3,717,607 | $3.72 |
| 2040 | $7,916,953 | $7.92 |
| 2041 | $9,694,251 | $9.69 |
| 2042 | $6,732,501 | $6.73 |
| 2043 | $7,838,269 | $7.84 |
| 2044 | $15,460,984 | $15.46 |
| 2045 | $2,545,595 | $2.55 |
| 2046 | $2,545,595 | $2.55 |
| 2047 | $2,545,595 | $2.55 |
| 2048 | $2,545,595 | $2.55 |
| **Total** | **$162,116,838** | **$162** |
| 30-Year Average | $5,403,894.6 | $5.4 |

**Halifax Water 2018/2019 AMPs**

**C3 Stormwater Cross Culverts**

| Year | Planned Expenditure | |
|---|---|---|
| 2019 | $1,000,000 | $1.00 |
| 2020 | $1,800,000 | $1.80 |
| 2021 | $2,100,000 | $2.10 |
| 2022 | $2,100,000 | $2.10 |
| 2023 | $2,100,000 | $2.10 |
| 2024 | $0 | $0.00 |
| 2025 | $0 | $0.00 |
| 2026 | $0 | $0.00 |
| 2027 | $2,600,000 | $2.60 |
| 2028 | $4,100,000 | $4.10 |
| 2029 | $100,000 | $0.10 |
| 2030 | $100,000 | $0.10 |
| 2031 | $300,000 | $0.30 |
| 2032 | $0 | $0.00 |
| 2033 | $0 | $0.00 |
| 2034 | $100,000 | $0.10 |
| 2035 | $5,000,000 | $5.00 |
| 2036 | $9,500,000 | $9.50 |
| 2037 | $0 | $0.00 |
| 2038 | $9,200,000 | $9.20 |
| 2039 | $2,000,000 | $2.00 |
| 2040 | $0 | $0.00 |
| 2041 | $1,900,000 | $1.90 |
| 2042 | $0 | $0.00 |
| 2043 | $4,300,000 | $4.30 |
| 2044 | $0 | $0.00 |
| 2045 | $9,200,000 | $9.20 |
| 2046 | $0 | $0.00 |
| 2047 | $7,800,000 | $7.80 |
| 2048 | $0 | $0.00 |
| **Total** | **$65,300,000** | **$65** |
| 30-Year Average | $2,176,666.7 | $2.2 |

**C3 Driveway Culverts**

| Year | Planned Expenditure | |
|---|---|---|
| 2019 | $850,000 | $0.85 |
| 2020 | $850,000 | $0.85 |
| 2021 | $850,000 | $0.85 |
| 2022 | $850,000 | $0.85 |
| 2023 | $850,000 | $0.85 |
| 2024 | $850,000 | $0.85 |
| 2025 | $850,000 | $0.85 |
| 2026 | $850,000 | $0.85 |
| 2027 | $850,000 | $0.85 |
| 2028 | $850,000 | $0.85 |
| 2029 | $850,000 | $0.85 |
| 2030 | $850,000 | $0.85 |
| 2031 | $850,000 | $0.85 |
| 2032 | $850,000 | $0.85 |
| 2033 | $850,000 | $0.85 |
| 2034 | $850,000 | $0.85 |
| 2035 | $850,000 | $0.85 |
| 2036 | $850,000 | $0.85 |
| 2037 | $850,000 | $0.85 |
| 2038 | $850,000 | $0.85 |
| 2039 | $850,000 | $0.85 |
| 2040 | $850,000 | $0.85 |
| 2041 | $850,000 | $0.85 |
| 2042 | $850,000 | $0.85 |
| 2043 | $850,000 | $0.85 |
| 2044 | $850,000 | $0.85 |
| 2045 | $850,000 | $0.85 |
| 2046 | $850,000 | $0.85 |
| 2047 | $850,000 | $0.85 |
| 2048 | $850,000 | $0.85 |
| **Total** | **$25,500,000** | **$26** |
| 30-Year Average | $850,000.0 | $0.9 |

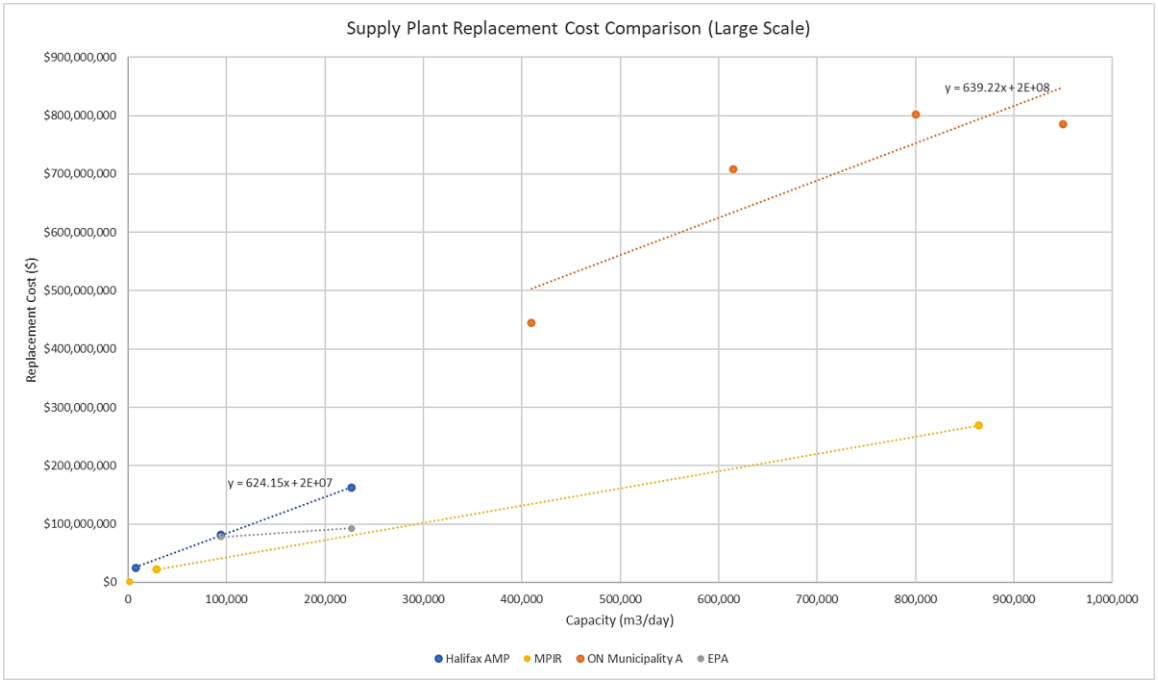
# Appendix D – AMPs Expenditure Needs Analysis

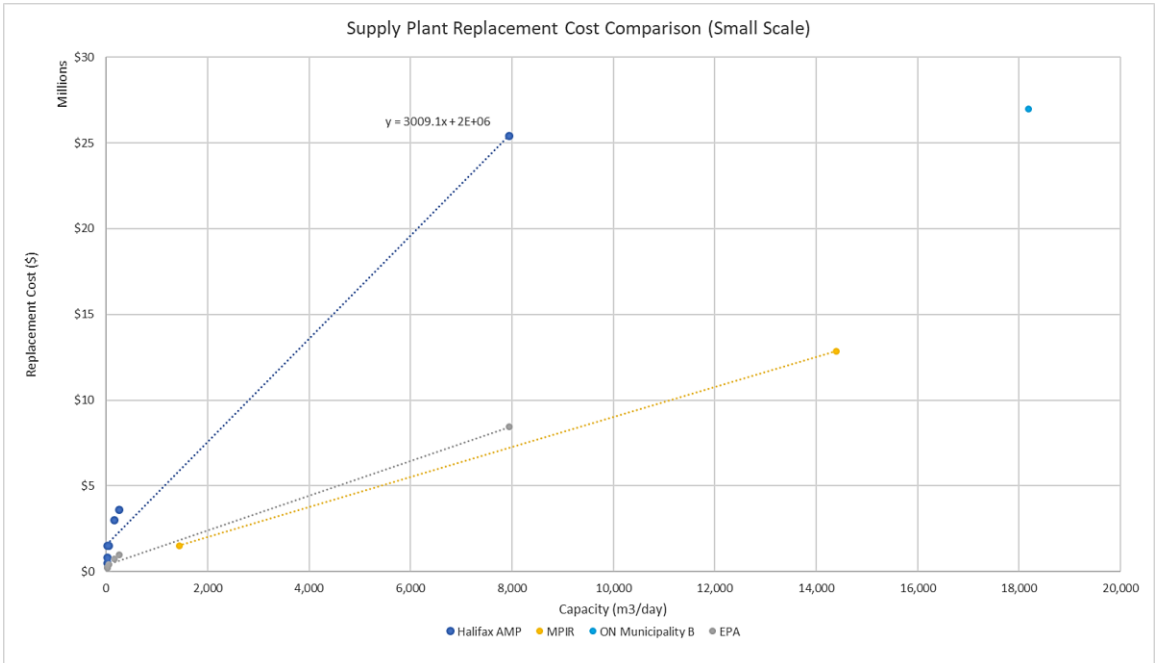
## Appendix D - AMPs Expenditure Needs Analysis

| Asset Level 1 (Asset Group) | Asset Level 2 (Asset Class) | Asset Level 3 (Facilty or Object) | Asset Level 4 (Process Area) | Asset Level 5 (Component) | SOGR Need (Annual Expenditure $Ms) | Time Period for SOGR Need (Referenced in Column F) | AMP Inlcudes | Granularity | Year Orientated? | GIS Compatible? | AMP Replacement Cost Source | Condition Source |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Water | Supply Plant | - 11 Facilities | | | $ 11.20 | Over 30 years | - Design capacity and replacement cost<br>- 30-year average CAPEX<br>- 5-year detailed CAPEX<br>- Maintenance Activity Plan (summary)<br>- 5-year History of OPEX | Condition and replacement values are to the facility level, capital plan is sometimes to the process area level | Yes | GIS compatible, there is a facilities location map according to the facility name | Staff opinion based off of $2015 replacement cost and insurance valuation | Staff knowledge |
| Water | Supply Dam | - 6 Facilities | - Dam, spillway, etc. | | $ 0.19 | Over 30 years | - Design capacity and replacement cost<br>- 30-year CAPEX plan<br>- 5-year detailed CAPEX<br>- Maintenance Activity Plan<br>- 5-year History of OPEX | Condition and replacement values are to the facility level | Yes | There is facility location name however, there is not GIS ID/information | Taken from 2016 AMP (which were taken from 2013 report provided by MECO) | Condition assessment are judgement from Engineering and AM team, using informatin in the 2012 Dam Safety Review |
| Water | Booster Station | - 20 Facilities | | | $ 0.18 | Over 30 years | - 100-year average CAPEX<br>- 30-year average CAPEX<br>- 5-year detailed CAPEX<br>- 5-year History of OPEX | Replacement costs are to the facility level | Yes | Yes, Object ID (GIS) available per facility | Adjusted based off of insurance valuation | - Age/Estimated Service Life (ESL) used for condition<br>- Capital projections based on operations/engineering judgement |
| Water | Reservoir | - 16 Facilities | | | $ 1.00 | Over 30 years | - 100-year average CAPEX<br>- 30-year average CAPEX<br>- 5-year detailed CAPEX<br>- 5-year History of OPEX | Condition and replacement values are to the facility level | Yes | GIS compatible, there is a facilities location map with the facility name | - AECOM provided replacement values during the condition assessment, however HW identified that they were low and were contractor costs only and would stick to their costs.<br>- The replacement values consider both replacement and rehabilitation where appropriate. The reservoirs with the condition data have detailed information, the remaining assets' expenditure needs were determined based off of the 2016 AMP | - Half of the assets have condition data (2017 AECOM report), the rest are estimated by age/ESL |
| Water | Chambers | - 13 Control Chambers<br>- 29 Meter Chambers<br>- 85 PRV Chambers<br>- 11 Reservoir Chamers<br>- 4 Valve Chambers | | | $ 0.34 | Over 30 years | - 100-year average CAPEX<br>- 30-year average CAPEX<br>- 5-year detailed CAPEX<br>- Maintenance Activity Plan<br>- 5-year History of OPEX | Replacement costs are to the facility level | Yes | Yes, Object ID (GIS) available per facility | Adjusted based off of insurance valuation | - Age/Estimated Service Life (ESL) used for condition<br>- Capital projections based on operations/engineering judgement |
| Water | Transmission Main | - 1821 Pipe Segments (296km in length) | - Linear | Diameter | $ 6.60 | Over 30 years | - 100-year average CAPEX<br>- 30-year average CAPEX<br>- 5-year detailed CAPEX<br>- Maintenance Activity Plan<br>- 5-year History of OPEX | Replacement costs are to pipe cohorts | Yes | Yes, Object ID and limits available for each transmission main | Unit Costs taken from 2012 IRP App. C Table 3.1 Transmission and Distribution mains and added up to 2015-2016 Stats Can prices for 2017 AMP | Age/ESL |
| Water | Distribution Main | - 10,666 Pipe Segments (1,216km in length) | - Linear | Diameter | $ 12.00 | Over 30 years | - 100-year average CAPEX<br>- 30-year average CAPEX<br>- 5-year detailed CAPEX<br>- Maintenance Activity Plan<br>- 5-year History of OPEX | Replacement costs are to pipe cohorts | Yes | Yes, Object ID available for each distribution main | Unit Costs taken from 2012 IRP App. C Table 3.1 Transmission and Distribution mains and added up to 2015-2016 Stats Can prices for 2017 AMP | Age/ESL |
| Wastewater | Treatment Facility | - 14 Facilities | - Civil<br>- Mechanical<br>- Electrical<br>- Instrumental | Pump, valve, gate, tanks, etc. | $ 12.50 | Over 30 years | - 30-year average CAPEX<br>- 5-year detailed CAPEX<br>- Maintenance Activity Plan<br>- 5-year History of OPEX | Condition and replacement values are to the component level | Yes | Yes | - Based of IRP 2012 and 2016 AMP | Condition established by staff disscusions |
| Wastewater | Pumping Station | 166 Facilities | - Civil<br>- Mechanical<br>- Electrical<br>- Instrumental | Pump, valve, panel, etc. | $ 12.50 | Over 30 years | - 30-year average CAPEX<br>- 5-year detailed CAPEX<br>- Maintenance Activity Plan<br>- 5-year History of OPEX | Condition and replacement costs are to the process area level | Yes | Yes, it shows GIS data (ID, address, region,etc) in AMP B2 spreadsheet | The pump station aceess database | Conditions established by staff knowledge and collected at sites |
| Wastewater | Gravity Sewer | - 24,825 Pipe Segments (1271km in length)<br>- Also broken down by wastewater and combined | - Linear | Diameter | $ 4.90 | Over 30 years | - 100-year average CAPEX<br>- 30-year average CAPEX<br>- 5-year detailed CAPEX<br>- Maintenance Activity Plan<br>- 5-year History of OPEX | Replacement costs are to component level | Yes | Yes | Based on Unit Costs with larger scale from 2012 IRP | Age/ESL |
| Wastewater | Force Main | - 483 Pipe Segments (126km in length) | - Linear | Diameter | $ 4.00 | Over 30 years | - 50-year average CAPEX<br>- 30-year average CAPEX<br>- 5-year detailed CAPEX<br>- Maintenance Activity Plan<br>- 5-year History of OPEX | Replacement costs are to component level | Yes | Yes, Object ID and Pipe ID) in AMP B4 spreadsheet | Unit Costs initially from IRP 2012 | Age/ESL |
| Stormwater | Management Structure | - 50 Facilities | - Inlet<br>- Outlet<br>- Fence<br>- Bank Stabilization, wall, berm<br>- Accessibility | | $ 0.02 | Over 30 years | - 70-year average CAPEX<br>- 30-year average CAPEX<br>- 5-year detailed CAPEX<br>- Maintenance Activity Plan | Replacement costs are to the facility level | Yes | Yes, it has GIS ObjectID per facility/structure | - Rehabiliation costs<br>- Data taken from 2016 AMP Unit Costs | Age/ESL used for condition |
| Stormwater | Gravity Sewer | - 44,757 Pipe Segments (1,155km in length) | - Linear | Diameter | $ 7.00 | Over 30 years | - 100-year average CAPEX<br>- 30-year average CAPEX<br>- 5-year detailed CAPEX<br>- Maintenance Activity Plan<br>- 5-year History of OPEX | Replacement costs are to component level | Yes | Yes, it shows ObjectID, in AMP C2 spreadsheet | - Replacement Costs by condition grade<br>- Data taken from 2016 AMP | Age/ESL, starting to collect condition data from cctv |
| Stormwater | Cross Culvert | - 2432 Pipe Segments | - Linear | Diameter | $ 2.20 | Over 30 years | - 30-year average CAPEX<br>- 5-year CAPEX program<br>- 5-year History of OPEX | Replacement costs are to the component level | Yes | Yes, there is Pipe ID (have to cofirm if there are shape_files) | Unit Costs taken from 2016 AMP | Condition from on site visual inspection |
| Stormwater | Ditches | | | | $ - | Replaced when needed | - Maintenance Activity Plan<br>- 5-year History of OPEX | | No | There is missing ditch data in GIS (38% missing) | Case by case/ replaced when needed | Annual inspection program identifies assets to treat |
| Stormwater | Driveway Culvert | - 18,000 Culverts | - Linear | Diameter | $ 0.72 | Over 5 years | - Replacement Plan<br>- 5-year detailed CAPEX<br>- Maintenance Activity Plan<br>- 5-year History of OPEX | Funds are budgetted to the program and not specific assets. But there is asset data that could be made into a plan. | No | Yes, there is limited and incomplete Driveway Culvert GIS inventory (have to cofirm if there are shape_files) | Based on unit rate $3,500 provided by Wastewater and Stormwater Services | - Sample of inspections used<br>- 100 driveway culvert replacements per year. The expenditure need could be significantly higher |
| **Total** | | | | | **$ 75.354** | | | | | | | |

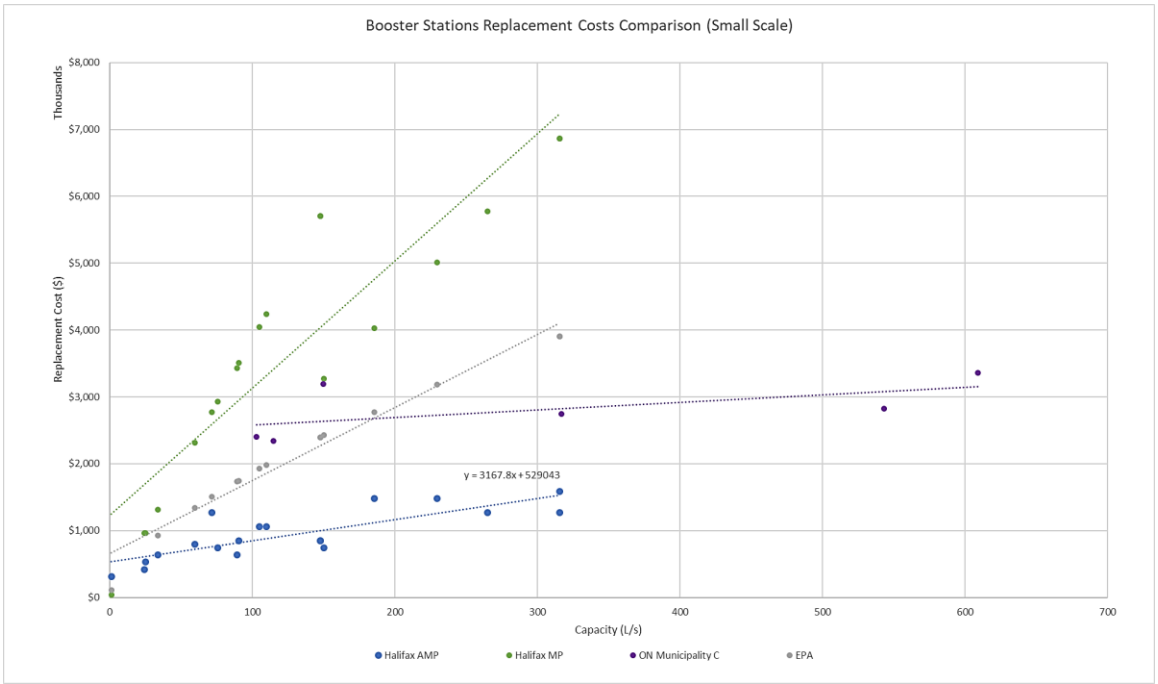
# Appendix E – Cost Comparison

## Water Supply Plants

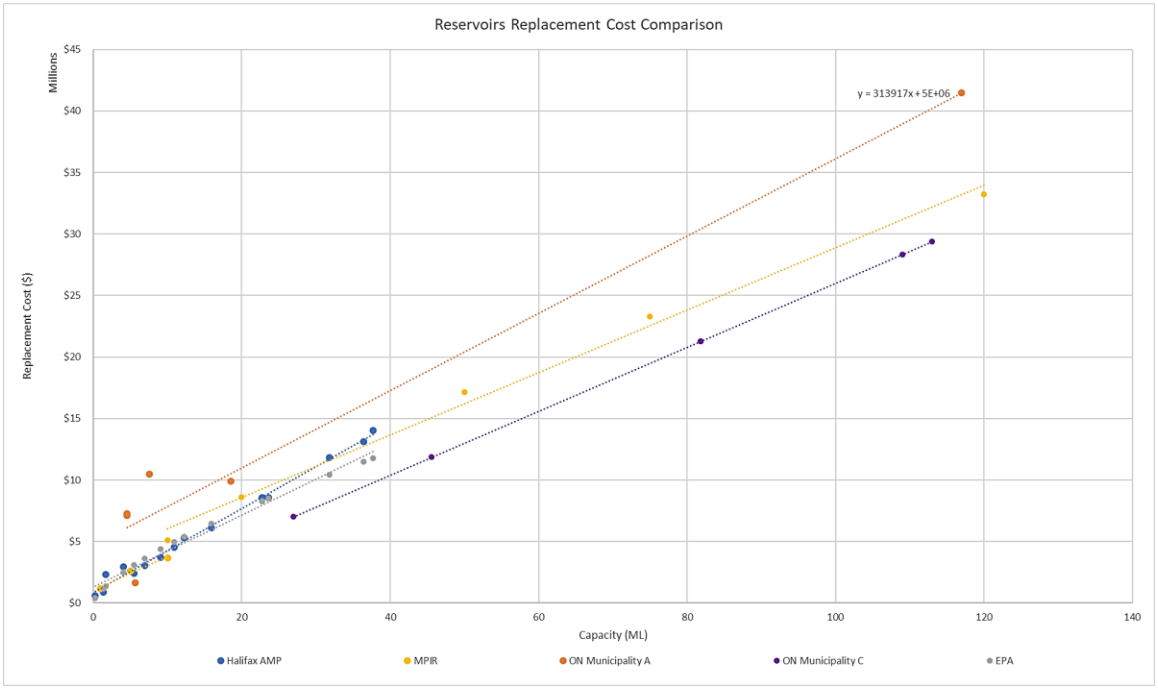


## Booster Stations

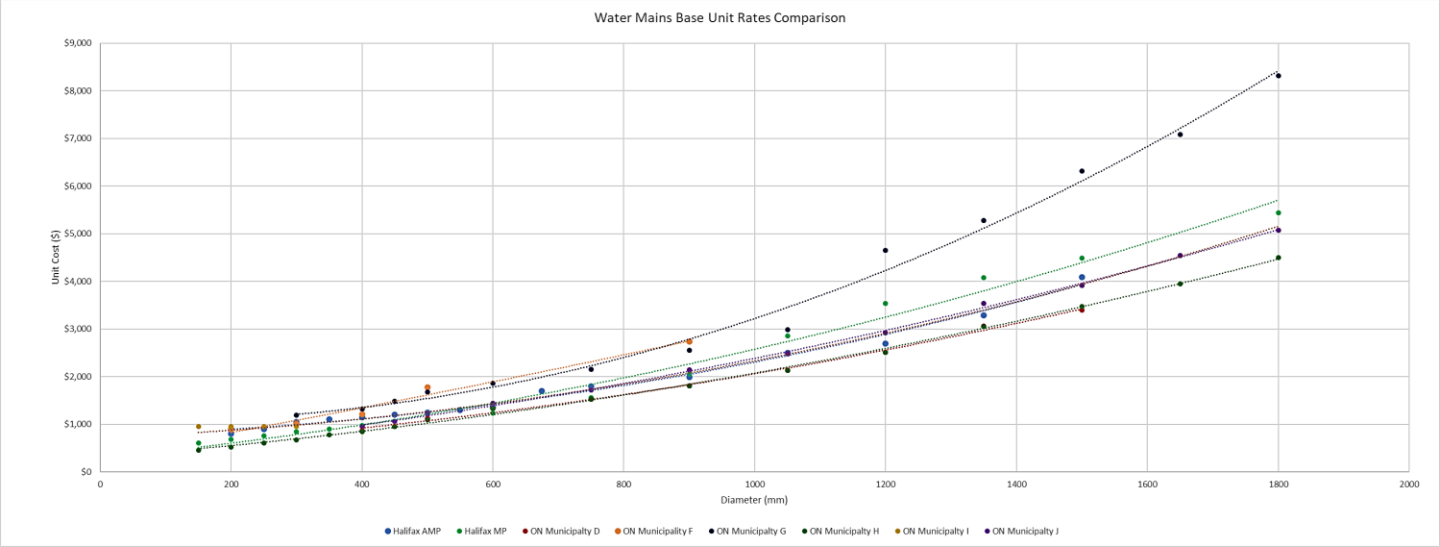


## Reservoirs


Reservoirs Replacement Cost Comparison
Millions
$45
$40
$35
$30
$25
$20
$15
$10
$5
$0
Replacement Cost ($)
y = 313917x + 5E+06
0
20
40
60
80
100
120
140
Capacity (ML)
Halifax AMP
MPIR
ON Municipality A
ON Municipality C
EPA

# Appendix E – Cost Comparison

## Watermains




| Halifax AMP | | |
|---|---|---|
| Diameter (mm) | 2017 AMP Unit Cost ($/m) | 2019 AMP Unit Cost ($/m) |
| 200 | $771 | $802 |
| 250 | $867 | $902 |
| 300 | $1,011 | $1,052 |
| 350 | $1,059 | $1,102 |
| 400 | $1,106 | $1,151 |
| 450 | $1,154 | $1,201 |
| 500 | $1,203 | $1,252 |
| 550 | $1,250 | $1,301 |
| 600 | $1,298 | $1,350 |
| 675 | $1,633 | $1,699 |
| 750 | $1,728 | $1,798 |
| 900 | $1,920 | $1,998 |
| 1,050 | $2,399 | $2,496 |
| 1,200 | $2,590 | $2,695 |
| 1,350 | $3,164 | $3,292 |
| 1,500 | $3,930 | $4,089 |

| Halifax MP | |
|---|---|
| Diameter (mm) | 2019 MP Unit Cost ($/m) |
| 150 | $610 |
| 200 | $682 |
| 250 | $760 |
| 300 | $844 |
| 350 | $902 |
| 400 | $976 |
| 500 | $1,109 |
| 600 | $1,233 |
| 750 | $1,562 |
| 900 | $2,053 |
| 1050 | $2,862 |
| 1200 | $3,543 |
| 1350 | $4,080 |
| 1500 | $4,488 |
| 1800 | $5,443 |
| 2100 | $6,174 |

| ON Municipalty F | | |
|---|---|---|
| Diameter (mm) | Unit Cost (2012 $/m) | Unit Cost (2019 $/m) |
| 200 | $770 | $904 |
| 300 | $860 | $1,010 |
| 400 | $1,030 | $1,209 |
| 500 | $1,510 | $1,773 |
| 900 | $2,330 | $2,735 |

| ON Municipalty D | |
|---|---|
| Diameter (mm) | 2019 MP Unit Cost ($/m) |
| 400 | $869 |
| 450 | $960 |
| 500 | $1,131 |
| 600 | $1,330 |
| 750 | $1,525 |
| 900 | $1,813 |
| 1,050 | $2,131 |
| 1,200 | $2,516 |
| 1,350 | $3,062 |
| 1,500 | $3,400 |

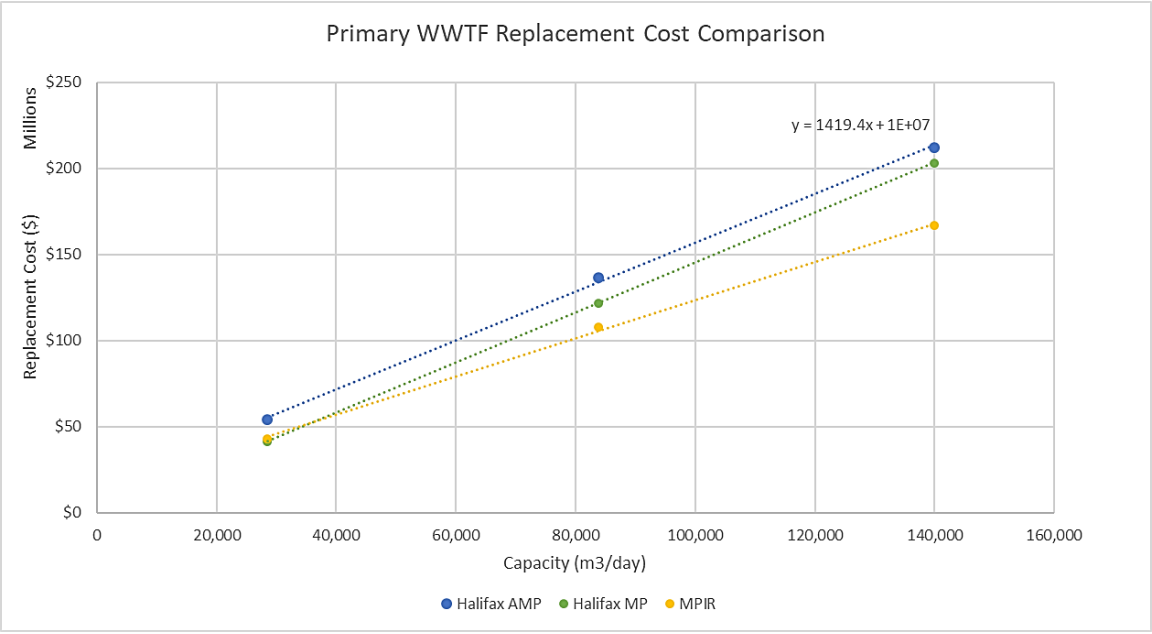
| ON Municipalty G | | |
|---|---|---|
| Diameter (mm) | Cost 2012$ | Cost 2019$ |
| 300 | $1,018 | $1,195 |
| 400 | $1,131 | $1,328 |
| 450 | $1,260 | $1,479 |
| 500 | $1,434 | $1,684 |
| 600 | $1,584 | $1,860 |
| 750 | $1,835 | $2,154 |
| 900 | $2,176 | $2,555 |
| 1050 | $2,548 | $2,991 |
| 1200 | $3,961 | $4,650 |
| 1350 | $4,500 | $5,283 |
| 1500 | $5,383 | $6,320 |
| 1650 | $6,034 | $7,084 |
| 1800 | $7,083 | $8,316 |
| 2100 | $7,715 | $9,058 |
| 2400 | $8,191 | $9,616 |

| ON Municipalty H | |
|---|---|
| Diameter (mm) | Total Unit Cost (2019 $/m) |
| 150 | $459 |
| 200 | $527 |
| 250 | $604 |
| 300 | $676 |
| 350 | $784 |
| 400 | $846 |
| 450 | $959 |
| 500 | $1,094 |
| 600 | $1,329 |
| 750 | $1,523 |
| 900 | $1,810 |
| 1050 | $2,128 |
| 1200 | $2,513 |
| 1350 | $3,057 |
| 1500 | $3,471 |
| 1650 | $3,944 |
| 1800 | $4,504 |
| 2100 | $4,973 |

| ON Municipalty I | | |
|---|---|---|
| Diameter (mm) | Total Unit Cost 2016 | Total Unit Cost 2019 |
| 150 | $867 | $954 |
| 200 | $867 | $954 |
| 250 | $867 | $954 |
| 300 | $867 | $954 |
| 400 | $868 | $955 |
| 450 | $968 | $1,065 |
| 500 | $1,104 | $1,215 |
| 600 | $1,309 | $1,441 |
| 750 | $1,565 | $1,722 |
| 900 | $1,944 | $2,140 |
| 1050 | $2,248 | $2,474 |
| 1200 | $2,655 | $2,922 |
| 1350 | $3,216 | $3,539 |
| 1500 | $3,562 | $3,920 |
| 1650 | $4,131 | $4,546 |
| 1800 | $4,605 | $5,068 |
| 2100 | $5,253 | $5,781 |

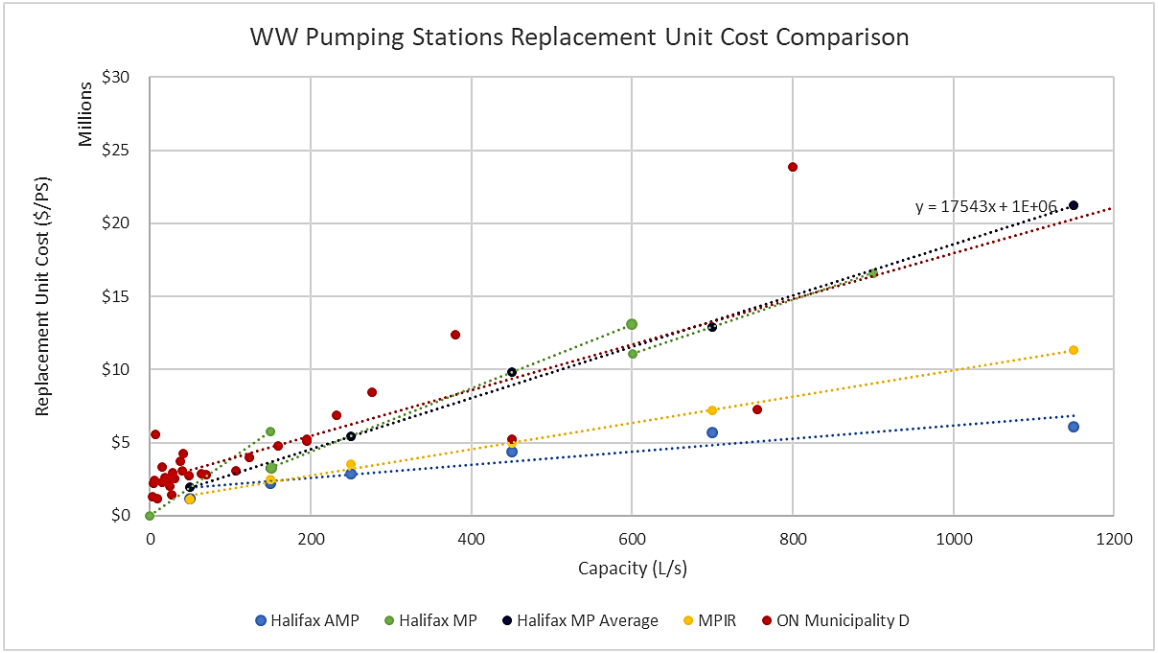
| ON Municipalty J | | |
|---|---|---|
| Diameter (mm) | Total Unit Cost 2016 | Total Unit Cost 2019 |
| 400 | $868 | $955 |
| 450 | $968 | $1,065 |
| 500 | $1,104 | $1,215 |
| 600 | $1,309 | $1,441 |
| 750 | $1,565 | $1,722 |
| 900 | $1,944 | $2,140 |
| 1050 | $2,248 | $2,474 |
| 1200 | $2,655 | $2,922 |
| 1350 | $3,216 | $3,539 |
| 1500 | $3,562 | $3,920 |
| 1650 | $4,131 | $4,546 |
| 1800 | $4,605 | $5,068 |
| 2100 | $5,253 | $5,781 |

## Wastewater Treatment Plants



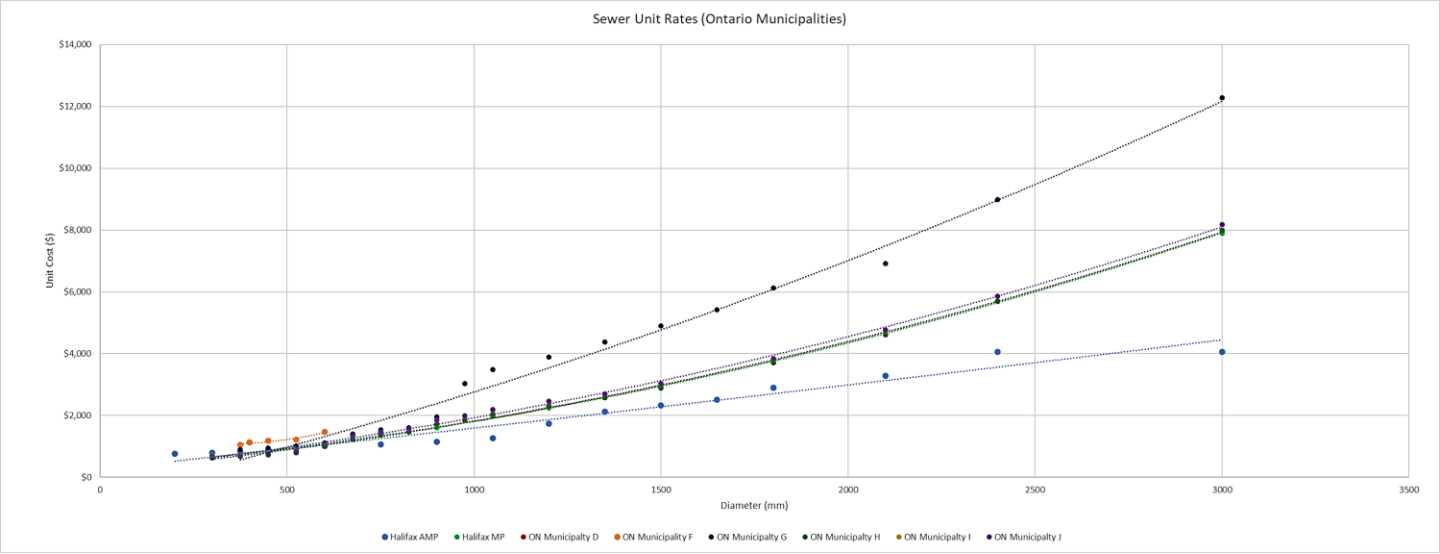

## Wastewater Treatment Plants

# Pumping Stations



# Appendix E – Cost Comparison

## Sewers




| Halifax AMP | |
|---|---|
| Diameter (mm) | 2019 AMP Unit Cost ($/m) |
| 200 | $759 |
| 300 | $797 |
| 375 | $836 |
| 450 | $894 |
| 525 | $952 |
| 600 | $1,010 |
| 750 | $1,068 |
| 900 | $1,145 |
| 1050 | $1,261 |
| 1200 | $1,744 |
| 1350 | $2,130 |
| 1500 | $2,323 |
| 1650 | $2,516 |
| 1800 | $2,902 |
| 2100 | $3,288 |
| 2400 | $4,061 |
| 3000 | $4,061 |
| | |

| Halifax MP | |
|---|---|
| Diameter (mm) | 2019 MP Unit Cost ($/m) |
| 300 | $736 |
| 375 | $786 |
| 450 | $849 |
| 525 | $911 |
| 600 | $997 |
| 750 | $1,387 |
| 900 | $1,599 |
| 1050 | $1,965 |
| 1200 | $2,238 |
| 1500 | $2,879 |
| 1800 | $3,807 |
| 2100 | $4,629 |
| 2400 | $5,700 |
| 3000 | $7,885 |

| ON Municipality F | | |
|---|---|---|
| Diameter (mm) | Unit Cost (2012 $/m) | Unit Cost (2019 $/m) |
| 375 | $900 | $1,057 |
| 400 | $970 | $1,139 |
| 450 | $1,010 | $1,186 |
| 525 | $1,040 | $1,221 |
| 600 | $1,250 | $1,468 |

| ON Municipalty D | |
|---|---|
| Diameter (mm) | 2019 MP Unit Cost ($/m) |
| 300 | $633 |
| 375 | $675 |
| 450 | $733 |
| 525 | $789 |
| 600 | $1,012 |
| 675 | $1,237 |
| 750 | $1,366 |
| 825 | $1,466 |
| 900 | $1,722 |
| 975 | $1,851 |
| 1050 | $2,047 |
| 1200 | $2,301 |
| 1350 | $2,584 |
| 1500 | $2,909 |
| 1800 | $3,716 |
| 2100 | $4,608 |
| 2400 | $5,697 |
| 3000 | $7,988 |

| ON Municipalty G | | |
|---|---|---|
| Diameter (mm) | Cost 2013$ | Cost 2019$ |
| 375 | $692 | $894 |
| 450 | $735 | $949 |
| 525 | $780 | $1,008 |
| 600 | $865 | $1,117 |
| 675 | $1,086 | $1,403 |
| 750 | $1,190 | $1,537 |
| 825 | $1,239 | $1,600 |
| 900 | $1,517 | $1,960 |
| 975 | $2,349 | $3,034 |
| 1050 | $2,693 | $3,479 |
| 1200 | $3,006 | $3,883 |
| 1350 | $3,383 | $4,370 |
| 1500 | $3,794 | $4,901 |
| 1650 | $4,202 | $5,428 |
| 1800 | $4,742 | $6,125 |
| 2100 | $5,355 | $6,917 |
| 2400 | $6,960 | $8,990 |
| 3000 | $9,509 | $12,283 |

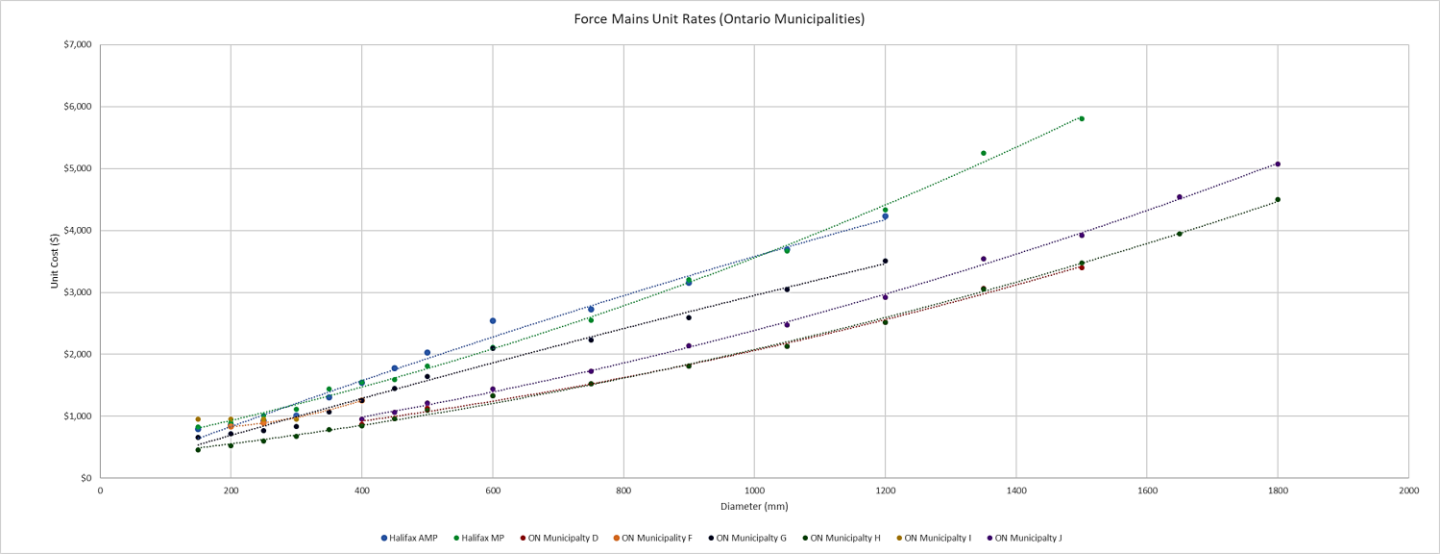
| ON Municipalty H | |
|---|---|
| Diameter (mm) | Total Unit Cost (2019 $/m) |
| 300 | $632 |
| 375 | $674 |
| 450 | $732 |
| 525 | $788 |
| 600 | $1,011 |
| 675 | $1,235 |
| 750 | $1,364 |
| 825 | $1,464 |
| 900 | $1,720 |
| 975 | $1,849 |
| 1050 | $2,045 |
| 1200 | $2,299 |
| 1350 | $2,582 |
| 1500 | $2,906 |
| 1800 | $3,713 |
| 2100 | $4,605 |
| 2400 | $5,694 |
| 3000 | $7,985 |

| ON Municipalty I | | |
|---|---|---|
| Diameter (mm) | Total Unit Cost 2016 | Total Unit Cost 2019 |
| 300 | $618 | $680 |
| 375 | $659 | $725 |
| 450 | $715 | $787 |
| 525 | $769 | $846 |
| 600 | $990 | $1,090 |
| 675 | $1,208 | $1,330 |
| 750 | $1,331 | $1,465 |
| 825 | $1,428 | $1,572 |
| 900 | $1,680 | $1,849 |
| 975 | $1,804 | $1,985 |
| 1050 | $1,995 | $2,196 |
| 1200 | $2,239 | $2,464 |
| 1350 | $2,454 | $2,701 |
| 1500 | $2,752 | $3,029 |
| 1800 | $3,496 | $3,848 |
| 2100 | $4,322 | $4,757 |
| 2400 | $5,323 | $5,858 |
| 3000 | $7,424 | $8,171 |

| ON Municipalty J | | |
|---|---|---|
| Diameter (mm) | Total Unit Cost 2016 | Total Unit Cost 2019 |
| 300 | $618 | $680 |
| 375 | $659 | $725 |
| 450 | $715 | $787 |
| 525 | $769 | $846 |
| 600 | $990 | $1,090 |
| 675 | $1,208 | $1,330 |
| 750 | $1,331 | $1,465 |
| 825 | $1,428 | $1,572 |
| 900 | $1,680 | $1,849 |
| 975 | $1,804 | $1,985 |
| 1050 | $1,995 | $2,196 |
| 1200 | $2,239 | $2,464 |
| 1350 | $2,454 | $2,701 |
| 1500 | $2,752 | $3,029 |
| 1800 | $3,496 | $3,848 |
| 2100 | $4,322 | $4,757 |
| 2400 | $5,323 | $5,858 |
| 3000 | $7,424 | $8,171 |

# Appendix E – Cost Comparison

## Forcemains




| Halifax AMP | | |
|---|---|---|
| Diameter (mm) | 2017 AMP Unit Cost ($/m) | 2019 AMP Unit Cost ($/m) |
| 150 | $765 | $796 |
| 200 | $827 | $860 |
| 250 | $893 | $929 |
| 300 | $972 | $1,011 |
| 350 | $1,253 | $1,304 |
| 400 | $1,485 | $1,545 |
| 450 | $1,710 | $1,779 |
| 500 | $1,950 | $2,029 |
| 600 | $2,445 | $2,544 |
| 750 | $2,624 | $2,730 |
| 900 | $3,035 | $3,158 |
| 1050 | $3,548 | $3,691 |
| 1,200 | $4,064 | $4,228 |

| Halifax MP | |
|---|---|
| Diameter (mm) | 2019 MP Unit Cost ($/m) |
| 150 | $824 |
| 200 | $891 |
| 250 | $1,013 |
| 300 | $1,110 |
| 350 | $1,440 |
| 400 | $1,551 |
| 450 | $1,590 |
| 500 | $1,812 |
| 600 | $2,116 |
| 750 | $2,554 |
| 900 | $3,206 |
| 1050 | $3,672 |
| 1200 | $4,329 |
| 1350 | $5,247 |
| 1500 | $5,806 |
| 1800 | $7,414 |

| ON Municipalty F | | |
|---|---|---|
| Diameter (mm) | Unit Cost (2012 $/m) | Unit Cost (2019 $/m) |
| 200 | $710 | $834 |
| 250 | 760 | $892 |
| 400 | $1,070 | $1,256 |

| ON Municipalty D | |
|---|---|
| Diameter (mm) | 2019 MP Unit Cost ($/m) |
| 400 | $869 |
| 450 | $960 |
| 500 | $1,131 |
| 600 | $1,330 |
| 750 | $1,525 |
| 900 | $1,813 |
| 1,050 | $2,131 |
| 1,200 | $2,516 |
| 1,350 | $3,062 |
| 1,500 | $3,400 |

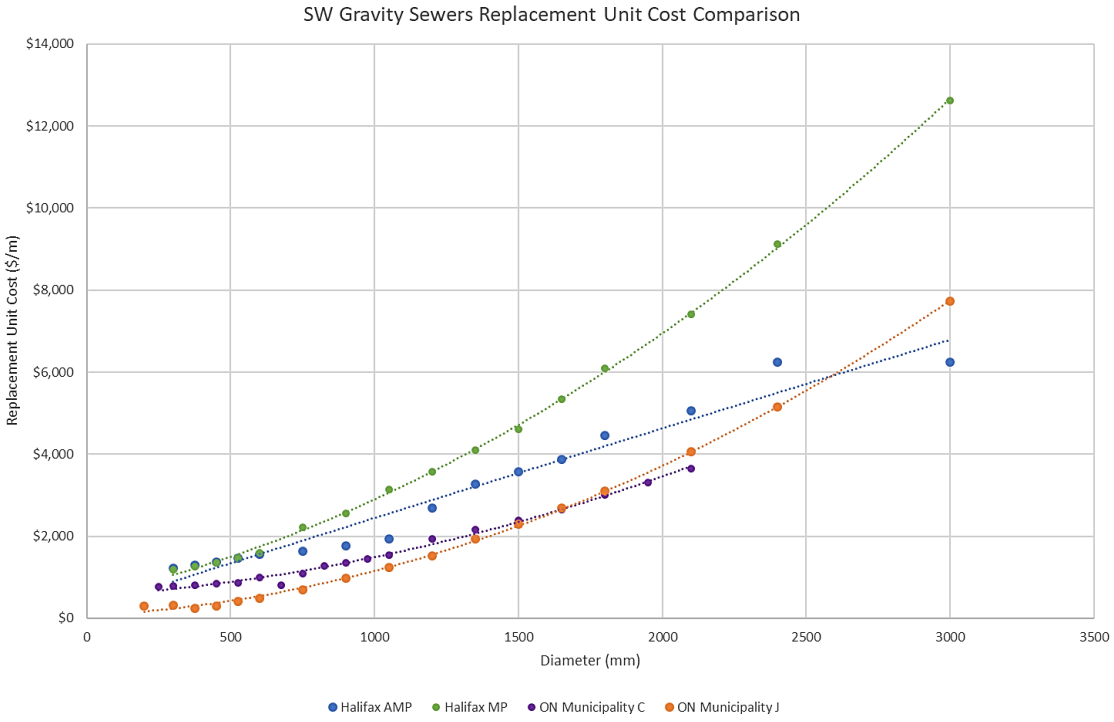
| ON Municipalty G | | |
|---|---|---|
| Diameter (mm) | Cost 2012$ | Cost 2019$ |
| 150 | $564 | $662 |
| 200 | $608 | $714 |
| 250 | $656 | $770 |
| 300 | $713 | $837 |
| 350 | $910 | $1,068 |
| 400 | $1,072 | $1,259 |
| 450 | $1,232 | $1,446 |
| 500 | $1,402 | $1,646 |
| 600 | $1,784 | $2,094 |
| 750 | $1,900 | $2,231 |
| 900 | $2,211 | $2,596 |
| 1050 | $2,597 | $3,049 |
| 1200 | $2,987 | $3,507 |

| ON Municipalty H | |
|---|---|
| Diameter (mm) | Total Unit Cost (2019 $/m) |
| 150 | $459 |
| 200 | $527 |
| 250 | $604 |
| 300 | $676 |
| 350 | $784 |
| 400 | $846 |
| 450 | $959 |
| 500 | $1,094 |
| 600 | $1,329 |
| 750 | $1,523 |
| 900 | $1,810 |
| 1050 | $2,128 |
| 1200 | $2,513 |
| 1350 | $3,057 |
| 1500 | $3,471 |
| 1650 | $3,944 |
| 1800 | $4,504 |
| 2100 | $4,973 |

| ON Municipalty I | | |
|---|---|---|
| Diameter (mm) | Total Unit Cost 2016 | Total Unit Cost 2019 |
| 150 | $867 | $954 |
| 200 | $867 | $954 |
| 250 | $867 | $954 |
| 300 | $867 | $954 |
| 400 | $868 | $955 |
| 450 | $968 | $1,065 |
| 500 | $1,104 | $1,215 |
| 600 | $1,309 | $1,441 |
| 750 | $1,565 | $1,722 |
| 900 | $1,944 | $2,140 |
| 1050 | $2,248 | $2,474 |
| 1200 | $2,655 | $2,922 |
| 1350 | $3,216 | $3,539 |
| 1500 | $3,562 | $3,920 |
| 1650 | $4,131 | $4,546 |
| 1800 | $4,605 | $5,068 |
| 2100 | $5,253 | $5,781 |

| ON Municipalty J | | |
|---|---|---|
| Diameter (mm) | Total Unit Cost 2016 | Total Unit Cost 2019 |
| 400 | $868 | $955 |
| 450 | $968 | $1,065 |
| 500 | $1,104 | $1,215 |
| 600 | $1,309 | $1,441 |
| 750 | $1,565 | $1,722 |
| 900 | $1,944 | $2,140 |
| 1050 | $2,248 | $2,474 |
| 1200 | $2,655 | $2,922 |
| 1350 | $3,216 | $3,539 |
| 1500 | $3,562 | $3,920 |
| 1650 | $4,131 | $4,546 |
| 1800 | $4,605 | $5,068 |
| 2100 | $5,253 | $5,781 |

## Stormwater Sewers



# Appendix F – Unit Cost Tables

**Table 1: Sewer Unit Costs up to 5m Depth**

| Diameter | Excavation | | | Granular Bedding | | | Pipe | | | Backfill | | | Subtotal Unit Cost | Restoration | Manhole Allowance | Total Unit Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Volume | Cost | Unit Cost | Volume | Cost | Unit Cost | Supply Cost | Install | Pipe Supply + Install | Vol | Cost | Unit Cost | | | | |
| (mm) | ($m^3$/m) | ($/$m^3$) | ($/m) | ($m^3$/m) | ($/$m^3$) | ($/m) | ($/m) | ($/m) | ($/m) | ($m^3$/m) | ($/$m^3$) | ($/m) | ($/m) | ($/m) | ($/m) | (2019 $/m) |
| **300** | 5.0 | 32 | $ 160 | 1.0 | 67 | $ 67 | $ 77 | $ 44 | $ 121 | 4.0 | 30 | 120 | $ 468 | $ 212 | $ 55 | **$ 736** |
| **375** | 5.5 | 32 | $ 176 | 1.0 | 67 | $ 67 | $ 96 | $ 44 | $ 140 | 4.5 | 30 | 135 | $ 518 | $ 212 | $ 55 | **$ 786** |
| **450** | 6.0 | 32 | $ 192 | 1.1 | 67 | $ 74 | $ 123 | $ 44 | $ 167 | 4.9 | 30 | 147 | $ 580 | $ 214 | $ 55 | **$ 849** |
| **525** | 6.5 | 32 | $ 208 | 1.2 | 67 | $ 80 | $ 148 | $ 44 | $ 192 | 5.3 | 30 | 159 | $ 640 | $ 216 | $ 55 | **$ 911** |
| **600** | 7.0 | 32 | $ 224 | 1.4 | 67 | $ 94 | $ 195 | $ 44 | $ 239 | 5.6 | 30 | 168 | $ 725 | $ 216 | $ 55 | **$ 997** |
| **750** | 9.0 | 32 | $ 288 | 2.0 | 67 | $ 134 | $ 390 | $ 53 | $ 443 | 7.0 | 30 | 210 | $ 1,075 | $ 247 | $ 65 | **$ 1,387** |
| **900** | 9.5 | 32 | $ 304 | 2.4 | 67 | $ 161 | $ 542 | $ 53 | $ 595 | 7.1 | 30 | 213 | $ 1,273 | $ 251 | $ 75 | **$ 1,599** |
| **1050** | 11.5 | 32 | $ 368 | 3.1 | 67 | $ 208 | $ 715 | $ 53 | $ 768 | 8.4 | 30 | 252 | $ 1,596 | $ 279 | $ 90 | **$ 1,965** |
| **1200** | 12.5 | 32 | $ 400 | 3.4 | 67 | $ 228 | $ 896 | $ 53 | $ 949 | 9.1 | 30 | 273 | $ 1,850 | $ 284 | $ 105 | **$ 2,238** |
| **1500** | 14.0 | 32 | $ 448 | 3.9 | 67 | $ 261 | $ 1,341 | $ 60 | $ 1,401 | 10.1 | 30 | 303 | $ 2,413 | $ 316 | $ 150 | **$ 2,879** |
| **1800** | 16.0 | 32 | $ 512 | 5.1 | 67 | $ 342 | $ 1,942 | $ 60 | $ 2,002 | 10.9 | 30 | 327 | $ 3,182 | $ 325 | $ 300 | **$ 3,807** |
| **2100** | 17.5 | 32 | $ 560 | 6.0 | 67 | $ 402 | $ 2,581 | $ 60 | $ 2,641 | 11.5 | 30 | 345 | $ 3,948 | $ 331 | $ 350 | **$ 4,629** |
| **2400** | 19.5 | 32 | $ 624 | 7.0 | 67 | $ 469 | $ 3,433 | $ 60 | $ 3,493 | 12.5 | 30 | 375 | $ 4,961 | $ 340 | $ 400 | **$ 5,700** |
| **3000** | 23.0 | 32 | $ 736 | 9.0 | 67 | $ 603 | $ 5,261 | $ 60 | $ 5,321 | 14.0 | 30 | 420 | $ 7,080 | $ 355 | $ 450 | **$ 7,885** |

**Table 2: Sewer Unit Costs up to 10m Depth**

| Diameter | Excavation | | | Granular Bedding | | | Pipe | | | Backfill | | | Subtotal Unit Cost | Restoration | Manhole Allowance | Total Unit Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Volume | Cost | Unit Cost | Volume | Cost | Unit Cost | Supply Cost | Install | Pipe Supply + Install | Vol | Cost | Unit Cost | | | | |
| (mm) | ($m^3$/m) | ($/$m^3$) | ($/m) | ($m^3$/m) | ($/$m^3$) | ($/m) | ($/m) | ($/m) | ($/m) | ($m^3$/m) | ($/$m^3$) | ($/m) | ($/m) | ($/m) | ($/m) | (2019 $/m) |
| **300** | 10.0 | 45 | $ 450 | 0.9 | 67 | $ 57 | $ 77 | $ 44 | $ 121 | 9.1 | 30 | 274 | $ 903 | $ 212 | $ 110 | **$ 1,225** |
| **375** | 11.0 | 45 | $ 495 | 1.0 | 67 | $ 64 | $ 96 | $ 44 | $ 140 | 10.0 | 30 | 301 | $ 1,001 | $ 212 | $ 110 | **$ 1,323** |
| **450** | 12.0 | 45 | $ 540 | 1.1 | 67 | $ 73 | $ 123 | $ 44 | $ 167 | 10.9 | 30 | 327 | $ 1,108 | $ 214 | $ 110 | **$ 1,432** |
| **525** | 13.0 | 45 | $ 585 | 1.4 | 67 | $ 92 | $ 148 | $ 44 | $ 192 | 11.6 | 30 | 349 | $ 1,218 | $ 216 | $ 110 | **$ 1,545** |
| **600** | 14.0 | 45 | $ 630 | 1.5 | 67 | $ 102 | $ 195 | $ 44 | $ 239 | 12.5 | 30 | 374 | $ 1,346 | $ 216 | $ 110 | **$ 1,673** |
| **750** | 18.0 | 45 | $ 810 | 1.9 | 67 | $ 127 | $ 390 | $ 53 | $ 443 | 16.1 | 30 | 484 | $ 1,863 | $ 247 | $ 130 | **$ 2,240** |
| **900** | 19.0 | 45 | $ 855 | 2.2 | 67 | $ 147 | $ 542 | $ 53 | $ 595 | 16.8 | 30 | 505 | $ 2,101 | $ 251 | $ 150 | **$ 2,502** |
| **1050** | 23.0 | 45 | $ 1,035 | 2.5 | 67 | $ 169 | $ 715 | $ 53 | $ 768 | 20.5 | 30 | 615 | $ 2,586 | $ 279 | $ 180 | **$ 3,046** |
| **1200** | 25.0 | 45 | $ 1,125 | 2.8 | 67 | $ 186 | $ 896 | $ 53 | $ 949 | 22.2 | 30 | 667 | $ 2,927 | $ 284 | $ 210 | **$ 3,421** |
| **1500** | 28.0 | 45 | $ 1,260 | 3.5 | 67 | $ 233 | $ 1,341 | $ 60 | $ 1,401 | 24.5 | 30 | 736 | $ 3,629 | $ 316 | $ 300 | **$ 4,246** |
| **1800** | 32.0 | 45 | $ 1,440 | 4.2 | 67 | $ 284 | $ 1,942 | $ 60 | $ 2,002 | 27.8 | 30 | 833 | $ 4,559 | $ 325 | $ 600 | **$ 5,484** |
| **2100** | 35.0 | 45 | $ 1,575 | 5.0 | 67 | $ 338 | $ 2,581 | $ 60 | $ 2,641 | 30.0 | 30 | 899 | $ 5,453 | $ 331 | $ 700 | **$ 6,484** |
| **2400** | 39.0 | 45 | $ 1,755 | 5.9 | 67 | $ 399 | $ 3,433 | $ 60 | $ 3,493 | 33.1 | 30 | 992 | $ 6,639 | $ 340 | $ 800 | **$ 7,779** |
| **3000** | 46.0 | 45 | $ 2,070 | 7.8 | 67 | $ 522 | $ 5,261 | $ 60 | $ 5,321 | 38.2 | 30 | 1147 | $ 9,059 | $ 355 | $ 900 | **$ 10,315** |

**Table 3: Watermain Unit Costs up to 2m Depth**

| Diameter | Excavation | | | Granular Bedding | | | Pipe | | | Backfill | | | Subtotal Unit Cost | Restoration | Valves and Appurtenances | Total Unit Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Volume | Cost | Cost | Volume | Cost | Cost | Supply Cost | Install | Pipe Supply + Install | Vol | Cost | Unit Cost | | | | |
| (mm) | ($m^3$/m) | ($/$m^3$) | ($/m) | ($m^3$/m) | ($/$m^3$) | ($/m) | ($/m) | ($/m) | ($/m) | ($m^3$/m) | ($/$m^3$) | ($/m) | ($/m) | ($/m) | ($/m) | ($/m) |
| **150** | 1.6 | 25 | $ 39 | 0.7 | 67 | $ 44 | $ 79 | $ 162 | $ 241 | 0.9 | 30 | 27 | $ 350 | $ 150 | $ 110 | **$ 610** |
| **200** | 1.7 | 25 | $ 41 | 0.7 | 67 | $ 49 | $ 111 | $ 162 | $ 273 | 0.9 | 30 | 28 | $ 392 | $ 170 | $ 120 | **$ 682** |
| **250** | 1.8 | 30 | $ 53 | 0.8 | 67 | $ 54 | $ 147 | $ 162 | $ 309 | 1.0 | 30 | 29 | $ 445 | $ 185 | $ 130 | **$ 760** |
| **300** | 1.9 | 30 | $ 56 | 0.9 | 67 | $ 59 | $ 185 | $ 162 | $ 347 | 1.0 | 30 | 30 | $ 492 | $ 212 | $ 140 | **$ 844** |
| **350** | 2.0 | 30 | $ 59 | 1.0 | 67 | $ 64 | $ 228 | $ 162 | $ 391 | 1.0 | 30 | 31 | $ 545 | $ 212 | $ 145 | **$ 902** |
| **400** | 2.1 | 30 | $ 63 | 1.0 | 67 | $ 70 | $ 275 | $ 162 | $ 437 | 1.0 | 40 | 42 | $ 611 | $ 214 | $ 150 | **$ 976** |
| **500** | 2.3 | 30 | $ 69 | 1.2 | 67 | $ 81 | $ 350 | $ 175 | $ 525 | 1.1 | 40 | 44 | $ 719 | $ 230 | $ 160 | **$ 1,109** |
| **600** | 2.5 | 30 | $ 75 | 1.4 | 67 | $ 92 | $ 425 | $ 175 | $ 600 | 1.1 | 45 | 52 | $ 819 | $ 245 | $ 170 | **$ 1,233** |
| **750** | 2.8 | 40 | $ 113 | 1.6 | 67 | $ 109 | $ 625 | $ 200 | $ 825 | 1.2 | 50 | 60 | $ 1,107 | $ 275 | $ 180 | **$ 1,562** |
| **900** | 3.1 | 50 | $ 157 | 1.9 | 67 | $ 127 | $ 800 | $ 400 | $ 1,200 | 1.3 | 55 | 69 | $ 1,553 | $ 300 | $ 200 | **$ 2,053** |
| **1050** | 3.4 | 65 | $ 223 | 2.1 | 67 | $ 143 | $ 1,200 | $ 600 | $ 1,800 | 1.3 | 90 | 116 | $ 2,282 | $ 330 | $ 250 | **$ 2,862** |
| **1200** | 3.8 | 80 | $ 302 | 2.5 | 67 | $ 165 | $ 1,500 | $ 750 | $ 2,250 | 1.3 | 125 | 166 | $ 2,883 | $ 360 | $ 300 | **$ 3,543** |
| **1350** | 4.1 | 95 | $ 392 | 2.8 | 67 | $ 187 | $ 1,750 | $ 800 | $ 2,550 | 1.3 | 150 | 202 | $ 3,330 | $ 400 | $ 350 | **$ 4,080** |
| **1500** | 4.3 | 110 | $ 476 | 3.0 | 67 | $ 200 | $ 1,900 | $ 850 | $ 2,750 | 1.3 | 175 | 236 | $ 3,663 | $ 425 | $ 400 | **$ 4,488** |
| **1800** | 5.5 | 150 | $ 825 | 4.2 | 67 | $ 283 | $ 2,252 | $ 900 | $ 3,152 | 1.3 | 200 | 259 | $ 4,518 | $ 450 | $ 475 | **$ 5,443** |
| **2100** | 6.1 | 175 | $ 1,068 | 4.9 | 67 | $ 329 | $ 2,581 | $ 900 | $ 3,481 | 1.2 | 225 | 272 | $ 5,149 | $ 475 | $ 550 | **$ 6,174** |

**Table 4: Watermain Unit Costs >5m Depth**

| Diameter | Excavation | | | Granular Bedding | | | Pipe | | | Backfill | | | Subtotal Unit Cost | Restoration | Total Unit Cost | HALIFAX FORCEMAIN Total Unit Cost (+40% for twin) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Volume | Cost | Cost | Volume | Cost | Cost | Supply Cost | Install | Pipe Supply + Install | Vol | Cost | Cost | | | | |
| (mm) | ($m^3$/m) | ($/$m^3$) | ($/m) | ($m^3$/m) | ($/$m^3$) | ($/m) | ($/m) | ($/m) | ($/m) | ($m^3$/m) | ($/$m^3$) | ($/m) | ($/m) | ($/m) | (2019 $/m) | (2019 $/m) |
| **150** | 4.0 | 45 | $ 180 | 1.0 | 67 | $ 67 | $ 44 | $ 57 | $ 101 | 3.0 | 30 | 90 | $ 439 | $ 150 | $ 589 | **$ 824** |
| **200** | 4.0 | 45 | $ 180 | 1.0 | 67 | $ 67 | $ 72 | $ 57 | $ 129 | 3.0 | 30 | 90 | $ 467 | $ 170 | $ 637 | **$ 891** |
| **250** | 4.5 | 45 | $ 203 | 1.1 | 67 | $ 74 | $ 103 | $ 57 | $ 160 | 3.4 | 30 | 102 | $ 539 | $ 185 | $ 724 | **$ 1,013** |
| **300** | 4.5 | 45 | $ 203 | 1.2 | 67 | $ 81 | $ 141 | $ 57 | $ 198 | 3.3 | 30 | 99 | $ 581 | $ 212 | $ 793 | **$ 1,110** |
| **350** | 5.0 | 45 | $ 225 | 1.4 | 67 | $ 94 | $ 332 | $ 57 | $ 389 | 3.6 | 30 | 108 | $ 816 | $ 212 | $ 1,029 | **$ 1,440** |
| **400** | 5.3 | 45 | $ 236 | 1.9 | 67 | $ 128 | $ 372 | $ 57 | $ 429 | 3.4 | 30 | 101 | $ 894 | $ 214 | $ 1,108 | **$ 1,551** |
| **450** | 5.3 | 45 | $ 236 | 2.0 | 67 | $ 134 | $ 390 | $ 57 | $ 447 | 3.3 | 30 | 98 | $ 915 | $ 220 | $ 1,135 | **$ 1,590** |
| **500** | 6.3 | 45 | $ 284 | 2.2 | 67 | $ 148 | $ 452 | $ 57 | $ 510 | 4.1 | 30 | 123 | $ 1,064 | $ 230 | $ 1,294 | **$ 1,812** |
| **600** | 6.3 | 45 | $ 284 | 2.4 | 67 | $ 161 | $ 542 | $ 162 | $ 705 | 3.9 | 30 | 117 | $ 1,266 | $ 245 | $ 1,511 | **$ 2,116** |
| **750** | 8.9 | 45 | $ 402 | 2.5 | 67 | $ 168 | $ 625 | $ 162 | $ 787 | 6.4 | 30 | 193 | $ 1,549 | $ 275 | $ 1,824 | **$ 2,554** |
| **900** | 13.3 | 45 | $ 599 | 3.1 | 67 | $ 208 | $ 715 | $ 162 | $ 877 | 10.2 | 30 | 306 | $ 1,990 | $ 300 | $ 2,290 | **$ 3,206** |
| **1050** | 14.4 | 45 | $ 649 | 3.4 | 67 | $ 228 | $ 896 | $ 189 | $ 1,085 | 11.0 | 30 | 331 | $ 2,293 | $ 330 | $ 2,623 | **$ 3,672** |
| **1200** | 16.9 | 45 | $ 762 | 3.9 | 67 | $ 262 | $ 1,096 | $ 221 | $ 1,316 | 13.0 | 30 | 391 | $ 2,732 | $ 360 | $ 3,092 | **$ 4,329** |
| **1350** | 20.6 | 45 | $ 928 | 4.2 | 67 | $ 282 | $ 1,341 | $ 303 | $ 1,644 | 16.4 | 30 | 493 | $ 3,348 | $ 400 | $ 3,748 | **$ 5,247** |
| **1500** | 22.1 | 45 | $ 992 | 3.1 | 67 | $ 207 | $ 1,606 | $ 347 | $ 1,954 | 19.0 | 30 | 569 | $ 3,722 | $ 425 | $ 4,147 | **$ 5,806** |
| **1800** | 27.6 | 45 | $ 1,240 | 3.5 | 67 | $ 233 | $ 2,252 | $ 398 | $ 2,650 | 24.1 | 30 | 723 | $ 4,846 | $ 450 | $ 5,296 | **$ 7,414** |
| **2100** | 30.6 | 45 | $ 1,378 | 6.0 | 67 | $ 403 | $ 2,581 | $ 398 | $ 2,979 | 24.6 | 30 | 739 | $ 5,499 | $ 475 | $ 5,974 | **$ 8,364** |

**Table 5: Sewer Trenchless Crossing Costs**

| Sewer Trenchless Crossings<br>Assumed Length Stated on table and includes manhole each side of crossing | | | |
|---|---|---|---|
| Diameter (mm) | For Creeks & Trans Canada | For Regional Roads, Rail and Hydro Corridors | For Freeways, Major Creek Crossings |
| | Length = 20m | Length = 60m | Length = 150m |
| | 2019 $ Cost | | |
| 200 | $66,000 | $118,000 | $235,000 |
| 250 | $66,000 | $118,000 | $235,000 |
| 300 | $66,000 | $118,000 | $235,000 |
| 375 | $166,000 | $418,000 | $985,000 |
| 450 | $196,000 | $448,000 | $1,015,000 |
| 525 | $196,000 | $448,000 | $1,015,000 |
| 600 | $196,000 | $448,000 | $1,015,000 |
| 675 | $246,000 | $498,000 | $1,065,000 |
| 750 | $246,000 | $498,000 | $1,065,000 |
| 825 | $316,000 | $708,000 | $1,590,000 |
| 900 | $366,000 | $758,000 | $1,640,000 |
| 975 | $366,000 | $758,000 | $1,640,000 |
| 1050 | $416,000 | $808,000 | $1,690,000 |
| 1200 | $416,000 | $808,000 | $1,690,000 |
| 1350 | $480,000 | $1,000,000 | $2,170,000 |
| 1500 | $480,000 | $1,000,000 | $2,170,000 |
| 1650 | $480,000 | $1,000,000 | $2,170,000 |
| 1800 | $480,000 | $1,000,000 | $2,170,000 |
| 2100 | #N/A | #N/A | #N/A |
| 2400 | #N/A | #N/A | #N/A |
| 3000 | #N/A | #N/A | #N/A |

**Table 6: Forcemain/Watermain Trenchless Crossing Costs**

| Forcemain/Watermain Trenchless Crossings<br>Assumed Length Stated on table and includes valve each side of crossing | | | |
|---|---|---|---|
| Diameter (mm) | For Creeks & Trans Canada | For Regional Roads, Rail and Hydro Corridors | For Freeways, Major Creek Crossings |
| | Length = 20m | Length = 60m | Length = 150m |
| | 2019 $ Cost | | |
| 150 | $29,000 | $81,000 | $198,000 |
| 200 | $30,000 | $82,000 | $199,000 |
| 250 | $30,000 | $82,000 | $199,000 |
| 300 | $37,000 | $89,000 | $206,000 |
| 350 | $45,000 | $97,000 | $214,000 |
| 400 | $203,000 | $455,000 | $1,022,000 |
| 450 | $208,000 | $460,000 | $1,027,000 |
| 500 | $220,000 | $472,000 | $1,039,000 |
| 600 | $248,000 | $500,000 | $1,067,000 |
| 750 | $296,000 | $548,000 | $1,115,000 |
| 900 | $378,000 | $770,000 | $1,652,000 |
| 1050 | $439,000 | $831,000 | $1,713,000 |
| 1200 | $507,000 | $899,000 | $1,781,000 |

**Table 6: Tunneling Construction Unit Costs**

| Tunnelling Construction Costs | | | |
|---|---|---|---|
| **Diameter** | **2019 $ Cost** | **Diameter** | **2019 $ Cost** |
| **150** | $ 1,300.00 | **750** | $ 6,300.00 |
| **200** | $ 1,300.00 | **825** | $ 9,800.00 |
| **250** | $ 1,300.00 | **900** | $ 9,800.00 |
| **300** | $ 1,300.00 | **975** | $ 9,800.00 |
| **325** | $ 1,300.00 | **1050** | $ 9,800.00 |
| **350** | $ 1,300.00 | **1200** | $ 9,800.00 |
| **375** | $ 6,300.00 | **1350** | $ 13,000.00 |
| **400** | $ 6,300.00 | **1500** | $ 13,000.00 |
| **450** | $ 6,300.00 | **1650** | $ 13,000.00 |
| **500** | $ 6,300.00 | **1800** | $ 13,000.00 |
| **525** | $ 6,300.00 | **2100** | $ 13,000.00 |
| **600** | $ 6,300.00 | **2400** | $ 13,000.00 |
| **675** | $ 6,300.00 | **3000** | $ 13,000.00 |

# Appendix G – Sample Costing Sheet

**HALIFAX WATER**
**WATER AND WASTEWATER INFRASTRUCTURE MASTER PLAN**
**PROJECT TRACKING AND COSTING SHEET**

| | |
|---|---|
| **PROJECT NO.:** | **Strategy 2c - 4** |
| **PROJECT NAME:** | **Existing Conveyance Upgrades** |
| **PROJECT DESCRIPTION:** | **Sackville Trunk Upgrades (1050mm)** |

| | |
|---|---|
| **CAPITAL BUDGET YEAR:** | |
| **VERSION:** | |
| **DATE UPDATED:** | |
| **UPDATED BY:** | |

| | | |
|---|---|---|
| **Class Estimate Type:** | Class 4 | Class adjusts Contingency and expected accuracy |
| **Project Complexity** | Low | Complexity adjusts expected accuracy |
| **Accuracy Range:** | 20% | |
| **Area Condition:** | Urban | Area Condition uplifts unit cost and restoration |

= Field has drop down
= Field must be manually populated
= Field auto-filled based on project details

| | | |
|---|---|---|
| **PROPOSED DIAMETER:** | 1050 mm | |
| **TOTAL LENGTH:** | 632 m | |
| **Tunnelled** | 0 m | 0% |
| **Open Cut** | 632 m | 100% |

| | | |
|---|---|---|
| **CONSTRUCTION ASSUMPTION:** | | Sewer 5m |
| **SYSTEM:** | Wastewater | |

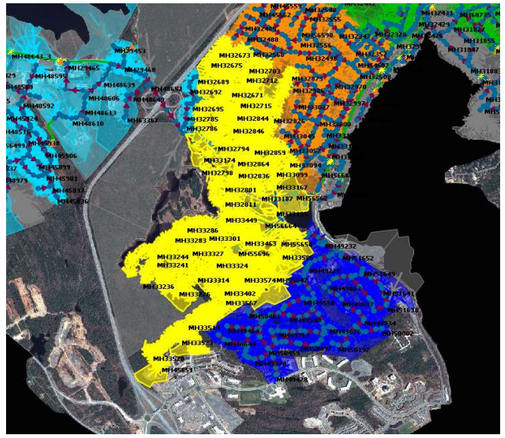
**COST ESTIMATION SPREADSHEET**

| COMPONENT | RATE (%) | RATE ($) | UNIT | ESTIMATED QUANTITY | COST PER UNIT | SUB-TOTAL | COMMENTS |
|---|---|---|---|---|---|---|---|
| **Construction Cost** | | | | | | | |
| Pipe Construction - Open Cut | | | m | 632 m | $1,965 | $1,241,884 | |
| Pipe Construction - Tunneling | | | m | 0 m | $0 | $0 | |
| Pipe Construction Uplift (Based on Area Conditions) | 30% | | | | | $372,565 | |
| Minor Creek Crossings | | | ea. | 0 | $416,000 | $0 | |
| Major Creek Crossings | | | ea. | 0 | $1,690,000 | $0 | |
| Road Crossings (Highway) | | | ea. | 2 | $808,000 | $1,616,000 | Bedford Bypass crossing |
| Major Road Crossings (Freeway) | | | ea. | 1 | $1,690,000 | $1,690,000 | Crossing Harvest Hwy |
| Utility Crossings | | | ea. | 0 | $808,000 | $0 | |
| Pumping Station - New | | | l/s | 0 | $0 | $0 | |
| Pumping Station - Upgrade | | | l/s | 0 | $0 | $0 | |
| Storage (In Ground) | | | m3 | 0 | $0 | $0 | |
| Treatment | | | ML/d | 0 | $0 | $0 | |
| | | | | | | | |
| **Sub-Total Construction Only Costs** | | | | | | **$4,920,000** | |
| | | | | | | | |
| Engineering/Design | 10% | | | | | $492,000 | includes planning, pre-design, detailed design, training, CAD, commissioning |
| **Engineering/Design Sub-Total** | | | | | | **$492,000** | |
| | | | | | | | |
| Professional Fees / Geotechnical / Hydrogeological / | 1.0% | | | | | $49,200 | |
| **Geotechnical Sub-Total Cost** | | | | | | **$49,200** | |
| | | | | | | | |
| Construction Management/Contract Administration | 10.0% | | | | | $492,000 | |
| **Geotechnical Sub-Total Cost** | | | | | | **$492,000** | |
| | | | | | | | |
| Property Requirements | 0.0% | | | | | $0 | |
| **Property Requirements Sub-Total** | | | | | | **$0** | |
| | | | | | | | |
| **Sub-Total Additional Costs** | | | | | | **$1,033,000** | |
| **Sub-Total Construction and Additional Costs** | | | | | | **$5,953,000** | |
| | | | | | | | |
| Project Contingency | 30% | | | | | $1,786,000 | ***Construction Contingency is dependent on Cost Estimate Class*** |
| **Project Contingency Sub-Total** | | | | | | **$1,786,000** | |
| | | | | | | | |
| **Sub-Total after Contingency** | | | | | | **$7,739,000** | |
| | | | | | | | |
| Non-Refundable HST | 4.286% | | | | | $331,700 | |
| **Non-Refundable HST Sub-Total** | | | | | | **$331,700** | |
| | | | | | | | |
| Overhead | 1% | | | | | $77,000 | |
| **Project Contingency Sub-Total** | | | | | | **$77,000** | |
| | | | | | | | |
| In House Labour/Engineering/Wages/CAD | 2% | | | | | $98,400 | |
| **In-house Labour/Wages Sub-Total** | | | | | | **$98,400** | |
| | | | | | | | |
| **Total (2018 Dollars)** | | | | | | **$8,246,000** | Rounded to nearest $1,000 |
| **Other Estimate** | | | | | | | |
| **Chosen Estimate** | | | | | | **$8,246,000** | **2019 Estimate** |

# Appendix H – Sample RDII Costing Sheet

| RDII Reduction Costing Sheet | |
|---|---|
| **Catchment Name** | FMZ03 |
| **WWTF Catchment** | Mill Cove |
| **Relevant Flow Monitors** | FMZ01, FMZ18 |
| **Date of Assessment** | 11/20/2018 |

**Map of RDII Reduction Area (Wastewater Model)**



| Item | Amount |
|---|---|
| Hectares | 162 |
| Residential Properties | 1776 |
| ICI Properties | 12 |
| Meter of Sewer | 23477 |
| Number of Manholes | 451 |
| Estimated Labour Hours (0.8hr/manhole) | 360.8 |

**ONLY ADJUST GREEN CELLS**

| Investigation | | | | | |
|---|---|---|---|---|---|
| | **Item and Description** | **Unit** | **Quantity** | **Unit Fee** | **Total Price** |
| 1 | Project Management | hours | 25.3 | $ 120 | $ 3,031 |
| 2 | Meetings and Interviews | hours | 28.9 | $ 120 | $ 3,464 |
| 3 | Background information, Desktop studies, Analysis of existing information | hours | 18.0 | $ 120 | $ 2,165 |
| 4 | Preparation of Scope Documentation | hours | 36.1 | $ 120 | $ 4,330 |
| 5 | Smoke Testing - sewers smaller than 675mm | meters | 8217.0 | $ 1 | $ 8,217 |
| 6 | Drainage Survey - Class A - Residential | properties | 1243.2 | $ 20 | $ 24,864 |
| 7 | Drainage Survey - Class A - ICI | buildings | 6.0 | $ 85 | $ 510 |
| 8 | Dye testing (8hrs day, dye trunk+ 2 on-site staff) | days | 9.0 | $ 960 | $ 8,659 |
| 9 | Drainage Survey - Class B | properties | 88.8 | $ 80 | $ 7,104 |
| 10 | Complete CCTV as required | meters | 11738.5 | $ 6 | $ 70,431 |
| 11 | Flow Monitoring | monitor/month | 20.0 | $ 1,200 | $ 24,000 |
| 12 | Rain Gauges | gauge/month | 5.0 | $ 850 | $ 4,250 |
| 13 | Flow Monitoring Data Analysis | monitor/month | 20.0 | $ 200 | $ 4,000 |
| 14 | Survey Management and results analysis | hours | 109.0 | $ 120 | $ 13,080 |
| 15 | Documentation (Report writing, GIS work, etc.) | hours | 145.0 | $ 120 | $ 17,400 |
| 16 | Provisional items (15%) | | | | $ 29,326 |
| | | **Total Investigation** | | | **$ 224,830** |

| Remediation | | | | | |
|---|---|---|---|---|---|
| | **Item and Description** | **Unit** | **Quantity** | **Unit Fee** | **Total Price** |
| 1 | Sewer lining | meters | 7043.1 | $ 670 | $ 4,718,877 |
| 2 | Property disconnection | per property | 669 | $ 500 | $ 334,500 |
| | | **Total Remediation** | | | **$ 5,053,377** |

| | |
|---|---|
| **Total Investigation & Remediation** | **$ 5,278,207** |

B

HALIFAX WATER

2019 INTEGRATED RESOURCE PLAN

# APPENDIX B.1

## INFRASTRUCTURE MASTER PLAN

Halifax Water

# INFRASTRUCTURE MASTER PLAN

## EXECUTIVE SUMMARY

**Prepared by: GM BluePlan Engineering**

**For: Halifax Water**

**October 2019**

GM BluePlan ENGINEERING

GUELPH | OWEN SOUND | LISTOWEL | KITCHENER | LONDON | HAMILTON | GTA

www.GMBluePlan.ca

# EXECUTIVE SUMMARY

The Infrastructure Master Plan is a long-term infrastructure planning and engineering study to identify the optimal regional water and wastewater infrastructure implementation plan for Halifax Water to service growth until 2046.

The Infrastructure Master Plan expands on work completed by GM BluePlan under the West Region Wastewater Infrastructure Plan (WRWIP, 2017), which formalized the foundational policies of regional infrastructure planning in wastewater infrastructure needs and formed the servicing strategy for the West Region (Halifax, Beechville-Lakeside-Timberlea (BLT) and Herring Cove). The Infrastructure Master Plan incorporates the WRWIP and provides servicing strategies for the rest of the wastewater network, covering the Central and East Regions. The Infrastructure Master Plan then follows a similar approach for the water system, by formalizing the foundational policies of regional water infrastructure planning and forming a preferred servicing strategy that covers the regional water network for Halifax Water.

## Aims and Objectives

The Infrastructure Master Plan has three distinct primary aims:

- To develop, evaluate, identify and detail the water and wastewater infrastructure servicing plans for Halifax Water to service growth to 2046.
- To integrate the WRWIP servicing strategy and its supporting studies into the Infrastructure Master Plan, forming a complete infrastructure master plan for Halifax Water.
- Provide value added through conceptual design and study scoping that support the Infrastructure Master Plan and enhance the preferred strategies.

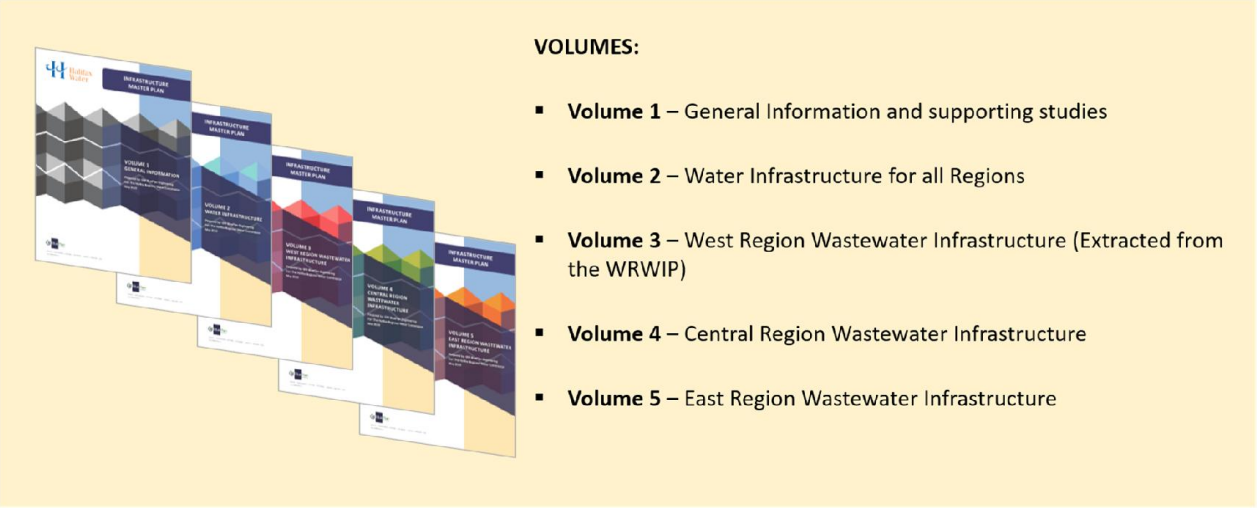
To achieve the aims of the Infrastructure Master Plan the following objectives have been satisfied:

- Undertake a baseline review of the water and wastewater systems and update assumptions made in the WRWIP.
- In coordination with Halifax Regional Municipality (HRM) Planning Department and Halifax Water, determine baseline and growth planning projections for HRM.
- Review existing criteria, level of service, policy, legislation and best practices related to long term infrastructure planning for water and wastewater networks.
- Review and study potential wet weather management techniques that may be beneficial for overall system management (Wet Weather Flow Management Study).
- Create a Climate Change Management Framework and assess the impact of climate change on water and wastewater design standards.
- Host a series of workshops with Halifax Water Planning, Asset Management, Engineering and Operation staff to understand and document known opportunities and constraints in the water and wastewater networks.
- Build and enhance the modelling tools for Halifax Water through transitioning wastewater models to InfoWorks ICM and updating the existing WaterCAD models.
- Develop strategy solutions, cost estimates, and evaluate alternatives to identify preferred servicing strategies.
- Develop Capital Programs for the water and wastewater projects, studies and costs and identify an implementation phasing plan for the preferred servicing strategies.

- Undertake conceptual designs and study scoping for imminent projects were value can be added to the design.

## Document Layout

The Infrastructure Master Plan is comprised of five Volumes as outlined in Executive Summary Figure 1.




**Executive Summary Figure 1: Infrastructure Master Plan Volume Layout**

**Volume 1** includes baseline information supporting the water and wastewater systems, the planning and growth projections, a summary of the standalone studies that were completed under the WRWIP and Infrastructure Master Plan, the general approach and methodologies used to develop the hydraulic model, strategy development processes used to form the final Capital Program, the conceptual designs completed and recommendations moving forward.

**Volumes 2 to 5** cover the details within the water and wastewater networks, the unique features, opportunities and constraints in the networks, the assessment of alternatives and projects that lead to forming the preferred strategies, costing and phasing to form the Capital Programs.

As illustrated in Figure 1, the WRWIP has been incorporated into the Infrastructure Master Plan to form a complete master plan of the wastewater and water networks across Halifax Water.

Halifax Water

# INFRASTRUCTURE MASTER PLAN

## EXECUTIVE SUMMARY

## VOLUME 1
## GENERAL INFORMATION

**Prepared by: GM BluePlan Engineering**
**For: Halifax Water**
**October 2019**

GM BluePlan ENGINEERING

GUELPH | OWEN SOUND | LISTOWEL | KITCHENER | LONDON | HAMILTON | GTA
www.GMBluePlan.ca

## VOLUME 1 – GENERAL INFORMATION

Volume 1 covers the general information of the Infrastructure Master Plan. It starts out with outlining how the WRWIP has been integrated into the Infrastructure Master Plan, the aim and objectives, document layout, as described above. The subsequent sections of Volume 1 are summarized below.

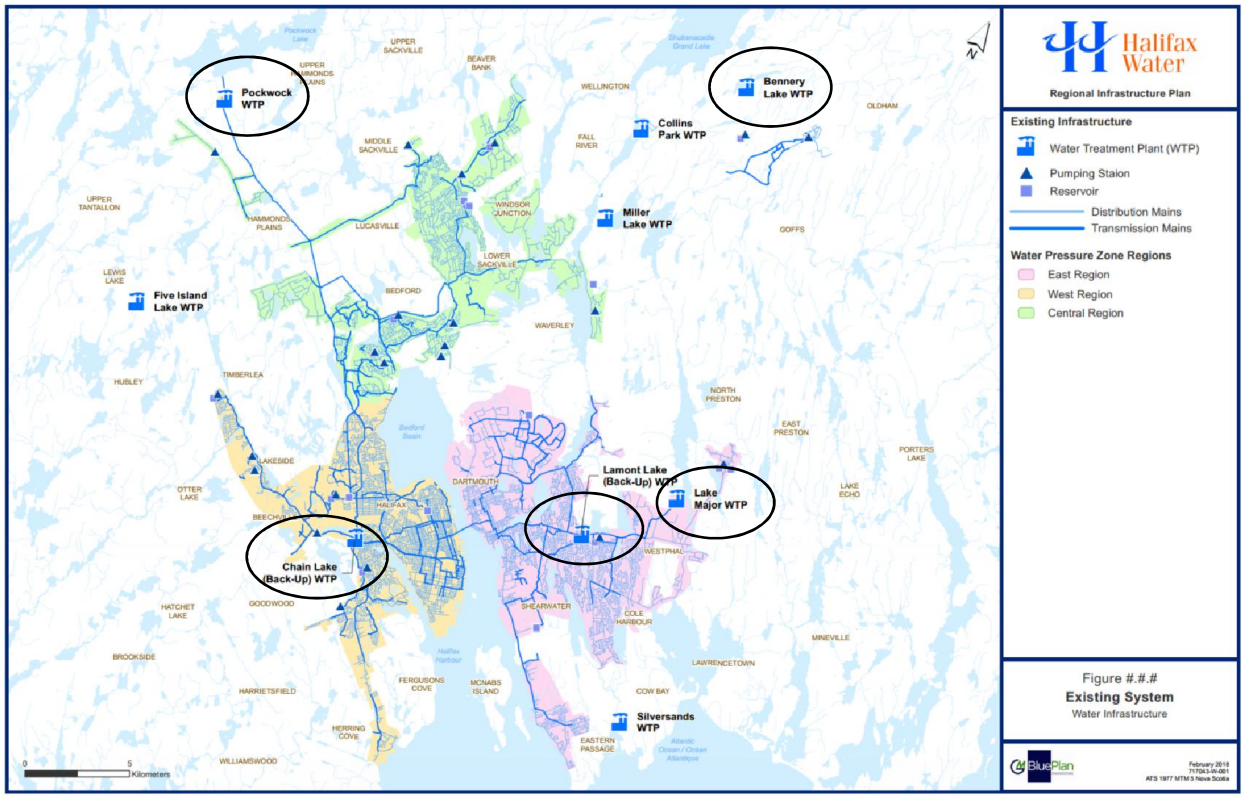
### Baseline Review and Consultation

The baseline review and consultation process were completed to develop the team's project knowledge on the water and wastewater study areas, and form technically feasible and acceptable solutions. The background review included existing data available and past reports on infrastructure needs and requirements. The background review provided detailed understanding on the existing and potential future requirements on the water and wastewater study areas.

The Figures below provide a general overview of the systems and the location of the main water and wastewater facilities included in the Infrastructure Master Plan study.

#### WATER

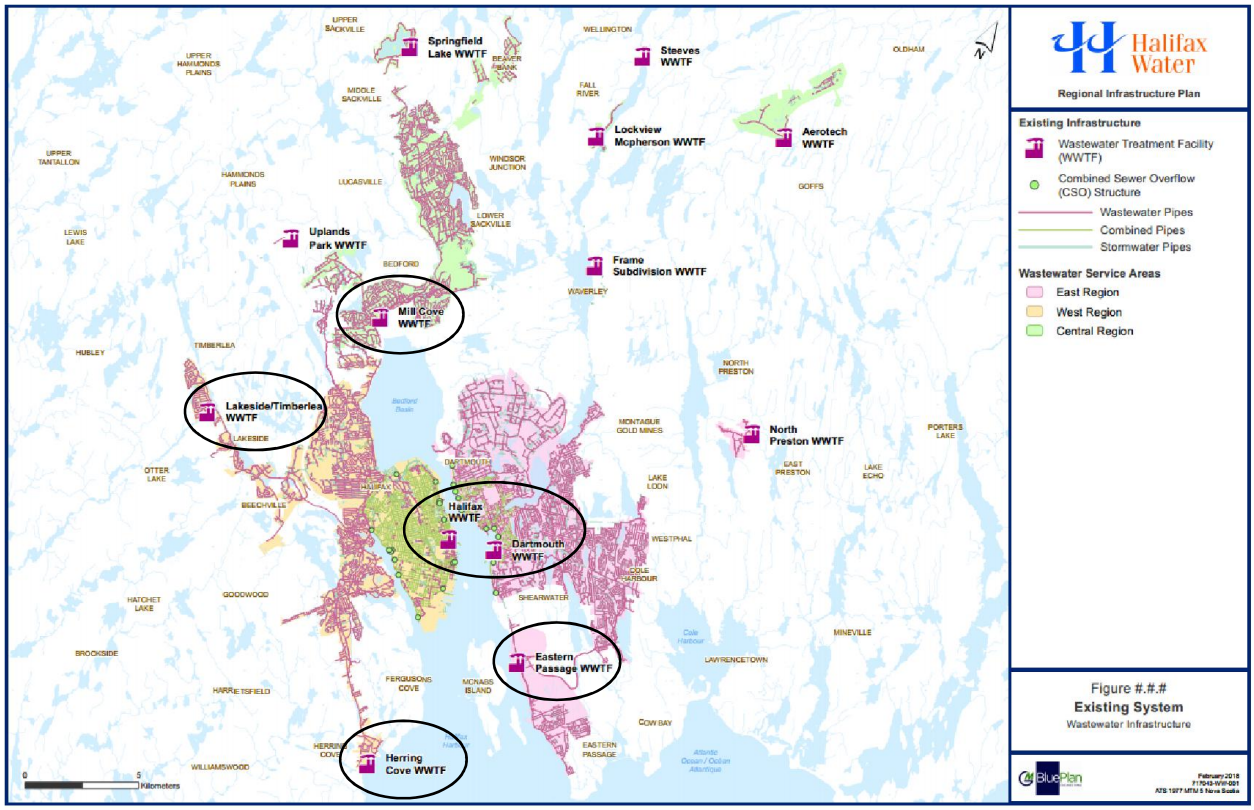
Executive Summary Figure 2 illustrates the delineation of the three main water distribution systems that are owned and operated by Halifax Water, and circles the main water supply plants (WSP) included in the Infrastructure Master Plan. The three main WSP are Pockwock, Lake Major and Bennery Lake WSPs, and the emergency back-ups supplies are Chain Lake and Lake Lamont.




**Executive Summary Figure 2: Overview of the Water Distribution System, highlighting the WSPs**

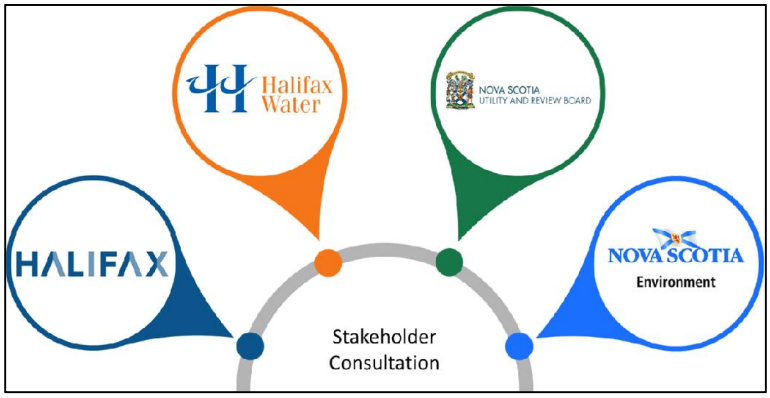
## WASTEWATER

Executive Summary Figure 3 illustrated the wastewater treatment facilities systems that are owned and operated by Halifax Water and circles the main wastewater treatment facilities (WWTF) included in the Infrastructure Master Plan. The six main WWTF are Halifax, Herring Cove, Beechville Lakeside Timberlea (BLT), Mill Cove, Dartmouth and Eastern Passage.




**Executive Summary Figure 3: Overview of the Wastewater Distribution System, highlighting WWTFs**

An important component of the Infrastructure Master Plan is stakeholders' involvement and input throughout the consultation process. The main consultation teams involved in the Infrastructure Master Plan are outlined in Executive Summary Figure 4. GM BluePlan has been liaising with the consultation teams to confirm regulatory requirements, determine population growth figures, understand issues and constraints in the networks, and to inform parties on progress and decisions made.




**Executive Summary Figure 4: Baseline Review Consultation Teams**

## Planning Data and Population Numbers

Halifax Water, GM BluePlan Engineering, and HRM Planning staff collaborated to define the planning projections dataset required to complete the Infrastructure Master Plan. Planning data and growth projections formed the baseline and growth demands on the systems, spanning the period from 2016-2046 (a 30-year planning horizon).

To form the baseline population numbers Census Data was used and distributed using dissemination blocks to civic address points, allowing existing population to be accurately added to the hydraulic models. The baseline employment numbers were determined from Industrial, Commercial and Institutional (ICI) customer billing points, that were then converted to population equivalent (PE), following design standards.

The growth projections defined under the Infrastructure Master Plan, reflect growth trends and planning guidelines to develop the Regional Centre, as outlined in the Centre Plan and Integrated Mobility Plan. Population growth was set to a 1% rate, and employment growth equating to 58% of population growth. Growth was divided between the Regions based on meeting the Integrated Mobility Plan population and employment growth splits and aligning with the Growth Areas and Allocation table, which included data on developments occurring over the project horizon.

**Executive Summary Table 1: Growth Population Equivalent (PE) 2016-2046**

| Location | Employment Growth PE | Population Growth PE | Total Growth PE |
|---|---|---|---|
| Mill Cove | 5,623 | 11,102 | 16,725[1] |
| Halifax | 28,839 | 66,365 | 95,204 |
| Herring Cove | - | 3,814 | 3,814 |
| BLT | - | 4,473 | 4,473 |
| Dartmouth | 32,436 | 42,074 | 74,510 |
| Eastern Passage | 3,591 | 3,385 | 6,976 |
| Aerotech | 8,597 | - | 8,597 |
| Rural | 6,877 | 17,000 | 23,877 |
| **Total** | **85,963** | **148,213** | **234,176** |

[1] *Total growth varied for Mill Cove between the water and wastewater systems. As two growth areas in the Central Region were only serviced by water the growth PE for wastewater was lower at 15,191.*

## Supporting Studies

Several supporting studies have been completed to formalize the foundational policies of regional infrastructure planning and guide the development of the preferred servicing strategies through a robust and defensible process. The supporting studies are a compilation of studies completed under the WRWIP and Infrastructure Master Plan. The studies are as follows:

### 1. Design Criteria, Level of Service and Policy Review

A comprehensive review of Halifax Water's existing design criteria, level of service (LOS) objectives, and relevant policies, for water supply and wastewater collection was completed as part of the Infrastructure Master Plan and supported by the investigations completed under the WRWIP.

**WASTEWATER**

The WRWIP assessed the design criteria, LOS and policy review for the wastewater collection system, to guide the West Region servicing strategy. This document was reviewed under the Infrastructure Master Plan to confirm and update the underlying assumptions for the East and Central Regions covered in the Infrastructure Master Plan.

**WATER**

A full review of the design criteria, LOS and policy review for the water distribution system was completed under the Infrastructure Master Plan, to support the water servicing strategies. The review for water followed the same approach as the WRWIP, including trend analyses and an industry best practice to validate the appropriateness of the criteria and level of service objectives, as they relate to the Infrastructure Master Plan.

### 2. WRWIP Supporting Studies

The Long-Term Planning Framework and Cost Estimation Framework were developed under the WRWIP to guide infrastructure planning needs and costing guidance and have been included in the Infrastructure Master Plan, as studies that assisted in guiding the final strategies.

- The Long-Term Planning Framework document provides direction for long-term water, wastewater and stormwater infrastructure planning needs, in a holistic approach that integrates and considers infrastructure types together. The framework considers all drivers of infrastructure management including growth, asset renewal, regulatory compliance, and operability.
- The Cost Estimation Framework was developed to form a standardized process for costing infrastructure projects. Infrastructure project cost estimates are used to create short, medium, and long-term budgets and impact funding requirements, and ultimately customer and developer charges.

### 3. Wet Weather Flow Management Study

The Wet Weather Flow Management Study was initiated under the WRWIP to better understand the feasibility of alternative wastewater servicing strategies, that focus on wet weather flow management options. The Wet Weather Flow Management Study was initially completed on just the West Region and therefore under the Infrastructure Master Plan the study was revisited and updated to include the Central and East Regions.

The study focuses on three feasibility studies:

- Combined Sewer Separation Feasibility Study
- Low Impact Development (LID) Feasibility Study
- Rainfall Derived Inflow and Infiltration (RDII) Reduction Feasibility Study

### COMBINED SEWER SEPARATION FEASIBILITY STUDY

The intent of this study is to identify the potential for strategic sewer separation within the combined networks (Halifax Peninsula and Dartmouth). Requirements to meet the Infrastructure Master Plan objectives and minimum local level of service of the wastewater infrastructure were considered against high level cost and feasibility.

It was ultimately determined that *Young Street, Kempt Road, and Connaught Avenue* in Halifax Peninsula and *Jamieson Street, Wyse Road, Nantucket Avenue, Thistle Street and Canal Street* in Dartmouth, are feasible areas for sewer separation and provide the greatest opportunities for flow reduction.

### LOW IMPACT DEVELOPMENT FEASIBILITY STUDY

The intent of this study was to highlight areas across the combined networks with the greatest opportunities to implement Low Impact Development (LID) solutions. This study assessed the feasibility of LID solutions in terms of constructability, cost/benefit, and implementation.

Based on the feasibility study and background review, it is unlikely that LID practices can provide sufficient reductions in flow with confidence in the performance over the short and long term to be an overall solution for the Regional servicing plan. However, these practices can be incorporated into the larger solution, where feasible, to reduce the extent of other capital projects and set the stage for a potential LID programs that targets the private level.

### INFLOW AND INFILTRATION REDUCTION FEASIBILITY STUDY

The intent of this study is to identify the potential for rainfall derived inflow and infiltration (RDII) reduction as part of the regional servicing strategy. The study covers the flow monitored separated networks across West, Central and East Regions. The RDII feasibility study provided RDII guidance for the West region under the WRWIP and was then expanded on under the Infrastructure Master Plan, for the Central and East Regions. A more in-depth assessment under the Infrastructure Master Plan led to providing pre-defined target RDII reduction areas that were incorporated into the preferred strategies for East and Central Regions.

### 4. Climate Change Study

The 2012 Integrated Resource Plan (IRP) identified the need to bring climate change considerations into municipal planning and meet a new objective of "adapting to future climate change". Through the Infrastructure Master Plan two climate change tasks were completed:

- Developing a "Vulnerability to Climate Change Risk Assessment" framework to create a robust framework that can be applied consistently across assets and be used to complete vulnerability assessments of existing infrastructure
- Review existing Design Standards and the Long-Term Planning Framework with climate change factors, allowing for future projects to include climate change considerations

The outcomes of the study led to climate change being included in the Infrastructure Master Plan as follows:

- Rainfall simulation events include a climate change factor of 16%
- Sea level rise was considered for infrastructure requirements
- A drought study was recommended on drinking water sources

### 5. Opportunities and Constraints Workshop

An Opportunities and Constraints workshop covering the wastewater and water systems was held at Halifax Water on March 6th, 2018. The workshop included Halifax Water's Operation Teams, Project Managers and Directors and the Halifax Water and GM BluePlan project teams. The workshop was set up to enable the project team to understand issues, constraints and opportunities within the wastewater and water supply networks. The GM BluePlan team then used the outcomes from the workshop to inform the overall servicing strategies that accommodate the Long-Term strategy drivers of growth, compliance, asset renewal, and operational optimization.

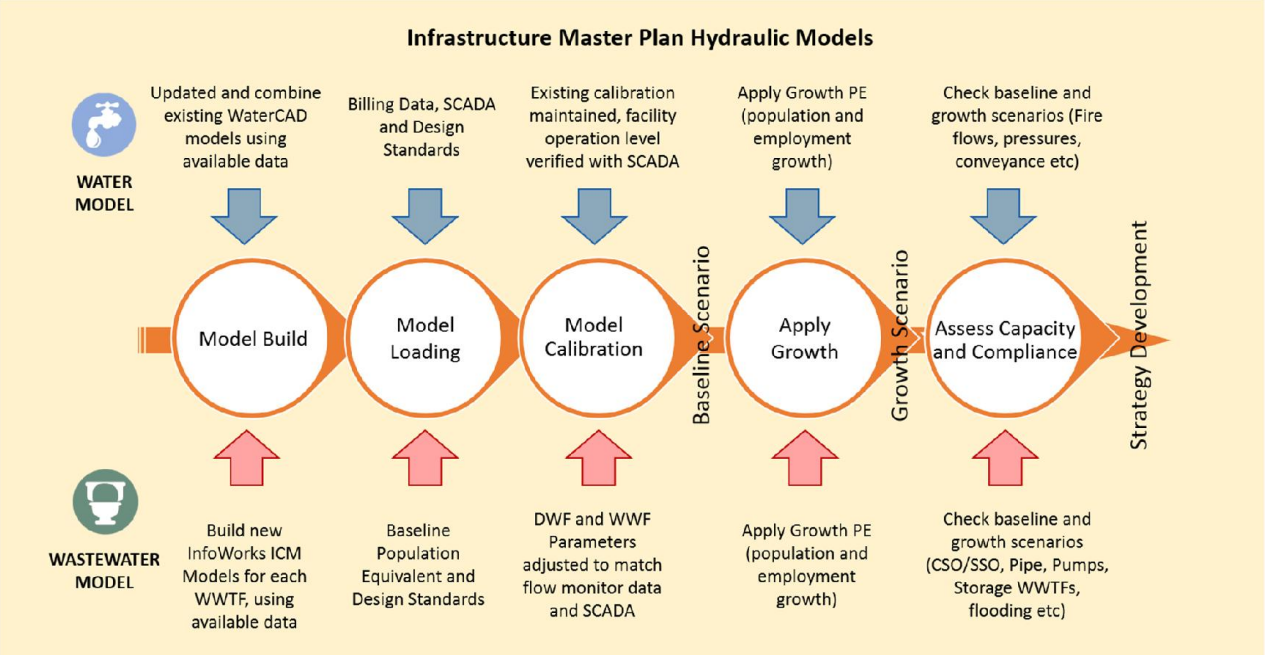
### 6. Unit Costing Workshop

Halifax Water's Unit Costing template is the main tool used for costing projects. The Unit Costing template has been refined over recent years, from costing capital projects under the IRP, being updated under the WRWIP to align with the Cost Estimation Framework, and further reviewed under the Infrastructure Master Plan at a Unit Costing Workshop. At the workshop the template was assessed to confirm current trends and updated to produce 2019 rates. The outcome of changes from a project cost perspective are relatively minor, and covered in the Project Evaluation and Costing section.

## Hydraulic Modelling

A series of activities were completed to prepare and ultimately use the water and wastewater models to undertake the growth impact analysis on infrastructure requirements. The modelling process included model build, loading and calibration to form the baseline scenario, growth was then applied to the calibrated models to form the growth scenario, from there capacity and compliance was assessed, allowing the strategy development stage to occur. Executive Summary Figure 5 outlines the modelling stages with the processes and steps completed for both the water and wastewater models.

At the end of the modelling process the water systems were included in one model, while the wastewater models were divided by WWTFs. The combined water model was due to the interconnection and synergies between the water systems and strategies combining the regions serviced, while the wastewater models were distinctly separated by the existing WWTFs catchments.




**Executive Summary Figure 5: Modelling Stages for the Water and Wastewater Models**

To assist with future update to the models, guidelines on the modelling process are included in the appendices of Volume 1.

## Capacity and Compliance

The newly calibrated models were used to assess system performance under both existing and growth scenarios. The results from these simulations were used to validate and identify the primary constraints within the system, and to evaluate opportunities to resolve these limitations.

Two other key sources of information were used for the capacity and compliance assessment, they were the opportunities and constrains workshop with Halifax Water staff and a facility desktop analyses. The desktop facility analysis included supply, storage and WSPs capacities for the water systems and WWTFs capacity for the wastewater systems.

The outcomes of the capacity and compliance assessment were used in the development of the servicing strategy for the water and wastewater systems.

## Strategy Development

The strategy development process varied between the water and wastewater systems to align with service requirements and regulations. The processes are as follows.

### WASTEWATER

The wastewater models followed the same strategy development process completed in the WRWIP. The opportunities and constraints identified for the Regions were used to inform the development of multiple servicing strategy alternatives, that were simulated using the model, costed and evaluated, to identify a preferred servicing strategy. Informed by the hydraulic model and various studies, the strategy development process began with the identification of projects common across all strategies, considered “Common Projects”. Once the Common Projects were defined different servicing strategies were tested in the models and compared, and the preferred servicing strategy was selected.

### WATER

The water distribution strategy was developed using four key drivers; accommodate growth, provide security of supply and system resiliency, identify synergies with asset renewal, and where possible provide opportunities for system optimization. The strategy approach for growth followed a top-down approach starting with providing adequate supply to all systems, ensuring transmission networks can sufficiently convey the supply, and confirming local needs are met.

## Project Evaluation and Costing Considerations

### WASTEWATER

The selection of the preferred strategy was based on selecting the top three to five alternative strategies that would be evaluated against each other to determine the preferred strategy.

The first step was to remove less desirable strategies due to aspects of feasibility, cost and level of service. Then the top three to five alternative strategies were evaluated using the five-point evaluation factors (Technical, Financial, Legal/Jurisdictional, Environmental, and Socio/Cultural). Following stakeholder consultation, the final preferred strategy was presented with input from the project team.

PROJECT COSTING

A capital cost estimate (in 2019 dollars) was completed for all projects encompassed within the proposed strategies. Halifax Water’s Unit Costing template, a newly developed RDII Reduction Costing Template and existing knowledge on projects were used to build the final Capital Program costs.

The Unit Costing template is a detailed costing sheet that includes hard and soft cost components. Use of this template in the Infrastructure Master Plan resulted in Class 4 (Master Plan level) cost estimates (planning cost estimate with a 30% margin), in accordance to the Cost Estimation Framework. The costs are unit based and include an allowance for the following additional components:

- Engineering and Design
- Professional Fees/Geotechnical/Hydrogeological
- Construction Management/Contract Administration
- In-House Labour/Engineering/Wages/CAD
- Overheads
- Project Contingency

The Unit Cost template was reviewed and updated through the Infrastructure Master Plan, based on outcomes from the Unit Costing Workshop. The changes to the Unit Cost template included adjustments to unit rates for pipe construction, moving the location of the soft costs in the template and updating the overhead contingencies rate.

The impact of the above changes from a project cost perspective are relatively minor. The main change to costing projects was introducing a RDII Costing Template. The RDII Costing Template was developed to improve the accuracy of costing RDII reduction, through reviewing case studies and costing RDII based on catchment size, land use and volume of existing facilities in the catchment.

A cash flow analysis was completed to assess the annual lifecycle costs and net present value of each project. The individual project costs were added to determine the capital cost of each strategy.

PROJECT PHASING

A project phasing exercise was completed to identify the timing requirements for each project. Projects are either triggered immediately due to existing constraints, in the future when a specified capacity is reached because of growth, or dependent on the completion of other projects.

CAPITAL PROGRAMS

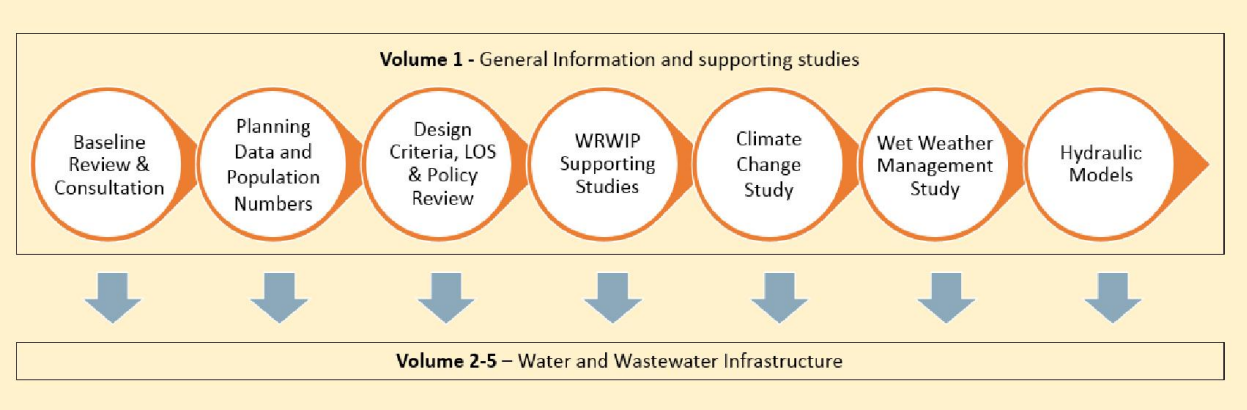
The final Capital Programs for wastewater are in Executive Summary Table 3 and for water are in Executive Summary Table 4, including project name, description, phasing, and capital cost. Executive Summary Table 2 summaries the capital cost per region for water and wastewater.

**Executive Summary Table 2: Total Water and Wastewater Capital Costs Per Region**

| Location | Total Capital Cost (2019$) |
|---|---|
| West Region* | **$186,261,000** |
| Central – Mill Cove | **$163,483,000** |
| East – Eastern Passage | **$49,478,000** |
| East – Dartmouth | **$104,358,000** |
| Water all Regions | **$284,706,000** |
| **Total** | **$788,286,000** |

*Cost updated from WRWIP to 2019 dollars using the updated Unit Costing and RDII Costing templates

As mentioned above, Volume 1 provides several supporting documents, methodologies and processes that feed into Volumes 2 to 5. Executive Summary Figure 6 summarizes the major components in Volume 1 that support the subsequent volumes.




**Executive Summary Figure 6: Volume 1 Supporting Studies Summary**

**Executive Summary Table 3: Wastewater Capital Program Summary**

| | Project Category | Project ID | Project Name | Project Description | Start Year | Planning Period | Total Capital Cost (2019$) |
|---|---|---|---|---|---|---|---|
| West Region: Halifax | Peninsula Halifax | WR1 | WRWIP: Spring Garden Area Sewer Separation | *Full separation of Spring Garden LoWSCA pocket - 5 individual projects* | 2018-2023 | 2016-2021 | $ 7,281,000 |
| | | WR2 | WRWIP: Young Street Area Sewer Separation | *Full separation of Young Street LoWSCA pocket - 18 individual projects* | 2018-2023 | 2016-2021 | $ 21,879,000 |
| | | WR3 | WRWIP: Sewer Separation Upstream of Kempt CSO | *Full separation of a portion of the Kempt CSO sewershed - 17 individual projects* | 2018-2025 | 2016-2021 | $ 14,752,000 |
| | | WR4 | WRWIP: Linear Upsize - Quinpool Road | *525mm ø combined sewer upsize along Quinpool Road (from Preston to Oxford)* | 2020 | 2016-2021 | $ 437,000 |
| | | WR5 | WRWIP: Linear Upsize - Gottingen & Cogswell Area | *750mm ø combined sewer upsize along Portland Place (from Saunders to Brunswick) + 900mm ø combined sewer upsize along Brunswick Street* | 2020 | 2016-2021 | $ 221,000 |
| | | WR6 | WRWIP: Gottingen Street and North Street Intersection Flow Split | *Lower the invert of the combined sewer along Gottingen, on the south side of North Street* | 2020 | 2016-2021 | $ 500,000 |
| | | WR7 | WRWIP: Young Pumping Station Upgrade | *New 300mm diameter alignment + Installation of new pumps to increase the station capacity from 114L/s to 250L/s* | 2027 | 2026-2031 | $ 2,169,000 |
| | | WR8 | WRWIP: New Fairfield Holding Tank | *New 3,700 cubic metre holding tank at the existing Fairfield Holding Tank site* | 2046 | 2041-2046 | $ 12,403,000 |
| | | WR9 | WRWIP: Replace Armdale Pumping Station Forcemains | *Upsize the existing 300mm ø Armdale Pumping Station forcemains with new twinned 400mm ø forcemains* | 2020 | 2016-2021 | $ 3,850,000 |
| | **Halifax Inflow and Infiltration** | **WR13** | WRWIP: RDII Reduction Program | *Implement an Inflow and Infiltration Reduction Program within the Fairview, Clayton Park, and Bridgeview areas (CCTV, Smoke/Dye Testing, Property Disconnections, Sewer Lining)* | 2020 | 2016-2021 | $ 15,491,589 |
| | **Halifax Fairview Cove Tunnel** | **WR19** | WRWIP: Fairview Cove Linear Upsize | *Upsize existing 1050mm ø tunnel to 1800mm ø* | 2019 | 2016-2021 | $ 19,781,000 |
| | **Wastewater Treatment Facility** | **WR20** | WRWIP: Halifax Treatment Plant Capacity Upgrade | *Increase the rated capacity of Halifax WWTF from 134 MLD to 140 MLD* | 2041 | 2036-2041 | $ 25,142,000 |
| | **Halifax Greenfield** | **WR21** | WRWIP: Linear Upgrades within the Kearney Lake Road Area | *Sanitary sewer upgrades downstream of the Kearney Lake Road Pumping Station* | 2033 | 2031-2036 | $ 2,997,000 |
| | **Halfax Flow Optimization** | **WR22** | Infrastructure Master Plan: CSO Management Study | *Monitor and assess CSO facilities to mitigate discharges (16 facilities). Costed at $14,000/monitor and $15,000/CSO for assessment.* | 2026 | 2016-2021 | $ 965,000 |
| | | **WR23** | Infrastructure Master Plan: SSO Management Study | *Monitor and assess SSO facilities to mitigate discharges (6 facilities). Costed at $14,000/monitor and $15,000/SSO for assessment.* | 2021 | 2016-2021 | $ 415,000 |
| | **HALIFAX Total Wastewater Servicing Strategy Cost** | | | | | | **$ 128,283,589** |

**Executive Summary Table 3: Wastewater Capital Program Summary (continued)**

| | Project Category | Project ID | Project Name | Project Description | Start Year | Planning Period | Total Capital Cost (2019$) |
|---|---|---|---|---|---|---|---|
| West Region: BLT | BLT WWTF Decommission | WR10 | WRWIP: BLT WWTF Decommission - New Timberlea PS | *New 247L/s Timberlea Pumping Station at existing BLT WWTF site* | 2020 | 2016-2021 | $ 5,928,000 |
| | | WR11 | WRWIP: BLT WWTF Decommission - New Timberlea Forcemain | *New 450mm ø forcemain from new Timberlea Pumping Station to gravity sewer start near Bayers Lake* | | | $ 19,436,000 |
| | | WR12 | WRWIP: BLT WWTF Decommission | *Decommissioning of BLT WWTF and site recovery* | | | $ 500,000 |
| | BLT Diversion to Herring Cove | WR14 | WRWIP: BLT Flow Diversion to Herring Cove - New Crown Drive Pumping Station | *Construct new 370L/s pumping station to divert all of BLT flow to Herring Cove* | 2033 | 2031-2036 | $ 8,063,000 |
| | | WR15 | WRWIP: BLT Flow Diversion to Herring Cove - New Crown Drive Forcemain | *Construct new twinned 450mm ø forcemain along Northwest Arm Drive from new proposed Crown Drive Pumping Station to Cowie Hill* | | | $ 9,026,000 |
| | | WR16 | WRWIP: BLT Flow Diversion to Herring Cove - New Gravity Sewer | *Construct new 600mm ø gravity sewer along Northwest Arm Drive from Cowie Hill to Herring Cove Road south of Levis Street* | | | $ 4,319,000 |
| | | WR17 | WRWIP: BLT Flow Diversion to Herring Cove - New Gravity Sewer | *Construct new 1050mm ø gravity sewer from COLTA sewer to new Crown Drive Pumping Station* | | | $ 3,266,000 |
| | **BLT Total Wastewater Servicing Strategy Cost** | | | | | | **$ 50,538,000** |
| Herring Cove | **Herring Cove Linear Upsizing** | **WR18** | WRWIP: Herring Cove Road - Gravity Sewer Upsize | *Upsize sanitary sewers (to 900mm ø) downstream of Roaches Pond Pumping Station* | 2033 | 2031-2036 | $ 7,439,000 |
| | **HERRING COVE Total Wastewater Servicing Strategy Cost** | | | | | | **$ 7,439,000** |
| | **WEST REGION Total Wastewater Servicing Strategy Cost** | | | | | | **$ 186,260,589** |

Executive Summary Table 3: Wastewater Capital Program Summary (continued)

| | Project Category | Project ID | Project Name | Project Description | Start Year | Planning Period | Total Capital Cost (2019$) |
|---|---|---|---|---|---|---|---|
| Central Region: Mill Cove and Springfiled Lake | Trunk Upgrades | MC1 | Trunk Sewer Upgrades | *Sackville Trunk Upgrades to 1200mm diameter* | 2036 | 2036-2041 | $ 5,101,000 |
| | | MC2 | Trunk Sewer Upgrades | *Sackville Trunk Upgrades to 1050mm diameter* | 2036 | 2036-2041 | $ 8,246,000 |
| | | MC3 | Trunk Sewer Upgrades | *Sackville Trunk Upgrades to 1500mm diameter* | 2036 | 2036-2041 | $ 144,000 |
| | Storage tank Upgrades | MC4 | Storage Tank | *Offline storage tank near Sackville Goodlife Fitness Centre (5ML)* | 2031 | 2031-2036 | $ 17,469,000 |
| | Upgrades to Pumping Stations | MC5 | Fish Hatchery Park Pumping Station Upgrade | *Upsize existing 450mm forcemain from Fish Hatchery Park PS to 675mm diameter and increase pumping capacity to 1500 L/s with an addition of 100 L/s capacity* | 2036 | 2031-2036 | $ 10,529,000 |
| | | MC6 | Pumping Station (Beaver Bank #3 PS and Majestic Avenue PS) | *Increase pumping capacity at Beaver Bank #3 PS from 55 L/s to 100 L/s, and increase pumping capacity of Majestic Avenue PS from 82 L/s to 165 L/s to eliminate growth-impacted SSO discharge* | 2036 | 2036-2041 | $ 1,090,000 |
| | Wastewater Treatment Facility | MC7 | Mill Cove Wastewater Treatment Plant Capacity Upgrade | *WWTF Upgrade* | 2021 | 2021-2026 | $ 89,256,000 |
| | Inflow and Infiltration | MC8 | RDII Reduction Program FMZ07, FMZ10, & FMZ40 | *Implement an Inflow and Infiltration Reduction Program within the Lower Sackville areas FMZ07, FMZ10, & FMZ40 (CCTV, Smoke/Dye Testing, Property Disconnections, Sewer Lining)* | 2020 | 2016-2021 | $ 9,288,248 |
| | | MC9 | RDII Reduction Program FMZ02 & FMZ03 | *Implement an Inflow and Infiltration Reduction Program within Bedford areas FMZ02 & FMZ03 (CCTV, Smoke/Dye Testing, Property Disconnections, Sewer Lining)* | 2031 | 2031-2036 | $ 8,023,065 |
| | Local New Networks and Upgrades | MC10 | Local network upgrades on Beaver Bank Rd. North of Glendale Dr. | *Upsize from 200mm to 450mm diameter gravity sewer along Beaver Bank Rd.* | 2021 | 2021-2026 | $ 2,086,000 |
| | | MC11 | Local network upgrades on Beaver Bank Rd. at Galloway Dr. | *Upsize from 300mm to 450mm diameter gravity sewer along Beaver Bank Rd.* | 2021 | 2021-2026 | $ 1,490,000 |
| | | MC12 | Local network upgrades on Beaver Bank Rd by Windgate Drive | *Upsize from 300mm to 375mm diameter gravity sewer along Beaver Bank Rd.* | 2021 | 2021-2026 | $ 1,667,000 |
| | | MC13 | Local network upgrades on Old Sackville Road south of Harvest Hwy | *Upsize from 200mm to 375mm diameter gravity sewer along Old Sackville Road* | 2036 | 2036-2041 | $ 845,000 |
| | | MC14 | Local network upgrades on on Hallmark Ave. | *Upsize from 200mm to 375mm diameter gravity sewer on Hallmark Ave.* | 2036 | 2036-2041 | $ 437,000 |
| | | MC15 | Local Sewer Upgrades on Waterfront Drive | *375 mm Sewer Upgrade on Waterfront Drive* | 2036 | 2036-2041 | $ 500,000 |
| | Springfield Lake | MC16 | Springfield Lake Connection to Sackville | *Decommission Springfield Lake WWTF, divert all flow to Mill Cove WWTF via new pumping station and gravity sewer to connect at top of Sackville trunk sewer.* | 2043 | 2041-2046 | $ 6,226,000 |
| | Flow Optimization | MC17 | SSO Management Study | *Monitor and assess SSO facilities to mitigate discharges (18 facilities). Costed at $14,000/monitor and $15,000/SSO for assessment.* | 2021 | 2021-2026 | $ 1,086,000 |
| | **CENTRAL REGION Total Wastewater Servicing Strategy Cost** | | | | | | **$ 163,483,313** |

Executive Summary Table 3: Wastewater Capital Program Summary (continued)

| | Project Category | Project ID | Project Name | Project Description | Start Year | Planning Period | Total Capital Cost (2019$) |
|---|---|---|---|---|---|---|---|
| East Region Eastern Passage | Gravity Pressure Sewer | EP1 | Install new Gravity Pressure Sewer | *Install new 450 and 825mm Ø gravity pressure sewer* | 2021 | 2021-2026 | $ 23,372,000 |
| | | EP2 | Connect Beaver Crescent and Caldwell Forcemains to new 450mm gravity pressure sewer | *Connect Beaver Crescent and Caldwell Forcemains to new gravity pressure sewer* | 2026 | 2026-2031 | $ 78,000 |
| | | EP3 | Install new pump out stations | *Install 4 new pump out stations in the low point of the gravity pressure sewer* | 2026 | 2026-2031 | $ 1,676,000 |
| | | EP4 | Install gate valves at surge tank | *Optimize flows at the surge tank through gate valves* | 2026 | 2026-2031 | $ 420,000 |
| | | EP5 | Decommission existing 450mm gravity pressure sewer | *Grout fill the 450mm Ø asbestos gravity pressure sewer* | 2043 | 2041-2046 | $ 559,000 |
| | Upgrades to Pumping Stations | EP6 | Upgrade Quigley Corner Pumping Station | *Increase pumping capacity at Quigley to 570l/s with an addition of 343l/s* | 2021 | 2021-2026 | $ 2,875,000 |
| | | EP7 | Optimize Quigley's Corner PS | *Forcemain optimization and SLR assessment* | 2021 | 2021-2026 | $ 336,000 |
| | | EP8 | Upgrade Memorial Drive Pumping Station | *Increase pumping capacity at Memorial Drive PS with an addition of 65l/s. Install new dual 300mm ø forcemain* | 2031 | 2031-2036 | $ 2,633,000 |
| | | EP9 | Upgrade Beaver Crescent Pumping Station | *Increase pumping capacity at Beaver Crescent PS with an addition of 20l/s* | 2036 | 2036-2041 | $ 168,000 |
| | | EP10 | Upgrade Bissett Lake Pumping Station | *Increase pumping capacity at Bissett Lake PS with an addition of 350l/s* | 2041 | 2036-2041 | $ 2,934,000 |
| | | EP11 | Upgrade Caldwell Road Pumping Station | *Increase pumping capacity at Caldwell Road PS with an addition of 70l/s. Install new dual 200mm ø forcemains* | 2039 | 2036-2041 | $ 631,000 |
| | Inflow and Infiltration | EP12 | RDII Reduction Program FMZ23 | *Implement an Inflow and Infiltration Reduction Program within the Cole Harbour areas (CCTV, Smoke/Dye Testing, Property Disconnections, Sewer Lining) - FMZ23* | 2031 | 2031-2036 | $ 3,204,580 |
| | | EP13 | RDII Reduction Program FMZ24 | *Implement an Inflow and Infiltration Reduction Program within the Loon Lake areas (CCTV, Smoke/Dye Testing, Property Disconnections, Sewer Lining)- FMZ24* | 2020 | 2016-2021 | $ 1,570,040 |
| | | EP14 | RDII Reduction Program FMZ37 | *Implement an Inflow and Infiltration Reduction Program within the Eastern Passage areas (CCTV, Smoke/Dye Testing, Property Disconnections, Sewer Lining)- FMZ37* | 2020 | 2016-2021 | $ 2,479,704 |
| | Local New Networks and Upgrades | EP15 | Local network upgrades on Caldwell Road | *Upsize from 200 to 300mm ø gravity sewer along Caldwell Road* | 2036 | 2036-2041 | $ 607,000 |
| | | EP16 | Local network upgrades on Colby Drive | *Upsize from 200 to 300mm ø gravity sewer along Colby Drive* | 2031 | 2031-2036 | $ 1,176,000 |
| | | EP17 | Local network upgrades on Forest Hill Parkway | *Construct new 450mm ø gravity sewer along Forest Hill Parkway connect to pipeline on Nestor Crescent* | 2041 | 2041-2046 | $ 4,275,000 |
| | Flow Optimization | EP18 | SSO Management Study | *Monitor and assess SSO facilities to mitigate discharges (8 facilities). Costed at $14,000/monitor and $15,000/SSO for assessment.* | 2021 | 2021-2026 | $ 484,000 |
| | EASTERN PASSAGE Total Wastewater Servicing Strategy Cost | | | | | | $ 49,478,324 |

Executive Summary Table 3: Wastewater Capital Program Summary (continued)

| | Project Category | Project ID | Project Name | Project Description | Start Year | Planning Period | Total Capital Cost (2019$) |
|---|---|---|---|---|---|---|---|
| East Region : Dartmouth | Lakes and Sewer Separation | D1 | LoWSCA: Canal Street Separation | *Full separation of Canal Street LoWSCA pocket - 1 individual project. Install new stormwater pipelines, separate 35 properties and reconnect 8 catchbasins.* | 2020 | 2016-2021 | $ 1,842,000 |
| | | D2 | LoWSCA: Wyse Road Separation | *Full separation of Wyse Road LoWSCA pocket - 3 individual project, two phases.*<br>*Phase 1 - Install new stormwater pipelines along Albro Lake Road and Windmill Road, separate 43 properties and reconnect 18 catchbasins (Area A).*<br>*Phase 2 - Install new stormwater pipelines along Wyse Road, connecting to Albro Lake stormwater pipe, separate 111 properties and reconnect 4 catchbasins (Area B).*<br>*Install new sewer diversion from Lyle St Catchment to Jamieson(Area C).* | 2020 | 2016-2021 | $ 3,860,000 |
| | | | | | 2021 | 2021-2026 | $ 2,802,000 |
| | | D3 | Additional Stormwater Separation on Wyse Street | *450mm ø stormwater pipe connecting to Park Ave CSO, separate 6 properties and reconnect 1 catchbasin.* | 2031 | 2026-2031 | $ 1,912,000 |
| | | D5 | Albro Lakes Watershed Separation | *Full separation of Albro Lakes Watershed, install new stormwater trunk line, connecting to Jamieson Street CSO outfall.* | 2021 | 2021-2026 | $ 8,111,000 |
| | | D6 | Maynard Lake and Clement Street Wetland Separation | *Full separation of Maynard Lake and the Clement Street Wetland - 4 phases*<br>*Phase 1 - Install 1050mm pipeline in Old Ferry Rd, connection to CSO outfall, connect stormwater pipeline from Hazlehurst Street and catchbasins en route*<br>*Phase 2 - Install 750mm pipeline working upstream to the Wetland, continue to connect to catchbasin en route*<br>*Phase 3 - Install 600mm pipeline connecting Maynard Lake to the pipeline*<br>*Phase 4 - Connect to stormwater network for DSM and Fenwick Drive properties and separate North Woodside - Southdale Elementary and surrounding businesses* | 2031 | 2026-2031 | $ 642,000 |
| | | | | | 2031 | 2031-2036 | $ 4,540,000 |
| | | | | | 2033 | 2031-2036 | $ 1,155,000 |
| | | | | | 2036 | 2031-2036 | $ 453,000 |
| | Upgrades to Pumping Stations | D7 | New Valleyford Pumping Station | *Install new pumping station by the Valleyford Holding Tank to a capacity of 300l/s. Install new forcemain down Raymond Street and Maple Drive, to connect to the trunk sewer* | 2041 | 2036-2041 | $ 10,446,000 |
| | | D8 | 390 Waverley Road Upgrades | *Install new dual 500mm ø forcemain following existing path with a diversion to the North Dartmouth Trunk Sewer, by Highway 118* | 2021 | 2021-2026 | $ 11,361,000 |
| | | D9 | Anderson Pumping Station Upgrades | *Install new 300mm ø forcemain following existing path. Alter flow path from holding tank to PS by adjusting pipe grades between infrastructure* | 2031 | 2031-2036 | $ 340,000 |
| | Dartmouth WWTF Upgrades | D10 | Upgrades to Dartmouth WWTF | *Upgrade Dartmouth WWTF to meet demand at end of Project Horizon* | 2043 | 2036-2041 | $ 12,572,000 |
| | Inflow and Infiltration | D11 | RDII Reduction Program | *Implement an Inflow and Infiltration Reduction Program within the Ellenvale areas (CCTV, Smoke/Dye Testing, Property Disconnections, Sewer Lining)* | 2021 | 2021-2026 | $ 5,941,076 |
| | | D12 | RDII Reduction Program | *Implement an Inflow and Infiltration Reduction Program within the Woodside areas (CCTV, Smoke/Dye Testing, Property Disconnections, Sewer Lining)* | 2031 | 2031-2036 | $ 1,120,232 |
| | | D13 | Additional flow monitoring | *Flow monitoring through the catchment to assess areas in model showing flooding* | 2020 | 2016-2021 | $ 252,000 |

Executive Summary Table 3: Wastewater Capital Program Summary (continued)

| | Project Category | Project ID | Project Name | Project Description | Start Year | Planning Period | Total Capital Cost (2019$) |
|---|---|---|---|---|---|---|---|
| East Region : Dartmouth | Local New Networks and Upgrades | D15 | Green St Upsize | *Common project - Upsize from 375 to 750mm ø gravity sewer along Green Street* | 2041 | 2041-2046 | $ 513,000 |
| | | D16 | Pinecrest Dr Upgrade | *Common project - Upsize from 200 to 375mm ø gravity sewer along Pinecrest Drive* | 2031 | 2031-2036 | $ 1,013,000 |
| | | D17 | Peddars Way Upgrade | *Common project - Upsize from 300 to 375mm ø gravity sewer along Peddars Way* | 2031 | 2031-2036 | $ 555,000 |
| | | D18 | Atlantic Street Upgrade | *Common project - Upsize from 250 to 450mm ø gravity sewer along Atlantic St* | 2021 | 2021-2026 | $ 3,831,000 |
| | | D19 | Akerley Blvd and Railway Alignment Upgrade | *Strategy project - Upsize from 250 to 600mm ø gravity sewer along Akerley Blvd and Railway easement towards Ferguson Road CSO* | 2041 | 2036-2041 | $ 4,814,000 |
| | | D20 | Pleasant Street Upgrade | *Strategy project - Upsize from 200 to 450mm ø gravity sewer along Pleasant St, and towards Cuisack Street CSO* | 2021 | 2021-2026 | $ 767,000 |
| | | D21 | Princess Margaret Blvd. Upgrade | *Strategy project - Upsize from 450 to 600mm ø gravity sewer along Princess Margaret Blvd.* | 2031 | 2031-2036 | $ 3,106,000 |
| | | D22 | Anderson Lake Development Connection | *Strategy project - Construct new 450mm ø gravity sewer to connect Anderson Lake development to Akerley Blvd* | 2036 | 2036-2041 | $ 7,609,000 |
| | | D23 | Marvin Connection | *Strategy project - Construct new 450mm ø gravity sewer in Marvin Street and connect to connect Cuisack Street CSO* | 2026 | 2026-2031 | $ 1,380,000 |
| | Flow Diversion | D24 | King Street Diversion | *Common Project - 450mm ø sewer diversion to NDTS* | 2026 | 2026-2031 | $ 78,000 |
| | | D25 | Diversion to Eastern Passage | *Install new pumping station at Melva St CSO. Install new dual 600mm ø forcemain following Pleasant Street and connecting to existing gravity pipe in Eastern Passage network. Upgrade existing gravity pipe from a 200 to 600mm ø.* | 2036 | 2036-2041 | $ 12,113,000 |
| | Flow Optimization | D14 | CSO Flow Management Study | Monitor and assess CSO facilities to mitigate discharges (11 facilities). Costed at $14,000/monitor and $15,000/CSO for assessment. | 2036 | 2036-2041 | $ 675,000 |
| | | D26 | SSO Flow Management Study | Monitor and assess SSO facilities to mitigate discharges (9 facilities). Costed at $14,000/monitor and $15,000/SSO for assessment. | 2021 | 2016-2021 | $ 555,000 |
| **DARTMOUTH Total Wastewater Servicing Strategy Cost** | | | | | | | **$ 104,358,308** |
| **EAST REGION Total Wastewater Servicing Strategy Cost** | | | | | | | **$ 153,836,631** |
| **ALL REGIONS Total Wastewater Servicing Strategy Cost** | | | | | | | **$ 563,082,533** |

**Executive Summary Table 4: Water Capital Program Summary**

| Project Category | Project Name | Project ID | Project Task | Start Year | Planning Period | Total Capital Cost (2019$) |
|---|---|---|---|---|---|---|
| Pockwock - Peninsula | Peninsula Transmission Upgrades (Chain Control) | W06.1 | Chain Control Transmission - Existing Peninsula Low Upsize | 2021 | 2021-2026 | $ 3,841,000 |
| | | W06.2 | Chain Control Transmission - Existing Peninsula Intermediate Upsize | 2021 | 2021-2026 | $ 2,650,000 |
| | | W06.3 | Pepperell Transmission | 2036 | 2036-2041 | $ 2,702,000 |
| | | W06.4 | Chain Control Transmission - Existing Peninsula Low Lining | 2036 | 2036-2041 | $ 2,916,000 |
| | | W06.5 | Chain Control Transmission - Valve Chambers | 2036 | 2036-2041 | $ 1,258,000 |
| | Twinning of Peninsula Transmission (Robie) | W07 | Replace High Risk Peninsula Transmission (Robie) | 2026 | 2026-2031 | $ 17,312,000 |
| | Quinpool to Young Connection | W08 | Peninsula Intermediate Looping - Quinpool Rd to Young St | 2021 | 2021-2026 | $ 4,319,000 |
| | Young Street Pocket Upgrades | W10.1 | Young St Upsize | 2026 | 2026-2031 | $ 1,315,000 |
| | | W10.2 | Robie St Upsize | 2026 | 2026-2031 | $ 956,000 |
| | | W10.3 | Almon St Upsize | 2026 | 2026-2031 | $ 1,168,000 |
| | | W10.4 | Windsor St Upsize | 2026 | 2026-2031 | $ 1,004,000 |
| Pockwock - Other | Lakeside Projects | W01.1 | Geizer 158 to Lakeside High Looping | 2021 | 2021-2026 | $ 2,249,000 |
| | | W01.2 | Gravity Supply to Brunello | 2041 | 2041-2046 | $ 2,328,000 |
| | | W01.3 | Dominion Cres Upsize | 2041 | 2041-2046 | $ 447,000 |
| | | W01.4 | Brunello Booster Pump Upgrades | 2021 | 2021-2026 | $ 236,000 |
| | Lively, Geizer Hill, and Leiblin Booster Pump Upgrades | W03 | Geizer Hill Booster Pump Upgrades | 2021 | 2021-2026 | $ 277,000 |
| | | W04 | Leiblin Booster Fire Pump | 2019 | 2016-2021 | $ 395,000 |
| | | W15 | Lively Booster Pump Upgrades | 2036 | 2036-2041 | $ 38,000 |
| | Herring Cover Upgrades | W05.1 | Herring Cove Rd Twinning | 2020 | 2016-2021 | $ 3,585,000 |
| | | W05.2 | St Michaels Ave Upsize | 2041 | 2041-2046 | $ 502,000 |
| | | W05.3 | Herring Cove Rd Looping - McIntosh St | 2021 | 2021-2026 | $ 2,272,000 |
| | Lucasville Road Twinning | W12.1 | Lucasville Rd Twinning (Phase 1) | 2019 | 2016-2021 | $ 8,117,000 |
| | | W12.2 | Lucasville Rd Twinning (Phase 2) | 2026 | 2026-2031 | $ 8,956,000 |
| | New Primary Sackville High and Beaver Bank Supply | W13.1 | New Primary Feed to Sackville High | 2026 | 2026-2031 | $ 4,953,000 |
| | | W13.2 | New Sackville Beaver Bank Valve Chamber | 2026 | 2026-2031 | $ 839,000 |
| | | W13.3 | Reconfiguration of Beaver Bank Booster | 2026 | 2026-2031 | $ 100,000 |
| | | W13.4 | New Sackville High PRV | 2026 | 2026-2031 | $ 420,000 |
| | Second Supply to Windsor Junction | W14.1 | Cobequid High Looping | 2026 | 2026-2031 | $ 2,233,000 |
| | | W14.2 | Windgate Dr Upsize | 2026 | 2026-2031 | $ 882,000 |
| | New Hemlock Tank | W16 | New Hemlock Elevated Tank | 2020 | 2016-2021 | $ 6,209,000 |
| | Pockwock Transmission Looping | W17 | Pockwock Transmission Loop through Bedford | 2021 | 2021-2026 | $ 5,069,000 |
| | Second Geizer 158 Feed and Lacewood Drive Loop | W02 | Geizer 158 Looping - Lacewood Dr | 2041 | 2041-2046 | $ 2,002,000 |
| | | W20 | Second Geizer 158 Feed | 2041 | 2041-2046 | $ 9,612,000 |

**Executive Summary Table 4: Water Capital Program Summary (continued)**

| Project Category | Project Name | Project ID | Project Task | Start Year | Planning Period | Total Capital Cost (2019$) |
|---|---|---|---|---|---|---|
| Lake Major | New Transmission from Topsail to Burnside | W22.1 | New Main Street to Caledonia Road Connection | 2021 | 2021-2026 | $ 3,072,000 |
| | | W22.2 | Caledonia Rd Twinning | 2021 | 2021-2026 | $ 3,429,000 |
| | | W22.3 | New Breeze Dr Watermain | 2021 | 2021-2026 | $ 5,801,000 |
| | | W28 | Tacoma PRV Chamber | 2021 | 2021-2026 | $ 420,000 |
| | Highway 118 Crossing | W23 | Highway 118 Crossing - Shubie Park to Dartmouth Crossing | 2021 | 2021-2026 | $ 6,063,000 |
| | Windmill Road Upgrade | W24 | Windmill Rd Upsize | 2026 | 2026-2031 | $ 6,104,000 |
| | New Woodside Industrial Park Feed | W25 | New Woodside Industrial Park Feed | 2021 | 2021-2026 | $ 1,649,000 |
| | Willowdale-Eastern Passage Connection | W26 | Willowdale to Eastern Passage Connection | 2036 | 2036-2041 | $ 6,290,000 |
| System Interconnections Pockwock Transmission WTP Decommissioning | Pockwock Transmission Twinning | W19.1 | Pockwock Transmission Twinning - 60in | 2031 | 2031-2036 | $ 65,516,000 |
| | | W19.2 | Pockwock Transmission Twinning - 54in | 2036 | 2036-2041 | $ 16,228,000 |
| | Extension to Springfield Lake | W21 | Extension to Springfield Lake | 2041 | 2041-2046 | $ 3,043,000 |
| | Bedford-Burnside Interconnection | W29.1 | Bedford-Burnside System Interconnection (Phase 1) | 2036 | 2036-2041 | $ 24,499,000 |
| | | W29.2 | Bedford-Burnside System Interconnection (Phase 2) | 2036 | 2036-2041 | $ 11,779,000 |
| | Dartmouth-Peninsula Interconnection | W30.1 | Lyle Emergency Booster | 2026 | 2026-2031 | $ 1,045,000 |
| | | W30.2 | Valving for Central Intermediate Boundary Change | 2026 | 2026-2031 | $ 629,000 |
| | Pockwock-Bennery Interconnection | W31.1 | Extension of Fall River to Bennery Lake (Phase 1) | 2026 | 2026-2031 | $ 8,067,000 |
| | | W31.2 | Extension of Fall River to Bennery Lake (Phase 2) | 2026 | 2026-2031 | $ 9,156,000 |
| | | W31.3 | Extension of Fall River to Bennery Lake (PS) | 2026 | 2026-2031 | $ 1,310,000 |
| | WSP Decommissioning | W32.1 | Decommission Miller Lake WSP - Linear | 2019 | 2016-2021 | $ 628,000 |
| | | W32.2 | Decommission Miller Lake WSP | 2019 | 2016-2021 | $ 61,000 |
| | | W33.1 | Decommission Collins Park WSP - Linear | 2041 | 2041-2046 | $ 1,086,000 |
| | | W33.2 | Decommission Collins Park WSP | 2041 | 2041-2046 | $ 168,000 |
| | | W34.1 | Decommission Silversands WSP - Linear | 2041 | 2041-2046 | $ 1,931,000 |
| | | W34.2 | Decommission Silversands WSP | 2041 | 2041-2046 | $ 168,000 |
| | Aerotech Storage | W40 | Aerotech Storage | 2021 | 2021-2026 | $ 4,752,000 |
| Studies | Studies | W18 | Chain Lake Backup Supply Study | 2020 | 2016-2021 | $ 50,000 |
| | | W27 | Mt Edward Booster Fire Pump | 2019 | 2016-2021 | $ 50,000 |
| | | W29.3 | New Orchard Control Chamber | 2021 | 2021-2026 | $ 50,000 |
| | | W30.3 | Robie Emergency Booster | 2021 | 2021-2026 | $ 50,000 |
| | | W35 | Safe Yield Study | 2020 | 2016-2021 | $ 100,000 |
| | | W36 | New Hydraulic Water Model (InfoWater) | 2020 | 2016-2021 | $ 200,000 |
| | | W37 | Comprehensive PRV Study | 2019 | 2016-2021 | $ 50,000 |
| | | W38 | Transmission Main Risk Assessment and Prioritization Framework | 2020 | 2016-2021 | $ 50,000 |
| | | W39 | Tomahawk Lake Supply Study | 2036 | 2036-2041 | $ 50,000 |
| **Total Water Servicing Strategy Cost** | | | | | | **$ 284,706,000** |

Halifax Water

# INFRASTRUCTURE MASTER PLAN

## VOLUME 2
## WATER INFRASTRUCTURE

Prepared by: GM BluePlan Engineering
For: Halifax Water
October 2019

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## VOLUME 2 – WATER INFRASTRUCTURE

### Catchment Overview

Halifax Water currently owns and operates three main water supply plants (WSP), two back-up WSPs, and six smaller community supply plants:

Main WSPs

- J.D. Kline WSP (West Region and Central Region) – the Pockwock System
- Lake Major WSP (East Region) – the Lake Major System
- Bennery Lake WSP (Airport and Aerotech Business Park) – the Bennery System

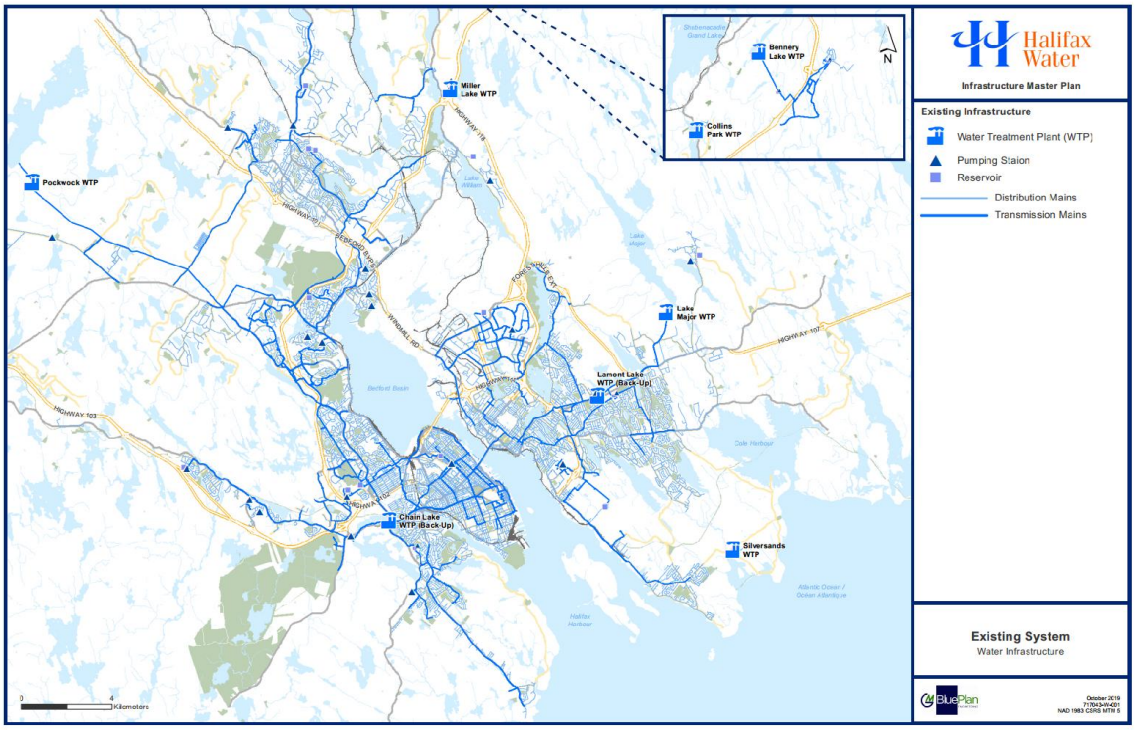
Back-up WSPs:

- Chain Lake
- Lake Lamont

Smaller Community WSPs

- Collins Park
- Silversands
- Miller Lake
- Five Island Lake
- Bomont
- Middle Musquodoboit

The water distribution systems are shown in Executive Summary Figure 7.




**Executive Summary Figure 7: Existing Water Network Overview**

## Water Infrastructure Strategy Development

The water distribution servicing strategy has been developed with the primary aim of providing an adequate level of service to existing and future customers out to the 2046 planning horizon, and provides the following key drivers:

- Servicing strategy can accommodate the planned growth and 2046 future system demands;
- Water supply and overall system resiliency are secured, and risk of service interruption is minimized;
- The water distribution system is optimized to enhance operations and maintenance;
- Asset renewals and opportunities for synergy are considered.

The following inputs were used to complete the capacity and compliance analysis for the water distribution system under both existing and growth scenarios, and then assist in developing and testing multiple servicing strategies and selecting the preferred strategy:

<u>Opportunities and Constraints Workshop with Halifax Water Staff</u>

- Input from the Halifax Water staff knowledgebase through workshops and other correspondence was invaluable for the identification of system constraints, opportunities for optimization, operational concerns, growth pressures, and previously-recommended infrastructure solutions.

Supply, Pumping, and Storage Desktop Analysis

- The desktop analysis identified facilities and water supply sources with insufficient capacity to meet growth demands.

Hydraulic Modelling

- The updated WaterCAD hydraulic water model was used to highlight areas with limitations or constraints within the transmission network and validate the selected servicing strategy to ensure that overall servicing needs were met.

## Water Infrastructure Preferred Strategy

The Capital Program for the Water Infrastructure Preferred Strategy is included in Volume 1 Executive Summary and supports the servicing of all regions. The Capital Costs for Water Infrastructure total approximately **$285M (in 2019 dollars).** The program costs are evenly distributed over the planning period as best as possible, by adjusting the implementation year of projects with flexible timing.

**Projects to Accommodate Growth**

System Supply

The servicing strategy aims to ensure sufficient system supply to meet 2046 growth demands for all three systems, with consideration given to post-2046 demands. Several concepts were reviewed to assess feasibility, social implications, and economic impacts.

i. Increase safe yield
ii. Water conservation
iii. New supply
iv. System interconnections

The following capital projects are proposed to accommodate system supply needs due to growth:

- Tomahawk Supply Study
- Lucasville Road Twinning
- New Primary Supply to Sackville High and Beaver Bank Boosted
- Orchard Control Chamber Study
- Bedford-Burnside Connection
- Second Supply to Windsor Junction
- Pockwock System Extension to Bennery Lake

Peninsula Supply

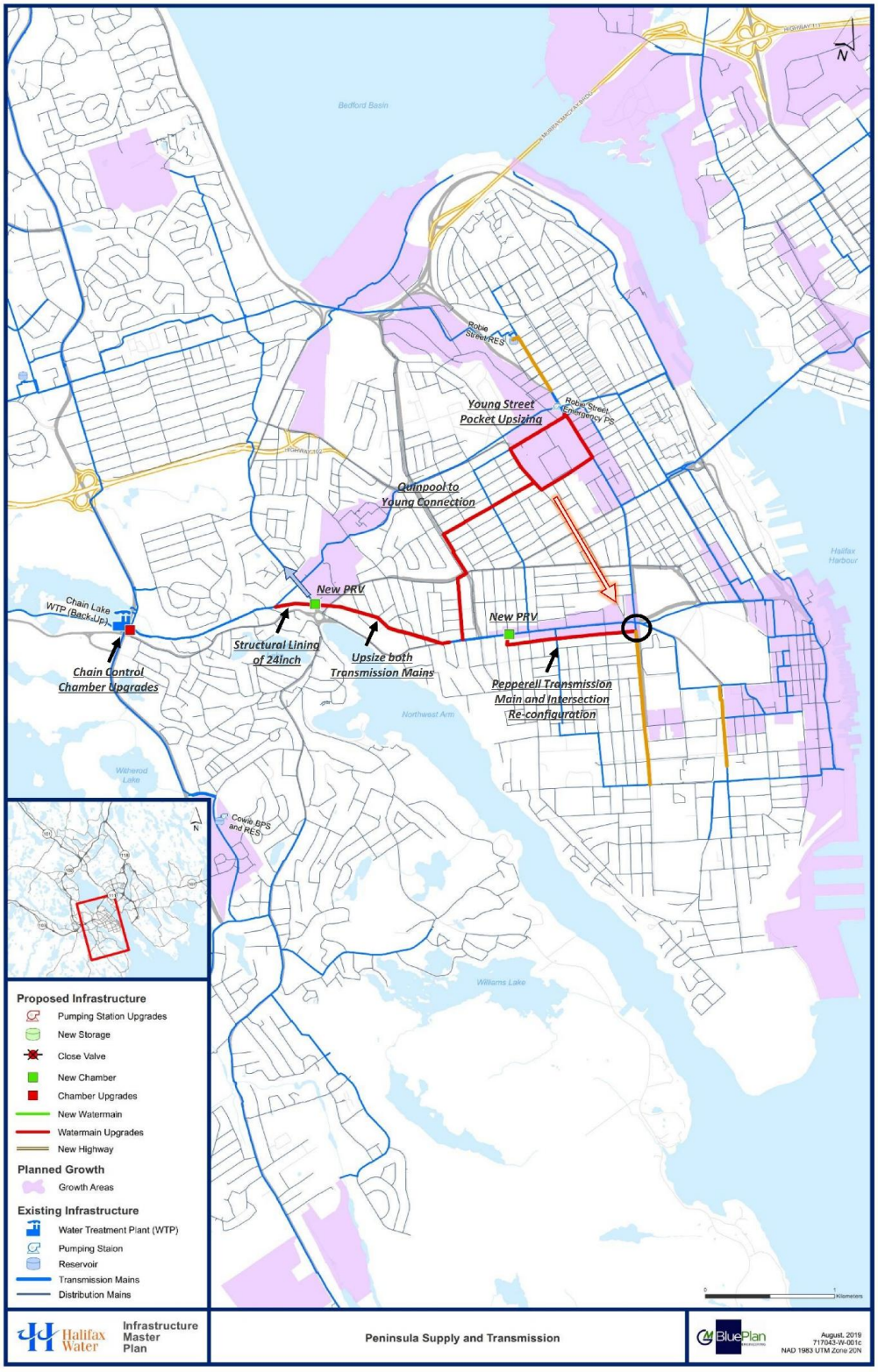
There is significant proposed growth on the Halifax Peninsula (approximately 51,000 population equivalent), and the existing transmission system is insufficient to meet 2046 demands. The preferred strategy for water supply to the Peninsula is through increased Chain Control transmission main capacity using a strategically-timed upsizing approach. The individual Peninsula supply strategy projects are shown in **Executive Summary** Figure 8.

Peninsula Transmission

Several opportunities have been identified to enhance the existing spine network to accommodate growth in the Peninsula, including:

- Young Street Pocket watermain upsizing
- Quinpool Road to Young Street transmission connection
- “Closing the Loop” strategy to enhance system resiliency from Young Street area to Quinpool/Robie intersection, as small old watermains are replaced
- Three (3) critical transmission mains in poor condition are to be strategically cleaned, lined, or replaced within the next 5 years as part of the Asset Management Program
- Local distribution watermains have not been focused on under the Infrastructure Master Plan; however, the replacement and/or upsizing of these local distribution mains will continue to improve localized pressure and fire flow capacity issues

These Peninsula transmission strategy opportunities are shown in **Executive Summary** Figure 8**.**




**Executive Summary Figure 8: Peninsula Supply and Transmission Objectives and Projects**

Hemlock Elevated Tank

A new storage facility is recommended within the Hemlock High pressure zone to support growth in the Bedford area, reduce peaking of water supply at Pockwock WSP, and improve overall system resiliency.

Aerotech Tank

The existing Aerotech Tank is currently operating at 90% of its design capacity. Proposed growth will require significantly more storage volume. A design study is recommended for storage tank replacement, as well as a review of tank location to identify opportunities for system optimization. The new storage facility should consider the proposed Fall River extension and new supply source.

Lakeside and Timberlea

The following projects are proposed to meet growth requirements in the Lakeside and Timberlea area:

- Brunello Booster Pump Upgrades
- Bayers Industrial Park Looping
- Gravity Supply to Brunello
- Dominion Crescent Watermain Upsize

Herring Cove

The previous water servicing strategy created in 2000 provided recommendations for the watermain extension along Herring Cove Road, a new reservoir, and local servicing throughout the Herring Cove area. The servicing strategy proposed in the Infrastructure Master Plan included a review of the previous water servicing strategy, and includes the following key projects:

- Twinning of Herring Cove Road watermain
- Upsize St. Michaels Avenue watermain and loop McIntosh Street watermain
- Extension of servicing along John Brackett Drive and Ketch Harbour Road (part of previous water servicing strategy) is likely to proceed

Lively (Berry Hills)

The Lively Booster was designed to meet peak domestic demands and provide fire flow capacity to the Lively subdivision. The existing capacity of the Lively Booster cannot meet the proposed 2046 growth demands, therefore future upgrades are needed. Demand monitoring is recommended as development comes online; when demands reach 80% of the existing capacity, the proposed upgrades should be implemented.

Geizer Hill

The Geizer Hill Booster was designed and constructed to meet domestic flows and provide fire flow capacity for current and future water demands. However, the existing capacity cannot meet the proposed growth demands to the 2046 planning horizon. Therefore, future upgrades are needed. Demand monitoring is recommended as development comes online; when demands reach 80% of the existing capacity, the proposed upgrades should be implemented.

Woodside Industrial Park

A gravity solution is recommended from the Woodlawn Intermediate transmission main to the Woodside Industrial Park, to accommodate the growth expansion. The existing Woodlawn Intermediate pressure zone HGL is adequate to service existing and future customers.

Shannon Park

Additional capacity is required within the Burnside Low pressure zone to accommodate significant growth in the Shannon Park and Wyse Road areas. It is recommended that the existing Windmill Road watermain is upsized to accommodate this growth.

**Projects to Enhance System Resiliency**

System resiliency is a key objective for the servicing strategy to minimize risk of loss of service, water quality issues, fire flow capacity, adaption to climate change, transmission main failure, etc. Numerous projects have been proposed in both the Pockwock and Lake Major systems that aim to enhance system resiliency.

Pockwock System

- Pockwock Lake has some redundancy available through Chain Lake emergency backup supply and will have additional redundancy through future Tomahawk Lake supply.
- Separate study for JD Kline WSP is recommended to review level of risk associated with the supply plant and the requirements to provide an adequate level of resiliency.
- Twinning of the single 60-inch transmission main servicing the Pockwock system from JD Kline WSP to provide capacity for post-2046 demands and allow the existing transmission main to be taken offline for rehabilitation.
- Twinning the single 54-inch transmission main from Lucasville Road to Hammonds Plains Road; however, this strategy should be reevaluated during the next Infrastructure Master Plan update.
- Loop watermain from Nine Mile Drive to Hammonds Plains Road to join the Pockwock transmission mains and provide redundancy to a large portion of the 48-inch transmission main, in addition to providing a second supply to Orchard Control, reducing risk for the existing single feed.
- The Peninsula transmission main from Geizer 123 to Robie does not require additional capacity to meet growth demands; however, as it is a critical piece of infrastructure and its current condition is not known, a detailed study is recommended to evaluate different strategies aimed at minimizing risk of failure.
- Twinning of the Geizer 158 transmission main is proposed, including looping of the Lacewood Drive watermain. This twinning would increase conveyance to the Geizer reservoirs, provide a second feed to Geizer 158 High zone, and enhance resiliency to Geizer-158 supported pressure zones.
- An investigation is proposed to determine the performance benefits of implementing an advanced operational system at the Robie 2 Emergency Booster (currently operated manually on an as-needed basis).
- The Chain Lake backup water supply does not provide major redundancy for the Pockwock transmission main. A comprehensive study is recommended to determine the requirements to activate Chain Lake WSP, the before and after conditions of the Pockwock system, and the overall additional resiliency that Chain Lake could provide.

Lake Major System

- A capacity increase is recommended from the Topsail Chamber to Burnside to improve system resiliency under the 2046 horizon. This will be achieved through a new 30-inch diameter watermain, and will allow increased conveyance to Akerley Reservoir, support the Bedford-Burnside connection, and allow for full Lake Major system resiliency.
- It is recommended that the flow capacity through Tacoma PRV is increased to eliminate the needs for significant linear upgrades. It is recommended that the PRV chamber is upgraded while the Topsail to Waverley projects are being constructed to strengthen and optimize system operations as demands increase with growth.
- The proposed Bedford-Burnside interconnection can provide over 60% of ADD supply to the Lake Major system; it is recommended that the Lyle Street Booster is designed to convey the other 40% of ADD supply, effectively providing complete redundancy to the Lake Major system in the event of catastrophic failure under 2046 demands. This redundancy would also negate the need for the Lake Lamont backup supply.

**Projects to Provide System Optimization**

Eastern Passage

The recommendation of the Infrastructure Master Plan is to construct a new feed to Eastern Passage from Willowdale (higher HGL) with a new PRV. This new 16-inch watermain would meet fire flow objectives, create a loop for improved resiliency, provide opportunities for improved water quality, and optimize system pressures.

Treatment Facilities

There are opportunities to connect three of the six smaller community WSP's (Miller Lake, Collins Park, and Silversands) into the main networks and decommission the existing smaller facilities These projects are not growth-triggered, and their timing requirements are flexible.

Springfield Lake Connection

There is an opportunity to extend potable water distribution service to the Springfield Lake area via new watermain connection, through a synergy opportunity with the planned wastewater diversion along Sackville Drive. The Infrastructure Master Plan includes the service extension to Springfield Lake; a more detailed servicing study will be required to develop a specific plan for adequate customer servicing.

The extension of water service to Springfield Lake would require consultation with HRM on an extension of the water service boundary. The extension would depend on the desire of residents to receive water service as system extensions are typically paid for by the new customers who would be receiving service.

Mt. Edward Booster Fire Pump Upgrade

The capacity and compliance analysis desktop study concluded that the fire flow provided by Mt. Edward Booster is inadequate for some serviced buildings, including multiple schools. It was noted that this was a desktop review using master planning criteria and a review in greater detail should be completed using the Fire Underwriters Survey (FUS) calculation approach.

Leiblin Booster Fire Pump Upgrade

The capacity and compliance analysis desktop study concluded that the fire flow provided by Leiblin Booster is inadequate for some serviced buildings, including the school. It should be noted that a fire pump capacity upgrade at the booster station is already underway.

Halifax Water

# INFRASTRUCTURE MASTER PLAN

## EXECUTIVE SUMMARY
## VOLUME 3
## WEST REGION WASTEWATER INFRASTRUCTURE

**Prepared by: GM BluePlan Engineering**
**For: Halifax Water**
**October 2019**

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## VOLUME 3 – WEST REGION WASTEWATER INFRASTRUCTURE

### Catchment Overview

As the West Region's servicing strategy was completed under the WRWIP, this volume has taken components of the WRWIP relating directly to the West Region. The more generic components in the WRWIP have been included in Volume 1 of the Infrastructure Master Plan.

The West Regions includes the wastewater sewersheds of Halifax, Herring Cove and Beechville, Lakeside and Timberlea (BLT). Herring Cove and BLT are separated systems while Halifax, being an older system, is combined, particularly within Halifax Peninsula. The main unique features for the West Region are in the Halifax catchment surrounding the combined areas. Several major combined sewer overflow (CSO) facilities are located at pumping stations and other locations throughout the combined network of Halifax Peninsular, and discharge to the Halifax Harbour. Flow that bypass the CSO are either conveyed by the Northwest Arm Trunk Sewer along the southern side of Halifax Peninsula, or the Fairview Cove tunnel along the north side of Halifax Peninsula, to the Halifax WWTF. Real time control (RTC) set-up restricts flows entering Young Street Pumping Station and the amount of flows pumped from Duffus Street to the WWTF.

The primary constraints identified in the West Region were the Halifax and BLT WWTFs exceeding rated capacity, bottlenecks in the trunk sewer along Fairview Cove, limited capacity to accommodate significant growth in Young Street and Spring Garden Road areas, and limitations downstream of Roaches Pond forcemain discharge. The main opportunities in the West Region are surplus capacity at Herring Cove WWTF and an upgrade to Mill Cove WWTF, which would allow for Central Region to accommodate growth, removing the need for the major diversion towards the Peninsula as previously noted in the RWWFP.

Additionally, under the Infrastructure Master Plan, components of the WRWIP were updated to align with the overall Infrastructure Master Plan process. This included outlining the revised growth in the West Region in accordance to the *Planning Data and Population Numbers* study and the Capital Program costs updated to align with 2019 dollars and include the new RDII Costing Template.

### Key Supporting Studies

#### WET WEATHER MANAGEMENT STUDY

The Wet Weather Management Study was developed under the WRWIP for the West Region. The combined areas in Halifax Peninsular were assessed under the sewer separation and LID feasibility studies, as outlined in Volume 1. For the RDII reduction feasibility study, it should be noted that the analysis was originally completed during the WRWIP for all areas within the West Region, including combined areas in the Peninsula. As part of the Infrastructure Master Plan, only the separated systems were carried forward for RDII reduction, as sewer separation is a more appropriate option for the combined sewer areas.

The outcome of the study for Halifax are as follows:

- The sewer separation study identified Young Street, Kempt Road, upstream of Bedford Hwy and Connaught Avenue as areas that were most feasible for sewer separation
- The RDII reduction study identified Bridgeview, Clayton Park and Fairview/Fairmount (flow monitor catchments FM-3, FM-4 and FM-6) as having significant issues of RDII and providing opportunities to remove wet weather from the separate sanitary system

- The study recommended that the RDII analysis was refined as a component of the overall strategy in the WRWIP, along with sewer separation

Adjustment to the RDII reduction areas made in the strategy, was to include only the Fairview area of FM-6 in the RDII reduction, this was done in recognition of Fairview being an old system and being located near other areas with high RDII.

#### ADDITIONAL STUDIES

In addition to the Supporting Studies in Volume 1, the other studies used to guide the preferred servicing strategies are as follows:

- Local Wastewater Servicing Capacity Analysis (LoWSCA)
- Northwest Arm Sewer Lining and Reconfiguration of Armdale Pumping Station
- Rehabilitation of Fairfield Holding Tank

### West Region Strategy Development

The PCSWMM models and WRWIP growth numbers were used to complete the capacity and compliance analysis for the West Region under both existing and growth scenarios, and then assisted in developing and testing multiple servicing strategies and selecting the preferred strategy. Climate change was not considered in the West Region strategy as it is a new component under the Infrastructure Master Plan.

Common Projects in the strategies included: decommission BLT WWTF and divert flows, upgrades to Young Street and Armdale Pumping Stations, sewer separation in Young Street and Spring Garden LoWSCA areas and upstream of Kempt Road CSO, re-commission the Fairfield Holding Tank, North Street flow split configuration and RDII reduction.

Once the Common Projects were confirmed a range of serving strategies were assessed. In the West Region four (4) overarching servicing strategy alternatives were considered, including:

- One strategy that conveys all flows to Halifax WWTF (Strategy 1), including BLT flows.
- Two strategies with flow diversion to Herring Cove WWTF (Strategy 2a – 2b), to reduce upgrades to Halifax WWTF. Strategy 2a includes the BLT diversion to Herring Cove WWTF and reduced upgrades to Halifax WWTF. Strategy 2b include the BLT and Armdale diversion to Herring Cove WWTF to remove upgrades to Halifax WWTF but requires an expansion at Herring Cove WWTF.
- One strategy to protect the peninsula from upgrades (Strategy 3), through a major Highway 102 diversion and the BLT diversion to Herring Cove WWTF. With all flows diverted to Herring Cove WWTF, significant expansions at that facility are required.

### West Region Preferred Strategy

The preferred strategy for West region was Strategy 2a which is detailed in Executive Summary Figure 9: Preferred Servicing Strategy for the West Region. Strategy 2a was selected mainly due to providing greater flexibility, utilizes existing capacity at Herring Cove WWTF, ‘buys time’ on the Halifax WWTF upgrade, performing to an acceptable level of service, and being a cost-effective solution. In addition to selecting the preferred approach, two component evaluations were considered – Roaches Pond Pumping Station alternatives and determining the location of Crown Drive Pumping Station. The Roches Pond Pumping Station alternatives considered the pros and cons of removing the pumping station and replacing with a gravity pipe. Due to the expected difficulties, level of disruption and costs it was not recommended to proceed, instead more detailed investigation and data collection is recommended to properly identify the

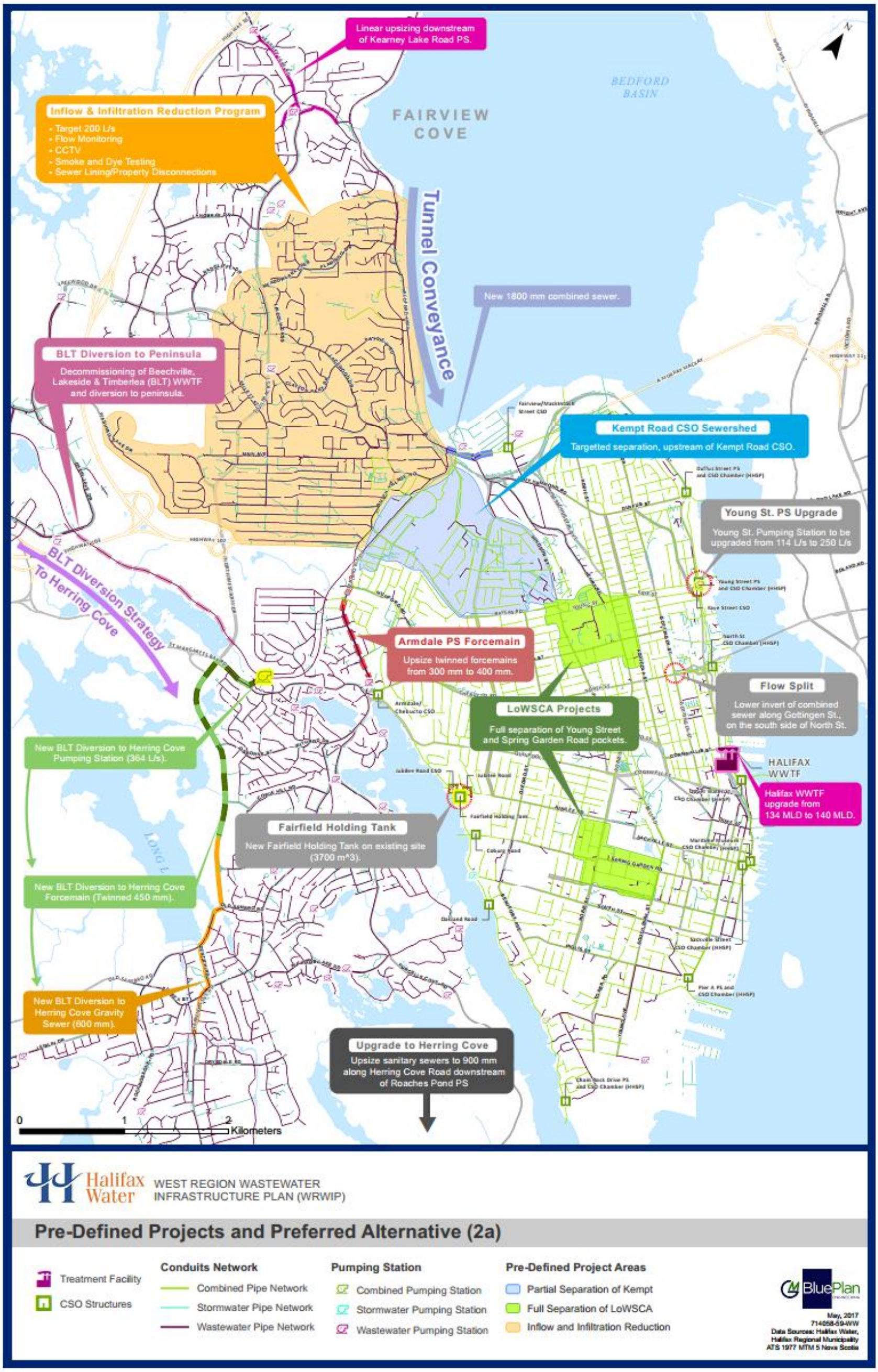
best operational strategy for this facility. The preferred strategy (2a) included a new pumping station within the Crown Drive and Northwest Arm Drive area. An exercise was completed to evaluate various locations and select a preferred location for the proposed Crown Drive Pumping Station.

The Capital Program for the West Region is included in Volume 1 Executive Summary. The capital cost for the WRWIP were updated under the Infrastructure Master Plan to be in 2019 dollars, including the updated RDII Costing Template and WRWIP Concept Design updates. This led to an increase in capital costs from **$165M (2018 dollars)** to **$186M (2019 dollars).**

The scope of work for the WRWIP project included conceptual design for all projects that are required within a 10-year horizon. The WRWIP preferred strategy Concept Design Projects were:

- New Fairview Cove Trunk Sewer
- New Crown Drive Pumping Station
- New BLT Pumping Station and Decommissioning of BLT WWTF
- Sewer Separation
- Young Street Pumping Station Upgrades

Refer to the WRWIP for the Conceptual Designs of the above projects.




**Executive Summary Figure 9: Preferred Servicing Strategy for the West Region**

Halifax Water

# INFRASTRUCTURE MASTER PLAN

## EXECUTIVE SUMMARY
## VOLUME 4
## CENTRAL REGION WASTEWATER INFRASTRUCTURE

**Prepared by: GM BluePlan Engineering**
**For: Halifax Water**
**October 2019**

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# VOLUME 4 – CENTRAL REGION WASTEWATER INFRASTRUCTURE

## Catchment Overview

Central Region servicing strategy was completed under the Infrastructure Master Plan, following the same process as the West Region under the WRWIP. The Central Region included Mill Cove WWTF, Springfield Lake WWTF, and Aerotech WWTF sewersheds.

The Springfield Lake catchment was not originally included in study area, however in recognition of the potential future benefits of diverting flows from Springfield Lake to Mill Cove WWTF, it was added to the Central Region study area.

The Aerotech wastewater collection system has been considered in the Infrastructure Master Plan; however, the only regional infrastructure features in the area is the Aerotech wastewater treatment facility itself. A significant facility upgrade was completed in 2016 on the WWTF, which included a full assessment of existing flows and future growth to evaluate capacity expansion requirements. As these upgrades have already been completed, the Aerotech WWTF system is not a primary focus area within the Infrastructure Master Plan.

The Mill Cove wastewater collection system is a separated system that covers the Sackville and Bedford areas and contains several key features that affect flow conveyance to the treatment facility.

- Main conveyance feature in Sackville is the Sackville trunk sewer, which drains by gravity to Fish Hatchery Pumping Station
- Fish Hatchery PS is located at the northernmost tip of the Bedford Basin and pumps all flow from the Sackville trunk sewer to Mill Cove WWTF
- Wastewater flows from the Bedford area converge via multiple smaller trunk sewers at the Bedford Pumping Station, located directly southwest of the Mill Cove WWTF
- Local wastewater network along Shore Drive that conveys wastewater flows directly to Mill Cove WWTF via Bedford Yacht Club Pumping Station.
- The Mill Cove Wastewater Treatment Facility is located near the Bedford Basin, and planning for major expansion to this treatment facility is currently underway

The Springfield Lake wastewater collection system is a separated system that surrounds Springfield Lake. Flows are conveyed to the Springfield WWTF through a chain of pumping stations due to the hilly topography around the lake. There is a localized low pressure system in the low-lying Falcon Crest Court peninsula catchment, that conveys flows to higher elevation without pumping.

## Key Supporting Studies

### WET WEATHER MANAGEMENT STUDY

As Mill Cove sewershed is a separated system the only Wet Weather Flow Management study incorporated into the strategy was the RDII Reduction Analysis. The Mill Cove flow monitoring catchments FMZ02 (Glen Moir), FMZ03 (Millview), FMZ10 (Bedford Common), and FMZ07 and FMZ40 (Lower Sackville), were highlighted as having significant RDII issues and provide an opportunity to remove wet weather from the separated sewer system.

ADDITIONAL STUDIES

In addition to the Supporting Studies in Volume 1, the other studies used to guide the preferred servicing strategies are as follows:

- The National Disaster Mitigation Program (NDMP) - identify thirty (30) key areas in HRM that are prone to frequent flooding during heavy rainfall events
- Fish Hatchery Forcemain Inspection Report

## Central Region Strategy Development

The InfoWorks ICM model for the Central Region was used to complete the capacity and compliance analysis under both existing and growth scenarios, and then assist in developing and testing multiple servicing strategies and selecting the preferred strategy. Climate change was considered in the strategies through applying a climate change factor to the rainfall simulations as outlined in the Climate Change Study.

Common Projects in Central Region included upgrades to Mill Cove WWTF, decommission of Springfield WWTF and connection to Mill Cove sewershed, upgrades to Majestic Avenue, Beaver Bank #3 Pumping Stations, local pipe upgrades and the RDII reduction.

Once the Common Projects were confirmed a range of serving strategies were assessed. In Central Region there were six (6) overarching servicing strategy alternatives were considered, including:

- Two conveyance strategies (Strategy 1a – 1b) based on upsizes to the Sackville trunk with/without enhanced RDII to reduce catchment flows.
- Three storage strategies (Strategy 2a – 2c) based on installing storage tanks along the Sackville trunk, with/without upgrade to the Sackville trunk. Variations between strategies included tanks sized and applying enhanced RDII to reduce catchment flows.
- Two tunnel strategies (Strategy 3a – 3b) aim to decommission Fish Hatchery Pumping Station via the construction of a new tunnel to Mill Cove WWTF. Strategy 3a has the tunnel starting from Fish Hatchery PS and includes trench upgrades to the Sackville trunk upstream of Fish Hatchery. Strategy 3b extends the tunnel up to the Bedford Bypass crossing to remove trench upgrades.

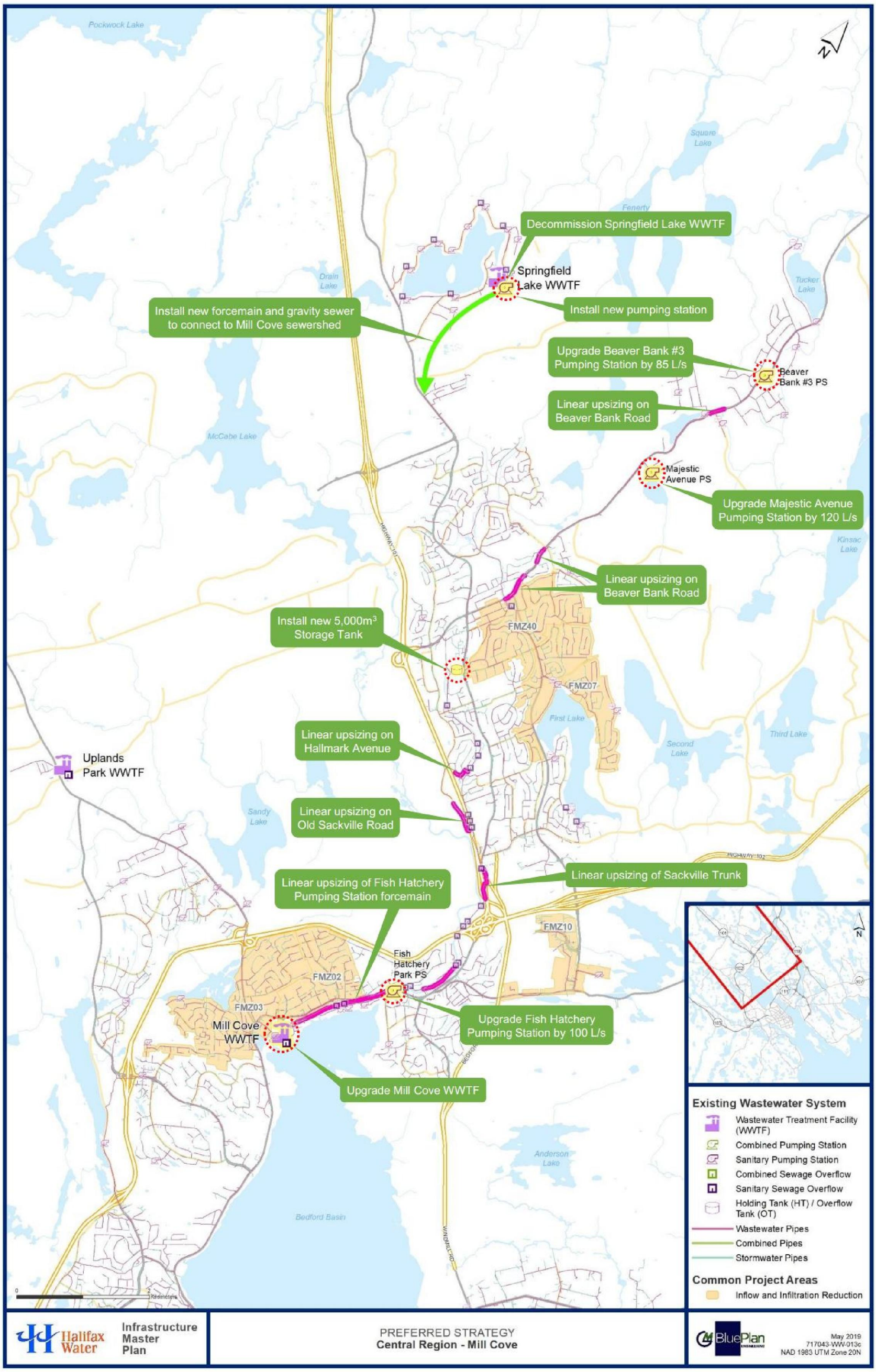
## Central Region Preferred Strategy

The preferred strategy for Central was Strategy 2c which is detailed in Executive Summary Figure 10. Strategy 2c was selected mainly due to providing future flexibility, maximizes the use of existing assets, performing to an acceptable level of service, and being a cost-effective solution. In addition to selecting the preferred strategy for Central a component evaluation was done on RDII reduction rates and the impact on infrastructure requirements as RDII reduction directly affects tank sizing.

The Capital Program for the Central Region is included in Volume 1 Executive Summary. The Capital Costs for Central Region total **$163M (2019$).** The program is front heavy due to the cost associated with the upgrades to Mill Cove WWTF and the RDII reduction project required at the start of the project horizon.

The scope of work for the Infrastructure Master Plan included conceptual design for certain projects which are complex in feasibility and/or constructability. The projects selected for Conceptual Design were:

- Springfield Lake WWTF decommissioning and diversion to Mill Cove WWTF wastewater system
- Fish Hatchery PS forcemain upsizing (450mm to 675mm diameter)




**Executive Summary Figure 10: Preferred Servicing Strategy for the Central Region**

Halifax Water

# INFRASTRUCTURE MASTER PLAN

# EXECUTIVE SUMMARY
# VOLUME 5
# EAST REGION WASTEWATER INFRASTRUCTURE

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**For: Halifax Water**
**October 2019**

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# VOLUME 5 – EAST REGION WASTEWATER INFRASTRUCTURE

## Catchment Overview

East Region servicing strategy was completed under the Infrastructure Master Plan, following the same process as the West Region under the WRWIP. The East Region includes two wastewater sewersheds Eastern Passage and Dartmouth, and the sewersheds contain unique components and constraints with them.

The Eastern Passage is a separated system that covers the Cole Harbour and Eastern Passage areas. The main unique feature in the catchment is the gravity pressure sewer that connects the Cole Harbour area to the Eastern Passage treatment facility. Due to existing capacity constraints at the gravity pressure sewer there is a real time control (RTC) set-up that restricts flows from the main pumping station in Cole Harbour, Bisset Lake Pumping Station, to the surge tank at the start of the gravity pressure sewer. The main issues identified with the gravity pressure sewer include: flow restrictions causing spills at Bissett Lake, the condition of the asset affecting conveyance, odour control requirement and ongoing operational and maintenance concerns. Additional concerns in the catchment are Memorial Drive, Beaver Crescent and Quigley's Corner Pumping Stations being under capacity, and Caldwell Crescent and Bissett Lake Pumping Stations being impacted by growth. The main opportunity in Eastern Passage is the newly upgraded WWTF. The treatment plant is located near Halifax Harbour and was expanded in 2014 to accommodate projected population growth in the serviceable boundary areas.

Dartmouth sewershed is an older system, largely comprised of combined systems within the Circumferential Highway, an area referred to as the Regional Centre. Outside the Regional Centre of the Dartmouth sewershed, it is considered a separated system. The combined system in Dartmouth includes flows from Albro Lake Watershed, Maynard Lake and the Clement Street Wetland located in the Southdale area, which leads to high peak flows and volumes being conveyed under storm events, causing capacity constraints on the system and combined sewer overflow (CSO) spills. Significant growth in the Dartmouth catchment will worsen conditions and lead to additional treatment capacity required at Dartmouth WWTF and increase flooding on Wyse Road and by Old Ferry Road CSO. In the separated areas upstream, there are existing constraints made worse by growth including SSO spills at Valleyford Holding Tank, Anderson Pumping Station and 111 Waverley Road Pumping Station.

## Key Supporting Studies

### WET WEATHER MANAGEMENT STUDY

It is evident from the background review and feasibility study outputs that there is significant potential for sewer separation within the combined system in Dartmouth and RDII reduction in the separated areas. The outcome of the wet weather management study for Dartmouth are as follows, and have been included in the strategy:

- The sewer separation study identified Jamieson Street, Wyse Road, Nantucket Avenue, Thistle Street, Rose Street and Canal Street as areas that were most feasible for sewer separation
- The Dartmouth flow monitoring catchments FMZ27 (Ellenvale) and FMZ45 (Woodside) were highlighted as having significant RDII issues and provide an opportunity to remove wet weather from the separated sewer system

As Eastern Passage sewershed is a separated system the only Wet Weather Flow Management strategy incorporated into the strategy was the RDII Reduction Analysis. The predefined flow monitor target areas were FMZ24 (Loon Lake), FLM23 and FMZ81 (Colby Village) and FMZ37 (Eastern Passage). All of the target areas were included with the exception of FMZ81, as the RDII reduction strategy did not alleviate flow restrictions observed along Colby Road making RDII reduction not the most cost-effective strategy.

### ADDITIONAL STUDIES

In addition to the Supporting Studies in Volume 1, the other studies used to guide the preferred servicing strategies are as follows:

Dartmouth:

- Local Wastewater Servicing Capacity Analysis (LoWSCA)
- Gravity Stormwater Sewer from Little Albro Lake to Jamieson Street Pumping Station, Preliminary Design Report
- Port Wallace Master Plan Infrastructure Study
- National Disaster Mitigation Program (NDMP)

Eastern Passage:

- Eastern Passage WW Management Plan
- Quigley's Corner Preliminary Design Report
- Cow Bay Road Draining Investigation – Hydrologic and Hydraulic Analysis
- National Disaster Mitigation Program (NDMP)

## Eastern Passage Strategy Development

The InfoWorks ICM models for the East Region were used to complete the capacity and compliance analysis under both existing and growth scenarios, and then assist in developing and testing multiple servicing strategies and the preferred strategy. Climate change was considered in the strategies through applying a climate change factor to the rainfall simulations and through looking at the impact of sea level rise on CSOs discharging to the Halifax Harbour in Dartmouth and SSOs in Eastern Passage.

Common Projects in Eastern Passage included upgrades to Memorial Drive, Beaver Crescent and Quigley's Corner Pumping Stations, local pipe upgrades and the RDII reduction.

Once the Common Projects were confirmed a range of servicing strategies were assessed. In Eastern Passage ten (10) overarching servicing strategy alternatives were considered, including:

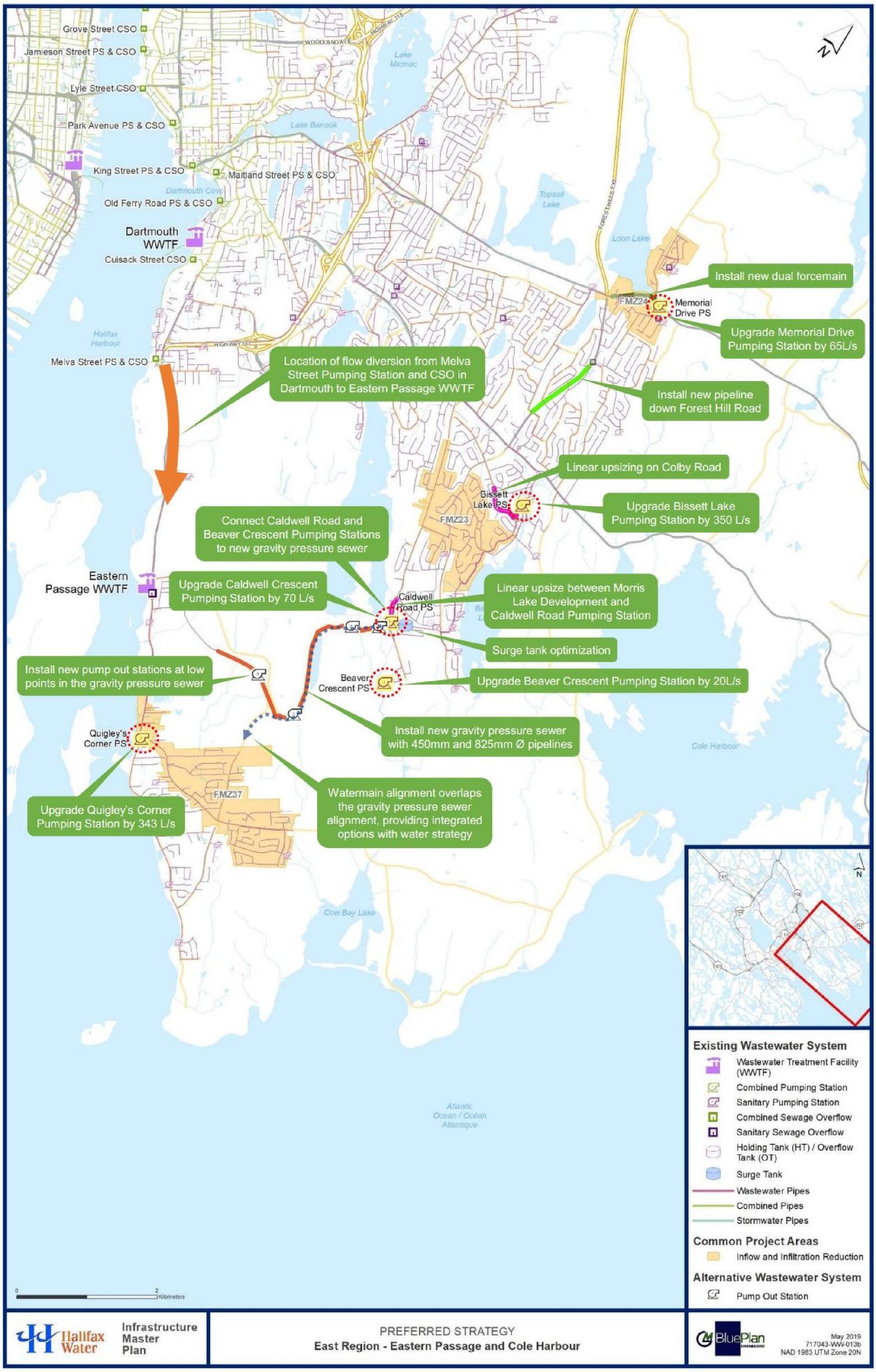
- Four conveyance strategies (Strategy 1a – 1d) based on installing a new gravity pressure sewer with pump out stations to improve conveyance and odour issues. Strategy 1d is a sub-option to all strategies where an alternate route for the gravity pressure sewer crossing under the Shearwater Airport is considered. Variation between Strategies 1a-1c included different pipe sizes and the use of enhanced RDII to reduce catchment flows.
- Four storage strategies (Strategy 2a – 2d) based on installing storage tanks, with/without upgrade to the gravity pressure sewer. Limited upgrades to the gravity pressure sewer meant the Strategies did not address odour issues. Variations between strategies included tanks sized to different level of services and applying enhanced RDII to reduce catchment flows.
- Two tunnel strategies (Strategy 3a – 3b) to remove the gravity pressure sewer. Strategy 3a installs a gravity tunnel from Bissett Lake Pumping Station to just upstream of Eastern Passage WWTF

and Strategy 3b is shortened alignment from the surge tank to the WWTF, including connections by Morris Lake to service growth in the area.

## Eastern Passage Preferred Strategy

The preferred strategy for Eastern Passage was Strategy 1c which is detailed in Executive Summary Figure 11. Strategy 1c was selected mainly due to addressing the operations and maintenance issues surrounding the gravity pressure sewer, performing to an acceptable level of service, and being a cost-effective solution. The selected gravity pressure sewer alignment travels around the Shearwater Airport, forming an indirect path. It was recommended to revisit the cost saving of tunneling under the airport throughout the design stages. In recognition that additional assessment of the gravity pressure sewer could improve the design, it was included as one of the Conceptual Designs included under the Infrastructure Master Plan.

The Capital Program for Eastern Passage is included in Volume 1 Executive Summary. The program is front-heavy due to the cost associated with the gravity pressure sewer replacement which is required at the start of the project horizon.




**Executive Summary Figure 11: Preferred Servicing Strategy for Eastern Passage**

## Dartmouth Strategy Development

Common Projects in Dartmouth included separation of Lake Albro, Maynard lake and the Clement Street Wetland, sewer separation in Wyse Road and Canal Street LoWSCA areas, Rose Street and Thistle Street, flow diversions in the Lyle Street and King Street CSO catchments, upgrades to Anderson Pumping Station, local pipe upgrades, RDII reduction, additional flow monitoring and a CSO Management Plan to improve CSO performance.

Once the Common Projects were confirmed a range of serving strategies were assessed. In Dartmouth seven (7) overarching servicing strategy alternatives were considered, including:

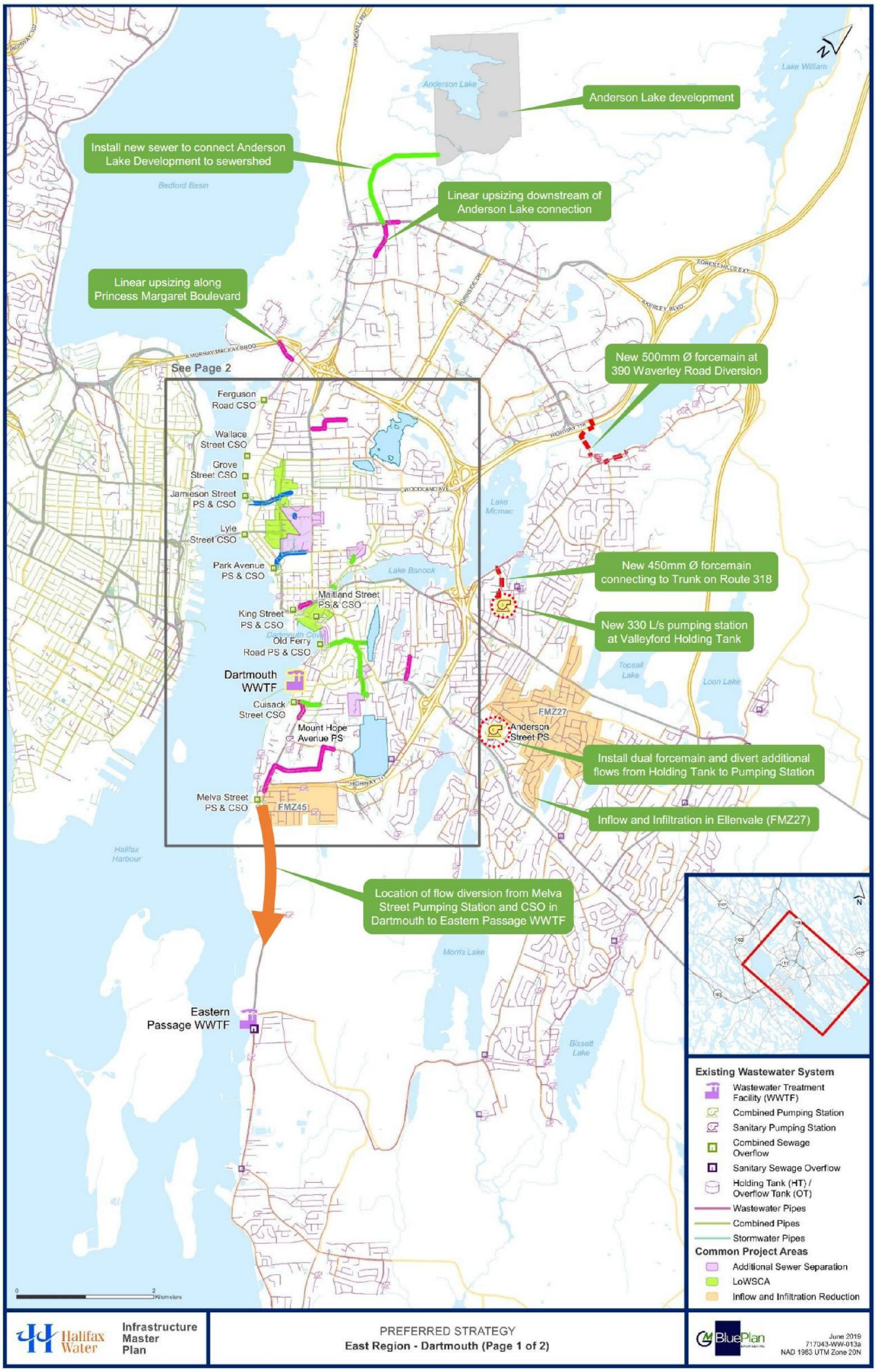
- Four conveyance strategies (Strategy 1a – 1d) include upgrades to existing alignment, reducing upgrades required through enhance RDII reduction and new conveyance alignments. Strategy 1d was a sub-option to all strategies with a diversion of Dartmouth flows to Eastern Passage WWTF to reduce the upgrades required at Dartmouth WWTF.
- Two storage strategies (Strategy 2a – 2b) consider installing storage tanks over conveyance upgrades to. Variations between strategies included tanks with/without applying enhanced RDII to reduce catchment flows.
- One tunnel strategies (Strategy 3) explores a tunnel option to eliminate CSO spills. The tunnel option is a cost on top of the other strategies, that address inner system constraints, making this strategy an expensive addition to the other strategies.

## Dartmouth Preferred Strategy

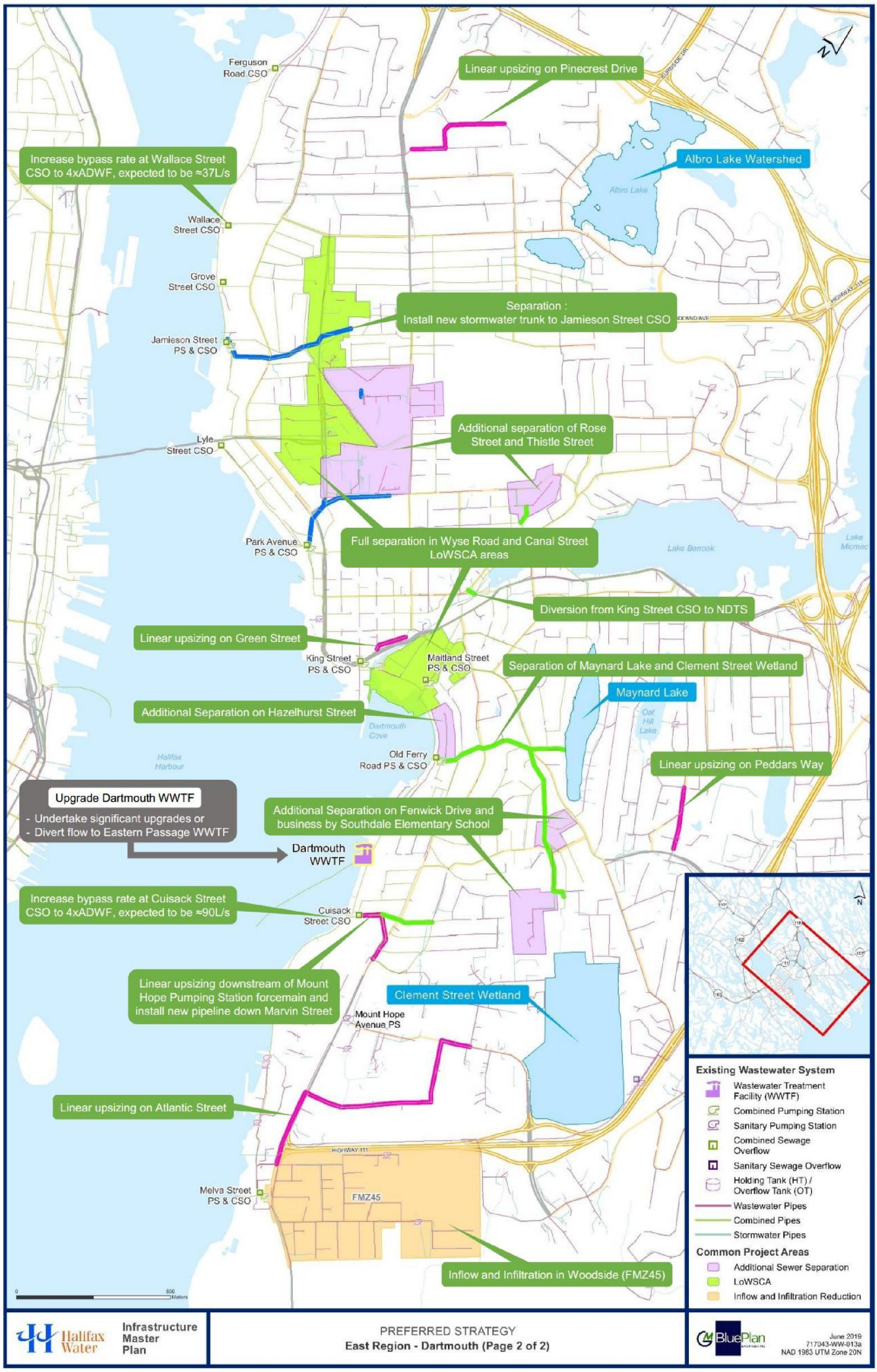
The preferred strategy for Dartmouth was Strategy 1c which is detailed in Executive Summary Figure 12. Strategy 1c was selected mainly due to providing future flexibility, balancing flows across system trunks, performing to an acceptable level of service, and being a cost-effective solution. In addition to selecting the preferred approach for inner system constraints two component evaluations were also considered - increasing the bypass rates at two CSOs and a flow diversion from Dartmouth to Eastern Passage WWTF (Strategy 1d). The CSO assessed were Cuisack and Wallace and based on the growth upstream the bypass rates were adjusted to match the CSO design rate of 4x average dry weather flow (ADWF). The rates were able to be increased due to the extent of sewer separation in the catchment and offsetting spill rates at other CSOs.

The flow diversions from Dartmouth to Eastern Passage WWTF was considered due to additional space for treatment being reserved at Eastern Passage WWTF, allowing for the rated capacity to be increased at a lower cost than upgrading Dartmouth WWTF. Upgrades to Dartmouth WWTF are expected to be high as the WWTF would likely require a system overhaul to accommodate growth while considering higher treatment standards and improved processes. The flow diversion therefore showed significant cost savings and ‘buys time’ on the upgrades to Dartmouth. As the diversion did not completely remove the need for increase capacity at Dartmouth WWTF a cost to upgrade Dartmouth WWTF by 3MLD was included in the strategy. The projects within Dartmouth that were brought forward to the Infrastructure Master Plan Concept Designs, were the separation of Lake Albro, Maynard lake and Clement Street Wetland, as sewer separation became a major component in the Dartmouth strategy and the projects showed potential for improvements to the designs.

The Capital Program for the East Region is included in Volume 1 Executive Summary. The Capital Costs for Eastern Passage total **$49M** and for Dartmouth are **$104M (2019$)** totaling **$153M** for the East Region.




**Executive Summary Figure 12: Preferred Servicing Strategy for Dartmouth**




**Executive. Summary Figure 13: Preferred Servicing Strategy for Dartmouth**

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HALIFAX WATER
2019 INTEGRATED RESOURCE PLAN

# APPENDIX B.2

## COMPLIANCE PLAN

# Compliance Plan

2019

EXECUTIVE SUMMARY

STRAIGHT from the SOURCE

Halifax Water

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# 1 Introduction

The overall goal of the Compliance Plan is to use the information Halifax Water has available to create a path forward to maintain or achieve compliance for our wastewater, water and stormwater infrastructure systems over the next 30 years. The Engineering and IS, Water Services, Wastewater and Stormwater Services and Regulatory Services departments all contributed to the development of the Compliance Plan. The Compliance Plan highlights the current state of compliance at our wastewater treatment facilities and water supply plants as well as examines future compliance requirements. Additional sections discuss the wastewater collection systems, sanitary and combined sewer overflows and water distribution systems including water storage reservoirs.

The Compliance Plan was developed based on the best available data at the time of preparation. The information presented in the compliance plan is only as accurate as the data that is collected. Ensuring the collection of quality data through proper quality assurance and quality control practices is critical to developing accurate long-term plans.

Past studies that support the 2019 Compliance Plan are listed below:

- Integrated Resource Plan (IRP, 2012)
- Infrastructure Master Plan (2019)
- West Region Wastewater Infrastructure Plan (WRWIP, 2017)
- 5-year Capital Program and project table – *outlines known projects occurring over the next 5 years, including compliance related projects*
- Asset Management Plans (2018)

The Compliance Plan, the 2019 Infrastructure Master Plan and the 2018/2019 Asset Management Plans, will be used to form part of the 2019 Integrated Resource Plan (IRP), covering the three drivers behind infrastructure planning (Growth, Asset Renewal and Compliance).

# 2 Wastewater Compliance

Wastewater management in Canada is governed federally, provincially and at the municipal level. Legislation is issued federally to stipulate minimum standards for wastewater effluent, while provincial governments are responsible for issuing permits or licenses to wastewater treatment facilities to construct and operate under their regulatory framework. Permits are typically site specific and may require increased stringency based on provincial legislation to improve human health and ensure environmental protection based on population density and assimilative capacity of the receiving waters.

Halifax Water has been consistently working toward achieving the provincial level of wastewater treatment as stipulated by Nova Scotia Environment (NSE) permits and the Federal Wastewater System Effluent Regulations (WSER). Historically, NSE has set compliance standards for each wastewater treatment facility (WWTF) by issuing an Approval for Operation which sets the effluent limits and the Canada-wide Strategy for the Management of Municipal Wastewater Effluent (CSMMW) provided national standards for combined sewer overflows (CSO) and sanitary sewer overflows (SSO). June of 2012,

the WSER was enacted which set national standards for WWTF effluent discharge and CSO and SSO standards.

Since the introduction of the federal WSER standards, NSE has been reviewing and renewing Halifax Water's operating permits with steady increases in compliance and reporting requirements.

To understand the current level of compliance and actions required for remaining compliant, several initiatives have recently been completed or are underway. Current compliance initiatives are as follows:

- Compliance Monitoring and Reporting through the Regulatory Services Department
- Engaging Dalhousie University in compliance research
- Adopting the Environmental Management System (EMS)
- Environmental Risk Assessments (ERA)
- WSER Transitional Authorization

## 2.1 Wastewater Treatment Facilities

Halifax Water's wastewater treatment facilities provide varying levels of treatment ranging from chemically enhanced primary to tertiary and have a broad range of average daily flow (ADF) capacities. Halifax Water owns and operates fourteen wastewater treatment facilities (Table 1). Five of the wastewater treatment facilities discharge to marine receiving environments whereas the remainder discharge to a variety of small freshwater lakes or streams.

*Table 1: Wastewater Treatment Facility Summary*

| Facility | Treatment Level | Treatment Process | Type of Receiving Water |
|---|---|---|---|
| **Halifax** | Enhanced Primary | High rate solids contact clarifier w/ UV disinfection and sludge dewatering | Marine |
| **Dartmouth** | Enhanced Primary | High rate solids contact clarifier w/ UV disinfection and sludge dewatering | Marine |
| **Herring Cove** | Enhanced Primary | High rate solids contact clarifier w/ UV disinfection and sludge dewatering | Marine |
| **Eastern Passage** | Secondary | Conventional activated sludge w/ UV and sludge dewatering | Marine |
| **Mill Cove** | Secondary | Pure oxygen activated sludge w/ UV disinfection, anaerobic digestion and sludge dewatering | Marine |
| **Uplands** | Secondary | Trickling filter, clarification w/ UV and wetland polishing | fresh water |
| **Middle Musquodoboit** | Secondary | Rotating biological contactor w/ UV disinfection and aerated polishing pond | fresh water |
| **Springfield Lake** | Secondary | Enhanced aeration activated sludge w/ UV | fresh water |
| **Timberlea (BLT)** | Secondary | Rotating biological contactor w/ Sodium hypochlorite | fresh water |

| | | | |
|---|---|---|---|
| **North Preston** | Advanced Treatment | Sequencing batch reactor w/ UV and engineered wetland polishing | fresh water |
| **Frame** | Advanced Treatment | Membrane bioreactor (MBR) w/ UV | fresh water |
| **Wellington** | Advanced Treatment | Conventional activated sludge w/ UV and reed bed | fresh water |
| **Fall River** | Advanced Treatment | Conventional activated sludge w/ post filtration and UV | fresh water |
| **Aerotech** | Advanced Treatment | Membrane bioreactor (MBR) w/ UV and sludge dewatering | fresh water |

The Compliance Plan reviews each facility, summarizes the data from 2015 to 2019 and provides a short and near-term corrective action plan where applicable. Other compliance related project may be generated through the 2019 Infrastructure Master Plan and therefore the costs outlined below may be adjusted.

*Table 2: Short Term WWTF Expenditures*

| Facility | Total Capital Costs ($2019) |
|---|---|
| Halifax WWTF | $9,034,500 |
| Dartmouth WWTF | $7,900,000 |
| Herring Cove WWTF | $4,750,000 |
| Lakeside-Timberlea WWTF | $25,000 |
| Mill Cove WWTF | $70,000,000 |

*Table 3: Long Term WWTF Expenditures*

| Facility | Total Capital Costs ($2019) |
|---|---|
| Halifax WWTF – Upgrades to meet WSER | $160,750,000 |
| Dartmouth WWTF - Upgrades to meet WSER | $87,400,000 |
| Herring Cove WWTF | $38,200,000 |

## 2.2 Wastewater Collection System

Along with WWTFs, Halifax Water also operates the wastewater collection system. This includes wastewater pipe, forcemains, pump stations and combined sewer overflows (CSOs). The following programs support the operation of the operation of the wastewater collection system from a compliance perspective.

*Table 4: Collection System Annual Program Expenditures*

| Project | Estimated Cost |
|---|---|
| Wet Weather Management Program | $250,000 annually |
| Inflow and Infiltration Reduction Program | $25,000 annually |
| Corporate Flow monitoring Program | $1,700,000 annually |

# 3 Water Compliance

In Nova Scotia, Drinking Water treatment and delivery is regulated by Nova Scotia Environment through Approvals issued under the Environment Act. Approvals are issued for a period of 10 years. It is anticipated that new Approvals will be issued for all water supplies in Nova Scotia in 2019. The water supply plants are to be operated in accordance with the terms and conditions of the Approval.

Health Canada publishes the Guidelines for Canadian Drinking Water Quality. The guidelines can be published as either Maximum Acceptable Concentrations (MAC's) which are health related parameters; Aesthetic Objectives (AO's) and Operational Objectives. Drinking Water Approvals in Nova Scotia require that all MAC's must be achieved. While achievement of AO's in not required, many of them must be monitored and reported on. Any new or revised MAC published during the life of an Approval is deemed to form part of the Approval by NSE.

In Nova Scotia, there is no formal standard for water supply plant process wastewater discharge quality. There are no specific technology requirements for treatment and discharge limits are set on a site-specific basis by NSE when issuing the Approval.

Halifax Water has consistently met the requirements of provincial Approvals and regulations for its major drinking water supplies. Halifax Water does not anticipate any changes to regulations or standards that would challenge our ability to maintain compliance. There are challenges due to changes in source water quality and aging infrastructure that will challenge our ability to achieve compliance and these are discussed for each facility.

Over the last five years, Halifax Water has experienced changes in source water quality. These changes will impact the ability of our large treatment plants to maintain compliance and/or will reduce their effective capacity as filter runs become shorter and other process components are impaired.

There are two phenomenon that are currently being experienced which are working to have this effect; climate change and lake recovery. In response, Halifax Water has made the study of lake recovery and its treatment challenges two of four themes in its most recent water quality master plan and the NSERC Industrial Research Chair sponsored at Dalhousie University. The chairholder, Dr. Graham Gagnon, will be directing research into understanding lake recovery for the duration of the current term, ending in 2022.

## 3.1 Water Supply Plants

Halifax Water owns and operates three large water supply plants (WSP) and six small community water supply plants. The WSPs provide an average day demand of 329,616 $m^3$/day of drinking water serving approximately 360,000 people. The water supply plants use different treatment technologies depending on the source water quality and the size of the facility, refer to Table 5 for a summary.

*Table 5: Treatment Technology by Water Supply Plant*

| Treatment Technology | Water Supply Plant | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | JD Kline | Lake Major | Bennery Lake | Collins Park | Five Island | Middle Musq. | Silver Sands | Bomont |
| Direct dual media filtration | X | | | | | | | |
| Sedimentation with multi-media filtration | | X | X | | | | | |
| Disinfection (gas chlorine) | X | X | | | | | | |
| Disinfection (sodium hypochlorite) | | | X | | X | | X | |
| Disinfection (ultraviolet & sodium hypochlorite) | | | | X | | X | | X |
| Ultrafiltration | | | | X | | X | | X |
| Nanofiltration | | | | X | | X | | |
| Ion exchange | | | | | | | | X |
| Iron/manganese removal (green sand filtration) | | | | | | | X | |
| Air Stripping (removal of natural radionuclides) | | | | | X | | | |

*Table 6: WSP Expenditures*

| Facility | Total Capital Costs ($2019) |
|---|---|
| JD Kline WSP – Phase 1 | $32,660,000 |
| JD Kline WSP – Phase 2 | $25,440,000 |
| Lake Major WSP – Phase 1 | $31,163,000 |
| Lake Major WSP – Phase 2 | $16,960,000 |

## 3.2 Transmission and Distribution System

Regulatory requirements related to the operation of the transmission and distribution system include the following:

- Free chlorine residual of 0.20 mg/L at all location in the distribution system at all times.

- Distribution system turbidity of < 5 NTU.
- Total Trihalomethanes < 100 ug/L based on a locational running annual average (LRAA)
- Haloacetic Acids (5), <80 ug/L based on LRAA.
- Continuous chlorine residual monitoring on the outlet of all storage facilities.
- Provide water that is not corrosive to lead.

Halifax Water generally meets its free chlorine residual requirements. There are a small number of sampling locations where meeting the chlorine residual requirements is challenging, particularly in summer. Halifax Water is required to respond to all low chlorine residuals. The response may include increasing the residual at the treatment plant or flushing the distribution system. Also, Halifax Water has seven rechlorination facilities which are used to supplement distribution chlorine residuals.

# 4 Integration with the Integrated Resource Plan

Compliance is one of the three drivers for the IRP. The compliance program including costs, driver allocation and timing will be reviewed through the integration process for the IRP. The final compliance program in the IRP may differ from what is contained in the Compliance Plan due to integration. The Compliance Plan will be updated on a five year cycle to support the future IRP updates.

B

HALIFAX WATER

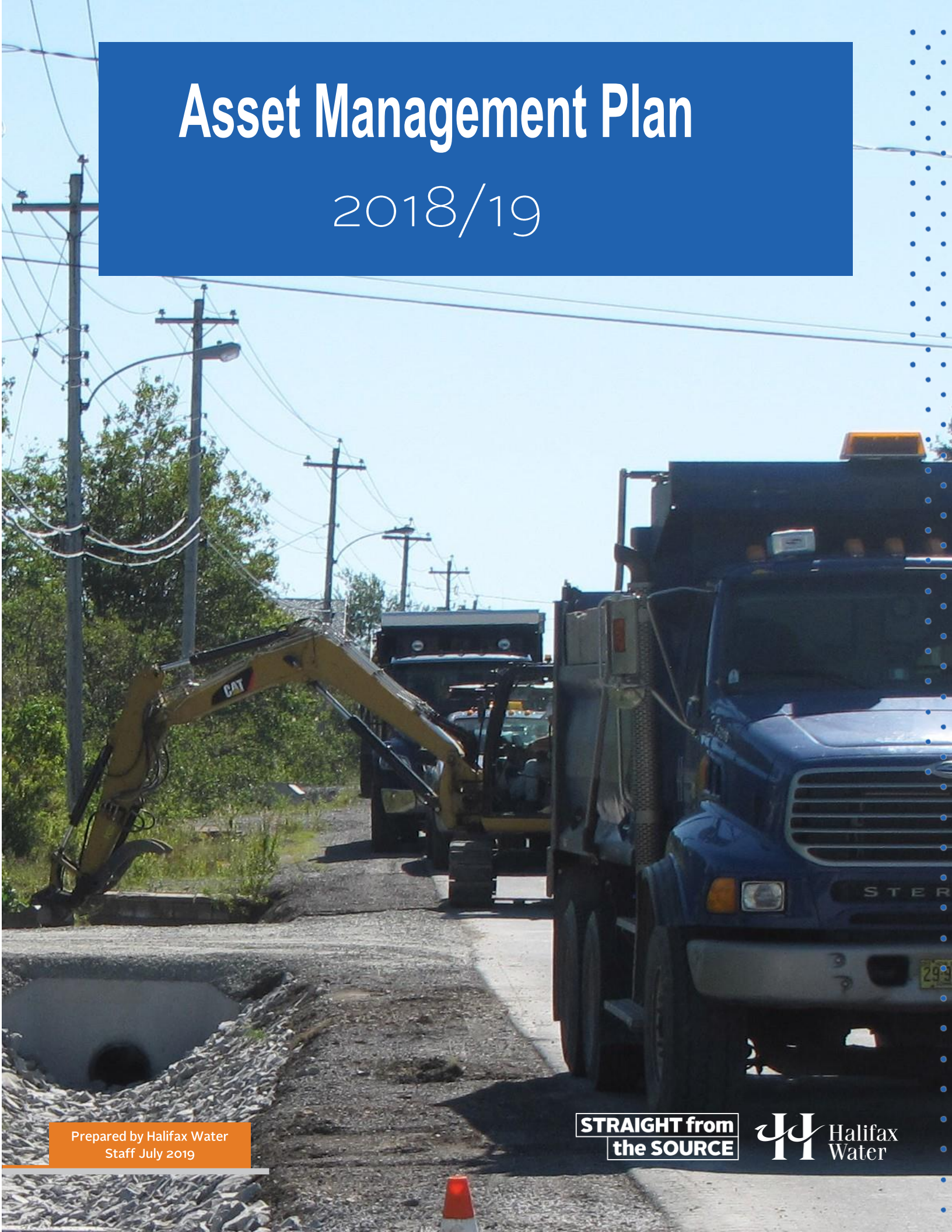
2019 INTEGRATED RESOURCE PLAN

# APPENDIX B.3

## ASSET MANAGEMENT PLAN

# Asset Management Plan

## 2018/19




Prepared by Halifax Water
Staff July 2019

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Sign-offs

This document has been reviewed and accepted by:

Jamie Hannam, MBA, P.Eng.
Director, Engineering & Information Services

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# PREFACE

The Asset Management Plan (AMP) provides a summary of how a municipality or utility manages its assets over a defined time period (e.g. annually). In some provincial jurisdictions in Canada, AMPs must be completed in order for municipalities to be eligible for federal and provincial infrastructure funding. While not yet a requirement in Nova Scotia, indications across Canada are moving towards AMPs as a basis for infrastructure funding.

Regardless of funding eligibility, an AMP acts as a report card on the state of the utility's infrastructure. It lays out the current status of the organization's assets, discusses levels of service the assets provide, what interventions are routinely undertaken to keep the assets providing service, and the financing approach to allow for implementing planned actions and improvements.

A key aspect of an AMP is its relationship to corporate goals – there should be a clear connection between Halifax Water's mission, vision, and values and the infrastructure that enables the services to be provided. The AMP will also show connections with other corporate programs where appropriate (e.g. Wet Weather Management Program, Water Loss Control Program, infrastructure master planning).

## *Halifax Water Mission, Vision, and Values*

Halifax Water's mission is **"To provide world class services for our customers and our environment"** and this is to be accomplished through our vision that states:

- We will provide our customers with high quality water, wastewater, and stormwater services.
- Through adoption of best practices, we will place the highest value on public health, customer service, fiscal responsibility, workplace safety and security, asset management, regulatory compliance, and stewardship of the environment.
- We will fully engage employees through teamwork, innovation, and professional development.

To achieve the mission and vision, Halifax Water's values promote a culture that:

- Engages employees, partners and stakeholders in achieving success;
- Encourages openness and transparency;
- Demonstrates individual and corporate accountability for results;
- Fosters innovation and progressive thinking;
- Respects diverse ideas, opinions and people;
- Is committed to service excellence; and
- Nurtures leadership at all levels.

# HALIFAX WATER ASSET MANAGEMENT PROGRAM

To ensure service delivery to ratepayers, Halifax Water has been carrying out asset management (AM) practices for decades simply through good utility management. In 2011, the utility underwent an asset management program assessment to identify where along the formal AM maturity spectrum the Halifax Water program was situated. Following the assessment, a number of implementation tasks were identified to fill information gaps and move the program along the spectrum.

## *Halifax Water's Asset Management Policy*

Halifax Water's asset management policy examines how corporate objectives are supported through the organization's goals, commitment, and expectations for asset management. The policy presents the broader intent of the asset management program and lists principles and opportunities for corporate integration including:

- Maintain and manage infrastructure assets at defined levels to support public and environmental safety, community well-being, and provide sustainable and affordable water, wastewater and stormwater services.
- Monitor standards and service levels to ensure corporate goals and objectives are met.
- Develop and maintain asset inventories of all infrastructures.
- Establish infrastructure replacement strategies through the use of full life cycle costing principles.
- Plan appropriate levels of maintenance of assets to meet service levels and to extend their useful life.
- Plan for and provide stable long term funding to replace, renew and/or decommission infrastructure assets.
- Consider and integrate, where appropriate, asset management in other corporate plans.
- Provide regular reports on the status and performance of the asset management policy.

## *Asset Management Foundation*

An asset management program works to answer fundamental questions (refer to Figure 1) about an organization's assets including:

- What do we own?
- Where is it located?
- What condition is it in?
- What are the service levels?
- How much is it worth?
- When does it need to be replaced?
- What is the right balance of capital versus maintenance effort?


Figure 2 - Guiding Asset Management Questions

### *Future Program Considerations*

The asset management foundational questions in the previous section are intended to act as a minimum requirement for the AM program. In reality, Halifax Water would benefit from incorporating several other factors or considerations into the program. Initially these factors would include:

***Risk*** – establishing a solid risk assessment and management process for asset management is essential to assisting with prioritizing where funds should be spent. Assessing the factors of assets with the highest criticality to the organization, highest probability of failure, and greatest consequence of failure (impact to the organization) must be incorporated into a risk-based prioritization strategy.

***Performance*** – another factor in prioritizing where Halifax Water determines to spend its funds is asset performance. Is the asset performing as intended or designed? This may relate to a capacity constraint or a capability assessment of the asset – can it do what it was supposed to do? Are we expecting the asset to perform more or less than what it was designed for? What are the implications to operational practices and costs and system integrity?

***Climate resilience*** - Halifax Water will be commencing a project to assess vulnerability to climate change on an asset class basis. The program will have a phased implementation and outcomes will be brought into the AMP. Climate resilience and impacts to existing assets may result in climate-related infrastructure programs (e.g. addressing submerged outfalls).

As the AM program continues to mature, there will be other factors that must be introduced. Asset Management Implementation Teams (AMITs) have been established with representation from engineering, operations, and asset management as a minimum. Where appropriate based on the recommended work plans, staff from other departments will be engaged. Through the AMITs and information provided from other initiatives, emerging factors can be built into the program.

## LEADING PRACTICE FOR ASSET MANAGEMENT PLANS

### *Alignment of Corporate Direction and AMP*

The Institute of Asset Management (IAM) – a leading association that advocates for asset management practices – encourages organizations to create alignment or “line of sight” between an organization’s strategic direction and the asset management activities performed by its staff. Corporate alignment connects the organizations mission, vision and values with the asset management policy and program. The alignment also allows for staff, at all levels of the organization, to understand the role their individual tasks have in supporting the corporate strategic direction and service delivery expectations.

Once corporate alignment has been established, the asset management policy and program allow the organization to create more detailed asset management plans and tasks. Having this clear connection

to the asset management program enables both top down (strategic) direction supported by bottom-up (evidence-based) analysis on asset performance, capacity, and service potential.

## Canadian Infrastructure Report Card

The Canadian Infrastructure Report Card (CIRC) Asset Management Primer 2014, provides guidance on the recommended content for an AMP (Figure 2). It should cover:


Figure 3 - CIRC Report Card

*Current State of Infrastructure*

- Asset inventory and replacement value
- Summary of asset condition
- Statement about services infrastructure supports

*Levels Current level of* service

- Current level of service
- Organizational goals for future or changed levels of service
- Include both technical and customer levels of service

*Plan Improvements*

- Highlights of tasks undertaken in current AMP period
- Outline items that may impact next iteration of AMP

*Asset Strategies*

- Develop long term renewal plans (consideration of 50 to 100 year plans)
- Infrastructure needs to support growth and regulatory requirements
- Balance of operations and maintenance versus renewal needs

*Financial Strategy*

- Funds needed to support ongoing operations and maintenance activities
- Funding strategy that balances long term renewal needs with available revenue

The CIRC Report Card is being updated in fall 2019 and subject to release of the updated report, the findings will be incorporated into the next AMP.

## Asset Management and Capital Program Process

The infrastructure asset management planning to capital program process is an iterative practice. At the outset it is based on assumptions and estimates that may seem overly conservative. As information is collected and the program continues to mature, the process will be refined. Efforts undertaken through the AM Program and with the AMP iterations are providing greater detail in the asset attribution that improves the utility's understanding of the asset classes.

The Asset Management and Capital Program process is an ongoing cycle. The master plan informs the long term needs, there may be additional assessments or studies needed to refine the problem, preliminary and detailed design is completed and the projects constructed, the assets are operated and maintained, and then they are monitored over time. Information resulting from the monitoring is

fed back into the process again at the master planning stage, together with a review of assumptions, growth projections, and regulatory inputs, and the cycle commences again.


Figure 4 - Typical Asset Management Planning Cycle

Through the annual capital budget process, the AMITs, or both, there is the opportunity for Engineering, Operations, and Asset Management staff to develop a more robust approach to identifying and planning for operational expenditures. Essentially, this could provide a clearly defined operational budget for each asset class. There may be additional operationally delivered programs that require a capital line in the 5 year capital budget (e.g. similar to the pump replacements or lateral replacements lines that are capitalized but delivered by Operations).

# HALIFAX WATER'S ASSET MANAGEMENT PLAN

Halifax Water's Asset Management Plan 2018/19 is based on the suggested sections outlined in the CIRC Asset Management Primer and covers the following asset classes:


**Figure 5 - Asset Classes for Halifax Water's AMP**

## State of the Infrastructure

The State of the Infrastructure section documents the current state of Halifax Water's core infrastructure under the direct ownership and control of the utility. This infrastructure enables Halifax Water to deliver water, wastewater and stormwater services to the residents of Halifax Municipality. The State of Infrastructure sections review our assets and form a picture of our asset base as a snapshot in time. The key questions answered here are what do we own, where is it, what condition is it in and what is its valuation?

### *Asset Inventory, Valuation and Data Improvements*

Inventories are provided based on known information as well as full field data collection exercises. Asset valuation is based on a variety of sources including detailed inventories, and staff knowledge. Any data improvements for the asset class will be noted in this section.

### *Condition Summary*

As part of the Halifax Water Asset Management Roadmap Implementation Project an Asset Condition Assessment Methodology was developed. This methodology allows Halifax Water to assign a condition grade on each asset based on known information, detailed condition assessments and/or operational experience, knowledge, and judgment. Table 1 – Condition Grade Definitions outlines the rating scale and general description used by Halifax Water.

Table 1 - Condition Grade Definitions

| Grade | Description | Label |
|---|---|---|
| 1 | Acceptable condition. | Very Good |
| 2 | Minimal failure risk in short term but potential for further deterioration. | Good |
| 3 | Failure unlikely in near future but further deterioration likely. | Fair |
| 4 | Failure likely in foreseeable future. | Poor |
| 5 | Failure or failure imminent. | Very Poor |

Generally, the point of optimum intervention to arrest asset deterioration and extend asset life occurs around Grade 3 or “Fair". This middle-of-the-road approach is established as a place to start given the early stage of AM implementation. As the utility gathers more information about the asset (e.g. condition, performance, complaints, operational effort, maintenance practices and frequency), staff will be in a better position to adjust the timing and types of intervention for each asset class. This will vary depending on the asset and its criticality. For example, intervention on a transmission main may start earlier in the condition life cycle to ensure a failure is avoided and service disruption does not occur. In contrast, intervention on a driveway culvert may not happen until failure as limited customers and service are impacted. The criticality of each asset class and in some cases a specific asset must be assessed to confirm the consequence of failure and the impact to Halifax Water’s customers.

## Levels of Service

Asset management is about maintaining a balance between the full life cycle costs of various services and the levels of service being provided. It is about knowing what levels of service customers expect and what they are willing to pay to receive that service. In other words, the level of service is a reflection of the quality, function and capacity of the services being provided.

The levels of service Halifax Water provides directly impacts many parts of asset management including both life cycle costs and risk management. As a rough generalization, the higher the level of service provided, the higher the life cycle costs of providing that service.

Levels of service drive the expected treatments in the management of infrastructure. Customer levels of service outline the overall quality, function, capacity, and safety of the service being provided. Technical levels of service outline the operating, maintenance, rehabilitation, renewal and upgrade activities expected to occur within the utility.

Developing appropriate LOS must be balanced with the availability of data as well as the ability to collect and analyze that data. It is important that the information collected supports the service areas, identifies any deficiencies, and sets goals for improvement.

Continued measurement of a variety of metrics will provide valuable information for Halifax Water staff. As more information becomes available, staff can analyze it and identify possible changes to the levels of service as needed.

## Asset Investment Strategies

Assets have a limited life expectancy, and their rate of deterioration can be estimated. An asset strategy is a set of actions that enable assets to provide the desired level of service in a sustainable way, while managing risk, at the lowest lifecycle cost.

Halifax Water applies a number of strategies to maintain, improve and grow its assets in a sustainable, effective manner. The asset strategy covers the development and implementation of plans and programs for asset creation, operation, maintenance, rehabilitation/replacement, disposal, and performance monitoring to ensure that the desired levels of service and other operational objectives are achieved at optimum cost.

### *Current Replacement and Renewal Strategy*

Often total asset renewal needs exceed the available financial resources dedicated towards asset renewal. Therefore, in order to prioritize asset renewal needs across the service area, personnel from the Operations, Engineering & IS Capital, and Asset Management teams review the first cut of identified projects and programs to identify the greatest need and for consideration and prioritization as part of the annual budget.

### *Future Strategy Considerations*

Data collected during the annual AMP process will be passed on to Operations and Engineering for use in prioritizing asset interventions. This provides a bit more formality to the current annual budget process with continuous improvement of the background information each year. Additional effort would be beneficial for improved understanding of asset intervention strategies. Figure 5 shows a typical asset deterioration curve. As an asset ages, condition continues to deteriorate. By undertaking asset interventions throughout this deterioration cycle, asset life can be extended.

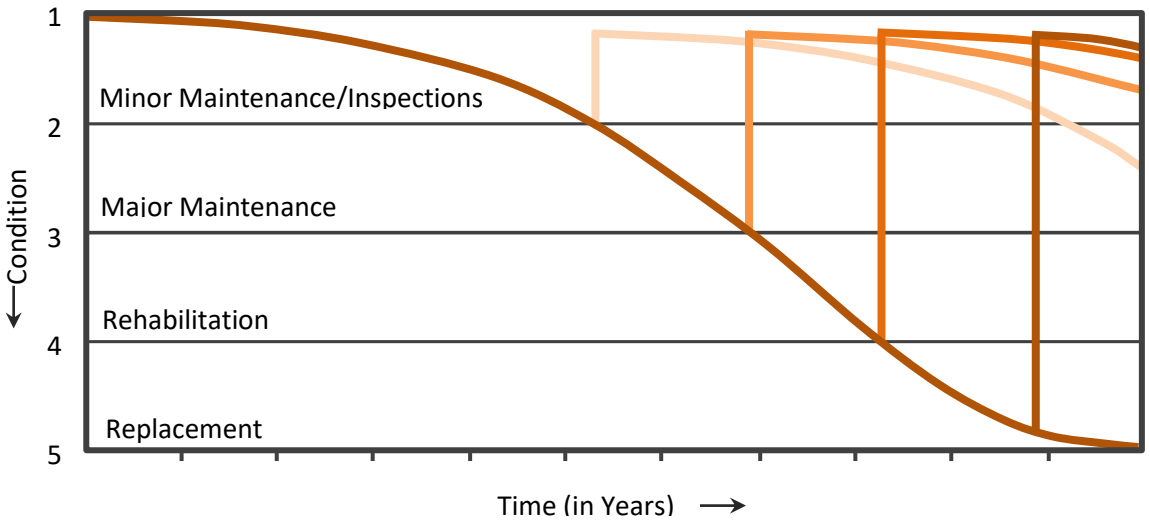



Figure 6 - Typical Relationship of Asset Condition Over Time and Asset Intervention Strategies

Table 2 highlights typical activities at various stages of the lifecycle.

**Table 2 - Typical Lifecycle Activities**

| | Phase | Lifecycle Activity | Asset Life Stage |
|---|---|---|---|
| Operating Budget | Minor Maintenance / Inspections | Activities such as inspections, monitoring, cleaning and flushing, hydrant flushing, pressure tests, visual / remote inspections, etc. | 0 – 25% of asset life |
| | Major Maintenance | Such events as repairing water main breaks, repairing valves, replacing individual small sections of pipe, rewinding motors, etc. | 25 – 50% of asset life |
| Capital Budget | Rehabilitation | Rehabilitation events such as structural lining, sleeves, cathodic protection programs to slow the rate of deterioration. | 50 – 75% of asset life |
| | Replacement | Asset or component replacements. | 75 – 100% of asset life |

Utilities want to balance the economic value of the interventions (operating to capital) so that the assets remain in a state of good repair and are able to deliver the intended service. Earlier, more frequent, less costly interventions not only extend the asset life but enable Halifax Water to more carefully predict when major expenditures will be needed. Carrying out more frequent, less costly interventions does not eliminate the need for complete replacement however it does support a more predictable and manageable approach to asset longevity. With more predictability, major expenditures can be mitigated by 'smoothing' out the expenditures (e.g. breaking larger projects into phases, staggering project starts, and layering on projects by other drivers, etc.) across the planning horizon.

The AMP provide a starting point for further discussions with engineering and operations personnel. Leading AM organizations go a step further and use multi-disciplinary working groups (set up by asset class and including representatives from all departments) to review the findings and recommendations of the AMP, develop an action plan, and implement the action plan. This approach further supports embedding the asset management culture more formally throughout the organization and allows individuals to see that their actions tie back to overall corporate goals and objectives (IAM's "line of sight" principle).

## *Summary of 2018/19 AMP Results*

Figure 6 – AMP Statistics provides a summary of the inventory, condition, valuation, and projected 30 year spend for each of the water, wastewater, and stormwater systems. Additional detail is provided in Table 3 – Summary State of Infrastructure Observations.

Halifax Water

# Asset Management Plan 2018/19

## Water Facts

### Inventory

**1,558 KM of Water Mains**

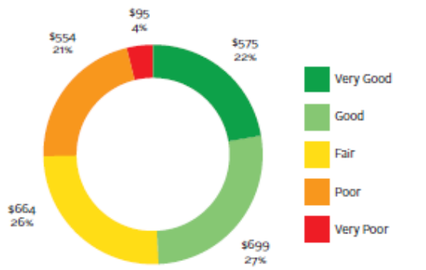
Including transmission and distribution mains.

Equivalent Distance:
Driving from Halifax to Yarmouth to Meat Cove and back to Halifax.

**8** Supply Plants
**2** Back-Up Water Supplies
**6** Water Supply Dams
**21** Booster Stations
**143** Chambers
**16** Reservoirs

### Condition

**Replacement Value: $2,587M**

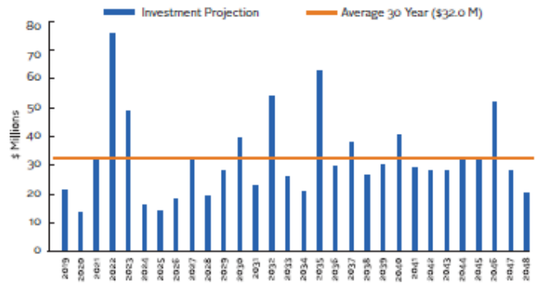



Dollar values have been rounded.

### Reinvestment

**Aggregated 30-Year Water Expenditures - Asset Renewal**

Supply Plants, Supply Dams, Chambers & Booster Stations, Transmission & Distribution Mains, & Reservoirs




## Wastewater Facts

### Inventory

**1,424 KM of Wastewater Sewers**

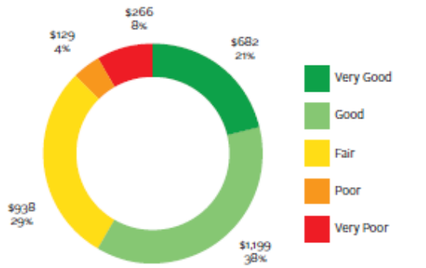
Including forcemains and gravity sewers.

Equivalent Distance:
Driving from Halifax to Yarmouth to Amherst to Canso and back to Halifax.

**14** Treatment Facilities
**1** Biosolids Processing Facility
**167** Pumping Stations
**5** Large Holding Tanks

### Condition

**Replacement Value: $3,214M**

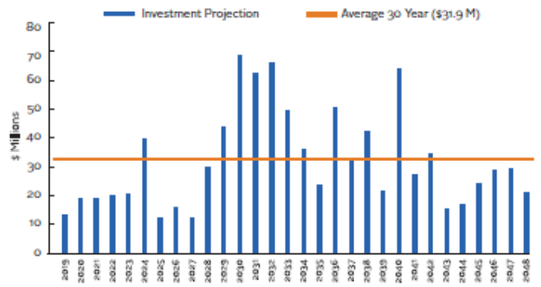



Dollar values have been rounded.

### Reinvestment

**Aggregated 30-Year Wastewater Expenditures - Asset Renewal**

Forcemains, Gravity Sewers, Pumping Stations, and Treatment Facilities




## Stormwater Facts

### Inventory

**878 KM of Stormwater Sewer**

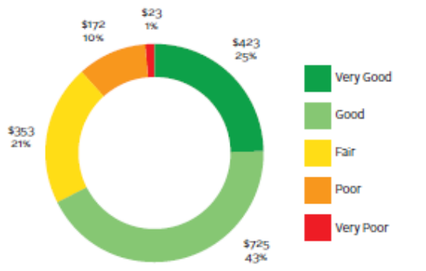
Ranging from 200 mm to 3000 mm in diameter.

Equivalent Distance:
Driving from Halifax to Louisbourg and back to Halifax.

**2,337** Cross Culverts
**16,000** Driveway Culverts (estimated)
**811 km** Ditches (estimated)
**40** Stormwater Management Structures

### Condition

**Replacement Value: $1,696M**




Dollar values have been rounded.

### Reinvestment

**Aggregated 30-Year Stormwater Expenditures - Asset Renewal**

Management Structures, Gravity Sewers, Cross Culverts and Ditches

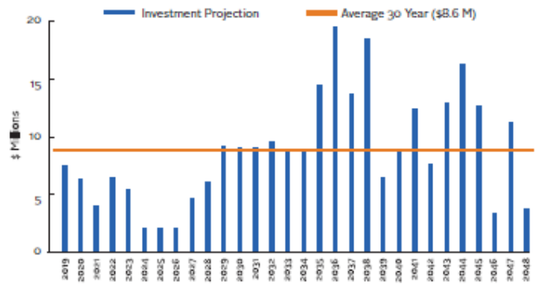
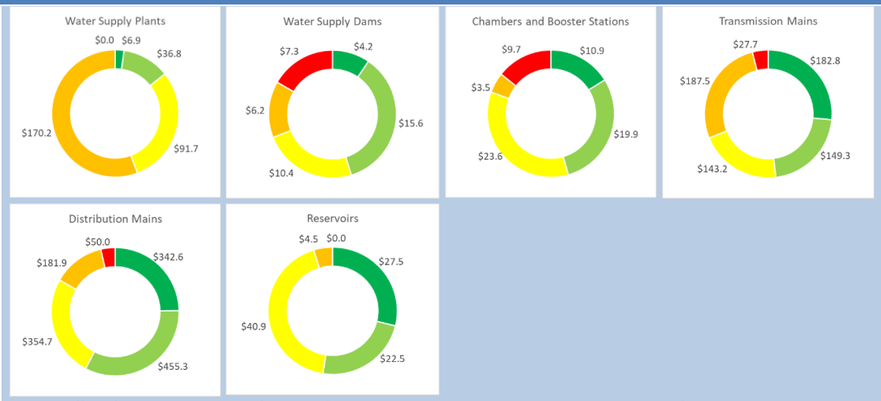
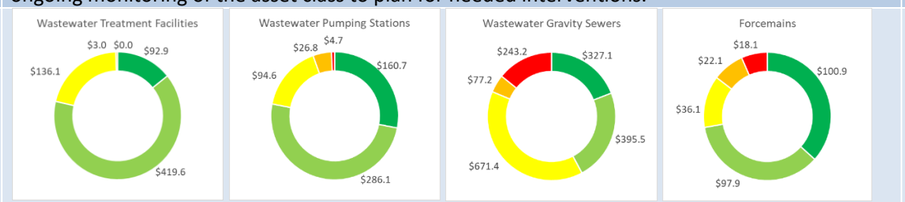
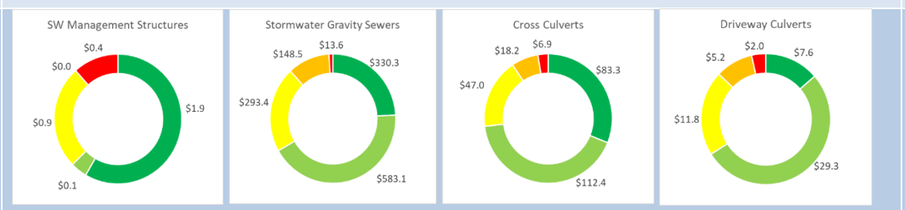



Figure 7 - AMP Statistics

Table 3 - Summary State of Infrastructure Observations

| System | Valuation | Condition | Projected Reinvestment | Capex / Opex Projections |
|---|---|---|---|---|
| **Water** | $2.5 B replacement value |  <br>Generally, the water asset classes show a positive position. In some asset classes, we are seeing larger percentages or asset value rated in Very Poor condition indicating a need for intervention or action in the near term. Higher percentages at the Poor condition indicate the need for ongoing monitoring of the asset class to plan for needed interventions. | • $32 M annual average reinvestment needed over 30 years for water assets<br>• Near term (2022, and 2023) large expenditures projected for Water Supply Plants<br>• Near term (2022) – expenditure for Water Reservoirs<br>• 2032 and 2035 – large expenditures projected for Water Transmission Mains with some moderate expenditures anticipated in 2027, 2030, 2037, and 2040<br>• Increasing expenditure projection for Water Distribution Mains after 2036 – indicative of age-based replacement<br>• Very little indicated for Water Boosters & Chambers – suggests Halifax Water investigate this asset class in greater detail to confirm this is accurate | • Variation in the annual projected capex budget ($15M to $65M) – indicates near term asset renewal needs with a slightly higher 5-year projected average capex spend than the 30-year average ($32M) projected in the reinvestment profile; indicates Halifax Water needs to assess its capacity to deliver this larger projected program with specific focus on year 4 and 5 with a sustained level needed to deliver the average capex<br>• Opex budget stable at the $22M mark – indicates no surprises in the operating environment however, there may be a need to confirm the direct correlation to the increasing capex projection |
| **Wastewater** | $3.2 B replacement value |  <br>Wastewater asset classes show a very positive position in terms of condition, however there are some indications of problems in the forcemain asset class and the gravity sewers. Ongoing monitoring of these asset classes is warranted to assess degradation. Some attention is needed for the gravity sewer asset class that is showing 14% at Very Poor ($243M). | • $31.9 M annual average reinvestment needed over 30 years for wastewater assets<br>• Near term (2024) large expenditures projected for Wastewater Pumping Stations<br>• Near term (2019, 2020) expenditures projected for Wastewater Forcemains followed by sporadic investment over the planning horizon<br>• Several large expenditures predicted for Wastewater Treatment Facilities (2029, 2030, 2031, 2032, 2033, 2036, 2038, 2042)<br>• Several large expenditures projected for Wastewater Pumping Stations outside of the near term (2028, 2030, 2032, 2040)<br>• Increasing expenditure projection for Wastewater Gravity Sewers from 2029 to 2038 – indicative of age-based replacement | • Variation in the annual projected capex budget ($17M to $34M) – indicates an increasing level of asset renewal in the near term with a slightly lower 5-year projected average capex spend than the 30-year average ($31.9M) projected in the reinvestment profile; indicates Halifax Water can likely ramp up its capacity to deliver the projected program and will have time to determine its capacity to deliver the larger mid-horizon program with a focus on a sustained level needed to deliver the average capex thereafter<br>• Opex budget stable at around the $32M mark with regular anticipated inflationary increases – indicates no surprises in the operating environment however, there may be a need to confirm the direct correlation to the increasing capex projection |
| **Stormwater** | $1.7 B replacement value |  <br>Overall, the stormwater asset classes show an extremely positive position. | • $8.8 M annual average reinvestment needed over 30 years for stormwater assets<br>• First five years shows a good mix of asset reinvestments across the four asset classes followed by fairly lean reinvestment over the next five years (2024 to 2028) | • The projected capex budget fluctuates over the near term varying between $7.4 M and $10.5 M and indicating a slightly lower 5-year capex average than the 30-year average ($8.8M) projected in the reinvestment profile<br>• Opex budget stable at around the $5.5M mark with regular anticipated inflationary increases – indicates no surprises in the operating environment however, there may be a need to confirm the direct correlation to the increasing capex projection |

## *Asset Strategy Recommendations*

Leading AM organizations have successfully integrated asset management practices and culture into all levels of their organization. Staff understand how the work they do on a daily basis contributes to the overall service requirements and strategic goals of the organization.

Table 4 highlights specific actions that support the integration of an asset management culture at Halifax Water. The Executive Team has a lead role in establishing the appropriate level of involvement from the various departments. Halifax Water's Executive Team role continues to:

- support asset management integration throughout the organization
- confirm roles of AM Team resources, Operations resources, Engineering resources
- guide and direct staff to incorporate enhancements to the AMP

**Table 4 - Strategic Asset Management Integration**

| Action | Lead | Supporting Roles |
|---|---|---|
| Be informed and provide direction to the Asset Management Program | Executive Team | Water / WWSW Services, Asset Management, Engineering Capital, Finance, IS as needed, GIS as needed |
| Establish multi-disciplinary Asset Management Implementation Team (AMIT)[1] for the asset classes[2] | Executive Team | Water / WWSW Services, Engineering (Capital & Asset Management), others as appropriate |
| Prepare annual AMP updates | Asset Management | AMIT |
| Use AMP outputs to provide input into annual budget process (Operating and Capital) | AMIT | Asset Management |
| Provide input to Operations maintenance strategy rationalization (where, why, what, when, how) | AMIT | Others as needed |
| Provide input to Engineering for capital prioritization process | AMIT | Others as needed |
| Review existing LOS measures and identify potential changes or additions | AMIT | Executive Team |
| Use AMP to establish the long term capital funding needs by asset class | AMIT | Finance, Asset Management |
| Formally sign off on Asset Management Policy | Executive Team | Asset Management |
| Align with Strategic Corporate goals (HW mission, vision, critical success factors, AM Policy) | Asset Management | AMIT, Executive Team |
| Develop an asset management data strategy (includes storage, extents (how much detail), roles and responsibilities, maintenance and updating, frequency). Coordinate with ongoing Data Governance initiative | Asset Management | AMIT, IS, GIS |
| Develop methods for monitoring and reporting, analyzing findings, and acting on outcomes | Asset Management | Data management resource (Asset Management team) |
| Reconcile reporting periods for corporate data collection exercises (e.g. Annual Report, NWWBI, AMP) [COMPLETE] | Executive Team | AMIT, GIS |

1. AMITs should be clearly named to differentiate their purpose from the corporate AM Team.
2. Where appropriate, AMITs may be established to cover multiple asset classes by the same group of AMIT participants.

## FINANCING STRATEGY

Sound financial decisions and developing an effective long-term funding strategy are critical to the implementation of an asset management program. Halifax Water has a funding strategy that was developed through evaluation of alternatives using three general principles:

1. Rate stability and affordability
2. HRWC's long-term financial sustainability
3. Intergenerational equity

Halifax Water assesses funding strategies against financial performance ratios such as a target Debt Service Ratio of 35% and a Target Debt/Equity Ratio of 40%/60%. These two targets provide benchmarks for HRWC's capital financing strategy when considering future use of debt. Additionally, Halifax Water monitors affordability by considering the average residential bill as a % of median household income, and by benchmarking rates for service with other utilities.

Capital financing strategies are reviewed and updated as required to reflect changes in key assumptions such as:

1. Interest rates
2. Availability of Federal/Provincial infrastructure funding
3. Impact of the Regional Development Charge
4. Financial constraints posed by rates and affordability issues

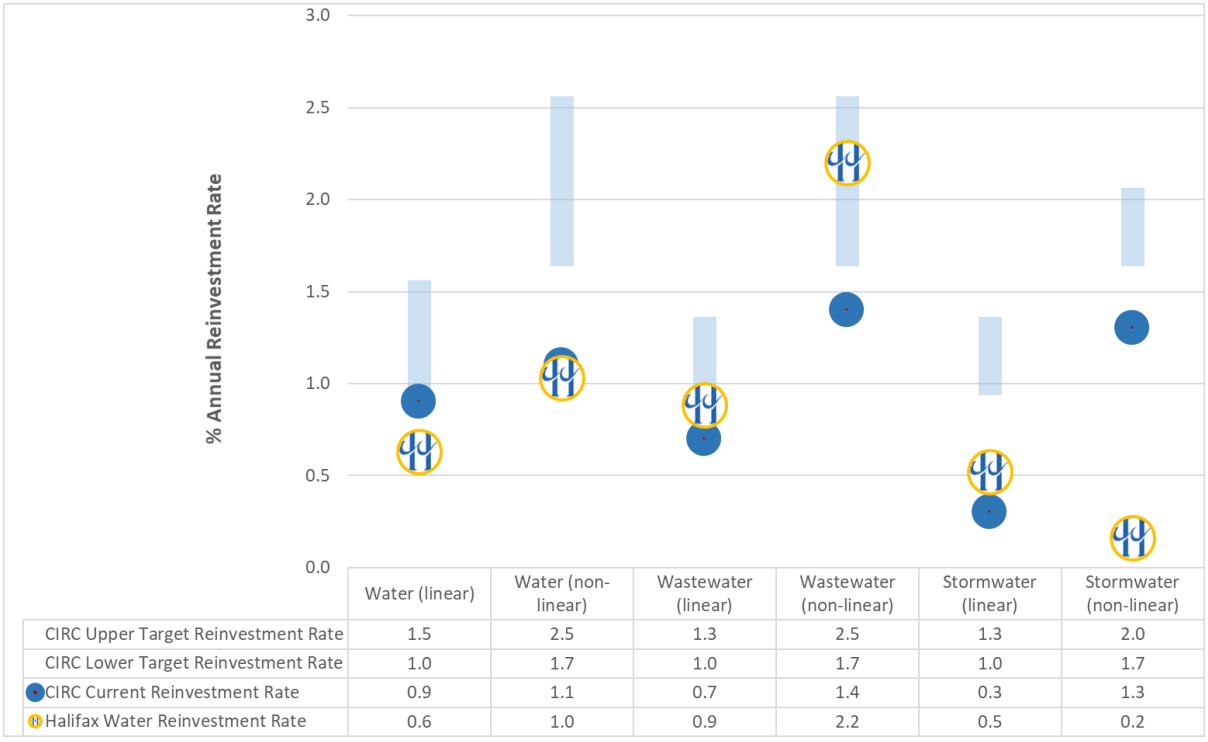
There are natural constraints in place that restrict the use of debt, such as the ability to absorb the operating costs of new capital, annual operating budget pressures caused by increased debt service and depreciation, and rate affordability and sensitivity around increasing rates. The impact of HRWC debt on HRM debt limits and policies as well as the current Nova Scotia Municipal Finance Corporation (MFC) requirement that HRM guarantee most of HRWC's debt are also considerations in the development of an efficient capital structure. In September 2014, HRM Council approved a blanket guarantee for HRWC debt subject to HRWC maintaining a debt service ratio of 35% or less.

Asset strategy funding is often a complex process drawing from a number of funding sources. The funding of Halifax Water's programs strives to maximize the use of external funding to limit the need for politically unappealing rate increases. However, ageing infrastructure and population demographic changes will create a need to replace and expand the current asset base which requires funding.

The renewal needs are based on asset replacement at end of life. With enhanced maintenance practices or interventions prioritized on remaining service life, Halifax Water may be able to extend asset life and defer the timing for full asset reinvestment. However, this is unlikely to completely address the funding gap. There is an optimal balance between enhanced maintenance expenses and capital expenses. This will vary for each asset class but the principle of finding that optimal balance of costs and benefits applies universally. An exercise to identify all factors (e.g. condition, performance, health and safety, environmental impacts, etc.) that will influence reinvestment needs would be beneficial.

A survey carried out in 2016 for the Canadian Infrastructure Report Card (CIRC) reported current reinvestment rates from municipalities across the country. Values are shown at Figure 7 of the current reinvestment rates reported from the 2016 CIRC survey and the average of Halifax Water's 2017/18 and

2018/19 reinvestment rates from expenditures reported in the National Water and Wastewater Benchmarking Initiative (NWWBI). As the completion of capital projects varies each year affecting Halifax Water's capital investment values, it would be worth looking at reinvestment rate trends over a number of years. The CIRC survey is being updated in 2019 and results will be bought forward into the next AMP.




| | Water (linear) | Water (non-linear) | Wastewater (linear) | Wastewater (non-linear) | Stormwater (linear) | Stormwater (non-linear) |
|---|---|---|---|---|---|---|
| CIRC Upper Target Reinvestment Rate | 1.5 | 2.5 | 1.3 | 2.5 | 1.3 | 2.0 |
| CIRC Lower Target Reinvestment Rate | 1.0 | 1.7 | 1.0 | 1.7 | 1.0 | 1.7 |
| CIRC Current Reinvestment Rate | 0.9 | 1.1 | 0.7 | 1.4 | 0.3 | 1.3 |
| Halifax Water Reinvestment Rate | 0.6 | 1.0 | 0.9 | 2.2 | 0.5 | 0.2 |

**Figure 8 - Reinvestment Rates**

Halifax Water uses a range of funding strategies to provide capital needed including incremental rate increases and gradualism, borrowing strategy and debt service ratio, and reassessment of current LOS for a given asset class. Incremental rate increases and gradualism support the need to reasonably introduce rate changes to allow the ratepayers to absorb the increases more slowly rather than be faced with "sticker shock" or drastic increases.

Halifax Water can assess its ability to borrow money responsibly within industry debt service ratio levels and without compromising borrowing needs in the future. Reviewing the historical and existing LOS may yield opportunities for LOS adjustment that would have funding implications. Adjustments to LOS must also be balanced with associated risks from these changes and would be subject to approval at the senior management level.

Halifax Water's financing needs and strategy have been thoroughly assessed in its Cost of Service Strategy, Debt Strategy, semi-annual Rate Applications, and financial model. These documents and tools

demonstrate that Halifax Water is proceeding towards the sustained level of investment needed annually.

## ASSET MANAGEMENT PLAN IMPROVEMENTS

Recommendations for improvements to the corporate AM Program, AMP, and the overall framework and process are part of a continuous improvement approach and support a learning organization philosophy. That is, we work with what we know, we gather and learn more, and we incorporate that learning back into our programs.

Table 5 provides a summary of recommendations for consideration during the annual work plans and updates.

**Table 5 - Asset Management Plan and Program Improvements**

| Corporate AM Program | AMP |
|---|---|
| • Establish and action the AMITs for all asset classes (implemented via pilot classes initially and phased in)<br>• Review and enhance methods for communicating asset status in a simple manner<br>• Ensure data model and data governance give consideration to asset management needs<br>• Enhance data collection and analysis processes to link criticality, performance, and condition to other influencing factors<br>• Coordinate and integrate data from condition assessment projects with other corporate initiatives (e.g. Asset Registry Index Project, Data Governance, Asset Accounting/IFRS, Cityworks)<br>• Develop an enhanced risk-based capital project prioritization method (with input from the AMITs as applicable)<br>• Develop methods to evaluate the effectiveness of the AMP and AMIT approach and feedback the results into the overall program | • Through the AMITs, review all AMP recommendations for the respective asset class, confirm priorities for the current year, and develop a workplan to enable input into the next iteration of the AMP<br>• Align asset replacement costs with the cost estimating framework and unit cost analysis effort (bring forward asset classes requiring additional cost analysis)<br>• Work with Finance to develop approach for advising on actual capital expenditures for each asset type to allow an update from planned capital renewal expenditures (enable comparisons of planned to actual expenditures)<br>• Investigate the use of asset optimization / decision support software to provide a consistent approach to short and long term capital expenditure planning<br>• Extend Cityworks deployment throughout the organization and develop work flows to support corporate tracking of corporate initiatives<br>• Leverage Cityworks work order information to visualize activities and assess impacts on service levels or identify possible changes to operating and maintenance practices |

### *Asset Management Plan Monitoring*

The AMP is intended to drive changes to practices or behaviors that facilitate decision making and optimized use of information. Therefore, monitoring of the plans themselves is critical to evaluating the effectiveness of each AMP and AMIT. The proposed AMIT approach provides an opportunity to embed asset management principles throughout the organization and allows the team members to have line-of-sight between the work they perform daily and the larger critical success factors for the utility overall.

The introduction of the AMIT pilots has shown an increase in overall understanding of asset management as a means to better understand the utility's assets and how and when interventions are needed.

As each iteration of Halifax Water's AMP is published, the level of confidence in the data and information that support it increases. Acknowledgement is made that the AMP is based on best available corporate information and that the detail and level of clarity will improve over time as better information becomes available.

Halifax Water encourages a culture of continuous improvement and celebrates innovation and the Asset Management Program must also be exposed to the rigour of continuous improvement. The progress of the program needs to be monitored to identify opportunities to change directions, adjust slightly, and to promote the positive outcomes achieved.

Initiatives to monitor the plan will include:

- Ensuring asset management statistics are updated annually
- Including past years' performance data in future versions
- Encouraging AMITs to analyze data and identify trends and potential responses
- Reviewing plan improvement opportunities as part of AMIT workplan options
- Reviewing and highlighting how the AMP is contributing to integrating asset management throughout the organization
- Identifying metrics that may drive changes in behavior, maintenance practices, or approach to asset interventions
- Accurately allocating expenditures to the appropriate driver (asset renewal, compliance and growth) to ensure the AMP reports on true asset renewal expenditures

Halifax Water can build on the experience of effective multidisciplinary work teams (e.g. previous condition assessment projects, pilot AMITs). Extending the AMITs to additional asset classes will further work to integrate and embed asset management principles throughout the organization. This supports the "line of sight" concept and staff will be able to better understand the impact their actions have on the utility as a whole and on the rate payers benefiting from the service. The outcomes of the AMP and AMITs will benefit from improved communications leveraging opportunities such as Halifax Water's intranet to inform personnel on what is happening. In terms of collected data, it must be purpose-driven and used for making decisions. Figure 8 shows the transformation of data to knowledge such that staff can use it for defendable decisions.

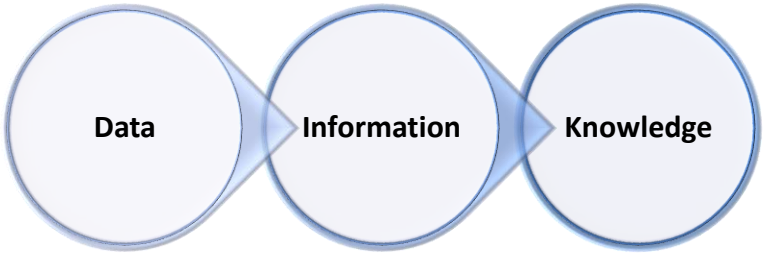



Figure 9 - Evolution from Data to Knowledge

Halifax Water will benefit from enhancing the way Asset Management Program outcomes are communicated and how leading AM practices permeate throughout the organization for the purpose of service to its customers.

C

HALIFAX WATER

2019 INTEGRATED RESOURCE PLAN

# APPENDIX C

## IRP CAPITAL PROGRAM

# 2019 IRP - Long-Term Capital Plan

| No. | Project Name | Region | Asset Group | Total Cost ($2019) | Year in Service | Source of Program/Project | Driver | Driver Allocation (%) | Objectives |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Install new twinned gravity pressure sewer (825mm and 450mm) | East | Wastewater - Trunk Sewers | $23,372,000 | 2022 | Master Plan | Asset Renewal - Compliance - Growth | 12.5:12.5:75 | 6,7,9,13,14 |
| 2 | Connect Beaver Crescent PS and Caldwell PS forcemains to new 450mm gravity pressure sewer | East | Wastewater - Forcemains | $78,000 | 2026 | Master Plan | Asset Renewal - Compliance - Growth | 12.5:12.5:75 | 6,7,9,13,14 |
| 3 | Install four (4) new pump out stations along gravity pressure sewer | East | Wastewater - Structures | $1,676,000 | 2023 | Master Plan | Asset Renewal - Compliance - Growth | 12.5:12.5:75 | 6,7,9,13,14 |
| 4 | Install gate valves at surge tank between Bissett Lake Pumping Station and gravity pressure sewer | East | Wastewater - Structures | $420,000 | 2026 | Master Plan | Asset Renewal - Compliance - Growth | 12.5:12.5:75 | 6,7,9,13,14 |
| 5 | Decommission existing 450mm gravity pressure sewer | East | Wastewater - Trunk Sewers | $559,000 | 2043 | Master Plan | Asset Renewal - Compliance - Growth | 12.5:12.5:75 | 6,7,9,13,14 |
| 6 | Upgrade Quigley's Corner Pumping Station | East | Wastewater - Structures | $2,875,000 | 2022 | Master Plan | Asset Renewal - Compliance - Growth | 47.5:47.5:5 | 6,7,9,10,13 |
| 7 | Optimize operation of Quigley's Corner Pumping Station | East | Wastewater - Structures | $336,000 | 2021 | Master Plan | Asset Renewal - Compliance - Growth | 47.5:47.5:5 | 7,11,14 |
| 8 | Upgrade Memorial Drive Pumping Station | East | Wastewater - Structures | $2,633,000 | 2031 | Master Plan | Asset Renewal - Compliance | 50:50 | 7,9,11 |
| 9 | Upgrade Beaver Crescent Pumping Station | East | Wastewater - Structures | $168,000 | 2036 | Master Plan | Asset Renewal - Compliance | 50:50 | 7,9,11 |
| 10 | Upgrade Bissett Lake Pumping Station | East | Wastewater - Structures | $2,934,000 | 2041 | Master Plan | Asset Renewal - Compliance - Growth | 25:25:50 | 6,7,9,10,13 |
| 11 | Upgrade Caldwell Road Pumping Station | East | Wastewater - Structures | $631,000 | 2039 | Master Plan | Asset Renewal - Growth | 25:75 | 6,7,9,10,13 |
| 12 | RDII Reduction Program (FMZ23) | East | Wastewater - Collection Sanitary | $3,204,580 | 2031 | Master Plan | Compliance - Growth | 5:95 | 6,7,9,14 |
| 13 | RDII Reduction Program (FMZ24) | East | Wastewater - Collection Sanitary | $1,570,040 | 2022 | Master Plan | Compliance - Growth | 5:95 | 6,7,9,14 |
| 14 | RDII Reduction Program (FMZ37) | East | Wastewater - Collection Sanitary | $2,479,704 | 2022 | Master Plan | Compliance - Growth | 5:95 | 6,7,9,14 |
| 15 | Local network upgrades on Caldwell Road | East | Wastewater - Collection Sanitary | $607,000 | 2036 | Master Plan | Asset Renewal - Compliance - Growth | 12.5:12.5:75 | 7,9,10,13 |
| 16 | Local network upgrades on Colby Drive | East | Wastewater - Collection Sanitary | $1,176,000 | 2031 | Master Plan | Asset Renewal - Compliance | 50:50 | 7,9,10 |
| 17 | Local network upgrades on Forest Hill Parkway | East | Wastewater - Collection Sanitary | $4,275,000 | 2041 | Master Plan | Compliance | 100 | 7,9,10 |
| 18 | Eastern Passage SSO Management Study | East | Wastewater - Collection System | $484,000 | 2023 | Master Plan | Compliance | 100 | 3,6,9 |
| 19 | LoWSCA: Canal Street Separation | East | Wastewater - Collection System | $1,842,000 | 2022 | Master Plan | Compliance - Growth | 25:75 | 7,8,9,13 |
| 20 | LoWSCA: Wyse Road Separation (Phase 1) | East | Wastewater - Collection System | $3,860,000 | 2022 | Master Plan | Compliance - Growth | 25:75 | 7,8,9,13 |
| 21 | LoWSCA: Wyse Road Separation (Phase 2) | East | Wastewater - Collection System | $2,802,000 | 2022 | Master Plan | Compliance - Growth | 75:25 | 7,8,9,13 |
| 22 | Additional Sewer Separation on Wyse Street | East | Wastewater - Collection System | $1,912,000 | 2031 | Master Plan | Compliance - Growth | 25:75 | 6,7,8,9,13 |
| 23 | Albro Lake Watershed Separation | East | Wastewater - Collection System | $8,111,000 | 2022 | Master Plan | Compliance - Growth | 5:95 | 6,7,8,9,13 |
| 24 | Maynard Lake and Clement Street Wetland Separation (Phase 1) | East | Wastewater - Collection System | $642,000 | 2025 | Master Plan | Asset Renewal - Compliance - Growth | 2.5:2.5:95 | 6,7,8,9,13 |
| 25 | Maynard Lake and Clement Street Wetland Separation (Phase 2) | East | Wastewater - Collection System | $4,540,000 | 2028 | Master Plan | Asset Renewal - Compliance - Growth | 2.5:2.5:95 | 6,7,8,9,13 |
| 26 | Maynard Lake and Clement Street Wetland Separation (Phase 3) | East | Wastewater - Collection System | $1,155,000 | 2028 | Master Plan | Asset Renewal - Compliance - Growth | 2.5:2.5:95 | 6,7,8,9,13 |
| 27 | Maynard Lake and Clement Street Wetland Separation (Phase 4) | East | Wastewater - Collection System | $453,000 | 2028 | Master Plan | Asset Renewal - Compliance - Growth | 2.5:2.5:95 | 6,7,8,9,13 |
| 28 | New Valleyford Pumping Station | East | Wastewater - Structures | $10,446,000 | 2041 | Master Plan | Compliance - Growth | 75:25 | 6,7,9,10,13 |
| 29 | 390 Waverley Road Forcemain Upgrades | East | Wastewater - Collection System | $11,361,000 | 2022 | Master Plan | Growth | 100 | 6,7,9,13,14 |
| 30 | Anderson Pumping Station Upgrades | East | Wastewater - Structures | $340,000 | 2031 | Master Plan | Asset Renewal - Compliance | 50:50 | 6,7,9,10 |
| 31 | Upgrades to Dartmouth WWTF | East | Wastewater - Treatment Facilities | $12,572,000 | 2041 | Master Plan | Growth | 100 | 4,7,9,10,13 |
| 32 | RDII Reduction Program (FMZ27) | East | Wastewater - Collection Sanitary | $5,941,076 | 2022 | Master Plan | Compliance - Growth | 25:75 | 6,7,9,14 |

# 2019 IRP - Long-Term Capital Plan

| No. | Project Name | Region | Asset Group | Total Cost ($2019) | Year in Service | Source of Program/Project | Driver | Driver Allocation (%) | Objectives |
|---|---|---|---|---|---|---|---|---|---|
| 33 | RDII Reduction Program (FMZ45) | East | Wastewater - Collection Sanitary | $1,120,232 | 2031 | Master Plan | Compliance - Growth | 5:95 | 6,7,9,14 |
| 34 | Additional flow monitoring | East | Wastewater - Collection Sanitary | $252,000 | 2021 | Master Plan | Compliance - Growth | 90:10 | 3,9 |
| 35 | Dartmouth CSO Flow Management Plan | East | Wastewater - Collection System | $675,000 | 2036 | Master Plan | Compliance - Growth | 90:10 | 3,6,9 |
| 36 | Green St. Sewer Upsize | East | Wastewater - Collection Sanitary | $513,000 | 2041 | Master Plan | Asset Renewal - Compliance | 50:50 | 7,9,10 |
| 37 | Pinecrest Dr. Sewer Upgrade | East | Wastewater - Collection Sanitary | $1,013,000 | 2034 | Master Plan | Asset Renewal - Compliance - Growth | 12.5:12.5:75 | 7,9,10,13 |
| 38 | Peddars Way Sewer Upgrade | East | Wastewater - Collection Sanitary | $555,000 | 2031 | Master Plan | Asset Renewal - Compliance - Growth | 12.5:12.5:75 | 7,9,10,13 |
| 39 | Atlantic Street SewerUpgrade | East | Wastewater - Collection Sanitary | $3,831,000 | 2026 | Master Plan | Asset Renewal - Compliance - Growth | 2.5:2.5:95 | 7,9,10,13 |
| 40 | Akerley Blvd and Railway Alignment Sewer Upgrade | East | Wastewater - Collection Sanitary | $4,814,000 | 2041 | Master Plan | Asset Renewal - Compliance - Growth | 12.5:12.5:75 | 7,9,10,13 |
| 41 | Pleasant Street Sewer Upgrade | East | Wastewater - Collection Sanitary | $767,000 | 2021 | Master Plan | Asset Renewal - Compliance - Growth | 12.5:12.5:75 | 7,9,10,13 |
| 42 | Princess Margaret Blvd. Sewer Upgrade | East | Wastewater - Collection Sanitary | $3,106,000 | 2031 | Master Plan | Asset Renewal - Compliance - Growth | 2.5:2.5:95 | 7,9,10,13 |
| 43 | Anderson Lake Development Connection | East | Wastewater - Collection Sanitary | $7,609,000 | 2036 | Master Plan | Growth | 100 | 9,13 |
| 44 | Marvin Street Connection to Cuisack CSO | East | Wastewater - Collection Sanitary | $1,380,000 | 2026 | Master Plan | Compliance - Growth | 47.5:47.5:5 | 6,7,9,14 |
| 45 | King Street Diversion | East | Wastewater - Collection Sanitary | $78,000 | 2026 | Master Plan | Compliance - Growth | 47.5:47.5:5 | 6,7,9,14 |
| 46 | Diversion to Eastern Passage | East | Wastewater - Collection Sanitary | $12,113,000 | 2041 | Master Plan | Growth | 100 | 6,9,13,14 |
| 47 | Dartmouth SSO Flow Management Plan | East | Wastewater - Collection Sanitary | $555,000 | 2023 | Master Plan | Compliance | 100 | 3,6,9 |
| 48 | Sackville Trunk Sewer Upgrades (1200mm diameter) | Central | Wastewater - Trunk Sewers | $5,101,000 | 2041 | Master Plan | Asset Renewal - Compliance - Growth | 12.5:12.5:75 | 7,9,10,13 |
| 49 | Sackville Trunk Sewer Upgrades (1050mm diameter) | Central | Wastewater - Trunk Sewers | $8,246,000 | 2041 | Master Plan | Asset Renewal - Compliance - Growth | 12.5:12.5:75 | 7,9,10,13 |
| 50 | Sackville Trunk Sewer Upgrades (1500mm diameter) | Central | Wastewater - Trunk Sewers | $144,000 | 2041 | Master Plan | Asset Renewal - Compliance - Growth | 25:25:50 | 7,9,10,13 |
| 51 | New 5ML storage tank in Lower Sackville (GoodLife Fitness Sackville Downsview Plaza) | Central | Wastewater - Structures | $17,469,000 | 2031 | Master Plan | Compliance - Growth | 5:95 | 9,10,13,14 |
| 52 | Fish Hatchery Park Pumping Station Upgrade | Central | Wastewater - Structures | $10,529,000 | 2036 | Master Plan | Asset Renewal - Compliance - Growth | 25:25:50 | 6,9,10,13 |
| 53 | Pumping Station (Beaver Bank #3 PS and Majestic Avenue PS) | Central | Wastewater - Structures | $1,090,000 | 2036 | Master Plan | Asset Renewal - Compliance - Growth | 2.5:2.5:95 | 6,9,10,13 |
| 54 | Mill Cove Wastewater Treatment Plant Capacity Upgrade | Central | Wastewater - Treatment Facilities | $89,256,000 | 2022 | Master Plan | Asset Renewal - Compliance - Growth | 25:25:50 | 1,4,6,9,10,13 |
| 55 | RDII Reduction Program (FMZ07, FMZ10, & FMZ40) | Central | Wastewater - Collection Sanitary | $9,288,248 | 2022 | Master Plan | Compliance - Growth | 5:95 | 6,7,9,14 |
| 56 | RDII Reduction Program (FMZ02 & FMZ03) | Central | Wastewater - Collection Sanitary | $8,023,065 | 2031 | Master Plan | Compliance - Growth | 5:95 | 6,7,9,14 |
| 57 | Local network upgrades on Beaver Bank Rd. North on Glendale Dr. | Central | Wastewater - Collection Sanitary | $2,086,000 | 2022 | Master Plan | Compliance - Growth | 75:25 | 7,9,10 |
| 58 | Local network upgrades on Beaver Bank Rd. at Galloway Dr. | Central | Wastewater - Collection Sanitary | $1,490,000 | 2022 | Master Plan | Asset Renewal - Compliance - Growth | 2.5:2.5:95 | 7,9,10,13 |
| 59 | Local network upgrades on Beaver Bank Rd by Windgate Drive | Central | Wastewater - Collection Sanitary | $1,667,000 | 2022 | Master Plan | Asset Renewal - Compliance - Growth | 37.5:37.5:25 | 7,9,10 |
| 60 | Local network upgrades on Old Sackville Road south of Harvest Hwy | Central | Wastewater - Collection Sanitary | $845,000 | 2036 | Master Plan | Asset Renewal - Compliance | 50:50 | 1,7,9,10 |
| 61 | Local network upgrades on  Hallmark Ave. | Central | Wastewater - Collection Sanitary | $437,000 | 2036 | Master Plan | Asset Renewal - Compliance | 50:50 | 7,9,10 |
| 62 | Local sewer upgrades on Waterfront Drive | Central | Wastewater - Collection Sanitary | $500,000 | 2036 | Master Plan | Asset Renewal - Compliance | 50:50 | 7,9,10 |
| 63 | Springfield Lake Connection to Sackville | Central | Wastewater - Collection Sanitary | $6,226,000 | 2043 | Master Plan | Compliance - Growth | 50:50 | 1,7,9,13 |
| 64 | Central Region SSO Management Study | Central | Wastewater - Collection Sanitary | $1,086,000 | 2024 | Master Plan | Compliance | 100 | 3,6,9 |

# 2019 IRP - Long-Term Capital Plan

| No. | Project Name | Region | Asset Group | Total Cost ($2019) | Year in Service | Source of Program/Project | Driver | Driver Allocation (%) | Objectives |
|---|---|---|---|---|---|---|---|---|---|
| 65 | WRWIP: Spring Garden Area Sewer Separation | West | Wastewater - Collection System | $7,281,000 | 2021 | Master Plan | Compliance - Growth | 50:50 | 7,8,9,13 |
| 66 | WRWIP: Young Street Area Sewer Separation | West | Wastewater - Collection System | $21,879,000 | 2022 | Master Plan | Compliance - Growth | 25:75 | 7,8,9,13 |
| 67 | WRWIP: Sewer Separation Upstream of Kempt CSO | West | Wastewater - Collection System | $14,752,000 | 2021 | Master Plan | Compliance - Growth | 5:95 | 7,8,9,13 |
| 68 | WRWIP: Linear Upsize - Gottingen & Cogswell Area | West | Wastewater - Collection System | $221,000 | 2019 | Master Plan | Compliance - Growth | 5:95 | 7,9,10,13 |
| 69 | WRWIP: Young Pumping Station Upgrade | West | Wastewater - Structures | $2,169,000 | 2027 | Master Plan | Asset Renewal - Compliance - Growth | 2.5:2.5:95 | 6,7,9,10,13 |
| 70 | WRWIP: New Fairfield Holding Tank | West | Wastewater - Structures | $12,403,000 | 2046 | Master Plan | Asset Renewal - Compliance - Growth | 25:25:50 | 6,7,9,13 |
| 71 | WRWIP: Replace Armdale Pumping Station Forcemains | West | Wastewater - Forcemains | $3,850,000 | 2022 | Master Plan | Asset Renewal - Growth | 50:50 | 3,7,9,10,13 |
| 72 | WRWIP: BLT WWTF Decommission - New Timberlea PS | West | Wastewater - Structures | $5,928,000 | 2022 | Master Plan | Compliance - Growth | 5:95 | 1,9,13 |
| 73 | WRWIP: BLT WWTF Decommission - New Timberlea Forcemain | West | Wastewater - Forcemains | $19,436,000 | 2022 | Master Plan | Compliance - Growth | 5:95 | 1,9,13 |
| 74 | WRWIP: BLT WWTF Decommission | West | Wastewater - Treatment Facilities | $500,000 | 2020 | Master Plan | Compliance - Growth | 5:95 | 1,9,13 |
| 75 | WRWIP: RDII Reduction Program in Fairview, Clayton Park, and Bridgeview areas | West | Wastewater - Collection Sanitary | $15,491,589 | 2021 | Master Plan | Compliance - Growth | 5:95 | 6,7,9,14 |
| 76 | WRWIP: BLT Flow Diversion to Herring Cove - New Crown Drive Pumping Station | West | Wastewater - Structures | $8,063,000 | 2033 | Master Plan | Compliance - Growth | 5:95 | 1,11,13 |
| 77 | WRWIP: BLT Flow Diversion to Herring Cove - New Crown Drive Forcemain | West | Wastewater - Forcemains | $9,026,000 | 2033 | Master Plan | Compliance - Growth | 5:95 | 1,11,13 |
| 78 | WRWIP: BLT Flow Diversion to Herring Cove - New Gravity Sewer | West | Wastewater - Collection Sanitary | $4,319,000 | 2033 | Master Plan | Compliance - Growth | 5:95 | 1,10,13 |
| 79 | WRWIP: BLT Flow Diversion to Herring Cove - New Gravity Sewer | West | Wastewater - Collection Sanitary | $3,266,000 | 2033 | Master Plan | Compliance - Growth | 5:95 | 1,10,13 |
| 80 | WRWIP: Herring Cove Road - Gravity Sewer Upsize | West | Wastewater - Collection Sanitary | $7,439,000 | 2033 | Master Plan | Compliance - Growth | 5:95 | 1,7,9,10,13 |
| 81 | WRWIP: Fairview Cove Linear Upsize | West | Wastewater - Collection Sanitary | $19,781,000 | 2021 | Master Plan | Asset Renewal - Compliance - Growth | 12.5:12.5:75 | 6,7,9,10,13 |
| 82 | WRWIP: Halifax Treatment Plant Capacity Upgrade | West | Wastewater - Treatment Facilities | $25,142,000 | 2041 | Master Plan | Asset Renewal - Compliance - Growth | 2.5:2.5:95 | 1,10,13 |
| 83 | WRWIP: Linear Upgrades within the Kearney Lake Road Area | West | Wastewater - Collection Sanitary | $2,997,000 | 2033 | Master Plan | Asset Renewal - Compliance - Growth | 2.5:2.5:95 | 7,9,10,13 |
| 84 | Infrastructure Master Plan: West Region CSO Management Study | West | Wastewater - Collection Sanitary | $965,000 | 2026 | Master Plan | Compliance - Growth | 90:10 | 3,6,9 |
| 85 | Infrastructure Master Plan: West Region SSO Management Study | West | Wastewater - Collection Sanitary | $415,000 | 2023 | Master Plan | Compliance | 100 | 3,6,9 |
| 86 | Chain Control Transmission - Existing Peninsula Low Upsize | West | Water - Transmission | $3,841,000 | 2022 | Master Plan | Asset Renewal - Growth | 25:75 | 10,13 |
| 87 | Chain Control Transmission - Existing Peninsula Intermediate Upsize | West | Water - Transmission | $2,650,000 | 2022 | Master Plan | Asset Renewal - Growth | 25:75 | 1,10,13 |
| 88 | Pepperell Transmission Upsize | West | Water - Distribution | $2,702,000 | 2036 | Master Plan | Asset Renewal - Growth | 25:75 | 10,13 |
| 89 | Chain Control Transmission - Existing Peninsula Low Lining | West | Water - Transmission | $2,916,000 | 2036 | Master Plan | Asset Renewal - Growth | 25:75 | 10,13 |
| 90 | Chain Control Transmission - Valve Chambers | West | Water - Structures | $1,258,000 | 2036 | Master Plan | Asset Renewal - Growth | 25:75 | 10,13 |
| 91 | Replace High Risk Peninsula Transmission (Robie) | West | Water - Transmission | $17,312,000 | 2026 | Master Plan | Asset Renewal | 100 | 11 |
| 92 | Peninsula Intermediate Looping - Quinpool Rd to Young St | West | Water - Distribution | $4,319,000 | 2022 | Master Plan | Asset Renewal - Growth | 25:75 | 10,13 |
| 93 | Young St. Watermain Upsize | West | Water - Distribution | $1,315,000 | 2026 | Master Plan | Asset Renewal - Growth | 25:75 | 10,13 |
| 94 | Robie St. Watermain Upsize | West | Water - Distribution | $956,000 | 2026 | Master Plan | Asset Renewal - Growth | 25:75 | 10,13 |
| 95 | Almon St. Watermain Upsize | West | Water - Distribution | $1,168,000 | 2026 | Master Plan | Asset Renewal - Growth | 25:75 | 10,13 |
| 96 | Windsor St. Watermain Upsize | West | Water - Distribution | $1,004,000 | 2026 | Master Plan | Asset Renewal - Growth | 25:75 | 10,13 |

# 2019 IRP - Long-Term Capital Plan

| No. | Project Name | Region | Asset Group | Total Cost ($2019) | Year in Service | Source of Program/Project | Driver | Driver Allocation (%) | Objectives |
|---|---|---|---|---|---|---|---|---|---|
| 97 | Geizer 158 to Lakeside High Watermain Looping | West | Water - Distribution | $2,249,000 | 2028 | Master Plan | Asset Renewal | 100 | 11 |
| 98 | Gravity Supply to Brunello | West | Water - Distribution | $2,328,000 | 2041 | Master Plan | Asset Renewal | 100 | 10,12 |
| 99 | Dominion Cres. Watermain Upsize | West | Water - Distribution | $447,000 | 2041 | Master Plan | Asset Renewal | 100 | 10 |
| 100 | Brunello Booster Pump Upgrades | West | Water - Structures | $236,000 | 2021 | Master Plan | Asset Renewal | 100 | 10 |
| 101 | Geizer 158 Looping - Lacewood Dr | West | Water - Distribution | $2,002,000 | 2041 | Master Plan | Asset Renewal | 100 | 10 |
| 102 | Geizer Hill Booster Pump Upgrades | West | Water - Structures | $277,000 | 2021 | Master Plan | Asset Renewal | 100 | 10 |
| 103 | Leiblin Booster Fire Pump | West | Water - Structures | $395,000 | 2019 | Master Plan | Asset Renewal | 100 | 10 |
| 104 | Herring Cove Rd. Watermain Twinning | West | Water - Distribution | $3,585,000 | 2022 | Master Plan | Asset Renewal | 100 | 11 |
| 105 | St. Michaels Ave. Watermain Upsize | West | Water - Distribution | $502,000 | 2041 | Master Plan | Asset Renewal | 100 | 11 |
| 106 | Herring Cove Rd. Watermain Looping - McIntosh St | West | Water - Distribution | $2,272,000 | 2022 | Master Plan | Asset Renewal | 100 | 11 |
| 107 | Lucasville Rd. Twinning (Phase 1) | Central | Water - Distribution | $8,117,000 | 2019 | Master Plan | Growth | 100 | 13 |
| 108 | Lucasville Rd. Twinning (Phase 2) | Central | Water - Distribution | $8,956,000 | 2026 | Master Plan | Growth | 100 | 13 |
| 109 | New Primary Feed to Sackville High | Central | Water - Distribution | $4,953,000 | 2026 | Master Plan | Growth | 100 | 13 |
| 110 | New Sackville Beaver Bank Valve Chamber | Central | Water - Structures | $839,000 | 2026 | Master Plan | Growth | 100 | 13 |
| 111 | Reconfiguration of Beaver Bank Booster | Central | Water - Structures | $100,000 | 2041 | Master Plan | Asset Renewal | 100 | 10,12 |
| 112 | New Sackville High PRV | Central | Water - Structures | $420,000 | 2036 | Master Plan | Growth | 100 | 13 |
| 113 | Cobequid High Looping | Central | Water - Distribution | $2,233,000 | 2026 | Master Plan | Asset Renewal - Growth | 25:75 | 11,13 |
| 114 | Windgate Dr. Watermain Upsize | Central | Water - Distribution | $882,000 | 2026 | Master Plan | Asset Renewal - Growth | 25:75 | 11,13 |
| 115 | Lively Booster Pump Upgrades | Central | Water - Structures | $38,000 | 2036 | Master Plan | Asset Renewal | 100 | 10 |
| 116 | New Hemlock Elevated Tank | West | Water - Structures | $6,209,000 | 2022 | Master Plan | Asset Renewal - Growth | 59:41 | 10,13 |
| 117 | Pockwock Transmission Loop through Bedford | Central | Water - Distribution | $5,069,000 | 2025 | Master Plan | Asset Renewal | 100 | 11 |
| 118 | Second Geizer 158 Feed | West | Water - Distribution | $9,612,000 | 2041 | Master Plan | Asset Renewal | 100 | 11 |
| 119 | New Main Street to Caledonia Road Connection | East | Water - Distribution | $3,072,000 | 2022 | Master Plan | Asset Renewal | 100 | 11 |
| 120 | Caledonia Rd. Watermain Twinning | East | Water - Distribution | $3,429,000 | 2022 | Master Plan | Asset Renewal | 100 | 11 |
| 121 | New Breeze Dr. Watermain | East | Water - Distribution | $5,801,000 | 2022 | Master Plan | Asset Renewal | 100 | 11 |
| 122 | Highway 118 Crossing - Shubie Park to Dartmouth Crossing | East | Water - Distribution | $6,063,000 | 2025 | Master Plan | Asset Renewal | 100 | 11 |
| 123 | Windmill Rd. Watermain Upsize | East | Water - Distribution | $6,104,000 | 2030 | Master Plan | Asset Renewal - Growth | 25:75 | 10,13 |
| 124 | New Woodside Industrial Park Feed | East | Water - Distribution | $1,649,000 | 2025 | Master Plan | Asset Renewal | 100 | 10 |
| 125 | Willowdale to Eastern Passage Connection | East | Water - Distribution | $6,290,000 | 2036 | Master Plan | Asset Renewal | 100 | 11 |
| 126 | Tacoma PRV Chamber | East | Water - Structures | $420,000 | 2020 | Master Plan | Asset Renewal | 100 | 10 |
| 127 | Pockwock Transmission Twinning - 60in | West | Water - Transmission | $65,516,000 | 2031 | Master Plan | Asset Renewal - Growth | 63:37 | 11 |
| 128 | Pockwock Transmission Twinning - 54in | West | Water - Transmission | $16,228,000 | 2036 | Master Plan | Asset Renewal - Growth | 63:37 | 11 |

# 2019 IRP - Long-Term Capital Plan

| No. | Project Name | Region | Asset Group | Total Cost ($2019) | Year in Service | Source of Program/Project | Driver | Driver Allocation (%) | Objectives |
|---|---|---|---|---|---|---|---|---|---|
| 129 | Extension to Springfield Lake | Central | Water - Distribution | $3,043,000 | 2043 | Master Plan | Asset Renewal | 100 | 7,10,13 |
| 130 | Bedford-Burnside System Interconnection (Phase 1) | All | Water - Distribution | $24,499,000 | 2036 | Master Plan | Asset Renewal - Growth | 53:47 | 9,11,13 |
| 131 | Bedford-Burnside System Interconnection (Phase 2) | All | Water - Distribution | $11,779,000 | 2036 | Master Plan | Asset Renewal - Growth | 53:47 | 9,11,13 |
| 132 | Lyle Emergency Booster Upgrade | East | Water - Structures | $1,045,000 | 2026 | Master Plan | Asset Renewal - Growth | 53:47 | 11 |
| 133 | Valving for Central Intermediate Boundary Change | East | Water - Structures | $629,000 | 2026 | Master Plan | Asset Renewal - Growth | 53:47 | 11 |
| 134 | Extension of Fall River to Bennery Lake (Phase 1) | East | Water - Distribution | $8,067,000 | 2026 | Master Plan | Asset Renewal - Growth | 26:74 | 9,11,13 |
| 135 | Extension of Fall River to Bennery Lake (Phase 2) | East | Water - Distribution | $9,156,000 | 2026 | Master Plan | Asset Renewal - Growth | 26:74 | 9,11,13 |
| 136 | Extension of Fall River to Bennery Lake (PS) | East | Water - Structures | $1,310,000 | 2026 | Master Plan | Asset Renewal - Growth | 26:74 | 9,11,13 |
| 137 | Decommission Miller Lake WTP - Linear | East | Water - Distribution | $628,000 | 2019 | Master Plan | Asset Renewal | 100 | 10,12 |
| 138 | Decommission Miller Lake WTP | East | Water - Treatment Facilities | $61,000 | 2019 | Master Plan | Asset Renewal | 100 | 10,12 |
| 139 | Decommission Collins Park WTP - Linear | East | Water - Distribution | $1,086,000 | 2041 | Master Plan | Asset Renewal | 100 | 10,12 |
| 140 | Decommission Collins Park WTP | East | Water - Treatment Facilities | $168,000 | 2041 | Master Plan | Asset Renewal | 100 | 10,12 |
| 141 | Decommission Silversands WTP - Linear | East | Water - Distribution | $1,931,000 | 2041 | Master Plan | Asset Renewal | 100 | 10,12 |
| 142 | Decommission Silversands WTP | East | Water - Treatment Facilities | $168,000 | 2041 | Master Plan | Asset Renewal | 100 | 10,12 |
| 143 | Chain Lake Backup Supply Study | West | Water - Transmission | $50,000 | 2020 | Master Plan | Asset Renewal - Growth | 50:50 | 2,5,11,13 |
| 144 | Mt. Edward Booster Fire Pump Study | East | Water - Structures | $50,000 | 2019 | Master Plan | Asset Renewal - Growth | 50:50 | 10,13 |
| 145 | New Orchard Control Chamber Study | West | Water - Structures | $50,000 | 2021 | Master Plan | Asset Renewal - Growth | 50:50 | 10,13 |
| 146 | Robie Emergency Booster Study | West | Water - Structures | $50,000 | 2041 | Master Plan | Asset Renewal - Growth | 50:50 | 10,13 |
| 147 | Safe Yield Study | All | Water - Treatment Facilities | $100,000 | 2020 | Master Plan | Compliance - Growth | 50:50 | 2,5,13 |
| 148 | New Hydraulic Water Model (InfoWater) | All | Water - Corporate Projects | $200,000 | 2020 | Master Plan | Asset Renewal - Growth | 50:50 | 9,10,12,13 |
| 149 | Comprehensive PRV Study | All | Water - Structures | $50,000 | 2019 | Master Plan | Asset Renewal - Growth | 50:50 | 10,12,13 |
| 150 | Transmission Main Risk Assessment and Prioritization Framework | All | Water - Transmission | $50,000 | 2020 | Master Plan | Asset Renewal - Growth | 50:50 | 10,13 |
| 151 | Tomahawk Lake Supply Study | Central | Water - Treatment Facilities | $50,000 | 2036 | Master Plan | Compliance - Growth | 50:50 | 2,5,7,9,13 |
| 152 | Aerotech Storage | Central | Water - Structures | $4,752,000 | 2022 | Master Plan | Asset Renewal - Growth | 20:80 | 2,10,13 |
| 153 | Water Supply Plants (A1) - Asset Renewal | All | Water - Treatment Facilities | $230,428,000 | 2019-2048 | AMPs | Asset Renewal | 100 | 2,10 |
| 154 | Water Supply Dams (A2) - Asset Renewal | All | Water - Structures | $8,345,000 | 2019-2048 | AMPs | Asset Renewal | 100 | 2,10 |
| 155 | Water Chambers and Booster Stations (A3) - Asset Renewal | All | Water - Structures | $25,164,682 | 2019-2048 | AMPs | Asset Renewal | 100 | 10 |
| 156 | Water Transmission Mains (A4) - Asset Renewal | All | Water - Transmission | $269,144,527 | 2019-2048 | AMPs | Asset Renewal | 100 | 10 |
| 157 | Water Distribution Mains (A5) - Asset Renewal | All | Water - Distribution | $301,734,210 | 2019-2048 | AMPs | Asset Renewal | 100 | 10 |
| 158 | Water Reservoirs (A6) - Asset Renewal | All | Water - Structures | $32,249,015 | 2019-2048 | AMPs | Asset Renewal | 100 | 10,11 |
| 159 | Wastewater Treatment Facilities (B1) - Asset Renewal | All | Wastewater - Treatment Facilities | $373,129,278 | 2019-2048 | AMPs | Asset Renewal | 100 | 10 |
| 160 | Wastewater Pumping Stations (B2) - Asset Renewal | All | Wastewater - Structures | $337,852,112 | 2019-2048 | AMPs | Asset Renewal | 100 | 10 |

# 2019 IRP - Long-Term Capital Plan

| No. | Project Name | Region | Asset Group | Total Cost ($2019) | Year in Service | Source of Program/Project | Driver | Driver Allocation (%) | Objectives |
|---|---|---|---|---|---|---|---|---|---|
| 161 | Wastewater Gravity Sewers (B3) - Asset Renewal | All | Wastewater - Collection System | $248,764,304 | 2019-2048 | AMPs | Asset Renewal | 100 | 10 |
| 162 | Forcemains (B4) - Asset Renewal | All | Wastewater - Forcemains | $48,139,079 | 2019-2048 | AMPs | Asset Renewal | 100 | 10 |
| 163 | Stormwater Management Structures (C1) - Asset Renewal | All | Stormwater - Structures | $10,538,402 | 2019-2048 | AMPs | Asset Renewal | 100 | 10 |
| 164 | Stormwater Gravity Sewers (C2) - Asset Renewal | All | Stormwater - Pipes | $162,116,838 | 2019-2048 | AMPs | Asset Renewal | 100 | 7,10 |
| 165 | Stormwater Cross Culverts (C3) - Asset Renewal | All | Stormwater - Culverts/Ditches | $65,229,942 | 2019-2048 | AMPs | Asset Renewal | 100 | 7,10 |
| 166 | Driveway Culvert (C4) - Asset Renewal | All | Stormwater - Culverts/Ditches | $25,500,000 | 2019-2048 | AMPs | Asset Renewal | 100 | 7,10 |
| 167 | JD Kline WSP - Process Upgrades - PH 1 | West | Water - Treatment Facilities | $32,660,000 | 2020-2025 | Compliance Plan | Compliance | 100 | 2 |
| 168 | JD Kline WSP - Process Upgrades - PH 2 | West | Water - Treatment Facilities | $25,440,000 | 2025-2028 | Compliance Plan | Compliance | 100 | 2 |
| 169 | Lake Major WSP - Process Upgrades - PH 1 | East | Water - Treatment Facilities | $31,163,000 | 2020-2024 | Compliance Plan | Compliance | 100 | 2 |
| 170 | Lake Major WSP - Process Upgrades - PH 2 | East | Water - Treatment Facilities | $16,960,000 | 2027-2030 | Compliance Plan | Compliance | 100 | 2 |
| 171 | Halifax WWTF - Preliminary Treatment | West | Wastewater - Treatment Facilities | $1,950,000 | 2022 | Compliance Plan | Asset Renewal - Compliance | 50:50 | 1,10 |
| 172 | Halifax WWTF - Coagulant Dosing System | West | Wastewater - Treatment Facilities | $135,000 | 2020 | Compliance Plan | Asset Renewal - Compliance | 50:50 | 1,10 |
| 173 | Halifax WWTF - Polymer Dosing System | West | Wastewater - Treatment Facilities | $39,500 | 2020 | Compliance Plan | Asset Renewal - Compliance | 50:50 | 1,10 |
| 174 | Halifax WWTF - Hydraulic Balancing Improvements | West | Wastewater - Treatment Facilities | $395,000 | 2019 | Compliance Plan | Asset Renewal - Compliance | 50:50 | 1,10 |
| 175 | Halifax WWTF - Disinfection Upgrades | West | Wastewater - Treatment Facilities | $850,000 | 2023 | Compliance Plan | Asset Renewal - Compliance | 50:50 | 1,10 |
| 176 | Halifax WWTF - UV System Level Controls | West | Wastewater - Treatment Facilities | $385,000 | 2023 | Compliance Plan | Asset Renewal - Compliance | 50:50 | 1,10 |
| 177 | Halifax WWTF - Solids Handling | West | Wastewater - Treatment Facilities | $935,000 | 2021 | Compliance Plan | Asset Renewal - Compliance | 50:50 | 1,10 |
| 178 | Halifax WWTF - Odour Control - Activated Carbon Reactors | West | Wastewater - Treatment Facilities | $275,000 | 2020 | Compliance Plan | Asset Renewal - Compliance | 50:50 | 1,10 |
| 179 | Halifax WWTF - Ballasted Flocculation Upgrades | West | Wastewater - Treatment Facilities | $4,070,000 | 2029 | Compliance Plan | Asset Renewal - Compliance | 50:50 | 1,10 |
| 180 | Halifax WWTF - Upgrade to secondary treatment / optimize advance primary treatment | West | Wastewater - Treatment Facilities | $160,750,000 | 2040 | Compliance Plan | Compliance | 100 | 1,4 |
| 181 | Dartmouth WWTF - Preliminary Treatment | East | Wastewater - Treatment Facilities | $1,785,000 | 2022 | Compliance Plan | Asset Renewal - Compliance | 50:50 | 1,10 |
| 182 | Dartmouth WWTF - Coagulant Dosing System | East | Wastewater - Treatment Facilities | $120,000 | 2020 | Compliance Plan | Asset Renewal - Compliance | 50:50 | 1,10 |
| 183 | Dartmouth WWTF - Polymer Dosing System | East | Wastewater - Treatment Facilities | $25,000 | 2020 | Compliance Plan | Asset Renewal - Compliance | 50:50 | 1,10 |
| 184 | Dartmouth WWTF - Hydraulic Balancing Improvements | East | Wastewater - Treatment Facilities | $335,000 | 2020 | Compliance Plan | Asset Renewal - Compliance | 50:50 | 1,10 |
| 185 | Dartmouth WWTF - Disinfection Upgrades | East | Wastewater - Treatment Facilities | $775,000 | 2021 | Compliance Plan | Asset Renewal - Compliance | 50:50 | 1,10 |
| 186 | Dartmouth WWTF - UV System Level Controls | East | Wastewater - Treatment Facilities | $325,000 | 2023 | Compliance Plan | Asset Renewal - Compliance | 50:50 | 1,10 |
| 187 | Dartmouth WWTF - Solids Handling | East | Wastewater - Treatment Facilities | $735,000 | 2023 | Compliance Plan | Asset Renewal - Compliance | 50:50 | 1,10 |
| 188 | Dartmouth WWTF - Ballasted Flocculation Upgrades | East | Wastewater - Treatment Facilities | $3,800,000 | 2029 | Compliance Plan | Asset Renewal - Compliance | 50:50 | 1,10 |
| 189 | Dartmouth WWTF - Upgrade to secondary treatment / optimize advance primary treatment | East | Wastewater - Treatment Facilities | $87,400,000 | 2038 | Compliance Plan | Compliance | 100 | 1,4 |
| 190 | Herring Cove - Preliminary Treatment | West | Wastewater - Treatment Facilities | $1,020,000 | 2022 | Compliance Plan | Asset Renewal - Compliance | 50:50 | 1,10 |
| 191 | Herring Cove - UV System Level Controls | West | Wastewater - Treatment Facilities | $300,000 | 2023 | Compliance Plan | Asset Renewal - Compliance | 50:50 | 1,10 |
| 192 | Herring Cove - Odour Control - Activated Carbon Reactors | West | Wastewater - Treatment Facilities | $165,000 | 2020 | Compliance Plan | Asset Renewal - Compliance | 50:50 | 1,10 |

# 2019 IRP - Long-Term Capital Plan

| No. | Project Name | Region | Asset Group | Total Cost ($2019) | Year in Service | Source of Program/Project | Driver | Driver Allocation (%) | Objectives |
|---|---|---|---|---|---|---|---|---|---|
| 193 | Herring Cove - Ballasted Flocculation Upgrades | West | Wastewater - Treatment Facilities | $3,265,000 | 2025 | Compliance Plan | Asset Renewal - Compliance | 50:50 | 1,10 |
| 194 | Herring Cove - Upgrade to secondary treatment / optimize advance primary treatment | West | Wastewater - Treatment Facilities | $38,200,000 | 2039 | Compliance Plan | Compliance | 100 | 1,4 |
| 195 | Lakeside-Timberlea WWTF - Improve Plant Hydraulics | West | Wastewater - Treatment Facilities | $25,000 | 2020 | Compliance Plan | Asset Renewal - Compliance | 50:50 | 1,10 |
| 196 | Wet Weather Management Program | All | Wastewater - Corporate Projects | $7,250,000 | 2020-2048 | Compliance Plan | Asset Renewal - Compliance - Growth | 33:33:33 | 3,6,9,10,14 |
| 197 | Armdale CSO Screening | West | Wastewater - Collection System | $3,000,000 | 2025 | Compliance Plan | Compliance | 100 | 6,7 |
| 198 | Quinpool Road CSO Screening | East | Wastewater - Collection System | $3,000,000 | 2025 | Compliance Plan | Compliance | 100 | 6,7 |
| 199 | Coburg Road CSO Screening | West | Wastewater - Collection System | $3,000,000 | 2025 | Compliance Plan | Compliance | 100 | 6,7 |
| 200 | South Street CSO Screening | West | Wastewater - Collection System | $3,000,000 | 2025 | Compliance Plan | Compliance | 100 | 6,7 |
| 201 | Beaufort CSO Screening | West | Wastewater - Collection System | $3,000,000 | 2025 | Compliance Plan | Compliance | 100 | 6,7 |
| 202 | Automated Flushing Program | All | Water - Distribution | $580,000 | 2020-2048 | Compliance Plan | Compliance | 100 | 3 |
| 203 | Corporate Flow Monitoring Program | All | Wastewater - Corporate Projects | $51,060,000 | 2019-2048 | Compliance Plan | Compliance - Growth | 50:50 | 3,6,13 |
| 204 | I&I Reduction (SIR) Program Flow Meters and Related Equipment | All | Wastewater - Equipment | $750,000 | 2019-2048 | Compliance Plan | Compliance | 100 | 3,6,14 |
| 205 | Watershed Land Acquisition | All | Water - Land | $3,000,000 | 2019-2048 | Compliance Plan | Compliance | 100 | 5 |
| 206 | Future Overflow Compliance Program (Enhanced Overflow Program - 10 overflows per year at B&C receiving waters) | All | Wastewater - Collection System | $198,889,474 | 2042 | Compliance Plan | Compliance | 100 | 6,9 |
| 207 | Bio-Solids Facility Upgrades | All | Wastewater - Treatment Facilities | $10,000,000 | 2023 | Compliance Plan | Compliance | 100 | 1,4 |
| 208 | Regional Development Charge Studies W | All | Water - Corporate Projects | $425,000 | 2019,+5...,2048 | Corporate Projects | Growth | 100 | 13,14 |
| 209 | Regional Development Charge Studies WW | All | Wastewater - Corporate Projects | $425,000 | 2019,+5...,2048 | Corporate Projects | Growth | 100 | 13,14 |
| 210 | Water System Master Plan Update | All | Water - Corporate Projects | $4,500,000 | 2023,+5...,2048 | Corporate Projects | Growth | 100 | 7,8,10,13,14 |
| 211 | Wastewater System Master Plan Update | All | Wastewater - Corporate Projects | $4,500,000 | 2023,+5...,2048 | Corporate Projects | Growth | 100 | 7,8,10,13,14 |
| 212 | IT Projects - Water | All | Water - Corporate Projects | $102,767,500 | 2019-2048 | Corporate Projects | Asset Renewal | 100 | 10 |
| 213 | IT Projects - Wastewater | All | Wastewater - Corporate Projects | $82,214,000 | 2019-2048 | Corporate Projects | Asset Renewal | 100 | 10 |
| 214 | IT Projects - Stormwater | All | Stormwater - Corporate Projects | $20,778,500 | 2019-2048 | Corporate Projects | Asset Renewal | 100 | 10 |
| 215 | GIS Projects - Water | All | Water - Corporate Projects | $10,050,000 | 2019-2048 | Corporate Projects | Asset Renewal | 100 | 10,11 |
| 216 | GIS Projects - Wastewater | All | Wastewater - Corporate Projects | $8,215,000 | 2019-2048 | Corporate Projects | Asset Renewal | 100 | 10,11 |
| 217 | GIS Projects - Stormwater | All | Stormwater - Corporate Projects | $2,385,000 | 2019-2048 | Corporate Projects | Asset Renewal | 100 | 10,11 |
| 218 | Asset Management Projects - Water | All | Water - Corporate Projects | $3,275,000 | 2019-2048 | Corporate Projects | Asset Renewal | 100 | 10,11 |
| 219 | Asset Management Projects - Wastewater | All | Wastewater - Corporate Projects | $9,552,500 | 2019-2048 | Corporate Projects | Asset Renewal | 100 | 10,11 |
| 220 | Asset Management Projects - Stormwater | All | Stormwater - Corporate Projects | $5,382,500 | 2019-2048 | Corporate Projects | Asset Renewal | 100 | 10,11 |
| 221 | Facility Projects - Water | All | Water - Corporate Projects | $20,750,000 | 2019-2048 | Corporate Projects | Asset Renewal | 100 | 10 |
| 222 | Facility Projects - Wastewater | All | Wastewater - Corporate Projects | $16,600,000 | 2019-2048 | Corporate Projects | Asset Renewal | 100 | 10 |
| 223 | Facility Projects - Stormwater | All | Stormwater - Corporate Projects | $4,150,000 | 2019-2048 | Corporate Projects | Asset Renewal | 100 | 10 |
| 224 | SCADA & Other Equipment - Water | All | Water - Corporate Projects | $10,283,500 | 2019-2048 | Corporate Projects | Asset Renewal | 100 | 10 |

# 2019 IRP - Long-Term Capital Plan

| No. | Project Name | Region | Asset Group | Total Cost ($2019) | Year in Service | Source of Program/Project | Driver | Driver Allocation (%) | Objectives |
|---|---|---|---|---|---|---|---|---|---|
| 225 | SCADA & Other Equipment - Wastewater | All | Wastewater - Corporate Projects | $10,016,800 | 2019-2048 | Corporate Projects | Asset Renewal | 100 | 10 |
| 226 | SCADA & Other Equipment - Stormwater | All | Stormwater - Corporate Projects | $79,200 | 2019-2048 | Corporate Projects | Asset Renewal | 100 | 10 |
| 227 | Fleet Upgrade Program - Water | All | Water - Corporate Projects | $14,091,000 | 2019-2048 | Corporate Projects | Asset Renewal - Growth | 50:50 | 10 |
| 228 | Fleet Upgrade Program - Wastewater | All | Wastewater - Corporate Projects | $30,972,000 | 2019-2048 | Corporate Projects | Asset Renewal - Growth | 50:50 | 10 |
| 229 | Fleet Upgrade Program - Stormwater | All | Stormwater - Corporate Projects | $8,993,000 | 2019-2023 | Corporate Projects | Asset Renewal - Growth | 50:50 | 10 |
| 230 | Integrated Resource Plan W | All | Water - Corporate Projects | $1,250,000 | 2024,+5...,2048 | Corporate Projects | Asset Renewal - Compliance - Growth | 33:33:33 | 2,5,7,9,10,11,12,13,14 |
| 231 | Integrated Resource Plan WW | All | Wastewater - Corporate Projects | $1,000,000 | 2024,+5...,2048 | Corporate Projects | Asset Renewal - Compliance - Growth | 33:33:33 | 1,3,4,6,7,9,10,11,12,13,14 |
| 232 | Integrated Resource Plan SW | All | Stormwater - Corporate Projects | $250,000 | 2024,+5...,2048 | Corporate Projects | Asset Renewal - Compliance - Growth | 33:33:33 | 7,8,9,10,11,13,14 |
| 233 | Climate Change Adaptation - Water | All | Water - Corporate Projects | $250,000 | 2020-2026 | Corporate Projects | Asset Renewal - Compliance | 20:80 | 9,12 |
| 234 | Climate Change Adaptation - Wastewater | All | Wastewater - Corporate Projects | $240,000 | 2020-2026 | Corporate Projects | Asset Renewal - Compliance | 20:80 | 9,12 |
| 235 | Climate Change Adaptation - Stormwater | All | Stormwater - Corporate Projects | $210,000 | 2020-2026 | Corporate Projects | Asset Renewal - Compliance | 20:80 | 9,12 |
| 236 | Energy Management Capital Program (Water) | All | Water - Energy | $1,200,000 | 2021-2023 | Corporate Projects | Asset Renewal | 100 | 9,12 |
| 237 | Energy Management Capital Program (Wastewater) | All | Wastewater - Energy | $14,500,000 | 2020-2048 | Corporate Projects | Asset Renewal | 100 | 9,12 |
| 238 | Lead Service Line Replacement Program | All | Water - Distribution | $30,000,000 | 2019-2048 | Corporate Projects | Asset Renewal | 100 | 5,10 |
| 239 | CCC Various - Water | All | Water - Distribution | $555,000 | 2019-2023 | Corporate Projects | Growth | 100 | 13 |
| 240 | CCC Various - Wastewater | All | Wastewater - Collection System | $7,305,000 | 2019-2020, 2022-2023 | Corporate Projects | Growth | 100 | 13 |
| | | | **Total Cost ($2019)** | **$4,053,662,397** | | | | | |