Asset Management Plan

May 27, 2019

The Corporation of

The Town of Fort Erie

EXECUTIVE SUMMARY

The Town of Fort Erie continues to make planned investments in existing infrastructure staying aware of legislative changes, future growth, and changing climate. The implementation of an Asset Management Policy, Strategy and Plan is necessary to adapt to infrastructure challenges as the Town continues to evolve.

The AM Policy articulates the Town's commitments and principles that will be considered in corporate AM planning. It ensures alignment and integration of AM into strategic planning processes.

The purpose of the AM Strategy is to determine the specific approaches that the Town will enact to link infrastructure decisions to the Town's overall priority of effective, sustainable infrastructure.

The overall purpose of the Town's AMP is to provide a comprehensive document that will guide corporate decision making related to the construction, operation, maintenance, replacement, expansion, and disposal of infrastructure assets, while minimizing risk and cost to the Town and its taxpayers and maximizing service delivery.

These strategic documents apply to assets owned by the Town of Fort Erie including:

1. Core municipal infrastructure assets:
- Roads (including all road assets in the right-of-way)
- Bridges
- Culverts
- Drinking water distribution
- Sanitary sewage collection
- Storm water management, and

2. Facilities Assets.

Levels of Service

Within the AMP, a comprehensive Level of Service (LOS) Framework has been developed for the AMP asset categories within the current scope. The development of performance measures that align with community values and corporate priorities and the technical indicators/metrics is a critical component on a functional Asset Management Plan. LOS are also at the core of O. Reg. 588/17 which will require municipalities to understand the cost of providing services, and to achieve higher or lower levels of service. Although this AMP has developed a LOS Framework that addresses legislated requirements, further work is required to fully develop, measure, and verify several current and proposed LOS, including several legislated performance measures.

State of Local Infrastructure

Asset information is stored in multiple locations, with GIS being the main source for inventory data. This data was combined into an asset inventory containing approximately 8,944 asset records with a total replacement value of approximately $1 billion, given the following caveats:

- Valuations shown are predicated upon average local values for replacement of infrastructure in the absence of invoice costs or average values provided from Town Staff.
- Values shown do not reflect economies of scale with respect to the coordinated replacement of infrastructure.
- Replacement values assume replacement with modern equivalent infrastructure.
- Increase to the accuracy of these valuations and the financial plan presented will require the improvement of the Town's core infrastructure data in several key areas.

Table ES1: Asset Valuations

Service Category	Asset	Current Replacement Value
Roads & ROW	Roads	$386,403,656
	Streetlights	$2,406,240
	Sidewalks	$23,326,386
Water	Mains	$171,796,084
	Hydrants	Built into Main Costs
	Valves	Built into Main Costs
Wastewater	Sewers	$136,003,666
	Manholes	Built into Sewer Costs
Stormwater	Sewers	$156,184,476
	Manholes	Built into Sewer Costs
Bridges & Structures	All	$37,350,500
Facilities Management	All	$98,423,527
	Total:	**$1,003,807,668**

The average condition of all assets, weighted by replacement value was determined to be in Good condition, as illustrated in Figure ES1.

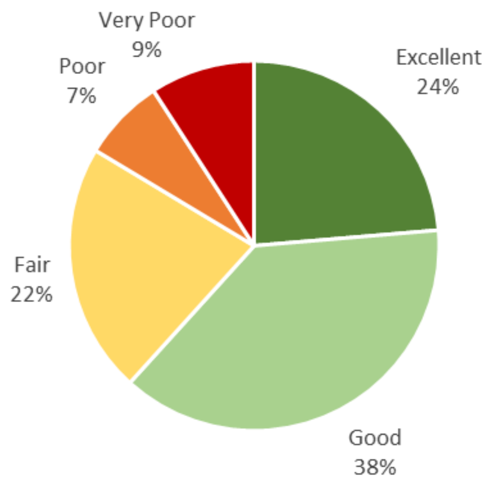

Figure ES1: Performance Breakdown for All Assets (with performance data)

Implementation Plan

An analysis of several scenarios was completed to forecast the Town's infrastructure needs and determine the required expenditures to address these needs. Asset risk was incorporated into some scenarios by establishing performance triggers for replacement based on the Consequence of Failure (COF) for different asset types.

Based on the findings of this analysis, only wastewater assets are recommended for additional spending to help maintain the state of good repair while the Town completes a CCTV inspection program. For the remainder of the asset categories, the existing budget was found to be adequate to maintain LOS. The spending projected for wastewater assets included a 3% increase per year over ten years, which would result in an increased expenditure of $2.7M over 10 years in addition to annual inflationary increases to contributions.

Figure ES2 outlines the recommended 10-year capital plan to address the state of good repair of the assets and their resulting average weighted performance which is maintained at a "Good" performance.

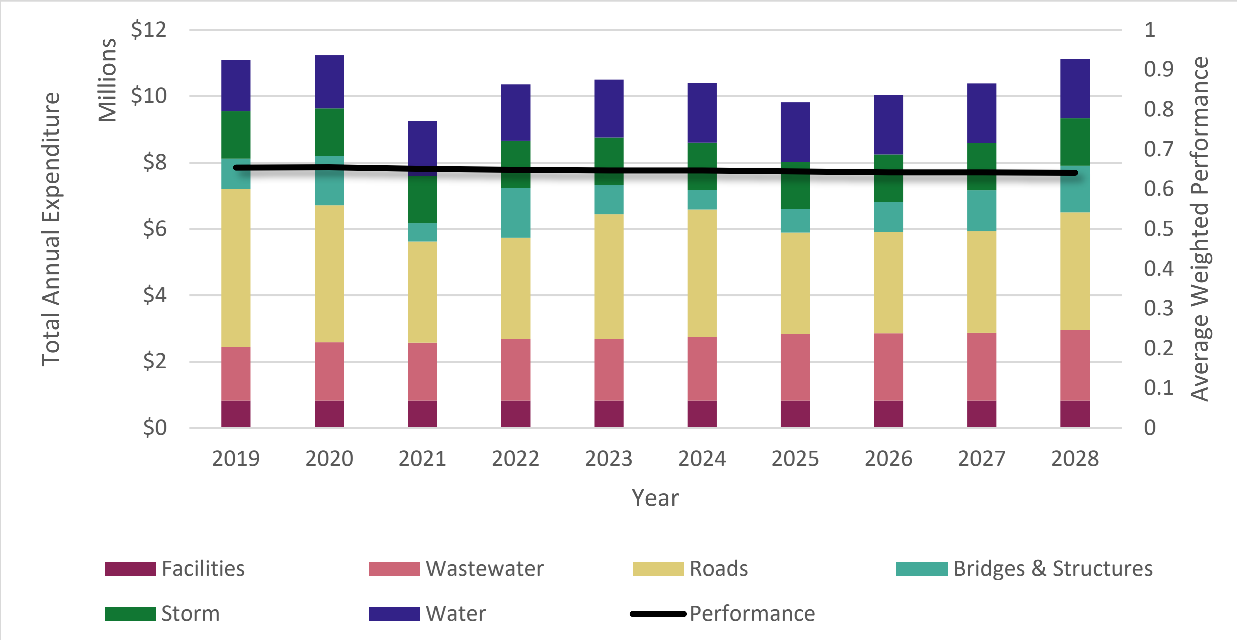

Figure ES2: Recommended 10 Year Capital Plan

Financing Strategy

The only infrastructure gap was related to water and wastewater, no gap was identified for assets funded through the Tax Levy. A 2.2% revenue increase would be required, on top of inflationary and other approved increases, to fund the additional $420K of related capital expenditures. It should be noted that the infrastructure gap for Sanitary may change as the Town completes the CCTV inspections over the next 10-years, as recommended by the 2019 Wastewater Master Plan. These inspections will provide condition data to inform the expenditure needs rather than the current age-based analysis.

The Town has developed a Long-Term Financial Plan (LTFP) Model which is a dynamic tool that incorporates all considerations from long-term capital and operating expenditures. The LTFP Model uses conventional accounting formula to track operating revenues and expenditures, debt and debt service obligations, reserves, etc., over a 30-year planning horizon.

The LTFP Model was used to analyze two rate increase scenarios to fund the infrastructure gap:

- Scenario 1 - Close the infrastructure gap over 3-years; and
- Scenario 2 - Close the infrastructure gap over 10-years.

In Scenario 1, the capital expenditures were gradually increased over the 3-year period and the deferred expenditures were spread over the following 7 years. Thus, the total expenditures for the 10-year period were equivalent. An additional 1% rate increase was required to fund Scenario 1, on top of inflationary increases, for 3 years from 2020-2022. Water and wastewater rates could then resume to inflationary increases.

Similarly, Scenario 2 had the same gradual increase but over 10-years and the deferred expenditures were spread over the following 10 years. The 30-year average annual expenditures were the same for both scenarios. The increase required to fund Scenario 2 was an additional 0.5% increase to rates, on top of inflationary increases, for 6 years from 2020-2025. Water and wastewater rates could then resume to inflationary increases.

It is prudent to consider the faster rate increase to close the annual funding gap to sustain the current LOS provided by the systems in a shorter time. Therefore, Scenario 1 is recommended to minimize the risk of deferred capital expenditures.

Over time, the Town can continue to refine their planning process and establish LOS that balance affordability with service delivery expectations.

Recommendations

Throughout the development of this AMP, a number of opportunities for improving AM at Fort Erie and supporting the development of subsequent AMP were identified. These recommendations are summarized within the AMP, and include the following:

1. Development of a formalized data management plan outlining the processes for data collection, verification, and management.
2. Completion of data management and business process improvement projects to support development of an asset centric, evidence-based asset management environment at the Town.
3. Software recommendations.
4. Collection of data to operationalize the LOS framework.
5. Fulfilment of required staff roles to ensure the Town has the resources to maintain and amalgamate the required data and perform the required analyses on an ongoing basis.

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ASSET MANAGEMENT POLICY

Asset Management Policy

- May 6, 2019 -

The Corporation of
The Town of Fort Erie

Strategic Asset Management Policy

1.0 Article 1 - Application and Administration

Strategic municipal asset management involves the challenge of planning and investing in core municipal infrastructure assets while ensuring sound stewardship of public resources and delivering valued customer services.

The purpose of this Asset Management Policy is to affirm the Town of Fort Erie's commitments in asset management through defined principles and processes and to ensure alignment and integration of asset management into our strategic planning processes. This policy is established to embed asset management principles into ongoing capital, operations, and maintenance activities, through the Asset Management Plan (AMP).

This policy provides a foundation to help identify and prioritize investments in existing and future infrastructure assets to ensure each investment is strong, safe, efficient, effective, and capable of supporting the quality of life desired in our community.

This policy applies to assets owned by the Town of Fort Erie including:

1. Core municipal infrastructure assets:
    - Roads (including all road assets in the right-of-way)
    - Bridges
    - Culverts
    - Drinking water distribution
    - Sanitary sewage collection, and
    - Storm water management.
2. Facilities Assets.

In the future, this policy will be expanded to include all infrastructure assets.

These policy requirements apply to all departments with responsibilities in the planning, maintaining or operating the municipal infrastructure assets listed above.

2.0 Article 2 - Definitions

For this policy, the following terms are defined:

"Asset" means a resource with economic value that a municipality controls with the expectation that it will provide a future benefit. An asset is specifically defined as property, equipment, vehicles, tools or other resources with a purchase value at or above the Capital Asset Threshold. Specifically, an Infrastructure Asset means the physical structures and associated facilities that form the foundation of development, and by or through which a public service is provided.

"Asset Management" means the coordinated activity of an organization to realize value from assets (AM).

"Asset Management Plan" (AMP) means a plan developed for the management of infrastructure assets, in compliance with the Strategic Asset Management Plan from O.Reg.588/17, that combines multi-disciplinary management techniques (including technical and financial) over the life cycle of the asset in the most cost-effective manner to provide a specific level of service. This typically includes plans to Invest, design, construct, acquire, operate, maintain, renew, replace and decommission assets.

"Capital Asset Threshold" means the threshold at or above which a resource is considered an asset, the value of a municipal infrastructure asset at or above which a municipality will capitalize the value of it and below which it will expense the value of it. For the Town of Fort Erie, the capital asset threshold is defined in the Capital Asset Policy. However, items below the defined threshold may be included in the Asset Management Plan, based on risk or criticality, under the authority of the Director of Infrastructure Services or Director of Corporate Services.

"Core municipal infrastructure asset" means any municipal infrastructure asset that is a,

- water asset that relates to the distribution of drinking water,
- wastewater asset that relates to the collection of wastewater, including any wastewater asset that from time to time manages storm water,
- storm water management asset that relates to the collection, transmission, treatment, retention, infiltration, control or disposal of storm water,
- road, including all assets in the right-of-way, or
- bridge or culvert.

"O.Reg.588/17" means Ontario Regulation 588/17 under the Infrastructure for Jobs and Prosperity Act 2015, as amended. Principles are set out in this regulation by the provincial government to regulate asset management planning for municipalities.

"Public" means residents and businesses in the Town of Fort Erie, and other interested parties.

"Road" means all road assets within the right-of-way, which may include sidewalks, curb, streetlights, boulevard, median, or other related assets.

3.0 Article 3 – Roles and Responsibilities

A robust Asset Management Plan includes a clear structure of parties with responsibilities in asset management at the Town of Fort Erie.

Asset Management Coordinator

Council and Committee is responsible for ensuring resources are provided to staff to ensure the Asset Management Policy and Plan are established and maintained. Council has the authority to approve this policy and municipal budgets, Committee has the authority to recommend policy, budgets and the Asset Management Plan and Policy to Council. Council also has the authority to make or override asset management decisions, in adherence with this policy.

CAO is overall responsible for implementing the Asset Management Policy and Plan. The CAO is responsible for endorsing the Asset Management Policy, assigning authorities and resources in administrative staff to ensure the Asset Management Plan is in place and the Asset Management Policy is executed. The CAO has the authority to execute the duties defined above and has the authority to make or override asset management decisions or recommendations from Senior Management or from the Asset Management Lead, in adherence with this policy.

Executive Lead at the Town of Fort Erie is the **Asset Management Lead**, a role filled by the Director of Infrastructure Services. The Asset Management Lead is responsible for ensuring Asset Management Policy and Plan is relevant, suitable, adequate, reviewed and updated as required. The Asset Management Lead also has the authority to make or override asset management decisions made by Managers within Infrastructure Services, in adherence with this policy.

The **Director of Corporate Services** is responsible for working with the Asset Management Lead and AMP outcomes, to ensure the financial budgets and long term financial plan is aligned with the asset forecasts and Levels of Service. The Director of Corporate Services is also responsible for financial reporting on assets and maintaining the financing and revenue strategy in alignment with the Asset Management Plan, Budget and Reserve Policies. In collaboration, the Director of Corporate Services, CAO and Director of Infrastructure Services have the authority to make asset management decisions in adherence with this policy, particularly when meeting financial policy, in accordance with the capital process flow chart, is challenged.

Managers are responsible for making asset recommendations related to the assigned portfolio, in adherence with this policy, and executing plans once approved and reporting on results once executed.

Members of the Public can stay informed, access information and provide feedback related to the AMP. The public may access information that provides a basis to decision making in the AMP under privacy and disclosure legislation.

The general structure is shown in Figure 1 below, with corresponding responsibilities and authorities further described in the AMP.

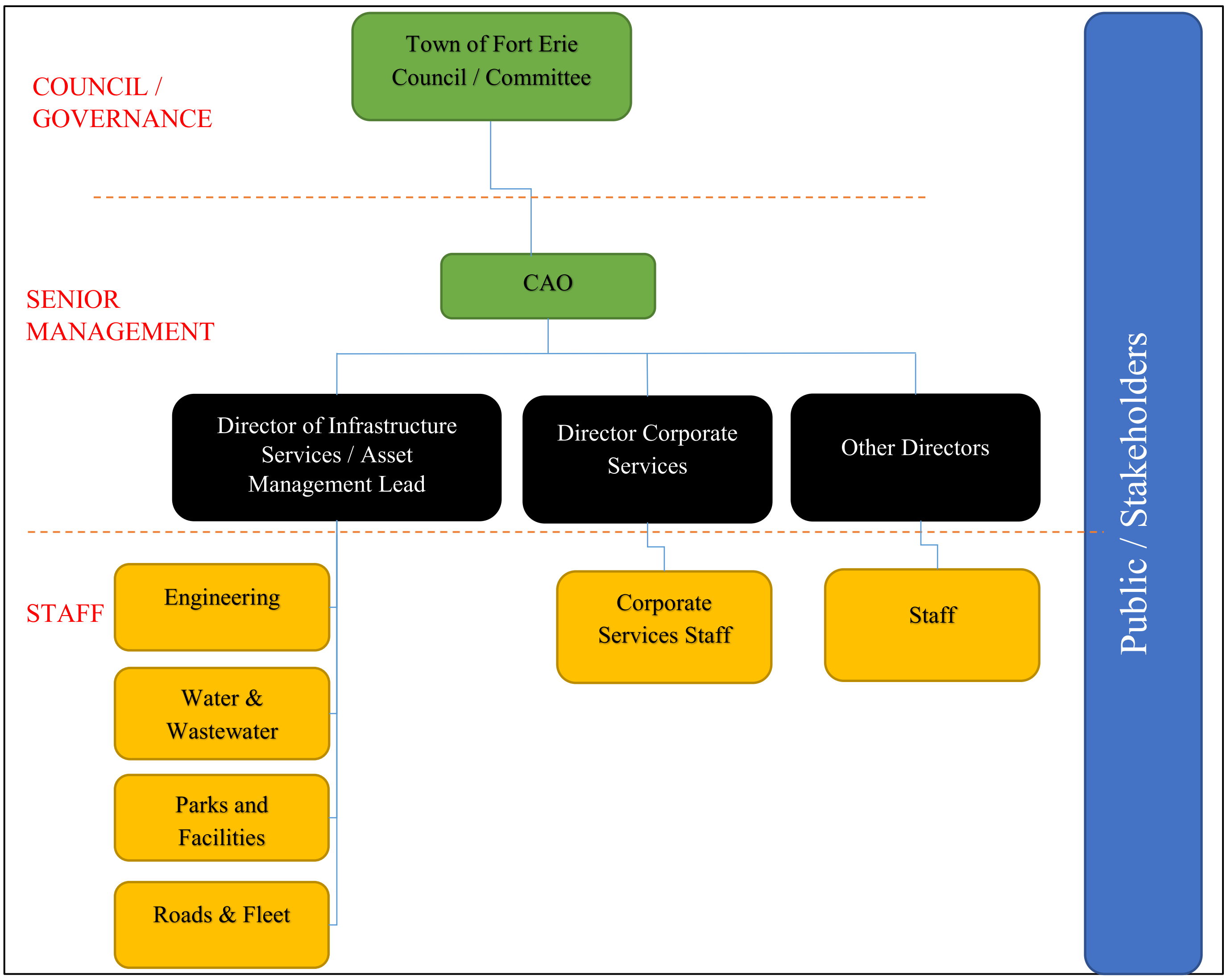


Figure 1: Overall governance Structure for Asset Management at the Town of Fort Erie.

4.0 Article 4 - Commitments

In our asset management planning, the Town of Fort Erie is committed to the following:

1. **Committing the resources to achieve sound stewardship of public resources** while maintaining the delivery of valued customer services at specified levels and upholding long term affordability.
2. **Consider public safety, risk tolerance and the Town's Strategic Plan**, under the Asset Management Plan and the principles defined in this Policy, when deciding to acquire, construct, maintain, rehabilitate, replace or dispose of core assets.

3. **Manage infrastructure assets with an integrated, not segregated, business approach** that delivers desired service results, and planning and investing in infrastructure within the context of our greater system, rather than examining assets in isolation.

4. **Enable residents, businesses and other interested parties** to provide input in asset management planning.

5. **Consider the impacts of climate change in asset planning and investment, and:**
    a. Identify the vulnerabilities of our assets caused by climate change,
    b. Consider the costs and means to address those vulnerabilities,
    c. Consider adaptation opportunities that may be undertaken to manage the vulnerabilities,
    d. Consider mitigation approaches to limit the magnitude or rate of long-term climate change (such as greenhouse gas emission reduction objectives), and
    e. Consider disaster planning and contingency funding.

6. **Coordinate planning** for asset management with Port Colborne, Welland, Niagara Falls, the Niagara Parks Commission, Ministry of Transportation of Ontario, the Region of Niagara and other local partners where assets connect or are related.

This Asset Management Policy conforms to prescribed requirements from Ontario Regulation 588.

5.0 Article 5 - Principles

Embracing the principles below, the Town of Fort Erie's Asset Management Plan provides a framework for decision-making, based on a defined level of service, when we invest, design, construct, acquire, operate, maintain, renew, replace or decommission assets.

In our asset management planning, the Town of Fort Erie will strive to follow the principles listed below.

Health, Safety and the Environment

1. Ensure health & safety of workers is protected, including those involved in the construction and maintenance of assets.

2. Consider resilience to the effects of climate change in the design of infrastructure.

3. Minimize the impact of infrastructure on the environment.

4. Respect and help maintain ecological and bio-diversity.

5. Endeavour to make use of acceptable recycled aggregates.

Prioritization and Value

6. Ensure we continue to provide our public services in Roads, Water, Wastewater, Storm, Bridges, Culverts and Facilities, at or above defined levels of service.

7. Identify and respect defined infrastructure priorities, based on risk and criticality. A clearly defined hierarchy for infrastructure priorities is a necessary foundation for an effective asset management plan, as priorities should inform investment decisions. Priorities are further described in the AMP.

8. Take a Long-term view in making asset decisions, especially considering the municipal life cycle of assets from acquisition to disposal. The Town strives to choose practices, interventions and operations that aim at reducing the lifecycle cost of asset ownership,

while satisfying agreed levels of service, basing decisions on a balance of service levels, risks, and costs.

9. Factor information with implications for infrastructure planning into infrastructure investment decisions.

10. The Town will choose practices, interventions and operations that aim at reducing the lifecycle cost of asset ownership, while satisfying agrees levels of service. Decisions are based on balancing service levels, risks, and costs.

Connection and Communication

11. Align with all relevant Town of Fort Erie financial or asset plans prepared under applicable financial budgeting policies and legislation.

12. Practice asset management transparently, and under the law:
    - Base decisions on evidence and information that is made available to the public, and
    - Share information with implications for infrastructure planning with other public sector entities.

13. Be mindful of and align with the Strategic Plan, other Town policies and other plans and strategies in effect. A description of connected plans is provided in further detail in the AMP.

Community and the People

14. Promote economic competitiveness, productivity, job creation and training opportunities.

15. Promote accessibility for persons with disabilities.

16. Promote community benefits, being the supplementary social and economic benefits arising from an infrastructure project that should improve community well-being.

17. Foster innovation by creating opportunities to make use of proven technologies, practices and services.

6.0 <u>Article 6 - Other Provisions</u>

Plans, Budgets and Forecasts

To fulfil Policy commitments, a process is in place at the Town of Fort Erie for using the AMP when developing municipal budgets and long-term forecasting related to assets, with special consideration to align to the Town of Fort Erie Water and Wastewater Service Area Financial Plans and master plans. This process is further described in the AMP.

Continual Improvement

The AMP must be continually improved, not just from nonconformities or weaknesses, but also making improvements in what the Town already excels in, by continually improving the asset management planning approach, incorporating new practices and principles. A process is in place to improve, adapt and tweak asset management processes, which includes responsibilities to stay current in asset management, adopt new practices, monitor the effectiveness of the AMP, and make changes. This process is further described in the AMP.

Land-Use Planning Framework

A process is in place to ensure that the Asset Management Plan aligns with Ontario's land-use planning framework, including the Town of Fort Erie Official Plan, Development Charge By-Law, and other master plans as they may apply. This process is further described in the AMP.

Risk Management

Climate change introduces risk and vulnerabilities for core municipal infrastructure assets. To fulfill climate change commitments in this Policy and stay aware of these risks and vulnerabilities, the Risk Assessment process is in place. Risk Assessment is further described in the AMP.

Also, as noted in Definitions, items below the capitalization threshold may be included in the AMP. Occasionally, an item's value may be less than the defined capitalization threshold, but it has a functional value that introduces risk should the item's inventory, availability, condition or forecast not be considered and planned for. In that case, assets may be added using the Risk Assessment process that is defined in the AMP.

Finally, infrastructure priorities are clearly identified in alignment with the Risk Management process. The process for identifying infrastructure priorities includes Risk Assessment, which is further described in the AMP.

Stakeholder Consultation

Stakeholder involvement is a commitment in this Policy and an important factor of a successful and relevant AMP. It is imperative that opportunities to provide input are consistently offered to residents and interested parties. Consultation and communication processes are described in the AMP.

Availability and Update

This policy shall be posted on the Town website and provided to anyone who requests it. It shall be reviewed and updated as required, as other infrastructure AMPs are completed, and no more than five years from the last revision date posted.

ASSET MANAGEMENT STRATEGY

Asset Management Strategy

- May 6, 2019 -

The Corporation of

The Town of Fort Erie

DEFINITIONS

Asset: An item, thing or entity that has potential or actual value to an organization (ISO 55000, 2014). The value can be tangible (or intangible); financial (or non-financial) and includes consideration of risks and liabilities.

Asset Management Plan (AMP): Documented information that specifies the activities, resources and timescales required for asset-based services to achieve the organization's Asset Management (AM) objectives (ISO 55000, 2014).

Asset Management Policy: A high-level statement of an organization's principles and approach to asset management (IIMM, 2015).

Asset Management Strategy: Documented information that specifies how organizational objectives are to be converted into Asset Management objectives, the approach for developing AMPs and the role of the Asset Management System in supporting achievement of the Asset Management objectives (ISO 55000, 2014).

Infrastructure: Infrastructure means the physical structures and associated facilities that form the foundation of development, and by or through which a public service is provided to Ontarians, such as highways, bridges, bicycle paths, drinking water systems, as well as any other thing by or through which a public service is provided to Ontarians (Infrastructure for Jobs and Prosperity Act, 2015, S.O. 2015, c. 15).

Level of Service (LOS): Level of Service is a qualitative or quantitative description of a service that is being provided. Two types of Levels of Service generally exist: Customer (or Community) Levels of Service; and, Technical Levels of Service.

Useful Life (service life): An estimate of the duration of time that an asset is forecasted to be in service.

1 INTRODUCTION

This Asset Management (AM) Strategy is a foundational element of the Town of Fort Erie's AM system. AM at the Town of Fort Erie is comprised of a Council-endorsed AM Policy which conforms to prescribed requirements from Ontario Regulation 588/17, as amended, the AM Strategy and the AMP.

The AM Policy articulates the Town's commitments and principles that will be considered in corporate AM planning. It ensures alignment and integration of AM into strategic planning processes.

The purpose of the AM Strategy is to determine the specific approaches that the Town will enact to link infrastructure decisions to the Town's overall priority of effective, sustainable infrastructure. The AM Strategy will set out to achieve the commitments and principles of the AM Policy through a set of inter-related business processes necessary to produce an AMP. The Strategy defines how the Town's AM processes are developed and connected, in order to provide the means through which the objectives of the AM Policy will be achieved (Based on *"Building Together – Guide For Municipal Asset Management Plans*" – Government of Ontario). The activities and processes described provide the basic elements for sound management of assets throughout their service life.

The Strategy is comprised of the following sections:

- **Lifecycle Activities**
- **Expansion and Development Process**
- **Procurement Process**
- **Risk Management**
- **Climate Change Considerations**

2 LIFECYCLE ACTIVITIES

This section summarizes different lifecycle activities typically used by the Town to manage assets.

2.1 Non-Infrastructure Activities

Non-infrastructure solutions are actions or policies that are not capital in nature, which can result in the lowering of costs and can extend the life of an asset through optimized planning and management. The Town takes the following general non-infrastructure actions:

- The Town strives to integrate the planning of infrastructure renewal across asset categories and with neighbouring/connected municipalities. This allows for economies of scale. For example, the Town will design for road reconstruction to align with buried infrastructure replacements or combine Town cross culvert replacements with Regional road reconstruction.
- Demand management initiatives are sometimes used to optimize asset use and educate the public. For example, transportation master planning will include consideration of traffic planning with consideration of matching road asset class & suitability to traffic use.
- Studies, investigations and master plans are regularly carried out to ensure there is a thorough understanding of the asset performance and needs, to inform the asset management planning decisions.
- The Town shares assets across divisions, where practical, to reduce or control a growing asset portfolio and avoid unnecessary duplication of spending or effort. This may include sharing equipment (e.g. fleet vehicles), more efficient equipment access & storage, and coordinating construction projects.
- The Town has been using software technology to inform AM decisions for many years. These systems help to more efficiently manage and operate assets across an organization by helping to improve consistency, recording, reliability, and reducing duplication of data. Examples include:
    - *Financial Management System*: This system which is known as FMW is used to exercise financial control and accountability related to the Town's budget. In addition, Accpac is used to house a PSAB register to track costs/depreciation related to the Town's assets.
    - *Customer Relationship Management (CRM)*: IBM Notes is used by the Town to track staff and public customer complaints which can be used for measuring Levels of Service (LOS).
    - *Computerized Maintenance Management System (CMMS)*: The Town has recently selected and begun implementing a CMMS (Fiix) for several service categories.
    - *Geographical Information System (GIS)*: This system is used to capture, store, manipulate, analyze, manage, and present spatial or geographical data. The locations of the Town's physical linear assets are inventoried within this system.
    - *Bridge and Structures Management System*: This system (Asset Management Forecaster) is used to gather, store, and analyze data about the Town's bridge and structure assets. It also allows for forecasting future needs for this infrastructure.

- *Pavement Management System*: This system (Decision Optimization Technology) is used to gather, store, analyze and forecast data about the Town's roads. It also allows for forecasting future needs for this infrastructure.
- A performance forecasting tool has been developed for Roads, Water, Wastewater, Stormwater, Facility, and Bridge and Structure assets. This tool is used to forecast future infrastructure needs based on available data and compare different financial and Level of Service (LOS) scenarios. Where the Town already has forecasting tools in place, the Town will continue to use these systems.

2.2 Renewals and Rehabilitation Needs and Investment

Rehabilitation is done to restore an asset from its current condition to a better condition. Where appropriate, rehabilitation projects are recommended. Replacement is done when the asset has reached the end of its life and/or is no longer providing acceptable service. Upgrading is done when a like for like replacement of an asset will not meet current or anticipated future demands and service requirements.

Based on risk assessments and industry standards, general rehabilitation and renewal strategies for each asset category are established from target condition performance, which can vary based on asset type and risk.

Identification of renewal needs and investment is practiced through the development of comprehensive asset inventories and condition assessments, which are used to develop medium and long-term capital plans. Before capital approval, asset renewals and rehabilitation considerations are assessed and prioritized based on risk, which includes the following criteria:

- Asset condition, provided through Condition Assessment programs, with special focus on assets with high criticality.
- Impact of the deficiency or observed condition on current and future asset performance.
- Available options for maintenance and renewal work.
- Available infrastructure renewal and rehabilitation options are considered in the AMP assessment activities.

Asset renewal options for assets other than roads are not included in the Decision Support System, but it is anticipated these will be folded into that tool in the future.

2.2.1 ROADS & BRIDGES ASSETS – RENEWALS AND REHABILITATION

Roads can be either rehabilitated or replaced when road condition falls below the target for the particular road segment, defined in the AMP. The condition of a road segment is measured using a Pavement Condition Index (PCI), standardized by the American Society for Testing and Materials, which is a 100-point rating scale where a score of 100 is a road in excellent condition and a score of 0 is a road in very poor condition. The target condition for each road segment varies based on road classification - larger volume arterial and collector roads have a higher target PCI than lower volume local roads.

The Town's strategy is to replace roads in coordination with the replacement of other subsurface infrastructure (such as watermains) in urban areas when conditions of other assets merit replacement. Roads are typically rehabilitated (rather than replaced) when there is no other subsurface infrastructure that requires replacement. Other considerations such as the timing of proposed developments are also incorporated into the decisions to replace or rehabilitate a road.

Further, road renewal is guided by condition "windows" for which different renewal strategies can be applied. If a road condition falls below a target PCI defined in the AMP, then rehabilitation is no longer practical, and the road will require a full replacement.

Roads options include: crack sealing, overlay, mill and overlay, and full depth reconstruction for asphalt roads; and single surface treatment, double surface treatment (DST), pulverize and DST, and pulverized, emulsified reclaimed asphalt concrete (RAP) and DST for surface treated roads.

Sidewalks are rehabilitated when they fall below a target performance score in accordance with legislative standards and based on condition ratings (see AMP).

Walks and trails are rehabilitated when they fall below a target performance score (see AMP).

The bridges in the Town of Fort Erie are both bridge structures and large culverts. Bridges and large culverts are rehabilitated and/or replaced in accordance with the recommendations made by qualified professionals through regulated inspections and subsequent site investigations. Options for short and long-term treatments are provided by the external consultant.

2.2.2 WASTEWATER ASSETS – RENEWALS AND REHABILITATION

Wastewater sewers can be either rehabilitated or replaced. The Town's strategy is to replace wastewater sewers in poor or very poor condition (i.e. below a target performance condition defined in the AMP) in coordination with the replacement of the road surface and other subsurface infrastructure, such as watermains and storm sewers.

In striving to maintain sanitary sewers in fair condition or better, critical sanitary sewers are scheduled for rehabilitation or replacement as soon as anticipated to reach a poor condition. Less critical sanitary sewers are allowed to degrade further before rehabilitation or replacement is considered. Currently, the criticality of sewers is based on the size of the pipe as the consequence of failure is assumed to be greater for pipes with a larger diameter. However, as the Town collects more information and refines this analysis, more factors may be incorporated to define the criticality of sewer pipes.

The decision for timing when to rehabilitate poor or very poor condition wastewater sewers is based on a detailed review of the observations from camera inspections that help the Town's subject matter experts determine when rehabilitation is preferred over replacement. The location of a sewer may also affect decisions for timing, for example, under a newly resurfaced road, in easements, on high traffic roads, and within an area where open cuts may be too disruptive (e.g. business improvement areas).

2.2.3 WATER ASSETS – RENEWALS AND REHABILITATION

Watermains can be rehabilitated or replaced. Based on the master plan, a funding strategy has been devised to minimize watermain breaks (State of Good Repair strategy) and provide projections for the total number of breaks across the system over the next 50 years. The current strategy is to replace watermains that experience a high number of breaks or that have reached the end of their useful life.

In striving to maintain watermain at a fair condition or better, critical watermain is scheduled for replacement as soon as anticipated to reach a poor condition. Less critical watermain is allowed to degrade further before replacement is considered. Currently, the criticality of watermains is based on the size of the pipe as the consequence of failure is assumed to be greater for pipes with a larger diameter. However, as the Town collects more information and refines this analysis, more factors may be incorporated to define the criticality of watermains, including risk of freezing in shallow servicing areas.

The rehabilitation of watermains through the installation of a cured in place liner was investigated in 2018 but is not being considered further, as the cost was equal to the cost of replacement.

Watermain replacement currently drives many of the decisions for roads rehabilitation or replacement in urban areas.

2.2.4 STORM ASSETS – RENEWALS AND REHABILITATION

Stormwater management ponds are dredged on a routine basis to remove sediment and vegetation that has accumulated, restoring the full capability of the asset to provide its intended service to treat the quality and quantity control of stormwater runoff. The performance scores used for the stormwater management ponds are related to the time since the last dredging relative to the target dredging frequency, determined at the time of design. Ponds are rehabilitated (or dredged) when they fall below a condition performance score defined in the AMP or have reached their target dredging date.

Storm sewers can be either rehabilitated or replaced. The current strategy is to replace storm sewers in very poor condition in coordination with the replacement of the road surface and other subsurface infrastructure, such as watermains and/or wastewater sewers. Closed Circuit TV (CCTV) inspection of storm sewers has commenced and informs the strategy for storm rehabilitation or replacement.

In striving to maintain storm sewers in a fair condition or better, critical sewers are scheduled for rehabilitation or replacement when anticipated to reach a poor condition. Less critical sewers are allowed to degrade further before rehabilitation or replacement is considered. Currently, the criticality of sewers is based on the size of the pipe as the consequence of failure is assumed to be greater for pipes with a larger diameter. However, as the Town collects more information and refines this analysis more factors may be incorporated to define the criticality of sewer pipes, such as lowered risk due to preventative maintenance flushing programs.

A ditching program is being developed, which may include rehabilitation activities.

2.2.5 FACILITIES ASSETS – RENEWALS AND REHABILITATION

Facilities are typically rehabilitated through the replacement or refurbishment of individual components or groups of components. Each component has an industry accepted estimated service life that is combined with observations of the condition of each component during site investigations and a target condition for the respective component to project the required expenditures. Individual components are replaced when they fall below a condition performance score (defined in AMP).

2.3 Maintenance and Operations Needs and Investment

Incorporating planned maintenance solutions into the lifecycle management strategy ensures that these activities are funded at an appropriate level, enabling assets to reach their full service potential. Maintenance and operations needs and investment are assessed and prioritized based on criticality and reliability. Routine preventative maintenance activities are completed to ensure the preservation of existing assets. Operational and maintenance requirements are considered when planning new infrastructure.

Asset operations and maintenance requirements and required resources are assessed and prioritized based on:

- Carrying out legislated operations and maintenance activities to ensure safety and environmental sustainability in accordance with the appropriate regulations.
- Conducting routine and preventative maintenance activities to ensure preservation of existing assets.
- Reference to current operations and maintenance (O&M) contracts, historical costs of the established operational tasks, and forecasted industry pricing to forecast future O&M costs.
- Assessing consequential operational and maintenance requirements of significant new infrastructure planned to be added to the asset portfolio, especially before the asset portfolio expansion is approved.

For consistency, the Town has established Maintenance Quality requirements and complies with Ontario Regulation 239/02, as amended, “Minimum Maintenance Standards For Municipal Highways”. These Town requirements include:

- Sidewalk Inspection and Maintenance
- Roads Winter Operation and Salt Management
- Road Patrol

- Ditch Maintenance
- Culvert Maintenance
- Catchbasin Maintenance
- Storm Sewer Maintenance
- Streetlight Maintenance
- Bridge Inspection and Maintenance
- Fence Maintenance
- Spills Response
- Drinking Water Quality Management System – Distribution System Maintenance
- Wastewater Maintenance
- Facility Maintenance, and
- Elevator Maintenance.

Climate change poses infrastructure vulnerabilities that may impact maintenance and operations requirements, of which staff and management regularly discuss and stay aware in maintenance planning activities. More information on climate change vulnerabilities can be found in **Section 5 – Climate Change Considerations.**

Contingency plans are operational plans that can improve recovery times and reduce impacts of failure, thus affecting criticality. These types of plans are included in the maintenance and operation of assets at the Town.

2.4 Disposal Activities

The Town strives for consistency in disposal activities, when an asset has reached the end of its useful life or is otherwise no longer needed by the Town. Assets are disposed of within 12 months of when the asset is taken out of service and every effort to trade-in, resell, or auction the asset is made when practical. When disposal is required, assets are sent to the appropriate facility for recycling where possible.

With facilities, tenders often include removal and disposal of existing assets when renewing and this captures any trade-in or scrap value (e.g. old HVAC units). Recycling requirements are also stipulated in tenders, when appropriate (e.g. this is required with old lighting to achieve Ontario Power Authority grant funding).

2.5 Do Nothing

Consideration of 'doing nothing' should always be considered as a lifecycle option, as this position can establish a baseline against which other options are compared. Sometimes risk levels or levels of service requirements offer 'do nothing' as a legitimate alternative worth consideration or comparison.

3 EXPANSION AND DEVELOPMENT PROCESS

The Town must continually plan activities required to extend services to previously unserviced areas or expand services to meet growth demands, all in accordance with a financial strategy. Incorporating growth into the lifecycle management strategy ensures that the additional lifecycle costs associated with newly constructed or acquired assets and new services are accounted for in the long-term forecast.

3.1 Population Growth

The 2018 budget reported the 2017 population as 30,710, with a reported 15,569 households and 1.26% tax growth. Based on the Region's 2019 Development Charges Study, the population is expected to grow to a projected 37,003 by 2031, and 42,390 by 2041. These projections amount to approximately 1.4% average annual growth from now until 2041.

3.2 Asset Portfolio Growth

This level of population growth will place significant pressure on the capacity of existing infrastructure and creates demand for new infrastructure. The Town determines its recommended expansion program through master plans and development charge background studies, where projected needs are planned with consideration of capacity, impending regulatory changes, stakeholder demand, desired target levels of service, and availability of enabling technologies.

The following master plans and expansion-related studies are complete, underway or planned for the near future:

- Corporate Strategic Plan
- Town of Fort Erie Official Plan
- Niagara Region Transportation Master Plan (2016)
- Active Transportation Master Plan
- 2017 Fort Erie Facility Condition Assessment and Master Plan
- 2016 Fort Erie Water Master Plan
- Water Financial Plan
- 2019 Fort Erie Wastewater Master Plan Update and Pollution Control Plan Update Study
- Development Charge Background Study (2019)
- 2016 Regional Niagara Water and Wastewater Master Servicing Plan Update
- 2018 Road Needs Study
- Rural Ditching Master Plan
- Parks and Open Space Master Plan

3.3 Operational Expenditure Growth

Operational expenditure is the operations and maintenance cost of new assets. For example, for a new pedestrian streetlight in a subdivision streetscape, the cost of electricity, replacement bulbs, and graffiti removal all contribute to the consequential operational expenditure associated with that new asset, even though the streetlight was initially installed by a developer which then passed the streetlight to the Town through assumption.

For most assets, a good estimate of the consequential operational expenditure required to operate and maintain the new assets is the existing operations and maintenance cost multiplied by the growth factor.

Operational expenditure growth is considered in AM forecasting.

4 PROCUREMENT PROCESS

To ensure the most efficient allocation of resources, the Town strives to explore different delivery mechanisms, such as working with other municipalities to pool projects and resources, design-build or pooling capital projects for economies of scale.

Procurement methods help to ensure the most efficient allocation of resources when executing AM strategies such as maintenance and renewals works completed by external contractors and suppliers.

It is the aim of the Town that all goods and services are acquired in a fair and open manner that is efficient and accountable, in accordance with the Town's current Purchasing Bylaw which guides all procurement practices.

5 RISK MANAGEMENT

The Town strives to meet service levels and to manage risk while minimizing life cycle costs.

There are risks within many levels of AM, which are summarized in this section. Some risk management described is included as legislated, and some is described to ensure the AMP holistically describes how risk is managed at the Town of Fort Erie.

Risk events, such as an asset failure, are events which may compromise the delivery of the Town's Corporate Strategic objectives, impact public safety, or lead to financial loss.

5.1 Corporate Risk Assessment

The Ministry of Infrastructure Guide for Municipal Asset Plans identifies that risks associated with the strategy (i.e. ways the plan could fail to generate the expected service levels) and any actions that will be taken in response are to be identified.

Risk is inherent to this AM Strategy, as the AMP has the potential to fail to generate expected service levels. Risk events, such as an asset failure, are events which may compromise the delivery of the Town's strategic objectives.

a. Overall risk-based decisions are made by those with assigned authority. Those responsible for overall authority to make or override asset decisions for the Town ensure public safety and Town's strategic objectives are considered overall when approving plans or modifications to the plans under the AM Policy.
b. Should any catastrophic event occur, Town resources would be diverted/reallocated from the current plan as required. The AMP would be adjusted and updated accordingly.
c. Risks to revenues may also affect AM planning. For example, should water and sewer revenue forecasts not occur as per the financial plan, some projects that are required to maintain the water and sewer infrastructure will need to be removed from the forecast through a prioritization process.
d. Master planning exercises determine the overall funding allocation for each department/service category. The AMP must take the allocated overall department funding into account, but must also identify, through risk, any changes that may be required to funding streams. Master planning is further described in **Section 2 - Expansion and Development Process.** Should forecasted asset needs exceed allocated budgeted funding streams, adjustments to funding, levels of service and/or risk tolerance adjustments may be required and reflected in the AMP. Consideration of commitments and principles from the AM Policy is done at this level, when assessing the criticality of assets and prioritizing current and forecasted budgets.

5.2 Asset Risk Assessment

Risk is managed more specifically at the asset level to determine the risk criticality of assets and manage these risks. Managing risk is achieved by optimizing the timing and type of maintenance and renewal interventions. To provide guidance for asset maintenance and renewal decision-making, the Town's tolerance for risk arising from the deterioration and failure of assets has been defined based on an asset's criticality and likelihood of failure.

Asset criticality reflects the importance of an asset to the Town's delivery of services or, in technical terms, the potential consequences of the asset failing (and therefore failing to provide the required LOS). An asset's likelihood of failure reflects the probability of an asset failing, which will increase over time as assets age but can also be impacted by the type of asset and the conditions the asset is subjected to.

Based on risk assessment and industry standards, rehabilitation and replacement strategies for each asset category are established from target condition performance, which can vary based on asset type. Typically, assets considered higher risk will be replaced earlier in their lifecycle as they will not be allowed to degrade to a point where failure is possible, while lower risk assets will be allowed to degrade further before action is considered. How risk is defined will vary based on asset category and can be refined over time as more information is collected to consider different contributing factors.

Consideration of commitments and principles from the AM Policy is also done at this level when assessing criticality of assets and prioritizing current and forecasted budgets.

Risks specific to drinking water distribution are also managed directly through the Drinking Water Quality Management System in place at the Town.

5.3 Asset Registry

Less formal risk assessments are also carried out when considering the addition of an item below the capitalization threshold. If the risk of excluding the item in the AMP is significant, based on an assessment approved by the Director of Infrastructure Services or by the Director of Corporate Services, that asset is incorporated into the AMP.

6 CLIMATE CHANGE CONSIDERATIONS

The infrastructure vulnerabilities that may be caused by the impact of climate change must also be considered within the lifecycle strategy.

Vulnerabilities are assessed during risk assessment activities.

Options to address these vulnerabilities are three-fold:

- Increasing preventive maintenance activities where possible (e.g. more frequent re-application of rip rap for erosion prevention around large culverts)
- Adjusting levels of service (e.g. tolerating a lower road network PCI)
- Considering lifecycle activities that may be effective (e.g. lining watermain).

These options to address or adapt to the vulnerabilities are considered during many stages of asset decision-making - when reviewing levels of service, planning maintenance budgets and activities at the department level, and in business decisions related to rehabilitation options, procurement, non-infrastructure activities, and replacement options.

Costs that may arise from the identified vulnerabilities are considered during risk assessments when reviewing the potential impact and likelihood of asset failure.

Mitigation approaches are considered in the Corporate Strategic Plan and when considering options in infrastructure planning.

Disaster planning and contingency funding is managed through Infrastructure Services and the Fire Department, and projected asset demands or changes to the asset portfolio are reflected in the AMP as appropriate.

ASSET MANAGEMENT PLAN

1. DEFINITIONS AND GLOSSARY

Table 1: Glossary

Term	Definition
Asset	A resource with economic value that a municipality controls with the expectation that it will provide a benefit. An asset is specifically defined as property, equipment, vehicles, tools or other resources with a purchase value at or above the Capital Asset Threshold. Specifically, an Infrastructure Asset means the physical structures and associated facilities that form the foundation of development, and by or through which a public service is provided.
Asset Management (AM)	The coordinated activity of an organization to realize value from assets.
Asset Management (AM) Lead	A role within the Town responsible for directing asset management processes in the organization. The Asset Management Lead is responsible for ensuring the Asset Management Policy and Plan is relevant, suitable, adequate, reviewed and updated as required. The Asset Management Lead also has the authority to make or override asset management decisions made by Managers within Infrastructure Services, in adherence with this policy.
Asset Management Plan (AMP)	A plan developed for the management of infrastructure assets, in compliance with the Strategic Asset Management Plan from O. Reg. 588/17, that combines multi-disciplinary management techniques (including technical and financial) over the life cycle of the asset in the most cost-effective manner to provide a specific level of service. This typically includes plans to invest, design, construct, acquire, operate, maintain, renew, replace and decommission assets.
Asset Management Policy	A high-level statement of an organization's principles and approach to asset management (IIMM, 2015).

Term	Definition
Asset Management Strategy	Documented information that specifies how organizational objectives are to be converted into Asset Management objectives, the approach for developing AMPs and the role of the Asset Management System in supporting achievement of the Asset Management objectives (ISO 55000, 2014).
Asset Risk	The product of the likelihood/probability and the consequences that would be incurred if an asset was to fail.
Bridges and Structures	An asset category included within the AMP which includes bridges, culverts and retaining walls.
Capital Asset Threshold	The threshold at or above which a resource is considered an asset, the value of a municipal infrastructure asset at or above which a municipality will capitalize the value of it and below which it will expense the value of it. For the Town of Fort Erie, the capital asset threshold is defined in the Capital Asset Policy. However, items below the defined threshold may be included in the Asset Management Plan, based on risk or criticality, under the authority of the Director of Infrastructure Services or Director of Corporate Services.
Consequence of Failure (COF)	COF represents the socio-economic and environmental impacts of an asset's failure and is used to determine asset risk.
Core Municipal Infrastructure Asset	Any municipal infrastructure asset that is a - water asset that relates to the distribution of drinking water, - wastewater asset that relates to the collection of sanitary wastewater, - storm water management asset that relates to the collection, transmission, treatment, retention, infiltration, control or disposal of storm water, - road, including all assets in the right-of-way, or

Term	Definition
	- bridge or culvert.
Estimated Service Life (ESL) / Useful Life	An estimate of the duration of time that an asset is forecasted to be in service.
Facilities	An asset category included within the AMP which includes buildings maintained by the Town including Town Hall, libraries, fire stations, arenas, community centers and museums.
Infrastructure	Infrastructure means the physical structures and associated facilities that form the foundation of development, and by or through which a public service is provided to Ontarians, such as highways, bridges, bicycle paths, drinking water systems, as well as any other thing by or through which a public service is provided to Ontarians (Infrastructure for Jobs and Prosperity Act, 2015, S.O. 2015, c. 15).
Level of Service (LOS)	Level of Service is a qualitative or quantitative description of a service that is being provided. Two types of Levels of Service generally exist: Customer (or Community) Levels of Service which focus on statements of customer expectations for service delivery, in easy to understand language; and, Technical Levels of Service which focus on quantitative measures applied against assets and overall systems that define the performance requirements to support CLOS. In addition, the current LOS being provided by the Town (Current LOS) can be compared against the LOS the Town proposes to provide over the next ten years based on a lifecycle management and financial strategy (Proposed LOS).
Likelihood of Failure (LOF)	LOF represents the probability of an asset failing, which will increase over time as assets age but can also be impacted by the type of asset and the conditions the asset is subjected to.

Term	Definition
LOS Framework	A set of tables which outlines the Levels of Service developed for each service category.
O. Reg. 588/17	Ontario Regulation 588/17 under the Infrastructure for Jobs and Prosperity Act 2015, as amended. Principles are set out in this regulation by the provincial government to regulate asset management planning for municipalities.
Performance Measure	Parameters / metrics that can be measured and monitored to assess the delivery of a service that is being provided.
Public	Residents and businesses in the Town of Fort Erie and other interested parties.
Reserves	A reserve is an allocation of accumulated net revenue. The Town's current strategy is to contribute fixed amounts to capital reserves which supports capital spending together with grants, DCs, debt, etc.
Roads and Right of Ways	An asset category included within the AMP which includes the road base, asphalt, curbs, sidewalks and streetlights.
Stormwater Management	An asset category included within the AMP which includes storm sewers, ditches, stormwater management ponds and manholes.
Wastewater Collection	An asset category included within the AMP which includes wastewater sewers, manholes.
Water Distribution	An asset category included within the AMP which includes mains, valves, service laterals, curb stops, hydrants and hydrant leads.

1 INTRODUCTION

1.1 Objectives and Purpose

The Town of Fort Erie continues to make planned investments in existing infrastructure, staying aware of legislative changes, future growth and changing climate. The implementation of an Asset Management Policy, Strategy and Plan is necessary to adapt to infrastructure challenges as the Town continues to evolve.

The objective of this effort is to maximize benefits, manage risk, and provide satisfactory levels of service to the public in a sustainable manner. Asset management requires a thorough understanding of the characteristics and condition of infrastructure assets, as well as the service levels expected from these assets. It also involves setting strategic priorities to optimize decision making about when and how to proceed with investments. Finally, it requires the development of a financial plan which is the most critical step in putting the plan into action. The AMP embeds these asset management elements into ongoing capital, operations, and maintenance activities.

The overall purpose of the Town's AMP is to provide a comprehensive document that will guide corporate decision making related to the construction, operation, maintenance, replacement, expansion, and disposal of infrastructure assets, while minimizing risk and cost to the Town and its taxpayers and maximizing service delivery.

The AMP allows the Town to:

- Establish long-term infrastructure master plans and the annual budget;
- Develop sustainable financial plans;
- Maintain customer and technical levels of service;
- Consistently consider options related to assets, based on the AMP and levels of services;
- Support funding applications to the federal and provincial levels of government; and
- Meet legislative requirements.

1.2 Scope

This AMP applies to all core municipal infrastructure assets owned by the Town and has been expanded beyond mandated scope requirements to also include Facilities assets. The asset categories included in the scope are the following:

- Water Distribution (e.g. mains, valves)
- Wastewater Collection (e.g. sewers, manholes)

- Stormwater Management (e.g. sewers, manholes)
- Roads and Right of Ways (e.g. roads, sidewalks, streetlights)
- Bridges and Structures (e.g. bridges, culverts, retaining walls)
- Facilities (e.g. Town Hall, Fire Stations, Libraries)

The Town maintains other assets, including Parks, Cemeteries, Fleet, IT, etc., however, these are not considered core assets and have not been included in the current AMP.

While this report covers a forecast period of 10 to 50 years, the full lifecycle of the Town's assets included in this plan was considered in the calculations. It is suggested that more focus and attention be put on the first 10 years of the asset management plan to ensure accurate capital planning in the short term.

1.3 Methodology and Framework

The framework of this AMP is established fundamentally on the Corporate Strategic Plan, where Council set out priorities, goals, and initiatives for the Town of Fort Erie. In addition, the AM Policy also sets out the framework for this AM Plan.

This AMP structure and content aligns with the Province's "Building Together Guide for Municipal Asset Management Plans" and on "Ontario Regulation 588/17 – Asset Management Planning for Municipal Infrastructure" to ensure asset management at the Town of Fort Erie is most functional and effective.

Of most importance in the AMP are the following key sections:

The **Asset Management Policy** affirms the Town's approach to infrastructure asset management through defined commitments and principles for decision-making (prescribed by legislation) and aligns asset management into strategic planning processes. This policy was approved by the Town's Council on May 21, 2019.

The **Asset Management Strategy** sets out the main policies, practices, and actions that are taken to minimize the lifecycle cost of the assets. This includes operational activity and capital expenditures. Workshops were held with key staff to document the current policies and practices, and to identify opportunities for improvement to further reduce lifecycle costs while meeting desired LOS. This strategy was approved by the Town's Council on May 21, 2019.

The **Defined Levels of Service Section** contains both currently reported performance measures and a preliminary assessment of proposed LOS, or 'targets', including new legislated performance measures. Workshops were held with the key Town staff to obtain a common understanding of the nature and purpose of customer and technical LOS and to define a preliminary set of measures. Further work is required to fully develop, measure, and verify several current and proposed LOS including several legislated performance measures. Technical Memorandum 5 (provided in Appendix E) further supports the information in this section.

The **State of Local Infrastructure Section** includes details about the current condition and value of the asset classes covered by the AMP. This approach provides a common reporting protocol that can be used for all assets across the Town. Technical Memorandum 4 (provided in Appendix D) further supports the information in this section.

The **Implementation Plan Section** contains the results of the scenario analysis completed to compare strategies to address infrastructure needs while balancing LOS, risk, and affordability. This analysis was used to identify funding gaps to meet proposed LOS. Technical Memorandum 6/7 (provided in Appendix F) further supports the information in this section.

The **Financing Strategy Section** includes both historical and future budgeted capital and operating expenditure and identifies the major funding sources. This strategy represents the estimated amount of capital the Town requires to reinvest in its existing asset inventories on an annual basis to sustain the current level of service. The future budgeted expenditure has been compared to investment needs arising from the Asset Management Strategy to identify potential future funding shortfalls. Technical Memorandum 8 (provided in Appendix G) further supports the information in this section.

1.4 Linking to Corporate Planning Documents

The AMP is dynamic and must continually align with other corporate planning documents that involve needs or commitments related to municipal infrastructure assets. At the Senior Management and Council level, corporate plans are established in full consultation with infrastructure services and asset management authorities to ensure this alignment continues and the AMP remains current and relevant. It is the same staff that formulate these long term, strategic documents with financial commitments that are consulted throughout the AMP development process.

These corporate planning documents may include:

- Official Plan
- Corporate Strategic Plan
- Budget Book
- Wastewater Master Plan (2019)
- Water Master Plan (2017)
- Storm Sewer Master Plan
- Roads Master Plan (2017)
- Bridge and Culvert Assessments (2017)
- Accessibility Plan (2013-2017)
- Facilities Needs Study (2006)
- Roads Needs Database (2017)
- Fort Erie Waterfront Strategy (2017)
- Development Charge By-Law (2019)

1.5 Growth Considerations

Census data indicates that the Town's population was 30,700 in 2016. Population projections to the year 2041 were established by Niagara Region through Niagara 2041 and the Municipal Comprehensive Review. These projections estimated a total population of 43,940 by the year 2041. This number represents approximately 40% population growth over the 25-year period between 2016 and 2041. During that period, the rate of population growth was also projected to increase by approximately 10% over the ten (10) year period between 2016 and 2026. An increase in population growth will result in greater demands on the Town's infrastructure and will provide the Town with an increase in revenue that can be put towards asset renewal.

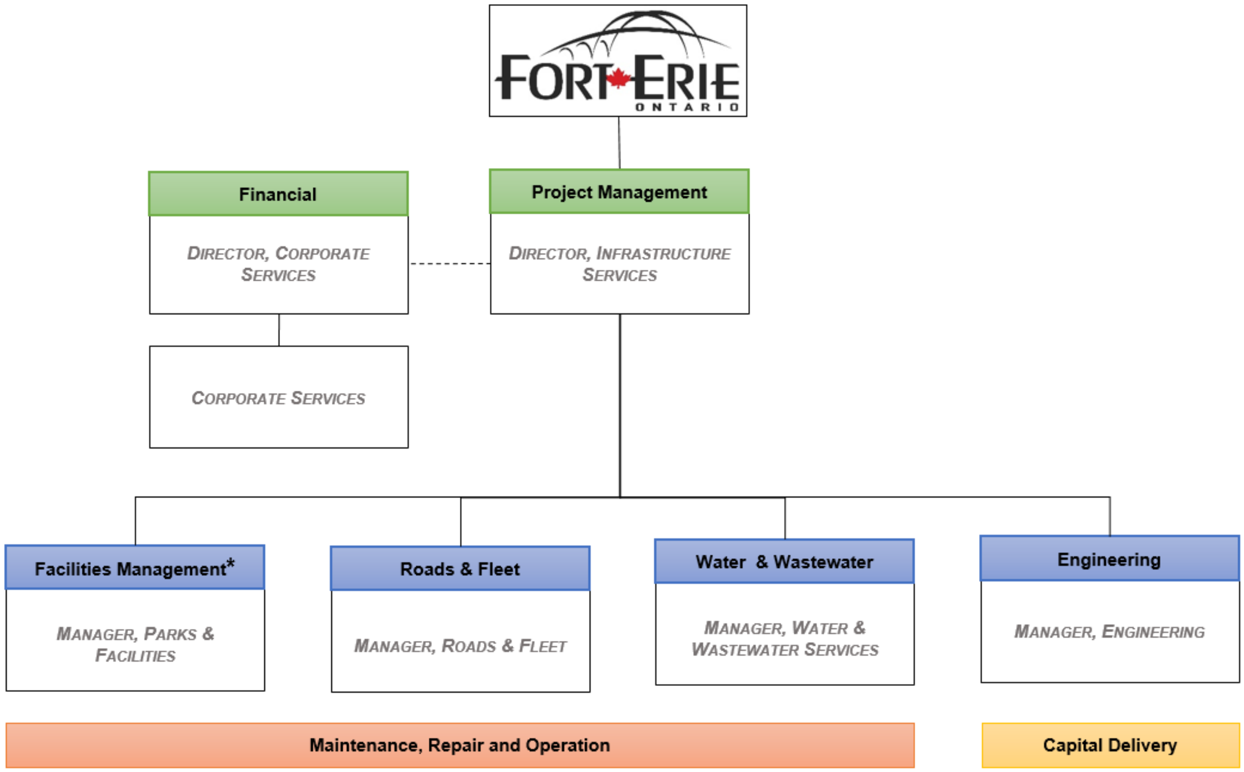
Along with population growth, infrastructure expenditures will also increase. The Niagara Region 2016 Water and Wastewater Master Servicing Plan Update indicates Capital Program expenditures of $306,649,000 for Water Services and $500,318,000 for Wastewater Services. Other infrastructure expenditures will follow suit.

Although the AMP's financial strategy does factor in population growth, the AMP is largely focused on expenditures to address the state of good repair of existing infrastructure. Corporate strategic documents, such as the Water and Wastewater Master Servicing Plans, address infrastructure needs to support growth. As new or upgraded infrastructure comes online from these capital programs, these assets will be incorporated into the AMP.

1.6 Roles & Responsibilities

The AM Policy defines the overall governance structure for Asset Management at the Town of Fort Erie, including key roles, responsibilities, and authorities.

To support this, further details on project staff hierarchy and roles are outlined with Figure 1 below.



* Facilities Management provides capital delivery for facilities.

Figure 1: AMP Staffing Hierarchy

The Director of Infrastructure Services is responsible for overseeing AMP progress, monitoring quality, and providing direction and support as required.

The department leads represent their respective asset category and act as the group's representative. The leads are responsible for providing the necessary input in terms of workshop discussion, technical review, coordinating the provision of data, and acquiring a summary of feedback from additional subject matter experts within the department. As outlined in the above organization chart, the Facilities Management, Roads & Fleet, and Water & Wastewater divisions are responsible for the ongoing maintenance, repair, and operation of their respective assets. Engineering is responsible for maintaining their own data for capital delivery for these groups, except Facilities Management provides the capital delivery for facility assets.

Corporate Services is responsible for working with Infrastructure Services to ensure the financial budgets and long term financial plan is aligned with the asset forecasts and Levels of Service. Corporate Services is also responsible for financial reporting on assets and maintaining the financing and revenue strategy in alignment with the Asset Management Plan, Budget, and Reserve Policies.

2 DEFINED LEVELS OF SERVICE

A comprehensive LOS Framework has been developed for all AMP asset categories and further details are available in Technical Memorandum 5, provided in Appendix E. The LOS Framework tables are provided in Appendix A.

2.1 Background

Asset Levels of Service are a foundational part of the Town's Corporate Asset Management Strategy. The development of performance measures that align with community values and corporate priorities to technical indicators/metrics is a critical component on a functional Asset Management System. Levels of Service (LOS) are also at the core of O. Reg. 588/17 which will require municipalities to understand the cost to achieve higher or lower levels of service. The Level of Service metrics presented in this report have been established through best practices and Town processes.

As noted above, further work is required to fully develop, measure, and verify several current and proposed LOS, including several legislated performance measures.

The legislated LOS deadlines are:

- current LOS assessment for core assets is July 1, 2021;
- current LOS assessment for all assets by July 1, 2023; and
- proposed LOS assessment for all assets, linking to a funding strategy, by July 1, 2024.

2.2 Framework

The structure of the LOS Framework tables was developed using international best practices. The LOS tables are comprised of the following components:

- Service Statement (overall objective of asset service to the public);
- Key Service Attribute (specific objective of asset service to the public);
- LOS Statement (description of objective in a statement form);
- Performance Measures (customer and technical parameters to measure and monitor as a means to assess delivery of LOS Statement);
- Current Performance (current level of service, as clearly defined or indexed where possible);
- Data Source (source of the information used to define the current performance);
- Proposed Performance (proposed level of service, where known); and
- Forecast (symbol indicating if proposed level of service is expected to trend up, down, or remain at current level).

Each performance measure is categorized as one of the following:

- Foundational Measures (shaded blue): These measures have available data to track current performance levels and have been tied into the financial strategy to develop proposed LOS.
- Advanced Measures (shaded green): These measures either do not have data to track current performance at this time or are currently not tied into the financial strategy.
- O. Reg. 588/17 Measures (shaded peach): These measures are legislated under O. Reg. 588/17 and must have current performance defined by 2021 and proposed performance defined by 2024.

The Town will continue to collect additional data and complete various projects/activities to populate remaining current performance metrics over the life of this plan.

2.3 Growth Trends

Population growth and increasing expenditures will affect the Levels of Service established by the Town during this project. Several of the established Customer and Technical performance measures – in particular, current performances and targets – will likely increase along with population and expenditures.

An analysis of the performance measures established within this AMP has been completed to understand how the performance and targets are forecasted to change, either increasing or remaining the same. Typically, metrics that are estimated to remain the same are those that measure performance as an average or percentage of the system of assets in question. These results are included in the LOS Tables (Appendix A), for both Customer and Technical performance measures.

3 STATE OF LOCAL INFRASTRUCTURE

3.1 Asset Inventory & Valuation

3.1.1 Asset inventory

Asset information is stored in multiple locations, including Accpac, with GIS being the main source for inventory data. This data was combined into an asset inventory containing approximately 8,944 asset records with a total replacement value of approximately $1 billion, given the following caveats:

- Valuations shown are predicated upon average local values for replacement of infrastructure in the absence of invoice costs or average values provided from Town Staff.
- Values shown do not reflect economies of scale with respect to the coordinated replacement of infrastructure.
- Replacement values assume replacement with modern equivalent infrastructure.
- Increase to the accuracy of these valuations and the financial plan presented will require the improvement of the Town's core infrastructure data in several key areas.

An overview of the asset inventory is provided in Table 2.

Table 2: Asset Inventory

Regulatory Category	Service Category	Asset	Data Source	Inventory
Core Assets	Roads & Right of Ways (ROW)	Roads	GIS Inventory	423 km
		Streetlights	GIS Inventory	3,342 assets
		Sidewalks	Inspections	144 km
	Water	Mains	GIS Inventory	265 km
		Hydrants	GIS Inventory	1,531 assets
		Valves	GIS Inventory	1,836 assets
	Wastewater	Sewers	GIS Inventory	194 km
		Manholes	GIS Inventory	2,477 assets
	Stormwater	Sewers	GIS Inventory	123 km
		Manholes	GIS Inventory	2,093 assets
	Bridges & Structures	All	Database, Inspections	179 assets
Non-Core Assets	Facilities Management	All	Inspections	16 Facilities, 974 Assets

It should be noted that for the AMP analysis, the linear infrastructure was only broken down into mains or sewers, as hydrants, valves, and manholes are typically replaced with the main/sewer. In addition, roads include all the assets that fall within the ROW.

The asset inventory was structured in a hierarchy with four levels to support subsequent AM analysis. The purpose of an asset hierarchy is to ensure that asset inventories are broken down into logical cohorts to support decisions that are made by subject matter experts pertaining to how, when, and why to spend money on assets. The hierarchy of each asset category should be considered as flexible to ensure that it can evolve as the practical management of the Town's assets changes over time.

Asset Level 1 is consistent across all assets, representing the 6 asset categories of the data provided by the Town. Asset Levels 2, 3, and 4 are then used to further break down assets based on the practical need to assign different levels of service or lifecycle management strategies to an asset. The asset hierarchies used in the AM analysis are provided in Table 3.

Table 3: Asset Hierarchy

<table>
<tr><th>Level 1</th><th>Level 2</th><th>Level 3</th><th>Level 4</th></tr>
<tr><td rowspan="11">Roads & ROW</td><td>Sidewalks</td><td>-</td><td>-</td></tr>
<tr><td>Streetlights</td><td>-</td><td>-</td></tr>
<tr><td rowspan="9">Roads</td><td rowspan="2">Collector</td><td>Hot Mix Asphalt</td></tr>
<tr><td>Surface Treated</td></tr>
<tr><td rowspan="4">Local</td><td>Earth</td></tr>
<tr><td>Gravel</td></tr>
<tr><td>Hot Mix Asphalt</td></tr>
<tr><td>Surface Treated</td></tr>
<tr><td rowspan="2">Minor Arterial</td><td>Hot Mix Asphalt</td></tr>
<tr><td>Surface Treated</td></tr>
<tr><td>Gravel & Clay</td><td>Gravel & Clay</td></tr>
<tr><td rowspan="3">Bridges and Structures</td><td>Bridge</td><td>-</td><td>-</td></tr>
<tr><td>Culvert</td><td>-</td><td>-</td></tr>
<tr><td>Retaining Wall</td><td>-</td><td>-</td></tr>
<tr><td>Sanitary</td><td>Sewers</td><td>-</td><td>-</td></tr>
<tr><td>Stormwater</td><td>Sewers</td><td>-</td><td>-</td></tr>
<tr><td>Water</td><td>Mains</td><td>-</td><td>-</td></tr>
<tr><td>Facilities*</td><td>Facility Name (e.g. Centennial Library)</td><td>Uniformat II (e.g. C3020-Floor Finishes)</td><td>Asset Type (e.g. Carpet)</td></tr>
</table>

*Due to the size of the Facilities hierarchy, not all types have been shown.

3.1.2 Data Sources and Gaps

A detailed review of the Town's data was completed to identify the maturity (completeness) of the data and the confidence (accuracy/consistency) in the data. In addition, all critical data gaps that prevented further analysis and/or limited reporting capabilities (e.g., performance could not be calculated from lack of condition or age information) were also outlined in Technical Memorandum 1, provided in Appendix B. A summary of gaps and assumptions are provided in Table 4, using the following guide:

- ✓ Data was available and no, or limited, adjustments were made.
- ✓ No or partial data was available, but full data was derived using standards and assumptions.
- ✗ No data was available (data gap) or there is low confidence in the available data.

Table 4: Data Gaps and Assumptions

Asset Data	Replacement Costs	Estimated Service Life	Age/Install Date	Performance/ Condition
Roads	✓	✓	✗	✓
Streetlights	✓	✓	✓	✓
Sidewalks	✓	✓	✗	✓
Wastewater Sewers	✓	✓	✓	✓
Storm Sewers	✓	✓	✓	✓
Water Mains	✓	✓	✓	✓
Bridges & Structures	✓	✓	✓	✓
Facilities Management	✓	✓	✓	✓

3.1.3 Valuations

Traditionally, there have been two types of valuations; financial accounting valuations use historical costs and depreciation assumptions while replacement cost valuation is forward-looking and accounts for expected inflation, changes in technology, and other factors. For the AMP, replacement costs valuations were used, while financial accounting valuations are available through the Town's financial reporting, in accordance with Public Sector Accounting Board (PSAB) requirements.

The Town had previously established per-asset costs for Bridges and Structures and most Facility assets. Through the development of this AMP, a combination of Town-provided replacement unit costs and industry standard best practice replacement unit costs were used to determine the appropriate per-asset replacement values for the remaining asset categories. It should be noted that these replacement values do not address economies of scale as they represent the value to replace each asset individually. The unit replacement cost estimates for core asset categories and Facilities are available in Technical Memorandum 4 Table 2 and 3, provided in Appendix D.

The Roads asset category was the only one to use rehabilitation treatment types in this iteration of the analysis even though the Town performs rehabilitation treatments on other asset categories (such as Wastewater, Stormwater, etc.). There was a lack of data on the impact of these forms of rehabilitation on an asset's performance for these other asset categories, and so they were left for future refinement of the Town' analysis. As a result, all asset categories aside from Roads used replacement-only treatment types in their lifecycle strategies in the predictive scenarios. The unit rehabilitation costs used in the AM analysis are available in Technical Memorandum 4 Table 4, provided in Appendix D.

An overview of the total replacement value for the assets within each service category are provided in Table 5 below.

Table 5: Asset Valuations

Service Category	Asset	Current Replacement Value
Roads & ROW	Roads	$386,403,656
	Streetlights	$2,406,240
	Sidewalks	$23,326,386
Water	Mains	$171,796,084
	Hydrants	Built into Main Costs
	Valves	Built into Main Costs
Wastewater	Sewers	$136,003,666
	Manholes	Built into Sewer Costs
Stormwater	Sewers	$156,184,476
	Manholes	Built into Sewer Costs
Bridges & Structures	All	$37,350,500
Facilities Management	All	$98,423,527
	Total:	**$1,003,807,668**

The replacement value breakdown for each asset category are provided in Figure 1 to 7.

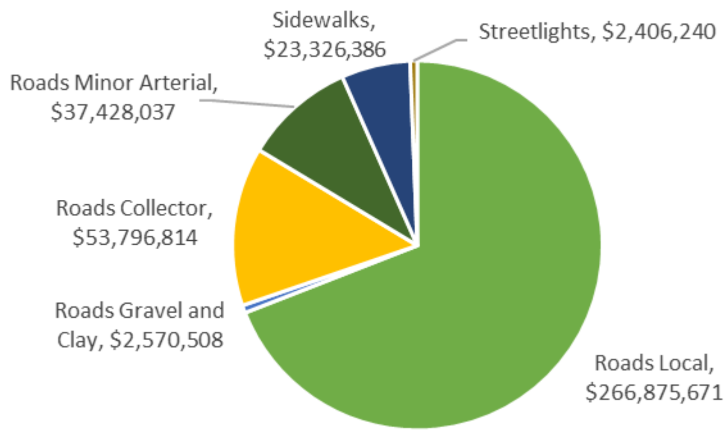


Figure 2: Road Replacement Value Breakdown by Road Class

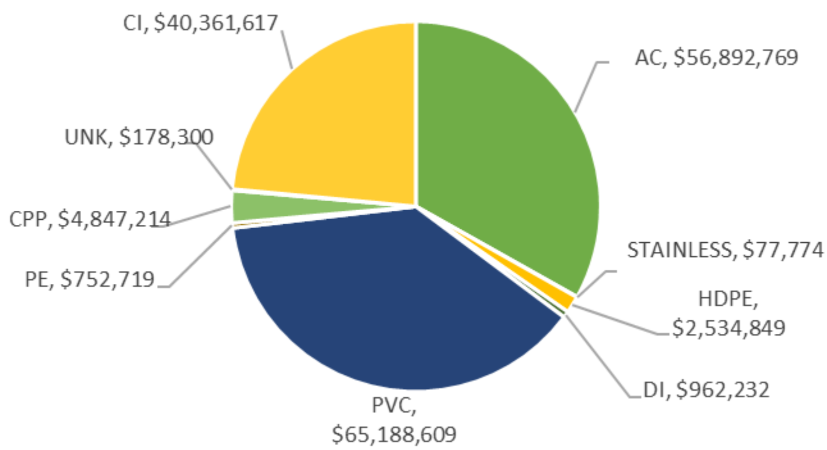


Figure 3: Watermain Replacement Value Breakdown by Material

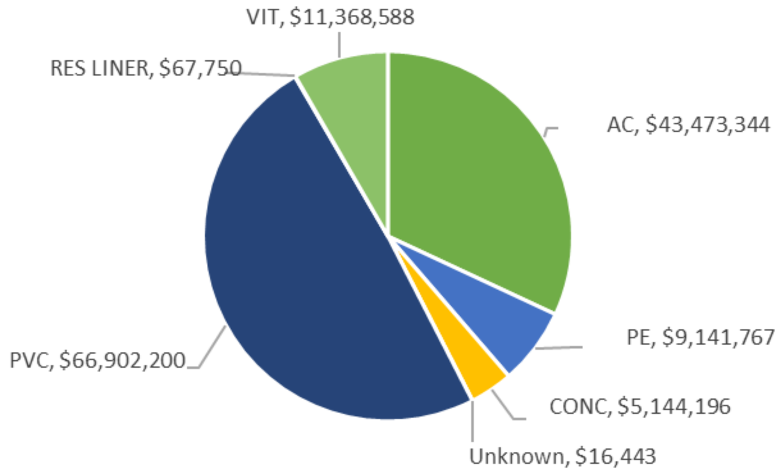


Figure 4: Wastewater Sewer Replacement Value Breakdown by Material

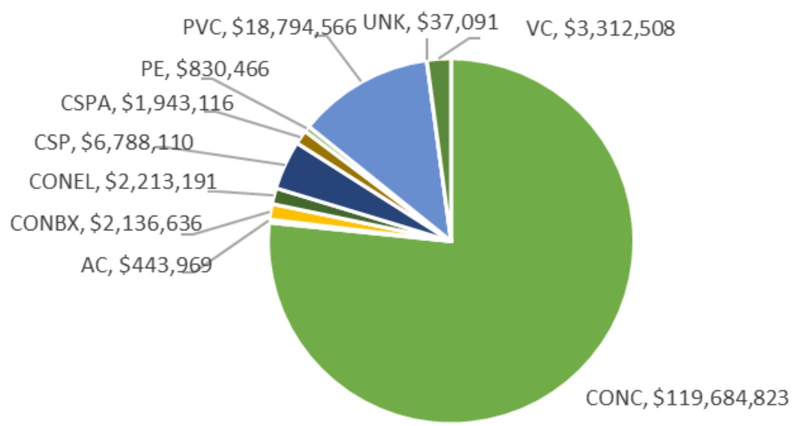


Figure 5: Storm Sewer Replacement Value Breakdown by Material

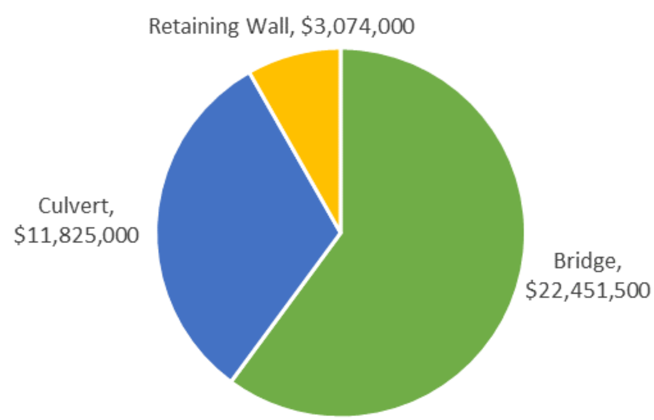


Figure 6: Bridges & Structure Replacement Value Breakdown by Asset Type

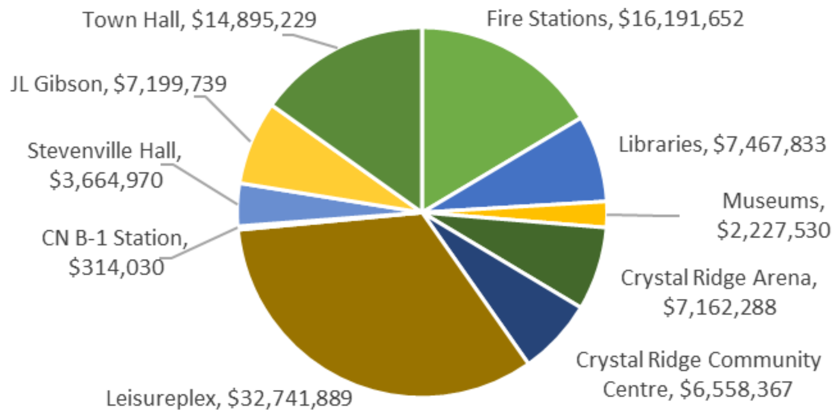


Figure 7: Facilities Management Replacement Value Breakdown by Facility Type

3.1.4 Age Distribution and Service Life

The average age of each asset category is provided in Table 6.

Table 6: Asset Age

Service Category	Asset	Average Age (Years)
Roads & ROW	Roads	62
	Streetlights	2
	Sidewalks	Insufficient Data
Water	Mains	38
	Hydrants	Same as Mains
	Valves	Same as Mains
Wastewater	Sewers	35
	Manholes	Same as Sewers
Stormwater	Sewers	33
	Manholes	Same as Sewers
Bridges & Structures	All	44
Facilities Management	All	18

The asset age distribution and the asset age as a proportion of ESL for all assets are provided in Figure 8 and 9.

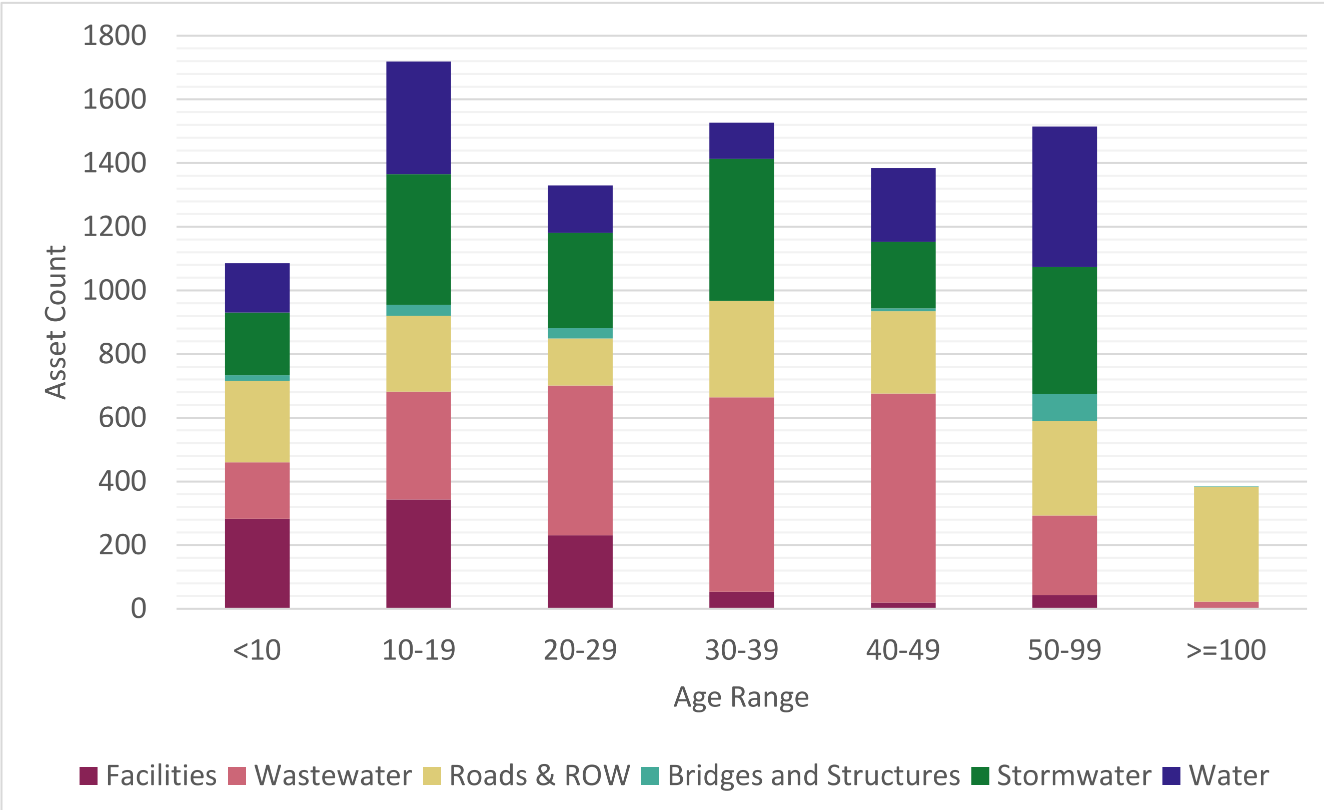


Figure 8: Age Distribution of All Assets

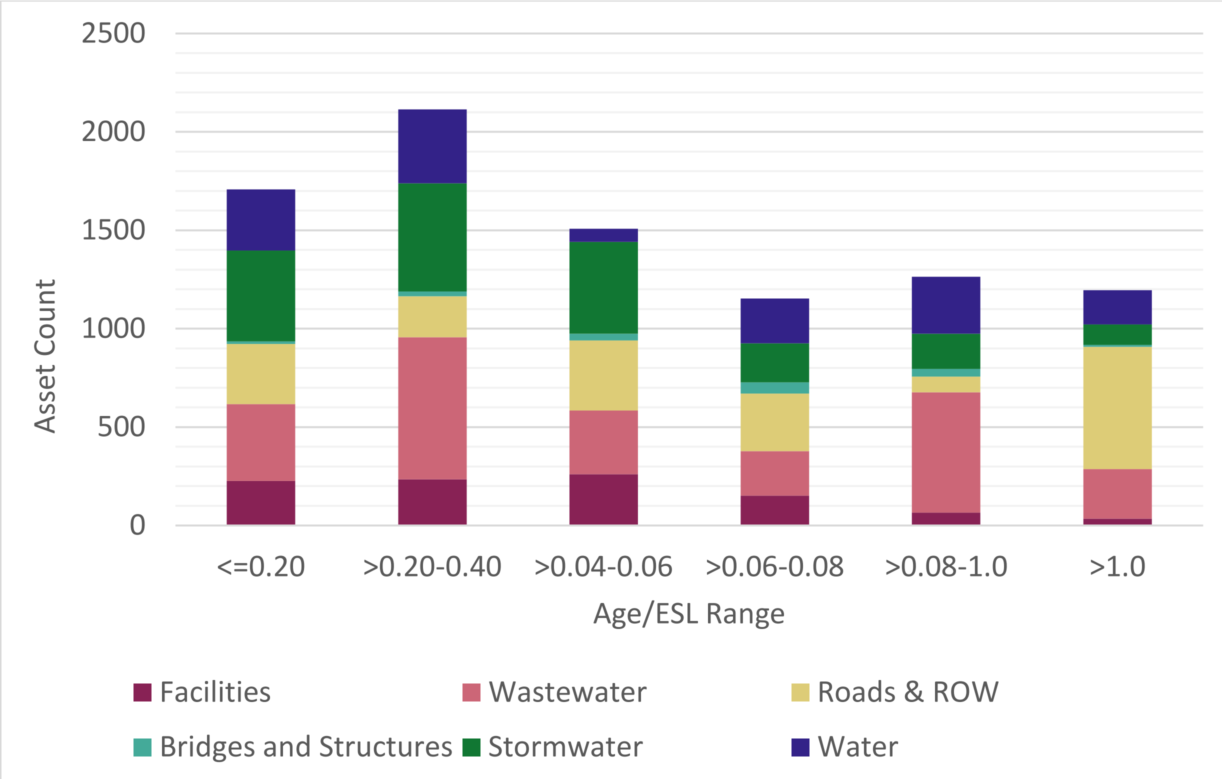


Figure 9: Age Distribution as a proportion of ESL for All Assets

3.2 Asset Condition

Performance categories were assigned based on a performance score which was calculated for each asset based on the best available data. Condition data was used where available, otherwise the age and ESL of an asset were used to estimate performance. Where condition and age/ESL data were limited or unavailable, no performance score was assigned.

For ease of comparison, this performance score was made consistent across all asset groups, except water assets. For water assets, it was found that the age of the assets misrepresented the performance of the system and therefore the number of breaks was used to assign a performance category but could not be easily converted to the same performance scoring system. The performance categories used for all asset groups is shown in Table 7.

Table 7: Performance Categories

Performance Category	Description
Very Poor	**Unfit for sustained Service** - These assets are below standard condition with widespread signs of deterioration
Poor	**At Risk** - These assets are mostly below standards and many elements are approaching the end of their service life
Fair	**Requires Attention** - some assets show general signs of deterioration and some deficiencies are starting to show
Good	**Adequate for Now** - Most assets are functioning with a few elements showing signs of deterioration
Excellent	**Fit for the Future** - Overall condition of assets and their associated elements is good or newly replaced/rehabilitated

The complete methodology for how the performance was assigned within the system is available in Technical memorandum #12: Database Analysis and Logic, provided in Appendix I.

The average condition of all assets weighted by replacement value was determined to be in Good condition, as outlined in Table 8 and illustrated in Figure 10.

Table 8: Average Condition for Each Service Category

Service Category	Asset	Data Used for Performance	Average Performance Weighted by Value
Roads & ROW	Roads	Condition	Good
	Sidewalks	Condition	Good
Water	Mains	Number of Breaks	Good
Wastewater	Sewers	Age/ESL	Fair
Stormwater	Sewers	Age/ESL	Fair
Bridges & Structures	All	Condition	Good
Facilities Management	All	Condition	Good
		Overall Average:	**Good**

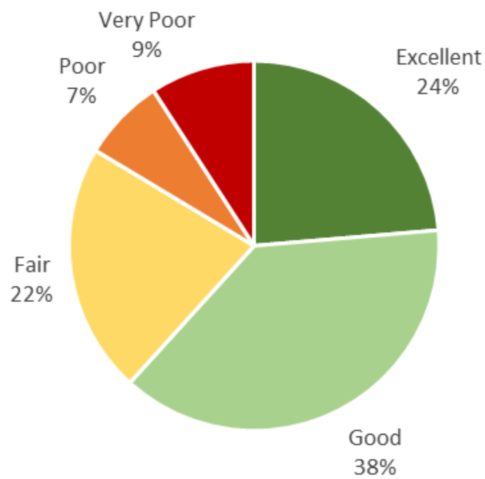


Figure 10: Performance Breakdown for All Assets (with performance data)

The condition breakdown for each asset category are provided in Figure 11 to 17.

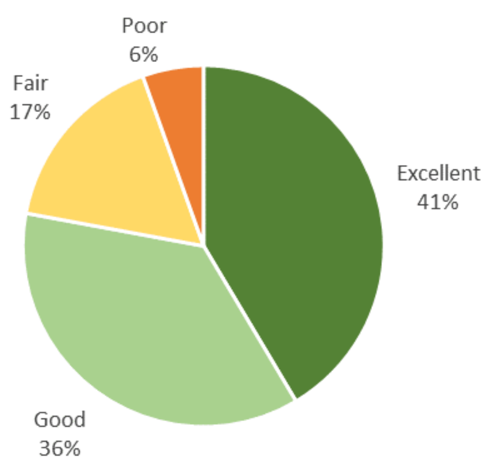


Figure 11: Road Performance Breakdown

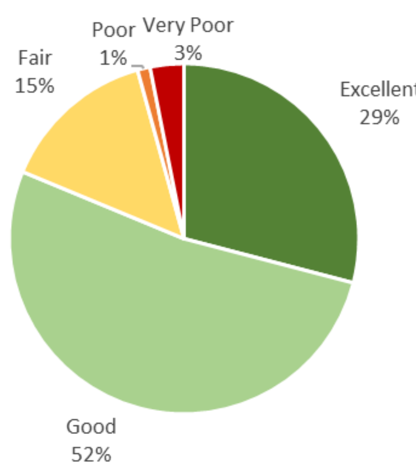


Figure 12: Sidewalk Performance Breakdown

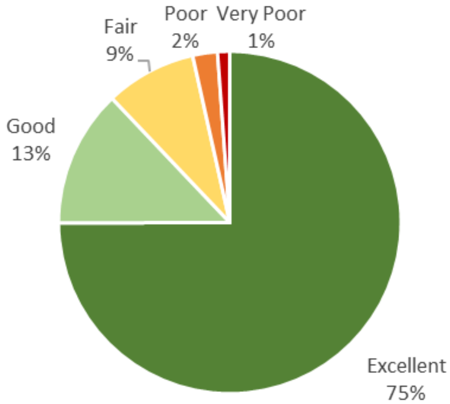


Figure 13: Watermain Performance Breakdown

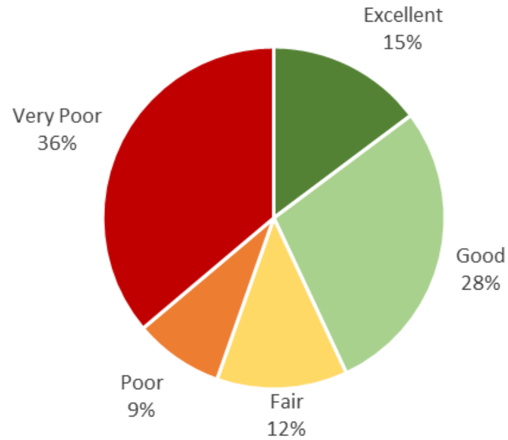


Figure 14: Wastewater Sewer Performance Breakdown

Figure 15: Stormwater Sewer Performance Breakdown

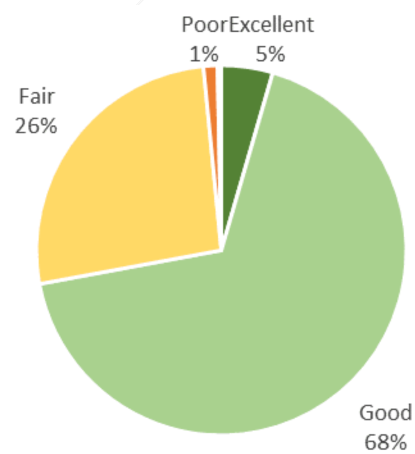


Figure 16: Bridge & Structures Performance Breakdown

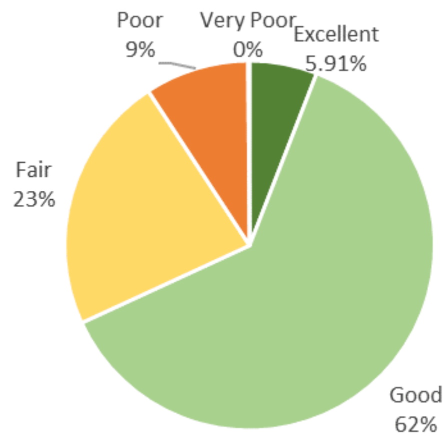


Figure 17: Facilities Management Performance Breakdown

3.3 Data Verification Process and Condition Assessment Process

Each department within Infrastructure Services schedules condition assessments for the assets they are responsible for, as required and in alignment with budget needs. Information related to tracking AMP progress (e.g. condition, age, value, etc.) will be updated within the register at least once per year to track current LOS and AMP progress. In addition, every 5 years the Town will update the AMP which will involve completing an updated analysis with the most recently available asset information.

Currently, the Town has basic processes to review and verify data, however, to support the development of subsequent AMPs it is recommended that the Town develop a formalized data management plan outlining the processes for data collection, verification, and management. The requirements and steps necessary to complete the data management plan are outlined in Section 8.1.

4 IMPLEMENTATION PLAN

4.1 Scenario Analysis

An analysis of several scenarios was completed to forecast the Town's infrastructure needs and determine the required expenditures to address these needs. The main analysis focused on two different scenarios, which were performed to understand the difference between performance projections using a fixed budget based on the Town's current forecasted spending and an unlimited spending scenario which replaces assets once they reach the end of their service life.

Alternatives to these scenarios were also analyzed to determine a better balance between risk, service levels, and affordability. The full details of the analyzed scenarios are available in Technical Memorandum 6/7, provided in Appendix F.

Asset risk was incorporated into some scenarios by establishing performance triggers for replacement based on the COF for different asset types. For example, assets with a high COF would have a higher performance target that would trigger an intervention earlier in its lifecycle than an asset with a low consequence of failure. The COF scores and associated performance triggers are outlined for each asset category in Technical Memorandum 6/7, provided in Appendix F. Table 9 below provides a high-level overview of the condition targets for each service category.

Table 9: Asset COF Score Assignment

Service Category	Criticality Based On	Condition Target
Bridge and Structures	Area (m^2)	Replace larger assets earlier in their lifecycle. The most critical assets are replaced before they reach very poor condition.
Facilities	Facility	Replace assets in the most critical facilities before they reach poor condition. Assets in less critical facilities are allowed to degrade to very poor condition (i.e. at the end of their ESL). While not included in this iteration of the DSS, most Facility assets have some sort of rehabilitation performed on them before they reach their target replacement condition.
Roads & ROW	Ontario MMS Highway Classification	Replace all roadways and assets that fall within the ROW before the roadway reaches poor condition. More critical

Service Category	Criticality Based On	Condition Target
		roadways (Minor Arterial and Collector) are maintained in Excellent condition, while less critical roadways (Local) are prevented from falling below good condition. The overall network target is Excellent condition.
Wastewater	Diameter (mm)	Replace larger diameter sewers earlier in their lifecycle. The most critical assets are replaced once they reach poor condition (maintained at fair or better).
Stormwater	Diameter (mm)	Replace larger diameter sewers earlier in their lifecycle. The most critical assets are replaced once they reach poor condition (maintained at fair or better).
Water	Diameter (mm)	Replace larger diameter sewers earlier in their lifecycle. The most critical assets are replaced once they reach poor condition (maintained at fair or better).

4.2 Findings

4.2.1 Roads

The results of the scenario analysis demonstrated that the Town's current budget should meet road asset needs over the next ten years, particularly if priority is given to higher COF roads (e.g. higher traffic roadways). In addition, the results corroborated that the additional $200,000 in spending (in addition to inflationary increases) recommended by the 2018 Road Needs Study Update report and included in the 2019 budget should bring the Town to their desired average performance of 80 PCI over the next ten years. Because the Town is currently using a system for determining future capital expenditures on Road assets, Decision Optimization Technology (DOT), it is recommended that the Town continue to follow the recommendations provided by this software and maintain the current budget.

4.2.2 Wastewater

Based on the results of this analysis, there appears to be a major gap between the Town's current spending and infrastructure needs. However, the performance for these models is based on the age of the sewers and their expected service life, rather than real condition information. This is due to the inability to access historical CCTV inspection data, as the condition information is not available in a digital format.

Because of this, it is recommended that the Town focus their efforts over the next few years to collect CCTV data in a digital format from a representative sample of sewers. As the analysis indicates, the current budget should maintain the average performance of the system over the short term while this additional information is collected and used to reevaluate these results based on real condition information.

To address the need for additional CCTV collection, a 3% increase per year, which equates to approximately $50,000 in 2020, is recommended to maintain assets at a similar performance level while increasing spending for the CCTV inspection work. With a 3% increase per year for 10 years, the Town should be able to inspect a representative sample over the next few years and completely CCTV their system over 7 years if all additional funding goes towards this program. However, based on available data it is expected that more than 7 years of increased funding will be required to maintain the LOS of the system, though the result data from the CCTV inspection will provide additional insight.

4.2.3 Storm

As this analysis demonstrates, the Town's currently planned spending results in a minor degradation of performance over the next 10 years. However, this data is based on the age of assets rather than the actual condition of assets. To address this, the Town has begun a storm sewer CCTV program with currently available funding which will provide actual condition information rather than relying on age-based estimates. As such, it is recommended that the Town continue with the current budget, which only results in minor degradation in this analysis, while CCTV data is collected. This will provide the Town with a more accurate view of the performance of this asset portfolio, which can then be used to provide more accurate predictions regarding funding requirements.

4.2.4 Bridges & Structures

The results of this analysis indicate that the Town is meeting the bridge and structure infrastructure needs, however, the average performance of this portfolio is projected to degrade over the next ten years regardless of the scenario. This is due to the analysis being restricted to replacement work which, due to the nature of the infrastructure having long life spans, would not be expected to reach the target condition for replacement over the next ten years. This suggests that performing ongoing maintenance and rehabilitation work over the next ten years will help to maintain the performance of the Town's Bridges and Structures. Since the Town has a current system for determining capital expenditures for these assets, it is recommended that the Town continue to follow the recommendations provided by this software.

4.2.5 Facilities

The results of this analysis indicate that the average performance of this portfolio is projected to degrade over the next ten years but is still meeting the projected infrastructure needs.

This lowering of the average performance for Facilities over time is likely due to the analysis being restricted to replacement work. The majority of the replacement value for facilities is in assets that are forecasted to be replaced in the long term, beyond the next ten years. This results in the assets showing a trend of performance degrading over the ten-year forecast without enough replacements taking place in that span to bring the performance trend upwards.

However, these scenarios don't account for the maintenance and rehabilitation work that is typically completed to maintain facilities. This type of work helps to maintain and improve the condition of assets, which improves the average performance of the asset category. Because of this, as long as typical maintenance and rehabilitation work are completed as needed, the Town should be able to maintain the current level of service provided by Facility assets with the existing budget.

4.2.6 Water

The results of the updated watermain break analysis corroborate the findings from the 2017 WMSP, which indicated that an increase of $380,000/year in funding from 2015 levels will allow the Town to remain below the 50 breaks/year target threshold. As the Town's Council has since endorsed this additional funding strategy for 2018 to 2024, no further funding increases should be necessary.

4.2.7 Resulting Plan

As described in the previous section, only wastewater assets are recommended for additional spending to help maintain the state of good repair while completing a CCTV program. The spending projected within these analyses included a 3% increase per year over ten years for wastewater assets, which would result in an increased expenditure of $2.7M over 10 years in addition to annual inflationary increases to contributions. However, the required expenditure may vary based on the size and scope of the program the Town is interested in completing.

For the remainder of the asset categories, the existing budget was found to be adequate to maintain LOS.

Based on these recommendations, Table 10 outlines the recommended target funding and the current deficit for each asset class.

Table 10: Annual Capital Expenditure Summary

Asset Category	2019 Avg. Annual 10-Year Contribution to Reserves ($000)	Current Avg. Annual 10-Year Gas Tax and Other Grants ($000)	Total Current Avg. Annual 10-Year Funding ($000)	Avg. Annual Funding to Maintain Current LOS ($000)	Avg. Annual Infrastructure Funding Gap ($000)
Bridges & Structures	$370	$650	$1,020	$1,020	$0
Facilities	$830	$0	$830	$830	$0
Roads & ROWs	$3,050	$480	$3,530	$3,530	$0
Sanitary	$1,630	$0	$1,630	$1,900	$270
Stormwater	$1,430	$0	$1,430	$1,430	$0
Water	$1,720	$0	$1,720	$1,870	$150
Total	**$9,030**	**$1,130**	**$10,160**	**$10,430**	**$420**

In addition, Figure 18 outlines the recommended 10-year capital plan to address the state of good repair of the assets and their resulting average weighted performance.

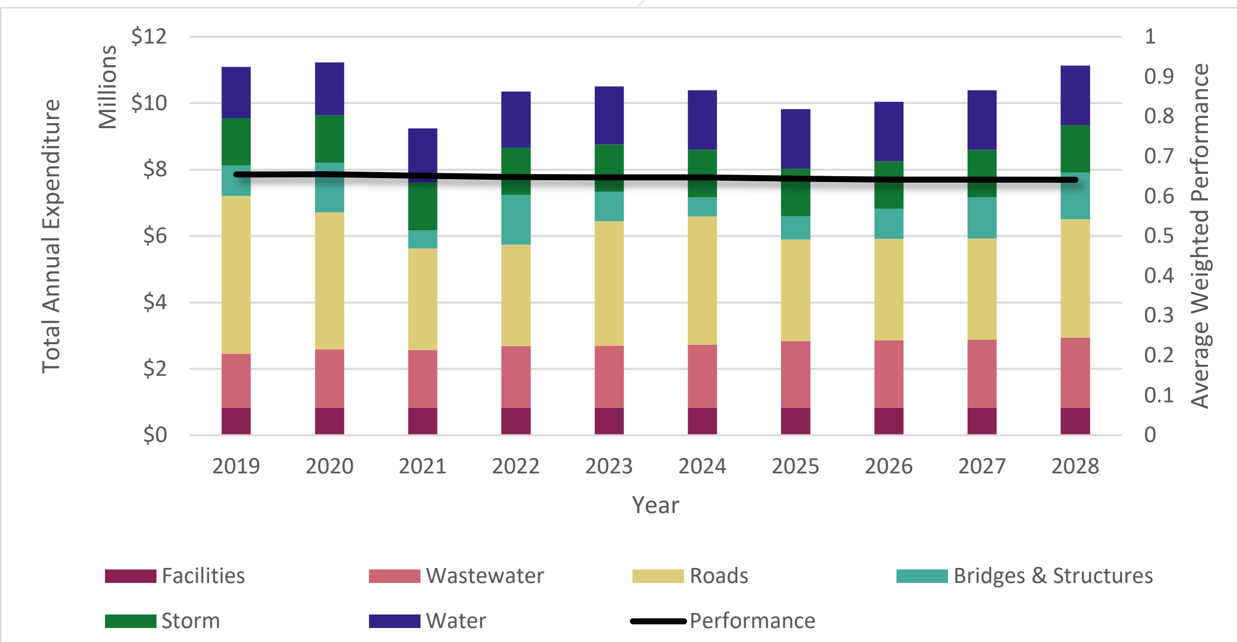


Figure 18: Recommended 10 Year Capital Plan

As this graph illustrates, this recommended 10-year capital plan should maintain the average performance of the system above 0.6 (Good) over the next 10 years (water asset performance was not factored into this average as a comparable performance was not forecasted). The performance of the system can be further maintained through ongoing preventative maintenance of the assets. In addition, this analysis can be further refined to provide more accurate forecasts of infrastructure needs through the collection of condition, replacement costs, and estimated service life data, and through the development of lifecycle curves and strategies.

5 FINANCING STRATEGY

This strategy ensures the process for linking asset plans to financing is in place, as committed to in the Asset Management Policy. Having a financial plan is critical for putting an asset management plan into action. In addition, by having a strong financial plan, the Town can demonstrate a concerted effort to integrate asset management planning with financial planning and budgeting and to make full use of all available infrastructure financing tools.

The financing strategy was built on the processes described below, which aids in fulfilling policy commitments for processes to ensure asset plans are aligned with financial plans and budgets.

5.1 Current and Planned Financial Strategies

The Town has developed a Long-Term Financial Plan (LTFP) Model which is a dynamic tool that incorporates all considerations from long-term capital and operating expenditures. The Town's financial analysts will be able to understand the impact of adjusting a range of funding strategies that relate to revenue and the expected change to expenditures from adjusting services or implementing planned infrastructure projects. The LTFP Model was not intended to replace existing operating budgeting, capital planning, or assessment growth projecting processes but rather augment existing processes by providing a longer-term perspective to inform decision making.

The LTFP Model uses conventional accounting formula to track operating revenues and expenditures, debt and debt service obligations, reserves, etc. A 30-year planning horizon was used in the LTFP Model instead of the lifecycle period of the assets. This is an optimal timeframe for financial analysis as costs tend to appear increasingly skewed due to inflation when applying a planning horizon beyond 30 years. There tends to be volatility in 10-year plans, therefore years 11 to 30 are used to illustrate the financial trend that the Town is moving toward.

Several variables were used to project the finances over the planning horizon, including:

- Inflation rates for operating costs and capital costs;
- Specific escalation rates for each type of revenues (property taxes, user fees, etc.); and
- Assessment growth forecasts based on population increase assumptions.

The details of the LTFP Model are provided in Technical Memorandum 8. The current and planned revenues and expenditures are provided in Figure 19 to 20 and Table

11. The annual capital reinvestment rates are summarized in Table 12 and compared against the Canadian Infrastructure Report Card.

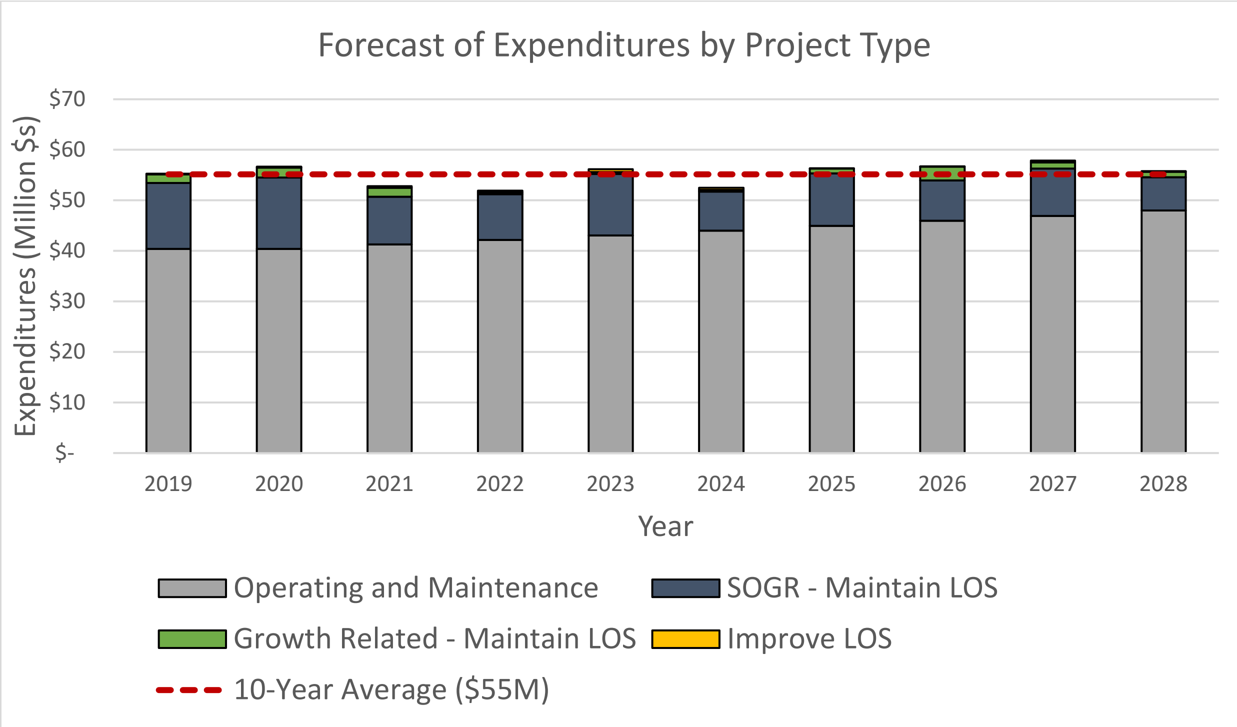


Figure 19: Expenditure Forecast

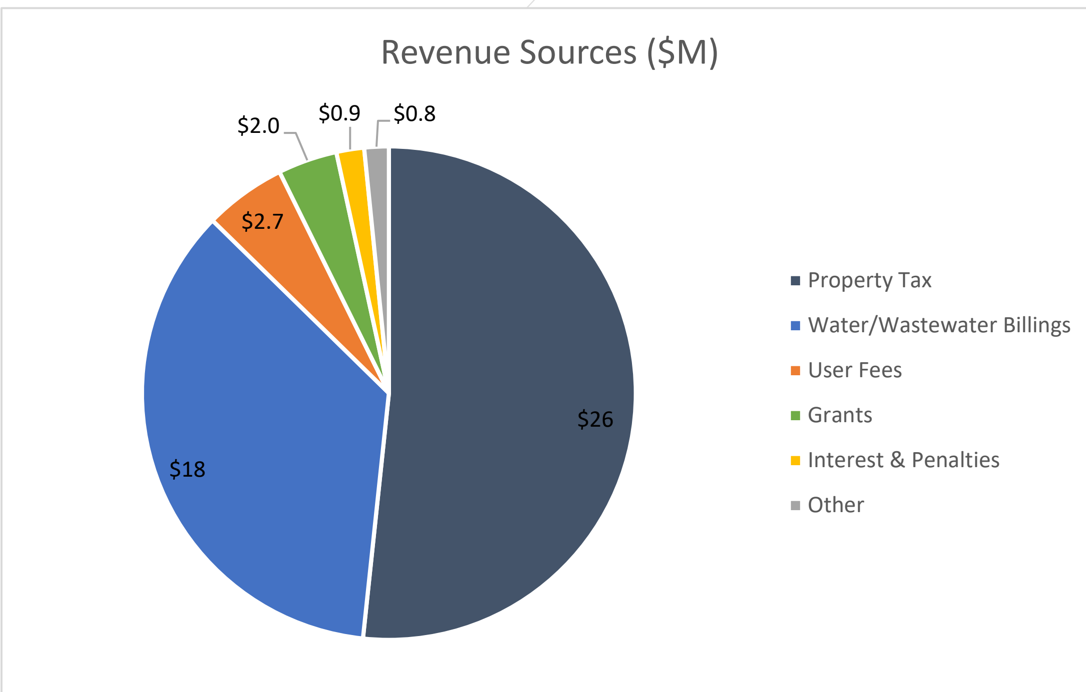


Figure 20: 2018 Revenue Breakdown

Table 11: Revenue Forecast

Revenue Sources ($M)	2018	2019	2020	2023	2028
Property Tax	$26	$27	$28	$30	$33
Water/Wastewater Billings	$18	$19	$19	$20	$23
User Fees	$2.7	$2.5	$2.6	$2.7	$2.8
Grants	$2.0	$1.8	$1.8	$1.8	$1.8
Interest & Penalties	$0.9	$0.9	$0.9	$0.9	$1.0
Other	$0.8	$0.8	$0.8	$0.8	$0.8

Table 12: Annual Capital Reinvestment Rates

Asset Category	Current 10-Year Reinvestment Rate	Canadian Infrastructure Report Card
Bridges & Structures	2.7%	1.0% - 1.5%
Facilities	0.8%	1.7% - 2.5%
Roads & ROWs	0.9%	2.0 - 3.0%
Sanitary	1.2%	1.0 - 1.3%
Stormwater	0.8%	1.0 - 1.3%

5.2 Infrastructure Gap

Traditional Asset Management Plans have used an age-based analysis to forecast the infrastructure needs and identify an “infrastructure backlog” which is the replacement value of the infrastructure that exceeds its service life. The new approach that aligns with O.Reg. 588/17 is to first quantify the current level of service being provided by the infrastructure systems and then to forecast the impact of current spending levels on service levels. The infrastructure gap is now determined as an annual funding shortfall to maintain current or achieve proposed LOS, rather the traditional ‘backlog’ of replacement needs.

The infrastructure gap was identified to be an annual $420K as summarized in Table 10. The 2019 water and wastewater revenue were projected to be $18.9M. A 2.2% revenue increase would be required, on top of inflationary and other approved increases, to fund the additional $420K of related capital expenditures. It should be noted that the infrastructure gap for Sanitary may change as the Town completes the CCTV inspections over the next 10-years as recommended by the 2019 Wastewater Master Plan. These inspections will provide condition data to inform the expenditure needs rather than the current age-based analysis.

5.3 Planned Actions/Implementation Plan

The Town has been provided the LTFP Model with the scenario that addresses the additional capital expenditures starting in 2020. Since the current plan did not account for the increased expenditures, there were not enough funds within the reserves to finance the additional capital expenditures. Thus, the model was adjusted to increase the contributions from operating to ensure there were reasonable amount of funds remaining in the reserves, resulting in a deficit for the operating budget. The revenues in the model were increased until the operating budget was no longer in a deficit position.

The following scenarios were analyzed:

- Scenario 1 - Close the infrastructure gap over 3-years; and
- Scenario 2 - Close the infrastructure gap over 10-years.

In Scenario 1, the capital expenditures were gradually increased over the 3-year period and the deferred expenditures were spread over the following 7 years. Thus, the total expenditures for the 10-year period were equivalent. An additional 1% rate increase was required to fund Scenario 1, on top of inflationary increases, for 3 years from 2020-2022. Water and wastewater rates could then resume to inflationary increases.

Similarly, Scenario 2 had the same gradual increase but over 10-years and the deferred expenditures were spread over the following 10 years. The 30-year average annual expenditures were the same for both scenarios. The increase required to fund Scenario 2 was an additional 0.5% increase to rates, on top of inflationary increases, for 6 years from 2020-2025. Water and wastewater rates could then resume to inflationary increases.

It is prudent to consider the faster rate increase to close the annual funding gap to sustain the current LOS provided by the systems in a shorter time. Therefore, Scenario 1 is recommended to minimize the risk of deferred capital expenditures.

If future updates to the Town's AMP result in larger expenditure needs to achieve proposed LOS, the following strategies can be considered to fund the infrastructure gap:

1. Property tax levy dedicated to infrastructure renewal

Dedicating a portion of the property tax levy to fund infrastructure renewal activities in the Town is one of the best strategies to fund infrastructure needs. This approach provides a more direct line of sight from the taxes that residents pay to the services/infrastructure that it funds. The Town currently applies this approach by allocating a portion of the level to the capital reserves that are used to fund infrastructure renewal activities.

2. Increase Other Revenue Sources

Another option is to increase User Fees, Fines, or other non-property tax revenue sources. These increases can be in conjunction with a general tax levy increase to lessen the burden on property owners.

3. Continue to pursue Provincial/Federal grants

Both the Ontario and Federal governments have established substantial programs to fund the rehabilitation or replacement of municipal infrastructure. The grants are typically awarded to fund specific projects through an application-based system. The ad-hoc funding of specific projects through these types of grants will lower the overall magnitude of capital dollars that will need to be funded through the reserve accounts.

4. Leverage Public-Private Partnerships

In some cases, it may be feasible to fund infrastructure renewal projects by leveraging private capital funds through a public-private partnership (P3). Similar to the impact of receiving grants, the funding of specific projects through a P3 will lower the overall magnitude of capital dollars that will need to be funded through the reserve accounts. However, it should be noted that P3s are typically applied in large or complex infrastructure projects. The strategy would not be appropriate for routine infrastructure renewal activities, but may be an option for large discrete infrastructure projects (recreation center, bridge, etc.).

6 STAKEHOLDER CONSULTATION AND COMMUNICATION

External stakeholders include the Town's residents, businesses, investors, local communities, regulatory bodies, and any other customers. External stakeholders expect that the services provided by the Town in general are safe, reliable, accessible, high quality, operational, environmentally conscious, and provided in a cost-efficient manner.

Data used to develop the AMP is made available online to the public, subject to privacy or other legal restrictions as applicable. Under O. Reg. 588/17, the approved Policy and AMP will be posted on the Town website and provided to any person who requests this information.

The Town also ensures communication on AM options or decisions with all stakeholders, especially those with connected or related infrastructure (e.g. Region of Niagara, neighbouring local municipalities). This is a policy commitment and is regular practice through staff communication.

The Town strives to work with the Public and stakeholders to ensure their concerns and aspirations are considered or directly reflected in the options considered. Workshops, polling, public notices, and social media posts are several of the forums that may be used for engaging with the public and stakeholders.

Internal Stakeholders are primarily the Town's elected officials and staff. Internal stakeholders have recognized that continued AM will provide value to many areas of the Town's business. It will assist in coordination among departments, provide a better understanding of asset needs, and provide better evidence that can be used in decision-making activities that support delivery of services.

7 REVIEW AND CONTINUAL IMPROVEMENT

7.1 Review and Approval

Asset management for the Town of Fort Erie is continually evolving and maturing. The AMP will be updated as the capital needs and priorities of the Town change, and as legislative requirements and the Town budget process proceed.

Monitoring and maintaining the AMP is an important task. Staff will annually re-assess the Policy, Strategy, and AMP to ensure it is:

- Suitable – right or appropriate for the current and future conditions and culture at the Town of Fort Erie.
- Adequate – satisfactory and acceptable in quality, as defined by the regulatory and guidance requirements for municipal asset management.
- Effective - successful in producing a desired and intended result, fulfilling a specific long-term asset forecasting and planning function for the Town.

Table 13 below details the frequency of required AMP review and approvals.

Table 13: AMP Review and Approval

Action	Mechanism for Implementing Action	Frequency	Responsibility
Review of AM progress, including: (a) the municipality's progress in implementing its asset management plan; (b) any factors impeding the municipality's ability to implement its asset management plan; and (c) a strategy to address the factors described in (b).	Report to Council	Annually, before July 1st	Asset Management Coordinator prepares review, reports to Asset Management Lead Asset Management Lead prepares and delivers summary report to Council

Action	Mechanism for Implementing Action	Frequency	Responsibility
Review of suitability, adequacy and effectiveness of AMP	Report to AM Lead	Annually, before July 1st	Asset Management Coordinator reviews and prepares recommendations for AM Lead
Update AMP accordingly	Update asset information and run analyses Update business processes, if required Report to Council	At least every five years, or as required	Asset Management Coordinator
Review of AM Policy & Strategy	Report to AM Lead	Annually, before July 1st	Asset Management Coordinator reviews and prepares recommendations for AM Lead
Update Policy & Strategy accordingly	Update Policy and Strategy, if required Report to Council	At least every five years, or as required	Asset Management Coordinator

The AMP is endorsed by the Asset Management Lead and approved by a resolution passed by Council.

In addition, the performance of LOS measures shall be specifically reviewed on an annual basis and monitored. This will provide the Town with a continued understanding of the relationship between cost and LOS, which will be used to set proposed targets for each performance measure by 2024.

7.2 Continual Improvement

As asset management practices evolve, so will the completeness and effectiveness of this AMP. The following tasks will ensure the AMP continues to improve over time:

- Through annual reviews defined above, staff will identify areas within the AMP with opportunity for improvement and areas that may be deficient. Staff will define an action plan to address these issues and report to the Asset Management Lead accordingly.
- Staff will continue to work towards keeping information and supporting data updated and gathering comprehensive and quality data for smaller asset classes.
- Efforts to continue to develop staff competence and improve the AMP, and staff will attend training and consult AM resources as appropriate.

8 RECOMMENDATIONS

8.1 AMP Data Management Plan

It is recommended that the Town develop a formalized data management plan to support the development of subsequent Asset Management Plans (AMP) over the short term. The requirements and steps necessary to complete the data management plan are outlined below.

- **Business Process / Workflow Development**

The data management plan will outline processes for the collection, maintenance, and aggregation of data for use within the AMP. Reviewing current processes will be necessary to understand how data is currently handled and determine where changes are required, or if improvements can be made to better align with AMP requirements.

- **Outline Roles & Responsibilities**

The data management plan should also outline the roles and responsibilities for key staff involved in developing the AMP. Recommendations have been provided on the resources necessary for AMP development in Technical Memorandum #10: Recommended Future Staffing Structure and AMP Requirements (combined with Technical Memorandum #2). The previously developed workflows can be used to identify who is responsible for each action, including data collection, data verification, data management, data aggregation, etc.

8.2 Data Management and Business Process Improvement

The following represents a step wise approach to the development of an asset centric, evidence-based asset management environment at the Town. This approach focuses on addressing fundamental data fidelity, ownership, and maintenance issues before considering software needs, as most of the issues / frustrations expressed by staff are not software centric, rather fundamental business process and data management issues.

A full description of scope and estimates of resource needs for each recommendation are outlined within Technical Memorandum 9, provided in Appendix H.

- **Document Existing Data Sources, Authors, Contributors, and Consumers**

The first step in bringing efficiency and clarity to data management efforts at the Town is to explicitly document the “as is” state with respect to supporting data. This process will involve defining and deciding on the: location and format of supporting data, its suitability as the authoritative source, identifying duplicates, accountability and ownership of the data, and currency and frequency of update. This will aid in defining what information is available, highlighting any inefficiencies with respect to its upkeep and the extent to which the data can be used by multiple stakeholders for complementary, yet different, functional needs. The source, accuracy, and currency of new incoming information will be required along with roles for staff on its upkeep and ownership.

This process needs to be mindful of and respect the fact that there are many "expert systems" currently in use at the Town which, in addition to housing asset information, produce functional use specific output for specific tasks. Examples of these systems include but are not limited to: financial systems, water and wastewater hydraulic models, pavement management systems, etc.

Outcome: Data and Roles Register

➢ Document Existing and Future Functional Needs

The completion of the preceding task will clearly define what data is available, its maturity, and confidence for use by Town staff. Under this task, a broad cross section of Town staff need to discuss, define, and document their functional needs with respect to: work management, asset planning, budgeting, and reporting.

In defining these needs the following needs to be considered:

- Criticality of functional use – is it a "want" or is it a business-critical need?
- Frequency of use – annual, monthly daily?
- Required level of detail for each use – some differing uses may employ the data, however at differing levels of detail
- Primary consumer of the data for a given functional use
- Primary and secondary sources of data for functional use
- What and how many data sources are accessed to meet the need

The documentation of these needs will provide the basis to match functional need with the data that is available. This process will clearly result in the gaps between the required needs of stakeholders and the data that is available, current, and reliable.

Outcome: Functional Needs Documentation

➢ Defining Gaps, Consolidation, and Rightsizing Opportunities

Upon completion of the functional use assessment, the Town will have the ability to compare business critical needs against available data. This will also allow for a review of existing data from a "to be" or optimized state. A thorough data review should follow to examine opportunities for:

- Disposal of data that does not address a defined need.
- Aggregation and consolidation of data to meet functional needs, ideally from one maintainable and authoritative information source.
- Definition of owner, author, update frequency, and schedule of update for core asset: inventory condition, capacity, risk, and valuation data.

- Data that requires augmentation, or conversely, simplification to meet a functional need.
- System integration opportunities.
- Location of data source either within or outside of an expert system.

This will result in a data improvement plan that is clearly coupled with functional need. Needs should ideally be prioritized to allow for the recognition of some quick wins along with a data project management plan with clear resource requirements and deadlines. Results need to be documented and made explicit to all stakeholders to keep expectations in check with the planned data improvement schedule.

The ownership or accountability for the data improvement plan should ideally rest with senior staff within the division or department with the authority to act on or direct staff for data improvement. The owner of the plan should ideally be a subject matter expert on the data. Improvement plans can be coordinated amongst departments if there are named owners for all components and one senior staff member who has the authority to act on the overall plan. Data improvement plans are generally living documents and centre around the ongoing audit and revaluation of data versus core business functional needs.

Outcome: Functional Needs Documentation

➢ Definition of Data Improvement Plan and Resource Requirements

The aggregate of the assessments resulting from the preceding will form the basis for a data improvement plan along with required resources. At this juncture, the GMBP team does not have sufficient information to support an accurate assessment of the resources required to fully build out the Town's data sets, however, an estimate has been provided for core water, wastewater, structure, drainage, and stormwater data sets which do require some augmentation. Other functional areas and departments, parks etc., will likely require additional effort.

Outcome: Data Improvement Plan

➢ Definition Data Intake Standards

The Town, like most municipalities, relies on outside vendors to supply information deemed critical for AM planning. Examples of this include but are not limited to the following:

- Design and construction of new assets.
- CCTV of wastewater and stormwater networks.
- Procurement of equipment – significant component assets.
- Inspection and condition assessment services.

Effective data management, with limited staff resources, will require Town staff to put the onus of the construction of data sets consistent with data structures in use at the Town on vendors. This will avoid resource inefficient transposition of data into Town systems. Town AM staff will then become validators and analyzers of data versus authors.

The construction of standards should begin immediately after a final structure for each asset type is defined. Town staff should leverage those standards already in place at different locales: Region of Waterloo, Regional Municipality of Wood Buffalo, etc. and alter them to meet their needs.

Outcome: Incoming Data Intake Standards

- **Development / Population of Centralized Asset Data Register**

This task will involve the aggregation, centralization, and consolidation of the core asset inventory attributes and spatial information into one accessible source for all stakeholders and expert systems to access. Careful regard should be paid to that which should remain in an expert system versus those attributes considered core e.g., asset type, unique identifier, material of construction, date of construction, symbol, GIS geometry, etc. For those assets that are managed independently (e.g. Fleet, facilities etc.) where no or limited interaction with other systems is required, those inventories should remain in the host system.

It is understood that the Town of Fort Erie will be transitioning from a Manifold to an ESRI based corporate GIS framework. GMBP recommends that the Town evaluate the Canadian Municipal Data Model as an Asset Register, given its high functionality with embedded ESRI software applications. It is understood that local area municipalities of similar sizes, Grimsby, Welland, etc., either have or will be implementing this data model. This common back end should result in efficiencies with respect to application development and sharing with other municipalities.

The implementation of this, or any data model, should be evaluated against existing software in place at the Town and possible future software purchases.

Outcome: Asset Data Register

- **Define, Amalgamate Requirements, and Develop Software Functional Specifications**

Although a summary review of needs has been completed through this project for various type of software, defining the full business needs and the associated software requirements from all stakeholders is essential prior to the introduction of any software to ensure that it provides value to the Town.

This process should involve a full needs review with key stakeholders from all staff groups that will be using the software to obtain early buy-in. The prioritization of these needs must distinguish between mandatory and optional (future) requirements and the development of functional specifications to evaluate software suitability. This process should be combined with a Business Requirements Document.

A final, however very important, consideration for any upcoming software purchase is that all software being purchased must be able to integrate with the asset register, where necessary, and have an open and published Application Program Interface (API) which will ensure that data collected within the system is easily accessed and not held hostage by the software vendor.

Outcome: Business Requirements Document(s)

GMBP strongly recommends these steps be completed prior to procuring any software solution(s). This initial investigation will provide the necessary understanding and documentation to justify the requirements, as well as detail the user functionalities required in any software system.

8.3 Software Recommendations

The following software recommendations assume that the preceding data management and business process issues have been resolved and outcomes as described have been achieved.

The optimum asset management state at the Town will be the development of asset centric and evidenced based short to long term capital and operations plans. In order to achieve this state, the Town will require comparative metrics at an asset level for the following:

- Defined customer and technical levels of service
- Replacement and renewal triggers for assets
- Core attributes for each asset they own (Asset Register)
- Replacement, remediation, maintenance, and repair costs
- Risk on a predefined scale
- Capacity
- Condition

To achieve this optimized state, the Town will be required to capture and store information at the asset level, in any system, using predefined master identifiers or IDs used within an Asset Register. This will allow for the aggregation and analysis of all metrics, existing “as is” to preferred “to be” state.

To facilitate the development of the “to be” state, assuming the CMDM or generic equivalent is used for an Asset Register, the following two systems should be considered.

Corporate Maintenance Management Work Order System (MMWS)

Timing: **1 to 3 years**

Capital Cost: **$150,000 - $200,000**

Implementation Cost: **$450,000 - $800.000**

Total: **$600,000 - $1.0M**

Annual Cost: **(25 to 30% of Software Purchase Cost)**

Currently the Town lacks a thorough understanding of the type, extent, and distribution of costs at an asset level for the majority of the asset portfolios, both within and outside of the scope of this project with the exception of buildings for which Fiix has been purchased and implemented. In addition, the Town does not have a full understanding of the frequency and cause of failure that results in their current largely reactive maintenance state.

The introduction of a modern, geospatial, mobile, and web based MMWS will provide significant benefits in the following areas:

- The construction of an ongoing, centralized, and staff member independent maintenance corporate memory
- Understanding what maintenance money was spent on, an asset, versus knowing purely what activity was involved.
- Provide core asset information, past and planned maintenance, and capital activity data to front line workers allowing them to make better informed decisions in the field.
- Preservation of asset life through proactive, preventive maintenance.
- Efficiencies through the movement away from a reactive to planned maintenance state. Identification of reactive maintenance that can be grouped into preventive planned maintenance programs with defined resources and budgets.
- Identification of assets that require capital intervention versus repeated maintenance.
- Identification of aggregate maintenance costs and frequency by asset. Understanding the root cause of asset failure or assets that fail to perform at the desired level of service.
- Provide a structured method for operators and maintainers to inform capital and operations budgets and authors.
- Provide a structured environment for asset inspection data and attachment of media.
- Inform level of service key performance indicators.
- Standardize and monitor customer response times by activity and ensure that the customer service loop is both auditable and closed.

- In most cases modern MMWS software also provides the following:
- Fleet / rolling stock management;
- Stores / inventory functionality;
- Asset specific condition assessment and analysis functionality – CCTV, OSIM, PM, etc.;
- GIS work planning; and
- Financial and time analysis.

The introduction of a new MMWS should be viewed in the context of providing front line worker value first and foremost, as all the benefits listed can only be recognized if buy in at this level is achieved and data captured appropriately.

Please note that costs shown are for an "on premise" solution meaning that software would be installed on Town servers. The Town may opt for Software as a Service, (SAAS), web hosted, which provides economies through the use of a subscription-based model that does not require capital hardware investment. Ideally the MMWS being considered should include Customer Relations Management functionality to link service requests with inspections and work orders in one seamless and auditable environment.

Again, prior to the introduction of a new MMWS the Town must fully understand their current maintenance processes and streamline these to an optimized state. Failure to do so will result in digital representation of the existing state which will fail to recognize significant value. In addition, the Town should construct a functional and technical specification that outlines software needs for inclusion within a suitable RFP. This is not to be confused with a list of Information Technology driven requirements. A suitable example recently constructed by the GMBP for the City of Brantford has been included under separate cover.

Corporate Decision Support System (DSS)

Timing:	**2 to 4 years**
Subscription / Lease Cost:	**$25,000 to $50,000 per annum**
Implementation Cost:	**$100,000**

This project has provided a non-proprietary SQL Server based DSS and financial tool for the Town's use. The full functionality within this system has yet to be recognized within one commercial DSS system, however, base functionality with respect to the creation and bundling of projects and programs for budgeting has. The Town can continue to use the installed systems with minor to no support from GMBP.

GMBP has provided peer review and implementation services for many products including but not limited to: Assetic, Power Plan, Copper Leaf, and others. Generally speaking, these systems provide a more intuitive user interface with base level optimized decision-making functionality, however, most require significant implementation effort around decision making trigger and financial calibration. All these systems do also provide adequate financial modelling. GMBP can provide additional information on these systems and their various pros and cons given our review of 8 commercially available systems as part of our Municipal DSS Working Group.

Non-Proprietary Tangible Capital Asset Reporting System and Templates

Timing:	**1 to 2 Years**
Development Cost:	**$45,000**
Implementation Cost:	**$10,000**
Annual Cost:	**N/A**

It is understood that the Town expends significant effort in the production of TCA reports on an annual basis. This effort appears to be due to the use of a proprietary TCA reporting system that requires:

- Manual synchronization / input of asset inventory records, acquisitions, disposal, write downs etc. between this system and engineering systems and tenders.
- Inordinate amount of effort to translate system output into financial forecasts and reporting. Treasury staff have indicated that this inflexibility also creates a loss of synchronization between the various information sources.

This project would include the development of templates for external and internal service providers to populate that would provide the essential components for financial reporting within a TCA and AM environment. These templates would make these values explicit and would significantly decrease the effort required for both AM and TCA purposes and the effort required to push incoming data into Town systems.

The second component of this project is the creation of a linked Excel based TCA reporting tool. This tool would connect to the Town's Asset Register, the definitive and singular source for asset information for the portfolios specified, and generate the reporting required for the Town's mandatory financial reporting while informing other AM and financial modelling systems within one nonproprietary and accessible information source.

Core Requirements for Additional Systems

The Town may opt for additional systems to inform their AM process over the short to medium term. The following requirements should be used in evaluating the business fit for any given application:

- Town data input into these systems must be accessible through linkages via an application program interface (API) to ensure that data is not held captive within a proprietary back end.
- Systems should be web based, mobile device optimized, and GIS ready in cases where field staff input / use is required.
- In cases where subscription-based Software As A Service Software is selected, escrow and data ownership/download agreements need to be put in place.
- In all cases the Town should pilot functionality with Town data with the vendor to ensure that the base software requirements are met.
- Standalone encrypted / proprietary core or expert systems should be avoided at all costs.

8.4 Data Collection to Support Future AMPs

To facilitate the augmentation of the Town's data to support the creation of future AMPs, it is recommended the Town define the protocol for data capture to document the data structure and attributes that are necessary for each asset group. Once defined, the recommended data collection should commence quickly thereafter. Based on the sheer volume of assumptions required to fill data gaps for the purposes of the AMP, specifically for condition data and installation years, GMBP strongly recommends the Town initiate a CCTV program for both wastewater and stormwater within the next year.

A full listing and roadmap for data collection projects is available in Technical Memorandum 1, available in Appendix B.

8.4.1 Collecting Data to Operationalize LOS Frameworks

The LOS frameworks clearly distinguish between foundational and advanced metrics. Foundational metrics include performance measures that use readily available asset data, such as operational and capital expenditures, and condition/age data. For the advanced metrics, more data and logic are required to connect the expenditures needed to forecast the measure over time. For example, once a Work Management System is implemented for roads, storm, and wastewater, the percentage of preventative maintenance activities completed on schedule can be tracked and extracted for determining LOS.

In addition, the frameworks highlight the LOS measures that are required under O. Reg. 588/17. These measures include qualitative descriptions and technical metrics that need to have the current performance defined by 2021. The Town met internally to confirm how these measures were interpreted and defined based on available data, as well as temporary solutions for metrics that the Town does not currently have data available for. For example, until a stormwater hydraulic model has been developed the Town may choose to define property resiliency based on the proximity to stormwater infrastructure.

Where data is not available, the Town will need to begin collecting and tracking this information.

The refinements to the available LOS data that are described below should be prioritized and planned by the staff responsible for asset management, in collaboration with subject matter experts. In some cases, it may be feasible to complete the refinements using internal Town staff resources through incorporation into existing work planning processes. If the Town does not have sufficient resources then consideration should be given to retaining additional support through the procurement of external resources. Activities to refine or collect data may include, but not be limited to:

- New data collection;
- Digitizing existing data; and
- Data processes/analysis of existing data.

The different types of recommended projects/activities required to operationalize the LOS Frameworks is summarized in Table 15.

Table 14: Recommended Projects to Operationalize LOS

Service Category	Recommended Project / Activity	Description
All or Several Service Categories	Annual Update to Financial Analysis	Analyze operating and capital budgets annually to determine the amount of annual expenditures for each service category.
	Ongoing Asset Management Analysis	Develop the ability to apply asset management strategies (lifecycle rehabilitation/replacement options, degradation analysis, etc.) to the available asset data and financial analysis. This will enable the Town to forecast the foundational metrics immediately and the advanced metrics once the data is available. Asset management analysis includes spatial analysis of the asset inventory for the frameworks with spatial metrics. This capability will support the Town in their efforts to be in compliance with O. Reg. 588/17.
	Customer Relationship Management System (CRM)	Update the processes to collect, store, and analyze feedback/complaints from the community. The system should have the ability to tie feedback to both a service area

Service Category	Recommended Project / Activity	Description
		and specific asset, and outline if infrastructure needs were identified.
	Work Management System (WMS)	Implement a WMS for Roads, Storm, and Wastewater and connect the Town's work order management system so available data can be fed into the system to help capture and analyze the operation and maintenance expenditures on assets across the corporation and support the population of many advanced metrics in the LOS Frameworks.
	Customer Satisfaction Survey	The Town should complete a survey of the community every 5 years to understand their satisfaction of Town services, including understanding residents' satisfaction with traffic flow and the accessibility of road assets. Many of the advanced customer metrics require feedback from the public to understand how service meets their expectation. Ongoing and repetitive public survey is critical to provide consistent trending over time.
	Field Survey	Additional data collection is required to populate some of the performance measures in the LOS Frameworks.
	Internal Service Level Agreement	Internal department workshops to maintain and adjust targets and asset management analysis.
Stormwater	Stormwater Master Plan	The Town should undergo a Stormwater Master Plan Study in the near future. This Study is an ideal opportunity to collect data and develop the processes to operationalize the performance measures in the LOS Framework.
	Stormwater Hydraulic Model Update	Once data collection has been completed for the stormwater system, a stormwater hydraulic model should be created to determine the resiliency of the stormwater

Service Category	Recommended Project / Activity	Description
		network. This will support the Town in their efforts to be in compliance with O. Reg. 588/17.

8.4.2 Recommended Future Staffing Requirements

In order to ensure the Town has the resources to maintain and amalgamate the required data and perform the required analyses on an ongoing basis, the following recommendations for required roles and responsibilities have been provided. The Town will be required to determine whether these roles should be completed part time by existing staff, or if new fulltime roles should be created and filled; these roles include:

1. An **asset management professional** (1 FTE) who understands both the strategic and operational perspectives of what the system can do and how it can be refined. This individual should be considered an integrated asset management expert, directing the development, implementation, and sustainability of asset management processes in the organization. Amongst other responsibilities, the position will be required to liaise with IT, Finance, and subject matter experts to refine the system (updating costs, condition, etc.) in the short term and sustain it in the long term, as well as run outputs from the analysis. The core requirements for this position should include an engineering/infrastructure/financial education, financial experience, leadership experience, and executive facilitation skills. This role should have the authority to recommend overall asset management strategy to Council.

2. A **computer programming professional** (0.5 FTE) with an ability to develop queries in SQL based programming languages. This position will be responsible for adjusting algorithms under the direction of the integrated asset management professional, as well as managing the native data – SQL server – Excel connectivity.

The following points summarize the typical activities for these staff:

- Liaising with the subject matter expert staff to improve how asset data/information is collected and used.
- Liaising with the subject matter expert staff to adjust the approach to analyzing asset data within the system.
- Coordinating the adjustment of the analysis in the system to continually improve the relationships between the expenditure needs and the performance of the assets.

- Advancing the measurement of asset performance to go beyond the current approach of using primarily asset condition information.
- Liaising with the City's finance team to refine how the capital budget and capital project sheets are developed to better support the analysis of planned expenditures on the performance of the assets.

In the long term, the estimated FTE may need to be increased as the scope of the AMP will broaden over time to include all assets within the Town (required by 2023) and will result in an increased need for resources over time. This may include additional resources required within the Finance/Corporate Services group that would be responsible for AMP management including updating and interpreting the results of the LTFP.

APPENDIX A: LOS TABLES

Asset Levels of Service Framework

Service Category: Bridges & Structures
Service Statement: Efficiently providing operational and accessible bridges at the appropriate quality that support drivers, cyclists and pedestrians.

Key Service Attribute	LOS Statement	Customer/Council Focused Performance Measures					Technical Focused Performance Measures				
		Performance Measure	Current Performance	Data Source	Proposed Performance	Forecast	Performance Measure	Current Performance	Data Source	Proposed Performance	Forecast
Cost Efficient	Providing bridges and structures in an efficient manner	Annual cost to provide service ($/household)	$156/household	Operating Budget Capital Budget - 2018 Budget Book (PDF)	$156/household	-	Annual operating budget for bridges and structures	TBD	Operating Budget	TBD	↑
							Average annual capital expenditure for bridges and structures	$1,019,245	Capital Budget - 2018 Budget Book (PDF)	$1,019,245	↑
		Average bridge and structures renewal rate (# years)	37 years	Asset Management Forecaster (Excel)	37 years	-	10 Year average bridges and structure asset renewal budget as a % of replacement value	2.7%	Capital Budget - 2018 Budget Book (PDF)	1% - 1.5%	-
Operational	Providing operational bridges and structures that are safe for drivers, pedestrians and cyclists	# of vehicle, cyclist, and pedestrian incidents (complaints)	21	CRM Export (Excel)	TBD	↑	# of accessibility complaints of bridges and structures	0	CRM Export (Excel)	TBD	↑
							% of reactive work completed within (TBD) days	TBD	CMMS (once implemented)	TBD	-
							% of planned maintenance activities completed as per schedule	TBD	CMMS (once implemented)	TBD	-
							# of bridges that negatively impact the hydraulic capacity / flow of the watercourse	TBD	Ellis 2017 Engineering Report (PDF)	TBD	↑
Quality	Providing operational bridges and structures that are safe for drivers, pedestrians and cyclists	The general condition of bridges, and how general condition affects overall bridge use in Fort Erie	On average, the majority of bridges are in good condition, thus providing reliable bridge availability to the public.	SOGR TM	On average,majority of bridges in good condition, thus providing reliable bridge availability	-	For bridges in the municipality, average bridge condition index value.	69	Bridge Inspection Excel Export	58	↓
	Providing operational bridges and structures that are safe for drivers, pedestrians and cyclists	The general condition of culverts, and how general condition affects overall culvert use in Fort Erie	On average, the majority of culvert assets are in good condition, thus providing reliable culvert availability to the public.	SOGR TM	On average,majority of culverts in good condition, thus providing reliable culvert availability	-	For structural culverts in the municipality, average bridge condition index value.	68	Bridge Inspection Excel Export	57	↓
Scope	Providing an accessible transportation network to the public	Traffic that is supported by Fort Erie bridges (e.g., heavy transport vehicles, motor vehicles, emergency vehicles, pedestrians, cyclists)	All ranges of traffic types are supported by almost all bridges, unless otherwise posted.	Engineering	All ranges of traffic types are supported by all bridges wherever practicable.	-	% of bridges in the municipality with loading or dimensional restrictions	2.0%	Bridge Inspection Excel Export	2.0%	-

Foundational Metrics
Advanced Metrics
O.Reg 588/17 Metrics

Asset Levels of Service Framework

Service Category: Roads and Right-of-Ways
Service Statement: Efficiently providing operational and accessible roads at the appropriate quality that support drivers, cyclists and pedestrians.

Key Service Attribute	LOS Statement	Customer/Council Focused Performance Measures					Technical Focused Performance Measures				
		Performance Measure	Current Performance	Data Source	Proposed Performance	Forecast	Performance Measure	Current Performance	Data Source	Proposed Performance	Forecast
Cost Efficient	Providing an efficient transportation network for all modes	Cost to provide service ($/household)	$467/household	Operating Budget Capital Budget - 2018 Budget Book (PDF)	$467/household	-	Annual operating budget for roads	$4,540,515	Operating Budget	$4,540,515	↑
							Average annual capital expenditure for roads	$3,054,000	Capital Budget - 2018 Budget Book (PDF)	$3,054,000	↑
		Average asset renewal rate (# years)	117 years	Consultant Report (TBD)	117 years	-	10 Year average road linear asset renewal budget as a % of replacement value	0.9%	Capital Budget - 2018 Budget Book (PDF)	2% - 3%	-
Operational	Providing an operational road network that is safe for drivers, pedestrians and cyclists	# of vehicle, cyclist, and pedestrian incidents (complaints)	1,731	CRM Export (Excel)	TBD	↑	# of infrastructure needs identified from complaints of unsafe roads	TBD	TBD (CRM does not identify infrastructure needs)	TBD	↑
							% of reactive work completed within x days	TBD	CMMS (once implemented)	TBD	-
							% of planned maintenance activities completed as per schedule	TBD	CMMS (once implemented)	TBD	-
							# of road defects identified	906	CRM Export (Excel)	TBD	↑
							% of time when MMS are achieved as per O. Reg 366/18	TBD	CMMS (once implemented)	TBD	↑
Quality	Providing a transportation network at the appropriate condition with smooth and safe surfaces	# of customer service requests relating to service quality	1,189	CRM Export (Excel)	TBD	↑	% length of paved roads in poor or very poor condition	8.1%	Road Inventory (DOT)	1.9%	↓
							% length of unpaved roads in poor or very poor condition	90.2%	Road Inventory (GIS) - Age-based	10.3%	↓
							% length of sidewalks in poor or very poor condition	5%	Sidewalk Inventory (GIS)	TBD	-
							% of streetlights in poor or very poor condition	0%	Streetlight Inventory (GIS)	TBD	-
							% of other road and right-of-way assets in poor or very poor condition	TBD	TBD	TBD	-
		Levels of road class pavement condition	Range of minor arterial, collector and local roads, classes 0 and 3-6, in earth, gravel, surface treated and asphalt, in conditions that are poor, fair, good or excellent.	DOT	Range of minor arterial, collector and local roads, classes 0 and 3-6, in earth, gravel, surface treated and asphalt, in conditions that are poor, fair, good or excellent	-	Average surface condition (e.g. excellent, good, fair or poor) for paved roads.	Good	Road Inventory (DOT)	Excellent	↑
Accessible	Providing an accessible transportation network	Road network in the municipality and its level of connectivity	Good connectivity of a range of minor arterial, collector and local roads throughout the Town.	Engineering	Good connectivity of a range of minor arterial, collector and local roads throughout the Town	-	# of lane-kilometres of arterial roads as a proportion of square kilometres of land area of the municipality.	0.348	Road Inventory (GIS)	0.348	-
							# of lane-kilometres of collector roads and local roads as a proportion of square kilometres of land area of the municipality.	4.607	Road Inventory (GIS)	4.607	-
							# of lane-kilometres of local roads as a proportion of square kilometres of land area of the municipality	4.014	Road Inventory (GIS)	4.014	-
		% of road assets that are AODA compliant	TBD	TBD	TBD	-	% of sidewalks that are AODA compliant	TBD	TBD	TBD	-
							% of traffic signals with APS	TBD	TBD	TBD	-
Environmental Stewardship	Providing a transportation network that is environmentally conscious	% of streetlights that are energy efficient	TBD	TBD	TBD	-	% of streetlights with LED or low energy fixtures	TBD	TBD	TBD	-
		Volume of salt applied to road/lane km	2.65	Salt Management Plan (Annual Report to Environment Canada)	TBD	-	Volume of salt applied to road/lane km	2.65	Salt Management Plan (Annual Report to Environment Canada)	TBD	-

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Asset Levels of Service Framework

Service Category: Stormwater
Service Statement: Efficiently providing reliable stormwater services that protect the community and natural environment.

Key Service Attribute	LOS Statement	Customer/Council Focused Performance Measures					Technical Focused Performance Measures				
		Performance Measure	Current Performance	Data Source	Proposed Performance	Forecast	Performance Measure	Current Performance	Data Source	Proposed Performance	Forecast
Cost Efficient	Providing stormwater services in an efficient manner	Annual cost to provide service ($/household)	$218/household	Operating Budget Capital Budget - 2018 Budget Book (PDF)	$218/household	-	Annual operating budget for stormwater	TBD	Operating Budget	TBD	↑
							Average annual capital expenditure for stormwater	$1,428,000	Capital Budget - 2018 Budget Book (PDF)	$1,428,000	↑
		Average stormwater asset renewal rate (# years)	109 years	Operating Budget Capital Budget - 2018 Budget Book (PDF)	109 years	-	10 Year average stormwater linear asset renewal budget as a % of replacement value	0.8%	Capital Budget - 2018 Budget Book (PDF)	1% - 1.3%	-
Reliable	Providing stormwater services with minimal impact to the community	# of locations in the Town prone to flooding during wet weather events	0	CRM Export (Excel)	TBD	↑	% of major system with insufficient capacity to convey flows of a 100-year wet weather event	TBD	TBD	TBD	-
							% of minor system with insufficient capacity to convey flows of a 5-year wet weather event	TBD	TBD	TBD	-
							# of complaints of flooding during a wet weather event	0	CRM Export (Excel)	TBD	↑
							% of major system with adequate resiliency to accommodate the impacts of climate change	TBD	TBD	TBD	-
							% of minor system with adequate resiliency to accommodate the impacts of climate change	TBD	TBD (SW Master Plan will determine this)	TBD	-
							% of town area surcharged	TBD	TBD	TBD	-
							% length of storm sewers in poor or very poor condition	24.5%	GIS (shp)	35.5%	↑
							% of other stormwater assets in poor or very poor condition	TBD	TBD	TBD	-
							# of critical roads where flooding exceeds 100 mm during a Regulatory storm	TBD	TBD (SW Master Plan will determine this)	TBD	↑
							# of properties at risk of being flooded during a target wet weather event	3	CRM Export (Excel) (SW Master Plan will determine this in future)	TBD	↑
		% of community with stormwater quantity control	TBD	TBD (SW Master Plan will determine this)	TBD	-	% of runoff quantity control	TBD	TBD (SW Master Plan will determine this)	TBD	-
Environmental Stewardship	Providing stormwater services that protect the environment	% of community with stormwater quality control	TBD	TBD	TBD	-	# of SWM ponds that have exceeded their target dredging frequency	TBD	TBD	TBD	↑
							% of community with stormwater quality treatment control	TBD	TBD	TBD	-
							#/type of LID technologies implemented	TBD	TBD	TBD	↑
Scope	Providing protection from flooding due to ROW/infrastructure	User groups or areas of Fort Erie that are protected from ROW or infrastructure flooding, including the extent of the protection provided by the municipal stormwater management system	Some urban areas protected from ROW/infrastructure flooding through urban ditch system or underground storm collection, some with defined outlets. Most rural areas protected from flooding through provision of municipal drains or rural ditch systems, some with defined outlets	Engineering	Some urban areas protected from ROW flooding through urban ditch system or underground storm collection, some with defined outlets. Most rural areas protected from flooding through provision of municipal drains or rural ditch systems, some with defined outlets	-	% of properties in municipality resilient to a 100-year storm	TBD	TBD	TBD	TBD
							% of the municipal stormwater management system resilient to a 5-year storm	TBD	TBD	TBD	TBD

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Asset Levels of Service Framework

Service Category: Facilities Management
Service Statement: Efficiently providing high quality, safe, accessible, and energy efficient facilities for the community.

Key Service Attribute	LOS Statement	Customer/Council Focused Performance Measures					Technical Focused Performance Measures				
		Performance Measure	Current Performance	Data Source	Proposed Performance	Forecast	Performance Measure	Current Performance	Data Source	Proposed Performance	Forecast
Cost Efficient	Providing facilities management services in an efficient manner	Cost to provide service ($/sqft)	$3/sqft	Operating Budget Capital Budget - 2018 Budget Book (PDF)	$3/sqft	↑	Annual operating budget for facilities management	TBD	Operating Budget	TBD	↑
							Average annual capital expenditure for facilities management	$829,500	Capital Budget - 2018 Budget Book (PDF)	$829,500	↑
		Average facilities renewal rate (# years)	119 years	Operating Budget Capital Budget - 2018 Budget Book (PDF)	119 years	-	10 Year forecast average facility asset renewal budget as a % of replacement value	0.84%	Capital Budget - 2018 Budget Book (PDF)	0.84%	-
							% of building elements currently in poor or very poor condition that can be renewed within the next 10 years	90.43%	2018 Condition Assessment (Excel)	90.43%	-
Safe	Providing facilities management services to ensure that facilities are safe	# of building/design related public safety incidents reported OR # of claims filed	TBD	TBD	TBD	↑	# of outstanding safety improvements required at facilities/100 sqft	TBD	TBD	TBD	-
							% of buildings annually inspected	TBD	TBD	TBD	-
							% of facilities that meet security standards	TBD	TBD	TBD	-
							% of reactive work completed within x days	TBD	CMMS (once implemented)	TBD	-
							% of planned maintenance activities completed as per schedule	TBD	CMMS (once implemented)	TBD	-
							# of building defects identified	TBD	TBD	TBD	↑
Accessible	Providing facilities management services to ensure that facilities are AODA compliant	% of facilities that meet the Town's accessibility objectives / goals		Accessibility Audits (PDF)	TBD	-	% of facilities where waiting and queuing areas, and service counters are AODA compliant	50%	Accessibility Audits (PDF)	TBD	-
							% of facilities where the public parking facilities are AODA compliant	100%	Accessibility Audits (PDF)	TBD	-
							% of facilities where the public entrance paths of travel are AODA compliant	100%	Accessibility Audits (PDF)	TBD	-
Quality	Providing clean and safe facilities in good condition for users	% of facilities in poor or very poor condition	5.85%	2018 Condition Assessment (Excel)	0%	-	% of facility systems above target SCI	TBD	TBD	TBD	-
							% of facilities above target FCI	TBD	2018 Condition Assessment (Excel)	TBD	-
							% of facility assets by replacement value in poor or very poor condition	9.23%	2018 Condition Assessment (Excel)	33.6%	-
							Cleaning frequency	TBD	TBD	TBD	↑
							# of customer service requests relating to usage and availability	0	CRM Export (Excel)	TBD	↑
	Providing facilities at the right design standard	% of facilities at or above the target design standard	TBD	TBD	TBD	-	% of facilities that meet the target design standard	TBD	TBD	TBD	-
Environmental Stewardship	Providing facilities that are energy efficient	Annual energy consumption per square foot	TBD	TBD	TBD	-	Annual energy consumption per square foot	TBD	TBD	TBD	↑
	Providing facilities that are environmentally conscious	Annual water consumption per square foot	TBD	TBD	TBD	-	Annual water consumption per square foot	TBD	TBD	TBD	↑
							Volume of rainwater harvested	TBD	TBD	TBD	↑

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Asset Levels of Service Framework

Service Category: Water
Service Statement: The Town of Fort Erie will strive to provide safe, clean drinking water of adequate pressure and flow with minimum service interruptions.

Key Service Attribute	LOS Statement	Customer/Council Focused Performance Measures					Technical Focused Performance Measures				
		Performance Measure	Current Performance	Data Source	Proposed Performance	Forecast	Performance Measure	Current Performance	Data Source	Proposed Performance	Forecast
Cost Efficient	Providing water services in an efficient manner	Annual cost to provide water service ($/household)	$274/household	Operating Budget Capital Budget - 2018 Budget Book (PDF)	$274/household	↑	Annual operating budget for water services	$5,419,839	Operating Budget	$5,419,839	↑
							Average annual capital expenditure for water services	$1,793,000	Capital Budget - 2018 Budget Book (PDF)	$1,793,000	↑
		Average water service asset renewal rate (# years)	96 years	TBD	96 years	-	10 Year average water linear asset renewal budget as a % of replacement value	1.0%	Capital Budget - 2018 Budget Book (PDF)	1.0%	-
Safe	Water system supports community fire protection	% of community with sufficient fire flow protection	97.60%	2016 MSP Water Model	100%	-	% of system not meeting fire flow targets	6%	2016 MSP Water Model	0%	↑
	Water system provides safe potable drinking water	% of community with acceptable risk of experiencing adverse water quality	100%	Water Sampling Results	TBD	-	% compliance with all applicable water quality regulations	100%	Water Sampling Results	100%	-
							# of confirmed adverse water quality tests	0	Water Sampling Results	0	↑
Quality	Providing high quality water to residents	# of complaints due to rusty/discoloured water	19	CRM Export (Excel)	TBD	↑	% of system serviced by sources that provide substandard water	TBD	TBD	TBD	-
							% length of system that is unlined CI/DI	21.93%	GIS (shp) Inventory	16.27%	-
		# of complaints due to low pressure	12	CRM Export (Excel)	TBD	↑	% of system with pressure < 40 psi	1%	2016 MSP Water Model	0%	-
Reliable	Providing water services with minimal interruptions	% of customers where service is interrupted above target frequency	TBD	TBD	TBD	-	# of connection-days where service is interrupted due to water main breaks	TBD	TBD	TBD	↑
							# of WM breaks across the system annually	39	Water Main Break History (Excel)	45	↑
							# of watermains above target break rate	3	Water Main Break History (Excel)	3	-
							# of watermains prone to frozen water services	48	Frozen Services Property List (Excel)	TBD	↑
							% length of watermains in poor or very poor condition	3.69%	GIS (shp) - More than 5 breaks	3.69%	-
							% of Bulk Water Station assets in poor or very poor condition	TBD	TBD	TBD	-
							# of unplanned failures resulting in service interruption/reduction	TBD	TBD	TBD	↑
Safe & Reliable	Provinding safe and reliable drinking water	Boil water advisories and service interruptions	No boil water advisories, few service interruptions due to Town responsibilities	Water Dept	No boil water advisories, few service interruptions due to Town responsibilities	-	# of connection-days per year where a boil water advisory notice is in place compared to the total number of properties connected to the municipal water system	0	TBD	0	-
							# of connection-days per year due to water main breaks compared to the total number of properties connected to the municipal water system	TBD	TBD	TBD	-
Environmental Stewardship	Providing a water service that is environmentally conscious	Water consumption L/cap/day	TBD	TBD	TBD	-	Infrastructure Leakage Index (ILI)	3.84	AWWA - 2017 Water Audit (Excel)	3.84	-
Scope	Providing water services within the urban area	User groups or areas of Fort Erie that are connected to the municipal water system	Most properties within urban area are connected to the municipal water system.	2016 MSP	Most properties within urban area connected to the municipal water system.	-	% of properties connected to the municipal water system	88%	2016 MSP Water Model (Number of parcels in FE pressure zone)	88%	-
	Providing fire flow potable water services	User groups or areas of Fort Erie that have fire flow provided from the drinking water system	Most properties within urban area are connected to the municipal water system for fire flow.	2016 MSP	Most properties within urban area connected to the municipal water system for fire flow.	-	# of properties where fire flow is available	88%	2016 MSP Water Model (Number of parcels in FE pressure zone)	88%	-

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Asset Levels of Service Framework

Service Category: Wastewater
Service Statement: Efficiently providing reliable wastewater services that are conscious of impacts to private property and the environment.

Customer/Council Focused Performance Measures

Key Service Attribute	LOS Statement	Performance Measure	Current Performance	Data Source	Proposed Performance	Forecast
Cost Efficient	Providing wastewater services in an efficient manner	Cost to provide service ($/household)	$249/household	Operating Budget Capital Budget - 2018 Budget Book (PDF)	$308/household	↑
		Average wastewater asset renewal rate (# years)	106 years	TBD	85 years	-
Reliable	Providing wastewater services with minimal interruptions	# of customers that experience a service interruption	55	CRM Export (Excel) Work Order Data (CMMS when implemented)	55	↑
Safe	Protecting homes from sanitary wastewater backups or overflow	How combined sewers in the Fort Erie wastewater system are designed with overflow structures in place (to prevent backups into homes by allowing	No combined sewers allowed in new construction design. Overflow structures are the responsibility of the Region.	Engineering	No combined sewers allowed in new construction design. Overflow structures are the responsibility of the Region.	-
	Providing wastewater services that have minimal impacts on the environment	Frequency and volume of overflows in combined sewers in the Fort Erie wastewater system that occur in habitable areas or beaches	Few overflows in combined sewers in habitable areas or beaches.	Wastewater Dept	Few overflows in combined sewers in habitable areas or beaches	-
	Protecting homes from sanitary wastewater backups or overflow	How stormwater can get into sanitary sewers in the Fort Erie wastewater system, causing sewage to overflow into streets or backup into homes	Some Inflow and Infiltration into sanitary system exists, through private connections, cross connections and system infrastructure deficiencies, such as cracks & leaks.	Engineering	Some Inflow and Infiltration into sanitary system exists, through private connections, cross connections and system infrastructure deficiencies, such as cracks & leaks.	-
	Protecting homes from sanitary wastewater backups or overflow	How sanitary sewers in the Fort Erie wastewater system are designed to be resilient to avoid storm events	Design and construction criteria for sanitary sewers in place, to ensure consistent and industry-accepted performance requirements, materials, and installation methods are used.	Engineering	Design and construction criteria for sanitary sewers in place, to ensure consistent and industry-accepted performance requirements, materials, and installation methods are used.	-
	Not applicable - Sewage treatment is the responsibility of the Region	Description of the effluent that is discharged from sewage treatment plants in the municipal wastewater	Not applicable - Sewage treatment is the responsibility of the Region	Not applicable	Not applicable	-
Environmentally Conscious	Providing wastewater services that have minimal impacts on the environment	% of wastewater flows that meet environmental objectives when discharged	TBD	TBD	TBD	-
Scope	Providing sanitary wastewater services within the urban area	User groups or areas of Fort Erie that are connected to the municipal wastewater system	Most properties within urban area are connected to the municipal water system.	2019 MSP	Most properties within urban area connected to the municipal water system.	-

Technical Focused Performance Measures

Key Service Attribute	LOS Statement	Performance Measure	Current Performance	Data Source	Proposed Performance	Forecast
Cost Efficient	Providing wastewater services in an efficient manner	Annual operating budget and capital budget for wastewater	$10,669,940	Operating Budget Capital Budget - 2018 Budget Book (PDF)	$11,059,018	↑
		Annual operating and maintenance cost/km of sewer	$46,721/km	Operating Budget	$46,721/km	-
		Average annual capital expenditure for wastewater	$1,627,500	Capital Budget - 2018 Budget Book (PDF)	$2,016,578	↑
		10 Year average wastewater linear asset renewal budget as a % of replacement value	1.2%	Capital Budget - 2018 Budget Book (PDF)	1.40%	↑
Reliable	Providing wastewater services with minimal interruptions	# of customers that experience basement flooding caused by system surcharge	3	CRM Export (Excel)	3	↑
		km of sewers in poor or very poor condition	87.46	GIS (shp) - Age-based	79.36	↓
		% length of sewers in poor or very poor condition	45.19%	GIS (shp) - Age-based	41.01%	↓
		% of the system surcharged within 1.8 m of the ground elevation during a 25-year wet weather event	TBD	TBD	TBD	-
		% of the system with adequate resiliency to accommodate the impacts of climate change	TBD	TBD	TBD	-
		# of sewers with operational issues likely to cause service interruptions	TBD	CMMS (once implemented)	TBD	↑
		% of preventative maintenance activities completed on schedule	TBD	CMMS (once implemented)	TBD	-
		# of locations with FOG issues or prone to blockages	TBD	CMMS (once implemented)	TBD	↑
		# of residences that have been reimbursed through the Extraneous Flow Reduction Program.	541	Ex Flow Reimbursement Summary (Excel)	TBD	↑
Safe	Protecting homes from sanitary wastewater backups or overflow / Providing wastewater services that have minimal impacts on the environment	# of events per year where combined sewer flow in the municipal wastewater system exceeds system capacity compared to the total number of properties connected to the municipal wastewater system.	TBD	TBD	TBD	-
	Protecting homes from sanitary wastewater backups or overflow	The number of connection-days per year due to wastewater backups compared to the total number of properties connected to the municipal wastewater system.	TBD	TBD	TBD	-
	Protecting homes from sanitary wastewater backups or overflow / Not applicable - Sewage treatment is the responsibility of the Region	The number of effluent violations per year due to wastewater discharge compared to the total number of properties connected to the municipal wastewater system	TBD	TBD	TBD	-
Environmentally Conscious	Providing wastewater services that have minimal impacts on the environment	# of relief pumping events	TBD	TBD	TBD	↑
		Total volume of untreated wastewater discharged into the natural environment via relief pumping events	TBD	TBD	TBD	↑
Scope	Providing sanitary wastewater services within the urban area	Percentage of properties connected to the municipal wastewater system	73%	2018 WWMP Model	73%	-

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APPENDIX B: TECHNICAL MEMORANDUM #1 - BACKGROUND REVIEW AND GAP ANALYSIS

Date:	5/24/2019	File:	618004
To:	Kelly Walsh, P.Eng. Director, Infrastructure Services		
From:	GM BluePlan Engineering		
Project:	Asset Management Plan		
Subject:	Background Review and Gap Analysis		

TECHNICAL MEMORANDUM #1 – BACKGROUND REVIEW AND GAP ANALYSIS

1. INTRODUCTION

GM BluePlan (GMBP) has been retained by the Town of Fort Erie to develop an Asset Management Plan that follows the Province's structure outlined in the Guide for Municipal AM Plans, and that will also address all of the requirements required in Ontario Regulation 588/17. As a part of this project, GMBP has performed a complete gap analysis of the data provided by the Town and created a prioritized action plan and program to address augmenting data gaps.

Based on this, the key objectives of this memorandum are as follows:

- ***Background Data Review and Gap Analysis*****:** Review of all available asset information for each service category and documenting gaps, data sources, and information flows for AMP data collection.
- ***Asset Data and Inventory Improvements*****:** Identify data gaps, discrepancies, and augment asset information where data gaps exist into the asset register (GIS inventory).
- ***Recommended Prioritized Action Plan and Program*****:** Identify the approach for data collection through prioritization of these needs within a data collection program.

This memorandum provides a review of all relevant electronic information collected to-date to understand what information is available to support AM in the Town and define the level of maturity and confidence in the data. In particular, the gap analysis focused on identifying gaps that would affect O.Reg. 588/17 compliance such as data required for reporting Levels of Service (LOS) and the development of GMBP's Decision Support System (DSS) Excel tool.

2. BACKGROUND DATA REVIEW & GAP ANALYSIS

At the onset of the project, GMBP issued a comprehensive Request for Information (RFI) for all information relevant to the AM Program. This included:

- GIS database and other asset inventories
- Condition / Capacity / Risk / Criticality data
- Work order system data
- Operating and Capital budget / PSAB Register
- Reserve fund tracking spreadsheets
- Master Plans / studies
- Existing drawings and field records
- Any other existing systems/databases and documents that reference LOS or describe the conditional or functional performance of assets.

For the files collected from the Town that contained tabular data (ex. spreadsheets and shapefiles), the following reviews were completed:

2.1. DATA COMPLETION, MATURITY AND CONFIDENCE

This review involved the following process to identify gaps and level of data completion:

- **Basic Data Information**
  - Identify the file/layer to be analyzed:
    - Asset Category
    - File Name / Type
    - Geometry (if applicable, e.g. shapefiles)
  - Record details about each field:
    - Field Name
    - Field Type (if applicable, e.g. shapefiles)
    - Field Length (if applicable, e.g. shapefiles)
- **Maturity**
  - Calculate the percentage of filled records per field / layer (blanks and zeros were counted as gaps).
  - Assign data maturity per field / layer based on the following ranges:
    - 0 to 33 % Filled - Poor
    - >33 to 66% Filled - Fair
    - >66 to 100% Filled - Good
- **Confidence**
  - Note any concerns in the accuracy / consistency of the data. These included:
    - Duplicates in an ID field
    - Inconsistently filled in fields (e.g. using number or text rating within different records of a condition field)
    - Completely or mostly empty fields
    - Abundance of Unknown or N/A values
  - Assign a confidence rating per field / layer based on the concerns identified:
    - Low – Major data concerns identified
    - Medium – Minor or no data concerns identified
    - High – No concerns identified, and data appears to be very consistent, or further information from staff on the origin of the data has been provided suggesting high confidence.
- **Criticality**
  - Identify the select fields within each layer / file that are considered critical to support the AMP (i.e. are required for O.Reg. 588/17 compliance, the LOS frameworks, or the DSS).
  - The following data / types and information were considered critical at the asset level for use within the AMP, DSS, LOS frameworks, or for O.Reg. 588/17 compliance:

    - Replacement Costs
    - Age
    - Estimated Service Life (ESL)
    - Condition Measures
    - Performance Measures
- Depending on the asset, other attributes that are essential to the AMP (e.g. Unique IDs), or fields used for lifecycle analysis, modelling, etc. (e.g. material and diameter of pipes) **were also considered critical.**

2.2. NETWORK VALIDATION

In addition to the reviews above, the Town requested their road, water, wastewater, and stormwater networks be validated for topological errors; these errors have been flagged within the GIS layers for the Town's review and provided with this memorandum. The networks were validated using a combination of T-SQL scripts and FME workbenches to flag any errors in the tabular or geometric data that would affect each dataset's spatial integrity. Each issue was flagged from 1 to 21 based on the type of issue that was found, where flags 1 through 19 are scripted in T-SQL and flags 20 and 21 were completed in FME. Each of the data checks and their corresponding issue flags are outlined in detail in Appendix A.

3. ASSET MANAGEMENT PLAN DATA SOURCES

Following a thorough review of the information supplied, a gap analysis was completed to determine the suitability of the tabular data provided for the required asset management analyses; Table 1 below outlines these core data sources.

Table 1: Asset Management Plan Required Data Sources

Inventory / Data	Data Source	File Name	File Type	Date Provided
Roads Inventory	GIS Inventory	TOFE-ROAD MANAGEMENT INVENTORY-LINE	Shapefile	2018-07-09
Street Light Inventory	GIS Inventory	TOFE-STREET LIGHT-POINTS	Shapefile	2018-08-29
Sidewalk Inventory	Inspections	2018 Sidewalk Inspections	Shapefile	2018-09-17
Sanitary Maintenance Holes Inventory	GIS Inventory	TOFE-SAN MAINTENANCE HOLE-POINT	Shapefile	2018-07-09
Sanitary Sewer Line Inventory	GIS Inventory	TOFE-SANITARY SEWER-LINE	Shapefile	2018-07-09
Storm Manholes Inventory	GIS Inventory	TOFE-STORM MANHOLES-POINT	Shapefile	2018-07-09
Storm Sewers Inventory	GIS Inventory	TOFE-STORM SEWER-LINE	Shapefile	2018-09-17
Water Hydrants Inventory	GIS Inventory	TOFE-WATER HYDRANT-POINT	Shapefile	2018-07-09
Water Mains Inventory	GIS Inventory	TOFE-WATER MAIN-LINE	Shapefile	2018-07-09
Water Nodes Inventory	GIS Inventory	TOFE-WATER NODE-POINT	Shapefile	2018-08-22
Water Valves Inventory	GIS Inventory	TOFE-WATER SYSTEM VALVE-POINT	Shapefile	2018-07-09

Inventory / Data	Data Source	File Name	File Type	Date Provided
Facilities Inventory	Facilities Condition Assessment	Excel Spreadsheets - Working Copy	Excel	2018-08-10
Bridges and Culverts Inventory	Asset Management Forecaster	Asset Management Forecaster - Municipal Primary	Excel	2018-08-08
		Asset Management Forecaster - Municipal Secondary	Excel	2018-08-08
		Asset Management Forecaster - Retaining Walls	Excel	2018-08-08
		Asset Management Forecaster - Span	Excel	2018-08-08
	Inspections	Fort Erie MUNICIPAL PRIMARY Culvert Inspections 2017	Excel	2018-08-08
		Fort Erie RETAINING WALL Inspections 2017	Excel	2018-08-08
		Fort Erie MUNICIPAL SECONDARY Culvert Inspections 2017	Excel	2018-08-08
		Fort Erie SPAN Inspections 2017	Excel	2018-08-08
Financial Data	Asset Navigator	AssetNav Dump	Excel	2018-07-20
	PSAB Register	Accpac Asset Listing @ 12.31.17	Excel	2018-09-20
Customer Complaints	CRM Export	crmExportData - Engineering Closed Issues	Excel	2018-08-15
		crmExportData - Engineering Dept	Excel	2018-08-15
		crmExportData - Roads Dept	Excel	2018-08-15
		crmExportData - Water & Wastewater Dept	Excel	2018-08-15

4. GAP ANALYSIS FINDINGS

4.1. DATA COMPLETION, MATURITY AND CONFIDENCE

High level data results from the gap analysis are provided in Table 2 below, showing the overall maturity and confidence ratings for the fields considered critical for each data source.

Table 2: Data Maturity and Confidence Levels

Asset Category / Inventory Type	% Filled of Critical Fields	Maturity	Confidence	Notes
Roads	92%	Good	Medium	No replacement costs or ESL. Low confidence in installation dates. 1 duplicate in ID field.
Street Lights	89%	Good	Medium	No ESL or condition information in GIS data. This data is available in other sources.
Sidewalks	100%	Good	Medium	No ID field, replacement costs, installation dates or ESL.
Sanitary Maintenance Holes	99%	Good	Medium	No replacement costs, ESL or condition information. 3 duplicates in ID field.
Sanitary Sewer Line	89%	Good	Medium	No replacement costs, ESL or condition information. Majority of up and downstream invert measurements 0.
Storm Manholes	51%	Fair	Low	No replacement costs, ESL or condition information. Very little information available. Low confidence in installation dates. Some records without IDs.
Storm Sewers	62%	Fair	Low	No replacement costs, ESL or condition information. Many critical fields are missing approximately 40% of their data, including installation year and the ID field.
Water Hydrants	51%	Fair	Low	No replacement costs or ESL. Some condition related fields and an installation date field but they are empty or almost empty. 19 duplicates in ID field.

Asset Category / Inventory Type	% Filled of Critical Fields	Maturity	Confidence	Notes
Water Mains	90%	Good	Medium	No replacement costs, ESL or condition information. Only have age ranges rather than specific installation dates for most records. 5 duplicates in ID field.
Water Valves	35%	Fair	Low	No replacement costs, installation dates or ESL. Condition field is almost empty and not using a 1-5 scale. 4 duplicates in ID field.
Facilities	100%	Good	Medium	No Unique ID field. Contains costs, but only some are for replacement.
Bridges and Culverts – AM Forecaster	100%	Good	Medium	No ESL field. Most installation dates “Unknown”.
Bridge and Culverts – Inspections	81%	Good	Medium	No ESL and some cost fields but only some costs are for replacement. Most installation dates “Unknown”. 4 duplicates in ID field.
Asset Navigator / Financial Data	75%	Good	Medium	Contains replacement costs, however these are at a higher level than assets, and are older estimates which FE has low confidence in.
Customer Complaints	82%	Good	Medium	Many duplicate IDs (often if there is the same record open and closed). Lack of information confirming the cause of the complaint and whether it resulted in infrastructure improvements. Category field inconsistent.

The detailed analysis of each data source is presented in Appendix B.

4.2. NETWORK VALIDATION

The detailed results of the network validation have been provided to the Town through updated shapefiles of the networks with additional flag fields for each check performed. A summary of the number of points and lines that were found to have any applicable type of issue flag are outlined in Table 3 below.

Table 3: Network Validation Results

Asset Group	Geometry Type	Total # of Lines / Points	# of Lines / Points Flagged	% of Lines / Points Flagged
Roads	Lines	1863	1783	96%
Sanitary	Lines	2874	501	17%
	Points	2826	2826	100%
Storm	Lines	3627	3627	100%
	Points	2093	2093	100%
Water	Lines	1664	1381	83%
	Points	1253	212	17%

A detailed overview of the checks performed and the results for each flag are provided in Appendix A.

5. GAPS ANALYSIS ASSUMPTIONS & RESULTS

The following list outlines the data gaps / issues that reduce the **confidence levels** of the supporting data.

- **Replacement Costs**

  The inventories which included engineering department assigned replacement costs were Bridges and Culverts, as well as some Facility assets. Asset Navigator data did contain replacement costs, however, the replacement costs were tracked at different asset levels and further, the costs assigned are outdated and have been considered unsuitable for use within this project.

  - For all assets, excluding engineering assigned replacement costs, GMBP used industry standard best practice to assign replacement costs.
    - These replacement values do not address economies of scale as they represent the value to replace each asset individually.

- The best practice approach involved using our costing database to augment replacement costs with a review to similar local municipalities alike in area, age, population, etc.

Table 4 below summarizes the unit replacement costs for asset categories where this methodology was applied. Roads assets used a unit cost based on the road's surface area, while the other asset categories used unit costs based on pipe diameter.

Table 4: Unit Replacement Cost Estimates

Asset	Diameter (mm)	Material	Replacement Unit Cost	Replacement Units
Roads	N/A	Hot Mix Asphalt	$216.67	m^2
		Surface Treated	$47.51	m^2
		Gravel	$17.50	m^2
		Earth	$8.75	m^2
Sanitary Mains	d <= 150	N/A	$600	m
	150 < d <= 200		$630	m
	200 < d <= 225		$675	m
	225 < d <= 250		$690	m
	350 < d <= 350		$800	m
	450 < d <= 450		$900	m
	600 < d <= 600		$1,000	m
	750 < d <= 750		$1,100	m
	d > 750		$1,100	m
Storm Sewers	d <= 200		$650	m
	200 < d <= 250		$710	m
	250 < d <= 300		$835	m
	300 < d <= 450		$925	m
	450 < d <= 525		$1,030	m
	525 < d <= 600		$1,100	m
	600 < d <= 800		$1,150	m
	800 < d <= 1200		$2,625	m
	d > 1200		$3,600	m
Water Mains	d <= 150		$500	m
	150 < d <= 250		$660	m
	250 < d <= 300		$1,000	m
	300 < d <= 400		$1,580	m
	400 < d <= 600		$2,715	m

- Since the bridges and culverts data contained replacement costs for all assets, these replacement costs were taken to be accurate and were included as-is.

- For the overall replacement costs of facilities, GMBP utilized industry standards to make general estimates of the cost per square foot for different facility types and applied these to each facility (see Table 5 below).

Table 5: Overall Facility Costs

Town of Fort Erie - Facility	Facility Size (Sqft)	Rate ($/Sqft)	Facility Cost
Centennial Library	16,000	$339	$5,431,151
Central Fire Station	13,340	$378	$5,041,938
CN B-1 Station	814	$386	$314,030
Crystal Ridge Arena	28,000	$256	$7,162,288
Crystal Ridge Community Centre	17,000	$386	$6,558,367
Crystal Ridge Library	6,000	$339	$2,036,682
Fire Station 3	12,000	$378	$4,535,477
Fire Station 4	4,500	$378	$1,700,804
Fire Station 5	7,500	$378	$2,834,673
Fire Station 6	5,500	$378	$2,078,760
GTR Station Museum	1,028	$386	$396,588
JL Gibson	22,855	$315	$7,199,739
Gibson Storage Building	7,300	$173	$1,265,895
Leisureplex	128,000	$256	$32,741,889
Ridge Road Historical Museum	4,746	$386	$1,830,942
Stevensville Hall (Includes Library Within)	9,500	$386	$3,664,970
Town Hall	38,000	$392	$14,895,229

Rehabilitation Costs

The rehabilitation treatment type was used only for Road assets, all other asset categories used only replacement in their lifecycle strategies. Table 6 below summarizes the unit rehabilitation costs used in the DSS. These costs were provided in an email from the Town on December 12, 2018.

Table 6: Unit Rehabilitation Cost Estimates

Asset	Material	Rehabilitation Unit Cost	Replacement Units
Roads	Hot Mix Asphalt	$22.40	m²
	Surface Treated	$6.5	m²
	Gravel	$2.00	m²
	Earth	$2.00	m²

Estimated Service Life (ESL) Values

The financial data from Asset Navigator contained ESL values that were identified to be low in confidence due to the variation in ESL between similar assets.

- For example, in the AssetNav data 600 mm diameter concrete sanitary mains vary in ESL between 50, 75, or 90 years even though these pipes have identical attribute data and should therefore have no difference in ESL. For this reason, it was decided that industry standard ESL values would be augmented within the data as needed.
- The supplied facility data contained ESL values for the vast majority of the assets. For this asset category, all provided ESL values were assumed to be accurate and the very minor data gaps were filled using industry best practices.
- The bridges and culverts data that was provided contained ESL values for the vast majority of the assets. For this asset category, all provided ESL values were assumed to be accurate and any data gaps were filled using industry best practices.
- For all remaining assets, GMBP utilized industry standard ESL values. Aside from Roads, these ESL values varied depending on the material of the asset.

Table 7: Estimated Service Life Estimates

Asset Category	Material	Road Class	Estimated Service Life (Years)
Roads	N/A	Minor Arterial	48
		Collector	55
		Local	60
Sanitary Mains	AC	N/A	50
	CONC		80
	PE		50
	PVC		85
	RES LINER		50
	VIT		50
	Other		50
Storm Sewers	AC		50
	CONBX		80
	CONC		80
	CONEL		80
	CSP		50
	CSPA		50

Asset Category	Material	Road Class	Estimated Service Life (Years)
	PE		50
	PVC		85
	VC		50
	Other		50
Water Mains	AC		60
	CI		70
	CPP		70
	DI		50
	HDPE		50
	PE		40
	PVC		80
	Other		50

In addition to ESL values, the Town has adopted resurfacing frequencies for roads based on industry experience. Table 8 below shows the number of years between resurfacing that each road is expected to experience based on road class.

Table 8: Road Resurfacing Frequency

Asset Category	Material	Road Class	Resurfacing Frequency (Years)
Roads	Hot Mix Asphalt	Minor Arterial	25
		Collector	30
		Local	35
	Surface Treated	Minor Arterial	12
		Collector	15
		Local	20

Installation Dates

Concerns were identified for installation dates provided for water, storm, and sanitary mains. For example, some assets had date ***ranges*** assigned, further the distribution of installation years suggested issues with the data as such materials were not yet available.

- Water mains – Based on a review of the distribution of installation dates, it was found that 62% of the assets in the network did not have installation dates assigned. In addition, installation year ranges were provided by the Town on a per pipe basis, so any pipe without a specific installation date was assigned a random installation year within the provided age range.

- After this redistribution was applied to correct for the absence of installation dates, further investigation indicated that 7% of the network had an installation date of 1999. The spike in installations for 1999 was largely caused by a rush to replace watermains in Crystal Beach because of coloured water. As a result, this spike is not considered an outlier and was left as-is.

- Storm Sewers – Based on a review of the distribution of installation dates, low confidence was confirmed for the pipes which have an installation date of 1958. Of the 123 km of storm pipe in the GIS data, 39 km (or 31%) of the pipe was assigned an installation date of 1958. To address this issue, GMBP determined age ranges for each material type based on the Town's data and industry standards, then assigned all pipes that were built in 1958 a year within that range. The ranges that were applied can be seen below in Table 9.

Table 9: Installation Date Ranges for Storm Sewers

Material	Earliest Year	Last Year
AC	1958	1968
CONBX	1954	1994
CONC	1930	2000
CONEL	1973	1987
CSP	1972	2000
CSPA	1930	2000
PE	1982	2000
PVC	1975	2000
UNK	1930	1980
VC	1930	1960

- Sanitary pipes – Based on a review of the distribution of installation dates, a low confidence was confirmed as some had large spikes of installations in the years 1973, 1983, and 1990. These three years made up the installation dates of 26% of the sanitary network. Pipes installed in these years were redistributed by assigning each pipe installed in those years a random year up to three years before or three years after the installation year that was provided. All assets that had this applied were flagged within the GIS for confirmation/review.
- Roads - Based on a review of the distribution of installation dates, it was found that 30% of roads have an installation date of 1846. As these dates are likely not accurate the roads performance is being based off their PQI

data, not their age. As a result, these installation dates are not used within the AMP and their data was not redistributed.

- **CRM Data on Infrastructure Improvement Data**

A number of the Level of Service measures are related to customer complaints and require the identification of infrastructure improvements that resulted from a complaint. This analysis provides the driving factor for the improvement as safety, operability, etc., of the asset. However, this information is not easily extracted within the CRM data.

The complaints logged within the CRM system include a category field which is useful for filtering the data to determine the number of complaints for a specific issue, such as those outlined in the LOS measures (e.g. # of customer service requests relating to service quality [of Road & ROW assets]). However, these categories are not currently structured in a way to support the LOS measures.

- **O.Reg. 588/17 LOS Measures**

The following table outlines the LOS measures required by O.Reg. 588/17 which cannot currently be measured due to data gaps.

Table 10: O.Reg. 588/17 LOS Measures Data Gaps

Asset Category	LOS Measures with Data Gaps	Next Steps
Bridges & Structures	No Data Gaps	
Roads & ROW	No Data Gaps	
Stormwater	% of properties in municipality resilient to a 100-year storm	Determine how to define resiliency in the system, then collect the necessary data through field collection and desktop modelling. The first step will be to collect a full GIS inventory of ditching and piping.
	% of the municipal stormwater management system resilient to a 5-year storm	
Facilities Management	No O.Reg. 588/17 LOS Measures	
Water	# of connection-days per year due to water main breaks compared to the total number of properties connected to the municipal water system	Define a formal process for collecting and tracking the following information: • Duration of service interruptions • Number of properties affected by service interruptions

Wastewater	The number of connection-days per year due to wastewater backups compared to the total number of properties connected to the municipal wastewater system.	Define a formal process for collecting and tracking the following information: • Duration of sewer backups • Number of properties affected by sewer backups

6. RECOMMENDATIONS

To facilitate the augmentation of Fort Erie's data to support the creation of future AMPs, the following table provides an implementation plan for data augmentation. It is recommended the Town define the protocol for data capture, documenting the data structure and attributes that are necessary for each asset group. Once defined, the recommended data collection should commence quickly thereafter. Based on the sheer volume of assumptions required to fill data gaps for the purposes of the AMP, specifically for condition data and installation years, we strongly recommend the Town initiate a CCTV program for both wastewater and storm within the next year.

Table 11: Recommended Projects

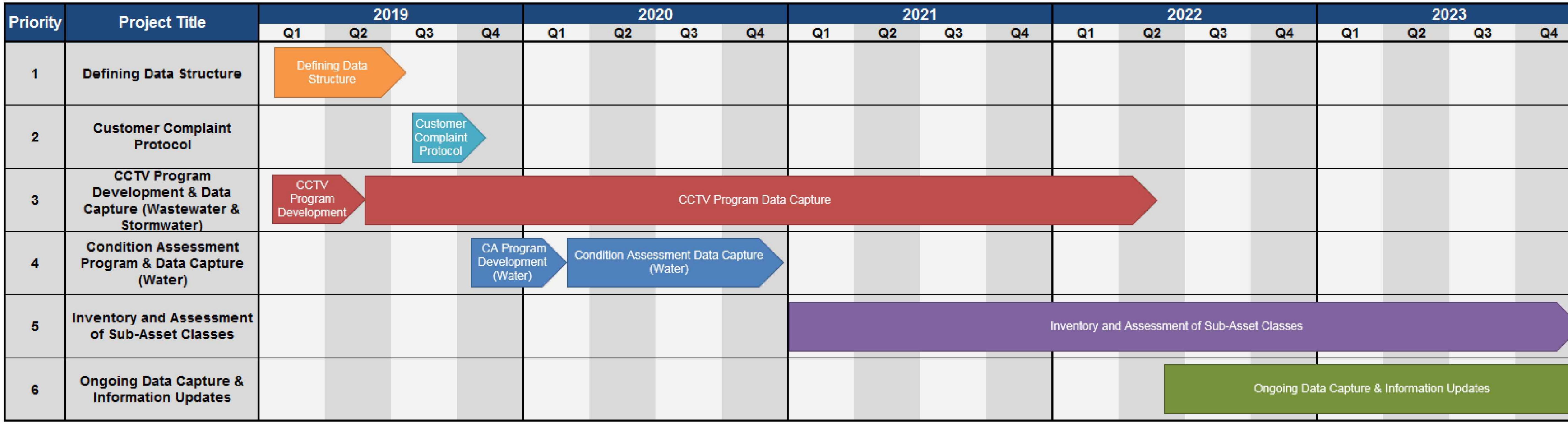
Priority #	Project Title	Project Description	Timeline
1	**Defining Data Structure**	Define the template, format, and structure for inventory to be collected and returned in, including limitations of how fields are to be populated (domain values, nomenclature, etc.) and developing asset hierarchies. This would include developing standard replacement costs and ESL for all asset types. Define the methodology for condition assessments and performance testing to provide capacity information for key assets amongst all asset groups. This will include outlining the level required to assign condition / performance metrics to (e.g. collecting break information at the asset level), as well as the deliverables to be provided (e.g. electronic databases). For facility condition assessments, it should be outlined that replacement costs should be determined at both the asset and facility level.	5-6 Months
2	**Customer Complaint Protocol**	Define the domain values for some CRM fields to ensure consistency and have categories / causes that support LOS measures. Develop a process to track complaints that result in or trigger infrastructure improvements.	2-3 Months

3	**CCTV Program Development & Data Capture (Wastewater Collection & Stormwater Collection)**	Outline a program to perform targeted PACP/MACP CCTV inspections of the following assets:
		• Storm Sewers & Manholes (GMBP to outline program details in Technical Memorandum #11)
		• Sanitary Sewers & Manholes
		  ○ Recommend deriving a re-inspection CCTV program based on both pipe and service criticality.
		  ○ CCTV should be conducted typically every 5 years. However, some pipes and manholes may require higher or lower inspection frequency, which would be assigned following program development.
		  ○ Based on the identified gaps and necessary assumptions carried into the AMP, it is recommended this program be derived and then initiated early 2019 with a large section of the network being assessed in the next 2-3 years.
		Upon completion of this program the Town will be able to rerun the AMP with true Town data.
			3-4 Months (Program)
			2-3 yrs (Network Wide CCTV)

5	**Condition Assessment Program & Data Capture (Water Distribution)**	Outline a program to perform targeted condition assessments on critical watermains. This will involve outlining which pipelines are necessary for reoccurring inspection, which pipelines should be inspected based on priority to manage risk and determining what the appropriate technologies are for inspecting each pipeline according to its size, material, and surroundings. Based on the identified gaps and necessary assumptions carried into the AMP, it is recommended this program be derived and then initiated early 2020 with critical watermains being assessed in the next 8 – 10 months.	3-4 Months (Program) 8-10 Month (Condition Assessments)
6	**Inventory and Assessment of Sub-Asset Categories**	Those assets associated with the larger asset classes completed within the AMP include: ➢ Ditches ➢ Sidewalks ➢ Streetlights ➢ Water Valves / Chambers ➢ Bulk Water Stations ➢ Water Sampling Stations ➢ Water Hydrants (if not already completed within the hydrant testing program in the Town's Work Order Management System) An individual inventory and condition assessment is recommended for each of these asset groups to identify the Town's assets within these sub categories as well as verify the condition of these assets. It is further recommended this analysis be completed for the remaining asset categories the Town is responsible for (For example, park assets etc.)	2-3 yrs
7	**Ongoing Data Capture & Information Updates**	Reoccurring updates to the asset inventories (addition of assets, retiring of assets, edits, etc.), addition of condition, capacity, and replacement cost data on assets already defined/captured to ensure information is maintained. This will be required for all asset groups. It should be noted the following asset groups were identified to have high confidence levels and are only recommended for revisions to data and additional data collection (i.e. unit cost assignments during the next iteration of the assets assessments): ➢ Roads ➢ Bridges ➢ Facilities	Continuous

The following roadmap outlines a recommended five-year strategy for augmenting these data gaps.

Figure 1: Recommendations Roadmap



APPENDIX A: Network Validation Methodology & Results

1. NETWORK DATA REVIEW

The network data review consisted of analyzing the road, water, sanitary, and stormwater linear GIS data using a standard validation process that is typically completed as part of a model development process. This process involves running each line or point feature through a series of checks, as outlined in Table A1. If a point or line does not satisfy a check, that object is flagged by setting the corresponding flag field to 1, otherwise it is left empty. Each feature can be flagged for multiple checks.

For error checks 1-19, they must be performed in the order outlined in Table A1 and it is assumed when proceeding to the next error check that all previous error checks have been satisfied or resolved. Flags 20 and 21 were developed separately and for road networks in particular, so their order is not important.

1.1 Field Descriptors – Order of Importance

Each error flag is rated based on its importance for the data set. While data integrity related to topology errors is incredibly important for modelling, there are many other reasons for having accurate topology data such as:

- Ensuring the data record accurately identifies each asset's location
- Identifying likely areas where assets have not been input into the GIS layer
- Use in obtaining accurate flow monitoring catchments
- Ensuring that field crews know precisely where each asset is located
- Etc.

The following list details the order of importance for each value in the [Order of Importance] field recorded in Table A1:

D – High data error. Cannot be assumed/inferred. Has high potential for significant impacts on system performance.

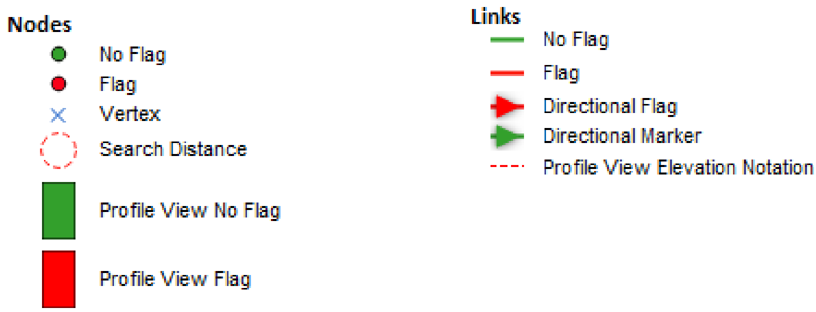
1 – High potential error. Cannot be assumed/inferred. Has medium potential for significant impacts on system performance.

2 – Medium potential error. Can be assumed/inferred. Low potential for significant impacts on system performance. Should review any area of high importance or with borderline results.

3 – Low potential error. Can be assumed/inferred. Low/no potential for significant impacts on system performance

1.2 Field Descriptors – Visual Representation

As a visual aid, a visual representation of each error flag is displayed in Table A1. The following legend summarizes which information is presented in the [Visual Representation] field for each error flag:



1.3 Field Descriptors – Potential Action

For each error flag, GM BluePlan (GMBP) has outlined one or more solutions. For example, error flag 6 can be resolved by adding the correct point to the source GIS. In Table A1 the column [Potential Action] will detail the actions to potentially resolve the error flag.

Note that while all checks described in the table are potential errors, several of the flags listed have the potential of being non-erroneous. For example, a pipe might have an inverted slope because of soil around the pipe having settled post-installation. In that example the error flag scripts will identify the error even though the data is accurately representing reality. As a result, each of the flags listed should be validated by reviewing the as-built drawings or conducting field inspections before being corrected where needed.

Table A1. Network Data Review Standard Validation Process

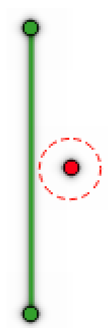
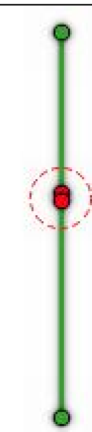
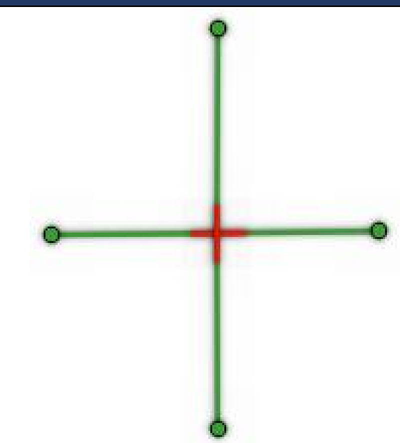
<table>
<tr><th>Flag #</th><th>Order of Importance</th><th>Description of Error Check</th><th>Visual Representation</th><th>Potential Action</th><th>Asset Class Using The Data Check</th></tr>
<tr><td>1</td><td>D</td><td>Check for duplicate element IDs:
• Lines and points are flagged for validation
• May be an indication of:
  ○ Duplicate line
  ○ Duplicate point
  ○ Mislabeled line
  ○ Mislabeled point</td><td>
</td><td>• Correct attribution error in source GIS.</td><td>• Sanitary
• Storm
• Water</td></tr>
<tr><td>2</td><td>3</td><td>Check that the non-elevation attributes for both lines and points are not blank or missing:
• Points and lines are flagged for validation
• May be an indication of:
  ○ Incorrect line attributes
  ○ Incorrect point attributes
  ○ Data entry error
  ○ Lack of sufficient data
• Erroneous data element</td><td><table><tr><th>AssetID</th><th>Diameter (mm)</th><th>Material</th></tr><tr><td>SL4-SA00-0270</td><td>600</td><td>CONC</td></tr><tr><td>SL4-SA00-0260</td><td>600</td><td>CONC</td></tr><tr><td>SL4-SA00-0210</td><td>0</td><td>CONC</td></tr><tr><td>SL4-SA00-0280</td><td>600</td><td>CONC</td></tr><tr><td>SL4-SA00-0200</td><td>450</td><td>CONC</td></tr><tr><td>SL4-SA00-0190</td><td>450</td><td>CONC</td></tr></table></td><td>• Configuration and attribution to be manually verified against as-built drawing and/or with OPS staff where available/appropriate.</td><td>• Sanitary
• Storm
• Water</td></tr>
<tr><td>3</td><td>2</td><td>Check for disconnected (orphan) points:
• Checks for points further than a set search distance away from any line.
• Points are flagged for validation
• May be an indication of:
  ○ Mislabeled point type (e.g. Air Release Valve labelled as manhole)
  ○ Point in the incorrect location
  ○ Missing pipe
  ○ Duplicate point
  ○ Line missing US/DS point reference</td><td></td><td>• Clean source GIS.
  ○ Delete excess points and/or fix point reference if lineed to pipe.</td><td>• Sanitary
• Storm
• Water</td></tr>
<tr><td>4</td><td>2</td><td>Check for points in close proximity/overlapping points:
• Check for points closer than a set search distance away from another point
  ○ Default search distance of 1m
• Points are flagged for validation
• May be an indication of:
  ○ Duplicate point
  ○ Point in the incorrect location
  ○ Erroneous data element</td><td></td><td>• Flag actual real instances
• Merge overlapping points and correct point reference in source GIS.</td><td>• Sanitary
• Storm
• Water</td></tr>
</table>

Table A1. Network Data Review Standard Validation Process

Flag #	Order of Importance	Description of Error Check	Visual Representation	Potential Action	Asset Class Using The Data Check

5	1	Check for intersecting lines:
		• Lines are flagged for validation
		• May be an indication of:
		  ○ Line in the incorrect location (drawn incorrectly)
		  ○ Missing point
		  ○ Erroneous data element
				• Flag actual real instance
				• Insert point and split pipe
				  ○ Requires new pipe IDs
				  ○ Correct in source GIS
					• Sanitary
					• Storm
					• Water

6	D	Check for lines spatially missing US/DS points:
		• Check for lines which have no manholes within a set search distance of their start/end points
		  ○ Default search distance of 1m
		  ○ Does not check attribute data
		• Lines are flagged for validation
		• May be an indication of:
		  ○ Mislabeled line type (e.g. service labelled as main)
		  ○ Line in the incorrect location
		  ○ Point in the incorrect location
		  ○ Missing point
		  ○ Erroneous data element
				• Add point to source GIS	• Sanitary
					• Storm
					• Water

7	D	Check spatially that line start/end point IDs match the listed point IDs in the attribute data:
		• Lines are flagged for validation
		• May be an indication of:
		  ○ Outdated line data
		  ○ Missing point
		  ○ Mislabeled point
		  ○ Missing line
		  ○ Mislabeled line
		  ○ Overlapping point
		  ○ Erroneous data element
				• Correct point reference in source GIS	• Sanitary
					• Storm
					• Water

Table A1. Network Data Review Standard Validation Process

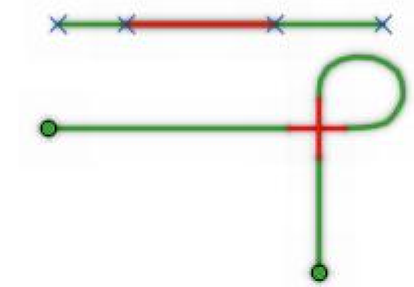
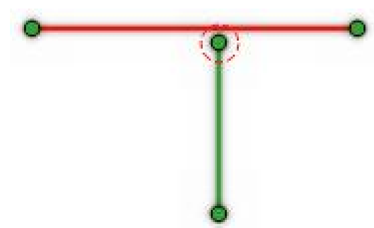
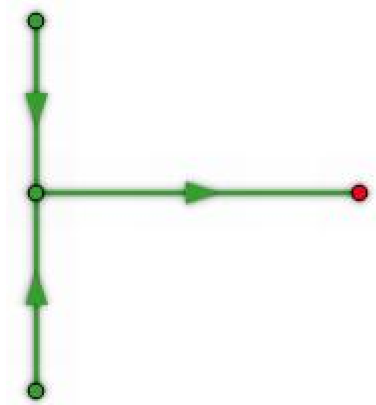
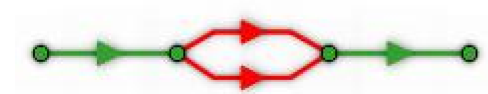
Flag #	Order of Importance	Description of Error Check	Visual Representation	Potential Action	Asset Class Using The Data Check
8	D	Check for self-intersecting or self-overlapping lines: • Lines are flagged for validation • May be an indication of: ○ Line is drawn incorrectly ○ Missing point ○ Missing line ○ Erroneous data element		• Add point to source GIS • Remove excess vertices from line in source GIS	• Sanitary • Storm • Water
9	1	Check for line split candidates: • Line that nearly connects to another line but doesn't quite fully connect ○ Default search distance of 0.5m • Lines are flagged for validation • Potential representation of actual configuration • May be an indication of: ○ Mislabeled line type (e.g. service labelled as a main) ○ Line in the incorrect location ○ Missing point ○ Line element missing US/DS point reference ○ Erroneous data element		• Cross check against as-built drawings • Flag actual real instance • Correct in source GIS ○ Insert point and split pipe ○ Requires new pipe IDs	• Sanitary • Storm • Water
10	D	Line not spatially snapped to its referenced US/DS points: • Lines are flagged for validation • May be an indication of: ○ Line in the incorrect location ○ Point in the incorrect location ○ Outdated line data ○ Missing line ○ Missing point ○ Erroneous data element		• Correct source GIS ○ Snap point to end of line	• Sanitary • Storm • Water

Table A1. Network Data Review Standard Validation Process

Flag #	Order of Importance	Description of Error Check	Visual Representation	Potential Action	Asset Class Using The Data Check

11	1	Point not referenced by a downstream line:
		• Want to ensure that these points are all connected to outfall pipes, wastewater treatment plants, etc.
		• Points are flagged for validation
		• May be an indication of:
		  ○ Outdated point data
		  ○ Outdated line data
		  ○ Missing line
		  ○ Incorrect line point reference
		  ○ Incorrect point ID
		  ○ Erroneous data element
				• Confirm if point is an outlet from drawing
				  ○ If not, need to correct source GIS
					• Sanitary
					• Storm
					• Water

12	2	Check for parallel lines:
		• Lines with identical or opposite US/DS point references
		• Lines are flagged for validation
		• Potential representation of actual configuration
		• May be an indication of:
		  ○ Parallel line
		  ○ Incorrect line US/DS reference
		  ○ Incorrect point ID
		  ○ Outdated line data
		  ○ Outdated point data
		  ○ Erroneous data element
				• Confirm if duplicate pipe from drawings
				  ○ Delete incorrect pipe in source GIS
					• Sanitary
					• Storm
					• Water

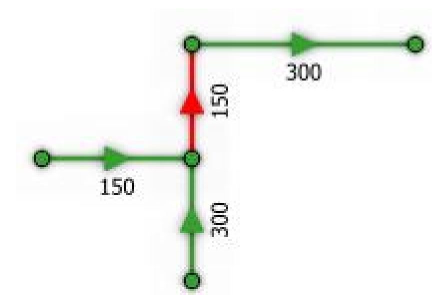
13	2 for Sanitary and Storm
	
	3 for Water
		Check for line diameter discrepancy:
		• Ensure the diameter of the upstream pipe is less than or equal to the diameter of the pipe being validated
		• Lines are flagged for validation
		• Potential representation of actual configuration
		• May be an indication of:
		  ○ Mislabeled line type (e.g. forcemain labeled as gravitymain)
		  ○ Line in the incorrect location
		  ○ Incorrect line US/DS point reference
		  ○ Outdated line data
		  ○ Erroneous data element
				• Confirm pipe diameter from drawings
				  ○ Update diameter in source GIS
					• Sanitary
					• Storm
					• Water
					  ○ Note that Water assets are having their diameter checked in the opposite direction (i.e. ensure the diameter of the downstream pipe is less than or equal to the diameter or the pipe being validated). Since Water is a pressurized system, this check is not as important.

Table A1. Network Data Review Standard Validation Process

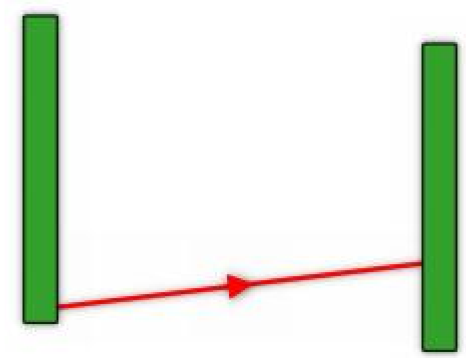
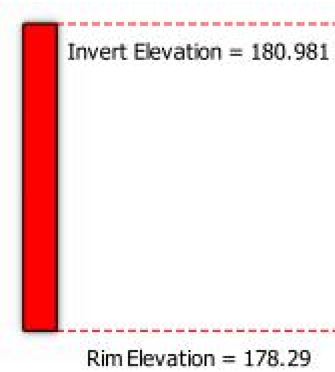
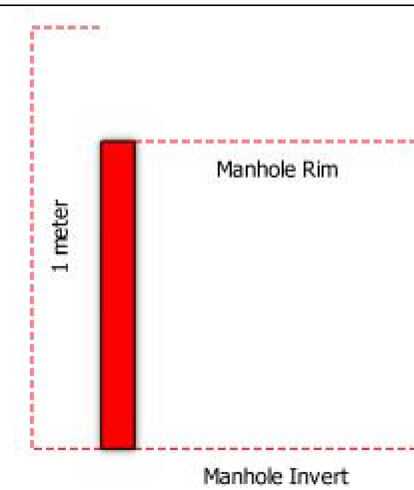
Flag #	Order of Importance	Description of Error Check	Visual Representation	Potential Action	Asset Class Using The Data Check
14	1	Check for line elevation discrepancy: • Ensure that line US elevation > DS Elevation • Lines are flagged for validation • Potential representation of actual configuration • May be an indication of: ○ Mislabeled line type (e.g. forcemain labeled as gravitymain) ○ Incorrect US/DS elevation ○ Incorrect line US/DS reference ○ Outdated line data ○ Erroneous data element		• Confirm pipe inverts from drawings ○ Update source GIS	• Sanitary • Storm
15	1	Check that point invert elevation is less than rim elevation: • Points are flagged for validation • May be an indication of: ○ Incorrect invert/rim elevation ○ Outdated point data ○ Erroneous data element		• Confirm point invert & rim elevations ○ Update source GIS	• Sanitary • Storm
16	2	Check that the elevation difference between each point rim and invert is greater than 1 meter: • 1 meter is a variable that can be changed • Points are flagged for validation • Potential representation of actual configuration • May be an indication of: ○ Incorrect invert/rim elevation ○ Outdated point data ○ Erroneous data element		• Confirm point invert & rim elevations ○ Update source GIS	• Sanitary • Storm

Table A1. Network Data Review Standard Validation Process

Flag #	Order of Importance	Description of Error Check	Visual Representation	Potential Action	Asset Class Using The Data Check

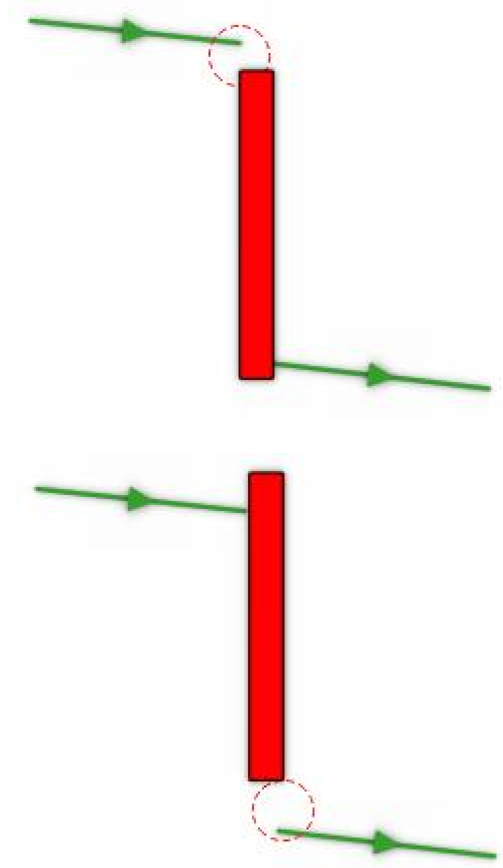
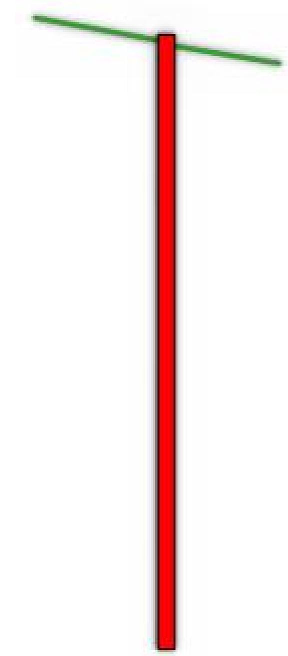
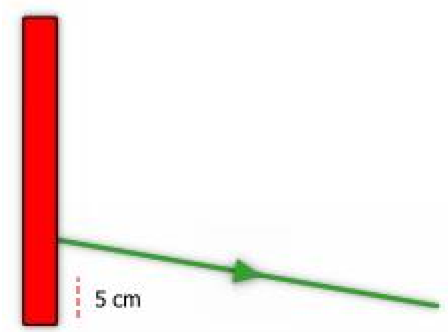
17	1	Check that the inflow and outflow pipe elevations lie within the manhole:
		• Ensure that the manhole invert is at a lower elevation than the invert of the US & DS pipes
		• Ensure that the manhole rim is at a higher elevation than the top of the US & DS pipes (i.e. the pipe invert elevation + the pipe diameter)
		• Points are flagged for validation
		• May be an indication of:
		  ○ Incorrect line US/DS reference
		  ○ Incorrect line US/DS elevations
		  ○ Incorrect point invert/rim elevations
		  ○ Outdated line data
		  ○ Outdated point data
		  ○ Erroneous data element
				• Confirm point invert & rim elevations
				  ○ Update source GIS
					• Sanitary
					• Storm

Table A1. Network Data Review Standard Validation Process

Flag #	Order of Importance	Description of Error Check	Visual Representation	Potential Action	Asset Class Using The Data Check

18	3	Check that the elevations for both lines and points does not equal zero:
		• Points and lines are flagged for validation
		• May be an indication of:
		  ○ Incorrect line elevation
		  ○ Incorrect point elevation
		  ○ Erroneous data element
				• Confirm point invert & rim elevations
				• Update source GIS
				  ○ Snap point invert to the DS line's US invert elevation
					• Sanitary
					• Storm

19	3	Check that the US elevation of each pipe is close to the manhole chamber floor:
		• Ensure that each point invert elevation is within 5 cm of their DS line invert elevation
		• Points are flagged for validation
		• May be an indication of:
		  ○ Incorrect line elevation
		  ○ Incorrect point invert elevation
		  ○ Outdated line data
		  ○ Outdated point data
		  ○ Erroneous data element
				• Confirm point invert & rim elevations
				• Update source GIS
				  ○ Snap point invert to DS line invert
					• Sanitary
					• Storm

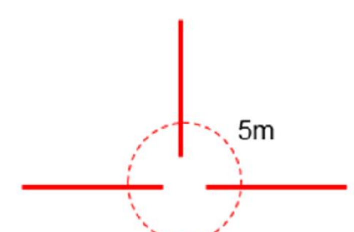
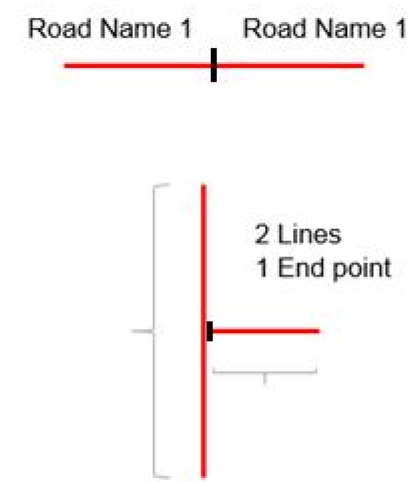
20	N/A	Check that road lines are connected(snapped): • Flag roads where at least one end is within 5m of another road end, but they are not snapped together.		• Confirm instersections where lines should be snapped • Snap end points	• Roads

Table A1. Network Data Review Standard Validation Process

Flag #	Order of Importance	Description of Error Check	Visual Representation	Potential Action	Asset Class Using The Data Check
21	N/A	Check that road segments are broken up correctly (go from intersection to intersection): • Check that the number of end points at an intersection equals the number of lines (5m radius used). • Check that a continuous road that has been broken into segments without an intersection has different street names for each segment. • Roads are flagged where at least one end of the segment does not meet these criteria.		• Review each flagged intersection • Update segments so they are only split at intersections or where road names change	• Roads

2. FINDINGS

The detailed results of the network validation have been provided to the Town through updated shapefiles of the networks with additional flag fields for each check. A summary of the number of points and lines that were found to have each applicable type of issue flag are outlined in Table A2 and Table A3 below.

Table A2: Network Validation Findings Summary (Flags 1 – 9)

Asset Group	Geometry Type	Total # of Lines / Points	# of Lines / Points Flagged	Flag 1	Flag 2	Flag 3	Flag 4	Flag 5	Flag 6	Flag 7	Flag 8	Flag 9
Roads	Lines	1863	1783	2	1	-	-	567	-	-	2	1528
Sanitary	Lines	2874	501	6	10	-	-	78	50	231	0	70
	Points	2826	2826	6	5	1	4	-	-	-	-	-
Storm	Lines	3627	3627	1390	1398	-	-	894	2010	2155	0	2383
	Points	2093	2093	110	197	101	2	-	-	-	-	-
Water	Lines	1664	1381	32	913	-	-	163	373	411	0	627
	Points	1253	212	75	0	2	4	-	-	-	-	-

Table A3: Network Validation Findings Summary (Flags 10 – 21)

Asset Group	Geometry Type	Flag 10	Flag 11	Flag 12	Flag 13	Flag 14	Flag 15	Flag 16	Flag 17	Flag 18	Flag 19	Flag 20	Flag 21
Roads	Lines	-	-	-	-	-	-	-	-	-	-	1768	249
Sanitary	Lines	241	-	21	39	155	-	-	-	116	-	-	-
	Points	-	78	-	-	-	61	61	77	2826	2661	-	-
Storm	Lines	3326	-	1398	1482	3627	-	-	-	3627	-	-	-
	Points	-	12	-	-	-	2093	2093	2083	2093	0	-	-
Water	Lines	560	-	66	339	-	-	-	-	-	-	-	-
	Points	-	135	-	-	-	-	-	-	-	-	-	-

3. GIS MAPS

The network data review standard validation process was completed on the available road, water, sanitary, and storm data given by the Town of Fort Erie. The resulting data used to make these maps will be provided as shapefiles of the provided GIS data with additional fields for each error check flag. Error flags numbered 14 to 19 were only applicable to sanitary and storm data. Error flags numbered 1 to 13 were applicable to water, sanitary and storm data. The error flags relevant to the roads data were flags 1, 2, 5, 8, 9, 20 and 21.

3.1 Water Network

The water network data review was completed by evaluating the data with error flags 1 through 13. Two GIS maps were created to map the error flags for the points and mains (lines) data (Figure 1 & 2 at the end of this appendix). Each map has categorized each asset into two groups: with error flags and without error flags. The results of mapping the water main error flags shows that the majority of water mains contain errors. Most lines that are error free are scattered throughout the Town, however there are several areas where lines with no error flags are grouped together. This may be a result of a change in the digitization process, and further evaluation from the Town of Fort Erie may provide insight on this occurrence. For water points, the results of mapping the error flags show that a majority of water points do not contain errors and that the errors are evenly dispersed throughout the network.

3.2 Sanitary Network

The sanitary network data review was completed by evaluating the data with error flags 1 through 19. A GIS map was created to map the error flags for sanitary lines (mains). The map categorized individual assets into two groups: with error flags and without error flags. The findings after mapping the sanitary sewer error flags showed that error flags were evenly spread throughout the sanitary network. However, there is an area in Fort Erie located near the QEW (Queen Elizabeth Way Highway) on the Niagara Falls and Fort Erie border where a large cluster of lines and points had errors flagged. This area is suspected to be a new subdivision and likely has not had its data input into the GIS yet. A map showing these error flags can be found in Figure 3 at the end of this appendix.

While the sanitary lines tended to have a sporadic distribution of errors throughout the network, every sanitary point was flagged for data errors. This was caused by flag 18 and was a result of none of the manholes having documented invert elevations. Interestingly, when flags 18 and 19 were ignored, every point which had an error corresponded to a line which also had an error. Due to this correlation, a map of the sanitary manholes was not provided.

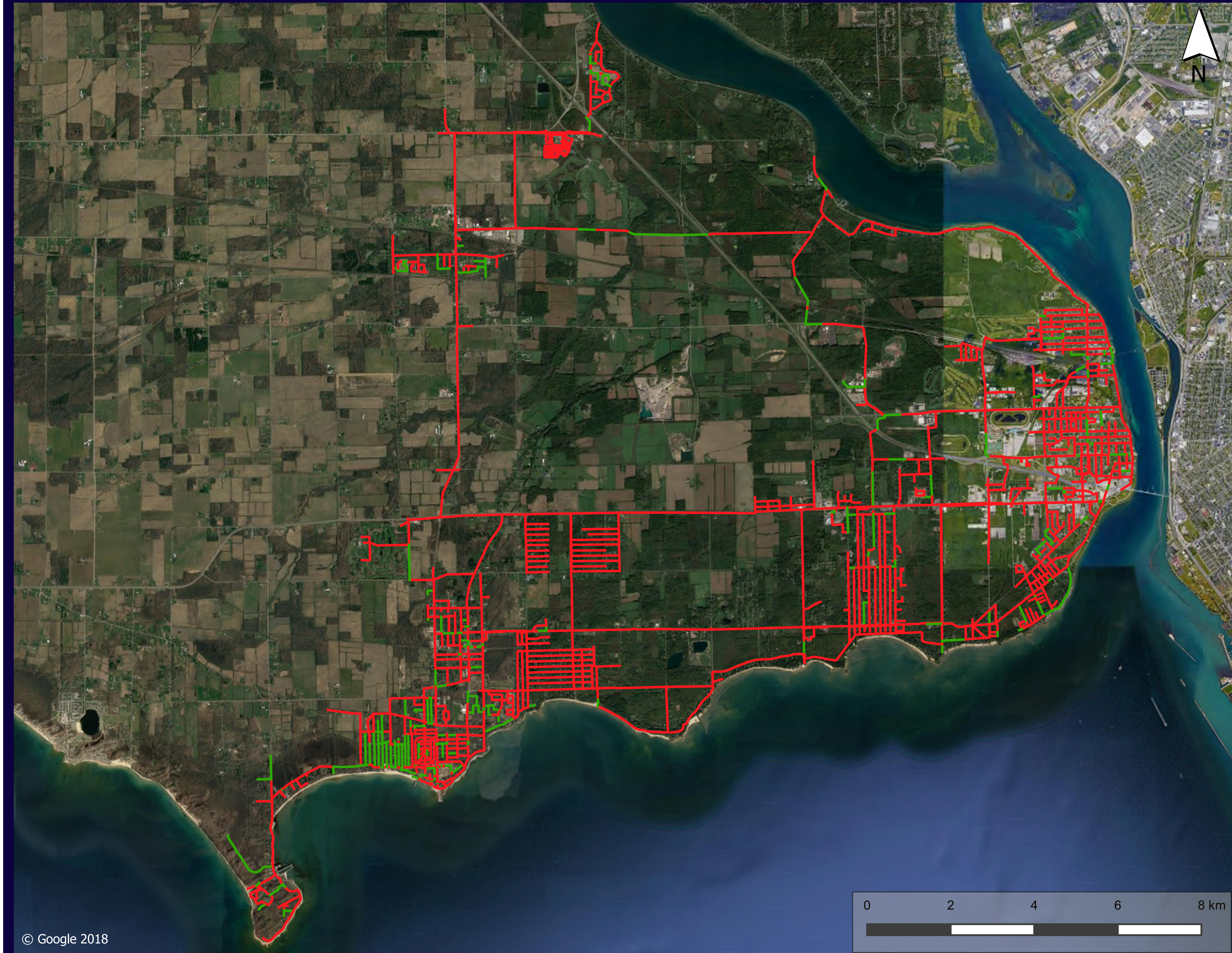
Overall, the spatial information pertaining to the X and Y coordinates (latitude and longitude) of each line and point in the system was well documented. However, the information pertaining to the Z coordinates (elevation) of the points was significantly lacking.

3.3 Storm Network

The storm network data review was completed by evaluating the data with error flags 1 through 19. A GIS map was created to map the error flags for storm sewers and can be found in Figure 3 at the end of this appendix. The map categorized individual assets into two groups: with error flags and without error flags. The map did not generate any patterns in the errors as the entire data set was flagged with errors and contained many data gaps (missing points and lines). The storm map shows the low competency of the storm data and the need for confident and mature storm data.

3.4 Road Network

The road network data review was completed by evaluating the lines data with error flags 1, 2, 5, 8 and 9, as well as the additional flags 20 and 21 developed specifically for roads. A GIS map was created to map the error flags for roads and can be found in Figure 4 at the end of this appendix. The map categorized individual assets into two groups: with error flags and without error flags. The map shows that the majority of the data has error flags and that the roads in rural areas have fewer errors than those in urban areas. The roads map shows the low competency of the topology data and the need for object snapping.



FORT ERIE
ONTARIO

Town of Fort Erie AMP

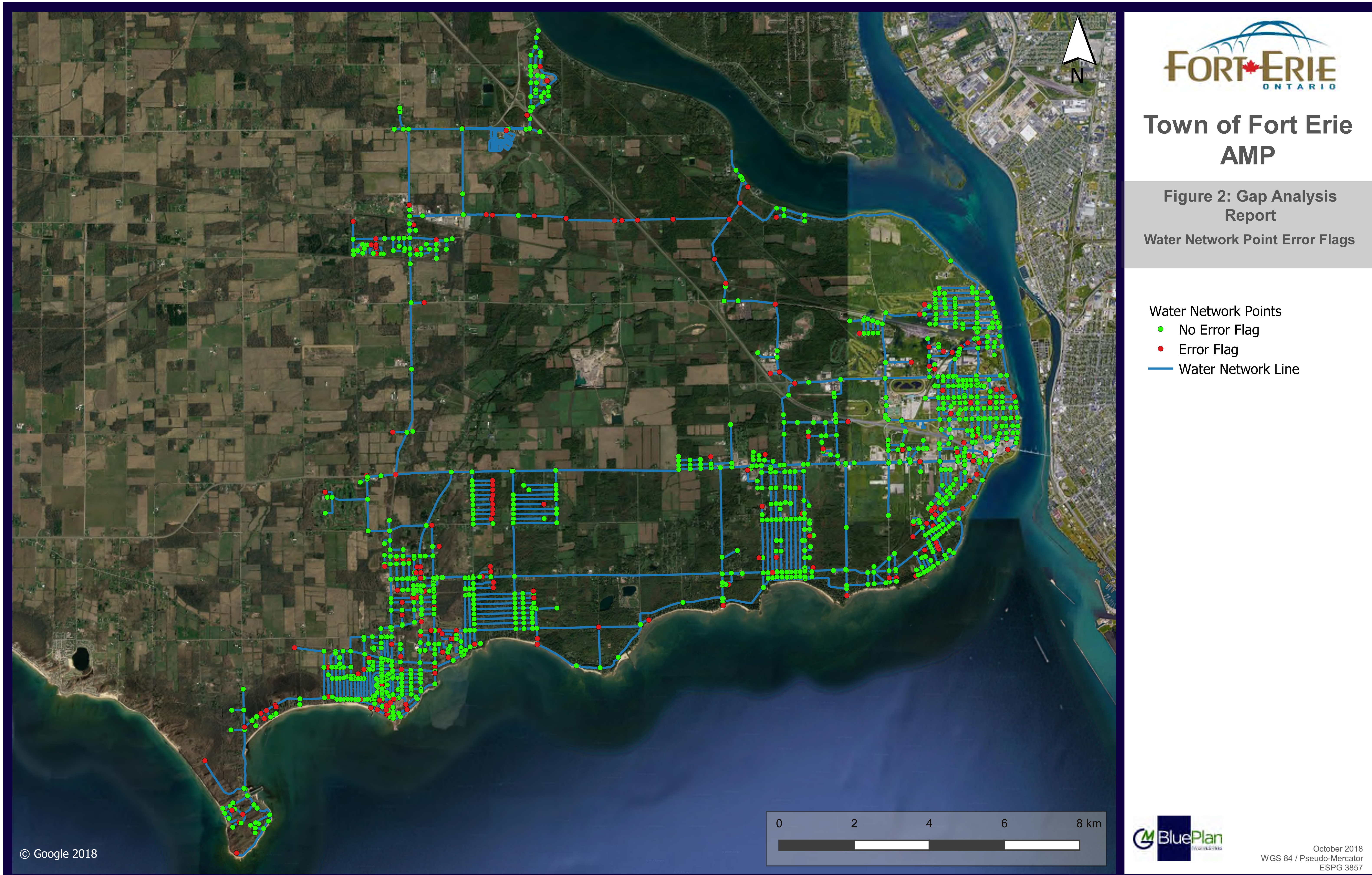
Figure 1: Gap Analysis Report

Water Network Lines Error Flags

Water Network Lines
No Error Flag
Error Flag

BluePlan

October 2018
WGS 84 / Pseudo-Mercator
ESPG 3857



FORT ERIE
ONTARIO
Town of Fort Erie
AMP
Figure 2: Gap Analysis Report
Water Network Point Error Flags
Water Network Points
No Error Flag
Error Flag
Water Network Line
N
0
2
4
6
8 km
© Google 2018
BluePlan
October 2018
WGS 84 / Pseudo-Mercator
ESPG 3857

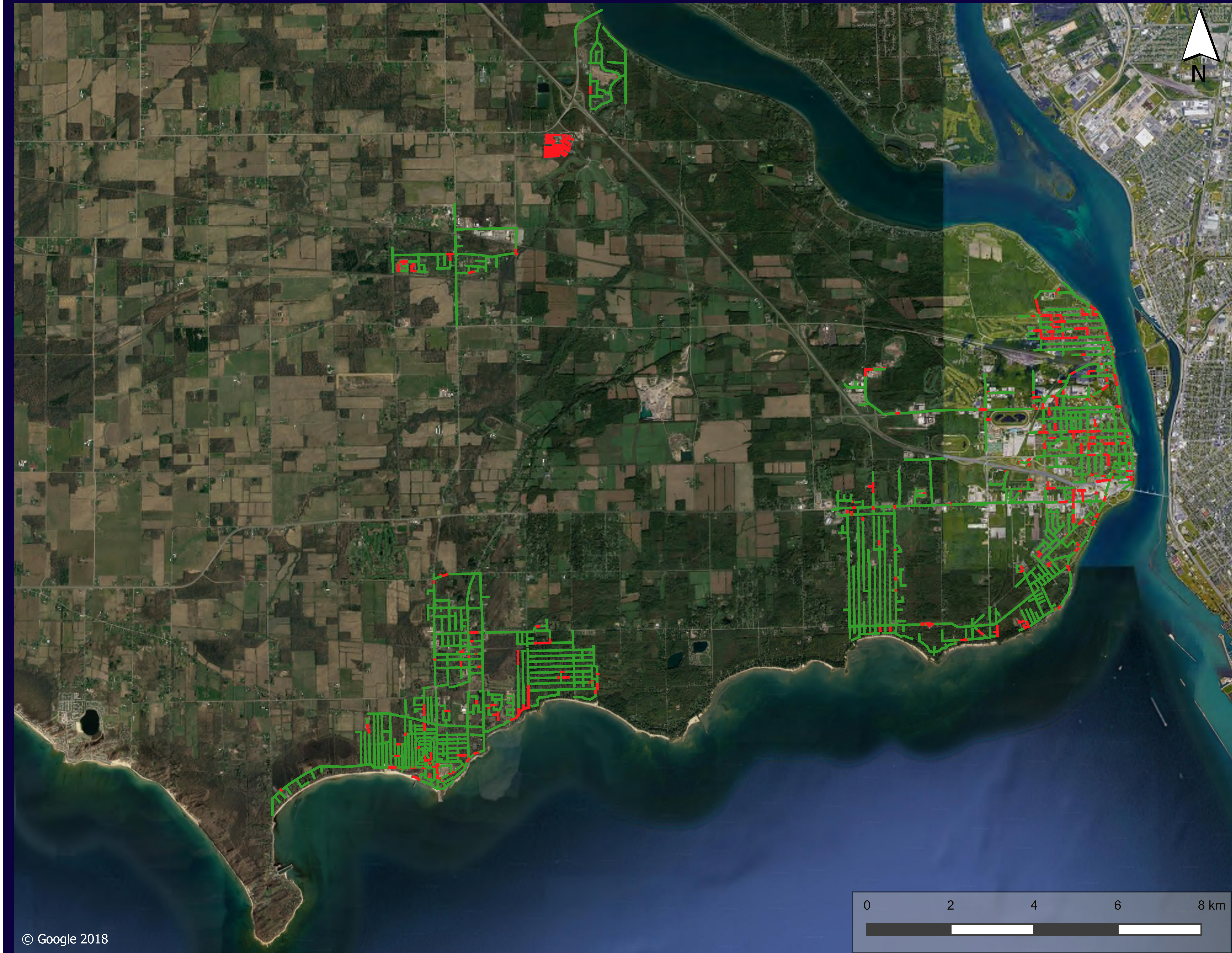


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Figure 3: Gap Analysis Report

Sanitary Network Line Error Flags

Sanitary Network Lines
- No Error Flag
- Error Flag

BluePlan

October 2018
WGS 84 / Pseudo-Mercator
ESPG 3857

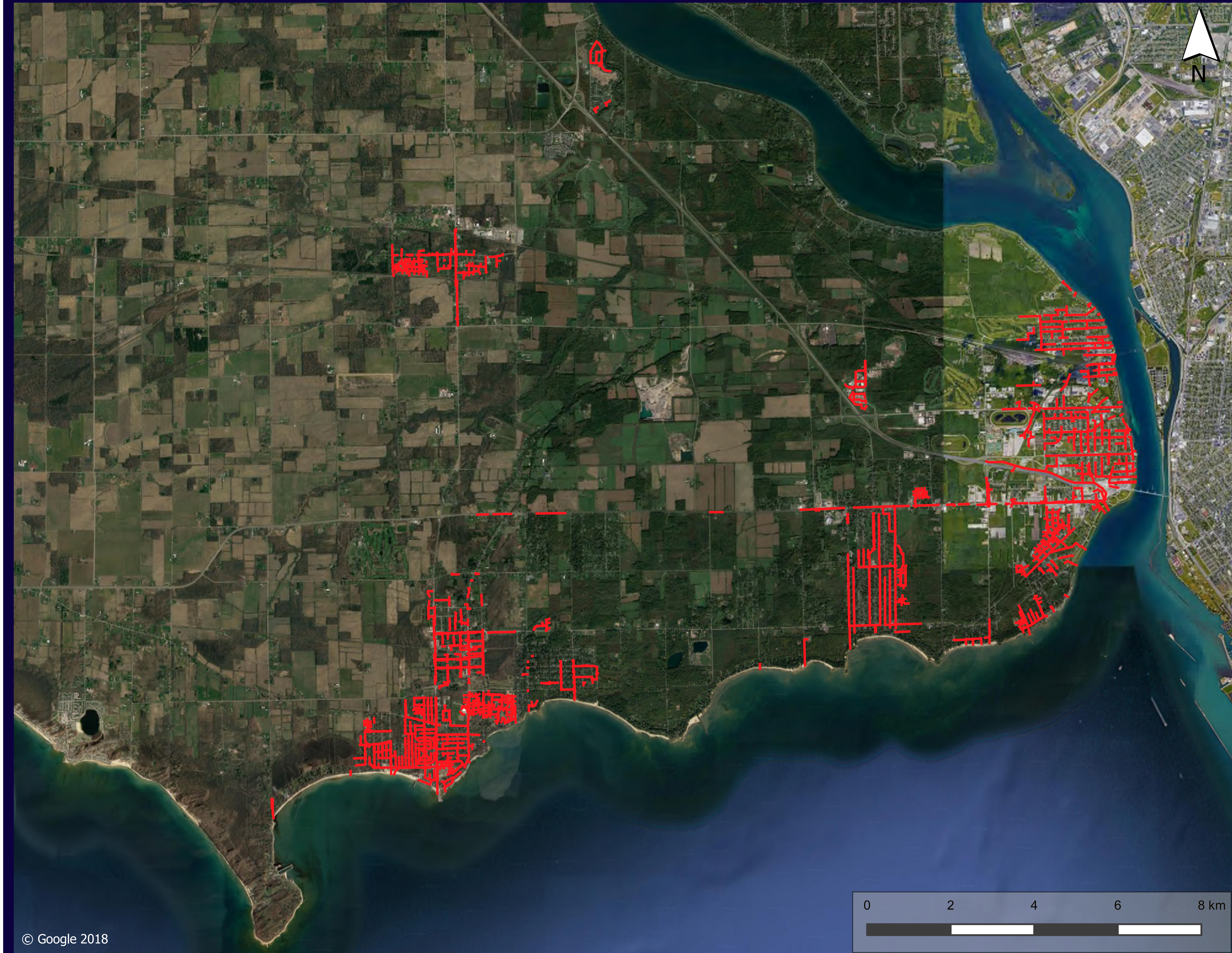

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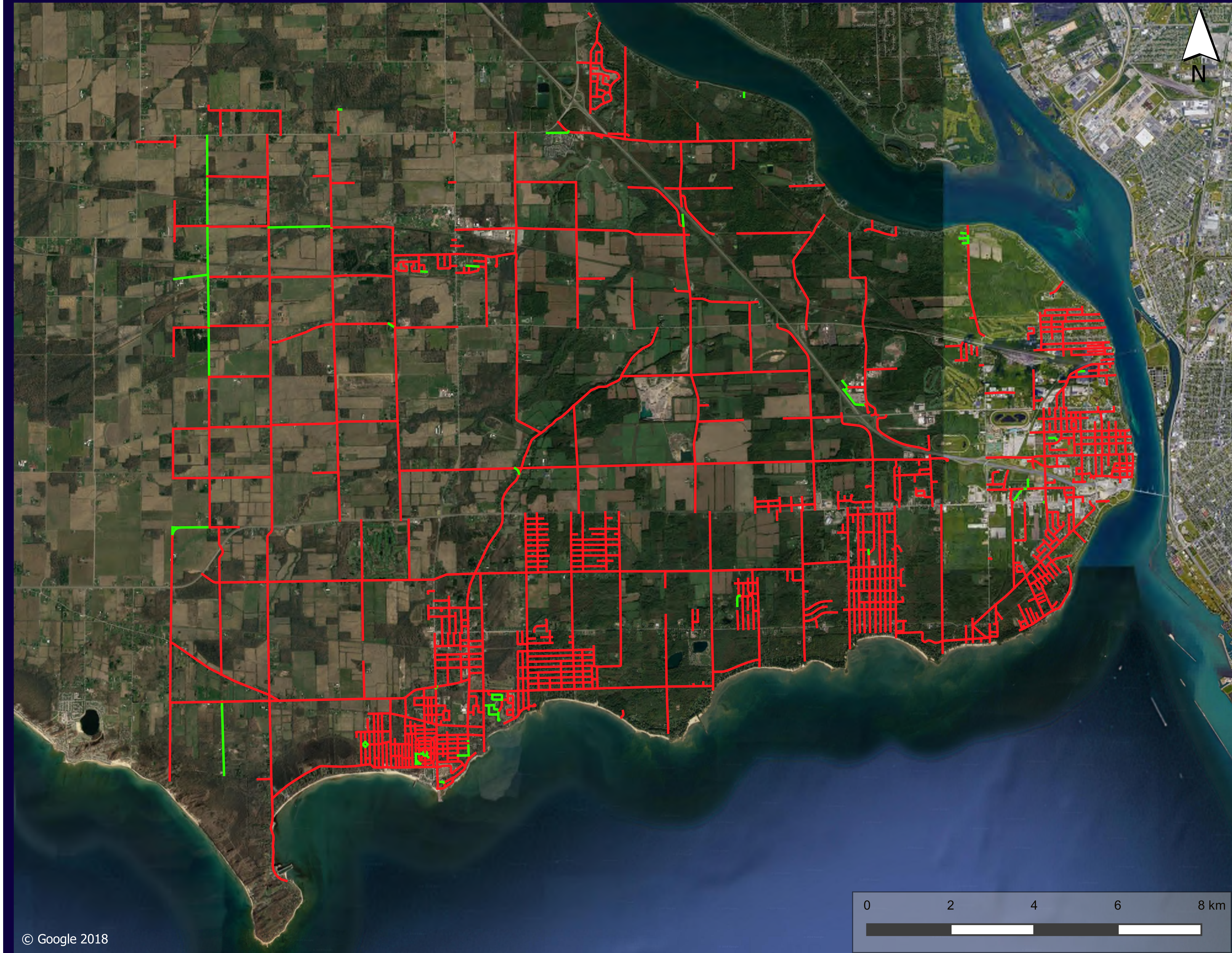
Figure 4: Gap Analysis Report

Storm Network Line Error Flags

Storm Network Lines
No Error Flag
Error Flag

BluePlan

October 2018
WGS 84 / Pseudo-Mercator
ESPG 3857



Town of Fort Erie AMP

Figure 5: Gap Analysis Report

Road Network Line Error Flags

Road Network Lines
- No Error Flag
- Error Flag

October 2018
WGS 84 / Pseudo-Mercator
ESPG 3857

APPENDIX B: Data Completion, Maturity and Confidence Results

Asset Class / Inventory Type Overview

Asset Class	Geometry	Critical % Filled	Critical Maturity	Total % Filled	Total Maturity	Comments
Roads	Line	92%	Good	72%	Good	No replacement costs or ESL. Low confidence in installation dates. 1 duplicate in ID field.
Streetlights	Point	89%	Good	72%	Good	No replacement costs, ESL or condition information. Low confidence in installation dates.
Sidewalks	Line	100%	Good	96%	Good	No ID field, replacement costs, installation dates or ESL.
Sanitary Maintenance Holes	Point	99%	Good	99%	Good	No replacement costs, ESL or condition information. 3 duplicates in ID field.
Sanitary Sewer Line	Line	89%	Good	74%	Good	No replacement costs, ESL or condition information. Majority of up and downstream invert measurements 0.
Storm Manholes	Point	51%	Fair	40%	Fair	No replacement costs, ESL or condition information. Low confidence in installation dates. Some records without IDs.
Storm Sewers	Line	62%	Fair	40%	Fair	No replacement costs, ESL or condition information. Many critical fields are missing approximately 40% of their data, including installation year and the ID field.
Water Hydrants	Point	51%	Fair	57%	Fair	No replacement costs or ESL. Some condition related fields and an installation date field but they are empty or almost empty. 19 duplicates in ID field.
Water Mains	Line	90%	Good	75%	Good	No replacement costs, ESL or condition information. Only have age ranges rather than specific installation dates for most records. 5 duplicates in ID field.
Water Valves	Point	35%	Fair	36%	Fair	No replacement costs, installation dates or ESL. Condition field is almost empty and not using a 1-5 scale. 4 duplicates in ID field.
Facilities	N/A	100%	Good	43%	Fair	No Unique ID field. Contains costs, but only some are for replacement.
Bridges and Culverts - Asset Management Forecaster	N/A	100%	Good	99%	Good	No ESL field. Most installation dates “Unknown”.
Bridges and Culverts - Inspections	N/A	81%	Good	64%	Fair	No ESL and some cost fields but only some costs are for replacement. Most installation dates “Unknown”. 4 duplicates in ID field.
Asset Navigator / Financial Data	N/A	75%	Good	77%	Good	Contains replacement costs, however these are at a higher level than assets, and are older estimates which FE has low confidence in.
Customer Complaints	N/A	82%	Good	70%	Good	Many duplicate IDs (often if there is the same record open and closed). Lack of information confirming the cause of the complaint and whether it resulted in infrastructure improvements. Category field inconsistent.

Asset Class Roads
File Name TOFE-ROAD MANAGEMENT INVENTORY-LINE.shp
# of Records 1863

Field Name	Type	Length	# Filled	% Filled	Maturity Rating	Confidence Rating	Criticality Rating	Confidence Notes
CONTROLCOD	String	254	1,740	93.4%	Good	Medium		
ROADSECTIO	Integer64	18	1863	100.0%	Good	Medium	Critical	1 Duplicate ID (2 records)
ROADNAME	String	254	1,863	100.0%	Good	Medium	Critical	
ROADFROM	String	254	1,862	99.9%	Good	Medium	Critical	
ROADTO	String	254	1,862	99.9%	Good	Medium	Critical	
yearroadco	Integer64	18	1,862	99.9%	Good	Low	Critical	320 records with construction dates in the 1800s
lanemeters	Integer64	18	1,862	99.9%	Good	Medium	Critical	
SECTIONLEN	Integer64	18	1,862	99.9%	Good	Medium		
DRAINAGETY	String	254	1,841	98.8%	Good	Medium		
ROADSIDEEN	String	254	1,842	98.9%	Good	Medium		
EXISTINGCL	String	254	1,847	99.1%	Good	Low		Records contain text or numbers
NUMBEROFLA	Integer64	18	1,852	99.4%	Good	Medium	Critical	
SURFACETYP	String	254	1,853	99.5%	Good	Medium	Critical	
PLATFORMWI	Integer64	18	1,401	75.2%	Good	Medium		
SURFACEWID	Real	17	1,848	99.2%	Good	Medium	Critical	
MEDIANWIDT	Integer64	18	6	0.3%	Good	Low		Field is mostly empty
SHOULDERTY	String	254	1,839	98.7%	Good	Medium		
SHOULDERWI	Real	17	1,863	100.0%	Good	Medium		
CURBTYPERI	String	254	1,838	98.7%	Good	Medium		
CURBTYPER1	String	254	1,838	98.7%	Good	Medium		
POSTEDSPEE	Integer64	18	1,847	99.1%	Good	High	Critical	
TRAFFICOPE	String	254	1,846	99.1%	Good	Medium		
TRAFFICCOU	Integer64	18	1,812	97.3%	Good	Medium		
PRESENTTRA	Integer64	18	1,812	97.3%	Good	Medium		
ROADWAYCLA	String	254	1,849	99.2%	Good	Medium		
SURFACECON	Integer64	18	1,792	96.2%	Good	Medium		
SHOULDERW1	Integer64	18	1,285	69.0%	Good	Medium		
SURFACEWI1	Integer64	18	1,715	92.1%	Good	Medium		
2008roadba	Integer64	18	14	0.8%	Poor	Low		Field is mostly empty
2008roadsu	Integer64	18	44	2.4%	Poor	Low		Field is mostly empty
LEVELOFSER	Integer64	18	1,427	76.6%	Good	Medium		
STRUCTURAL	Integer64	18	1,751	94.0%	Good	Medium		
DRAINAGE	Integer64	18	1,755	94.2%	Good	Medium		
MAINTENANC	Integer64	18	1,752	94.0%	Good	Medium		
STRUCTURA1	Integer64	18	1,762	94.6%	Good	Medium		
STRUCTURA2	String	254	1,755	94.2%	Good	Medium		
DRAINAGEYE	Integer64	18	1,762	94.6%	Good	Medium		
DRAINAGENE	String	254	1,756	94.3%	Good	Medium		
TYPEOFIMPR	String	254	584	31.3%	Poor	Medium		
TIMEOFIMPR	String	254	584	31.3%	Poor	Medium		
COMPLETEDB	String	254	1,752	94.0%	Good	Medium		
RESTONEAND	String	254	141	7.6%	Poor	Low		Field is mostly empty
DOUBLESURF	String	254	0	0.0%	Poor	Low		Field is mostly empty
FULLDEPTHC	String	254	0	0.0%	Poor	Low		Field is mostly empty
MAINTENAN1	String	254	1,428	76.7%	Good	Medium		
MILLANDOVE	String	254	97	5.2%	Poor	Low		Field is mostly empty
PULVERIZEA	String	254	67	3.6%	Poor	Low		Field is mostly empty
PULVERIZE1	String	254	23	1.2%	Poor	Low		Field is mostly empty
SINGLESURF	String	254	0	0.0%	Poor	Low		Field is mostly empty
OTHER	String	254	0	0.0%	Poor	Low		Field is mostly empty
PAVEMENTCO	Real	17	1,619	86.9%	Good	Medium		
REHABILITA	String	254	1,758	94.4%	Good	Medium		
SUGGESTEDR	String	254	1,757	94.3%	Good	Medium		
ChangesApr	String	254	2	0.1%	Poor	Low		Field is mostly empty
OntMunRoad	Integer64	18	1,818	97.6%	Good	Medium		
AADTAug201	Integer64	18	393	21.1%	Poor	Low	Critical	Field is mostly empty
TrafficCo1	String	254	1,835	98.5%	Good	Medium		
TCSpLtAgre	String	254	365	19.6%	Poor	Low		Field is mostly empty
PCIAug3120	Real	17	1,688	90.6%	Good	Medium	Critical	
RiskFactor	Real	17	1,687	90.6%	Good	Medium		

Asset Class Streetlights
File Name TOFE-STREET LIGHT-POINTS.shp
# of Records 4200

Field Name	Type	Length	# Filled	% Filled	Maturity Rating	Confidence Rating	Criticality Rating	Confidence Notes
DESC	String	254	3706	88.2%	Good	Medium		
STREET_NAM	String	254	3,729	88.8%	Good	Medium	Critical	1 records containing "4479"
STREET_NO	String	254	2,629	62.6%	Good	Low	Critical	Some fields contain only numerics while others contain street name
ARM_TYPE	String	254	69	1.6%	Good	Low		Field is mostly empty - may be that there are no arms for majority of lights
LIGHT_ID	Integer64	18	4,200	100.0%	Good	High	Critical	No Duplicates
LIGHT_WATT	Integer64	18	2,989	71.2%	Good	Medium		
LIGHT_OWNE	String	254	4,200	100.0%	Good	Medium	Critical	
POLE_OWNER	String	254	4,188	99.7%	Good	Medium	Critical	
LIGHT_TYPE	String	12	3,010	71.7%	Good	Medium	Critical	
INSTALL_DA	Date	10	4,200	100.0%	Good	Low	Critical	981 records containing "1950-01-01", 1 record containing "1950-10-18"
INSP_DATE	Date	10	4,200	100.0%	Good	Low		926 records containing "1950-01-01", , 1 record containing "1950-10-18"
LIGHT_LOCA	String	254	4,187	99.7%	Good	Medium		
URL	String	254	4,198	100.0%	Good	Medium		
CATALOGUE_	String	254	43	1.0%	Good	Medium		Field is mostly empty
CODE	String	254	43	1.0%	Good	Low		Field is mostly empty

Asset Class Sidewalks
File Name 2018 Sidewalk Inspections.shp
# of Records 5864

Field Name	Type	Length	# Filled	% Filled	Maturity Rating	Confidence Rating	Criticality Rating	Confidence Notes
Width	String	22	5817	99.2%	Good	Medium	Critical	7 records containing "other"
Street	Integer64	18	5859	99.9%	Good	Medium	Critical	
Inspection	String	254	5826	99.4%	Good	Medium		7 records containing "DNI"
Condition	String	254	5857	99.9%	Good	Medium	Critical	1 record containing "3C"
Note	String	254	4914	83.8%	Good	Medium		

Asset Class Sanitary Maintenance Holes
File Name TOFE-SAN MAINTENANCE HOLE-POINT.shp
# of Records 2826

Field Name	Type	Length	# Filled	% Filled	Maturity Rating	Confidence Rating	Criticality Rating	Confidence Notes
LAMID	String	20	2826	100.0%	Good	Medium	Critical	3 Duplicate IDs (7 records), Some IDs are pump station names
InstYear	Real	17	2,821	99.8%	Good	Medium	Critical	
STREET	String	254	2,810	99.4%	Good	Medium		
Owner	String	254	2,823	99.9%	Good	Medium	Critical	
TopElev	String	17	2,765	97.8%	Good	Medium	Critical	

Asset Class Sanitary Sewer Line
File Name TOFE-SANITARY SEWER-LINE.shp
# of Records 2874

Field Name	Type	Length	# Filled	% Filled	Maturity Rating	Confidence Rating	Criticality Rating	Confidence Notes
LENGTH	Real	17	2,867	99.8%	Good	Medium	Critical	
DIAM	Integer64	18	2,864	99.7%	Good	High	Critical	
YEARINSTAL	Integer64	18	2,873	100.0%	Good	Medium	Critical	
StreetName	String	254	2,874	100.0%	Good	Medium	Critical	168 Records begin with "^"
PIPE_ID	String	254	2,874	100.0%	Good	Medium	Critical	
UP_ID	String	254	2,871	99.9%	Good	Medium	Critical	
DOWN_ID	String	254	2,871	99.9%	Good	Medium	Critical	
MATERIAL	String	254	2,871	99.9%	Good	High	Critical	
SLOPE	String	254	2,586	90.0%	Good	Medium	Critical	
OWNER	String	254	2,874	100.0%	Good	High	Critical	
SAN_AREA	Integer64	18	2,874	100.0%	Good	Medium		
SEWERSHED	String	254	2,872	99.9%	Good	Medium		
As_built	String	254	2,478	86.2%	Good	Medium		
INVRT_UP	Real	17	1,218	42.4%	Fair	Medium	Critical	
INVRT_DN	Real	17	1,217	42.3%	Fair	Medium	Critical	
Comments	String	254	691	24.0%	Poor	Medium		Comment Field
Source_1	String	254	2,853	99.3%	Good	Low		Data inconsistent
Source_2	String	254	404	14.1%	Poor	Low		Data inconsistent
Comments1	String	254	112	3.9%	Poor	Medium		Comment Field
aquadatain	String	254	47	1.6%	Poor	Low		Field is mostly empty
stub	String	32	3	0.1%	Poor	Low		Field is mostly empty
UpstreamIn	Real	17	2,780	96.7%	Good	Medium		
Downstrem	Real	17	2,763	96.1%	Good	Medium		

Asset Class Storm Manholes
File Name TOFE-STORM MANHOLES-POINT.shp
# of Records 2093

Field Name	Type	Length	# Filled	% Filled	Maturity Rating	Confidence Rating	Criticality Rating	Confidence Notes
COMMENTS	String	254	142	6.8%	Poor	Medium		Comment Field
year_of_co	String	18	1,220	58.3%	Fair	Low	Critical	741 records containing "UNK"
STM_MH_DEP	Real	17	0	0.0%	Poor	Low	Critical	Field is empty
LAMID	String	254	2,001	95.6%	Good	Medium	Critical	

Asset Class Storm Sewers
File Name TOFE-STORM SEWER-LINE.shp
# of Records 3627

Field Name	Type	Length	# Filled	% Filled	Maturity Rating	Confidence Rating	Criticality Rating	Confidence Notes
YEARINSTAL	Integer64	18	2,242	61.8%	Fair	Medium	Critical	
LENGTH	Real	17	2,243	61.8%	Fair	Medium	Critical	
DIAM	Integer64	18	2,233	61.6%	Fair	Medium	Critical	
SLOPE	String	254	2,215	61.1%	Fair	Medium	Critical	
COMMENTS	String	254	247	6.8%	Poor	Medium		
SOURCE	String	254	2,120	58.5%	Fair	Medium		
MATERIAL	String	254	2241	61.8%	Fair	Medium	Critical	
CONTRACT	String	254	1	0.0%	Poor	Low		Field is empty
BOXCULVSIZ	String	254	22	0.6%	Poor	Low		Field is mostly empty
PIPEARCH	String	254	28	0.8%	Poor	Low		Field is mostly empty
STREET	String	254	2242	61.8%	Fair	Medium		
DRAINAGEAR	Integer64	18	2243	61.8%	Fair	Medium		
OWNERSHIP	String	254	2238	61.7%	Fair	Medium	Critical	
PIPE_ID	String	254	2241	61.8%	Fair	Low	Critical	Many records with no IDs, 2 Duplicate IDS (4 records)
UP_ID	String	254	2241	61.8%	Fair	Medium	Critical	
DOWN_ID	String	254	2241	61.8%	Fair	Medium	Critical	
OUTLETTOWA	String	254	82	2.3%	Poor	Low		Field is mostly empty
PVCPREDATI	String	254	0	0.0%	Poor	Low		Field is empty
CORRECTION	String	254	626	17.3%	Poor	Low		Field is mostly empty
CBLead	String	254	1388	38.3%	Fair	Low		Field is mostly empty

Asset Class Water Hydrants
File Name TOFE-WATER HYDRANT-POINT.shp
# of Records 1685

Field Name	Type	Length	# Filled	% Filled	Maturity Rating	Confidence Rating	Criticality Rating	Confidence Notes
Owner	String	10	1,684	99.9%	Good	High	Critical	
CUSTODIAN	String	32	1,681	99.8%	Good	Medium		
HydPw	String	254	1,684	99.9%	Good	Medium		19 Duplicate IDs (37 records)
Location	String	254	1,667	98.9%	Good	Medium	Critical	
Make	String	254	1,447	85.9%	Good	Medium		
NumberofOu	String	254	1,283	76.1%	Good	Medium	Critical	
Plugged	String	1	1,685	100.0%	Good	Medium		
Storz	String	1	1,685	100.0%	Good	Medium		
Valved	String	1	1,685	100.0%	Good	Medium		
Flanged	String	1	1,685	100.0%	Good	Medium		
CreatedBy	String	254	897	53.2%	Fair	Medium		
CreationDa	Date	10	1,685	100.0%	Good	Medium		
Static	Real	17	1,396	82.8%	Good	Medium	Critcal	
Pitot	Real	17	1,389	82.4%	Good	Medium		
Residual	Real	17	1,389	82.4%	Good	Medium	Critical	
GPM	Real	17	1,390	82.5%	Good	Medium		
HWMGPM	Real	17	1387	82.3%	Good	Medium		
OperatorIn	String	254	0	0.0%	Poor	Low	Critical	Field is empty
Date	String	254	0	0.0%	Poor	Low		Field is empty
Pumped	String	254	0	0.0%	Poor	Low		Field is empty
Dry	String	254	0	0.0%	Poor	Low		Field is empty
Lubed	String	254	0	0.0%	Poor	Low		Field is empty
Frozen	String	254	0	0.0%	Poor	Low		Field is empty
Thawed	String	254	0	0.0%	Poor	Low		Field is empty
Leaking	String	254	0	0.0%	Poor	Low	Critical	Field is empty
Comments	String	254	13	0.8%	Poor	Medium		Comment Field
DateofInst	Integers64	18	43	2.6%	Poor	Low	Critical	Field is mostly empty

Asset Class Water Mains
File Name TOFE-WATER MAIN-LINE.shp
# of Records 1664

Field Name	Type	Length	# Filled	% Filled	Maturity Rating	Confidence Rating	Criticality Rating	Confidence Notes
Pipe_ID	Real	17	1,642	98.7%	Good	Medium	Critical	5 Duplicate IDs (10 records)
Age_Range	String	12	1,650	99.2%	Good	Medium		
InstDate	Integer64	18	752	45.2%	Fair	Low	Critical	1 record containing "28" rather than a year
C_FAC	Real	17	1,619	97.3%	Good	Medium		
ST_NAME	Qstring	34	1,651	99.2%	Good	Medium		
TO_NODE	Real	17	1,642	98.7%	Good	Medium		
FROM_NODE	Real	17	1,642	98.7%	Good	Medium		
LENGTH	Integer64	18	1,649	99.1%	Good	Medium	Critical	
Diameter	Integer64	18	1,649	99.1%	Good	Medium	Critical	
Material	String	10	1,649	99.1%	Good	Medium	Critical	
Owner	String	6	1,649	99.1%	Good	Medium	Critical	
WAREA	Integer64	18	1,646	98.9%	Good	Medium		
As_Built	String	4	134	8.1%	Poor	Low		Field is mostly empty
Drawing	String	50	932	56.0%	Fair	Medium		
Notes	String	254	146	8.8%	Poor	Medium		Comment Field
stub	String	254	15	0.9%	Poor	Low		Field is mostly empty

Asset Class Water Valves
File Name TOFE-WATER SYSTEM VALVE-POINT.shp
# of Records 1856

Field Name	Type	Length	# Filled	% Filled	Maturity Rating	Confidence Rating	Criticality Rating	Confidence Notes
IDNumber	Integer64	18	1,856	100.0%	Good	Medium	Critical	4 Duplicate IDs (8 records)
Size	Integer65	18	46	2.5%	Poor	Low	Critical	Field is mostly empty
Type	String	32	1,851	99.7%	Good	Medium	Critical	
Condition	String	32	45	2.4%	Poor	Low	Critical	Field is mostly empty
Depth	String	254	0	0.0%	Poor	Low	Critical	Field is empty
Street	String	32	45	2.4%	Poor	Low		Field is mostly empty
CrossStree	String	32	44	2.4%	Poor	Low		Field is mostly empty
Notes	String	254	4	0.2%	Poor	Low		Field is empty
NormPosn	String	254	1,851	99.7%	Good	Medium		
Turns	String	32	1,851	99.7%	Good	Medium		
CloseDir	String	254	1,851	99.7%	Good	Medium		
Date	Date	10	1,856	100.0%	Good	Medium		
BeginTime	String	32	1,850	99.7%	Good	Low		Only contains date, not time
EndTime	String	32	1,850	99.7%	Good	Low		Only contains date, not time
OperatedBy	String	254	44	2.4%	Poor	Low		Field is mostly empty
Remarks	String	32	9	0.5%	Poor	Medium		Comment Field
Owner	String	254	100	5.4%	Poor	Low	Critical	Field is mostly empty
WSVType	String	10	174	9.4%	Poor	Low		Field is mostly empty
GPSPositio	String	32	1,006	54.2%	Fair	Medium		
GPSVerifie	String	254	0	0.0%	Poor	Low		Field is empty
HighTorque	Real	17	43	2.3%	Poor	Low		Field is mostly empty
Latitude	Real	17	43	2.3%	Poor	Low		Field is mostly empty
Longitude	Real	17	43	2.3%	Poor	Low		Field is mostly empty
ActivityId	Real	17	45	2.4%	Poor	Low		Field is mostly empty
TransferId	Real	17	45	2.4%	Poor	Low		Field is mostly empty

Asset Class Facilities
File Name Excel Spreadsheets - Working Copy.xlsm (all sheets/facilities combined)
# of Records 974

Field Name	Type	Length	# Filled	% Filled	Maturity Rating	Confidence Rating	Criticality Rating	Confidence Notes
LEVEL 1 MAJOR GROUP ELEMENT	N/A	N/A	974	100.0%	Good	Medium	Critical	
LEVEL 2 GROUP ELEMENT	N/A	N/A	973	99.9%	Good	Medium	Critical	
LEVEL 3 INDIVIDUAL ELEMENT	N/A	N/A	971	99.7%	Good	Medium	Critical	
COMPONENT	N/A	N/A	974	100.0%	Good	Medium	Critical	
LOCATION DESCRIPTION	N/A	N/A	973	99.9%	Good	Medium		
MANUFACTURER	N/A	N/A	244	25.1%	Poor	Medium		Only applicable to some asset types
MODEL NUMBER	N/A	N/A	116	11.9%	Poor	Medium		Only applicable to some asset types
SERIAL NUMBER	N/A	N/A	84	8.6%	Poor	Medium		Only applicable to some asset types
YEAR OF INSTALLATION (ESTIMATED AGE)	N/A	N/A	973	99.9%	Good	Medium	Critical	
EFFECTIVE AGE	N/A	N/A	951	97.6%	Good	Medium		22 records containing 0
SERVICE LIFE (YEARS)	N/A	N/A	973	99.9%	Good	Medium	Critical	
REMAINING LIFE (YEARS)	N/A	N/A	963	98.9%	Good	Medium		11 records containing 0
RECOMMENDATIONS	N/A	N/A	813	83.5%	Good	Medium		
RECOMMENDATIONS / OBSERVATIONS Ref.	N/A	N/A	973	99.9%	Good	Medium		
PHOTO REFERENCE	N/A	N/A	658	67.6%	Good	Medium		
CONDITION RATING	N/A	N/A	974	100.0%	Good	Medium	Critical	
PRIORITY RATING	N/A	N/A	955	98.0%	Good	Medium		Some records contain number ratings only, others contain condition label (ex. critical)
ENERGY RATING	N/A	N/A	964	99.0%	Good	Medium		17 records containing "N/A"
QUANTITY	N/A	N/A	972	99.8%	Good	Medium		
UNITS	N/A	N/A	973	99.9%	Good	Medium		
2018	N/A	N/A	47	4.8%	Poor	Medium		Only filled where recommendations were made for that year
2019	N/A	N/A	62	6.4%	Poor	Medium		Only filled where recommendations were made for that year
2020	N/A	N/A	83	8.5%	Poor	Medium		Only filled where recommendations were made for that year
2021	N/A	N/A	50	5.1%	Poor	Medium		Only filled where recommendations were made for that year
2022	N/A	N/A	68	7.0%	Poor	Medium		Only filled where recommendations were made for that year
2023	N/A	N/A	60	6.2%	Poor	Medium		Only filled where recommendations were made for that year
2024	N/A	N/A	33	3.4%	Poor	Medium		Only filled where recommendations were made for that year
2025	N/A	N/A	28	2.9%	Poor	Medium		Only filled where recommendations were made for that year
2026	N/A	N/A	36	3.7%	Poor	Medium		Only filled where recommendations were made for that year
2027	N/A	N/A	77	7.9%	Poor	Medium		Only filled where recommendations were made for that year
2028	N/A	N/A	36	3.7%	Poor	Medium		Only filled where recommendations were made for that year
2029	N/A	N/A	21	2.2%	Poor	Medium		Only filled where recommendations were made for that year
2030	N/A	N/A	16	1.6%	Poor	Medium		Only filled where recommendations were made for that year
2031	N/A	N/A	32	3.3%	Poor	Medium		Only filled where recommendations were made for that year
2032	N/A	N/A	72	7.4%	Poor	Medium		Only filled where recommendations were made for that year
2033	N/A	N/A	16	1.6%	Poor	Medium		Only filled where recommendations were made for that year
2034	N/A	N/A	19	2.0%	Poor	Medium		Only filled where recommendations were made for that year
2035	N/A	N/A	20	2.1%	Poor	Medium		Only filled where recommendations were made for that year
2036	N/A	N/A	28	2.9%	Poor	Medium		Only filled where recommendations were made for that year
2037	N/A	N/A	27	2.8%	Poor	Medium		Only filled where recommendations were made for that year
IDENTIFIER BARCODE	N/A	N/A	26	2.7%	Poor	Low		Field only included for Crystal Ridge Arena
ESTIMATED REPLACEMENT YEARS	N/A	N/A	107	11.0%	Poor	Low		Field only included for Crystal Ridge Arena

Asset Class	Bridges and Culverts - Asset Management Forecaster
File Name	Asset Management Forecaster - Municipal Primary.xlsx, Asset Management Forecaster - Municipal Secondary.xlsx, Asset Management Forecaster - Retaining Walls.xlsx, Asset Management F
# of Records	179

Field Name	Type	Length	# Filled	% Filled	Maturity Rating	Confidence Rating	Criticality Rating	Confidence Notes
ID Number	N/A	N/A	179	100.0%	Good	Medium	Critical	No Duplicates
Structure Name	N/A	N/A	179	100.0%	Good	Medium	Critical	Duplicate Names
Structure Type	N/A	N/A	179	100.0%	Good	Medium	Critical	
No. of Spans / Cells / Walls	N/A	N/A	179	100.0%	Good	Medium	Critical	
DIA / Span / Wall Length (m)	N/A	N/A	179	100.0%	Good	Medium	Critical	23 records containing multiple lengths, 4 records containing "m"
Deck / Plan / Wall Area (m2)	N/A	N/A	179	100.0%	Good	Medium	Critical	
Year Constructed	N/A	N/A	179	100.0%	Good	Low	Critical	140 records containing "Unknown", 21 records starting with "c."
General Overall Condition	N/A	N/A	179	100.0%	Good	Medium	Critical	
BCI	N/A	N/A	179	100.0%	Good	Medium	Critical	
Recommended Work	N/A	N/A	179	100.0%	Good	Medium		
Priority Rating	N/A	N/A	179	100.0%	Good	Medium		
Total Cost for Recommended Work	N/A	N/A	179	100.0%	Good	Medium		
Year Constructed	N/A	N/A	179	100.0%	Good	Medium	Critical	159 records starting with "c." or "c"
Year of Replacement	N/A	N/A	170	95.0%	Good	Medium		9 records containing 0
Residual Life	N/A	N/A	170	95.0%	Good	Medium		9 records containing 0
Cost to Replace	N/A	N/A	179	100.0%	Good	Medium	Critical	

Asset Class	Bridges and Culverts - Inspections
File Name	Fort Erie MUNICIPAL PRIMARY Culvert Inspections 2017.xlsx, Fort Erie MUNICIPAL SECONDARY Culvert Inspections 2017.xlsx, Fort Erie RETAINING WALL Inspections 2017.xlsx, Fort Erie SPAN Inspections 2017.xlsx
# of Records	181

Field Name	Type	Length	# Filled	% Filled	Maturity Rating	Confidence Rating	Criticality Rating	Confidence Notes
fldID	N/A	N/A	84	46.4%	Fair	Medium	Critical	24 Duplicate IDs (48 records), Field not included for Municipal Primary Structures
Structure Name	N/A	N/A	181	100.0%	Good	Medium	Critical	Duplicate Names
MTO Site Number	N/A	N/A	47	26.0%	Poor	Low	Critical	42 Records containing "N/A"
Bridge	N/A	N/A	181	100.0%	Good	Medium		
Culvert	N/A	N/A	181	100.0%	Good	Medium		
Number of Spans	N/A	N/A	181	100.0%	Good	Medium	Critical	
Structure	N/A	N/A	181	100.0%	Good	Medium		
Municipal	N/A	N/A	181	100.0%	Good	Medium		
Deck Area	N/A	N/A	181	100.0%	Good	Medium	Critical	
Location	N/A	N/A	181	100.0%	Good	Medium		
ID Number	N/A	N/A	181	100.0%	Good	Medium	Critical	4 Duplicate IDs (8 records)
Span Lengths	N/A	N/A	181	100.0%	Good	Medium	Critical	23 records containing multiple lengths, 5 records containing "m"
Load Posting	N/A	N/A	181	100.0%	Good	Medium		35 records containing "None", 7 records containing "N/A"
Structure Type	N/A	N/A	181	100.0%	Good	Medium	Critical	
txtStructTypeOther	N/A	N/A	82	45.3%	Fair	Medium		
Yr Constructed	N/A	N/A	181	100.0%	Good	Low	Critical	114 records containing "Unknown", 21 records starting with "c."
Yr Rehabilitated	N/A	N/A	70	38.7%	Fair	Low		20 records containing "Unknown", 48 records containing "N/A"
Spatial Reference	N/A	N/A	178	98.3%	Good	Medium		
Y	N/A	N/A	178	98.3%	Good	Medium		
Inspection Date	N/A	N/A	181	100.0%	Good	Medium		
Previous Inspection	N/A	N/A	81	44.8%	Fair	Medium		6 records containing "Unknown"
Current AADT	N/A	N/A	38	21.0%	Poor	Low	Critical	37 records containing "Unknown", 1 record containing "N/A"
Previous ID Number	N/A	N/A	74	40.9%	Fair	Medium		1 record containing "N/A"
Date of AADT	N/A	N/A	0	0.0%	Poor	Low		Field is empty
Speed Limit	N/A	N/A	37	20.4%	Poor	Low		1 record containing "N/A"
Effects of Deterioration	N/A	N/A	181	100.0%	Good	Medium		
Recommendation	N/A	N/A	181	100.0%	Good	Medium		95 records containing "None"
cboPriorityRating	N/A	N/A	0	0.0%	Poor	Low		Field is empty
cboPriorityRating1	N/A	N/A	181	100.0%	Good	Medium		
cboImpRank1	N/A	N/A	53	29.3%	Poor	Low		Field is mostly empty
chkDCS1	N/A	N/A	181	100.0%	Good	Medium		
chkRSP1	N/A	N/A	181	100.0%	Good	Medium		
chkRSB1	N/A	N/A	181	100.0%	Good	Medium		
chkRIR1	N/A	N/A	181	100.0%	Good	Medium		
chkPWP1	N/A	N/A	181	100.0%	Good	Medium		
chkWSR1	N/A	N/A	181	100.0%	Good	Medium		
chkCS1	N/A	N/A	181	100.0%	Good	Medium		
chkRSL1	N/A	N/A	181	100.0%	Good	Medium		
chkOWP1	N/A	N/A	181	100.0%	Good	Medium		
chkTJR1	N/A	N/A	181	100.0%	Good	Medium		
chkCSS1	N/A	N/A	181	100.0%	Good	Medium		

chkLCE1	N/A	N/A	181	100.0%	Good	Medium		
chkPDR1	N/A	N/A	181	100.0%	Good	Medium		
chkRRA1	N/A	N/A	181	100.0%	Good	Medium		
chkCDR1	N/A	N/A	181	100.0%	Good	Medium		
chkSPI1	N/A	N/A	181	100.0%	Good	Medium		
chkMIS1	N/A	N/A	181	100.0%	Good	Medium		
txtMISA1	N/A	N/A	13	7.2%	Poor	Medium		Only filled where recommendations were made for that year
txtMISB1	N/A	N/A	1	0.6%	Poor	Medium		Only filled where recommendations were made for that year
txtMISC1	N/A	N/A	0	0.0%	Poor	Medium		Only filled where recommendations were made for that year
fldEngCostA	N/A	N/A	61	33.7%	Fair	Medium		Only filled where recommendations were made for that year
fldEngCostB	N/A	N/A	3	1.7%	Poor	Medium		Only filled where recommendations were made for that year
fldEngCostC	N/A	N/A	61	33.7%	Fair	Medium		Only filled where recommendations were made for that year
fldEngCostD	N/A	N/A	3	1.7%	Poor	Medium		Only filled where recommendations were made for that year
txtReqWork1A	N/A	N/A	69	38.1%	Fair	Medium		Only filled where recommendations were made for that year
fldPrice1A	N/A	N/A	69	38.1%	Fair	Medium		Only filled where recommendations were made for that year
txtReqWork2A	N/A	N/A	7	3.9%	Poor	Medium		Only filled where recommendations were made for that year
fldPrice2A	N/A	N/A	7	3.9%	Poor	Medium		Only filled where recommendations were made for that year
txtReqWork3A	N/A	N/A	1	0.6%	Poor	Medium		Only filled where recommendations were made for that year
fldPrice3A	N/A	N/A	1	0.6%	Poor	Medium		Only filled where recommendations were made for that year
txtReqWork4A	N/A	N/A	0	0.0%	Poor	Medium		Only filled where recommendations were made for that year
fldPrice4A	N/A	N/A	0	0.0%	Poor	Medium		Only filled where recommendations were made for that year
txtReqWork5A	N/A	N/A	0	0.0%	Poor	Medium		Only filled where recommendations were made for that year
fldPrice5A	N/A	N/A	0	0.0%	Poor	Medium		Only filled where recommendations were made for that year
Additional Notes	N/A	N/A	181	100.0%	Good	Medium		
fldEngSubTotal	N/A	N/A	58	32.0%	Poor	Medium		Only filled where recommendations were made for that year
Text350	N/A	N/A	3	1.7%	Poor	Medium		Only filled where recommendations were made for that year
Next Inspection	N/A	N/A	181	100.0%	Good	Medium		
Board Order/Agreement	N/A	N/A	181	100.0%	Good	Medium		
General Oberall Condition	N/A	N/A	181	100.0%	Good	Medium		
BCI	N/A	N/A	181	100.0%	Good	Medium	Critical	
fldConSubTotal	N/A	N/A	69	38.1%	Fair	Medium		Only filled where recommendations were made for that year
Total Cost	N/A	N/A	70	38.7%	Fair	Medium		Only filled where recommendations were made for that year

Asset Class Asset Navigator / Financial Data
File Name AssetNav Dump.xlsx
# of Records 13,185

Field Name	Type	Length	# Filled	% Filled	Maturity Rating	Confidence Rating	Criticality Rating	Confidence Notes
LocationID	N/A	N/A	13185	100.0%	Good	Medium	Critical	16 duplicate IDs (32 records)
Asset	N/A	N/A	13157	99.8%	Good	Medium	Critical	3 duplicate IDs (6 records)
AssetName	N/A	N/A	2213	16.8%	Poor	Low	Critical	Field is empty
District	N/A	N/A	13185	100.0%	Good	Medium		
ParentSystem	N/A	N/A	13185	100.0%	Good	Medium		
Description	N/A	N/A	13185	100.0%	Good	Medium		
Material	N/A	N/A	10334	78.4%	Good	Medium	Critical	
Replacement Year	N/A	N/A	9546	72.4%	Good	Medium	Critical	
Future Replacement Cost	N/A	N/A	9287	70.4%	Good	Low	Critical	Older estimate that FE has low confidence in
Condition	N/A	N/A	8314	63.1%	Fair	Medium	Critical	
ACCPAC: ASTNO	N/A	N/A	9824	74.5%	Good	Medium		
Financial: Accumulated Ammortization	N/A	N/A	9809	74.4%	Good	Medium		12 records containing "-"
Financial: Age	N/A	N/A	13148	99.7%	Good	Medium	Critical	79 records containing "-"
Financial: Aggregate Historical Cost	N/A	N/A	9984	75.7%	Good	Medium		174 records containing "-"
Financial: Current Aggregate Replacement Cost	N/A	N/A	9436	71.6%	Good	Medium		81 records containing "-"
Financial: Current Replacement Cost	N/A	N/A	9424	71.5%	Good	Medium		81 records containing "-"
Financial: Estimated Repair Year	N/A	N/A	9546	72.4%	Good	Medium		
Financial: Future Aggregate Replacement Cost	N/A	N/A	9357	71.0%	Good	Medium		56 records containing "-"
Financial: Future Replacement Cost	N/A	N/A	9343	70.9%	Good	Medium		56 records containing "-"
Financial: Historical Cost	N/A	N/A	9977	75.7%	Good	Medium		179 records containing "-"
Financial: Net Book Value	N/A	N/A	9977	75.7%	Good	Medium		2477 records containing "-"
Financial: Remaining Life	N/A	N/A	9546	72.4%	Good	Low	Critical	2504 records containing "-", Data inconsistent
Financial: Service Life	N/A	N/A	10037	76.1%	Good	Medium		749 records containing "-"

Asset Class Customer Complaints
File Name crmExportData - Engineering Dept.xlsx, crmExportData - Roads Dept.xlsx, crmExportData - Water & Wastewater Dept.xlsx, crmExportData - Engineering CLOSED Issues 2016_2017_2018.xlsx, crmExportData - Roads Depart CLOSED Issues 2016_ 2017_ 2018.xlsx, crmExportData - Water & Wastewater CLOSED Issues
# of Records 10,801

Field Name	Type	Length	# Filled	% Filled	Maturity Rating	Confidence Rating	Criticality Rating	Confidence Notes
ISSUE_ID	N/A	N/A	10801	100.0%	Good	Medium	Critical	232 duplicate IDs (464 records)
ORIGIN	N/A	N/A	10801	100.0%	Good	Medium		
SUBJECT	N/A	N/A	10801	100.0%	Good	Medium		
DATE_CREATED	N/A	N/A	10801	100.0%	Good	Medium	Critical	
DATE_CLOSED	N/A	N/A	10065	93.2%	Good	Medium	Critical	10065 records are closed
AGE	N/A	N/A	10158	94.0%	Good	Medium		643 records containing "0"
LOCATION_STREETNO	N/A	N/A	6163	57.1%	Fair	Medium		
LOCATION_STREETNAME	N/A	N/A	10719	99.2%	Good	Medium		
LOCATION_ROLLNO	N/A	N/A	6058	56.1%	Fair	Medium		
LOCATION_FACILITY	N/A	N/A	58	0.5%	Poor	Medium		Not applicable to all records
LOCATION_FACILITY_L1	N/A	N/A	56	0.5%	Poor	Medium		Not applicable to all records
LOCATION_FACILITY_L2	N/A	N/A	56	0.5%	Poor	Medium		Not applicable to all records
LOCATION_OTHER	N/A	N/A	10801	100.0%	Good	Medium		
LOCATION_OTHER_AREA	N/A	N/A	46	0.4%	Poor	Medium		Not applicable to all records
LOCATION_DESC	N/A	N/A	3822	35.4%	Fair	Medium		Open text / comment field
ISSUE_SEVERITY	N/A	N/A	10801	100.0%	Good	Medium		
DEPARTMENT	N/A	N/A	10801	100.0%	Good	Medium		
DIVISION	N/A	N/A	10801	100.0%	Good	Medium		
CATEGORY	N/A	N/A	9647	89.3%	Good	Medium	Critical	Inconsistent
CAUSE	N/A	N/A	1195	11.1%	Poor	Low	Critical	
ISSUE_DESC	N/A	N/A	10799	100.0%	Good	Medium	Critical	
STATUS	N/A	N/A	10801	100.0%	Good	Medium		

APPENDIX C: TECHNICAL MEMORANDUM #2 - AMP STAFFING & STAFF ENGAGEMENT

Date:	5/24/2019	File:	618004
To:	Kelly Walsh, P.Eng. Director, Infrastructure Services		
From:	GM BluePlan Engineering		
Project:	Asset Management Plan		
Subject:	Meeting, Workshops, Staff Engagement and Recommended Future Staffing Structure and AMP Requirements		

TECHNICAL MEMORANDUM #2 & #10 – AMP STAFFING & STAFF ENGAGEMENT

1. INTRODUCTION

GM BluePlan (GMBP) has been retained by the Town of Fort Erie to develop an Asset Management Plan (AMP) that follows the Province's structure outlined in the Guide for Municipal AMPs and will also address all the requirements from Ontario Regulation 588/17. As a part of this project a key deliverable is defining both the current and future staffing structure to support ongoing AMP development. As such, this memorandum details a recommended staffing plan to ensure there is active and open communication between departments to ensure future AMP updates can be completed by Town staff.

This memorandum provides an overview of this project plan, including roles and responsibilities, and the number of meetings, workshops and opportunities for staff engagement. It also outlines resource challenges and the staffing requirements recommended to continue to perform the analyses for the AMP on an annual basis. Projections may change over time based on staff availability. Where exact meeting dates have not been scheduled at the time of writing this memo, general timelines have been provided.

2. CURRENT AMP PROJECT STAFF INVOLVEMENT

2.1. MEETINGS, WORKSHOPS AND PRESENTATIONS

To convey project requirements, outcomes, and recommendations appropriately, key stakeholder workshops and presentations have been scheduled at specific intervals throughout the project. These meetings ensure stakeholder feedback is integrated early and often through presentation of project progress and results as discussed below.

- **Council Presentation (1)**

  One of our AM leads, Nick Larson, is actively engaged with the Canadian Infrastructure Report Card project and was an advisor to FCM on the design of the Municipal Asset Management Program. With this perspective, Nick (in conjunction with David Watt) will present to Council highlighting project outcomes and the importance of implementing such AM processes to the Town. The overall message of the presentation will be to recognize the equal and integrated roles that financial planning and infrastructure planning processes provide to achieve the Town's economic, social, and environmental objectives. We will also detail the changes in regulations including O.Reg. 588/17 and other relevant legislation such as the AMO Federal Gas Tax Fund and the role of effective AM planning as a business case for future Provincial and Federal Funding.

Prior to completion of this project, the results of the Wastewater Master Plan project will also be presented to Council by GMBP.

Table 1 – Council Presentation Summary

Workshop / Meeting	Topic / Focus	Anticipated Schedule
Council Presentation	➢ Wastewater Master Plan	May 2019
Council Presentation	➢ Overview of AMP Project Outcomes ➢ Value of AM Planning ➢ Impacts of O.Reg 588/17 ➢ Next Steps	July 2019

- **Technical Steering Committee Meetings (3)**

  Three Technical Steering Committee Meetings were conducted throughout the course of the project. These meetings are used to provide a detailed update to project stakeholders at critical times during the project. The meetings are key to ensure the project is progressing and aligning with stakeholder expectations. In addition, these workshops allow for an opportunity to discuss upcoming tasks and strategize an appropriate approach.

- **Project Progress Meetings (6)**

  Monthly progress meetings have been held with the Town's Project Manager, Kelly Walsh. These meetings are typically one hour in length with the purpose of providing an update on both GMBP and Town project tasks. These meetings provide a project update in terms of schedule, scope, individual task status, and budget. In addition to these monthly meetings, bi-weekly reports have been supplied to the Town's project manager representing a more regular project update.

- **Workflow Management & Staff Capacity Building (3)**

  Capacity building workshops were held at the onset of the project for all the in-scope service categories. GMBP led workshops with Town staff to document the existing state of supporting AMP data and information and develop levels of service. These workshops focused on defining both the assets and respective asset attributes within each service category. Once defined, discussions were held on the logic used to determine the timing and type of maintenance and rehabilitation activities for these assets, resulting in a critical understanding of asset lifecycle decision making. These workshops also highlighted available capacity for AM support as well as training in core AM concepts and skills, all tailored to the asset category and subject matter being discussed.

Table 2 – Workflow Management & Staff Capacity Building Summary

Workshop / Meeting	Topic / Focus	Anticipated Schedule
Business Processes Workshop 1	➢ Review of Business Processes for Bridge & Structures, Roads & ROW and Stormwater	Complete – July 12, 2018
Business Processes Workshop 2	➢ Review of Business Processes for Water, Wastewater and Facilities Management	Complete – August 8, 2018
Levels of Service Workshop	➢ Level of Service Discussion for all Service Categories	Complete – August 8, 2018

- **Training Workshops (3)**

  These workshops will focus on the delivery and training of the SQL server and MS Excel based decision support tool (DST). One workshop will be used to deliver the tool and provide an overview of how to operate and core functions resulting from the tool. The second workshop will be spent working with IT as necessary onsite to assist with installation/setup, as well as train those assigned to maintain and run the tool in the future. The third workshop will be held one to two months post installation/setup and initial training to allow sufficient time for staff to test and run the tool without GMBP present. The third workshop will focus on key questions resulting from testing and will act as support for any requested tweaks to the tool.

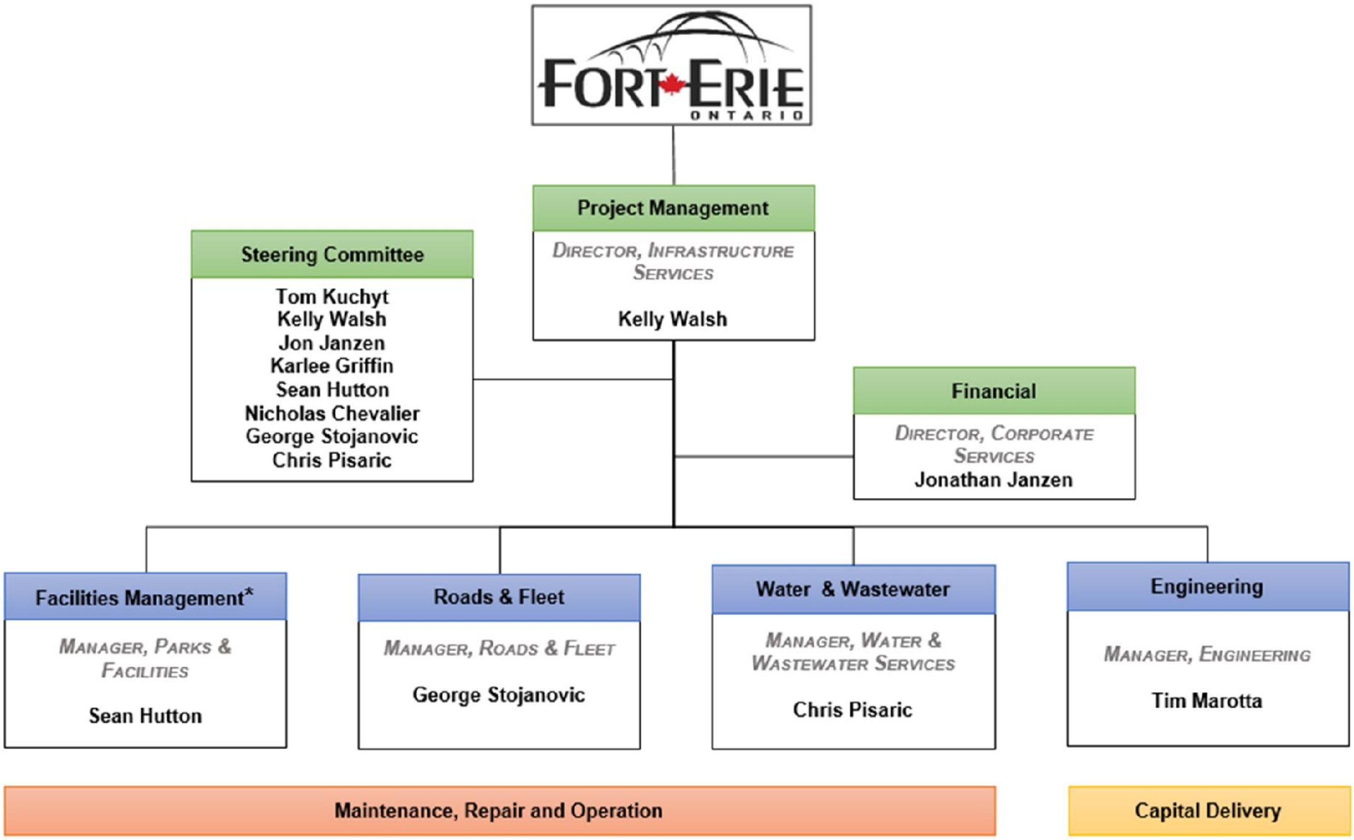
Table 3 – Training Workshops Summary

Workshop / Meeting	Topic / Focus	Anticipated Schedule
Training Workshop 1	➢ Delivery of Tool ➢ Installation & Setup ➢ Overview and Core Functionality	September 2019*
Training Workshop 2	➢ Training of IT Staff	September 2019*
Training Workshop 3	➢ Post Testing Support	September 2019*

*To be verified post AMP completion.

2.2. CURRENT ROLES AND RESPONSIBILITIES

Following the Workflow Management & Staff Capacity Building workshops, GMBP drafted the staffing hierarchy and respective roles of the Town's leading AM staff. The following Figure 1 represents the project stakeholders and outlines the functions of each division (i.e. maintenance, repair and operation of assets or capital delivery).



* Facilities Management provides capital delivery for facilities.

Figure 1- Staffing Hierarchy (AMP)

The workshop also allowed the Asset Management Policy to be drafted, which outlines the key AM roles and authorities.

The Project Manager for the 2018 AMP is Kelly Walsh, Director, Infrastructure Services; in this role he is responsible for overseeing project progress and will be the primary point of contact for GM BluePlan. The Steering Committee is responsible for attending Technical Steering Committee Meetings (3) to provide critical support and advice as the project develops. The team will monitor the quality of the project, provide direction and support as required.

The department leads represent their respective asset category and will act as the groups representative responsible for providing the necessary input in terms of workshop discussion, as well as coordinating the provision of data and acquiring a summary of feedback from additional subject matter experts within the department. As outlined in the above organization chart, the Facilities Management, Roads & Fleet, and Water & Wastewater divisions are responsible for the ongoing maintenance, repair, and operation of their respective assets. Engineering is responsible for maintaining their own data for capital delivery for these groups, except Facilities Management provides the capital delivery for facility assets.

Corporate Services will work closely with Infrastructure Services to provide financial data and input on the financial strategy. On an ongoing basis, Infrastructure Services will drive the forecasting of infrastructure needs while Corporate Services will control the financing of resulting plans.

3. ONGOING AMP DEVELOPMENT STAFF REQUIREMENTS

3.1. RESOURCE CHALLENGES

Industry standard provides supporting documentation for the requirement of designated Asset Management staff to both support and successfully implement a robust AMP and respective supporting tools. Our industry review details resource challenges in meeting the regulatory requirements for AM, as well as implementing an asset management program within an organization. These challenges may be applicable at the Town, and may include:

- **Application**

  Although the new regulatory changes prescribe Asset Management requirements, interpreting the new legislation, how it can be best applied at Fort Erie, and how to integrate with the existing culture and expectations will be a challenge. Fort Erie recognized the benefit of external resources to assist in this transition. As such an objective for this assignment is turnkey deliverables to ensure that new policy, strategies or processes are dynamic with changes in the Town, easy to modify and update, while staying useful and effective for a self-sufficient plan. Considering future staff needs and structure is also an essential means to ensure the success and strength of the new AM initiatives. Continuing to maintain staff training in Asset Management also helps ensure legislative compliance and that Asset Management is effective at the Town.

- **Buy-in**

  It is critical to ensure Council and staff agree and understand that financial planning and infrastructure planning should be integrated to achieve effective asset management. “Alignment” is a repeated requirement in the new regulation, as it is essential that infrastructure planning activities coordinate rather than segregate departments. The Town recognizes this and has included financial staff since the onset of this project. It is recommended that this could also be expanded in the future to include staff involvement in land use planning, emergency planning, risk assessment, and procurement to strengthen the acceptance “buy-in” throughout the Town and strengthen the processes within the AMP.

  Regular asset management Council updates outlining AMP implementation progress will also be a new regulatory requirement after 2024 and it is the current intention of the Town to provide these updates annually before this date. Initiating this activity sooner will assist Council in becoming more familiar and aware of the role and importance of asset management in municipal planning and operations.

- **Change Management**

  The AMP should be regularly used in business decisions and not only result in an annual report but provide a valuable tool in infrastructure and investment planning. When changes occur in a municipality, such as in legislation, staffing, operational programs or financial protocols for example, a Change Management process will help AM staff navigate through the effect of the changes on the AMP and the resulting tasks that should take place to update the AMP, train staff or inform Council. The current project provides an example of the changes that can impact the AMP as there were a number of personnel changes throughout the project with staff such as Doug Campbell, Jason Marr, Adam Allcock and Karlee Griffin leaving the organization and being replaced with staff such as Chris Pisaric, Tim Marrotta and George Stojanovic. Building a Change Management process should be a staff undertaking, once an AM structure is in place.

3.2. RECOMMENDED FUTURE STAFFING

This project will provide the Town with an AMP that will need to be followed and updated even after the completion of this project. In order to ensure the Town has the resources to maintain and amalgamate the required data and perform the required analyses on an ongoing basis, the following recommendations for required roles and responsibilities have been provided. The Town will be required to determine whether these roles should be completed by existing staff, or if new part-time or fulltime roles should be created and filled; these roles include:

1. An **asset management professional** (1 FTE) who understands the strategic, financial and operational perspectives of what the system must do and how it can be refined. This individual should be considered an integrated asset management expert, directing the development, implementation, and sustainability of asset management processes in the organization. Amongst other responsibilities, the position will be required to liaise with IT, Infrastructure, Finance and subject matter experts to refine the system (updating costs, condition, etc.) in the short term and sustain it in the long term and run outputs from the DSS. The core requirements for this position should include an engineering/infrastructure education, financial education or experience, leadership experience, and executive facilitation skills. This role should have the authority to recommend overall asset management strategy to Council.

2. A **computer programming professional** (0.5 FTE) with an understanding of data management and an ability to develop queries in SQL based programming languages. This position will be responsible for adjusting algorithms under the direction of the integrated asset management professional, as well as managing the native data – SQL server – Excel connectivity.

The following points summarize the typical activities that these staff will complete:

- Liaising with the subject matter expert staff to improve how asset data/information is collected and used.
- Liaising with the subject matter expert staff to adjust the approach to analyzing asset data and reconciling data within the system.
- Coordinating the adjustment of the analysis in the system to continually improve the relationships between the expenditure needs and the performance of the assets.
- Advancing the measurement of asset performance to go beyond the current approach of using primarily asset condition information.

- Liaising with the Town's finance team to refine how the capital budget and capital project sheets are developed to better support the analysis of planned expenditures on the performance of the assets.

In the long term, the estimated FTE may need to be increased as the scope of the AMP will broaden over time to include all assets within the Town (required by 2023), resulting in an increased need for resources over time.

4. CONCLUSION

The approach taken focuses on integrating Town staff as a vital member of this assignment, working with and training staff to provide an easy transition from GMBP-led AMP development to Town-led future AM needs and reporting. Supporting documentation provides a source for knowledge transfer, as such the meetings and workshops outlined in the above plan will help to ensure staff are engaged and will continue to support the process.

We strongly recommend the projected AM roles have overlap in training and responsibilities to reduce the risk of loss of productivity, training and corporate system knowledge from potential turnover.

APPENDIX D: TECHNICAL MEMORANDUM #4 - STATE OF LOCAL INFRASTRUCTURE

Date:	5/24/2019	File:	618004
To:	Kelly Walsh, P.Eng. Director, Infrastructure Services		
From:	GM BluePlan Engineering		
Project:	Asset Management Plan		
Subject:	State of Local Infrastructure Report		

TECHNICAL MEMORANDUM #4 – STATE OF LOCAL INFRASTRUCTURE

1. INTRODUCTION

GM BluePlan (GMBP) was retained by the Town of Fort Erie (the Town) to develop an Asset Management Plan that follows the Province's structure as outlined in their Guide for Municipal Asset Management Plans, and will address all of the requirements outlined in Ontario Regulation 588/17. As a part of this project, GMBP completed a technical asset management (AM) analysis that developed a projection of asset performance (condition) based on planned lifecycle activities with Level of Service (LOS) and risk considerations. This involved a comprehensive review of the existing state of the Town's Infrastructure and degradation modelled on condition/performance. The following provides an overview of the current and projected state of the Town's infrastructure.

2. DATA SOURCES, GAPS & ASSUMPTIONS

All data sources used to derive the information presented in this memo, as well as an outline of any gaps within this data were detailed in Technical Memorandum #1: Background Review and Gap Analysis, provided to the Town under a separate cover. The following sections outline where gaps or issues with data maturity (completeness) or confidence (accuracy/consistency) required assumptions to be made by GMBP to report on the data in this memorandum. In addition, these sections outline all critical data gaps which prevented further analysis and/or limited reporting capabilities (e.g. when no condition or age information was available, performance could not be calculated). A summary of where there were gaps or assumptions that needed to be used are outlined in Table 1 below, using the following guide:

- ✓ – Data was provided by Fort Erie and no, or limited adjustments, were made.
- ✓ – No or partial data was provided, but full data was derived using standards and assumptions.
- ✗ – No Data was provided or there is low confidence in the provided data, data has been augmented using standards and assumptions.

Table 1: Data Gaps & Assumptions

Asset Data	Replacement Costs	Estimated Service Life	Age/Install Date	Performance / Condition
Roads	✓	✓	✗	✓
Streetlights	✓	✓	✓	✓
Sidewalks	✓	✓	✗	✓
Sanitary Mains	✓	✓	✓	✓

Asset Data	Replacement Costs	Estimated Service Life	Age/Install Date	Performance / Condition
Storm Sewers	✓	✓	✓	✓
Water Mains	✓	✓	✓	✓
Bridges & Structures	✓	✓	✓	✓
Facilities Management	✓	✓	✓	✓

2.1. REPLACEMENT COST ASSUMPTIONS

The asset inventories that included replacement costs provided by the Town's engineering department were Bridges and Structures, as well as some Facility assets. For all assets, excluding those with engineering assigned replacement costs provided by the Town, GMBP used industry standard best practice to assign replacement costs. This approach involved using our costing database to augment replacement costs with a review to similar local municipalities alike in area, age, population, etc.

Table 2 below summarizes the unit replacement costs for most asset categories where this methodology was applied. It should be noted that these replacement values do not address economies of scale as they represent the value to replace each asset individually.

Table 2: Unit Replacement Cost Estimates

Asset	Diameter (mm)	Material	Replacement Unit Cost	Replacement Unit
Roads	N/A	Hot Mix Asphalt	$216.67	m²
		Surface Treated	$47.51	m²
		Gravel	$17.50	m²
		Earth	$8.75	m²
Sidewalk		N/A	$125	m
Streetlight			$720	$/light
Sanitary Mains	d <= 150		$600	m
	150 < d <= 200		$630	m
	200 < d <= 225		$675	m
	225 < d <= 250		$690	m
	350 < d <= 350		$800	m
	450 < d <= 450		$900	m
	600 < d <= 600		$1,000	m
	750 < d <= 750		$1,100	m
	d > 750		$1,100	m
Sanitary Manholes	N/A		Built into Sewer Costs	N/A
Storm Sewers	d <= 200		$650	m
	200 < d <= 250		$710	m
	250 < d <= 300		$835	m
	300 < d <= 450		$925	m

Asset	Diameter (mm)	Material	Replacement Unit Cost	Replacement Unit
	450 < d <= 525		$1,030	m
	525 < d <= 600		$1,100	m
	600 < d <= 800		$1,150	m
	800 < d <= 1200		$2,625	m
	d > 1200		$3,600	m
Storm Manholes	N/A		Built into Sewer Costs	N/A
Water Mains	d <= 150		$500	m
	150 < d <= 250		$660	m
	250 < d <= 300		$1,000	m
	300 < d <= 400		$1,580	m
	400 < d <= 600		$2,715	m
Water Hydrants	N/A		Built into Main Costs	N/A
Water Valves	N/A		Built into Main Costs	N/A

2.1.1 Bridges & Structures

The unit costs included in the Bridges and Structures inventories that were provided by the Town were assumed to be accurate and were not modified by GMBP.

2.1.3 Facilities

For facility asset replacement costs, GMBP used the assigned replacement values if available. This was done by reading through the comment field for each asset and determining the treatment type for the forecasted scenario that was provided by the Town.

Where unavailable, GMBP based asset costs on the typical proportion of Uniformat asset type within each type of facility, and broke the costs out proportionally based on the overall facility costs. These costs were reviewed by Town staff and updated where necessary.

For the overall replacement costs of facilities, GMBP utilized industry standards to estimate the cost per square foot for different facility types and applied these to each facility (see Table 3 below). These costs were reviewed with Town staff for validity.

Table 3: Overall Facility Costs

Town of Fort Erie - Facility	Facility Size (Sqft)	Rate ($/Sqft)	Facility Cost
Centennial Library	16000	$339	$5,431,151
Central Fire Station	13340	$378	$5,041,938
CN B-1 Station	814	$386	$314,030

Town of Fort Erie - Facility	Facility Size (Sqft)	Rate ($/Sqft)	Facility Cost
Crystal Ridge Arena	28000	$256	$7,162,288
Crystal Ridge Community Centre	17000	$386	$6,558,367
Crystal Ridge Library	6000	$339	$2,036,682
Fire Station 3	12000	$378	$4,535,477
Fire Station 4	4500	$378	$1,700,804
Fire Station 5	7500	$378	$2,834,673
Fire Station 6	5500	$378	$2,078,760
GTR Station Museum	1028	$386	$396,588
JL Gibson	22855	$315	$7,199,739
Gibson Storage Building	7300	$173	$1,265,895
Leisureplex	128000	$256	$32,741,889
Ridge Road Historical Museum	4746	$386	$1,830,942
Stevensville Hall (Includes Library Within)	9500	$386	$3,664,970
Town Hall	38000	$392	$14,895,229

Due to the methodology used to assign replacement values to facility assets, the individual cost per asset may not reflect the asset's actual replacement cost. This method was done as a cost-effective method to proportionally distribute the Facility's replacement cost. It is recommended that a project be completed to obtain accurate per-asset replacement costs of all Facility assets, and that going forward all condition assessments list the current replacement cost of every asset.

2.2. REHABILITATION COST ASSUMPTIONS

The rehabilitation treatment type was used only for Road assets, all other asset categories used only replacement in their lifecycle strategies. Table 4 below summarizes the unit rehabilitation costs used in the DSS. These costs were provided in an email from the Town on December 12, 2018.

Table 4: Unit Rehabilitation Cost Estimates

Asset	Material	Rehabilitation Unit Cost	Replacement Unit
Roads	Hot Mix Asphalt	$22.40	m²
	Surface Treated	$6.5	m²
	Gravel	$2.00	m²
	Earth	$2.00	m²

2.3. ESTIMATED SERVICE LIFE (ESL) ASSUMPTIONS

The financial data from Asset Navigator, a software used by the Town that pairs the finance data to the engineering GIS data, contained ESL values that were identified to be low in confidence due to the variation in ESL between similar assets. For example, in the Asset Navigator data, 600 mm diameter concrete sanitary mains vary in ESL between 50, 75, or 90 years even though these pipes have identical attribute data and should therefore have no difference in ESL. For this reason, it was decided that industry standard ESL values would be augmented within the data as needed.

Where no ESL values were provided within the inventory data provided by the Town, GMBP utilized industry standard ESL values as shown below in Table 5.

Table 5: Estimated Service Life Estimates

Asset Category	Material	Road Class	Estimated Service Life (Years)
Roads	N/A	Minor Arterial	48
		Collector	55
		Local	60
Streetlights		N/A	25
Sidewalks			60
Sanitary Mains	AC		50
	CONC		80
	PE		50
	PVC		85
	RES LINER		50
	VIT		50
	Other		50
Storm Sewers	AC		50
	CONBX		80
	CONC		80
	CONEL		80
	CSP		50
	CSPA		50
	PE		50
	PVC		85
	VC		50
	Other		50
Water Mains	AC		60
	CI		70
	CPP		70
	DI		50
	HDPE		50
	PE		40
	PVC		80
	Other		50

In addition to ESL values, all Roads assets were assigned a Resurfacing Frequency. Table 6 below shows the number of years between resurfacing that each road is expected to experience based on road class.

Table 6: Road Resurfacing (Hot Mix Asphalt) Frequency

Asset Category	Material	Road Class	Resurfacing Frequency (Years)
Roads	Hot Mix Asphalt	Minor Arterial	25
		Collector	30
		Local	35
	Surface Treated	Minor Arterial	12
		Collector	15
		Local	20

2.3.1 Bridges & Structures

The Bridges and Structures data that was provided by the Town contained residual life, inspection year, and installation year values for the all assets. For this asset category, all provided values relevant for calculating the ESL were assumed to be accurate, and there were no data gaps. The ESL of each asset was calculated using the following formula:

$$[ESL] = [LastInspection\ Year] - [Installation\ Year] + [Residual\ Life]$$

2.3.2 Facilities

The facility data provided contained detailed information to a granular asset level, however ESL values for individual assets were deemed to be of low confidence when compared against industry standards for similar assets. These values were updated based on industry standards and reviewed by Town staff.

2.4. INSTALLATION DATE / AGE ASSUMPTIONS

The installation date values were used in calculating the current age of each asset. For almost all asset categories, this data was provided in terms of an installation year, but not the full installation date. As a result, for the purposes of this analysis, each asset's age was calculated on a year basis. While there existed very few assets which had completely missing, or NULL, installation year values, several of the asset categories had abnormally large spikes of installations in several years. For the purposes of the analysis, these abnormal spikes were assumed to be interpolated values and not accurate representations of reality. Moving forward, it is recommended that the Town review historical construction drawings and documents or other archived information that was made for each asset to gather accurate installation date data. The following section describes the automated process that was applied to fill the installation date data gaps for each asset category.

2.4.1 Roads & Right of Way Assets

Roads

Based on a review of the distribution of installation dates, it was found that 17% of roads have an installation date before 1900. While these dates are likely not accurate, the road performance values were calculated from actual condition data, not their age. As a result, these installation dates were not used within the AMP and their installation date data was not redistributed.

Sidewalks

The data supplied by the Town did not include any information regarding sidewalk installation dates. GMBP's research of sidewalk installation date information in similar municipalities revealed an absence of data. However, installation dates were not necessary for calculating performance as condition data was provided.

Streetlights

The supplied GIS data had a range of installation dates, however, Fort Erie staff indicated to GMBP that all streetlights were replaced in 2016. Based on this knowledge, it will be assumed that the installation date for all streetlights is 2016.

2.4.2 Water Mains

Based on a review of the distribution of installation dates, it was found that 62% of the assets in the network did not have installation dates assigned. However, installation year ranges were provided by the Town on a per pipe basis, so any pipe without a specific installation date was assigned a random installation year within the provided age range.

After the redistribution of the water main data was applied using the Town's age ranges to correct for the absence of installation dates, further investigation indicated that 7% of the network had an installation date of 1999. The spike in installations for 1999 was largely caused by a concentrated effort to replace watermains in Crystal Beach to address a water colour issue. As a result, this spike was not considered an outlier and was left as-is. Figure 1 below shows the modified annual length of water pipe installed by material.

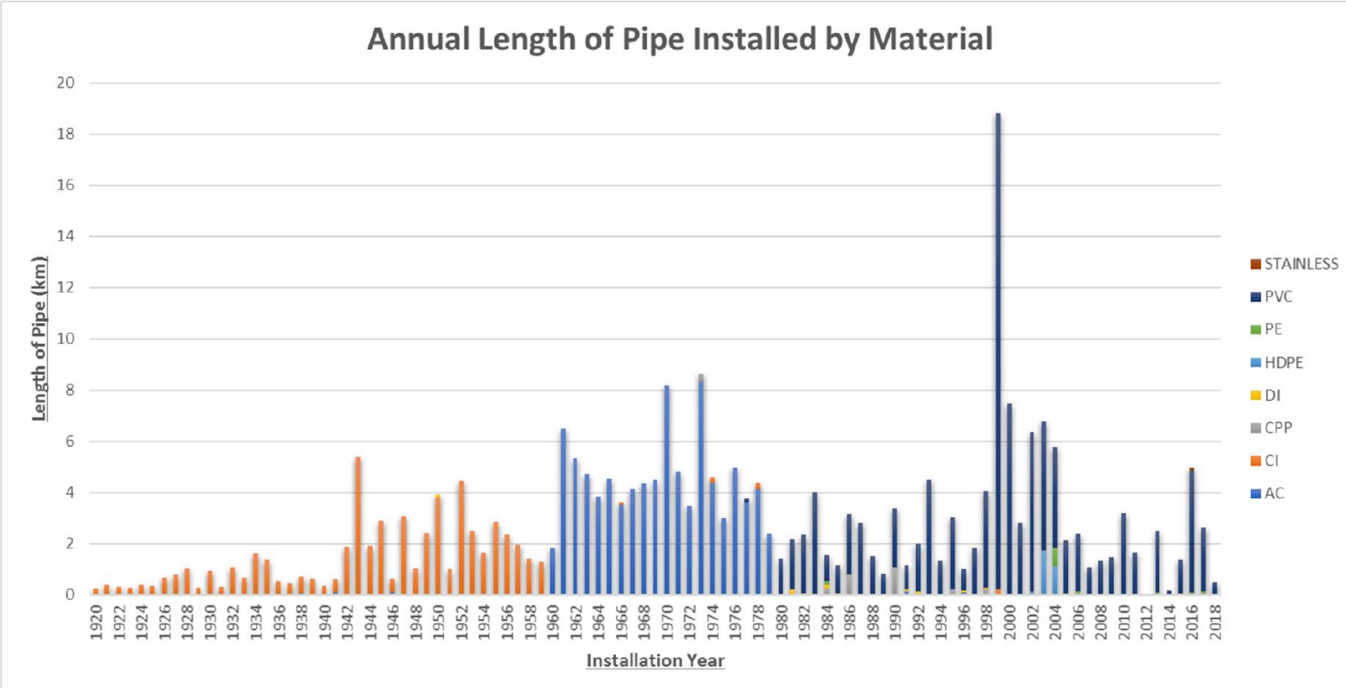


Figure 1: Modified installation date distribution of water mains.

2.4.3 Sanitary Sewers

Based on a review of the distribution of installation dates, it was found that the years 1973, 1983 and 1990 all had large spikes in the length of pipe installed, making up 26% of the sanitary network. However, upon further review with Town staff, it was determined that these installation dates were accurate and were not modified for the analysis. Figure 2 below shows the unmodified annual length of sanitary pipes installed by material used within the analysis.

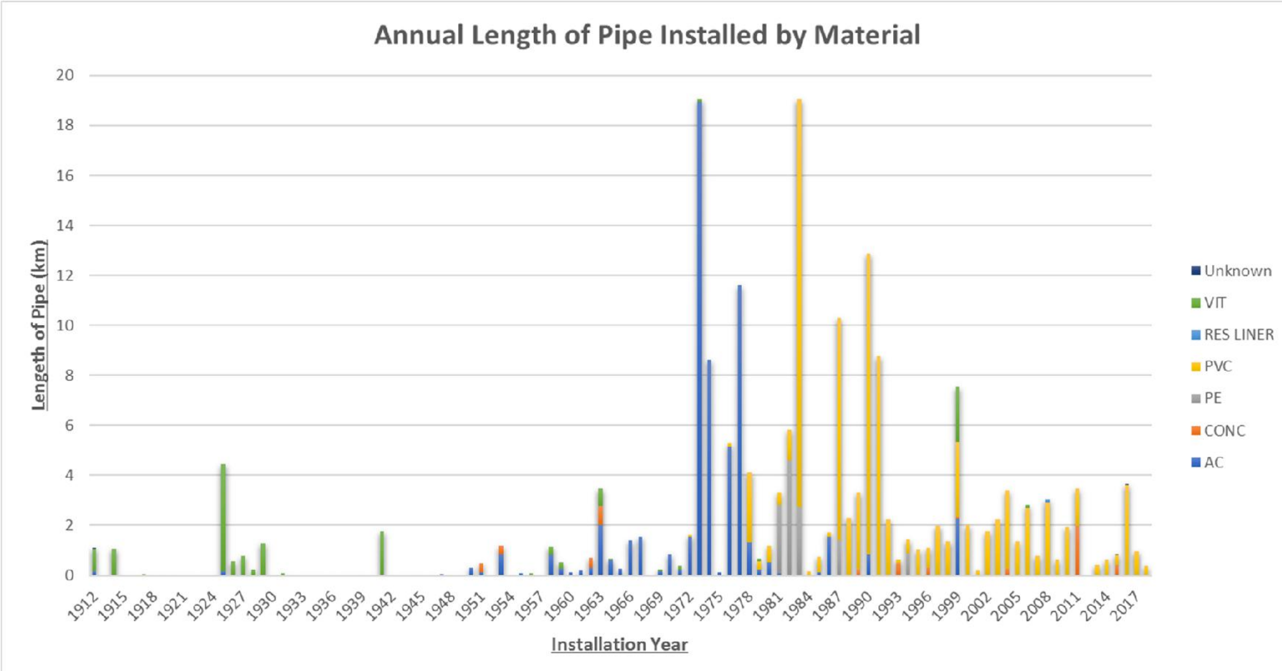


Figure 2: Original installation year distribution of sanitary sewers

2.4.4 Stormwater Sewers

Based on a review of the distribution of installation dates, there was a low confidence in installation date data for the pipes which have an installation date of 1958. Of the 123 km of storm pipe in the GIS data, 39 km (or 31%) of the pipe was assigned an installation date of 1958.

To address this issue, GMBP determined age ranges for each material type based on the Town's data and industry standards, then assigned all pipes that were built in 1958 a year within that range. The age ranges for each material that were applied to the data are listed below in Table 7. It was assumed that all pipes installed after 2000 have been given accurate installation dates and so post-2000 years were kept out of the redistribution ranges.

Table 7: Installation Date Ranges for Storm Sewers

Material	Earliest Year	Last Year
AC	1958	1968
CONBX	1954	1994
CONC	1930	2000
CONEL	1973	1987
CSP	1972	2000
CSPA	1930	2000
PE	1982	2000
PVC	1975	2000
UNK	1930	1980
VC	1930	1960

Figure 3 below shows the modified annual length of Stormwater Sewers installed by material after the age range redistribution had occurred.

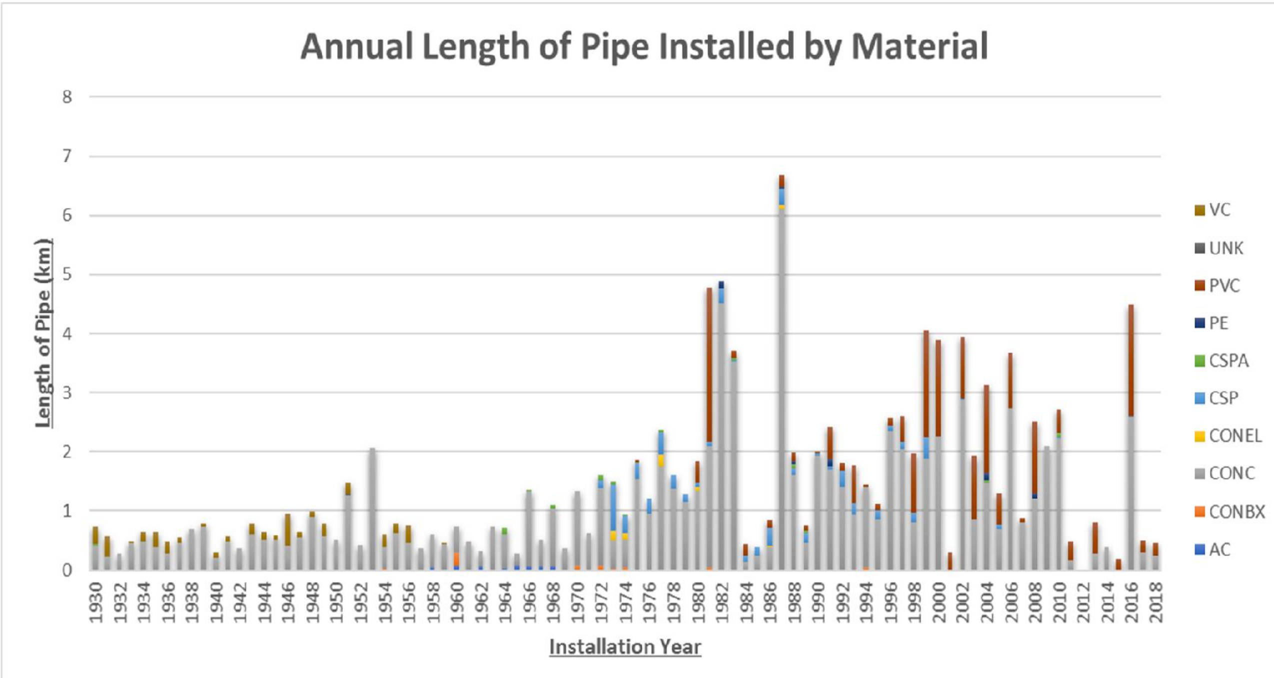


Figure 3: Modified installation date distribution for storm sewers

2.4.5 Bridge & Structure Assets

The construction year for all bridges and structures were provided without data gaps in the data provided by the Town. However, the performance for these assets was calculated based on the provided condition data, not their age. As a result, these construction dates were not used for calculations within the AMP and their data was not estimated or redistributed.

2.4.6 Facility Assets

Estimated installation years for all Facility assets were provided without data gaps in the data provided by the Town. Additionally, each Facility asset had an associated condition score and so the age was not required. As a result, these installation dates were not redistributed by GMBP.

2.5. PERFORMANCE ASSUMPTIONS

While condition data collected through appropriate inspection programs is the most accurate measure of an asset category's performance, in the absence of this data the best assumption that can be made is to approximate an asset's performance based on its age. The following sections describe the calculations for each asset type that were used to calculate performance whether actual condition information was available or not.

2.5.1 Condition Data

There are several asset categories in which accurate, up-to-date condition data has been collected. This may have applied to entire asset types or to only some assets in the category. The following section lists the assets for which condition data has been collected and how this condition data was converted to performance.

It is worth noting that the performance calculated for assets with condition information refers to the performance of the asset at the time it was last inspected, not at the time when the DSS calculated initial performance. For the purposes of maintaining data integrity, the performance of each asset that had condition data was degraded, based on its ESL and based on the period of time since its last inspection, using the following formula:

$$[Current\ Performance] = [Inspection\ Performance] - \frac{[Current\ Year] - [Inspection\ Year]}{[ESL]}$$

Bridges & Structures

The Bridge Condition Index (BCI) is an industry-standard method of measuring the condition of bridge and structure assets' condition from 0 to 100, where 0 is very poor and 100 is very good. BCI data was provided for all bridges and structures, which was used to calculate the performance of these assets using the following formula:

$$[Inspection\ Performance] = \frac{[BCI]}{100}$$

Facilities

The Facility inspection data included a condition field with numbers from 1 to 5, where 5 is excellent and 1 is very poor. No assets were missing condition data. Performance was determined using the Building Condition Index (BCI) as provided by the Town.

Roads

The Pavement Condition Index (PCI) is an industry-standard method of measuring the condition of road assets' condition from 0 to 100, where 0 is very poor and 100 is excellent. For the most part, a road with a PCI of 20 or less is considered undriveable. PCI data was supplied for all but 111 road assets. Upon review, GMBP found that the 111 road assets with no PCI data were not paved roads, and therefore cannot be assigned a PCI. As a result, these 111 non-paved assets were all assigned performance calculated by age. For the paved roads with PCI information, performance was calculated as follows:

$$[Inspection\ Performance] = \frac{[PCI]}{100}$$

Sidewalks

The sidewalk GIS data included a condition field with numbers from 1 to 5, where 1 is excellent and 5 is very poor. Of the 5864 sidewalk assets in the GIS data, a total of 45 assets, or 0.1%, were lacking condition dates and 7 assets, or 0.1%, were missing the actual condition scores. Condition scores for these sidewalks were provided by Town staff.

For calculating the current performance rather than the inspection performance, each asset which was missing an inspection date was assigned the earliest recorded date of June 30, 2016. For those assets which were missing the condition value itself, these assets were assumed to be condition 5. The formula for calculating performance using the sidewalk condition data can be seen below:

$$[Inspection\ Performance] = \frac{5 - [Condition]}{4}$$

Streetlights

All streetlights were replaced in 2016 and assumed to be in Excellent condition, with a 0.85 on a 0 to 1 scale (see Section 4.1 for performance category definitions).

2.5.2 Age and ESL

For the assets which lacked condition data but had accurate age and ESL information available, the following formula was applied to calculate each asset's performance:

$$[Performance] = 1 - \frac{Min([Age], [ESL])}{[ESL]}$$

Where

$$[Age] = [Installation\ Year] - [Current\ Year]$$

This may have applied to entire asset types or only specific assets which happened to be missing condition data.

Roads

As noted above, the 111 unpaved road assets without condition information were all assigned performance calculated by age.

Other

No condition or performance information was provided for several entire asset categories. As a result, age and ESL were used to estimate performance for the following assets:

- Sanitary sewers
- Storm sewers
- Water mains

2.6. ASSET SPECIFIC ASSUMPTIONS

All data sets were reviewed for discrepancies or inconsistencies. In addition to the data changes that were made in an automated fashion mentioned earlier in this report, there were some data outliers that resulted in some assets requiring individual changes. For these changes, the attributes of each asset were inspected in a GIS environment and were revised based on analysis of the attributes of other nearby assets. The issues found, and the corrections made are outlined for each asset category in Table 8 below.

Table 8: Asset Specific Data Corrections

Asset Category	Asset ID	Original Material	Material Change	Original Installation Year	Installation Year Change
Water	2999	Ductile Iron	PVC		
Water	1328			2015	1950
Water	1787	Unk	Cast Iron		
Water	1871	Unk	Cast Iron		
Water	2812			2009	1942
Sanitary	SL1-SA37-0100	VIT	PVC	1999	1991
Sanitary	SL1-SA37-0040	VIT	PVC	1999	2006
Sanitary	SL1-SA32-0330	VIT	PVC	1999	1996
Sanitary	SL1-SA32-0321	VIT	PVC	1999	1996
Sanitary	SL1-SA32-0450	VIT	PVC	1999	2008
Sanitary	SL1-SA32-0430	VIT	PVC	1999	2008
Sanitary	SL1-SA31-0050B	VIT	PVC	1999	2008
Sanitary	SL1-SA40-0210	VIT	PVC	1999	1996
Sanitary	SL1-SA30-0030	VIT	PVC		
Sanitary	SL1-SA30-0020	VIT	PVC		
Sanitary	SL1-SA26-0020	VIT	PVC	1999	2004
Sanitary	SL1-SA26-0010	VIT	PVC	1999	2004
Sanitary	SL1-SA26-0030	VIT	PVC	1999	2004
Sanitary	SL1-SA26-0040	VIT	PVC	1999	2004
Sanitary	SL1-SA23-0080	VIT	PVC	1999	1993
Sanitary	SL1-SA23-0090	VIT	PVC	1999	1993
Sanitary	SL1-SA23-0100	VIT	PVC	1999	1993
Sanitary	SL1-SA23-0110	VIT	PVC	1999	1993
Sanitary	SL1-SA15-0390			1999	1928
Sanitary	SL1-SA21-0201			1999	1925
Sanitary	SL1-SA21-0202			1999	1925
Sanitary	SL1-SA15-0221			1999	1925
Sanitary	SL1-SA15-0220			1999	1925
Sanitary	SL1-SA15-0100	VIT	PVC		
Sanitary	SL1-SA10-0250			1999	1914
Sanitary	SL1-SA10-0145			1999	1914
Sanitary	SL1-SA10-0130			1999	1914
Sanitary	SL1-SA42-0145			1999	1914

Asset Category	Asset ID	Original Material	Material Change	Original Installation Year	Installation Year Change
Sanitary	SL1-SA12-0020			1999	1926
Sanitary	SL1-SA12-0010			1999	1926
Sanitary	SL1-SA07-0110A	VIT	PVC	1999	1985
Sanitary	SL1-SA32-0350	PE	PVC	1928	2008
Sanitary	STUB 1	Unknown	PVC		
Sanitary	STUB 2	Unknown	PVC		
Sanitary	STUB 3	Unknown	AC	0	1977
Storm	35-STS-04-0020	UNK	CONC		

Note that these data corrections were made to fix obvious data outliers and were done without consulting the as-built drawings. GMBP recommends that the Town consult these drawings before making these modifications in their version of the GIS data.

3. INVENTORY & VALUATION

The scope of asset categories to be included in this assignment was defined by the Town and is listed in Table 9 below.

Table 9: Asset Inventory

Service Category	Asset	Inventory (# or m)	Average Age (Years)	Total Replacement Value ($)
Roads & ROW	Roads	422,880m	62	$386,403,656
	Streetlights	3,342	2	$2,406,240
	Sidewalks	144,410m	Insufficient Data	$23,326,386
Water	Mains	264,919m	38	$171,796,084
	Hydrants	1,531	Same as Mains	Built into Main Costs
	Valves	1,836	Same as Mains	Built into Main Costs
Wastewater	Sewers	193,538m	35	$136,003,666
	Manholes	2,477	Same as Sewers	Built into Sewer Costs
Stormwater	Sewers	123,326m	33	$156,184,476
	Manholes	2,093	Same as Sewers	Built into Sewer Costs
Bridges & Structures	All	179	44	$37,350,500
Facilities Management	All	16 Facilities, 974 Assets	18	$98,423,527
			Total Value:	**$1,003,807,668**

The following figure shows the asset replacement value of all service categories. The highest total asset replacement values can be found in the Roads & ROW category, which makes up over 40% of the total replacement value.

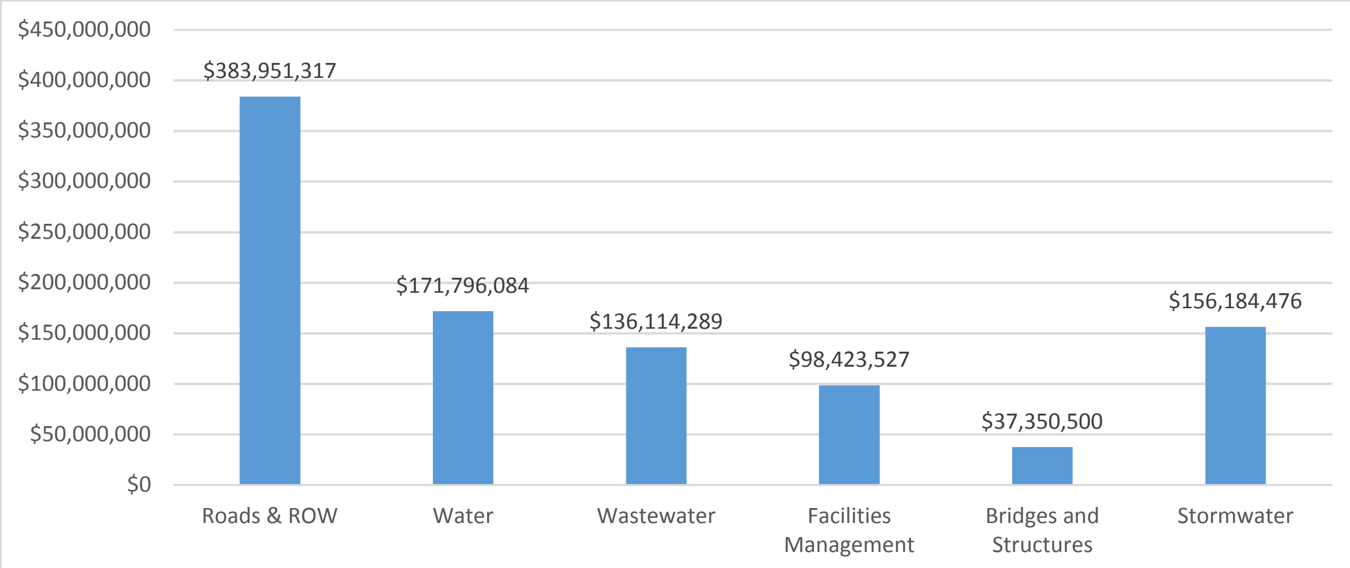


Figure 4: Asset Replacement Value by Asset Category

3.1. ROADS & RIGHT-OF-WAYS

Figure 5 shows the asset replacement values broken down for different road classes. The service has a total asset replacement value of $386,403,656, the majority of this value being local roads.

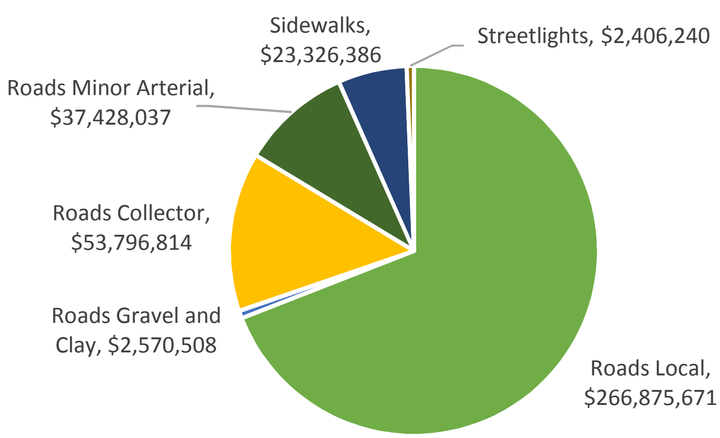


Figure 5: Road Replacement Value Breakdown by Road Class

3.1. WATER

Figure 6 shows the asset replacement values for watermains broken down based on pipe diameter. The service has a total asset replacement value of $171,796,084, with over 90% of this value being made up of polyvinyl chloride (PVC), asbestos cement (AC) and cast iron (CI) mains.

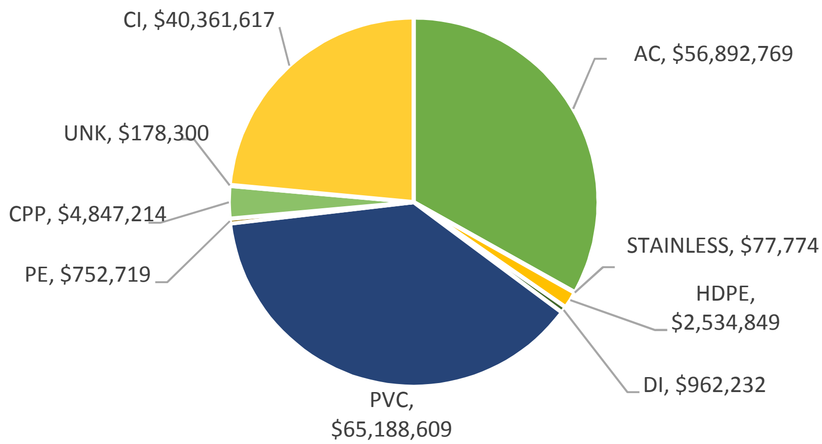


Figure 6: Watermain Replacement Value Breakdown by Material

3.1. WASTEWATER

Figure 7 shows the asset replacement values for wastewater sewers broken down based on pipe diameter. The service has a total asset replacement value of $136,003,666, with half of this value being made up of PVC sewers.

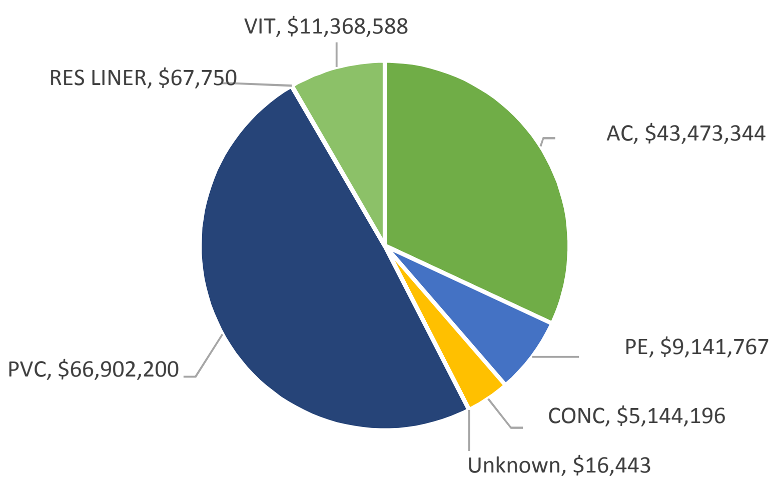


Figure 7: Wastewater Sewer Replacement Value Breakdown by Material

3.1. STORM

Figure 8 shows the asset replacement values for storm sewers broken down based on pipe diameter. The service has a total asset replacement value of $156,184,476, with over 75% of this value being made up of concrete (CONC) sewers.

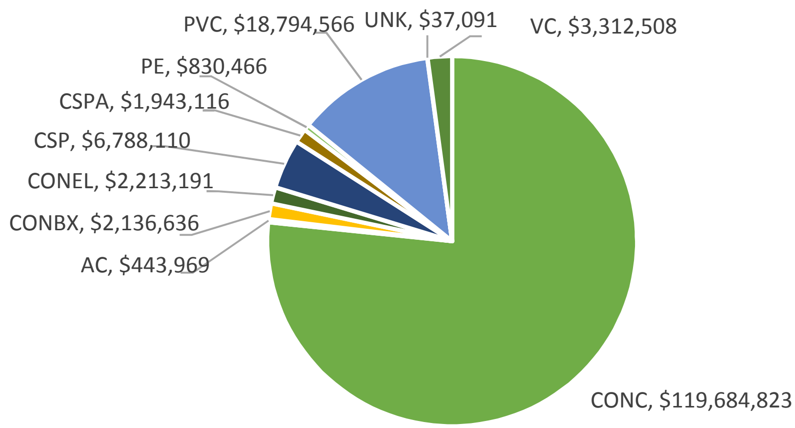


Figure 8: Storm Sewer Replacement Value Breakdown by Material

3.2. BRIDGES & STRUCTURES

Figure 9 shows the breakdown of asset replacement values for bridge and structure assets. The service has a total asset replacement value of $37,350,500, with the majority of this value being bridges.

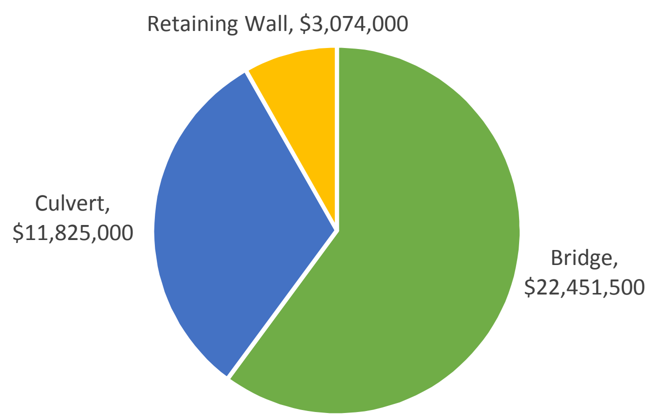


Figure 9: Bridge & Structure Replacement Value Breakdown by Asset Type

3.3. FACILITIES MANAGEMENT

Figure 10 shows the breakdown of asset replacement values for Facilities Management assets. The service has a total asset replacement value of $98,423,527, with the largest portion of this value being made up of the Leisureplex.

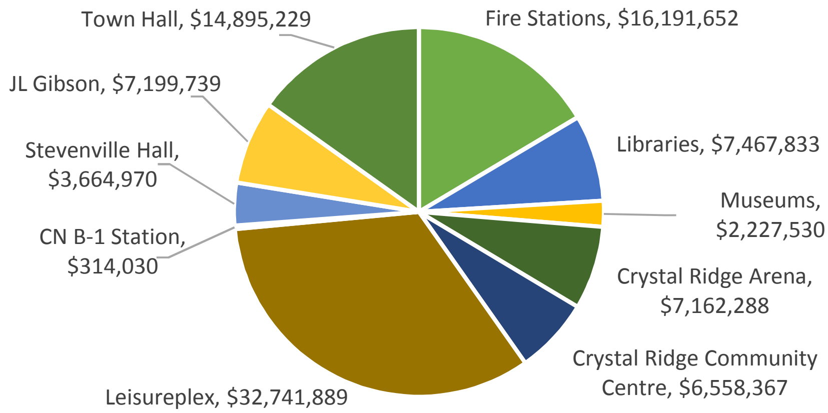


Figure 10: Facilities Management Replacement Value Breakdown by Facility/Facility Type

4. CURRENT CONDITION / PERFORMANCE

4.1. GENERAL APPROACH

The best available data was used to measure asset performance. Where condition data was provided, it was converted to a consistent 0 - 1 scale for performance scoring analysis with 1 being excellent. Asset performance for all other asset groups with no available condition data was calculated using age and ESL. Where this data was limited or unavailable, no performance value was calculated. The complete methodology for how the performance was assigned within the system will be provided in Technical memorandum #12: Database Analysis and Logic.

Table 10 illustrates how the performance score for each asset was assigned to a performance category that was consistent across all asset groups, except roads and water. These performance categories were used in the performance forecasts.

Table 10: Performance Categories

Performance Range	Performance Category	Description
0 - 0.2	Very Poor	**Unfit for sustained Service** - These assets are below standard condition with widespread signs of deterioration
> 0.2 - 0.4	Poor	**At Risk** - These assets are mostly below standards and many elements are approaching the end of their service life
> 0.4 - 0.6	Fair	**Requires Attention** - some assets show general signs of deterioration and some deficiencies are starting to show
> 0.6 - 0.8	Good	**Adequate for Now** - Most assets are functioning with a few elements showing signs of deterioration
> 0.8 - 1	Excellent	**Fit for the Future** - Overall condition of assets and their associated elements is good or newly replaced/rehabilitated

For Road assets, the Town's current system for tracking and forecasting performance uses a different range for categorizing performance. To be consistent with the Town's current system, performance ranges for Road assets were defined as listed in Table 11, below.

Table 11: Performance Categories for Roads

PCI Range	Performance Range	Performance Category
<50	< 0.50	Poor
50 - < 65	0.50 - < 0.65	Fair
65 - <80	0.65 - <0.80	Good
>=80	>=0.8	Excellent

For Water assets, the number of watermain breaks was used as a condition performance measure at the system level, based on available data. Functional performance measures, such as fire flow or pressure, can also be effectively used as performance measures, but this would require additional analysis not within the scope of this report. Age of watermain is sometimes used, but it was found that the age of the assets misrepresented the performance of the system and therefore the number of breaks was used to assign a performance category, as shown in Table 12.

Table 12: Performance Categories for Watermains

Total # of Breaks	Performance Category	Typical Break Frequency
>10	Very Poor	< 1 year
>5 - 10	Poor	Every year
>1 - 5	Fair	Every 1 – 2 years
>0 - 1	Good	> Every 2 years
0	Excellent	No breaks

Table 13 shows the average performance (weighted by replacement value) for each service category. The weighted average performance for all assets, where a performance was calculated, was 0.65 (Good).

Table 13: Average Performance (Weighted by Replacement Value) per Service Category

Service Category	Asset	Average Performance
Roads & ROW	Roads	0.75 (Good)
	Sidewalks	0.76 (Good)
Water	Mains	Good*
Wastewater	Sewers	0.45 (Fair)
Stormwater	Sewers	0.57 (Fair)
Bridges & Structures	All	0.66 (Good)
Facilities Management	All	0.71 (Good)
	Average:	**0.65 (Good)***

*Not including water assets as a 0-1 performance scale was not used.

Wastewater and Stormwater sewers were found to have the lowest average performance of the service categories. This was based on the performance for sewers being an estimated conditional performance using ESL and Age, therefore the low performance rating for these assets reflected the fact that much of the replacement value of the system was for pipes that were near, at, or beyond their ESL.

Figure 11 outlines the ratio of performance score categories for all assets where performance was weighted by asset replacement value. This figure includes water assets as the assets were assigned comparable performance categories.

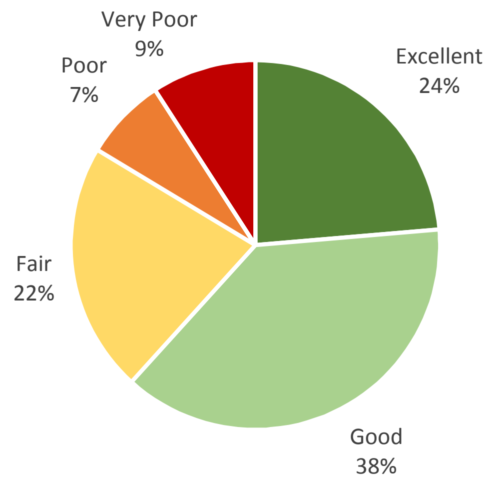


Figure 11: Performance Breakdown for All Assets (with performance data)

4.2. ROADS & RIGHT-OF-WAYS

Figure 12 below outlines the breakdown of performance categories for Roads. The average performance weighted by replacement value of these assets is 0.75 (Good).

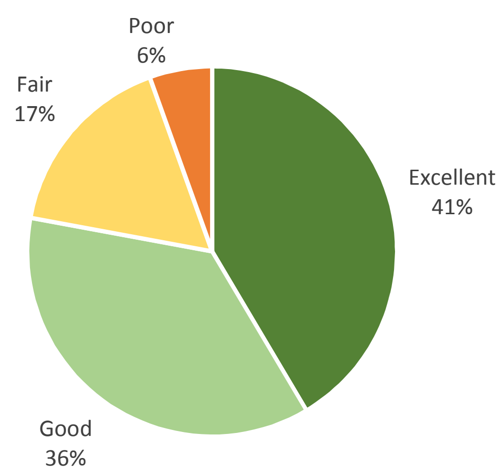


Figure 12: Road Performance Breakdown Weighted by Replacement Value

Figure 13 below outlines the breakdown of performance categories for Sidewalks. The average performance weighted by replacement value of these assets is 0.76 (Good). It should be noted these will require revision following the Town's Road Optimization Study.

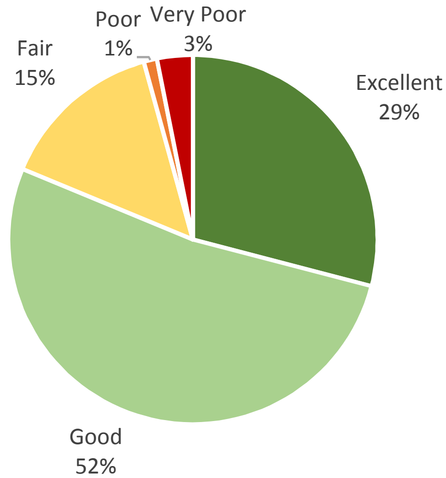


Figure 13: Sidewalk Performance Breakdown Weighted by Replacement Value

4.3. WATER

Figure 14 below outlines the breakdown of performance categories for all Water assets based on the total number of breaks per watermain. Worth noting is that these condition ranges were assigned based on the break model which is separate from the DSS, as such these condition ranges cannot be compared against the other asset categories. The average number of breaks weighted by replacement value of these assets is 0.7 which equates to "Good" condition when compared to Table 12 above.

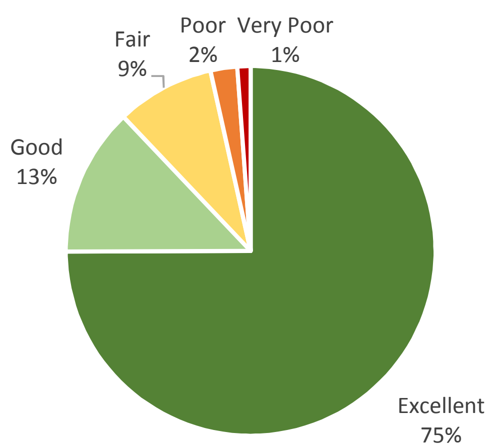


Figure 14: Watermain Performance Breakdown Weighted by Replacement Value

4.4. WASTEWATER

Figure 15 below outlines the breakdown of performance categories for Wastewater sewers. The average performance weighted by replacement value of these assets is 0.45 (Fair).

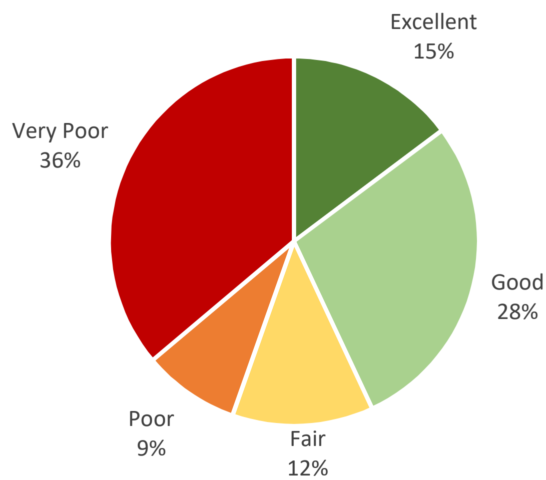


Figure 15: Wastewater Sewer Performance Breakdown Weighted by Replacement Value

4.5. STORM

Figure 16 below outlines the breakdown of performance categories for all Storm assets. The average performance weighted by replacement value of these assets is 0.57 (Fair).

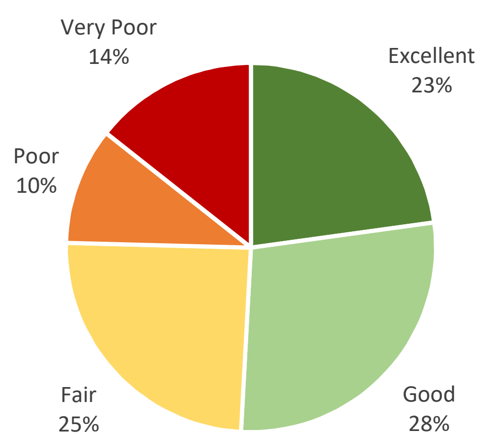


Figure 16: Stormwater Sewer Performance Breakdown Weighted by Replacement Value

4.6. BRIDGES & STRUCTURES

Figure 17 below outlines the breakdown of performance categories for all Bridge and Structure assets. The average performance weighted by replacement value of these assets is 0.66 (Good).

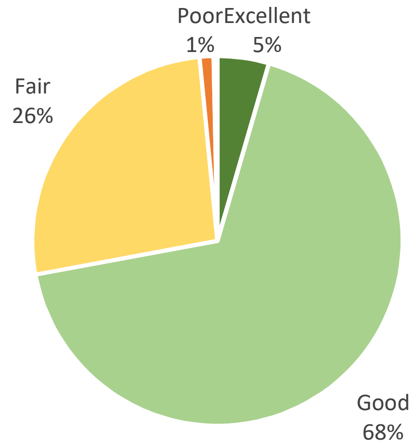


Figure 17: Bridge & Structures Performance Breakdown Weighted by Replacement Value

4.7. FACILITIES MANAGEMENT

Figure 18 below outlines the breakdown of performance categories for all Facilities Management assets. The average performance weighted by replacement value of these assets is 0.71 (Good).

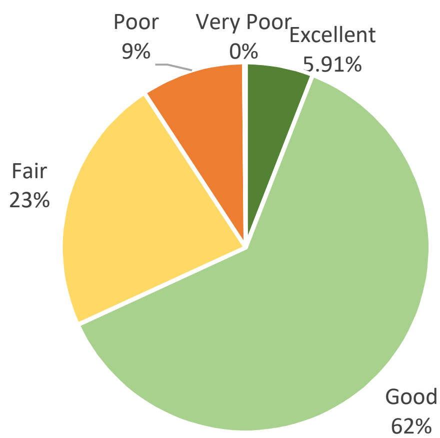


Figure 18: Facilities Management Performance Breakdown Weighted by Replacement Value

5. ASSET LIFECYCLE ACTIVITIES & COSTING

The following tables list possible lifecycle activities or treatment types, excluding replacement, for key asset types, with generalized costing information that may vary based on the asset being treated (location, size, material, etc.) and the type and severity of the defect. These activities have been provided to outline available rehabilitation options that may be used to extend the life of assets and does not represent current lifecycle activities in use within the Town currently.

Table 14: Road Lifecycle Activities & Costs

Activity	Surface Type	Unit Cost	Unit
Pothole Repair	Asphalt, Surface Treated	\$175 - \$250	tonne
Crack Sealing	Asphalt	\$1.70 - \$2.25	m
Mill Top	Asphalt	\$4	m^2
Pave Overlay	Asphalt	\$150	tonne
Mill Top & Mill Base	Asphalt	\$8	m^2
Single Surface Treatment (SST)	Surface Treated	\$4	m^2
Double Surface Treatment (DST)	Surface Treated	\$8	m^2
Bonded Wearing Course	Surface Treated	\$5 - \$10	m^2
Pulverize and Double Surface Treatment	Surface Treated	\$3.25	m^2

Table 15: Sanitary and Storm Sewer Lifecycle Activities & Costs

Activity	Diameter (mm)	Unit Cost	Unit
Full length Trenchless Lining	-	\$1.25	mm diameter x m length
Trenchless Spot Lining/Repair	<= 500	\$4,500 – \$5,500	each
	>500	\$8,500 – \$9,500	each

6. DATA MANAGEMENT RECOMMENDATIONS

It is recommended that the Town develop a data management plan to support the development of subsequent Asset Management Plans (AMP). The requirements and steps necessary to complete the data management plan are outlined below.

- **Business Process / Workflow Development**

  The data management plan will outline processes for the collection, maintenance and aggregation of data for use within the AMP. Reviewing current processes will be necessary to understand how data is currently handled and determine where changes are required, or if improvements can be made to better align with AMP requirements.

- **Outline Roles & Responsibilities**

  The data management plan should also outline the roles and responsibilities for key staff involved in developing the AMP. Recommendations have been provided on the resources necessary for AMP development in Technical Memorandum #10: Recommended Future Staffing Structure and AMP Requirements (combined with Technical Memorandum #2). Once roles have been assigned, the workflows can be used to identify who is responsible for each action, including data collection, data management, data aggregation, etc.

APPENDIX E: TECHNICAL MEMORANDUM #5 - LEVELS OF SERVICE DEVELOPMENT

Date:	5/24/2019	File:	618004
To:	Kelly Walsh, P.Eng. Director, Infrastructure Services		
From:	GM BluePlan Engineering		
Project:	Asset Management Plan		
Subject:	Level of Service Development		

TECHNICAL MEMORANDUM #5 – LEVEL OF SERVICE DEVELOPMENT

1. INTRODUCTION

GM BluePlan (GMBP) was retained by the Town of Fort Erie to develop an Asset Management Plan that follows the Province's structure outlined in the Guide for Municipal AM Plans, and will address the requirements from Ontario Regulation 588/17. As a part of this project, GMBP worked with Town staff to develop a comprehensive Level of Service (LOS) Framework that can apply to all services that the Town provides, which are reliant on infrastructure assets to be delivered.

Based on this, the key objectives of this memorandum are as follows:

- ***Framework Structure*****:** Overview of the various fields captured within the LOS frameworks.
- ***Key Service Attributes & Performance Measures*****:** Definitions of the various attributes used to within the level of service statements. Attributes are used to categorize the performance metrics.
- ***Implementation Plan and Future Updates*****:** Identify the approach for updating performance measures through prioritization of these needs within a data collection program.

The development of the LOS Framework was completed through a working session with the Town's Director of Infrastructure Services and subject matter experts. The details of the framework are illustrated in the LOS tables which were developed for each in-scope service category through a workshop, the details of which are summarized in Appendix A. Both Technical and Customer levels of service were derived for each of the following six (6) service categories:

1. Water
2. Wastewater
3. Stormwater
4. Facilities
5. Roads & Right of Ways
6. Bridges and Structures

Note that the focus of this project applied to the Town's services that are largely supported by infrastructure assets and have recent condition data and master plan-type studies.

2. STRUCTURE OF THE LEVELS OF SERVICE FRAMEWORK

The LOS tables were developed in conjunction with the Town's subject matter experts (SME) during the LOS workshop held on August 8th, 2018. In an effort to expedite discussion and ascertain SME feedback GMBP developed preliminary LOS tables based on available data and industry standard practices prior to commencing the workshop. The resulting feedback was incorporated into the LOS tables during the workshop and the final version of the tables were provided to, and later approved by, Town staff. The final staff recommended LOS tables are provided in Appendix A.

The structure of the LOS tables for the Town were developed by leveraging GMBP's experience and knowledge of international best practices. The tables were developed in accordance with Ontario Regulation 588/17 "Asset Management Planning for Municipal Infrastructure" made under the Infrastructure For Jobs and Prosperity Act, 2015.

The LOS tables were developed for each in-scope service category as listed above. Each table is comprised of four major components: Service Statements; Key Service Attributes; LOS Statements; and, Performance Measures. The tables are comprised of the following structure:

1. A ***Service Statement*** is listed above each table, which briefly describes the kind of service that will be provided to residents. For example, the service statement for facilities management is "Efficiently providing high quality, safe, accessible, and energy efficient facilities for the community".

2. ***Key Service Attributes*** is the first major column of the table. Each Key Service attribute consists of a phrase which describes an important area of focus for each service group. Examples of Key Service Attributes include Cost Efficient, Safe, Reliable, etc. The listed Key Service Attributes are meant to cover all important aspects of the service and be easy for the customer/public to understand and recognize. Each Key Service Attribute is listed along the rows of the LOS Table.

3. ***LOS Statement*** is the second major column of the table. Each LOS Statement consists of a short sentence, which describes the outputs of the service category. Each LOS Statement corresponds to a Key Service Attribute. One or multiple LOS statements may apply to each Key Service Attribute. Each LOS Statement should clearly state customer standards and be measurable. Using the facilities management service as an example, for the Key Service Attribute, "Quality", and the LOS Statement is "Providing clean and safe facilities in good condition for users".

4. The remainder of the table is comprised of ***Performance Measures***. Performance measures identify specific areas of focus that can be measured to support each Key Service Attribute. One or multiple performance measures can be listed for

each Key Service Attribute. The LOS tables provide two types of Performance Measures: Customer and Technical. Each Performance Measure should be defined using the SMART acronym (specific, measurable, achievable, relevant, and time-bound). Each Performance Measure is further subdivided into four components, which are represented as additional columns in the LOS table. These components detail the Performance Measure, Current Performance, Data Source (that will be used to measure performance), and Proposed Performance.

Each performance measure is categorized as one of the following:

- Foundational Measures (shaded blue): These measures have available data to track current performance levels and have been tied into the financial strategy to develop proposed LOS.
- Advanced Measures (shaded green): These measures either do not have data to track current performance at this time, or are currently not tied into the financial strategy.
- O.Reg. 588/17 Measures (shaded peach): These measures are legislated under O.Reg. 588/17 and must have current performance defined by 2021 and proposed performance defined by 2024.

The Town will continue to collect additional data and complete various projects/activities to populate remaining current performance metrics over the life of this plan.

3. KEY SERVICE ATTRIBUTES AND PERFORMANCE MEASURES

The Key Service Attributes that were used for the LOS tables include Cost Efficient, Quality, Reliable, Environmental Stewardship (or Environmentally Conscious), Safe, Accessible, Scope (O.Reg.588) and Operational.

Cost Efficient is a common Key Service Attribute used in LOS tables throughout many municipalities. In this project, Cost Efficient was used as a Key Service Attribute for every in-scope service category. Every table includes the cost to provide the service and average asset renewal rate as customer performance measures. The average asset renewal rates in some tables are broken down by asset type, where appropriate. The cost to provide the service is determined by using the operating and capital budgets as technical performance measures.

Quality is typically measured by assets meeting or exceeding target conditions and design standards. It can also be measured by the number of complaints about the quality of the service, such as the number of complaints due to rusty/discoloured water and low pressure for water services.

The Reliability of a service in most of the tables is measured by the physical condition of the assets and other types of performance measures, such as the number of customers that experience basement flooding caused by wastewater system surcharge.

Energy and water consumption are the most common performance measures used in Environmental Stewardship. There are some performance measures that are service-specific, such as the number of relief pumping events in wastewater services and the volume of salt applied within the road allowance.

Safety is included in the facilities management and water tables. For facilities management, safety is measured by the number of incidents, security standards, work performed, and defects/improvements identified. Water safety relates to sufficient fire flow and water quality regulations.

Accessibility is included in the facilities management and road tables and is measured based on AODA compliance and accessible pedestrian traffic signals (roads only).

Operational is included in the bridge and road tables and is measured based on incidents, defects, and maintenance activities.

Scope has been included for most asset service categories to comply with O.Reg 588/17 and typically includes descriptions of the services provided by the Town. Under the regulation, the scope of the asset category service provision to the community as a whole is a required performance measure for core asset categories.

4. IMPLEMENTATION PLAN TO OPERATIONALIZE PORTIONS OF THE FRAMEWORK

The LOS frameworks clearly distinguish between foundational and advanced metrics. Foundational metrics include performance measures that use readily available asset data such as operational and capital expenditures, and condition/age data. For the advanced metrics, more data and logic are required to connect the amount of expenditures needed to forecast the measure over time. For example, a hydraulic grade line analysis would need to be performed for wastewater assets to determine basement flooding risks. A wastewater hydraulic model needs to be fully developed and calibrated in order to determine the percentage of the system surcharged within 1.8 m of the ground elevation during a 25-year wet weather event.

In addition, the frameworks highlight the LOS measures that are required under O.Reg. 588/17. Further work is required to fully develop, measure, and verify several current and proposed LOS, including several legislated performance measures.

The legislated LOS deadlines are:

- current LOS assessment for core assets is July 1, 2021,
- current LOS assessment for all assets by July 1, 2023, and
- proposed LOS assessment for all assets, linking to a funding strategy, by July 1 2024.

It is recommended that the Town meet internally to confirm how these measures will be interpreted and defined based on available data. For example, until a stormwater hydraulic model has been developed, the Town may choose to define property resiliency based on the proximity to stormwater infrastructure. Where data is not available, the Town will need to begin collecting and tracking this information.

The refinements to the available LOS data that are described below should be prioritized and planned by the staff responsible for asset management, in collaboration with subject matter experts. In some cases, it may be feasible to complete the refinements using internal Town staff resources through incorporation into existing work planning processes. If the Town does not have sufficient resources, then consideration should be given to retaining additional support through the procurement of external resources. Activities to refine or collect data may include, but not be limited to:

- New data collection;
- Digitizing existing data; and
- Data processes/analysis of existing data.

The following table summarizes the different types of recommended projects/activities required to operationalize the LOS Frameworks.

Table 1: Recommended projects to operationalize LOS

Service Category	Recommended Project/Activity	Description
All or Several Service Categories	Annual Update to Financial Analysis	Through the annual analysis of operating and capital budgets, update the AMP financial strategy analysis to determine the amount of annual expenditures for each service category.
	Ongoing Asset Management Analysis	Refine the ability to apply asset management strategies to the available asset data and financial analysis. The current system largely focuses on asset replacements, however, developing more complex strategies (lifecycle rehabilitation options, degradation analysis, etc.) and incorporating them into the analysis will require additional effort. This will enable the Town to forecast the foundational metrics immediately and the advanced metrics once the data is available. Asset management analysis includes spatial analysis of the asset inventory for the frameworks with spatial metrics. This capability will support the Town in their efforts to be in compliance with O.Reg 588/17.
	Customer Relationship Management System (CRM)	Update the processes to collect, store and analyze feedback/complaints from the community. The system should have the ability to tie feedback to both a service area and specific asset, and outline if infrastructure needs were identified.

Service Category	Recommended Project/Activity	Description
	Work Management System	Connect the Town's work order management system so available data can be fed into the system to help capture and analyze the operation and maintenance expenditures on assets across the corporation and support the population of many advanced metrics in the LOS Frameworks.
	Customer Satisfaction Survey	The Town should complete a survey of the community every 5 years to understand their satisfaction of Town services, including understanding residents' satisfaction with traffic flow and the accessibility of road assets. Many of the advanced customer metrics require feedback from the public to understand how service meets their expectation. Ongoing and repetitive public survey is critical to provide consistent trending over time.
	Field Survey	Additional data collection is required to populate some of the performance measures in the LOS Frameworks.
	Internal Service Level Agreement	Internal department workshops to maintain and adjust targets and asset management analysis.
Stormwater	Storm Water Master Plan	The Town should undergo a Stormwater Master Plan Study in the near future. This Study is an ideal opportunity to collect data and develop the processes to operationalize the performance measures in the LOS Framework.
	Stormwater Hydraulic Model Update	Once data collection has been completed for the stormwater system, a stormwater hydraulic model should be created to determine the resiliency of the stormwater network. This will support the Town in their efforts to be in compliance with O.Reg 588/17.

5. UPDATING PERFORMANCE MEASURES AND REPORTING

As part of operationalizing Levels of Service, the Town should adopt an annual performance review and reporting exercise. As part of that review, current and proposed performances should be assessed and updated as needed. Figure 1 illustrates the typical procedure for updating performance measures and reporting on proposed LOS.

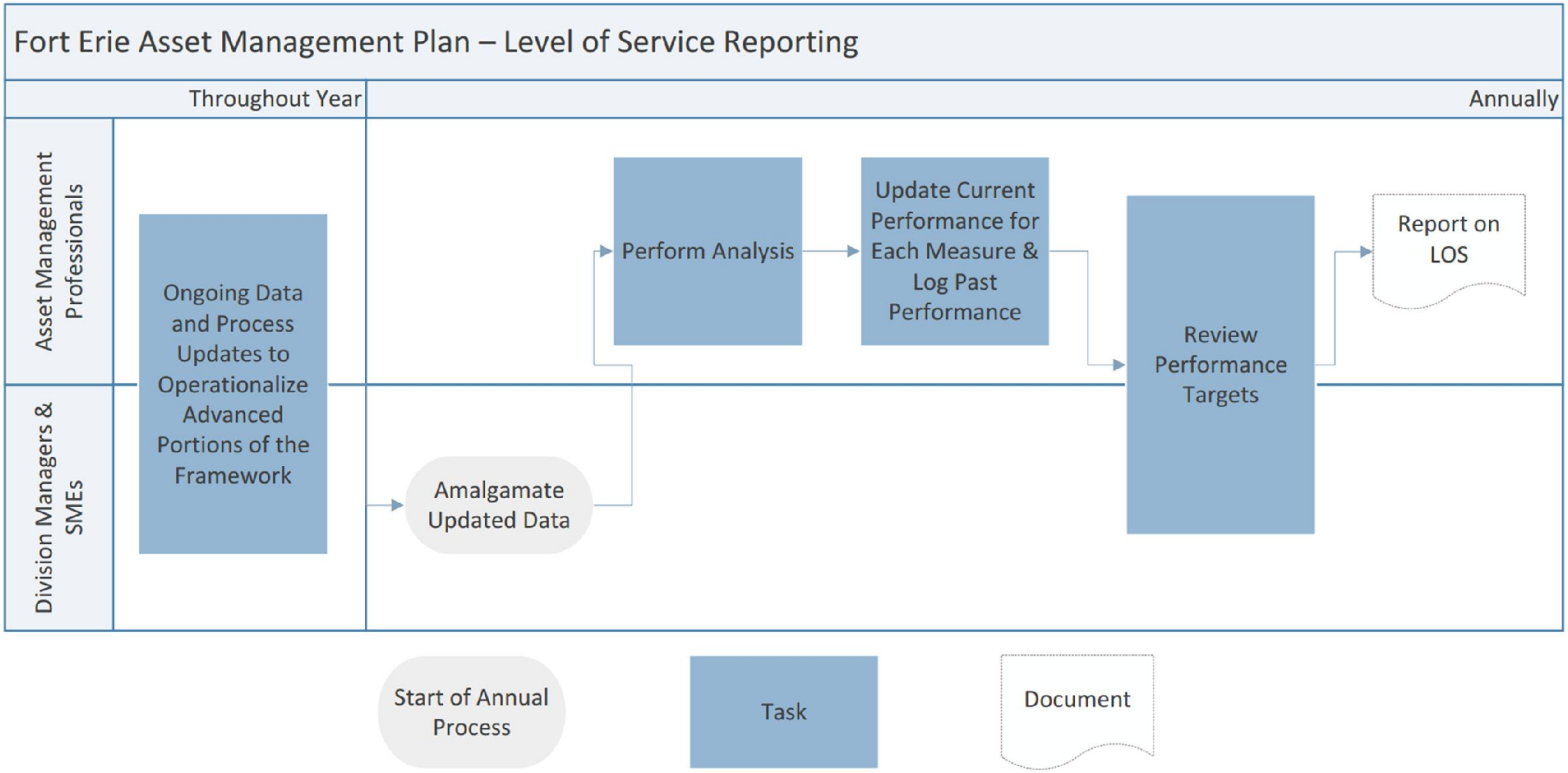


Figure 1: LOS Business Process Diagram

6. THE EFFECT OF PROJECTED POPULATION GROWTH AND EXPENDITURES ON LOS

Census data indicates that the Town of Fort Erie's population was 30,700 in 2016 (https://www.statcan.gc.ca). Population projections to the year 2041 were established by Niagara Region through Niagara 2041 and the Municipal Comprehensive Review. These projections estimated a total population of 43,940 in the year 2041. This number represents approximately 40% population growth over the 25-year period between 2016 and 2041. During that period, the rate of population growth was also projected to increase. The rate of population increase was projected to be approximately 10% over the ten (10) year period between 2016 and 2026, after which it was projected to be 10% over each five (5) year period between 2026 and 2041.

Along with population growth, infrastructure expenditures will also increase. The Niagara Region 2016 Water and Wastewater Master Servicing Plan Update indicates Capital Program expenditures of $306,649,000 for Water Services and $500,318,000 for Wastewater Services. Other infrastructure expenditures will follow suit.

Population growth and increasing expenditures will affect the Levels of Service established by the Town during this project. Several of the established Customer and Technical performance measures – in particular, current and proposed performances – will likely increase along with population and expenditures.

GM BluePlan has completed an analysis of the performance measures established by the Town, which is included in the LOS Tables (Appendix A). For both Customer and Technical performance measures, a “Forecast” column is provided on the LOS Tables. In areas where performances are expected to increase, a “↑” symbol is indicated in the Forecast column. In areas where performances and targets are expected to remain the same, a “-” symbol is indicated. Typically, metrics that are estimated to remain the same are those that measure performance as an average or percentage of the system of assets in question.

APPENDIX A: LOS TABLES

Asset Levels of Service Framework

Service Category: Bridges & Structures
Service Statement: Efficiently providing operational and accessible bridges at the appropriate quality that support drivers, cyclists and pedestrians.

Key Service Attribute	LOS Statement	Customer/Council Focused Performance Measures					Technical Focused Performance Measures				
		Performance Measure	Current Performance	Data Source	Proposed Performance	Forecast	Performance Measure	Current Performance	Data Source	Proposed Performance	Forecast
Cost Efficient	Providing bridges and structures in an efficient manner	Annual cost to provide service ($/household)	$156/household	Operating Budget Capital Budget - 2018 Budget Book (PDF)	$156/household	-	Annual operating budget for bridges and structures	TBD	Operating Budget	TBD	↑
							Average annual capital expenditure for bridges and structures	$1,019,245	Capital Budget - 2018 Budget Book (PDF)	$1,019,245	↑
		Average bridge and structures renewal rate (# years)	37 years	Asset Management Forecaster (Excel)	37 years	-	10 Year average bridges and structure asset renewal budget as a % of replacement value	2.7%	Capital Budget - 2018 Budget Book (PDF)	1% - 1.5%	-
Operational	Providing operational bridges and structures that are safe for drivers, pedestrians and cyclists	# of vehicle, cyclist, and pedestrian incidents (complaints)	21	CRM Export (Excel)	TBD	↑	# of accessibility complaints of bridges and structures	0	CRM Export (Excel)	TBD	↑
							% of reactive work completed within (TBD) days	TBD	CMMS (once implemented)	TBD	-
							% of planned maintenance activities completed as per schedule	TBD	CMMS (once implemented)	TBD	-
							# of bridges that negatively impact the hydraulic capacity / flow of the watercourse	TBD	Ellis 2017 Engineering Report (PDF)	TBD	↑
Quality	Providing operational bridges and structures that are safe for drivers, pedestrians and cyclists	The general condition of bridges, and how general condition affects overall bridge use in Fort Erie	On average, the majority of bridges are in good condition, thus providing reliable bridge availability to the public.	SOGR TM	On average,majority of bridges in good condition, thus providing reliable bridge availability	-	For bridges in the municipality, average bridge condition index value.	69	Bridge Inspection Excel Export	58	↓
	Providing operational bridges and structures that are safe for drivers, pedestrians and cyclists	The general condition of culverts, and how general condition affects overall culvert use in Fort Erie	On average, the majority of culvert assets are in good condition, thus providing reliable culvert availability to the public.	SOGR TM	On average,majority of culverts in good condition, thus providing reliable culvert availability	-	For structural culverts in the municipality, average bridge condition index value.	68	Bridge Inspection Excel Export	57	↓
Scope	Providing an accessible transportation network to the public	Traffic that is supported by Fort Erie bridges (e.g., heavy transport vehicles, motor vehicles, emergency vehicles, pedestrians, cyclists)	All ranges of traffic types are supported by almost all bridges, unless otherwise posted.	Engineering	All ranges of traffic types are supported by all bridges wherever practicable.	-	% of bridges in the municipality with loading or dimensional restrictions	2.0%	Bridge Inspection Excel Export	2.0%	-

Foundational Metrics
Advanced Metrics
O.Reg 588/17 Metrics

Asset Levels of Service Framework

Service Category: Roads and Right-of-Ways
Service Statement: Efficiently providing operational and accessible roads at the appropriate quality that support drivers, cyclists and pedestrians.

Key Service Attribute	LOS Statement	Customer/Council Focused Performance Measures					Technical Focused Performance Measures				
		Performance Measure	Current Performance	Data Source	Proposed Performance	Forecast	Performance Measure	Current Performance	Data Source	Proposed Performance	Forecast
Cost Efficient	Providing an efficient transportation network for all modes	Cost to provide service ($/household)	$467/household	Operating Budget Capital Budget - 2018 Budget Book (PDF)	$467/household	-	Annual operating budget for roads	$4,540,515	Operating Budget	$4,540,515	↑
							Average annual capital expenditure for roads	$3,054,000	Capital Budget - 2018 Budget Book (PDF)	$3,054,000	↑
		Average asset renewal rate (# years)	117 years	Consultant Report (TBD)	117 years	-	10 Year average road linear asset renewal budget as a % of replacement value	0.9%	Capital Budget - 2018 Budget Book (PDF)	2% - 3%	-
Operational	Providing an operational road network that is safe for drivers, pedestrians and cyclists	# of vehicle, cyclist, and pedestrian incidents (complaints)	1,731	CRM Export (Excel)	TBD	↑	# of infrastructure needs identified from complaints of unsafe roads	TBD	TBD (CRM does not identify infrastructure needs)	TBD	↑
							% of reactive work completed within x days	TBD	CMMS (once implemented)	TBD	-
							% of planned maintenance activities completed as per schedule	TBD	CMMS (once implemented)	TBD	-
							# of road defects identified	906	CRM Export (Excel)	TBD	↑
							% of time when MMS are achieved as per O. Reg 366/18	TBD	CMMS (once implemented)	TBD	↑
Quality	Providing a transportation network at the appropriate condition with smooth and safe surfaces	# of customer service requests relating to service quality	1,189	CRM Export (Excel)	TBD	↑	% length of paved roads in poor or very poor condition	8.1%	Road Inventory (DOT)	1.9%	↓
							% length of unpaved roads in poor or very poor condition	90.2%	Road Inventory (GIS) - Age-based	10.3%	↓
							% length of sidewalks in poor or very poor condition	5%	Sidewalk Inventory (GIS)	TBD	-
							% of streetlights in poor or very poor condition	0%	Streetlight Inventory (GIS)	TBD	-
							% of other road and right-of-way assets in poor or very poor condition	TBD	TBD	TBD	-
		Levels of road class pavement condition	Range of minor arterial, collector and local roads, classes 0 and 3-6, in earth, gravel, surface treated and asphalt, in conditions that are poor, fair, good or excellent.	DOT	Range of minor arterial, collector and local roads, classes 0 and 3-6, in earth, gravel, surface treated and asphalt, in conditions that are poor, fair, good or excellent	-	Average surface condition (e.g. excellent, good, fair or poor) for paved roads.	Good	Road Inventory (DOT)	Excellent	↑
Accessible	Providing an accessible transportation network	Road network in the municipality and its level of connectivity	Good connectivity of a range of minor arterial, collector and local roads throughout the Town.	Engineering	Good connectivity of a range of minor arterial, collector and local roads throughout the Town	-	# of lane-kilometres of arterial roads as a proportion of square kilometres of land area of the municipality.	0.348	Road Inventory (GIS)	0.348	-
							# of lane-kilometres of collector roads and local roads as a proportion of square kilometres of land area of the municipality.	4.607	Road Inventory (GIS)	4.607	-
							# of lane-kilometres of local roads as a proportion of square kilometres of land area of the municipality	4.014	Road Inventory (GIS)	4.014	-
		% of road assets that are AODA compliant	TBD	TBD	TBD	-	% of sidewalks that are AODA compliant	TBD	TBD	TBD	-
							% of traffic signals with APS	TBD	TBD	TBD	-
Environmental Stewardship	Providing a transportation network that is environmentally conscious	% of streetlights that are energy efficient	TBD	TBD	TBD	-	% of streetlights with LED or low energy fixtures	TBD	TBD	TBD	-
		Volume of salt applied to road/lane km	2.65	Salt Management Plan (Annual Report to Environment Canada)	TBD	-	Volume of salt applied to road/lane km	2.65	Salt Management Plan (Annual Report to Environment Canada)	TBD	-

Foundational Metrics
Advanced Metrics
O.Reg 588/17 Metrics

Asset Levels of Service Framework

Service Category: Stormwater
Service Statement: Efficiently providing reliable stormwater services that protect the community and natural environment.

Key Service Attribute	LOS Statement	Customer/Council Focused Performance Measures					Technical Focused Performance Measures				
		Performance Measure	Current Performance	Data Source	Proposed Performance	Forecast	Performance Measure	Current Performance	Data Source	Proposed Performance	Forecast
Cost Efficient	Providing stormwater services in an efficient manner	Annual cost to provide service ($/household)	$218/household	Operating Budget Capital Budget - 2018 Budget Book (PDF)	$218/household	-	Annual operating budget for stormwater	TBD	Operating Budget	TBD	↑
							Average annual capital expenditure for stormwater	$1,428,000	Capital Budget - 2018 Budget Book (PDF)	$1,428,000	↑
		Average stormwater asset renewal rate (# years)	109 years	Operating Budget Capital Budget - 2018 Budget Book (PDF)	109 years	-	10 Year average stormwater linear asset renewal budget as a % of replacement value	0.8%	Capital Budget - 2018 Budget Book (PDF)	1% - 1.3%	-
Reliable	Providing stormwater services with minimal impact to the community	# of locations in the Town prone to flooding during wet weather events	0	CRM Export (Excel)	TBD	↑	% of major system with insufficient capacity to convey flows of a 100-year wet weather event	TBD	TBD	TBD	-
							% of minor system with insufficient capacity to convey flows of a 5-year wet weather event	TBD	TBD	TBD	-
							# of complaints of flooding during a wet weather event	0	CRM Export (Excel)	TBD	↑
							% of major system with adequate resiliency to accommodate the impacts of climate change	TBD	TBD	TBD	-
							% of minor system with adequate resiliency to accommodate the impacts of climate change	TBD	TBD (SW Master Plan will determine this)	TBD	-
							% of town area surcharged	TBD	TBD	TBD	-
							% length of storm sewers in poor or very poor condition	24.5%	GIS (shp)	35.5%	↑
							% of other stormwater assets in poor or very poor condition	TBD	TBD	TBD	-
							# of critical roads where flooding exceeds 100 mm during a Regulatory storm	TBD	TBD (SW Master Plan will determine this)	TBD	↑
							# of properties at risk of being flooded during a target wet weather event	3	CRM Export (Excel) (SW Master Plan will determine this in future)	TBD	↑
		% of community with stormwater quantity control	TBD	TBD (SW Master Plan will determine this)	TBD	-	% of runoff quantity control	TBD	TBD (SW Master Plan will determine this)	TBD	-
Environmental Stewardship	Providing stormwater services that protect the environment	% of community with stormwater quality control	TBD	TBD	TBD	-	# of SWM ponds that have exceeded their target dredging frequency	TBD	TBD	TBD	↑
							% of community with stormwater quality treatment control	TBD	TBD	TBD	-
							#/type of LID technologies implemented	TBD	TBD	TBD	↑
Scope	Providing protection from flooding due to ROW/infrastructure	User groups or areas of Fort Erie that are protected from ROW or infrastructure flooding, including the extent of the protection provided by the municipal stormwater management system	Some urban areas protected from ROW/infrastructure flooding through urban ditch system or underground storm collection, some with defined outlets. Most rural areas protected from flooding through provision of municipal drains or rural ditch systems, some with defined outlets	Engineering	Some urban areas protected from ROW flooding through urban ditch system or underground storm collection, some with defined outlets. Most rural areas protected from flooding through provision of municipal drains or rural ditch systems, some with defined outlets	-	% of properties in municipality resilient to a 100-year storm	TBD	TBD	TBD	TBD
							% of the municipal stormwater management system resilient to a 5-year storm	TBD	TBD	TBD	TBD

Foundational Metrics
Advanced Metrics
O.Reg 588/17 Metrics

Asset Levels of Service Framework

Service Category: Facilities Management
Service Statement: Efficiently providing high quality, safe, accessible, and energy efficient facilities for the community.

Key Service Attribute	LOS Statement	Customer/Council Focused Performance Measures					Technical Focused Performance Measures				
		Performance Measure	Current Performance	Data Source	Proposed Performance	Forecast	Performance Measure	Current Performance	Data Source	Proposed Performance	Forecast
Cost Efficient	Providing facilities management services in an efficient manner	Cost to provide service ($/sqft)	$3/sqft	Operating Budget Capital Budget - 2018 Budget Book (PDF)	$3/sqft	↑	Annual operating budget for facilities management	TBD	Operating Budget	TBD	↑
							Average annual capital expenditure for facilities management	$829,500	Capital Budget - 2018 Budget Book (PDF)	$829,500	↑
		Average facilities renewal rate (# years)	119 years	Operating Budget Capital Budget - 2018 Budget Book (PDF)	119 years	-	10 Year forecast average facility asset renewal budget as a % of replacement value	0.84%	Capital Budget - 2018 Budget Book (PDF)	0.84%	-
							% of building elements currently in poor or very poor condition that can be renewed within the next 10 years	90.43%	2018 Condition Assessment (Excel)	90.43%	-
Safe	Providing facilities management services to ensure that facilities are safe	# of building/design related public safety incidents reported OR # of claims filed	TBD	TBD	TBD	↑	# of outstanding safety improvements required at facilities/100 sqft	TBD	TBD	TBD	-
							% of buildings annually inspected	TBD	TBD	TBD	-
							% of facilities that meet security standards	TBD	TBD	TBD	-
							% of reactive work completed within x days	TBD	CMMS (once implemented)	TBD	-
							% of planned maintenance activities completed as per schedule	TBD	CMMS (once implemented)	TBD	-
							# of building defects identified	TBD	TBD	TBD	↑
Accessible	Providing facilities management services to ensure that facilities are AODA compliant	% of facilities that meet the Town's accessibility objectives / goals		Accessibility Audits (PDF)	TBD	-	% of facilities where waiting and queuing areas, and service counters are AODA compliant	50%	Accessibility Audits (PDF)	TBD	-
							% of facilities where the public parking facilities are AODA compliant	100%	Accessibility Audits (PDF)	TBD	-
							% of facilities where the public entrance paths of travel are AODA compliant	100%	Accessibility Audits (PDF)	TBD	-
Quality	Providing clean and safe facilities in good condition for users	% of facilities in poor or very poor condition	5.85%	2018 Condition Assessment (Excel)	0%	-	% of facility systems above target SCI	TBD	TBD	TBD	-
							% of facilities above target FCI	TBD	2018 Condition Assessment (Excel)	TBD	-
							% of facility assets by replacement value in poor or very poor condition	9.23%	2018 Condition Assessment (Excel)	33.6%	-
							Cleaning frequency	TBD	TBD	TBD	↑
							# of customer service requests relating to usage and availability	0	CRM Export (Excel)	TBD	↑
	Providing facilities at the right design standard	% of facilities at or above the target design standard	TBD	TBD	TBD	-	% of facilities that meet the target design standard	TBD	TBD	TBD	-
Environmental Stewardship	Providing facilities that are energy efficient	Annual energy consumption per square foot	TBD	TBD	TBD	-	Annual energy consumption per square foot	TBD	TBD	TBD	↑
	Providing facilities that are environmentally conscious	Annual water consumption per square foot	TBD	TBD	TBD	-	Annual water consumption per square foot	TBD	TBD	TBD	↑
							Volume of rainwater harvested	TBD	TBD	TBD	↑

Foundational Metrics
Advanced Metrics

Asset Levels of Service Framework

Service Category: Water
Service Statement: The Town of Fort Erie will strive to provide safe, clean drinking water of adequate pressure and flow with minimum service interruptions.

Key Service Attribute	LOS Statement	Customer/Council Focused Performance Measures					Technical Focused Performance Measures				
		Performance Measure	Current Performance	Data Source	Proposed Performance	Forecast	Performance Measure	Current Performance	Data Source	Proposed Performance	Forecast
Cost Efficient	Providing water services in an efficient manner	Annual cost to provide water service ($/household)	$274/household	Operating Budget Capital Budget - 2018 Budget Book (PDF)	$274/household	↑	Annual operating budget for water services	$5,419,839	Operating Budget	$5,419,839	↑
							Average annual capital expenditure for water services	$1,793,000	Capital Budget - 2018 Budget Book (PDF)	$1,793,000	↑
		Average water service asset renewal rate (# years)	96 years	TBD	96 years	-	10 Year average water linear asset renewal budget as a % of replacement value	1.0%	Capital Budget - 2018 Budget Book (PDF)	1.0%	-
Safe	Water system supports community fire protection	% of community with sufficient fire flow protection	97.60%	2016 MSP Water Model	100%	-	% of system not meeting fire flow targets	6%	2016 MSP Water Model	0%	↑
	Water system provides safe potable drinking water	% of community with acceptable risk of experiencing adverse water quality	100%	Water Sampling Results	TBD	-	% compliance with all applicable water quality regulations	100%	Water Sampling Results	100%	-
							# of confirmed adverse water quality tests	0	Water Sampling Results	0	↑
Quality	Providing high quality water to residents	# of complaints due to rusty/discoloured water	19	CRM Export (Excel)	TBD	↑	% of system serviced by sources that provide substandard water	TBD	TBD	TBD	-
							% length of system that is unlined CI/DI	21.93%	GIS (shp) Inventory	16.27%	-
		# of complaints due to low pressure	12	CRM Export (Excel)	TBD	↑	% of system with pressure < 40 psi	1%	2016 MSP Water Model	0%	-
Reliable	Providing water services with minimal interruptions	% of customers where service is interrupted above target frequency	TBD	TBD	TBD	-	# of connection-days where service is interrupted due to water main breaks	TBD	TBD	TBD	↑
							# of WM breaks across the system annually	39	Water Main Break History (Excel)	45	↑
							# of watermains above target break rate	3	Water Main Break History (Excel)	3	-
							# of watermains prone to frozen water services	48	Frozen Services Property List (Excel)	TBD	↑
							% length of watermains in poor or very poor condition	3.69%	GIS (shp) - More than 5 breaks	3.69%	-
							% of Bulk Water Station assets in poor or very poor condition	TBD	TBD	TBD	-
							# of unplanned failures resulting in service interruption/reduction	TBD	TBD	TBD	↑
Safe & Reliable	Provinding safe and reliable drinking water	Boil water advisories and service interruptions	No boil water advisories, few service interruptions due to Town responsibilities	Water Dept	No boil water advisories, few service interruptions due to Town responsibilities	-	# of connection-days per year where a boil water advisory notice is in place compared to the total number of properties connected to the municipal water system	0	TBD	0	-
							# of connection-days per year due to water main breaks compared to the total number of properties connected to the municipal water system	TBD	TBD	TBD	-
Environmental Stewardship	Providing a water service that is environmentally conscious	Water consumption L/cap/day	TBD	TBD	TBD	-	Infrastructure Leakage Index (ILI)	3.84	AWWA - 2017 Water Audit (Excel)	3.84	-
Scope	Providing water services within the urban area	User groups or areas of Fort Erie that are connected to the municipal water system	Most properties within urban area are connected to the municipal water system.	2016 MSP	Most properties within urban area connected to the municipal water system.	-	% of properties connected to the municipal water system	88%	2016 MSP Water Model (Number of parcels in FE pressure zone)	88%	-
	Providing fire flow potable water services	User groups or areas of Fort Erie that have fire flow provided from the drinking water system	Most properties within urban area are connected to the municipal water system for fire flow.	2016 MSP	Most properties within urban area connected to the municipal water system for fire flow.	-	# of properties where fire flow is available	88%	2016 MSP Water Model (Number of parcels in FE pressure zone)	88%	-

Foundational Metrics
Advanced Metrics
O.Reg 588/17 Metrics

Asset Levels of Service Framework

Service Category: Wastewater
Service Statement: Efficiently providing reliable wastewater services that are conscious of impacts to private property and the environment.

Key Service Attribute	LOS Statement	Customer/Council Focused Performance Measures					Technical Focused Performance Measures				
		Performance Measure	Current Performance	Data Source	Proposed Performance	Forecast	Performance Measure	Current Performance	Data Source	Proposed Performance	Forecast
Cost Efficient	Providing wastewater services in an efficient manner	Cost to provide service ($/household)	$249/household	Operating Budget Capital Budget - 2018 Budget Book (PDF)	$308/household	↑	Annual operating budget and capital budget for wastewater	$10,669,940	Operating Budget Capital Budget - 2018 Budget Book (PDF)	$11,059,018	↑
							Annual operating and maintenance cost/km of sewer	$46,721/km	Operating Budget	$46,721/km	-
							Average annual capital expenditure for wastewater	$1,627,500	Capital Budget - 2018 Budget Book (PDF)	$2,016,578	↑
		Average wastewater asset renewal rate (# years)	106 years	TBD	85 years	-	10 Year average wastewater linear asset renewal budget as a % of replacement value	1.2%	Capital Budget - 2018 Budget Book (PDF)	1.40%	↑
Reliable	Providing wastewater services with minimal interruptions	# of customers that experience a service interruption	55	CRM Export (Excel) Work Order Data (CMMS when implemented)	55	↑	# of customers that experience basement flooding caused by system surcharge	3	CRM Export (Excel)	3	↑
							km of sewers in poor or very poor condition	87.46	GIS (shp) - Age-based	79.36	↓
							% length of sewers in poor or very poor condition	45.19%	GIS (shp) - Age-based	41.01%	↓
							% of the system surcharged within 1.8 m of the ground elevation during a 25-year wet weather event	TBD	TBD	TBD	-
							% of the system with adequate resiliency to accommodate the impacts of climate change	TBD	TBD	TBD	-
							# of sewers with operational issues likely to cause service interruptions	TBD	CMMS (once implemented)	TBD	↑
							% of preventative maintenance activities completed on schedule	TBD	CMMS (once implemented)	TBD	-
							# of locations with FOG issues or prone to blockages	TBD	CMMS (once implemented)	TBD	↑
							# of residences that have been reimbursed through the Extraneous Flow Reduction Program.	541	Ex Flow Reimbursement Summary (Excel)	TBD	↑
Safe	Protecting homes from sanitary wastewater backups or overflow	How combined sewers in the Fort Erie wastewater system are designed with overflow structures in place (to prevent backups into homes by allowing	No combined sewers allowed in new construction design. Overflow structures are the responsibility of the Region.	Engineering	No combined sewers allowed in new construction design. Overflow structures are the responsibility of the Region.	-	# of events per year where combined sewer flow in the municipal wastewater system exceeds system capacity compared to the total number of properties connected to the municipal wastewater system.	TBD	TBD	TBD	-
	Providing wastewater services that have minimal impacts on the environment	Frequency and volume of overflows in combined sewers in the Fort Erie wastewater system that occur in habitable areas or beaches	Few overflows in combined sewers in habitable areas or beaches.	Wastewater Dept	Few overflows in combined sewers in habitable areas or beaches	-					
	Protecting homes from sanitary wastewater backups or overflow	How stormwater can get into sanitary sewers in the Fort Erie wastewater system, causing sewage to overflow into streets or backup into homes	Some Inflow and Infiltration into sanitary system exists, through private connections, cross connections and system infrastructure deficiencies, such as cracks & leaks.	Engineering	Some Inflow and Infiltration into sanitary system exists, through private connections, cross connections and system infrastructure deficiencies, such as cracks & leaks.	-	The number of connection-days per year due to wastewater backups compared to the total number of properties connected to the municipal wastewater system.	TBD	TBD	TBD	-
	Protecting homes from sanitary wastewater backups or overflow	How sanitary sewers in the Fort Erie wastewater system are designed to be resilient to avoid storm events	Design and construction criteria for sanitary sewers in place, to ensure consistent and industry-accepted performance requirements, materials, and installation methods are used.	Engineering	Design and construction criteria for sanitary sewers in place, to ensure consistent and industry-accepted performance requirements, materials, and installation methods are used.	-	The number of effluent violations per year due to wastewater discharge compared to the total number of properties connected to the municipal wastewater system	TBD	TBD	TBD	-
	Not applicable - Sewage treatment is the responsibility of the Region	Description of the effluent that is discharged from sewage treatment plants in the municipal wastewater	Not applicable - Sewage treatment is the responsibility of the Region	Not applicable	Not applicable	-					
Environmentally Conscious	Providing wastewater services that have minimal impacts on the environment	% of wastewater flows that meet environmental objectives when discharged	TBD	TBD	TBD	-	# of relief pumping events	TBD	TBD	TBD	↑
							Total volume of untreated wastewater discharged into the natural environment via relief pumping events	TBD	TBD	TBD	↑
Scope	Providing sanitary wastewater services within the urban area	User groups or areas of Fort Erie that are connected to the municipal wastewater system	Most properties within urban area are connected to the municipal water system.	2019 MSP	Most properties within urban area connected to the municipal water system.	-	Percentage of properties connected to the municipal wastewater system	73%	2018 WWMP Model	73%	-

Foundational Metrics
Advanced Metrics
O.Reg 588/17 Metrics

APPENDIX F: TECHNICAL MEMORANDUM #6/7 - TEN YEAR CAPITAL PLAN & INVESTMENT PLAN

Date:	5/24/2019	File:	618004
To:	Kelly Walsh, P.Eng. Director, Infrastructure Services		
From:	GM BluePlan Engineering		
Project:	Town of Fort Erie Asset Management Plan		
Subject:	Ten Year Capital Plan and Capital Investment and Re-Investment Plan		

TECHNICAL MEMORANDUM #6 & #7 – TEN YEAR CAPITAL PLAN & INVESTMENT PLAN

1. INTRODUCTION

GM BluePlan Engineering Limited (GMBP) has been retained by the Town of Fort Erie to develop an asset management plan (AMP) that follows the Province's structure outlined in the Guide for Municipal AM Plans and will address the requirements prescribed in Ontario Regulation 588/17. As part of this project, GMBP has analyzed various capital expenditure and asset performance scenarios over a 50-year period that can be used to support optimized decision making. This analysis focuses only on the following asset classes: Roads, Water, Wastewater, Storm, Bridges & Structures, and Facilities.

This technical memorandum provides an understanding of the relationship between the performance of the assets in the Town and the planned versus the recommended expenditures to maintain current Levels of Service (LOS). In addition, an analysis of different investment scenarios which focus on balancing risk, service levels, and affordability was also included. The final sections outline the recommendations for each asset class over the next ten years and provides the resulting 10-year capital plan.

A glossary of several key terms used throughout the report can be found in Appendix A.

2. 2018 EXISTING BUDGET

Based on the Reserve Contribution data provided by Town staff, an average of approximately $9,030,000 per year will be contributed to reserves for core infrastructure asset categories over the next ten years. It is the Town's current practice to contribute the anticipated spending for the following year to reserves to ensure there is sufficient funding available. In addition, Roads and Bridge & Structure assets receive additional gas tax funding, bringing the existing budget to an average of $10,153,919 per year for all asset classes. Table 1 and Figure 1 outline the existing ten-year budget, including both contribution from reserves and gas tax funding, used within this technical memorandum.

It should be noted that the ongoing Wastewater Master Servicing Plan may affect these projections once completed.

Table 1: 2018 Existing Ten-Year Capital Reserve & Grant Funding

Year	Facilities	Wastewater	Roads & ROW	Bridges and Structures	Stormwater	Water	Total
2019	$829,500	$1,627,500	$4,754,000	$916,200	$1,428,000	$1,543,000	**$11,098,200**
2020	$829,500	$1,627,500	$4,130,740	$1,498,250	$1,428,000	$1,593,000	**$11,106,990**
2021	$829,500	$1,627,500	$3,054,000	$550,500	$1,428,000	$1,643,000	**$9,132,500**
2022	$829,500	$1,627,500	$3,054,000	$1,498,250	$1,428,000	$1,693,000	**$10,130,250**
2023	$829,500	$1,627,500	$3,754,000	$886,250	$1,428,000	$1,743,000	**$10,268,250**
2024	$829,500	$1,627,500	$3,854,000	$584,500	$1,428,000	$1,793,000	**$10,116,500**
2025	$829,500	$1,627,500	$3,054,000	$703,500	$1,428,000	$1,793,000	**$9,435,500**
2026	$829,500	$1,627,500	$3,054,000	$912,000	$1,428,000	$1,793,000	**$9,644,000**
2027	$829,500	$1,627,500	$3,054,000	$1,236,000	$1,428,000	$1,793,000	**$9,968,000**
2028	$829,500	$1,627,500	$3,554,000	$1,407,000	$1,428,000	$1,793,000	**$10,639,000**
Total:	**$8,295,000**	**$16,275,000**	**$35,316,740**	**$10,192,450**	**$14,280,000**	**$17,180,000**	**$101,539,190**

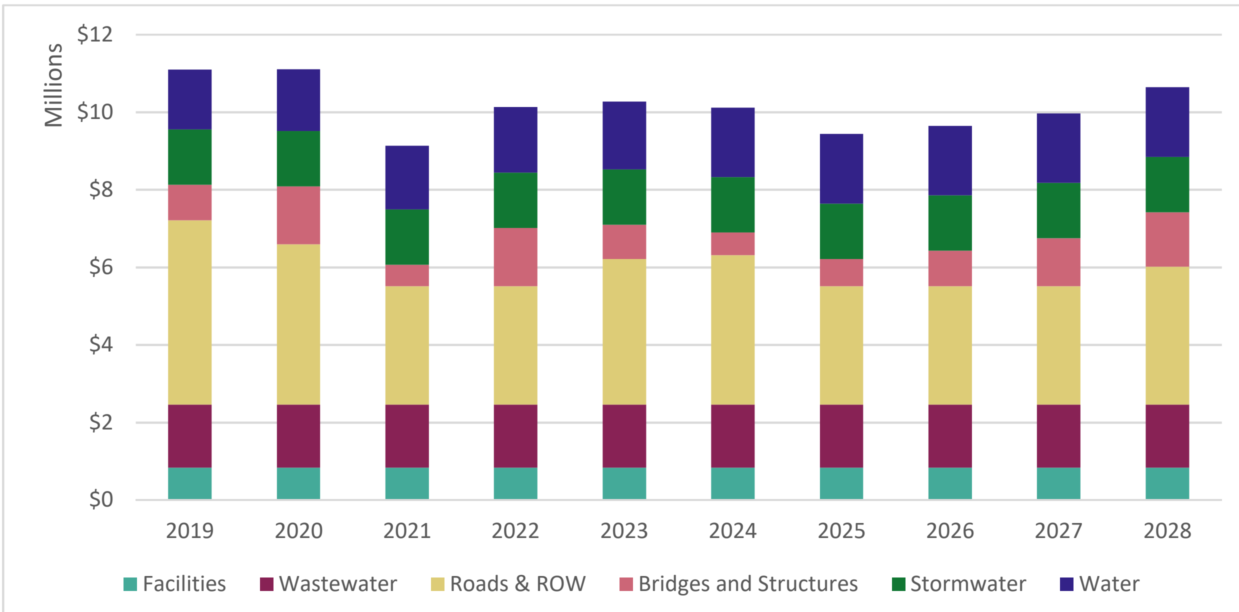


Figure 1: Existing Ten-Year Capital Forecast (based on 2019 Capital budget)

3. SCENARIO ANALYSIS

An analysis of several scenarios was completed within an Excel/SQL Server based Decision Support System (DSS) to forecast the Town's infrastructure needs and determine the required expenditures to address these needs. The following sections outline the methodology used and the results produced from this analysis.

3.1. BUDGET VERSUS TARGET SCENARIOS

Two basic types of scenarios are used for these analyses:

- **Budget Scenarios**

  Budget scenarios assume the user has a limited amount of funding, with a set budget for each forecasted year. The budget scenarios degrade the performance of each asset until it reaches the minimum level of service allowed for that asset and then improves the asset if funding is available. The analytical system "spends" all the budgeted money in each forecasted year to improve assets and then shows the expected performance of each system and the distribution of assets in each of the five condition states.

- **Target Scenarios**

  Target scenarios allow for unlimited spending to understand infrastructure needs with no budget constraints. The Target scenarios degrade the performance of each asset until it reaches a preset target performance. Once any asset reaches this performance value it is automatically treated.

In the following sections, different target and budget scenarios are compared to understand how different investment strategies will affect the performance of the Town's assets.

3.2. CONSEQUENCE OF FAILURE SCORES

Consequence of Failure (COF) scores represent the socio-economic and environmental impacts of an asset's failure. These scores range from 1 to 5, with 1 having a negligible impact and 5 having catastrophic side effects. Since the Town did not have COF scores assigned to each asset already, GMBP and Town staff assigned each asset a COF score based on the most relevant data that was available. These COF scores can be updated over time as more information is available to incorporate more factors that will affect the criticality of each asset.

COF scores were assigned to each asset as shown below in Table 2 on the following page.

Table 2: Asset COF Score Assignment

Asset Category	Criticality Based On	Parameters	COF Score
Bridge and Structures	Area (m^2)	Area < 10	2
		10 <= Area <= 100	3
		Area > 100	4
		No Area Provided	2
Facilities	Facility	Central Fire Station	5
		Fire Station 3	4
		Fire Station 4	4
		Fire Station 5	4
		Fire Station 6	4
		Leisureplex	3
		Town Hall	5
		Gibson Centre	4
		Crystal Ridge Arena	2
		All other facilities	2
Roads & ROW	Ontario MMS Highway Classifications (O.Reg. 366/18)	3	5
		4	3
		5	2
		6	1
		Unassigned	1
Wastewater	Diameter (mm)	d <= 200 or No Diameter Provided	1
		d <= 400	2
		d <= 600	3
		d <= 800	4
		d > 800	5
Stormwater	Diameter (mm)	d <= 300 or No Diameter Provided	1
		d <= 600	2
		d <= 900	3
		d <= 1200	4
		d > 1200	5
Water	Diameter (mm)	d <= 200 or No Diameter Provided	2
		d <= 300	3
		d <= 400	5
		d > 400	5

These COF scores were then used in several of the predictive scenarios discussed in later sections of this technical memorandum. Specifically, they are used to set the minimum performance that is acceptable for an asset to reach before it is replaced (the asset's minimum Level of Service target). Table 3 shows the correlation between COF and LOS.

Table 3: COF Scores and Their Relation to Minimum LOS

COF Score	COF Category	Condition Target	Performance Minimum LOS Trigger
1	Negligible	Allow asset to run to failure.	0.00
2	Low	Replace before asset fails.	0.10
3	Moderate	Replace once asset reaches very poor condition	0.20
4	Severe	Replace before asset reaches very poor condition	0.30
5	Catastrophic	Replace once asset reaches poor condition	0.40

3.3. SCENARIOS

3.3.1. Base Scenarios

An analysis of two different scenarios was performed to understand the difference between projections of current spending and recommended infrastructure needs over the next 50 years. The following Figures will outline the first 10 years, but full results are available in Appendix B “10, 25 and 50 Year Analysis Results”. The scenarios included in this analysis are outlined below.

- **Scenario 1: Existing Budget**

  This budget scenario (shown in **teal** in all figures) provides perspective on the projected performance of the assets based on an assumed budget or set of planned expenditures for each asset group. The analytical system “spends” all the planned money to replace assets, and then shows the expected performance of each system and the distribution of assets in each of the five condition states. The analysis presented in this report is based on the planned reserve contributions as provided by Town staff as presented above in Table 1. This scenario takes COF scores into consideration when it is prioritizing which assets to replace in each year.

- **Scenario 2: Run to End of Service Life**

  The basic target scenario (shown in **orange** in all figures) follows the traditional Asset Management (AM) analysis approach of estimating future expenditure needs using a simplistic ‘replace at end of life’ approach. It does not reflect any maintenance or remediation work and assumes the asset fails at the end of its service life. No budget constraints are applied, as this scenario is not meant to reflect realistic spending, but instead to compare the current budget against infrastructure needs. In this target scenario, since each asset is replaced at the end of its service life, the predictive model does not take COF scores into consideration.

3.3.2. Additional Scenarios

Alternatives to the current budget and basic target analysis scenario were also analyzed to determine a better balance between risk, service levels, and affordability. These scenarios are outlined below.

- **Scenario 3: Risk Analysis**

  This target scenario (shown in **blue** in all figures) involves early replacement of assets with high COF scores, before they reach poor condition and are at increasing likelihood of causing a service disruption, thus maintaining LOS levels with a lower level of risk. This generally relates to replacing an asset when its condition / performance reaches a target point where it requires renewal, with the targets for high COF assets being at a better condition than those with a low COF. This scenario mitigates Risk of critical assets but also increases spending relative to Scenario 2 (Run to End of Service Life) since assets are replaced before they reach the end of their estimated service life. As with all target scenarios, spending is not capped.

- **Scenario 4: Extended Service Life of Assets Through Enhanced Maintenance (Conceptual Analysis)**

  In this target scenario (shown in **black** in all figures), the estimated service life (ESL) of each asset has been increased by thirty percent (30%), with the assumption that the annual maintenance costs are 15% higher than in the basic scenario. This analysis provides additional perspectives on how asset management analysis can be applied to understand the cost versus benefit of adjusting the amount of maintenance that is performed on the assets. It should be emphasized that this is a conceptual, although reasonable, assumption on the additional maintenance activities that would be required to extend the service life of assets. As with all target scenarios, spending is not capped. It is worth reiterating that the current iteration of the DSS can only implicitly incorporate maintenance activities, and as a result there is no explicit increase to spending that will appear in the analysis. This may result in some years showing zero spending, since no replacement is being done if no assets reach their target LOS, but maintenance is being done and is not shown. Future iterations of the DSS may be able to incorporate explicit maintenance activities, however Fort Erie does not currently have the data for this level of analysis.

- **Scenario 5: 3% Increase Per Year for 10 Years**

  This budget scenario (shown in **pink** in all graphs) uses the Town's average capital spending rate per year and includes a 3% yearly increase (exclusive of inflation) to provide a consistent increase to spending for 10 years. As with the current budget scenario, the analytical system "spends" all the planned money to replace assets, and then shows the expected performance of each system and the distribution of assets in each of the five condition states. This scenario demonstrates the effect on LOS of increased spending at a more consistent and manageable pace. This scenario takes COF scores into consideration when it is prioritizing which assets to replace in each year.

It should be noted that none of the scenarios in either analysis take growth, and therefore increased strain on the system, into account.

3.4. SYSTEM SUMMARY

Figure 4, on page 10, illustrates the annual capital expenditures and the aggregate performance for all AMP assets, except Water assets which used a break-based analysis instead and was left out of the DSS, over 10 years for all scenarios. This type of graph is used to determine the effect on LOS and expenditure requirements for the scenarios described above and helps to outline the costs required to maintain the current LOS as required by Ontario Regulation 588/17.

3.4.1. Base Scenarios

- **Scenario 1: Existing Budget** – spending constrained by existing budget
- **Scenario 2: Run to End of Service Life** – unlimited spending on assets at the end of their service life

The results of this analysis demonstrate that the current budget (**Scenario 1**) will maintain the average asset performance across the system over the next ten years. The proportions of assets in fair and poor condition are expected to increase slightly, but this will be balanced by an increase in the proportion of assets in very good condition as assets are replaced (Figure 2).

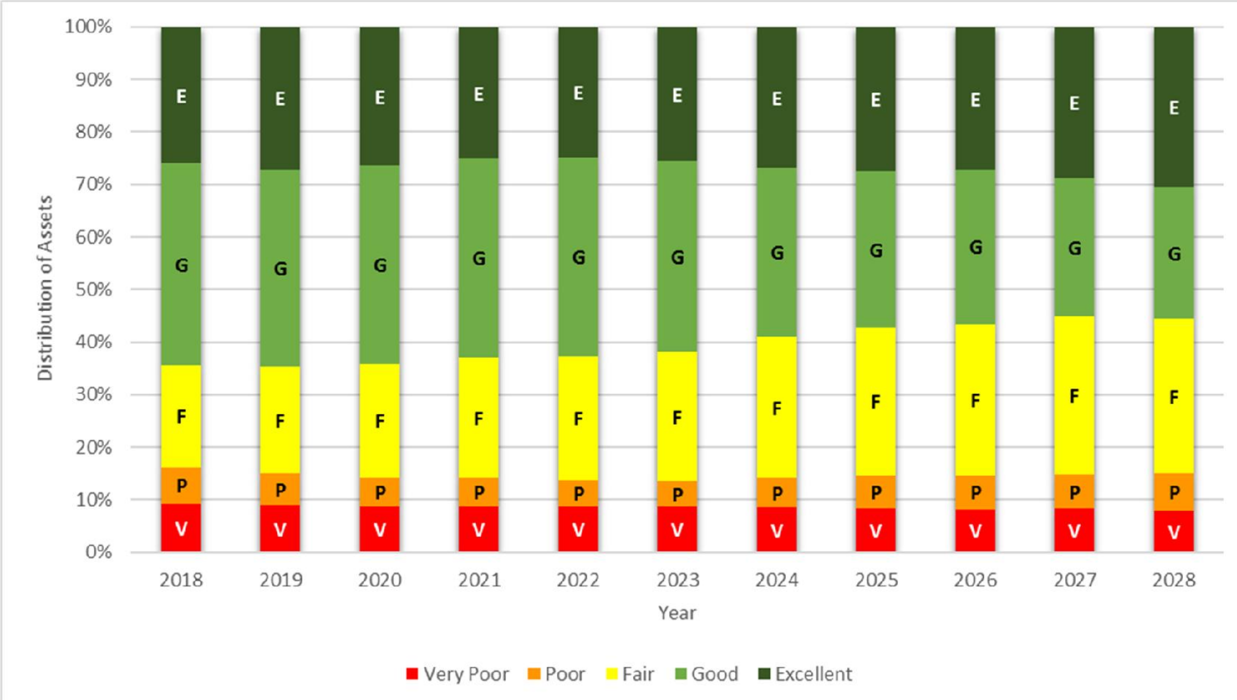


Figure 2: Performance Distribution of All Assets (Except Water) – Scenario 1

In comparison, replacing all assets when they reach they end of their service life with no budget constraints (**Scenario 2**) results in a degradation of performance with a greater proportion of assets being in fair or worse condition (Figure 3). This demonstrates that the current budget, combined with replacing higher risk assets before the end of their service life, is meeting the infrastructure needs over the next 10 years.

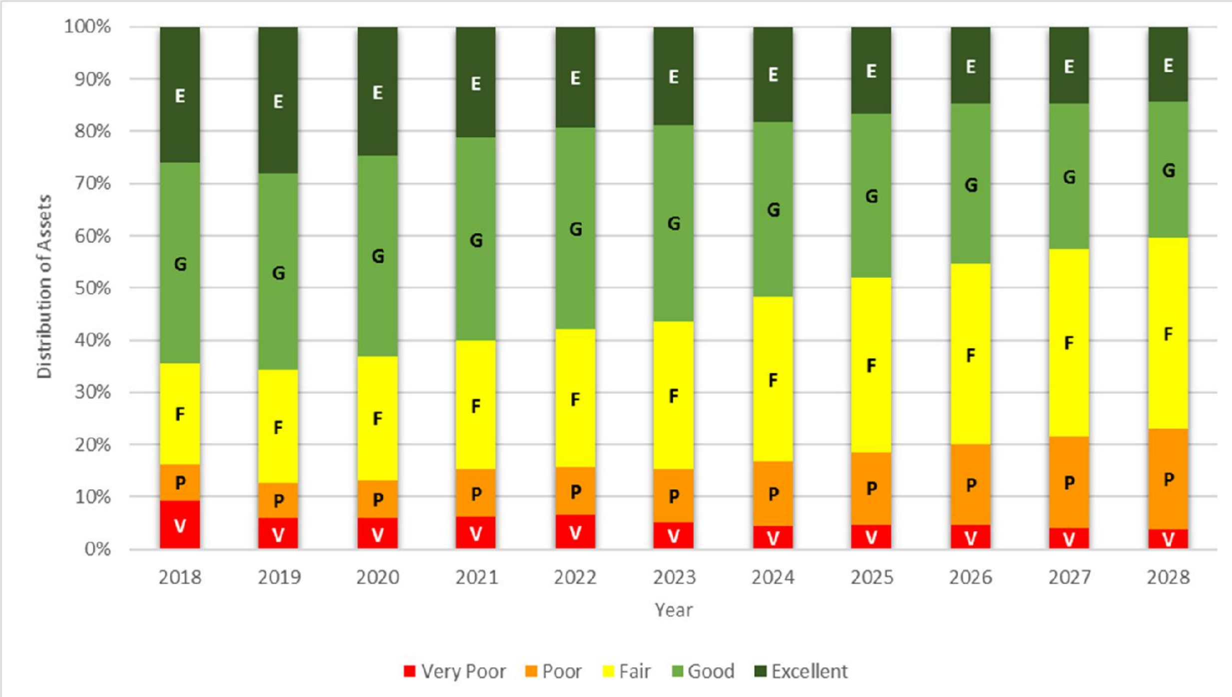


Figure 3: Performance Distribution of All Assets (Except Water) – Scenario 2

3.4.2. Additional Scenarios

- **Scenario 3: Risk Analysis** – unlimited spending on assets that have reached their LOS target performance
- **Scenario 4: Enhanced Maintenance** – unlimited spending on assets at the end of their service life which has been extended due to increased maintenance
- **Scenario 5: 3% Increase Per Year for 10 Years** – spending constrained by the existing budget increased by 3% per year

The results of this analysis show that having an extended service life due to maintenance (**Scenario 4**), can improve the average performance in comparison to keeping the service life the same (**Scenario 2**). However, replacing assets at a target condition based on their consequence of failure (**Scenario 3**) made a more significant improvement on the average performance, but required a greater expenditure as assets were replaced earlier.

In comparison to the existing budget (**Scenario 1**), the increased budget scenario (**Scenario 5**) did result in an improvement to the average performance.

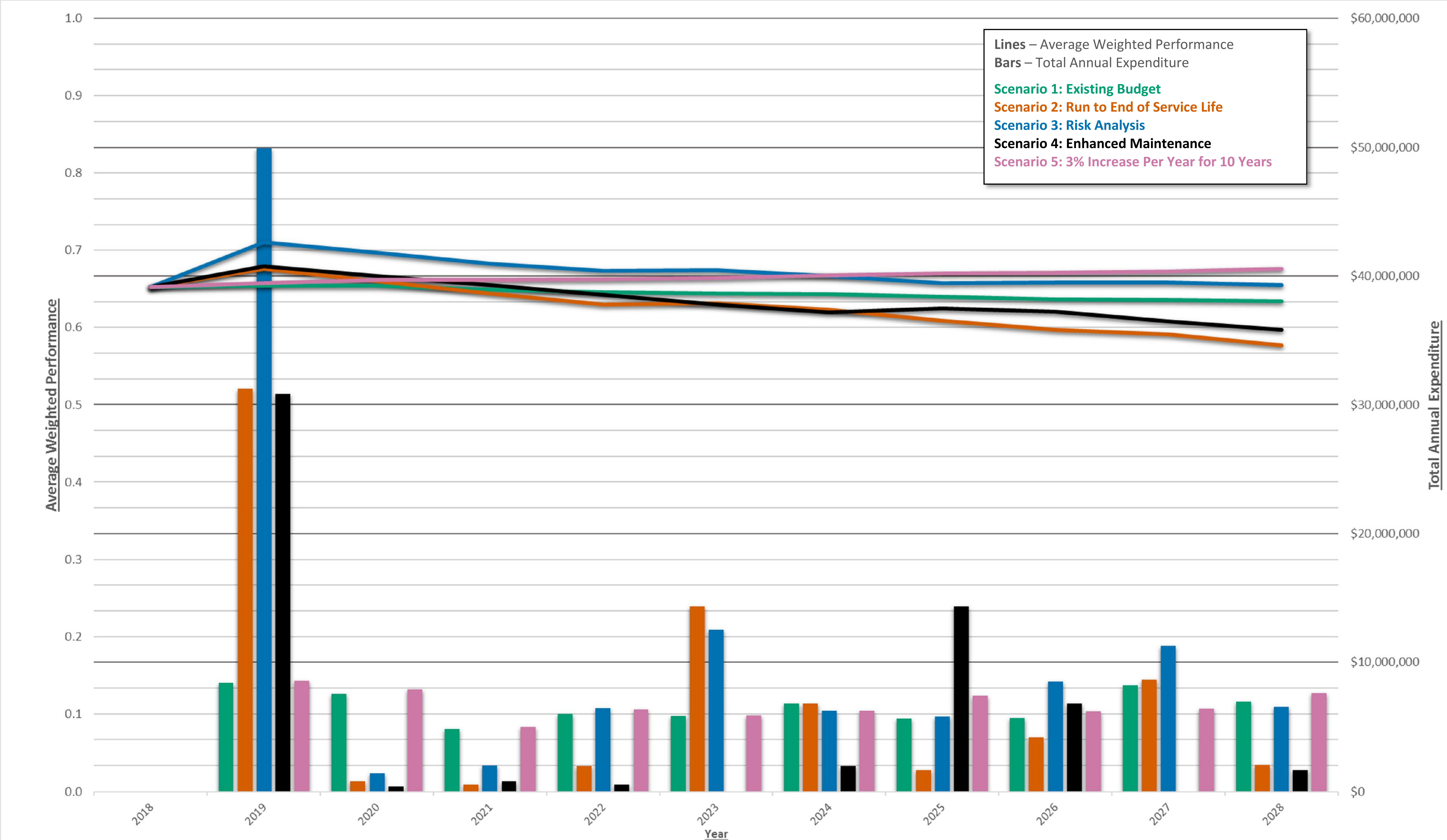


Figure 4: Expenditures and Performance of All Assets (Except Water)

3.5. ROADS

Figure 7, on page 13, illustrates the annual capital expenditures and the aggregate performance for all roads over 10 years for all scenarios. This analysis will vary from the Town's current system (DOT) that is used for determining future capital expenditures on Road assets, as this analysis assumes replacement and resurfacing only.

3.5.1. Base Scenarios

- **Scenario 1: Existing Budget** – spending constrained by existing budget
- **Scenario 2: Run to End of Service Life** – unlimited spending of assets at the end of their service life

The results of this analysis demonstrate that the current budget (**Scenario 1**) will improve the average asset performance across the system over the next ten years. This will lead to a reduction in the proportion of assets in poor condition (Figure 5).

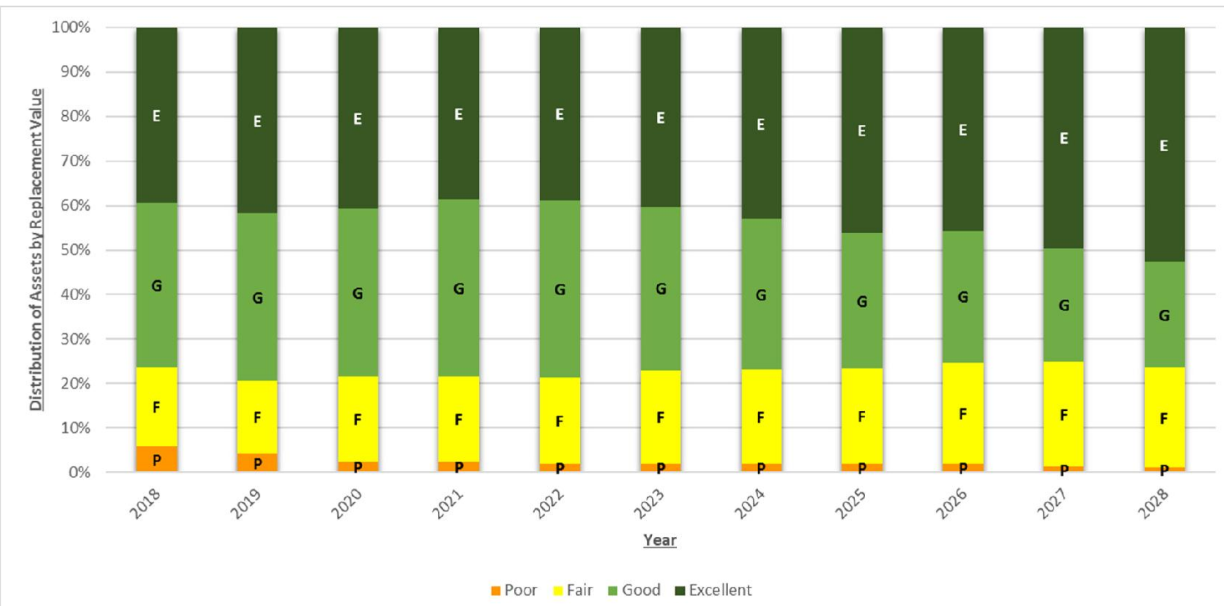


Figure 5: Performance Distribution of Road Assets – Scenario 1

In comparison, replacing all assets when they reach they end of their service life with no budget constraints (**Scenario 2**), will result in a degradation of performance with a greater proportion of assets being allowed to fall into fair and poor condition (Figure 6).

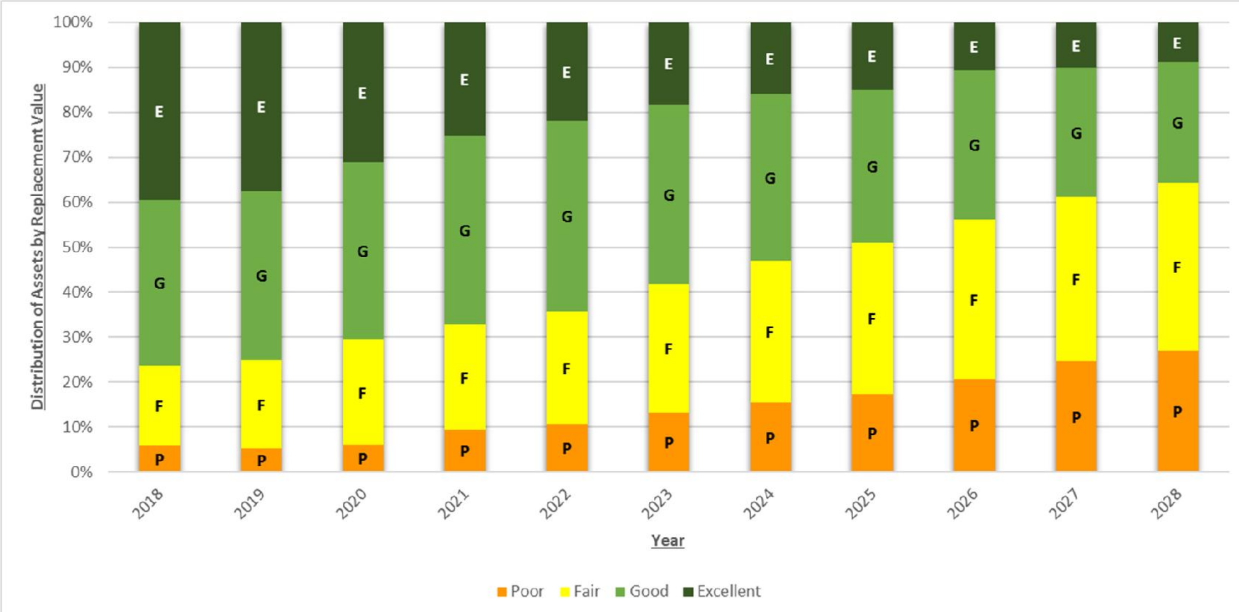


Figure 6: Performance Distribution of Road Assets – Scenario 2

3.5.2. Additional Scenarios

- **Scenario 3: Risk Analysis** – unlimited spending on assets that have reached their LOS target performance
- **Scenario 4: Enhanced Maintenance** – unlimited spending on assets at the end of their service life which has been extended due to increased maintenance
- **Scenario 5: 3% Increase Per Year for 10 Years** – spending constrained by the existing budget increased by 3% per year

The results of this analysis show that having an extended service life due to maintenance (**Scenario 4**), can improve the average performance over the next 10 years in comparison to keeping the service life the same (**Scenario 2**). In addition, replacing assets at a target condition based on their consequence of failure (**Scenario 3**) leads to an even larger increase in average performance.

In comparison to the existing budget (**Scenario 1**), the increased budget scenario (**Scenario 5**) did result in an improvement to the average performance. Additionally, both Budget scenarios show a higher average performance than the Target scenarios. This is a result of Fort Erie's current plan to maintain a system-wise average PCI of 80, which the existing budget (**Scenario 1**) scenario currently accomplishes.

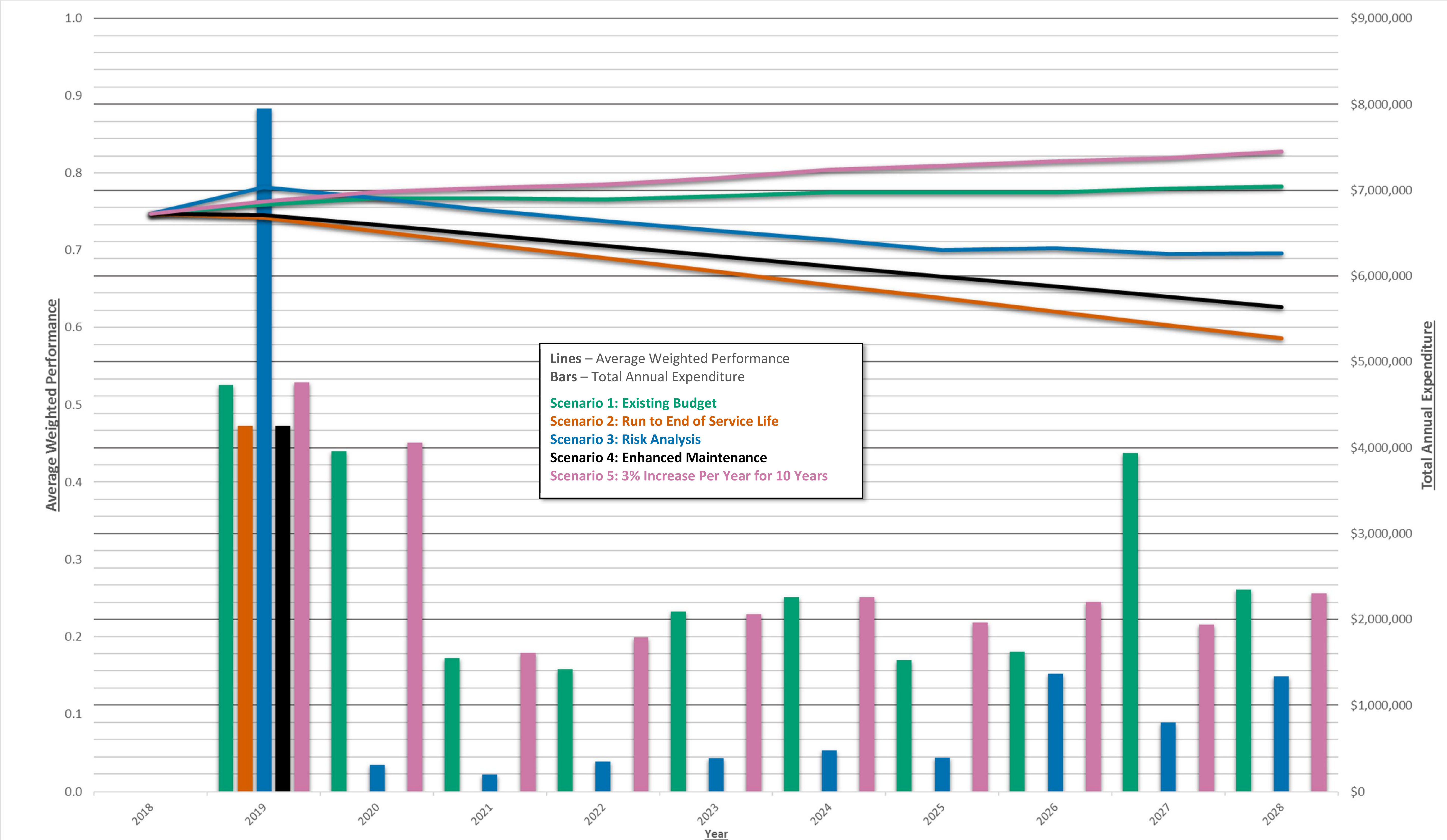


Figure 7: Expenditures and Performance of Roads Assets

3.6. WASTEWATER

Figure 10, on page 16, illustrates the annual capital expenditures and the aggregate performance for all wastewater assets over 10 years for all scenarios.

3.6.1. Base Scenarios

- **Scenario 1: Existing Budget** – spending constrained by existing budget
- **Scenario 2: Run to End of Service Life** – unlimited spending of assets at the end of their service life

The results of this analysis demonstrate that the current budget (**Scenario 1**) will maintain the average asset performance across the system over the next ten years. This will lead to a reduction in the proportion of assets in very poor and poor condition but increase the proportion of assets in fair condition (Figure 8).

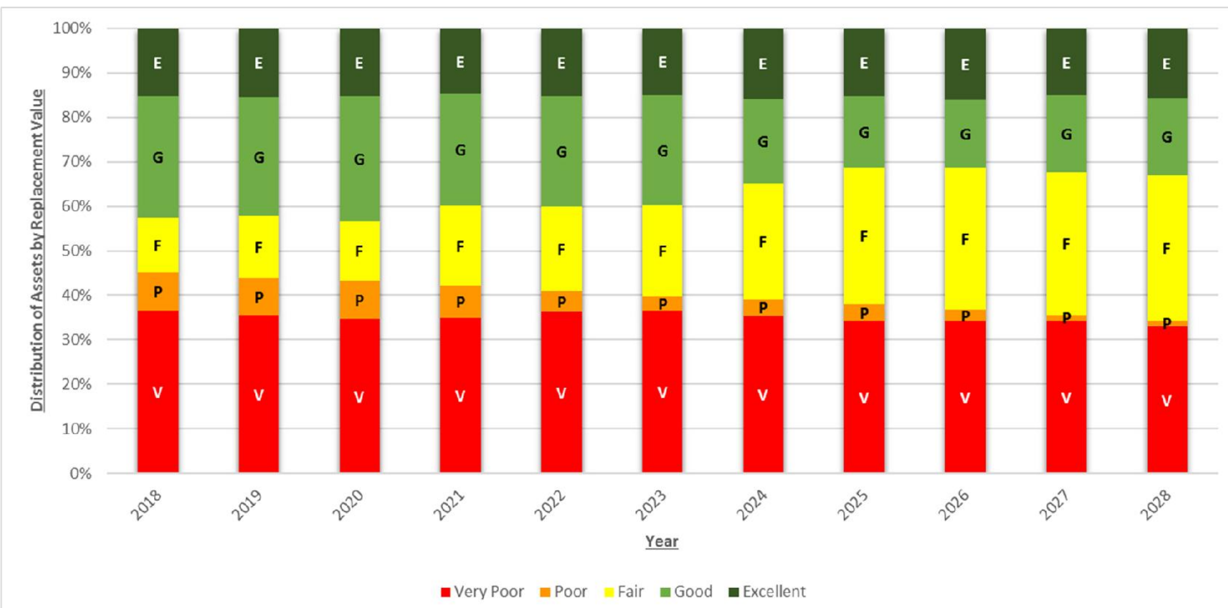


Figure 8: Performance Distribution of Wastewater Assets – Scenario 1

In comparison, replacing all assets when they reach they end of their service life with no budget constraints (**Scenario 2**) will result in a significant increase to asset performance over the next ten years. The proportion of very poor and poor assets will significantly decrease, and by 2028, ~40% of the system would be in excellent condition (Figure 9). This is due to many of the sewers having reached, or being close to reaching, the end of their service life, leading to significant expenditures to replace these assets.

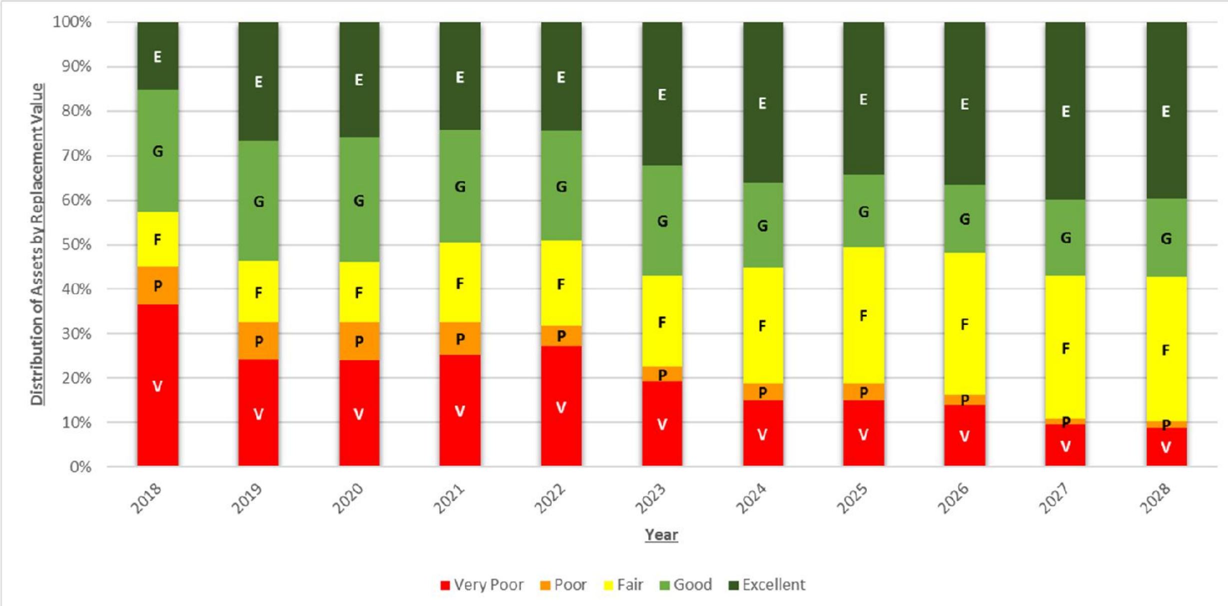


Figure 9: Performance Distribution of Wastewater Assets – Scenario 2

Because the existing budget (***Scenario 1***) results in a significantly lower performance, as shown in Figure 10, it suggests that there is a major gap between the Town's current spending and infrastructure needs.

3.6.2. Additional Scenarios

- **Scenario 3: Risk Analysis** – unlimited spending on assets that have reached their LOS target performance
- **Scenario 4: Enhanced Maintenance** – unlimited spending on assets at the end of their service life which has been extended due to increased maintenance
- **Scenario 5: 3% Increase Per Year for 10 Years** – spending constrained by the existing budget increased by 3% per year

The results of this analysis show that having an extended service life due to maintenance (**Scenario 4**) made very little impact on the performance in comparison to keeping the service life the same (**Scenario 2**). However, replacing assets at a target condition based on their consequence of failure (**Scenario 3**) did improve the average performance even further, but required a greater expenditure as assets were replaced earlier.

In comparison to the existing budget (**Scenario 1**), the increased budget scenario (**Scenario 5**) did result in an improvement to the average performance.

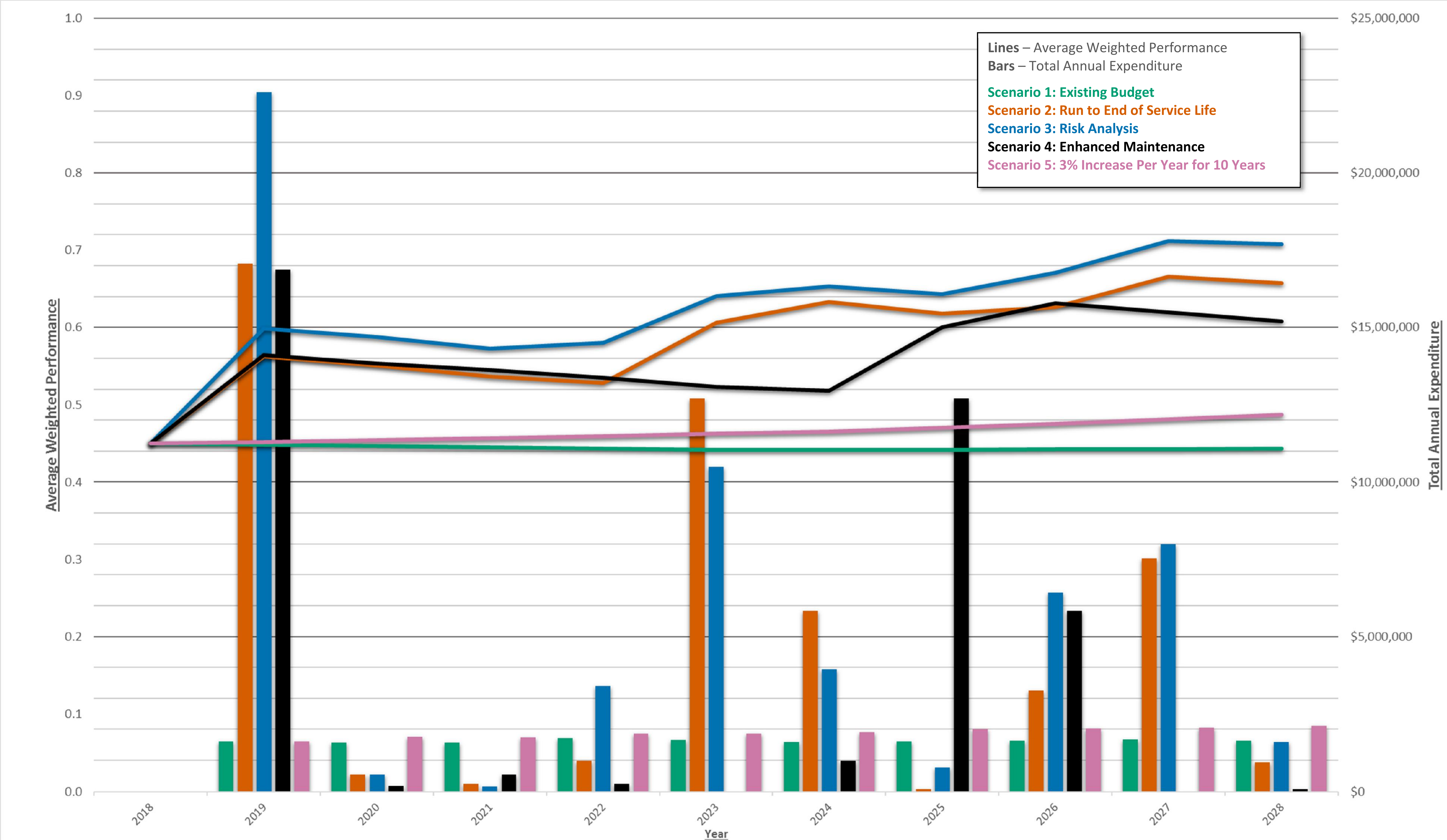


Figure 10: Expenditures and Performance of Wastewater Assets

3.7. STORM

Figure 13, on page 19, illustrates the annual capital expenditures and the aggregate performance for all stormwater assets over 10 years for all scenarios.

3.7.1. Base Scenarios

- **Scenario 1: Existing Budget** – spending constrained by existing budget
- **Scenario 2: Run to End of Service Life** – unlimited spending on assets at the end of their service life

The results of this analysis demonstrate that the current budget (**Scenario 1**) will result in a minor degradation of asset system performance over the next ten years while increasing the amount of assets in fair or worse condition (Figure 11).

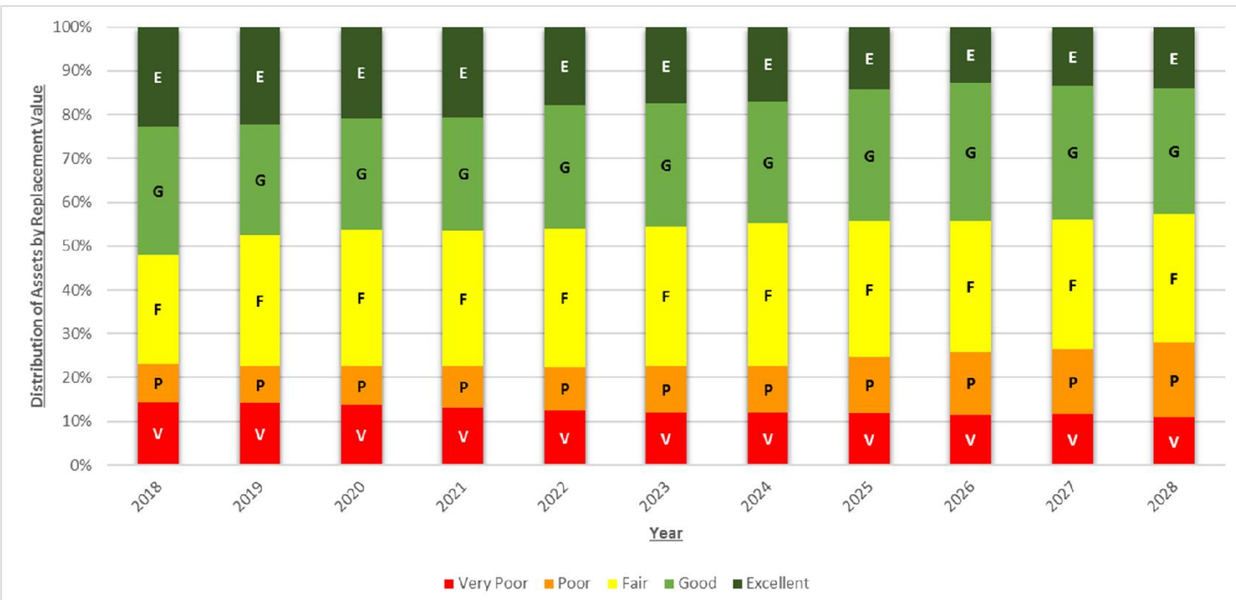


Figure 11: Performance Distribution of Storm Assets – Scenario 1

Replacing all assets when they reach they end of their service life with no budget constraints (**Scenario 2**) shows a similar degradation of performance. Although a large amount is spent within the first year to replace assets past their service life, there is not a large difference in average performance or the performance distribution by 2028 (Figure 12). This suggests a majority of the stormwater assets will not reach the end of their expected service life over the next ten years.

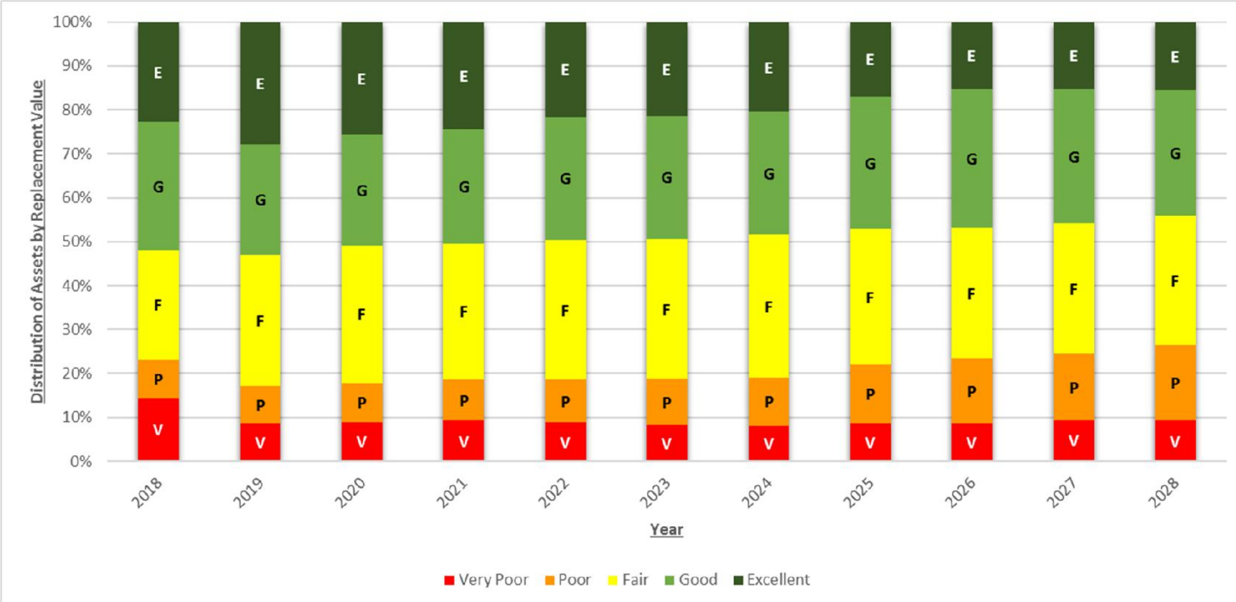


Figure 12: Performance Distribution of Storm Assets – Scenario 2

3.7.2. Additional Scenarios

- **Scenario 3: Risk Analysis** – unlimited spending on assets that have reached their LOS target performance
- **Scenario 4: Enhanced Maintenance** – unlimited spending on assets at the end of their service life which has been extended due to increased maintenance
- **Scenario 5: 3% Increase Per Year for 10 Years** – spending constrained by the existing budget increased by 3% per year

The results of this analysis show that having an extended service life due to maintenance (**Scenario 4**), made very little impact on the performance in comparison to keeping the service life the same (**Scenario 2**). However, replacing assets at a target condition based on their consequence of failure (**Scenario 3**) did improve the average performance even further, but required a greater expenditure as assets were replaced earlier.

In comparison to the existing budget (**Scenario 1**), the increased budget scenario (**Scenario 5**) did maintain the average performance around current levels.

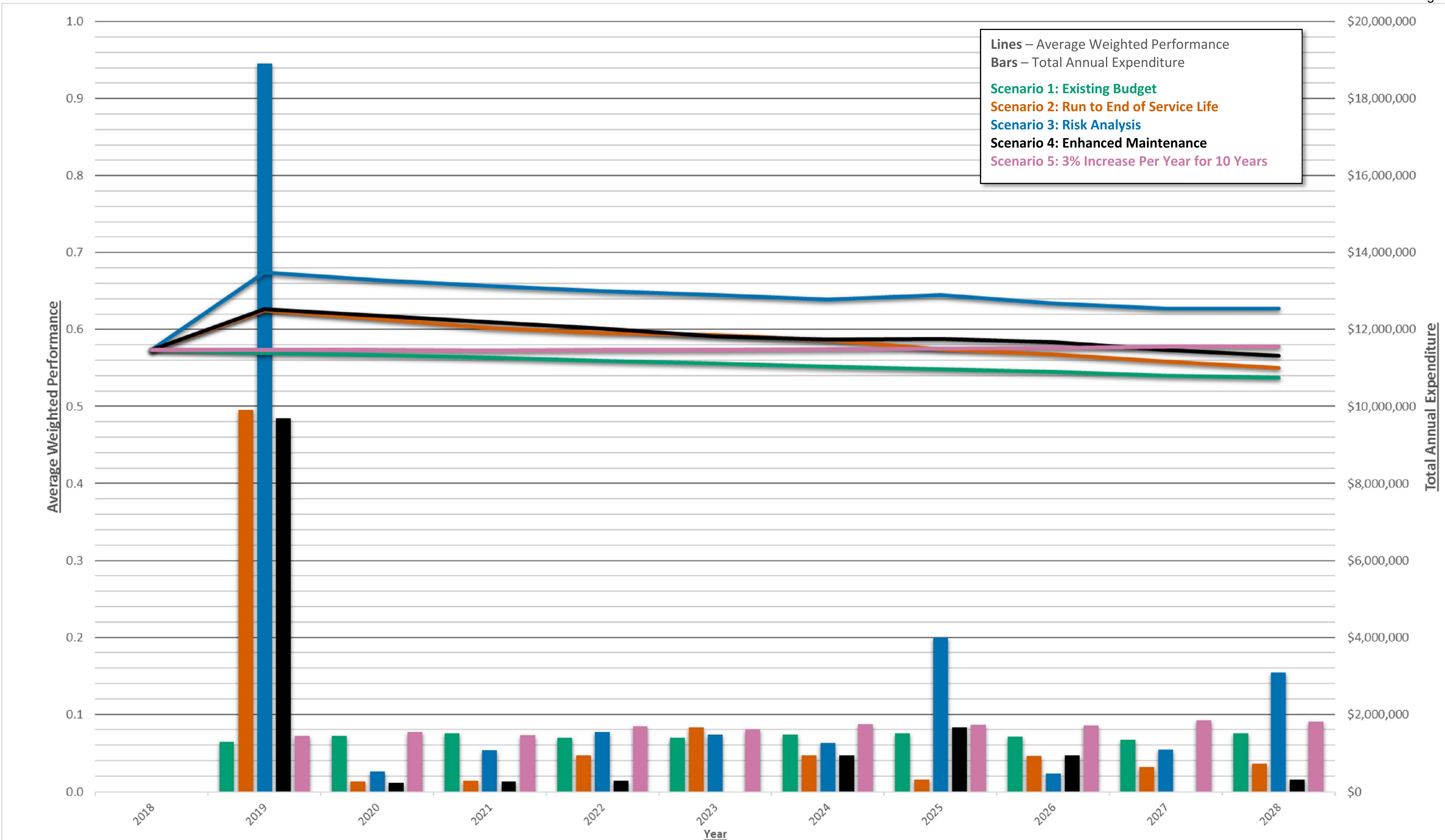


Figure 13: Expenditures and Performance of Storm Assets

3.8. BRIDGES & STRUCTURES

Figure 16, on page 23, illustrates the annual capital expenditures and the aggregate performance for all Bridge and Structure assets over 10 years for all scenarios. This analysis will vary from the Town's current system that they use for determining future capital expenditures on Bridge and Structure assets, Asset Management Forecaster, due to this analysis only including replacement work.

3.8.1. Base Scenarios

- **Scenario 1: Existing Budget** – spending constrained by existing budget
- **Scenario 2: Run to End of Service Life** – unlimited spending on assets at the end of their service life

The results of this analysis demonstrate that the current budget (**Scenario 1**) will result in a minor degradation of asset system performance over the next ten years while increasing the amount of assets in fair or worse condition (Figure 14).

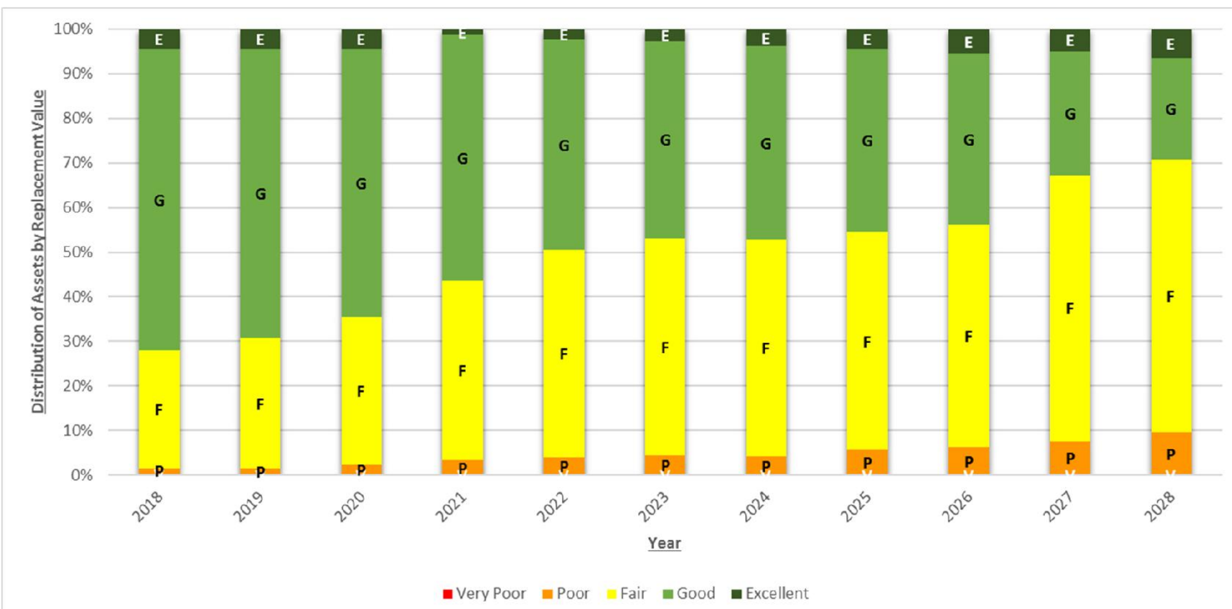


Figure 14: Performance Distribution of Bridge & Structure Assets – Scenario 1

However, replacing all assets when they reach they end of their service life with no budget constraints (**Scenario 2**) shows a greater degradation of performance with a greater proportion of assets being in fair or worse condition (Figure 15).

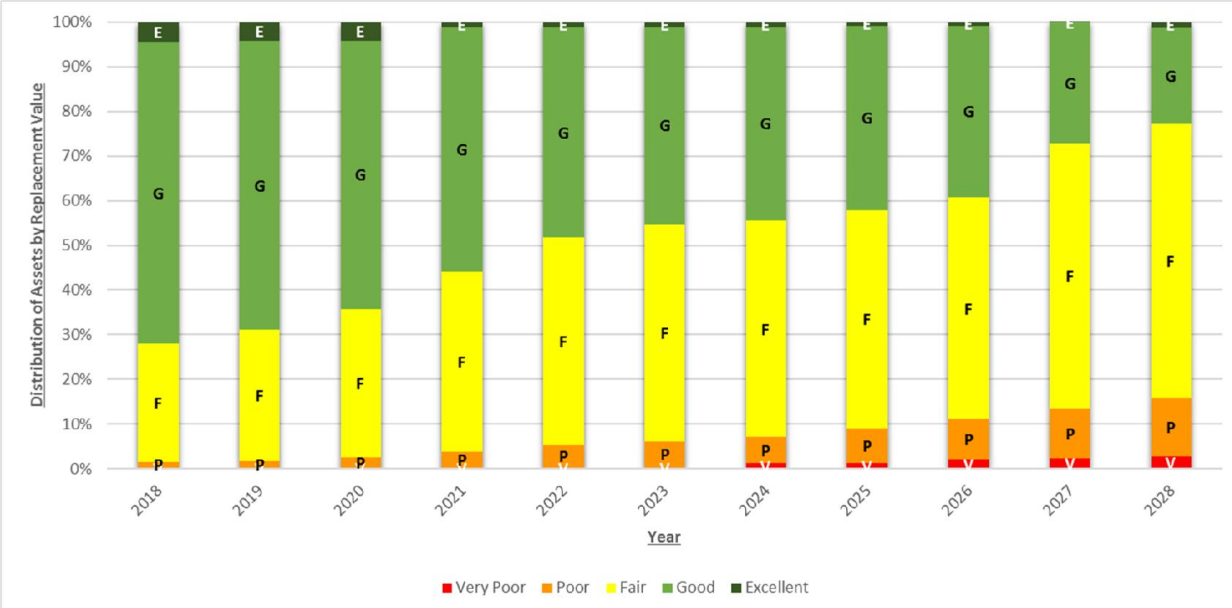


Figure 15: Performance Distribution of Bridge & Structure Assets – Scenario 2

Because the existing budget (**Scenario 1**) is showing a better projection, this suggests that the Bridge and Structure assets are fully funded despite the degradation in condition, which is likely caused by these scenarios not accounting for rehabilitation work. Both scenarios are showing an overall degradation in performance (as shown by the increase in assets which are in fair condition) which is to be expected as assets age but have not yet met their minimum level of service which would trigger replacement.

It should be noted that although this suggests that the existing budget (**Scenario 1**) is sufficient to maintain the level of service, it is still showing that some assets are falling into poor condition. This is because, as described in Section 3.2, some small structures were assigned a low COF and are therefore allowed to reach a poor condition before being targeted for replacement.

3.8.2. Additional Scenarios

- **Scenario 3: Risk Analysis** – unlimited spending on assets that have reached their LOS target performance
- **Scenario 4: Enhanced Maintenance** – unlimited spending on assets at the end of their service life which has been extended due to increased maintenance
- **Scenario 5: 3% Increase Per Year for 10 Years** – spending constrained by the existing budget increased by 3% per year

The results of this analysis show that having an extended service life due to maintenance (**Scenario 4**) and replacing assets at a target condition based on their consequence of failure (**Scenario 3**) can improve the average performance over the next 10 years in comparison to keeping the service life the same (**Scenario 2**).

In comparison to the existing budget (**Scenario 1**), the increased budget scenario (**Scenario 5**) did maintain a higher average performance, but it still degraded from current levels.

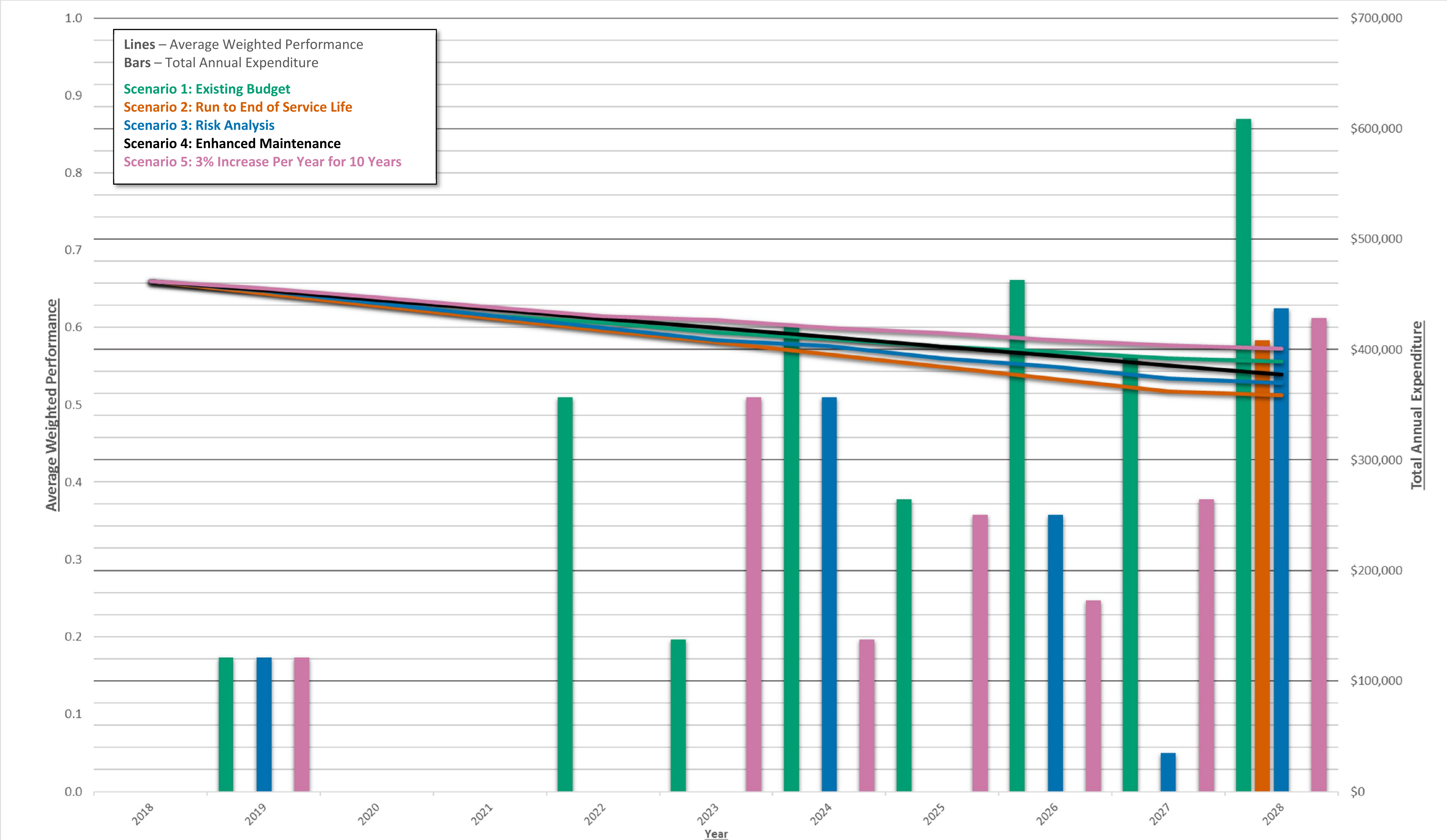


Figure 16: Expenditures and Performance of Bridge & Structure Assets

3.9. FACILITIES

Figure 19, on page 26, illustrates the annual capital expenditures and the aggregate performance for all Facility assets over 10 years for all scenarios.

3.9.1. Base Scenarios

- **Scenario 1: Existing Budget** – spending constrained by existing budget
- **Scenario 2: Run to End of Service Life** – unlimited spending on assets at the end of their service life

The results of this analysis demonstrate that the current budget (**Scenario 1**) will result in a minor degradation of asset system performance over the next ten years while increasing the amount of assets in fair or worse condition (Figure 17).

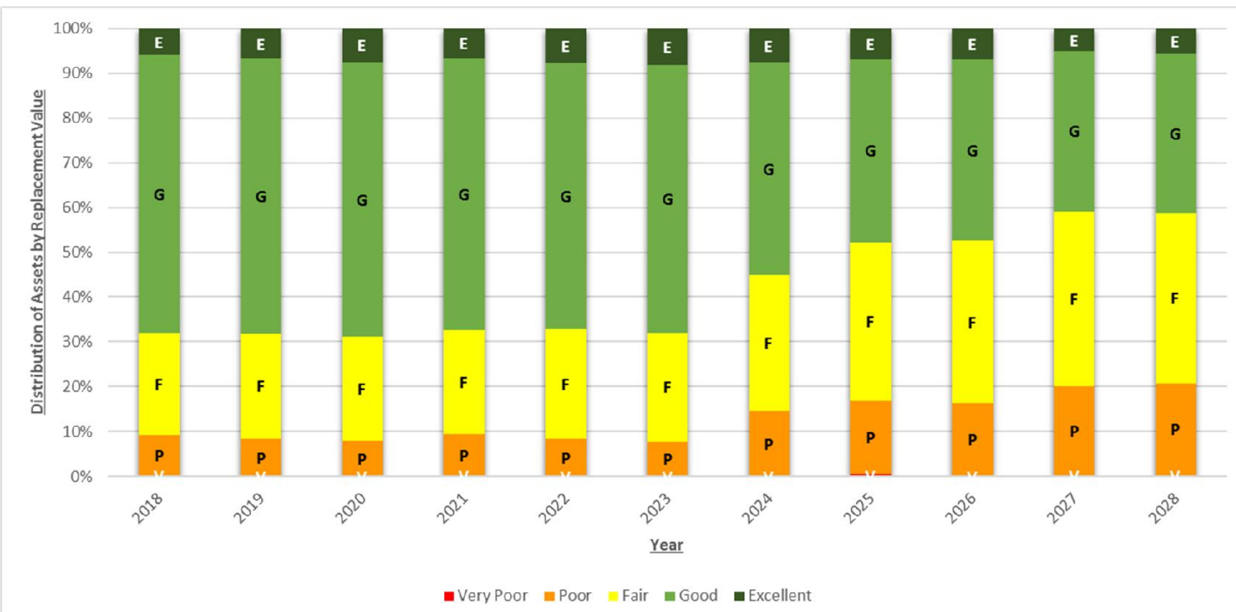


Figure 17: Performance Distribution of Facility Assets – Scenario 1

However, replacing all assets when they reach they end of their service life with no budget constraints (**Scenario 2**) shows a greater degradation of performance with a similar proportion of assets being in fair or worse condition (Figure 18).

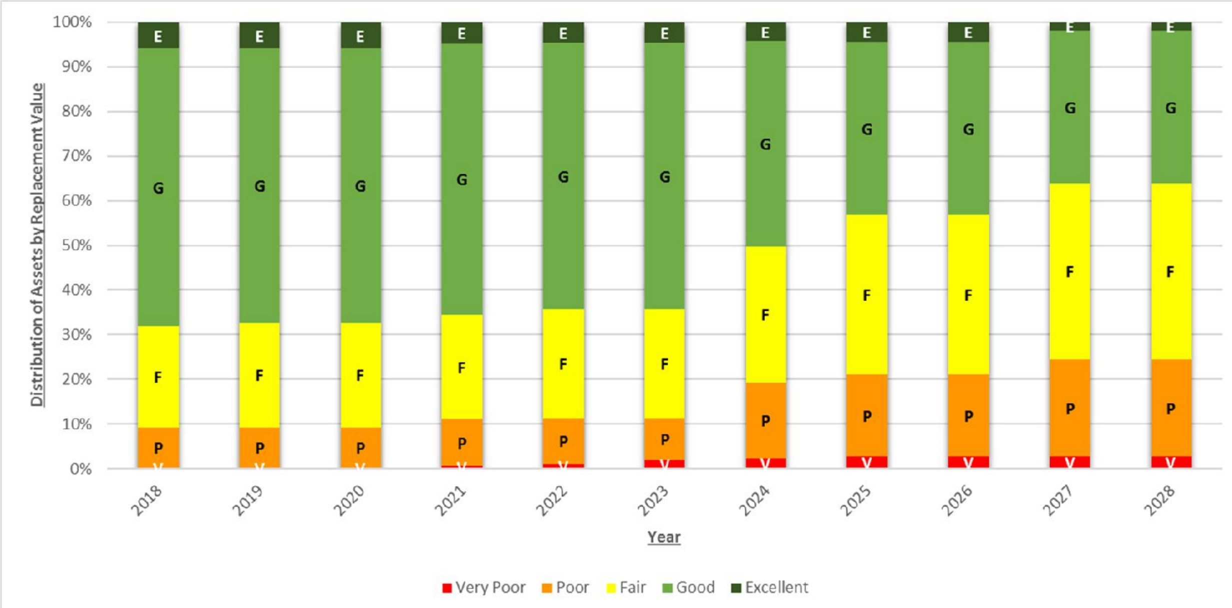


Figure 18: Performance Distribution of Facility Assets – Scenario 2

Because the existing budget (**Scenario 1**) is showing a better projection, this suggests that the Facility assets are fully funded despite the degradation in condition, which is likely caused by these scenarios not accounting for rehabilitation or maintenance work.

3.9.2. Additional Scenarios

- **Scenario 3: Risk Analysis** – unlimited spending on assets that have reached their LOS target performance
- **Scenario 4: Enhanced Maintenance** – unlimited spending on assets at the end of their service life which has been extended due to increased maintenance
- **Scenario 5: 3% Increase Per Year for 10 Years** – spending constrained by the existing budget increased by 3% per year

The results of this analysis show that having an extended service life due to maintenance (**Scenario 4**) and replacing assets at a target condition based on their consequence of failure (**Scenario 3**) can improve the average performance over the next 10 years in comparison to keeping the service life the same (**Scenario 2**).

In comparison to the existing budget (**Scenario 1**), the increased budget scenario (**Scenario 5**) did maintain a higher average performance, but it still degraded from current levels.

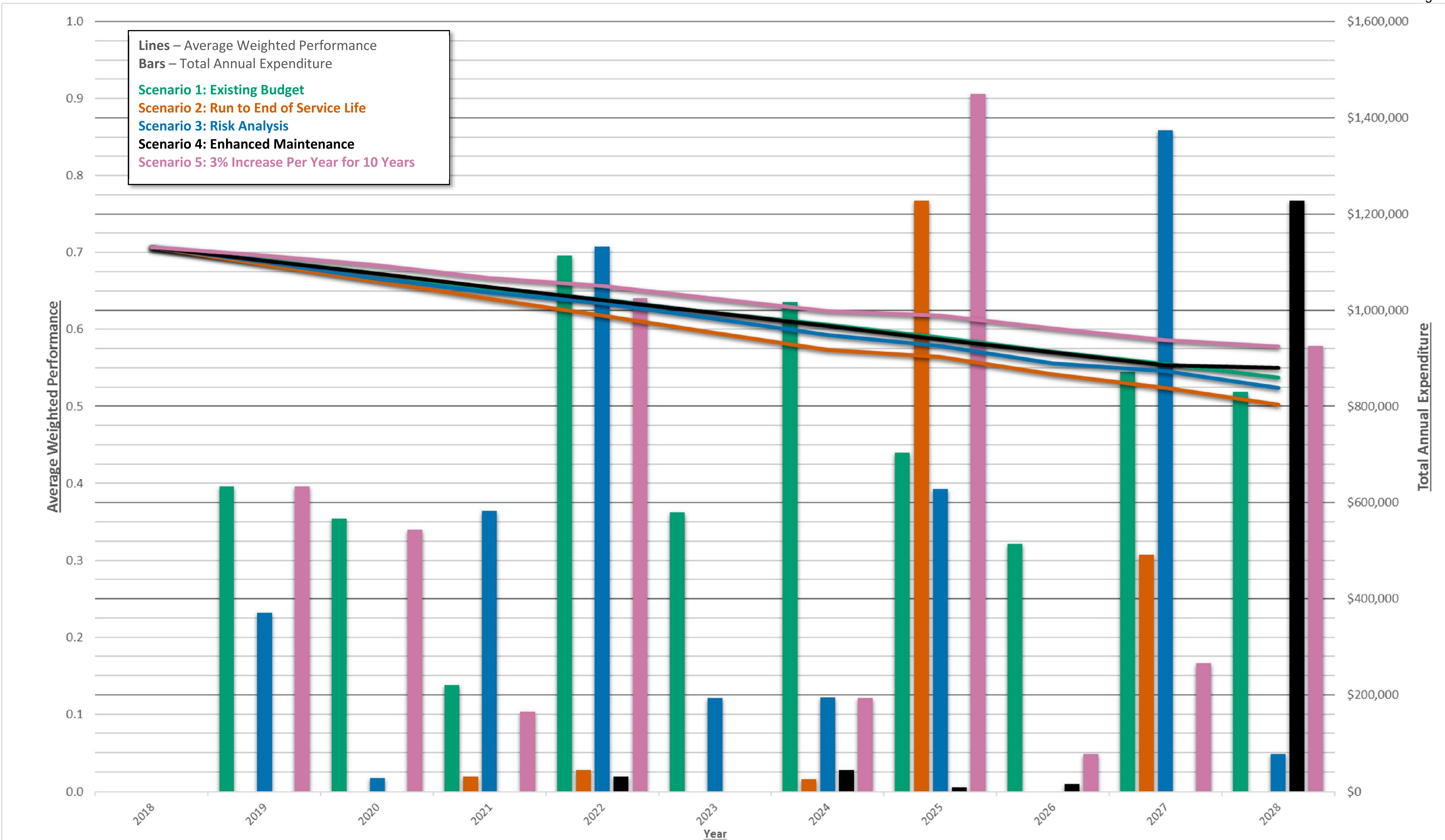


Figure 19: Expenditures and Performance of Facility Assets

4. WATERMAIN BREAK ANALYSIS

As part of the Water Master Servicing Plan (WMSP) that was completed in April 2017, a break prediction model was built to predict the number of watermain failures for the next 100 years. As part of this AMP, the break prediction model was updated to use the latest pipe and break data available, as this information should provide a more realistic view of asset performance than inferring condition based on age.

There are several factors which were used to affect the probability of a watermain breaking, they are as follows:

- Number of breaks that the pipe has experienced throughout its lifetime.
- Age of the pipe.
- Number of previous breaks that have recently occurred.

The model performs the following calculations in sequence for every predictive year:

- Calculate the probability of each pipe breaking based on the supplied break record and the measurement of the acceleration of the time between breaks, after the first break.
- Prioritize which pipes get replaced, where the pipes with the highest break probabilities get replaced first.
- Replace as many pipes as possible in priority to the maximum available budget. The model does not allow for partial replacement or budget deficit in any given year. Surplus funds are applied continuously to subsequent budget years.
- Pipes that get replaced have their number of breaks reset to zero and are assumed to be replaced with PVC pipe. Since this model only includes Asbestos Cement (AC) and Cast Iron (CI) pipes, this results in no more breaks occurring on the replaced pipe segment.
- The model deteriorates each pipe based on the break history supplied and the break probability is recalculated for all pipes on an annual and repeated basis as the simulation is run.

This is performed for each year for the next 50 years and the values stored. A sensitivity analysis using a Weibull continuous probability distribution is performed over 50 iterations for each funding scenario, and the results shown in the final output.

Worth noting are the following discrepancies between the previous model and the updated model:

- Data Changes
    - The pipe network was updated to include the latest pipe ownership information. The previous dataset had 2519 water mains owned by the Town, 2232 of which were AC or CI, while the current dataset has 1450

pipes owned by the Town, 702 of which are AC or CI. The difference appears to be caused by a combination of ownership changes and pipes that were previously flagged as mains but were laterals.

- The pipe network was updated to include the same replacement values used in the DSS for this AMP.
- The break record has been updated to include the breaks that have occurred since the WMSP model was completed.

- Probability Calibration
  - Due to the data changes, the break prediction model was underpredicting the number of breaks per year that will occur by approximately two thirds. This was caused by the loss of two thirds of the pipes which were being used in the model. As a result, the break model needed to be recalibrated. The predictions used in this AMP are shown using these updated break probabilities.

Figure 20 summarizes the results of the models that were generated using the following scenarios:

- **Existing Funding:** Assumed to be the existing funding at the time of the WMSP in 2016. Of the approximately $1,400,000 of replacement capital available from 2016, $770,000 of this amount is used for watermain replacement only. As such, the existing funding was assumed to be $770,000/year for future years for the purposes of watermain replacement.
- Additional funding, in addition to the Existing Funding, of:
  - **$100,000**
  - **$200,000**
  - **$300,000**

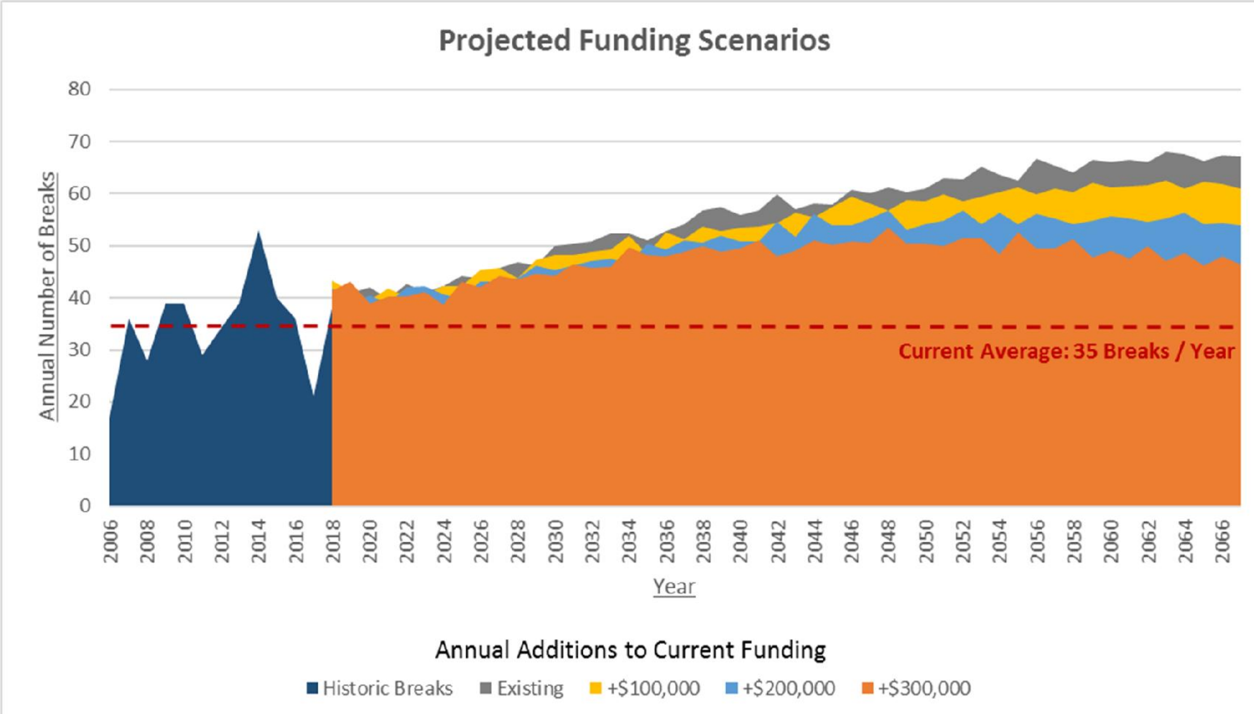


Figure 20: Projected Watermain Break – Funding Scenarios

The results of this model show the need for an additional $300,000/year in funding from 2015 levels to remain below the 50 breaks/year target threshold. Town Council has since approved this additional funding, thus no further funding increases should be necessary.

5. RECOMMENDATIONS & 10-YEAR CAPITAL PLAN

The following recommendations are based on the analysis provided within this memorandum which focuses the State of Good Repair of the system but does not account for functional performance and growth requirements.

5.1. ROADS

The results of this analysis demonstrate that the Town's current budget should meet road asset needs over the next ten years, particularly if priority is given to higher COF roads (e.g. higher traffic roadways). In addition, the results of **Scenario 1** corroborated that the additional $200,000 in spending (in addition to inflationary increases) recommended by the 2018 Road Needs Study Update report (included in the existing budget scenario) should bring the Town to their desired average performance of 80 PCI over the next ten years. Because the Town is currently using a system for determining future capital expenditures on Road assets, Decision Optimization Technology (DOT), it is recommended that the Town continue to follow the recommendations provided by this software and maintain the current budget.

5.2. WASTEWATER

Based on the results of this analysis, there appears to be a major gap between the Town's current spending and infrastructure needs. However, the performance for these models is based on the age of the sewers and their expected service life, rather than real condition information. This is due to the inability to access historical CCTV data, as the condition information is not available in a digital format.

Because of this, it is recommended that the Town focus their efforts over the next few years to collect CCTV data in a digital format from a representative sample of sewers. As the budget scenario indicates, the current budget should maintain the average performance of the system over the short term while this additional information is collected and used to reevaluate these results based on real condition information.

To address the need for additional CCTV collection, a 3% increase per year (**Scenario 5**), which equates to approximately $50,000 in 2020, has been used within the capital plan to maintain assets at a similar performance level, while increasing spending for the CCTV work. With a 3% increase per year for 10 years, the Town should be able to CCTV a representative sample over the next few years and completely CCTV their system over 7 years if all additional funding goes towards this program. However, based on our available data we expect that more than 7 years of increased funding will be required to maintain the LOS of the system, though the results of the CCTV data will provide additional insight.

5.3. STORM

As this analysis demonstrates, the current budget scenario results in a minor degradation of performance over the next 10 years. However, this data is based on the age of assets rather than the actual condition of assets. To address this, the Town is planning to begin a storm sewer CCTV program which would provide actual condition information, rather than relying on age-based estimates. As such, it is recommended that the Town continue with the current budget (**Scenario 1**), which only results in minor degradation in this analysis, while CCTV data is collected. This will provide the Town with a more accurate view of the performance of this asset portfolio, which can then be used to provide more accurate predictions regarding funding requirements.

5.4. BRIDGES & STRUCTURES

The results of this analysis indicate that the Town is meeting the infrastructure needs (**Scenario 1**), however, the average performance of this portfolio is projected to degrade over the next ten years, regardless of the scenario. This is due to the analysis being restricted to replacement work, which due to the nature of the infrastructure having long life spans, would not be expected to reach the target condition for replacement over the next ten years. This suggests that performing ongoing maintenance and rehabilitation work over the next ten years will help to maintain the performance of the Town's Bridges and Structures. Since the Town has a current system for determining capital expenditures for these assets, it is recommended that the Town continue to follow the recommendations provided by this software.

5.5. FACILITIES

The results of this analysis indicate that the average performance of this portfolio is projected to degrade over the next ten years. However, because the scenario which allows for unlimited spending once assets reach the end of their service life (**Scenario 2**) shows an even greater degradation over time than the current budget (**Scenario 1**), it suggests the Town is meeting the infrastructure needs.

This lowering of the average performance for Facilities over time is likely due to the analysis being restricted to replacement work. The majority of the replacement value for facilities is in assets that are not forecasted to be replaced in the next ten years. This results in the assets having their performance degraded over time, without enough replacements taking place to improve the performance. This is demonstrated in Appendix B which contains longer term projections where **Scenario 2** (unlimited spending at the end of service life) does return to current performance levels once more high value assets with long life spans begin to be replaced.

However, these scenarios don't account for the maintenance and rehabilitation work that is typically completed to maintain facilities. This type of work helps to maintain and improve the condition of assets, improving the average performance of the asset category. Because of this, as long as typical maintenance and rehabilitation work are completed as needed, the Town should be able to maintain the current level of service provided by Facility assets with the existing budget (**Scenario 1**).

5.6. WATER

The results of the updated watermain break analysis corroborate the findings from the 2017 WMSP, that an increase of $300,000/year in funding from 2015 levels will allow the Town to remain below the 50 breaks/year target threshold. As the Town Council has since approved this additional funding, no further funding increases should be necessary.

5.7. FINAL CAPITAL PLAN

As described in the previous section, only wastewater assets are recommended for additional spending to help maintain the state of good repair while completing a CCTV program. The spending projected within these analyses included a 3% increase per year over ten years for wastewater assets (**Scenario 5**), would result in an increased expenditure of $2.7M over 10 years in addition to annual inflationary increases to contributions. However, the required expenditure may vary based on the size and scope of the program the Town is interested in completing.

For the remainder of the asset categories, the existing budget (**Scenario 1**) was found to be adequate to maintain LOS.

Based on these recommendations, Table 4 outlines the recommended target funding and the current deficit for each asset class.

Table 4: Annual Capital Expenditure Summary

Asset Category	Current Avg. Annual 10-Year Contribution to Reserves ($000)	Current Avg. Annual 10-Year Gas Tax and Other Grants ($000)	Total Current Avg. Annual 10-Year Funding ($000)	Avg. Annual Funding to Maintain Current LOS ($000)	Avg. Annual Infrastructure Funding Gap ($000)
Bridges & Structures	$370	$650	$1,020	$1,020	$0
Facilities	$830	$0	$830	$830	$0
Roads & ROWs	$3,050	$480	$3,530	$3,530	$0
Sanitary	$1,630	$0	$1,630	$1,900	$270
Stormwater	$1,430	$0	$1,430	$1,430	$0
Water	$1,720	$0	$1,720	$1,720	$0
Total	**$9,030**	**$1,130**	**$10,160**	**$10,430**	**$270**

In addition, Figure 21 outlines the recommended 10-year capital plan to address the state of good repair of the assets and their resulting average weighted performance.

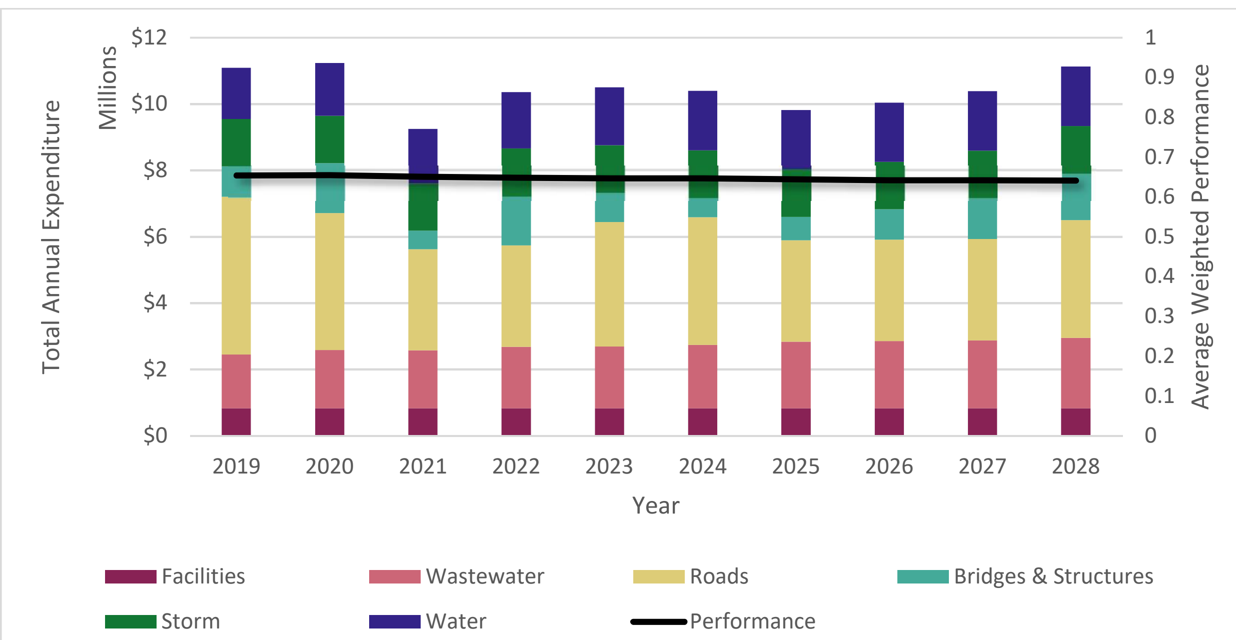


Figure 21: Recommended 10 Year Capital Plan

As this graph illustrates, this recommended 10-year capital plan should maintain the average performance of the system above 0.6 (Good) over the next 10 years (water asset performance was not factored into this average as a comparable performance was not forecasted). The performance of the system can be further maintained through ongoing preventative maintenance of the assets. In addition, this analysis can be further refined to provide more accurate forecasts of infrastructure needs through the collection of condition, replacement costs and estimated service life data, and through the development of lifecycle curves and strategies.

APPENDIX A: GLOSSARY OF TERMS

Asset: An item, thing or entity that has potential or actual value to an organization" (ISO 55000, 2014). The value can be tangible (or intangible); financial (or non-financial) and includes consideration of risks and liabilities.

Asset Management Plan (AMP): Documented information that specifies the activities, resources and timescales required for asset-based services to achieve the organization's Asset Management (AM) objectives (ISO 55000, 2014).

Average Weighted Performance: When calculating the average performance of a group of 2 or more assets, the average weighted performance by replacement cost was used. The following formula was used to calculate the average weighted performance of a group of assets:

$$[Average\ Weighted\ Performance] = \frac{\sum([Asset\ Performance] * [Replacement\ Cost])}{\sum[Replacement\ Cost]}$$

Budget Scenario: Budget scenarios assume the user has a limited amount of funding, with a set budget for each forecasted year. The budget scenarios degrade the performance of each asset until it reaches the minimum level of service allowed for that asset and then improves the asset if funding is available. The analytical system "spends" all the budgeted money in each forecasted year to improve assets and then shows the expected performance of each system and the distribution of assets in each of the five condition states.

Consequence of Failure (COF): COF scores represent the socio-economic and environmental impacts of an asset's failure. These scores generally range from 1 to 5, with 1 having a negligible impact and 5 having catastrophic side effects.

Estimated Service Life (ESL): An estimate of the duration of time that an asset is forecasted to be in service.

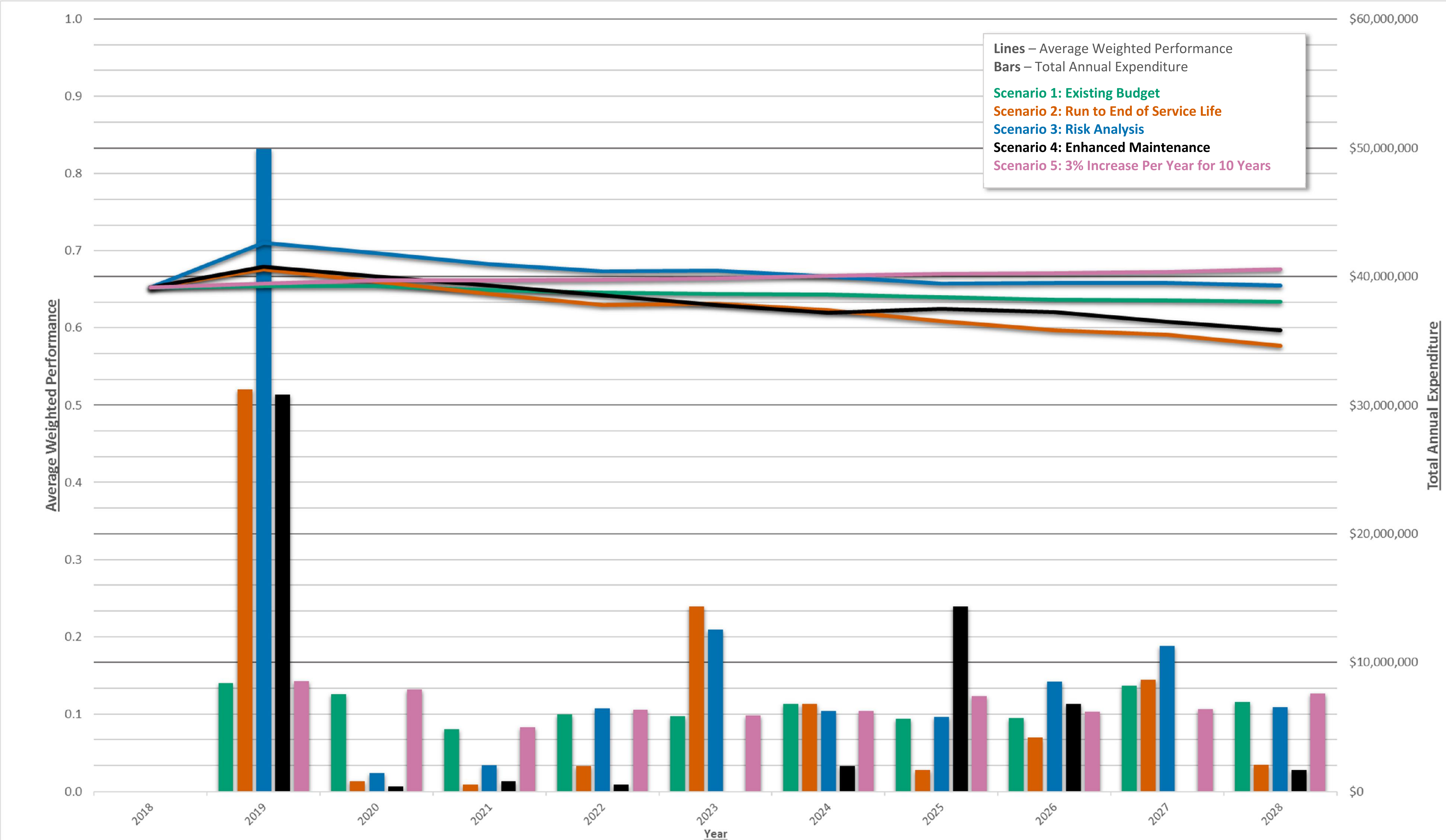
Infrastructure: Infrastructure means the physical structures and associated facilities that form the foundation of development, and by or through which a public service is provided to Ontarians, such as highways, bridges, bicycle paths, drinking water systems, as well as any other thing by or through which a public service is provided to Ontarians (Infrastructure for Jobs and Prosperity Act, 2015, S.O. 2015, c. 15).

Level of Service (LOS): Level of service is a qualitative or quantitative description of a service that is being provided. Two types of Levels of Service generally exist: Customer (or Community) Levels of Service; and, Technical Levels of Service.

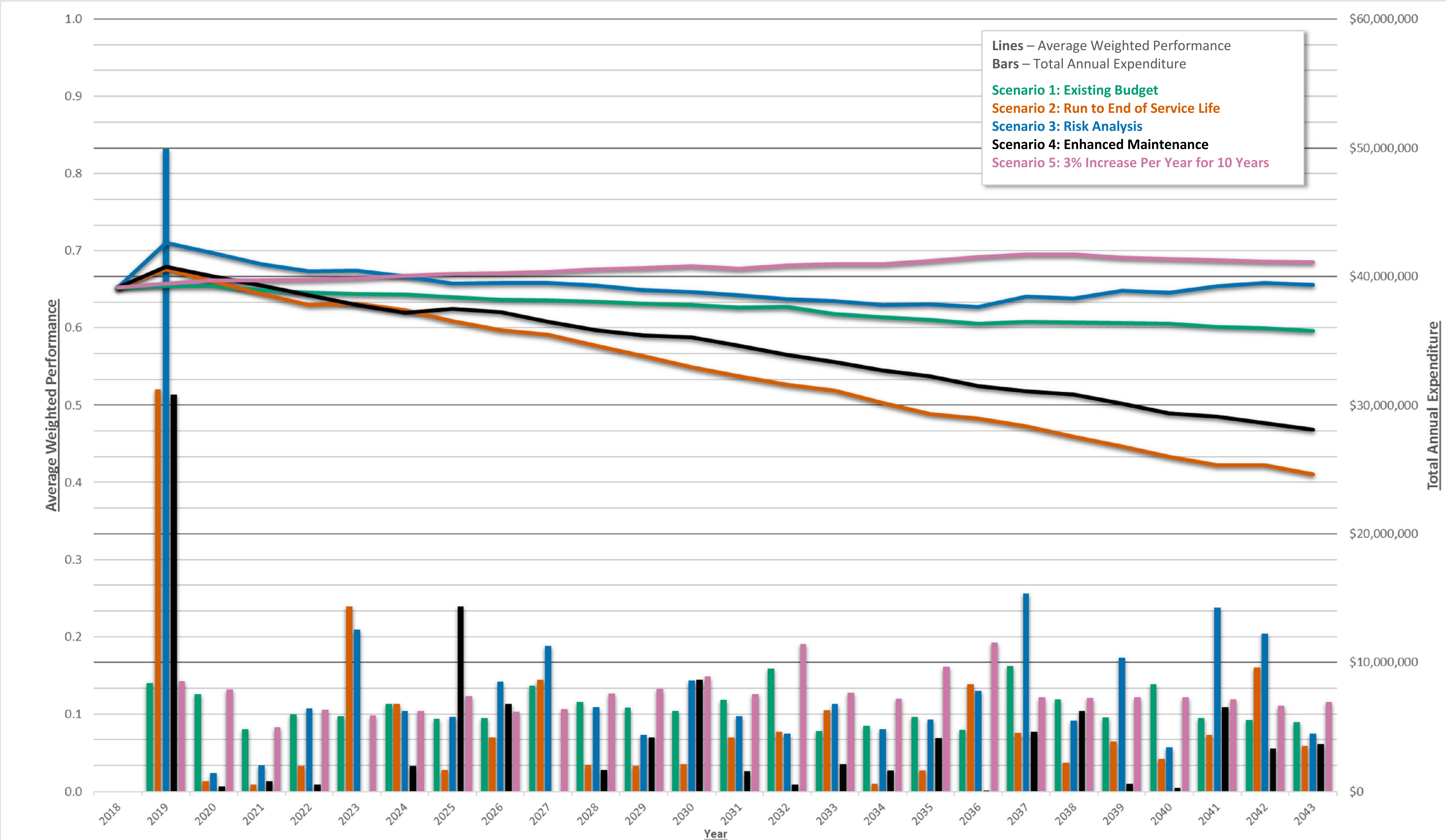
Target Scenario: Target scenarios allow for unlimited spending to understand infrastructure needs with no budget constraints. The Target scenarios degrade the performance of each asset until it reaches a preset target performance. Once any asset reaches this performance value it is automatically treated.

APPENDIX B: 10, 25, AND 50 YEAR ANALYSIS RESULTS

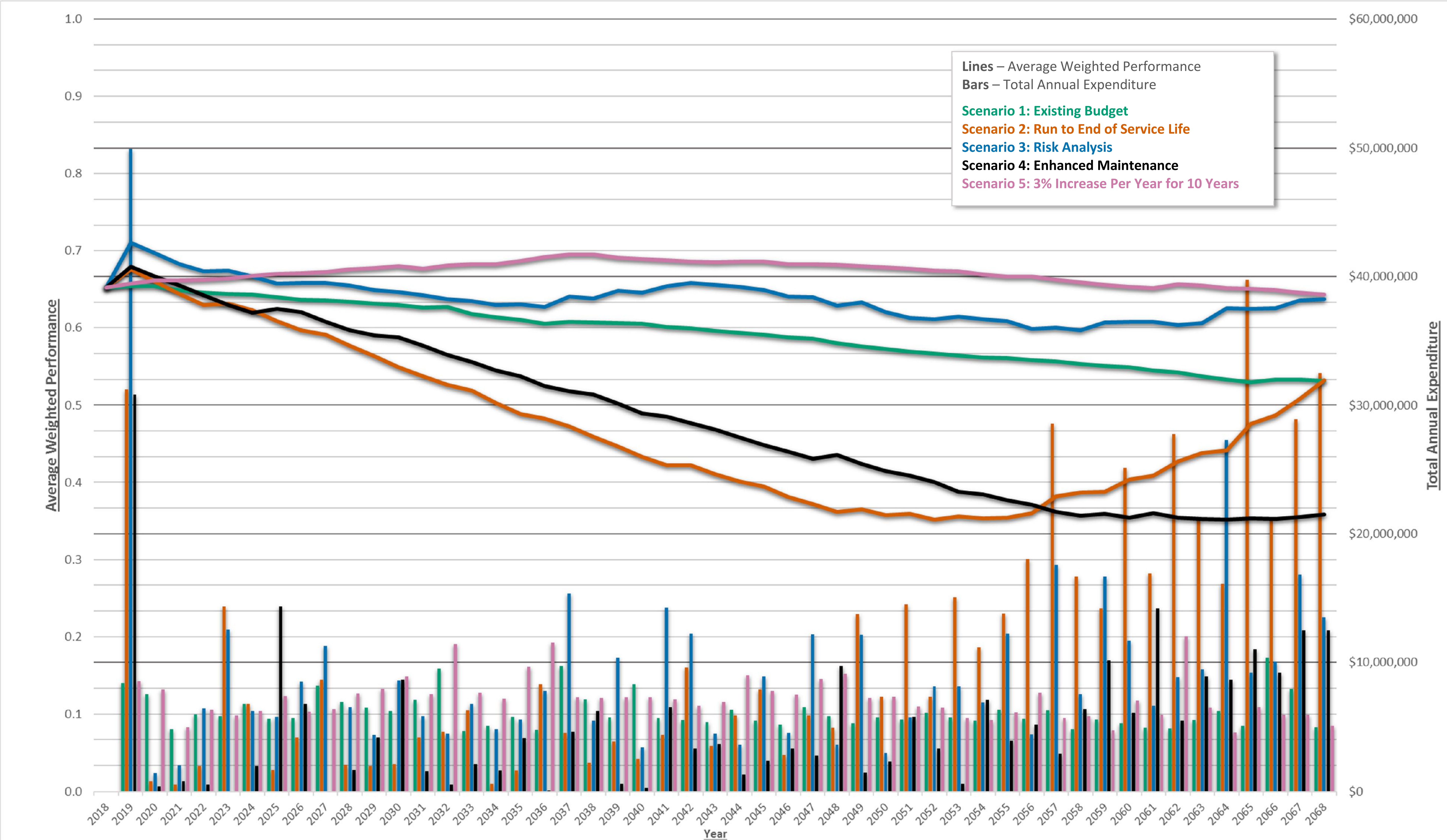
System Overview (Except Water) - 10 Years



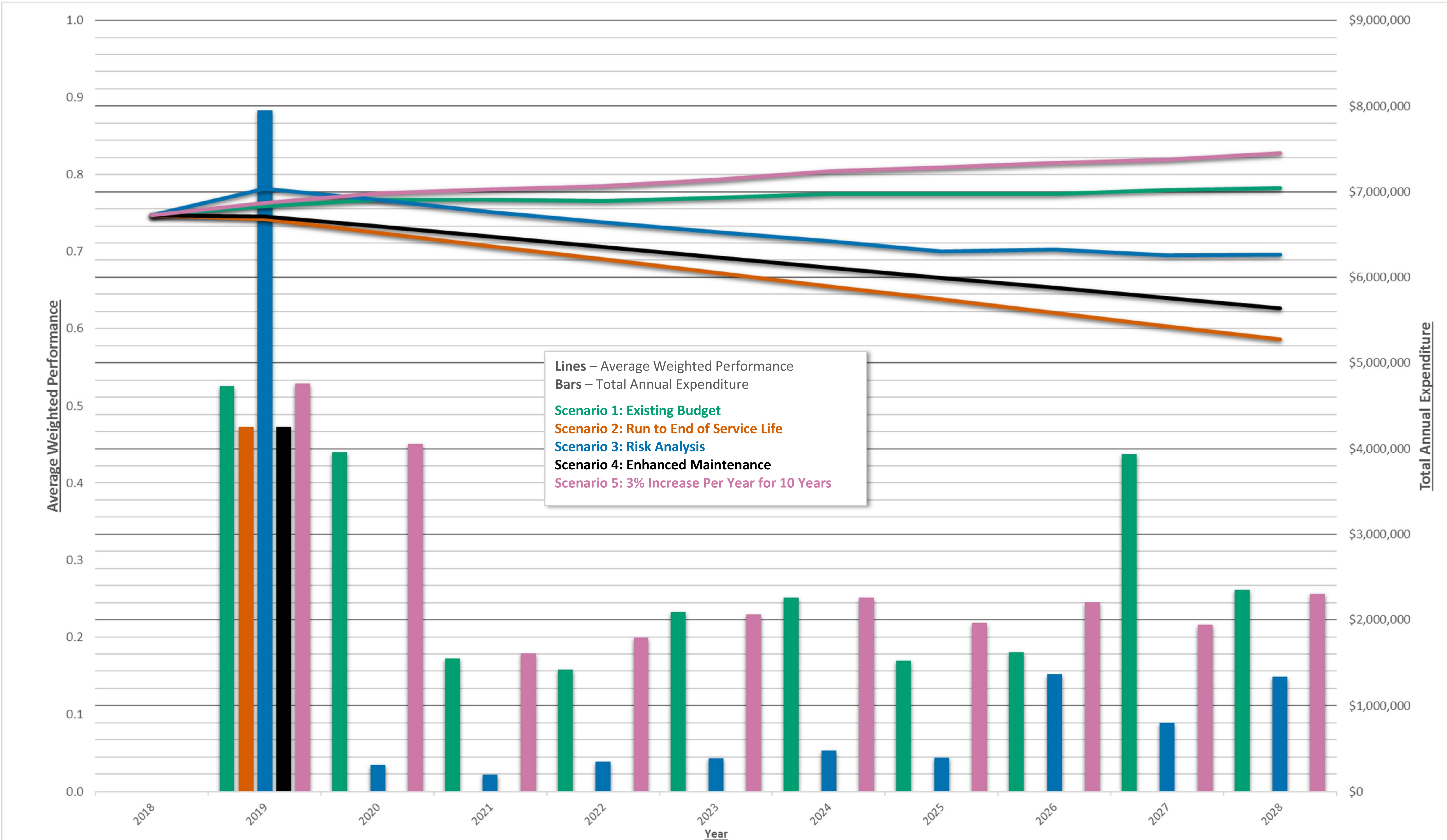
System Overview (Except Water) - 25 Years



System Overview (Except Water) - 50 Years



Roads - 10 Years



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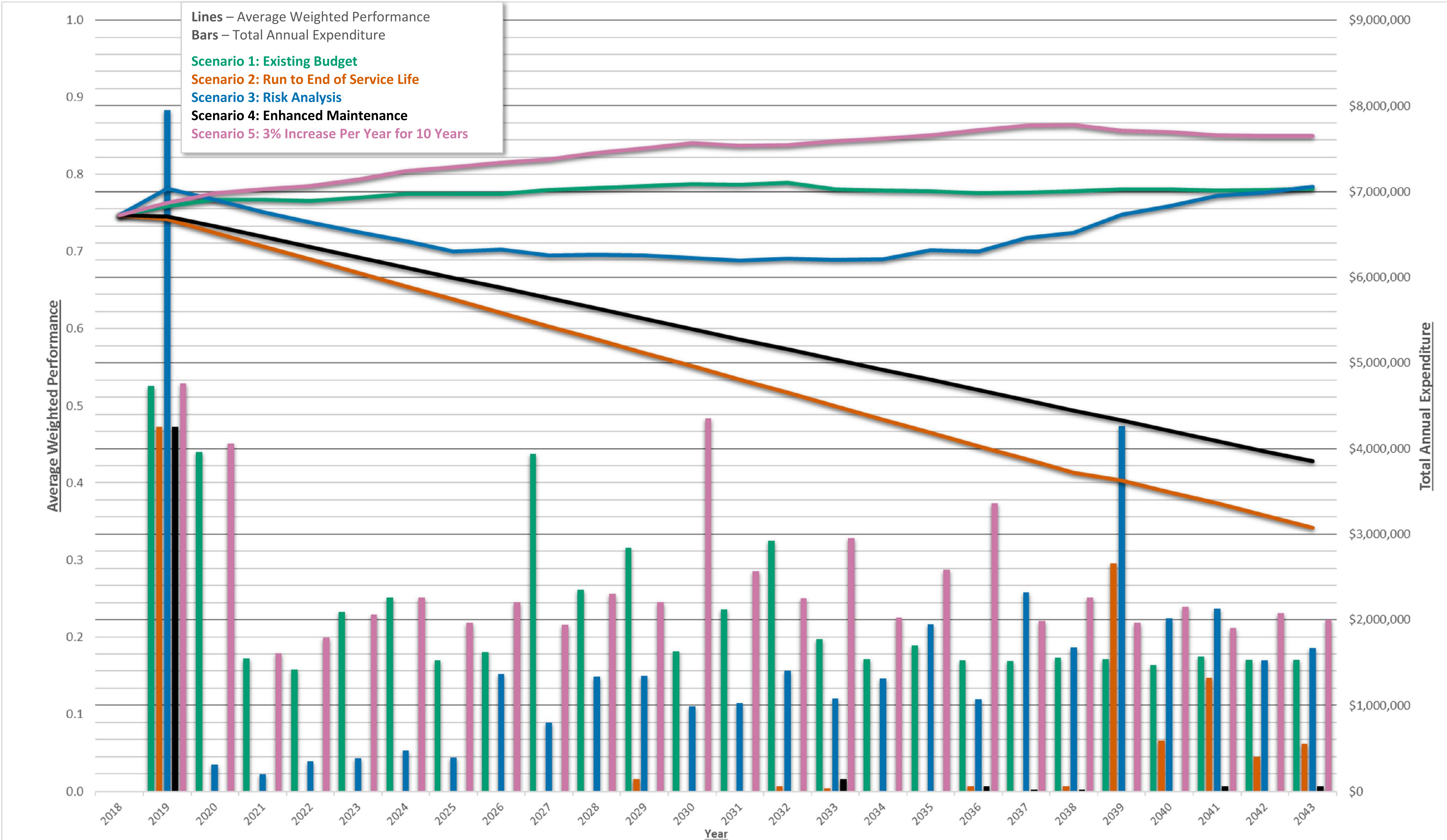
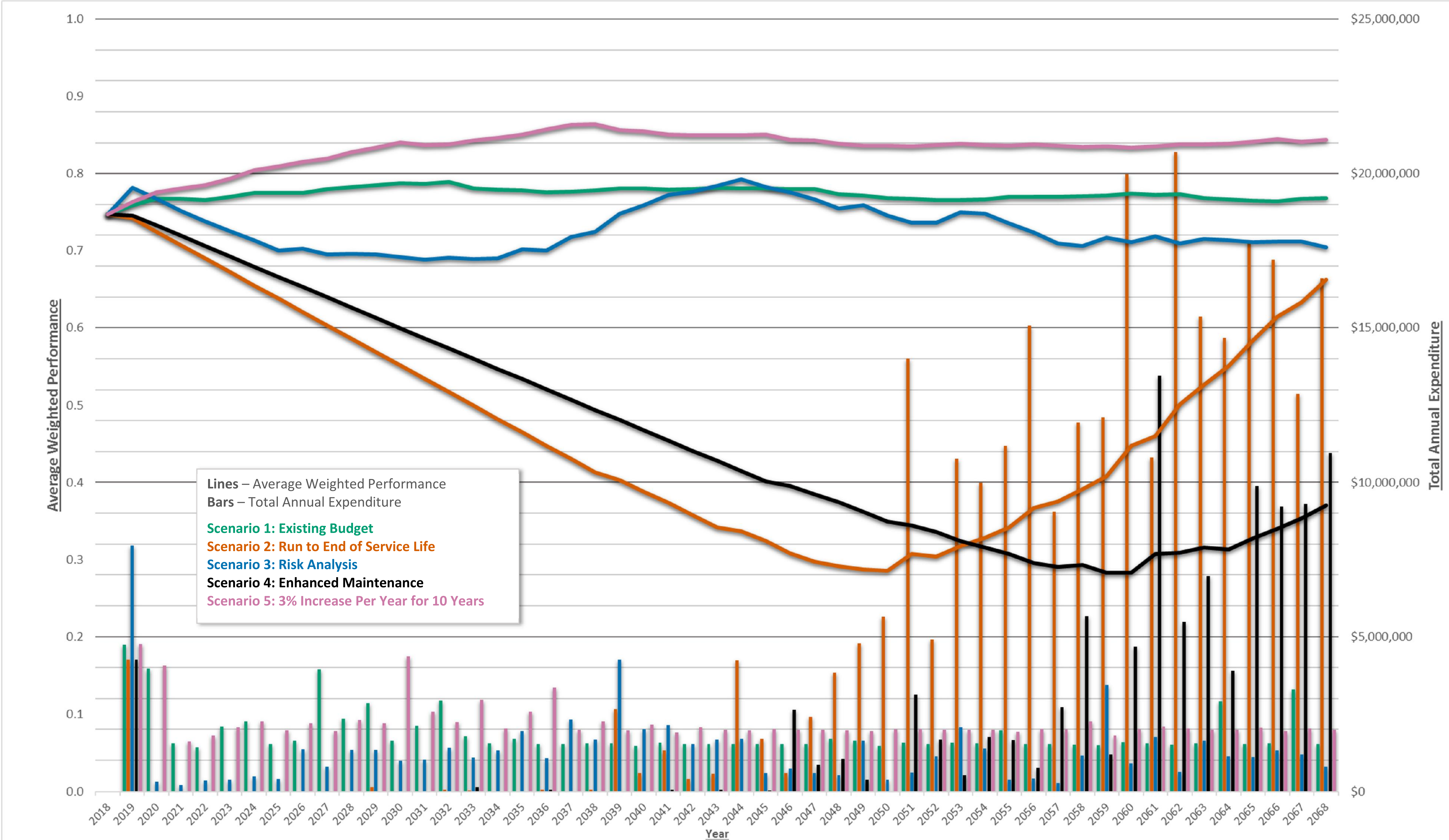
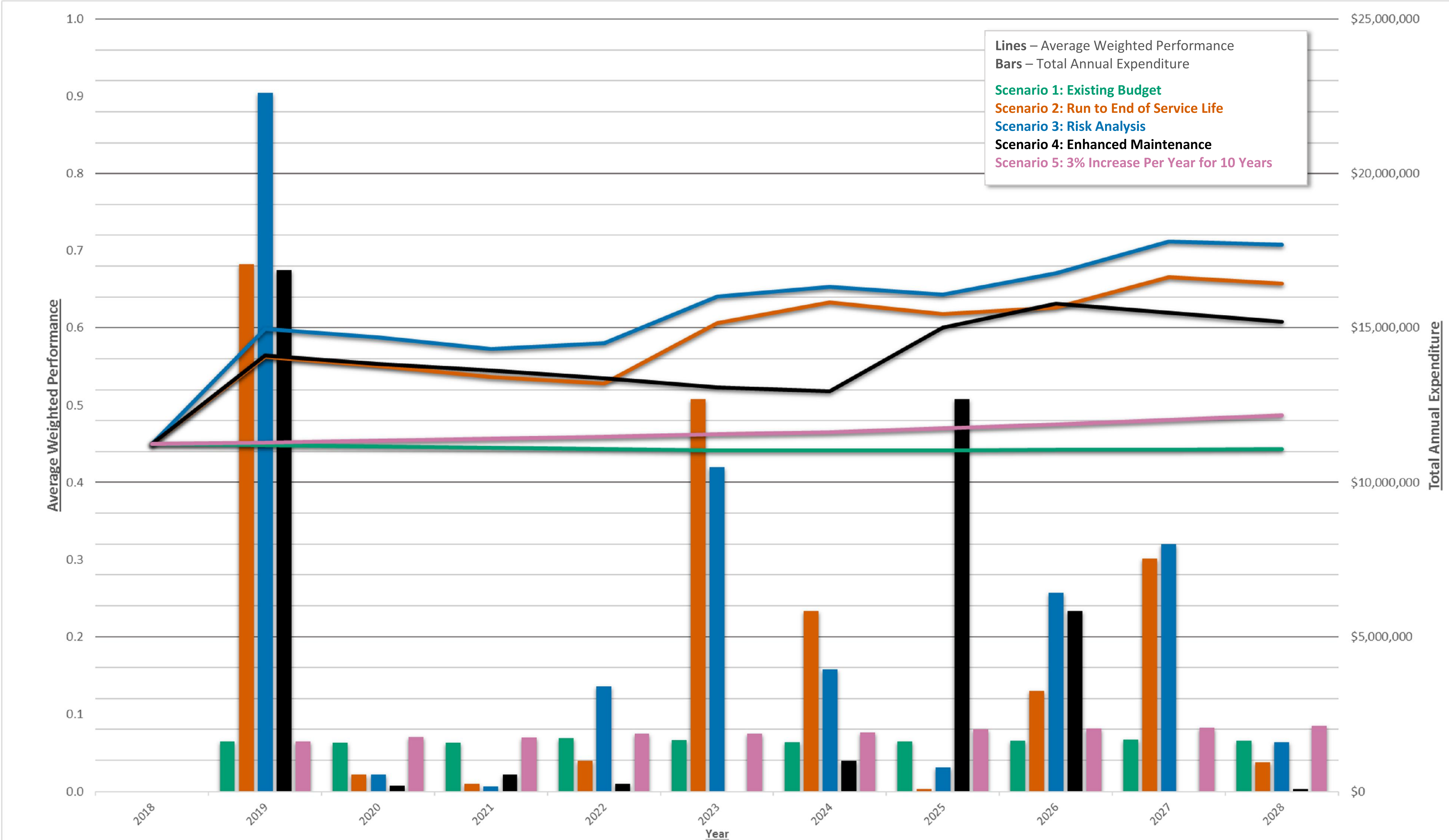
Roads - 25 Years



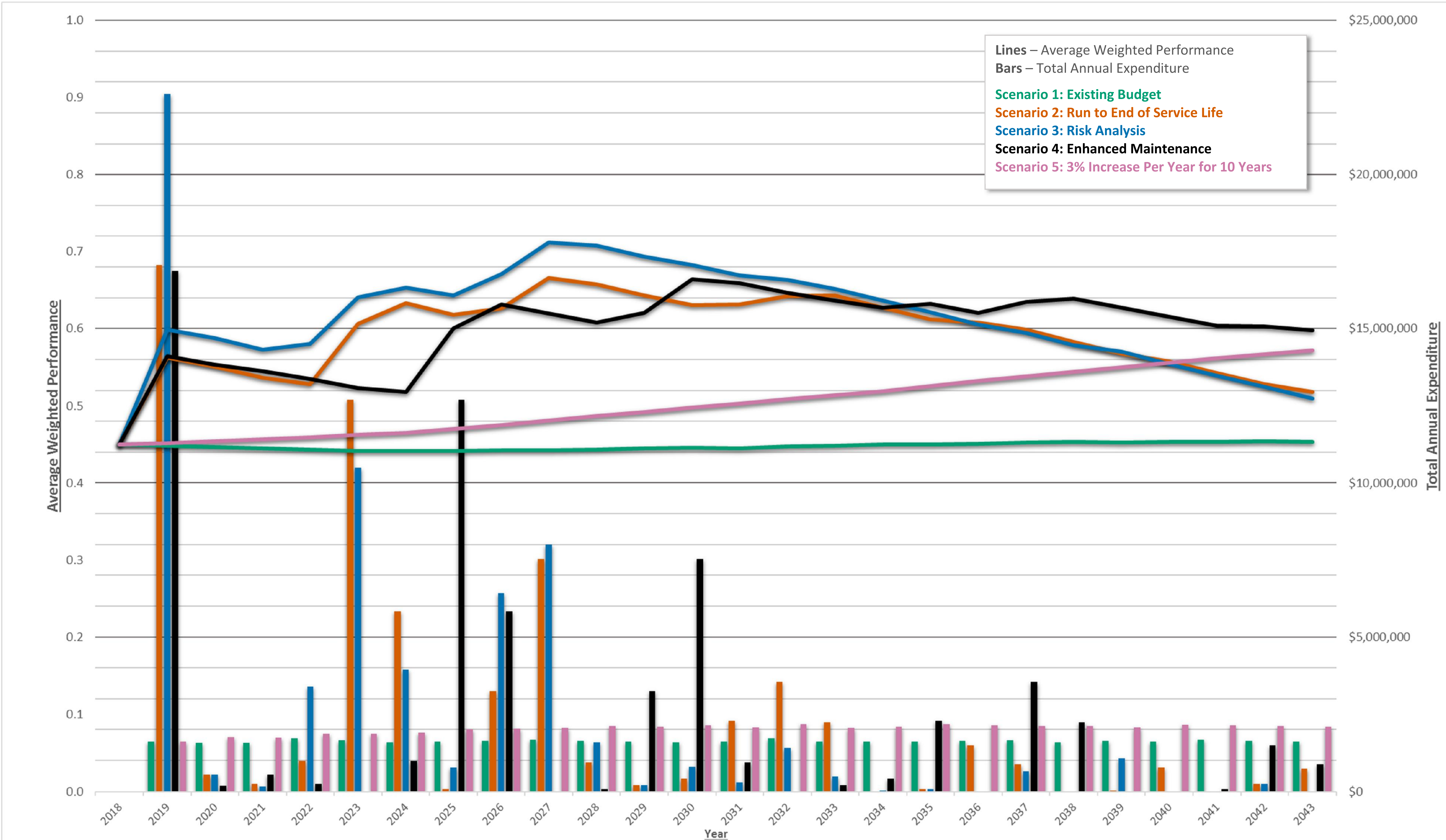
Roads - 50 Years



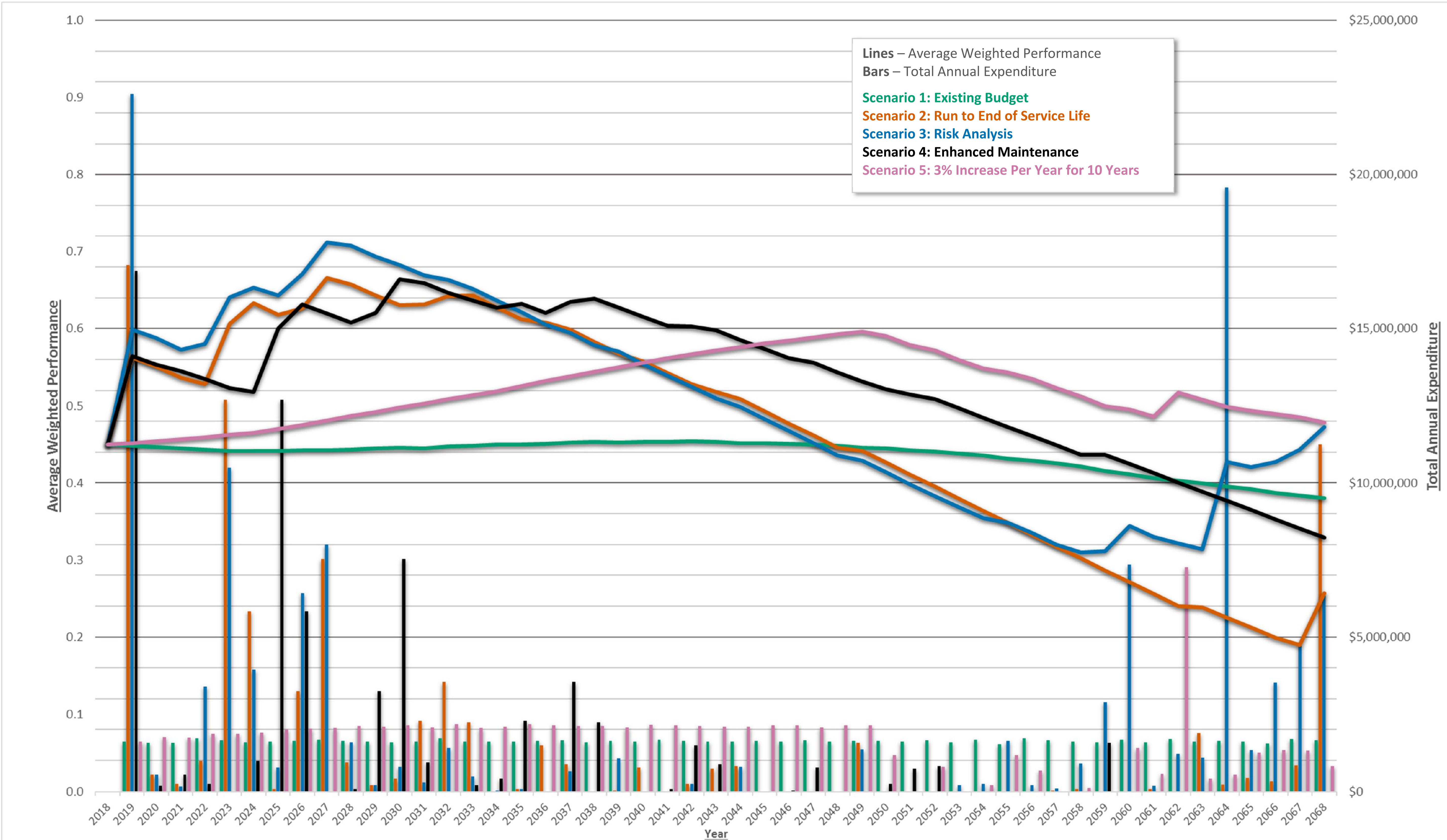
Wastewater - 10 Years



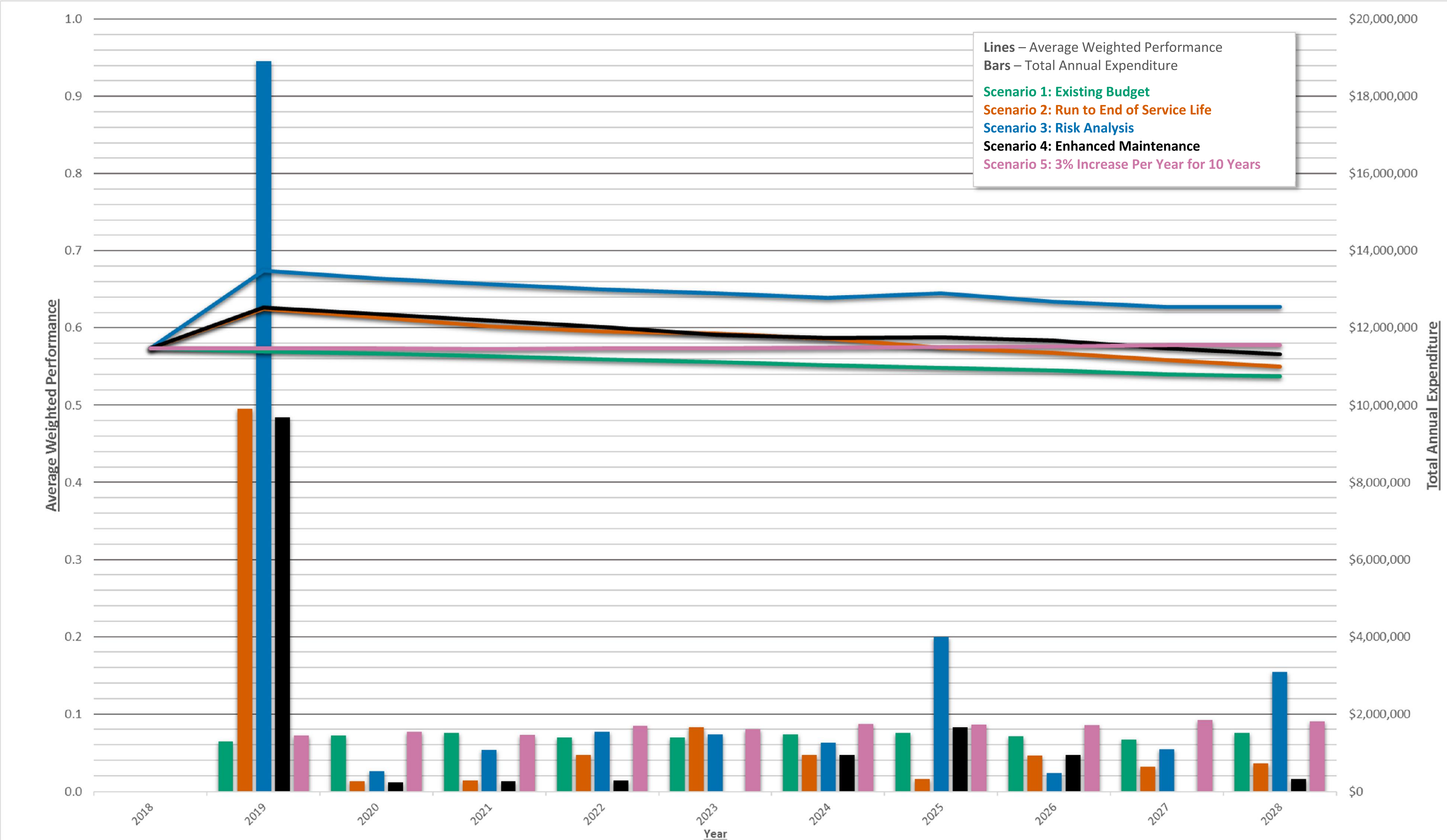
Wastewater - 25 Years



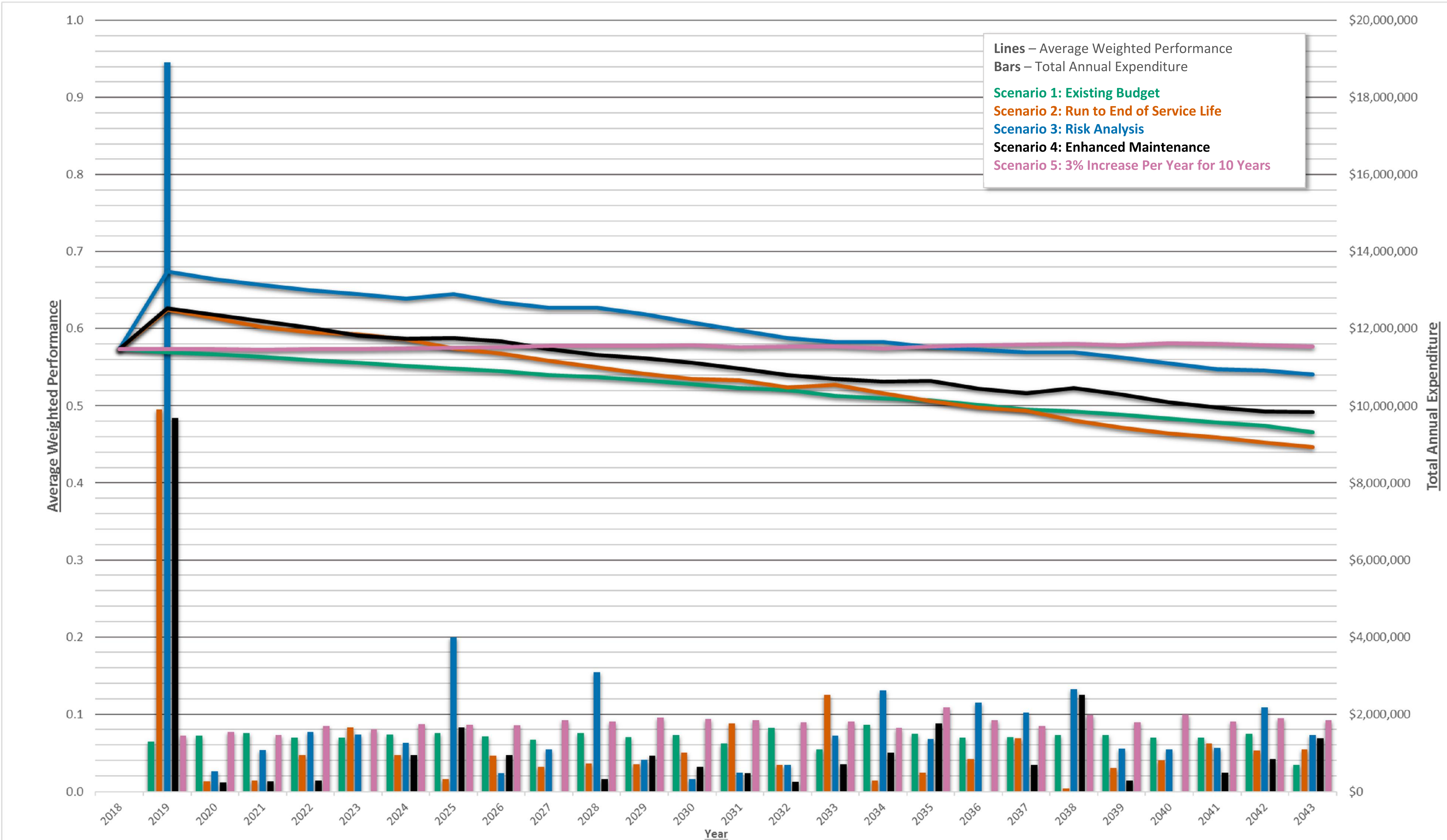
Wastewater - 50 Years



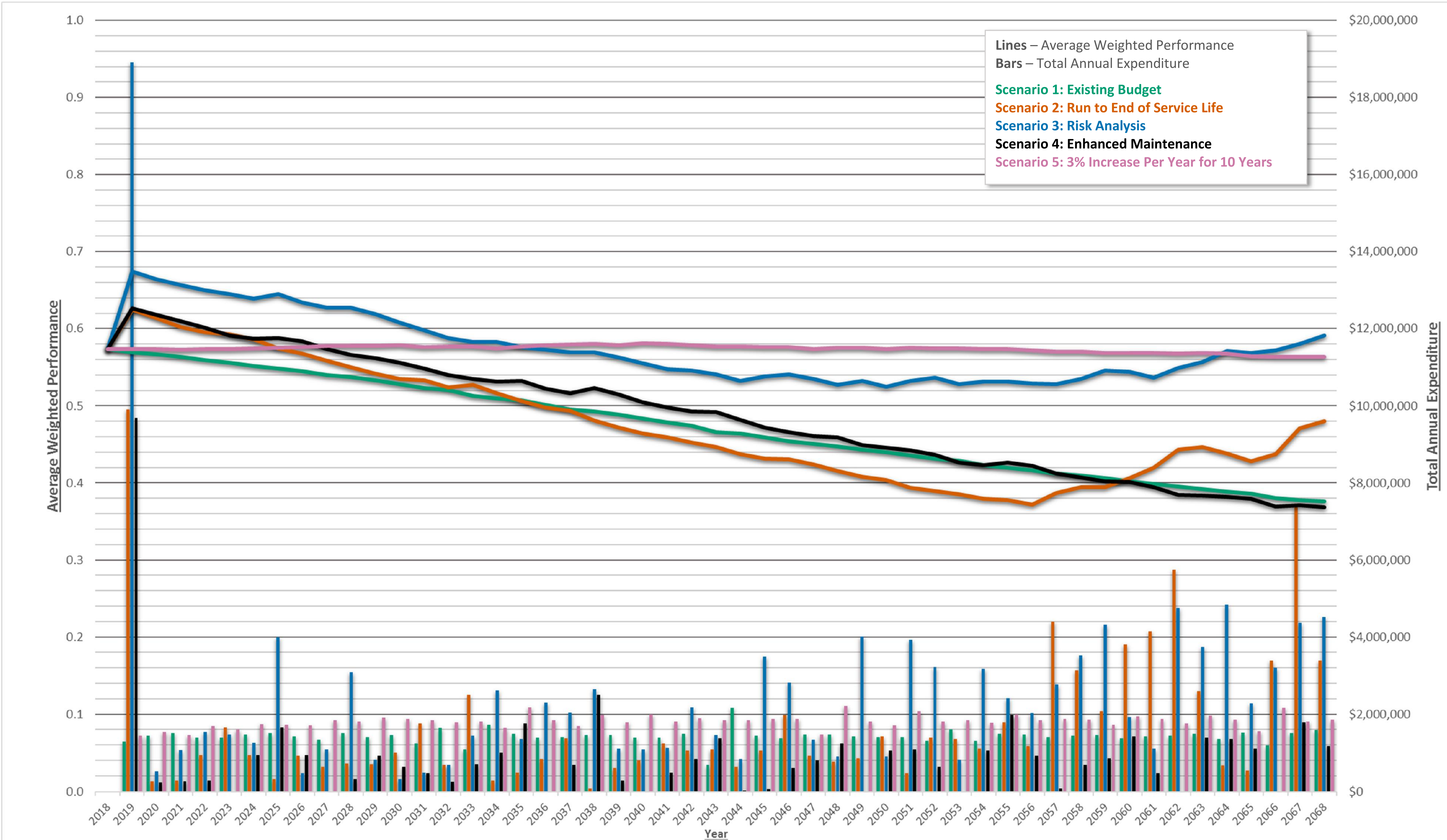
Storm - 10 Years



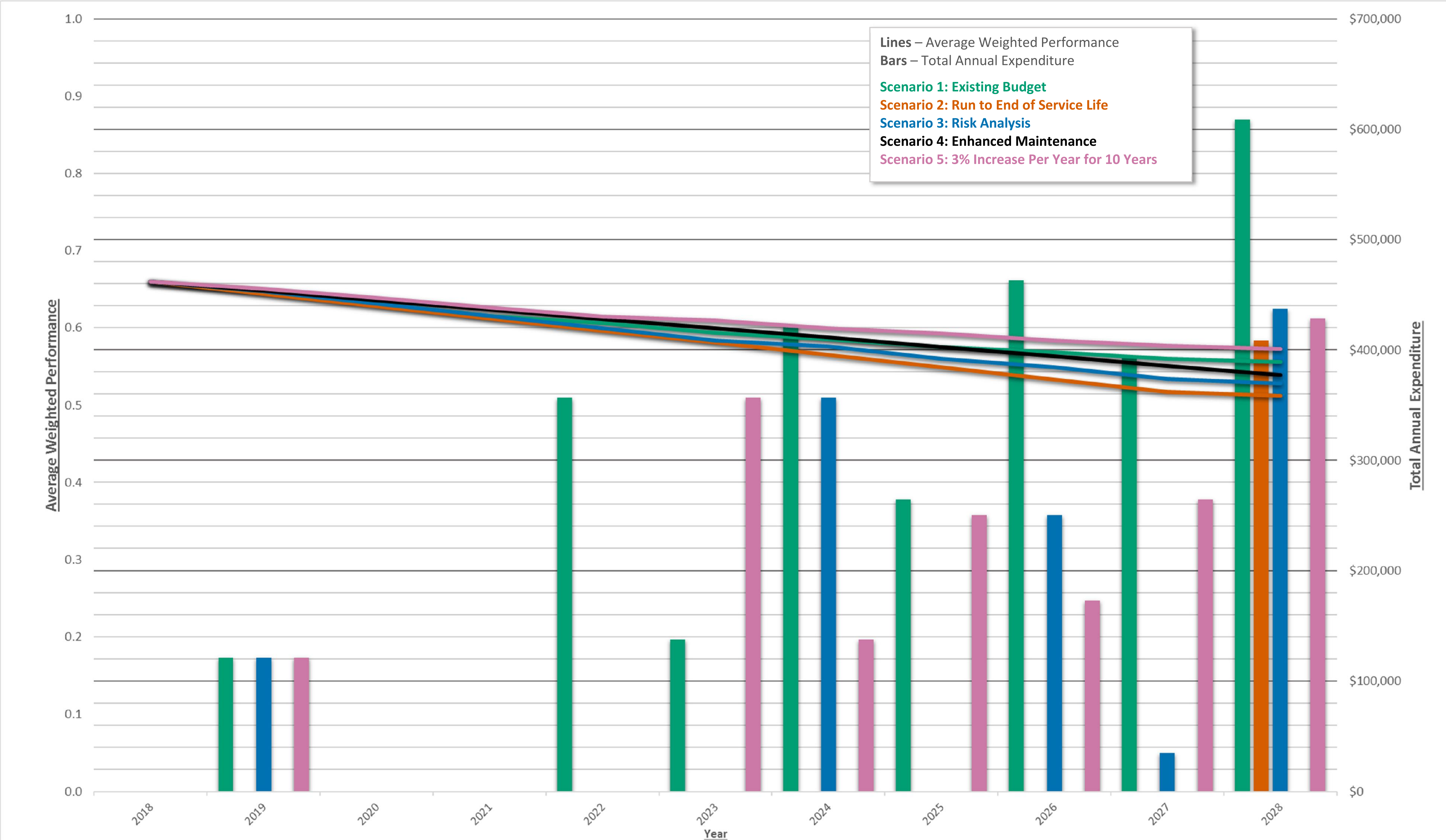
Storm - 25 Years



Storm - 50 Years



Bridges & Structures - 10 Years



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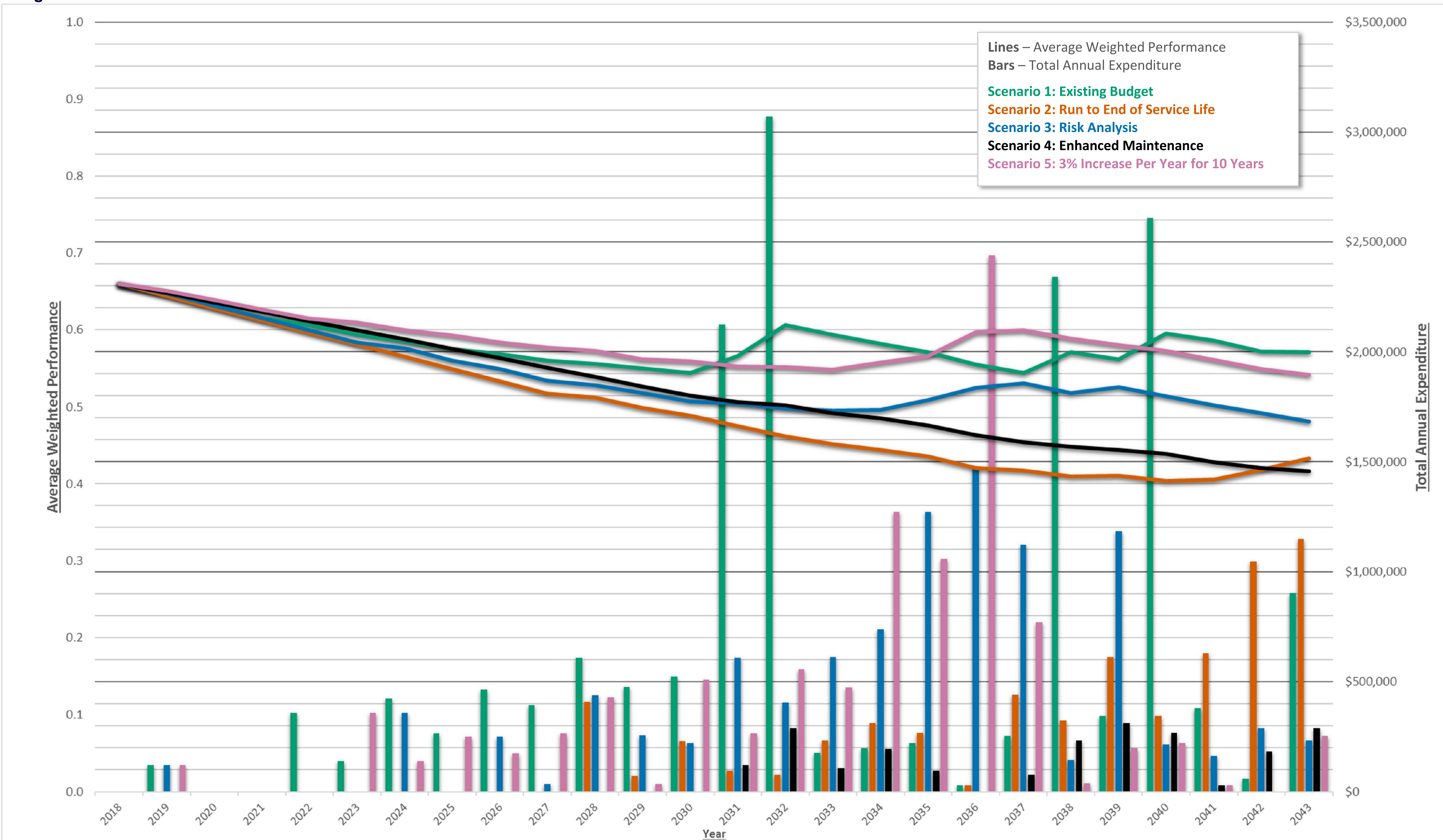
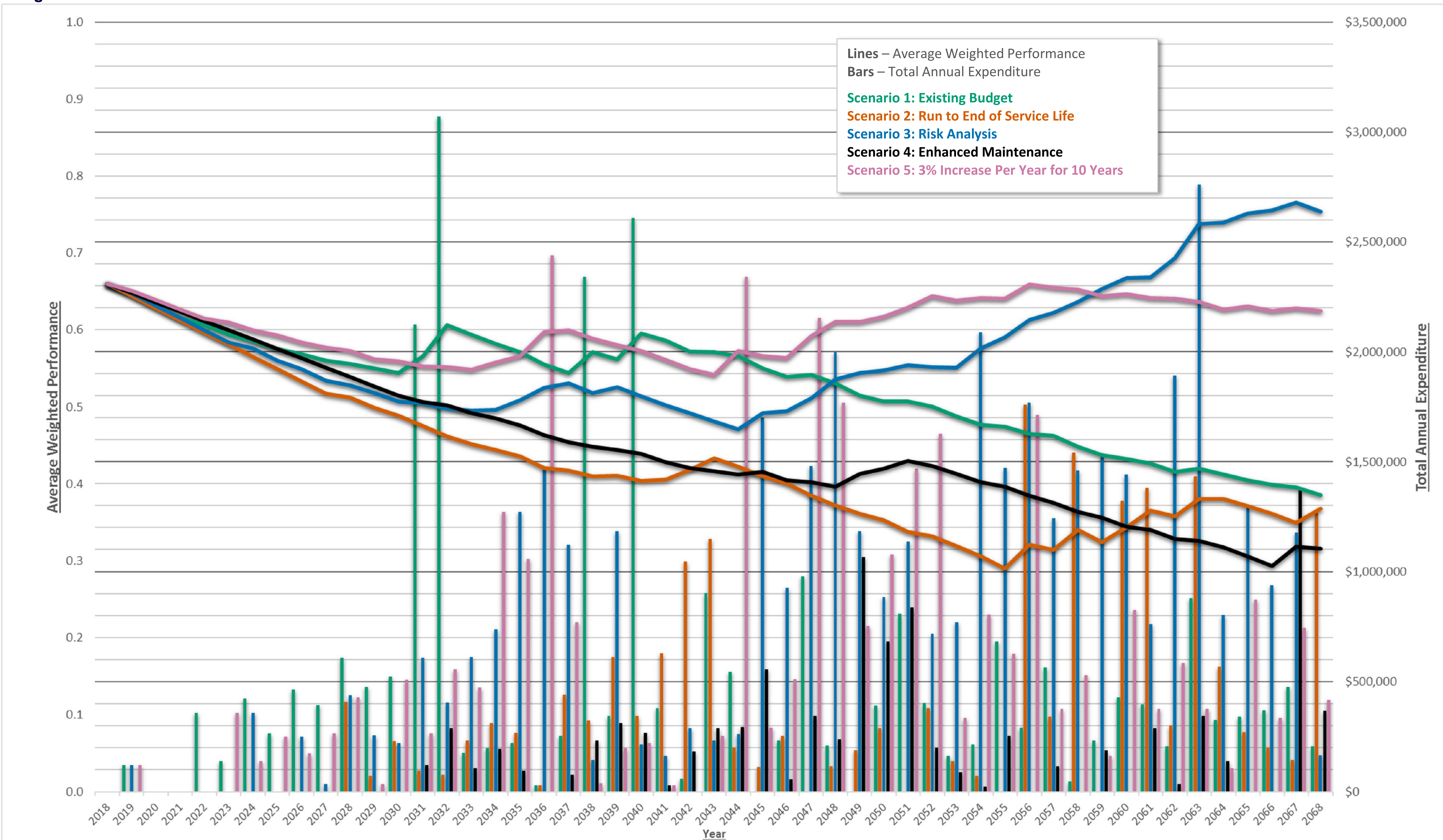
GMBP Project: 618004
April 18, 2019
Appendix B

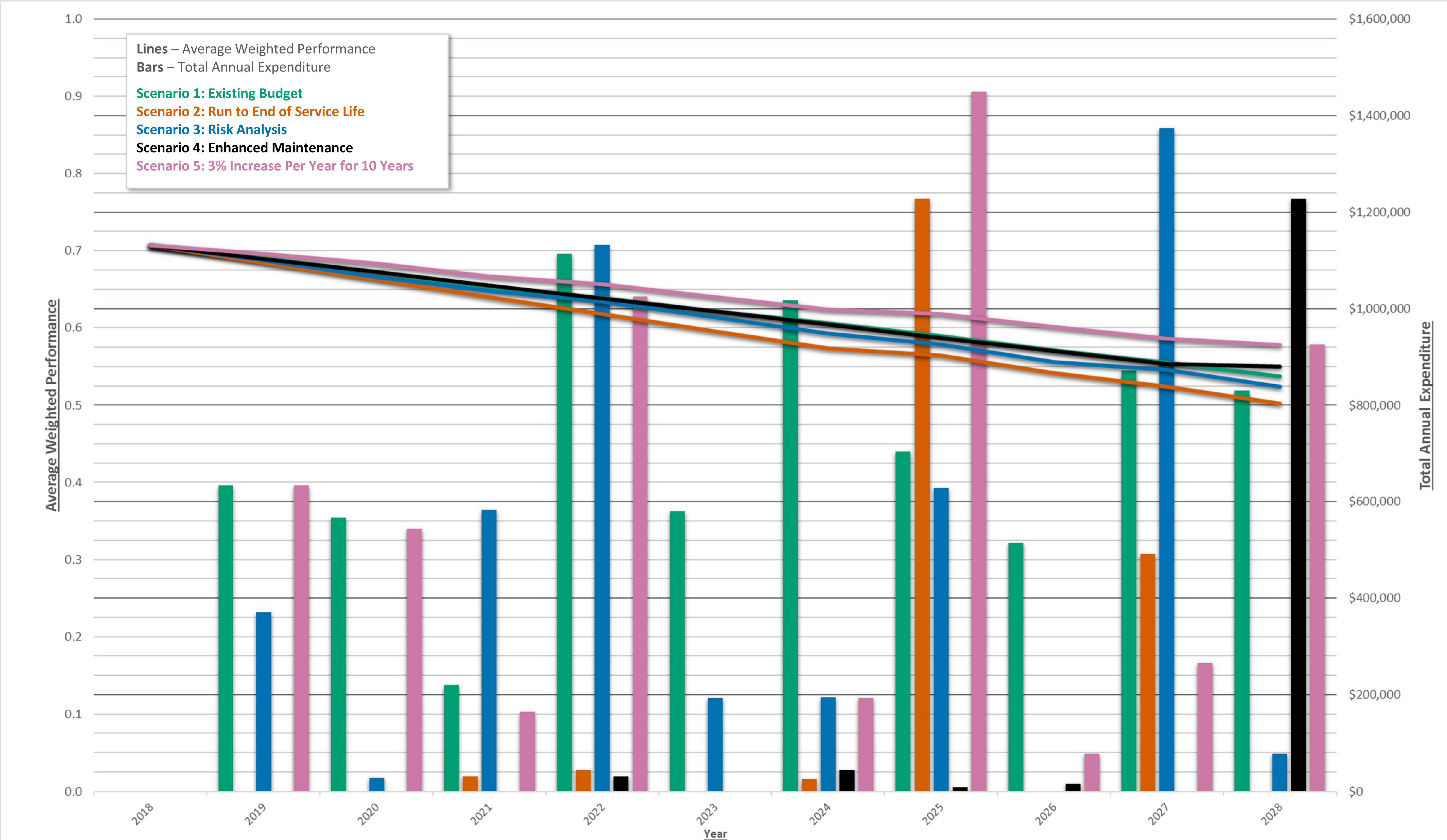
Bridges & Structures - 25 Years



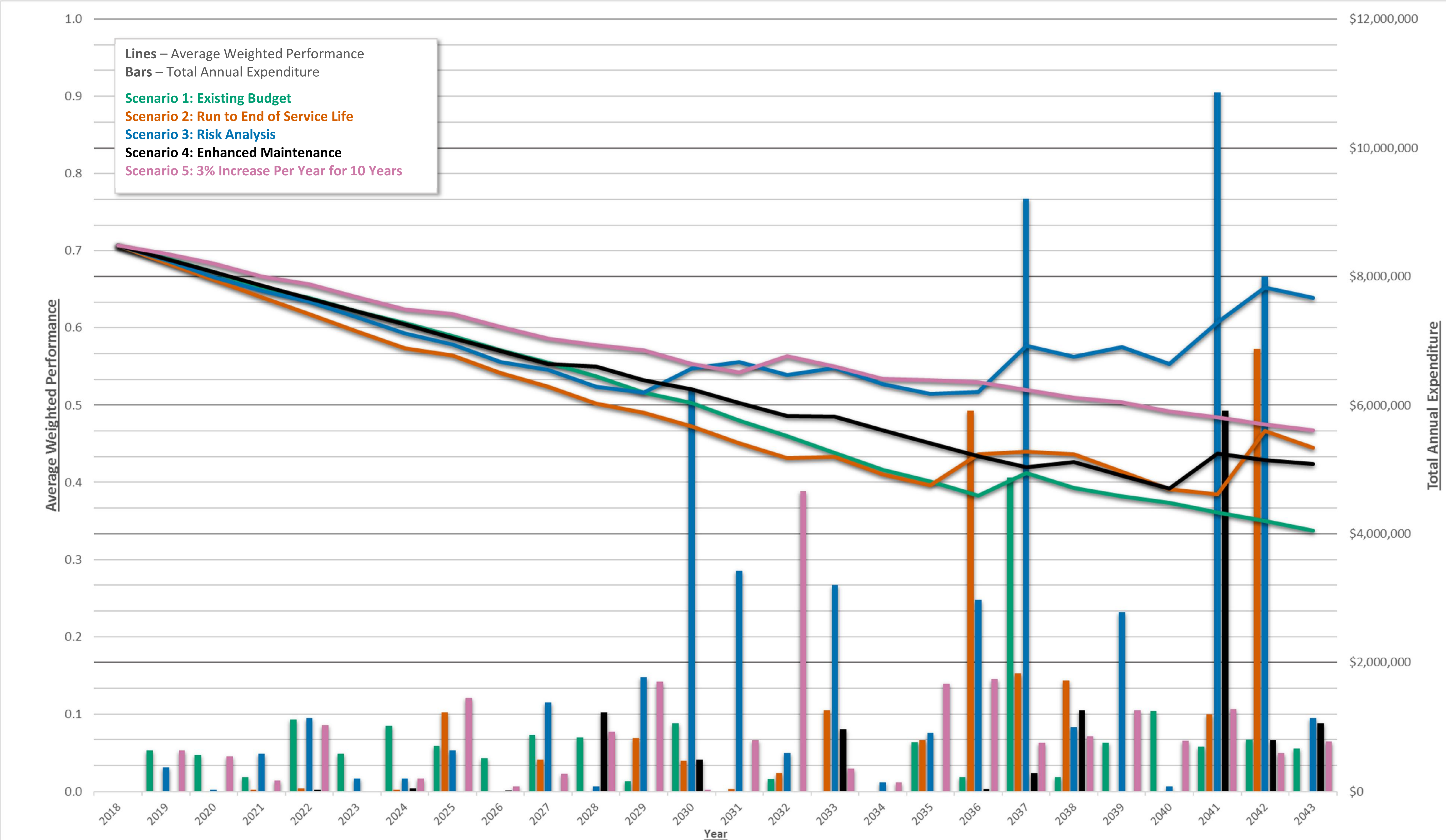
Bridges & Structures - 50 Years



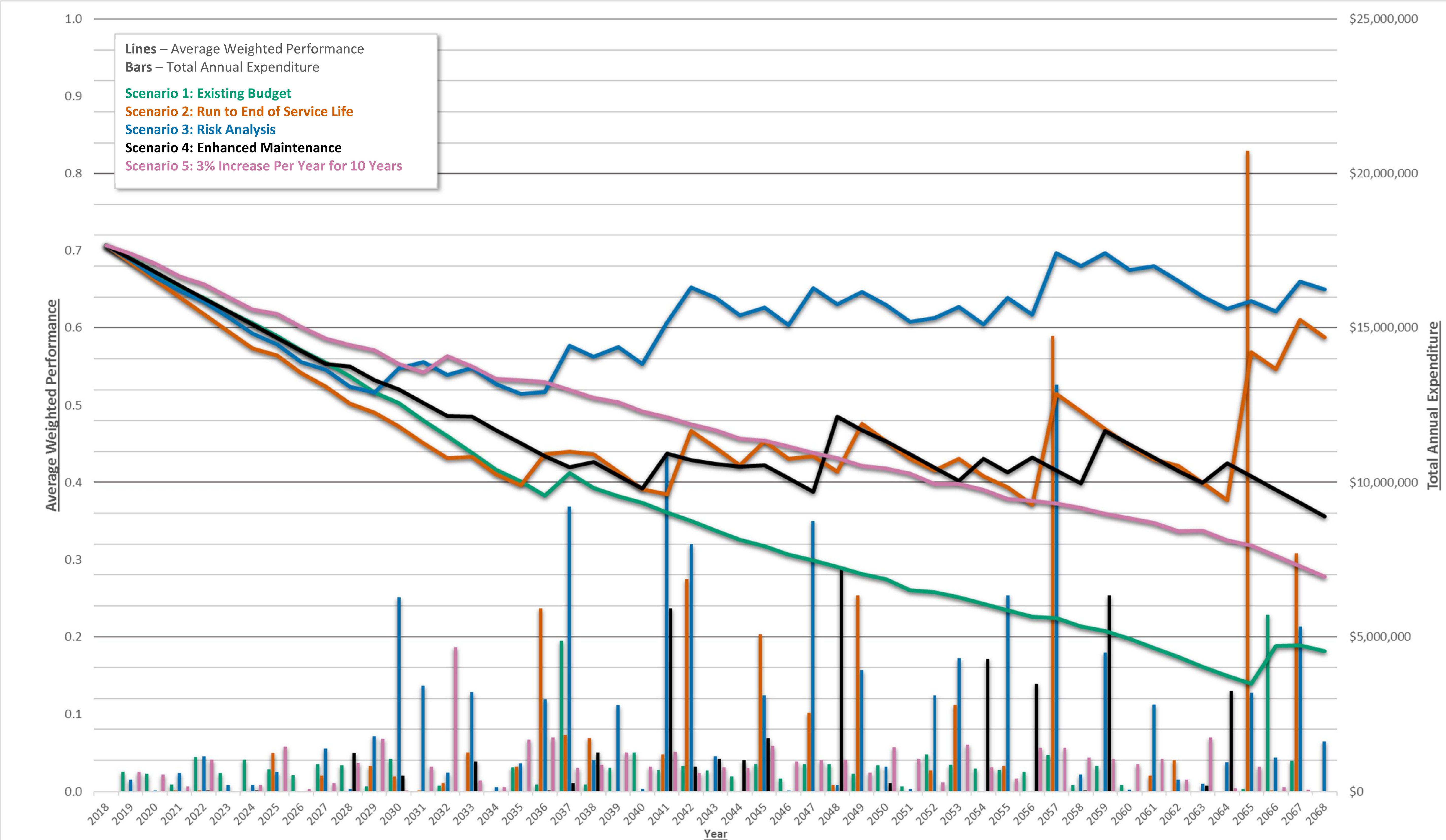
Facilities - 10 Years



Facilities - 25 Years



Facilities - 50 Years



APPENDIX G: TECHNICAL MEMORANDUM #8 - FINANCIAL MODEL AND PLAN

Date:	6/14/2019	File:	618004
To:	Kelly Walsh, P.Eng. Director, Infrastructure Services		
From:	GM BluePlan Engineering		
Project:	Town of Fort Erie Asset Management Plan		
Subject:	Financial Model and Plan		

TECHNICAL MEMORANDUM #8 – FINANCIAL MODEL AND PLAN

1. INTRODUCTION

1.1 BACKGROUND

GM BluePlan (GMBP) was retained by the Town of Fort Erie to develop an Asset Management Plan that follows the Provincial structure outlined in the Guide for Municipal AM Plans and will address requirements outlined in Ontario Regulation 588/17. As a part of this project, GMBP developed a financial model and plan that connects to the Decision Support System (DSS).

Based on this, the key objectives of this memorandum are as follows:

- ***Financial Model Development:*** An overview of the model's structure and the data used to populate the model, calibration of the baseline scenario, and the assumptions that were used.
- ***Scenario Analysis:*** The descriptions of scenarios used in the AM analysis, the connection between the financial and technical analysis, and further capabilities of the model.
- ***Financial Strategy Development:*** An overview of the considerations for all life-cycle funding options, such as levy, debt and other external contributions.

1.2 PURPOSE

The approach taken in this AMP identifies the timing and magnitude of expenditures required to meet level of service objectives in a dynamic manner, enabled through the DSS developed as part of the project. The outputs of the DSS are then connected to the year/budget source in a dynamic long-term financial model. The approach to this AMP was centered on a recognition of the integrated role that finance and engineering play in providing infrastructure services to a community. This financial analysis considers the importance of connecting the required asset expenditure with a pragmatic, sustainable, and affordable funding plan.

This approach augments traditional AM approaches included in financial strategies that establish static rate/levy increases to fund an expenditure plan to provide an assumed level of service from each infrastructure system. The static rate increase perspective is considered the basic way of comparing municipalities and describing needs in an annual levy increase (e.g., AMO lobbying).

1.3 REGULATORY REQUIREMENTS

As of January 1, 2018, the province of Ontario has implemented O.Reg. 588/17 under the Infrastructure for Jobs and Prosperity Act, 2015. At its core, the regulation requires municipalities to establish an understanding of the infrastructure expenditure needs that are required to maintain or achieve the current or desired level of service (LOS) provided by each infrastructure group, as well as the financial strategy to fund these identified expenditure needs. The DSS and Financial Model will provide the Town with the tools necessary to achieve full compliance with the new regulation by its 2024 deadline.

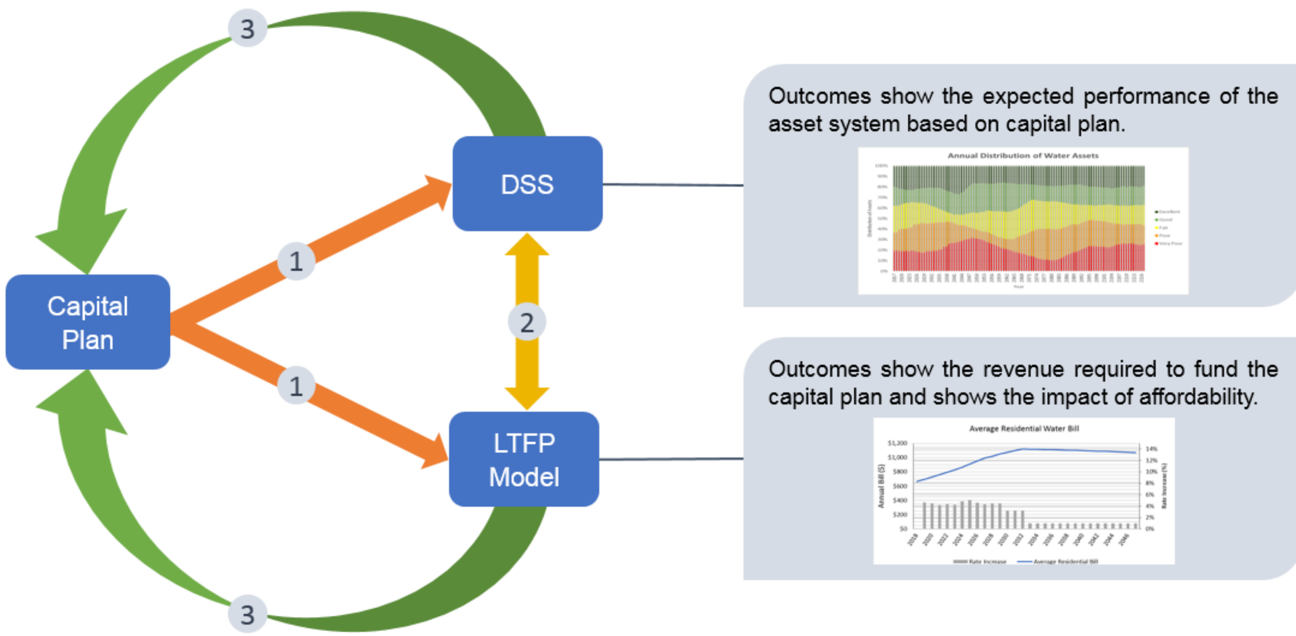
2. CONNECTION TO CAPITAL PLANNING

The common starting point for both the analytical system and the Long-Term Financial Plan (LTFP) Model is the Capital Plan. The Capital Plan describes the proposed set of planned projects to address questions such as:

- How much of each type of asset will be replaced/rehabilitated?
- What year will an asset need to be replaced/rehabilitated?
- What will the impact of increased capital expenditures be on the operating budget (i.e. the additional staff to deliver the increased capital program)?
- What will the funding source be?

The data is input into the 'capital budget input' table of the analytical system which produces the performance graphs based on the set of planned expenditures. The Capital Plan is simultaneously used in the LTFP analysis, as described in Section 3 of this memorandum. The LTFP Model can demonstrate how to achieve the required revenue to fund any proposed Capital Plan to achieve a particular LOS scenario. A robust planning process involves the cycle of inputting the first draft for the Capital Plan into the DSS and the LTFP to understand the impacts it has on LOS and available funding. The DSS will suggest the level of funding needed to achieve the proposed LOS and the LTFP Model is used to determine the affordability and financial strategy to fund the proposed LOS. Affordability can be quantified as property taxes and rates as a percentage of household income. A financial strategy is the approach to fund the required infrastructure expenditures.

The LTFP Model forecasts population and revenue overtime which provides the data to determine future affordability. The DSS and LTFP Model are used together to show the impact that the planned expenditures have on LOS and affordability. The relationship between the Capital Plan, DSS, and the LTFP Model is shown in Figure 1.



1 – The current Capital Plan is starting input into the DSS and LTFP Model. It is used to inform the budget/baseline scenario to compare against the proposed LOS.

2 – The DSS will output the expenditures required to fund the proposed LOS, which are then input into the LTFP Model to determine its affordability. If the proposed LOS, is unaffordable, the LTFP Model can be used to inform an adjusted budget, which is input back into the DSS. This process can be repeated until an affordable budget with the acceptable amount of risk is agreed upon.

3 – The outputs from the DSS and LTFP Model are both used to revise the new Capital Plan.

Figure 1: Relationship Between Capital Plan, DSS, and LTFP Model

3. FINANCIAL MODEL DEVELOPMENT

The LTFP Model provides the Town with a dynamic tool that incorporates all considerations from the Town's long-term finances inclusive of all capital and operating expenditures. The Town's financial analysts will be able to understand the impact of adjusting a range of funding strategies that impact revenues and the expected change to expenditures from adjusting services or implementing planned infrastructure projects. The Model is not intended to replace existing operating budgeting, capital planning, or assessment growth projecting processes, but rather augment existing processes by providing a longer-term perspective to inform decision making about funding needs.

3.1 MODEL STRUCTURE

The LTFP Model is developed to use data inputs from the Town's existing financial planning processes and is based in MS Excel. This approach is essential to ensure that the financial model is both useful and usable for the Town. The model is fully dynamic and connected to the Town's *Reserve Funding* spreadsheet.

The LTFP Model uses conventional accounting formula to track operating revenues and expenditures, debt and debt service obligations, reserves, etc. A 30-year planning horizon was used in the LTFP Model instead of the lifecycle period of the assets. This is an optimal timeframe for financial analysis, as costs tend to appear increasingly skewed due to inflation when applying a planning horizon beyond 30 years. There tends to be volatility in 10-year plans, therefore years 11 to 30 are used to illustrate the financial trend that the Town is moving toward.

Several variables were used to project the finances over the planning horizon, including:

- Interest rates for debt based on amortization period;
- Inflation rates for operating costs and capital costs;
- Specific escalation rates for each type of revenue (property taxes, user fees, etc.); and
- Assessment growth forecasts based on population increase assumptions.

The inputs to the model are listed in the Table 1. The logic used in the financial model is illustrated in Figure 1.

Table 1: Financial Model Inputs

Source	Model Input	Comments
2017 and 2018 Budget Book	Assessment growth	Average of the past 6 years was used to forecast future years
	Revenue from tax, PIL, fees and chargers	Used budget values up to 2020 to forecast future years
	Operating expenditures	Used budget values up to 2020 to forecast future years
	Operating increases	
Reserve Funding Excel Workbook	Reserve balances and transfers	
	Capital plan	
	Existing and new long-term debt	
2016 Stats Canada Census Data	Base year population and population growth	
Non-Residential Building Consumer Price Index (NRBCPI) from Stats Canada	Capital expenditure inflation rate	The 10-year average NRBCPI was determined to be ~1.6%, professional judgment of 2% was used instead

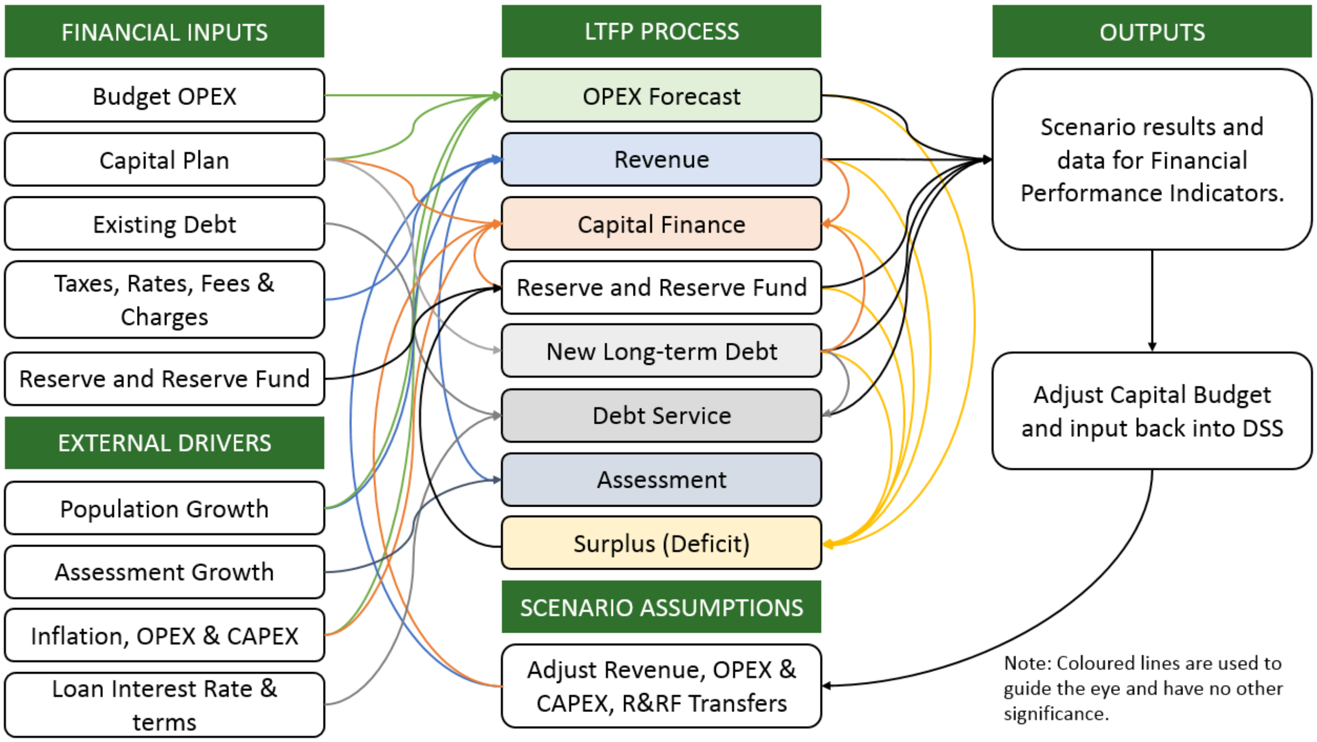


Figure 2: Financial Model Logic

The LTFP Model was structured to provide key outcomes related to two major financial planning areas:

1. Operating budget data inclusive of all revenues and expenditures.
2. Reserve and reserve fund data inclusive of all contributions and withdrawals used to fund capital projects.

The sub-sections 3.1.1 and 3.1.2 provide insight into the granularity and extent of data that is available within the LTFP Model for these financial planning areas.

3.1.1 Operating Budget

The operating budget is used to understand the annual revenues, expenditures, and financing (i.e. debt and reserve transfers) of the Town. The LTFP Model projects the future operating needs inclusive of all annual expenditures and revenues.

In the LTFP model, operating expenditures can be separated into as many as 50 individual cost centers to appropriately analyze the operating costs of the Town. Revenues were distinguished by overall category, such as property taxes and user fees. The LTFP model can include as many as 15 individual types of revenue sources such as user fees, fines, donations, etc. The total gross operating values were used and then separated by tax supported and utility (rate supported) budgets.

The model can consider a range of operating factors for a 30-year period, including but not limited to:

- Total revenues and expenditures;
- Revenues or expenditures by individual cost center or revenue source;
- The impact of real growth on revenues and expenditures;
- The impact of discretionary tax/rate increases on revenues;
- The impact of inflation on expenditures; and
- The impact of investment income on revenues.

The ability to model the above noted considerations is dependent on the available data. For example, modelling the impact of real growth on revenues and expenditures requires the understanding of the net new infrastructure donated by developers. This can change for brown field intensification versus green field development with a corresponding impact on operating expenditures required to service this new infrastructure.

3.1.2 Reserve and Reserve Funds

Reserve funds are one tool used to fund the Town's capital program. Contributions from reserve funds are generally around 70-80% and are also required to fund the Town's portion of DC-funded growth projects. The LTFP Model shows the projected year-end closing balances of individual reserve funds that recognize the annual revenues, withdrawals and interest earned of each fund. The amount of debt is shown for each reserve fund if it goes into a deficit position in any year during the analysis of a scenario. The current use of debt is limited to growth assets or efficiency projects with related operating payback, such as LED Street Lights and fire station amalgamations. In contrast, the use of debt in the LTFP Model to cover a shortfall in reserves is intended to raise a flag for the user to adjust other inputs to either increase revenue or reduce the withdrawals from reserve funds to eliminate the use of debt to cover a shortfall in a reserve.

There are a total of 41 reserves and reserve funds that were included in the LTFP Model, which includes 24 capital, 14 operating, and 3 deferred revenue reserves (Federal Gas Tax, Provincial Gas Tax, and Development Charges). Each reserve fund is structured to distinguish between the different types of contributions (revenue to fund) and withdrawals. The reserve fund data is also provided at a consolidated level, as well as separately for the tax supported, utility, and development charges (DC) reserves.

The model considers a range of reserve fund factors for a 30-year period, including, but not limited to:

- Total balances of all reserve funds, recognizing the annual revenues into and withdrawals out of the reserves to fund the Town's capital program;

- Detailed and specific revenues and withdrawals into individual reserve funds;
- The impact on closing balances of reserves from changing the capital program; and
- The allocation of money in the reserves to fund the Town's portion of DC Growth projects.

3.1.3 Planning for External Grants

The Town does expect to receive some funding from the Provincial or Federal governments over the next 10 years. However, the availability of grant funding is very unpredictable and larger grant programs have been observed to be lower and slower in recent years. Therefore, the strategies should be focused on addressing funding shortfalls that excludes a reasonable portion that can be expected to be funded through external grant revenues. The Town should identify the appropriate reliance on external grants to be able incorporate this revenue into financial scenarios.

3.2 BASELINE CALIBRATION – BUDGET SCENARIO

The baseline scenario provides the user with a long-term forecast of current planned operating or capital budgets. An analysis of the current operating budget, capital budget, and reserve hub data was completed to calibrate the baseline scenario.

The structure of the LTFP Model forecasts the long-term (i.e. 2030 to 2046) reserve fund status (funds used for capex, revenues to reserves, etc.) based on the average of the information from the period of 2017 to 2028. In most cases, the approach to long-term forecasts was appropriate, but some reserves needed adjustments to reflect the best judgment of staff (i.e. if reserves are going to close in the future, the expected long-term increases to funding/expenses, etc.).

GM BluePlan has provided the Town with a version of the LTFP Model that has been adjusted with a range of assumptions related to variables such as interest rates, user fee revenue increases, and capital inflation rates which are provided in Table 2 and 3.

Table 2: Forecasted Annual Change in Revenues

<table>
<tr><th>Revenues</th><th>Forecasted Change</th><th>Comments</th></tr>
<tr><td>Interest & Penalties</td><td>0.36%</td><td rowspan="4">Determined from an analysis of the planned/actual 2017-2020 values from the 2018 Budget.</td></tr>
<tr><td>Water & Wastewater Billings</td><td>2%</td></tr>
<tr><td>Grants, User Fees, Gaming, Fines, Donations, Other</td><td>0%</td></tr>
<tr><td>BIA Levy</td><td>1.1%</td></tr>
<tr><td>Assessment Growth</td><td>0.74%</td><td>Determined by the 6-year historic average.</td></tr>
<tr><td>Population (2018-2023)</td><td>1.3%</td><td rowspan="2">Population increases were calculated to achieve the development planning forecasts.</td></tr>
<tr><td>Population (2024 and onward)</td><td>1.4%</td></tr>
</table>

Table 3: Forecasted Annual Change in Expenses

Expenses	Forecasted Change	Comments
Capital	2%	
General Operations	2%	All operating expenditures excluding sewage treatment
Regional Treatment Costs	5.15%	As per the 10-year Regional plan

The final step in the development of the baseline scenario model was to establish the annual rate increase to the property tax and water/wastewater rate that would be required to ensure that total forecasted revenues match total forecasted expenditures in each year over the 30-year planning horizon (i.e. zero surplus/deficit in each year). The tax rate increases required to fund the Baseline Scenario were between 1 to 2% annually over the 30-year period.

4. SCENARIO ANALYSIS

The LTFP Model was structured to enable the user to effectively analyze scenarios related to all relevant financial planning processes of the Town. This ranges from a relatively straight forward analysis that considers the long-term impact of salary increases, to a complex analysis that considers additional operating expenditures from the construction of new infrastructure assets.

The Model can further adjust asset categories at a granular level to analyze the impacts, including but not limited to:

- Allocating operating funds to specific large projects, such as dredging stormwater ponds;
- Increasing capital expenditures to address infrastructure backlogs; and
- Increasing operating costs from new infrastructure related to growth and service improvements (dedicated bike lanes, stormwater LID, etc.).

The Model can be adjusted with the appropriate assumptions to fund any proposed LOS scenario from the technical DSS analysis. The financial analysis can identify whether the proposed LOS can be achieved with planned revenues. If the proposed LOS is unaffordable, the 2024 requirements of O.Reg. 588/17 ask the municipality to describe the risks associated with not being able to fund the proposed LOS.

4.1 CLOSING THE INFRASTRUCTURE GAP

The scenario analysis provides perspective on the revenue required to close the infrastructure gap and the rate increase required to achieve it. The infrastructure gaps that were identified in Technical Memorandum 6/7 are summarized in Table 4. The corresponding infrastructure gaps were allocated to the Sanitary Sewer Refurbishing and Water Refurbishing reserve funds.

Table 4: Annual Capital Expenditure Summary

Asset Category	Current Avg. Annual 10-Year Contribution to Reserves ($000)	Current Avg. Annual 10-Year Gas Tax and Other Grants ($000)	Total Current Avg. Annual 10-Year Funding ($000)	Avg. Annual Funding to Maintain Current LOS ($000)	Avg. Annual Infrastructure Funding Gap ($000)
Bridges & Structures	$370	$650	$1,020	$1,020	$0
Facilities	$830	$0	$830	$830	$0
Roads & ROWs	$3,050	$480	$3,530	$3,530	$0
Sanitary	$1,630	$0	$1,630	$1,900	$270
Stormwater	$1,430	$0	$1,430	$1,430	$0
Water	$1,720	$0	$1,720	$1,870	$150
Total	**$9,030**	**$1,130**	**$10,160**	**$10,430**	**$420**

The 2019 water and wastewater revenue were projected to be $18.9M. A 2.2% revenue increase would be required, on top of inflationary and other approved increases, to fund the additional $420K of related capital expenditures. It should be noted that the infrastructure gap for Sanitary may change as the Town completes the CCTV inspections over the next 10-years as recommended by the 2019 Wastewater Master Plan. These inspections will provide condition data to inform the expenditure needs rather than the current age-based analysis.

The following scenarios were analyzed:

- Scenario 1 - Close the infrastructure gap over 3-years; and
- Scenario 2 - Close the infrastructure gap over 10-years.

The Town has been provided the LTFP Model with the scenario that addresses the additional capital expenditures starting in 2020. Since the current plan did not account for the increased expenditures, there were not enough funds within the reserves to finance the additional capital expenditures. Thus, the model was adjusted to increase the contributions from operating to ensure there were reasonable amount of funds remaining in the reserves, resulting in a deficit for the operating budget. The revenues in the model were increased until the operating budget was no longer in a deficit position.

In Scenario 1, the capital expenditures were gradually increased over the 3-year period and the deferred expenditures were spread over the following 7 years. Thus, the total expenditures for the 10-year period were equivalent. An additional 1% rate increase was required to fund Scenario 1, on top of inflationary increases, for 3 years from 2020-2022. Water and wastewater rates could then resume to inflationary increases.

Similarly, Scenario 2 had the same gradual increase but over 10-years and the deferred expenditures were spread over the following 10 years. The 30-year average annual expenditures were the same for both scenarios. The increase required to fund Scenario 2 was an additional 0.5% increase to rates, on top of inflationary increases, for 6 years from 2020-2025. Water and wastewater rates could then resume to inflationary increases.

5. RECOMMENDATIONS AND FURTHER CAPABILITIES

The Town's LTFP Model provided financial planning and asset management staff with a tool that can be applied to a range of processes. Importantly, the LTFP Model will allow the Town to be compliant with the July 1st, 2024 O.Reg. 588/17 requirements, which are summarized below:

1. An identification of the lifecycle activities that would need to be undertaken to provide the proposed levels of service.
2. An estimate of the annual costs the lifecycle activities, separated into capital expenditures and significant operating costs.
3. An identification of the annual funding projected to be available to undertake lifecycle activities and an explanation of the options examined by the municipality to maximize the funding projected to be available.
4. If a funding shortfall is projected:
    i. The lifecycle strategies that will be undertaken.
    ii. An explanation of risks associated with not undertaking any of the lifecycle activities will be managed.
    iii. The estimated capital expenditures and significant operating costs to achieve the proposed levels of service to accommodate projected increases in demand caused by population and employment growth.
    iv. including estimated capital expenditures and significant operating costs related to new construction or upgrades.
5. The funding projected to be available by source as a result of increased population and economic activity.
6. An overview of the risks associated with implementation of the asset management plan and any actions that would be proposed in response to those risks.

The Scenario Analysis provides perspective on how the LTFP Model is used with the DSS to establish a financial strategy to fund a proposed LOS provided by the infrastructure systems. Over time if the Town decides to increase service levels they will be able to balance affordability with service delivery expectations.

It is prudent to consider the faster rate increase to close the annual funding gap to sustain the current LOS provided by the systems in a shorter time. Therefore, Scenario 1 is recommended to minimize the risk of deferred capital expenditures.

The LTFP Model can be used and integrated into relevant financial planning activities including:

- **Developing Long Term Financial Plans**
  The Model can be used to develop Long Term Financial Plans that consider the impacts of population growth, technical analysis of the asset expenditures required to achieve proposed LOS, the long term operating cost of new assets (that were not completed in this plan), and a range of other factors that have financial implications. The Model can be aligned with Council approved updates within the context of the current budget and ongoing updates to the Town's Asset Management Plan.
- **Monitoring of Town Finances**
  The LTFP Model can be used to monitor the Town's finances on an ongoing basis. The assumptions and variables that are used in the Model can be continually improved by staff to ensure that the Model accurately reflects the expected long-term finances of the Town.
- **Aligning with Asset Management Processes**
  The LTFP Model has been developed to align with the Town's DSS that supports the technical analysis of the Town's assets. The Town's asset management staff will use the LTFP Model in conjunction with the analytical system to enhance asset management processes. It should be noted that the combination of the LTFP Model and the analytical system will also be used to ensure the Town is compliant with O.Reg. 588/17.

APPENDIX H: TECHNICAL MEMORANDUM #9 - RECOMMENDATION OF SOFTWARE

Date:	9/29/2019	File:	618004
To:	Kelly Walsh, P.Eng. Director, Infrastructure Services		
From:	David Watt		
Project:	Asset Management Plan		
Subject:	Software and Data Management Recommendations Version 9		

TECHNICAL MEMORANDUM #9: SOFTWARE RECCOMMENDATIONS

1. INTRODUCTION

GM BluePlan (GMBP) was retained by the Town of Fort Erie to develop an Asset Management Plan that follows the Province's structure outlined in their *Guide for Municipal AM Plans*, to address the requirements outlined in *Ontario Regulation 588/17*.

As a part of this project, GMBP conducted various workshops with Town staff to understand users' needs in terms of software and data requirements to support decision making and asset management analytics. Following these workshops, GMBP has developed recommendations for the types of software and investments that will provide the most value to the Town and recommendations for optimizing the asset management readiness state. In the context of this memo "readiness" refers to the degree to which staff, data and systems can achieve the outcomes required by *O. Reg. 588/17. ASSET MANAGEMENT PLANNING FOR MUNICIPAL INFRASTRUCTURE* and further the sustainability of level of service and evidence-based budgeting.

There are several types of software that can be used to support Asset Management within a municipal setting. These software types are described below.

- **Asset Register:**

  An asset register is a centralized, single source of the core asset information that is required to support asset management processes for all assets, and acts as a reference source of asset related data to support expert systems. Core asset information refers to the base attributes that describe a physical asset. This includes a unique asset identifier, material of construction, date of construction etc.

  Asset registers are typically structured in a hierarchy for ease of access to information, and to allow for summarization and analysis of data at multiple levels as required by different users. An "asset register" as described above, should not be confused with a Tangible Capital Asset Register used for financial reporting in accordance with PSAB 3150.

  For asset management purposes, standalone asset registers are not generally available on the market, but customized generic systems can be developed and used to pull information from various systems. However, asset registers are often built into or can be hosted in other commercially available systems including GIS, CMMS, and DSS.

Currently, the Town does not have an asset register, but maintains separate inventories in several systems and files. These systems include but are not limited to: excel files, ESRI GIS, Fiix, Lotus Notes etc...

- **Geographic Information System (GIS):**

GIS applications are used to store, analyze and visualize spatial data, most often for complex systems or networks like the Town's water distribution network. Within the municipal context, GIS is often used to maintain an inventory of linear assets, road/water/sewer to support various business needs, including asset management. Spatial analyses can also be used to support asset management, such as corridor analysis which allows for the grouping of work along road sections to provide appropriate sequencing of works and to achieve economies of scale.

There are several commercially available GIS programs that are available and commonly used within a municipal setting including ArcGIS, Manifold, and MapInfo. The Town is currently migrating from Manifold GIS to ESRI ArcGIS for their GIS needs.

- **Computerized Maintenance Management System (CMMS):**

A CMMS application is software used to support management of the maintenance of assets through the creation and tracking of work orders. These systems are useful for asset management because they allow for tracking operating and maintenance costs at the asset level, which can be used to determine if capital expenditures are required. These systems also typically contain core inventory information for vertical assets. Core functionality of these systems include but is not limited to:

- Tracking of maintenance activities against an asset and or address or geographical location.
- Estimation of aggregate cost of labour, materials and 3rd party costs against an asset or system.
- Tracking and diagnosis of failure statistics, root cause of failure and remediation actions.

There are many CMMS currently available on the market and vary in functionality, platform, and integration capabilities, including Lucity, Maximo, and VueWorks. The Town has recently selected and begun implementing a new CMMS called Fiix for their vertical / facility asset portfolio.

- **Decision Support System (DSS):**

A DSS application supports decision making around the risk, condition, and capacity of assets and systems, and assesses the need to spend capital dollars to rehabilitate or replace assets. These systems allow for the use of lifecycle strategies, including deterioration curves and rehabilitation options, to predict future infrastructure investment needs at the asset level. These systems also typically allow for scenario analysis to understand the impact of different capital projects or budget scenarios on the performance or level of service of the system.

While many of these analyses can be completed through common off the shelf software, there is commercially available software that can provide greater functionality and capabilities, such as Assetic, PowerPlan, and CopperLeaf. These Decision Support Systems are further explored within the software section of this memo.

Currently, the Town uses Decision Optimization Technology (DOT) by Infrastructure Solutions Incorporated for road assets only. As part of the Town's 2019 AMP, GMBP has delivered a DSS in the form of an excel front end analytical tool with a SQL server back end. This nonproprietary system can be used in both the short and long term for the determination of LOS evidence based budgets and funding levels for both core and non-core asset data to meet the present and future requirements of O Reg 588/17. Documentation has been provided for the intended user of this system which is yet to be determined. Town staff have been provided training on the use and update of this system.

2. PRELIMINARY NEEDS REVIEW

The Town currently uses several systems to support asset management, as described in the previous section. In addition, the Town maintains several other systems for various business needs including financial management and customer relationship management (CRM). Much of their enterprise data (Finance, Property information, CRM's) are stored in a relational structure and integrated through a common IBM Notes front end. There is less integration between systems that store linear assets necessitating the need for manual processes for the transfer of data between systems. As part of this project requests were made for the following:

- Inventory of software applications currently in use at the Town
- Physical and logical integration diagrams
- Planned software application purchases and upgrades

At the time of the production of this report, the requested documentation was not available and as such the discussion around integration, descriptions of and interaction between software applications is limited in this document.

To provide further context for understanding the Town's software needs, GMBP developed a process flow chart of the Town's capital planning procedure to understand how capital works are determined. This flowchart provides a clear definition of the process to support a greater understanding of information flow and where software may provide value.

This draft business process is outlined in Figure 1 on the following page.

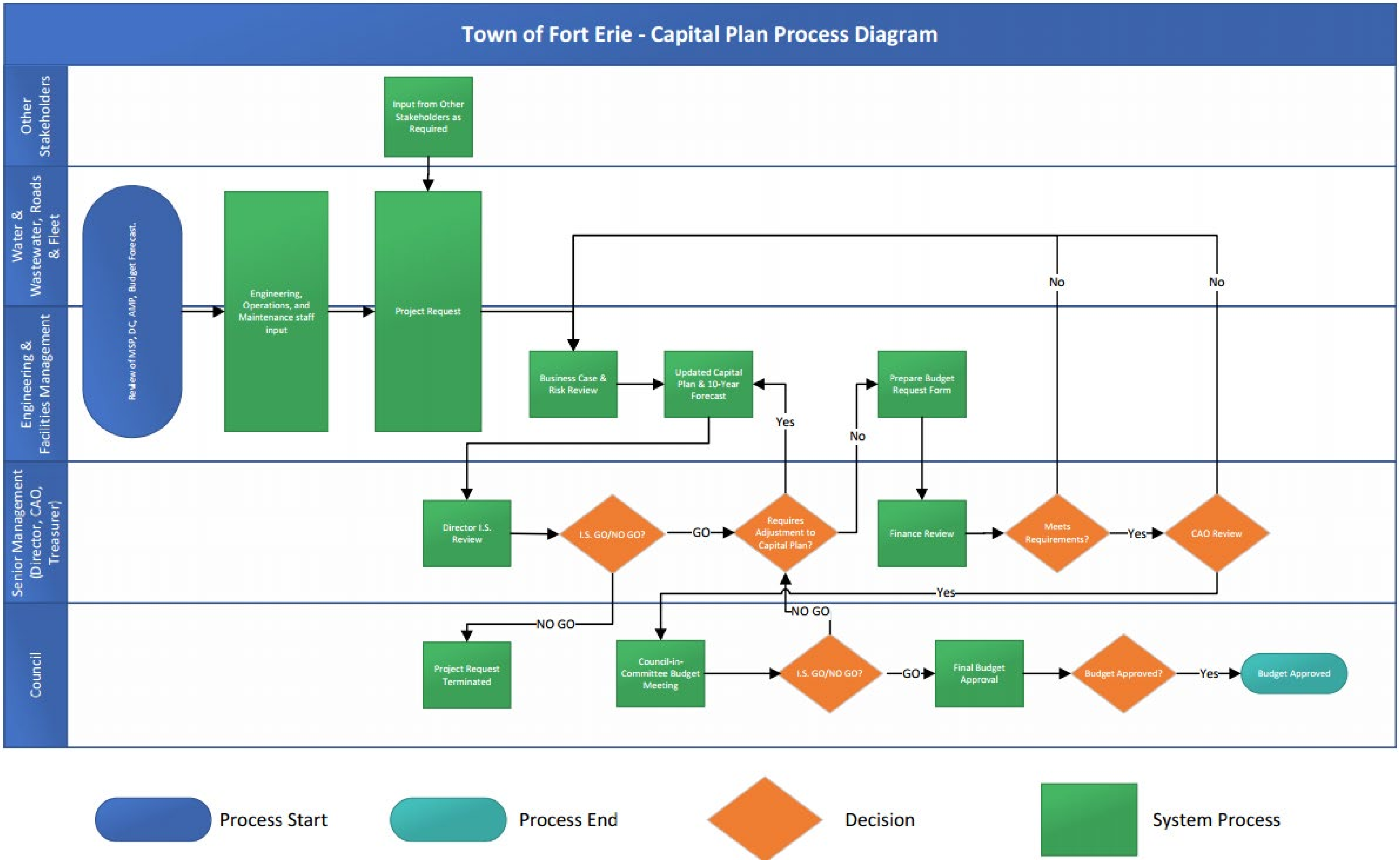


Figure 1: Capital Plan Process Diagram

In addition, on October 26, 2018, GMBP facilitated a workshop with key internal stakeholders to outline recommendations for the review of available software and to understand the Town's needs. GMBP provided an overview of key considerations when procuring and implementing software, and feedback was received on software requirements for the Town. This feedback was amalgamated and categorized to determine where the majority of the Town's needs lie, and is provided in Appendix A. Figure 2 below illustrates, staff needs as it relates to each category of software namely: asset register, a DSS, and a CMMS / Mobile GIS solution.

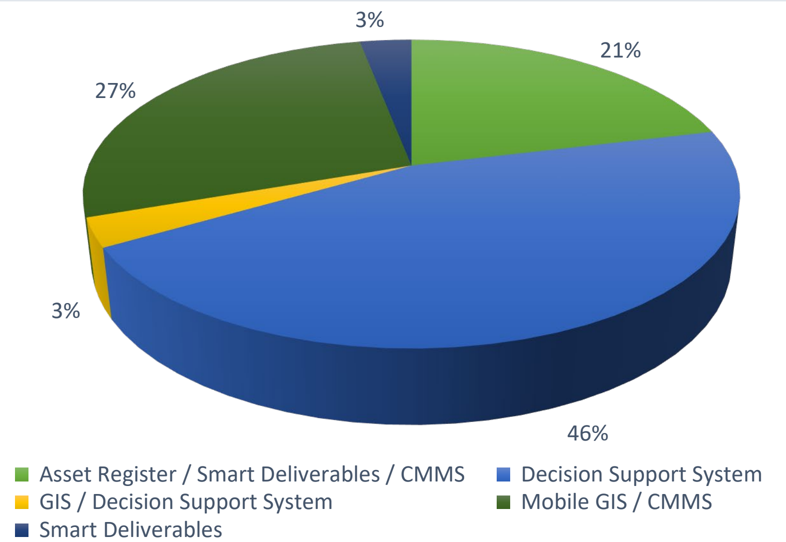


Figure 2: Software Requirements by Count

The results of this interactive session must be viewed in the context of the staff's familiarity and or maturity with the use of these systems. A poll of the steering committee indicated that generally speaking familiarity with these systems is low to medium. Categorized feedback as provided, "verbatim", by staff during this session follows:

Table 1: Session Feedback

Functional Requirements	Reponses Summary
Centralized Asset Register	*Increased Data Reliability*
Asset Register / Smart Deliverables	*(Cap Assets) - Ability to capitalize assets in automated process (vs current manual/manual process now)*
Asset Register / MMWS	*Communication between Departments*

Functional Requirements	Reponses Summary
Centralized Asset Register	*Integration b/w Systems - Currently GIS is maintained and any changes are typed into Excel, walked down to Finance, manually typed into Accpac. Would like these systems to be integrated.*
Centralized Asset Register	*Would like to see all support electronically in one system. i.e. If engineering creates forms detailing asset costs, shouldn't need to duplicate for Finance. Should be able to access electronically.*
Centralized Asset Register	*Centralized Inventory with minimal duplication*
Centralized Asset Register	*Asset registry*
Decision Support System	*Integration of Condition Data and Operating Data*
Decision Support System	*Data Integration (Non-Manual)*
Decision Support System	*System Support*
Decision Support System	*Would like to see condition, replacement, all attributes in one system - risk of failures, likelihood of failure, etc.*
Decision Support System	*Long Term Cap Plan based on Optimized/Lowest Risk*
Decision Support System	*Replacement cost for Long Term Planning for Reserve Contributions*
Decision Support System	*Would like to see if/when scenarios that show if we spend $ xx, it extends the life by X*
Decision Support System	*Using Condition Assessments to Drive Capital Decisions and Priorities*
Decision Support System	*Budget: Prioritized Projects*
Decision Support System	*(For Managers) - Ability to see Life Cycle Costs when deciding on whether to buy/lease (say equipment)*
Decision Support System	*Financial Modelling with Full Life Cycle*
Decision Support System	*Replacement cost - Current budgeting * Forecasting*

Functional Requirements	Reponses Summary
Decision Support System	*DSS*
Decision Support System	*Level of Financial Requirements (Cap)*
Decision Support System	*Budget Reporting that integrates Condition, etc.*
GIS / Decision Support System	*Easily display multiple levels of information (as little or as much as needed)*
MMWS	*Work Order System that connects Inventory System to Jobs*
MMWS	*Development of a Work Order System/Plan based on Asset Condition/Risk*
MMWS	*(Procurement Hat) - Know inventory on hand - Ability to plan buying/economies of scale*
MMWS	*I don't want to replace fiix*
Mobile GIS / MMWS	*Accurate GIS - with Accessibility*
Mobile GIS / MMWS	*Provide the ability to map all AMP data in an easy to use and quick to access format. Keep it simple!*
Mobile GIS / MMWS	*(Overall) - All data visible to all staff to assist reporting/use of data for decision-making*
Mobile GIS / MMWS	*Access to Data in the Field*
Mobile GIS / MMWS	*Update Asset in the Field after Asset has been Rehabilitated/Replaced*
Smart Deliverables	*Provide an input process that can be shared with Consultants/Contractors, so information can be input/received either remotely or in a specified/easy to use format.*

In addition, some stakeholders, at the outset of the workshop, viewed the introduction of software as an immediate solution or panacea for current issues being experienced.

Most of the issues / frustrations expressed by staff are not software centric, rather they are fundamental business process and data management issues. The feedback obtained relates to the optimized state of AM planning and data management at the Town. The expressed software needs should not be considered until some of the fundamental data fidelity, ownership and maintenance issues are addressed.

The feedback from stakeholders suggest that the Town requires an asset register to centralize data and a DSS to support capital planning and long-term forecasting. In particular, an asset register is recommended to act as a central definitive source of information to ensure data is standardized across different departments within the organization. This will reduce the need for data duplication and manual, redundant data entry, while a DSS is required to use asset data such as condition, risk, and costs to drive and prioritize long term capital planning and budgeting through scenario analysis.

The Town is currently implementing a new CMMS (Fiix) for facilities and fleet. The functionality of this software is geared toward a facility versus network / linear maintenance management environment. At this juncture, Fiix does not have the inherent functionality required to support road, water, sewer assets in a field environment.

Please note that Fiix does not preclude the introduction of a new CMMS for linear / area based asset systems as most if not all new systems allow for connectivity and data exchange between these systems. This, and the fact that these assets are generally managed with different approaches and different groups, makes the introduction of a new CMMS for the remainder of the assets, water, sewer, roads, parks etc. feasible in the short term provided that core asset inventory, condition and capacity data needs are met.

A summary of observations, potential constraints and challenges follows:

3. SUMMARY OF OBSERVATIONS AND DISCUSSION

A review of the software currently in use and candid discussions with staff at workshops revealed the following challenges:

- Access to information for desktop information is problematic and inefficient given the multiple copies of information and the lack of documented: ownership/ accountability and update frequency of/for each information source. This can be resolved through the use of business process changes in combination with the creation of one accessible and centralized asset register.
- Fidelity and currency of information employed for capital and maintenance planning is of concern in that owners, contributors and consumers for data are not documented nor explicitly defined.
- Duplication of information across the Town by different stakeholders for their own or department specific needs is leading to dilution of core data sets with orphaned Excel based information being updated outside of a centralized data set. An example of this is the rationalization of Tangible Capital Asset data with core infrastructure data contained in the various systems.

- Inefficient use of time and resources rationalizing multiple data sets of core infrastructure data for differing functional needs.
- Resource inefficient data intake and update methods. Much of the information that the Town receives from vendors, consultants and service providers is paper or pdf based which results in the Town having to translate this information into digital information.
- Perceived lack of visibility between line items in annual Capital and Operating budgets and substantiating asset level needs. This relates to the inability of the Town to demonstrate the efficacy of funding levels beyond simplistic age and or condition-based analyses. Ideally Town staff should have the ability to clearly illustrate the need for, scope and priority of any given investment based on asset level risk, condition and performance data. Any given budget item be traceable to the asset level information that supports it.

The following section outlines our recommended tactical approach to improving the state of asset management, infrastructure planning and data management at the Town.

4. DATA MANAGEMENT AND BUSINESS PROCESS IMPROVEMENT

The following represents a stepwise approach to the development of an asset centric, evidence based asset management environment at the Town. Resource needs indicated are for a dedicated or consultant-based effort by one appropriately qualified data management / applied GIS staff resource. These estimates do not include that required for stakeholders in the various departments at the Town. To determine an equivalent cost for a consultant delivered option, please apply a $100 per hour average rate to the hours shown.

➢ Document Existing Data Sources, Authors, Contributors and Consumers

The first step in bringing efficiency and clarity to data management efforts at the Town is to explicitly document the “as is” state with respect to supporting data. The GMBP staff have completed a data assessment for core infrastructure data however not the other non-core infrastructure portfolios. This process will involve defining and deciding on the: optimum location and format of supporting data, its suitability as the authoritative source, identifying duplicates, accountability and ownership of the data, currency, and frequency of update. This will aid in defining what information is available and highlights any inefficiencies with respect to its upkeep and the extent to which the data can be used by multiple stakeholders for complementary however different functional needs. The source, accuracy, currency of new incoming information will be required along with roles for staff on its upkeep and ownership.

This process needs to be mindful of and respect the fact that there are many "expert systems" currently in use at the Town which, in addition to housing asset information, produce functional use specific output for specific tasks. Examples of these systems include but are not limited to: financial systems, water and wastewater hydraulic models, pavement management systems, etc.

Resource Need Estimate: 160 to 200 hours

Outcome: Data and Roles Register

➢ Document Existing and Future Functional Needs

The completion of the preceding task will clearly define what data is available, its maturity and confidence for use by Town staff. Under this task a broad cross section of Town staff need to discuss, define and document their functional needs with respect to: work management, asset planning, budgeting and reporting.

In defining these needs the following needs to be considered:

- Criticality of functional use – is it a "want" or is it a business-critical need?
- Frequency of use – annual, monthly daily?
- Required level of detail for each use – some differing uses may employ the data however at differing levels of detail
- Primary consumer of the data for a given functional use
- Primary and secondary sources of data for functional use
- What and how many data sources are accessed to meet the need

The documentation of these needs will provide the basis to match functional need with the data that is available. This process will clearly result in the gaps between the required needs of stakeholders and the data that is available, current and reliable.

Resource Needs: 80 hours

Outcome: Functional Needs Documentation

➢ Defining Gaps, Consolidation and Rightsizing Opportunities

Upon completion of the functional use assessment the Town will have the ability to compare business critical needs against available data. This will also allow for a review of existing data from a "to be" or optimized state. A thorough data review should follow to examine opportunities for:

- Disposal of data that does not address a defined need.
- Aggregation and consolidation of data to meet functional needs, ideally from one maintainable and authoritative information source.

- Definition of owner, author, update frequency and schedule of update for core asset: inventory condition, capacity, risk and valuation data.
- Data that requires augmentation or conversely simplification to meet a functional need.
- System integration opportunities.
- Location of data source either within or outside of an expert system.

This will result in a data improvement plan that is clearly coupled with functional need. Needs should ideally be prioritized to allow for the recognition of some quick wins along with a data project management plan with clear resource requirements and deadlines. Results need to be documented and made explicit to all stakeholders to keep expectations in check with the planned data improvement schedule.

In an optimized state, the ownership or accountability for the data improvement plan will rest with senior staff within the division or department with the authority to act on or direct staff for data improvement. The owner of the plan should ideally be a subject matter expert on the data. Improvement plans can be coordinated amongst departments if there are named owners for all components and one senior staff member who has the authority to act on the plan. Data improvement plans are generally living documents and centre around the ongoing of audit of data and revaluation of data versus core business functional needs.

Resource Needs: 40 hours (Initial Implementation)

Outcome: Functional Needs Documentation

- **Definition of Data Improvement Plan and Resource Requirements**

  The aggregate of the assessments resulting from the preceding will form the basis for a data improvement plan along with required resources. At this juncture the GMBP team does not have sufficient information to support an accurate assessment of the resources required to fully build out the all the Town's data sets, non-core as well as core, however we have provided an estimate for core water, wastewater, structure, drainage and stormwater data sets which do require some augmentation. Other functional areas and departments, parks etc., will likely require additional effort and were not part of the scope of this assignment.

Resource Needs: 500 to 1000 hours

Outcome: Data Improvement Plan

- **Definition Data Intake Standards**

The Town like most municipalities relies on outside vendors to supply information deemed critical for AM planning. Examples of this include but are not limited to the following:

- Design and construction of new assets.
- CCTV of wastewater and stormwater networks.
- Procurement of equipment – significant component assets.
- Inspection and condition assessment services.

Effective data management, with limited staff resources, will require Town staff to put the onus of the construction of data sets consistent with data structures in use at the Town on vendors. This will avoid resource inefficient transposition of data into Town systems. Town AM staff will then become validators and analyzers of data versus authors. GMBP has provided the optimum base data models for all core infrastructure within the DSS provided.

The construction of standards should begin immediately after a final structure for each asset type is defined. Town staff should leverage those standards already in place at different locales: Region of Waterloo, Regional Municipality of Wood Buffalo etc. and alter them to meet their needs.

Resource Needs: 250 hours

Outcome: Incoming Data Intake Standards – "Smart Deliverables"

➢ **Development / Population of Centralized Asset Data Register**

This task will involve the aggregation, centralization and consolidation of the core asset inventory attributes and spatial information into one accessible source for all stakeholders and expert systems to access. Careful regard should be paid to that which should remain in an expert system versus those attributes considered core e.g.: asset type, unique identifier, material of construction, date of construction, symbol, GIS geometry etc. For those assets that are managed independently e.g. Fleet, facilities etc. where no or limited interaction with other systems is required, those inventories should remain in the host system.

It is understood that the Town of Fort Erie will be transitioning from a Manifold to an ESRI based corporate GIS framework. GMBP recommends that the Town evaluate the Canadian Municipal Data Model as an Asset Register, given its high functionality with embedded ESRI software applications. It is understood that local area municipalities of similar sizes, Grimsby, Welland etc. either have or will be implementing this data model. This common back end should result in efficiencies with respect to application development and sharing with other municipalities.

The implementation of this or any data model should be evaluated against existing software in place at the Town and possible future software purchases.

Resource Needs: 200 hours

Outcome: Asset Data Register

- **Define, Amalgamate Requirements and Develop Software Functional Specifications**

  Although a summary review of needs has been completed through this project for various type of software, defining the full business needs and the associated software requirements from all stakeholders is essential prior to the introduction of any software to ensure that it provides value to the Town.

  This process should involve a full needs review with key stakeholders from all staff groups that will be using the software to obtain early buy-in. The prioritization of these needs must distinguish between mandatory and optional (future) requirements and the development of functional specifications to evaluate software suitability. This process should be combined with a Business Requirements Document.

  An explanation follows here: https://en.wikipedia.org/wiki/Business_requirements . Traditionally these documents mix both functional and business requirement needs.

  A final however very important consideration for any upcoming software purchase is that all software being purchased must be able to integrate with the asset register, where necessary, and have an open and published Application Program Interface, (API), which will ensure that data collected within the system is easily accessed and not held hostage by the software vendor. This includes DSS, CMMS, Financial and TCA software or any system that requires the use of infrastructure asset data for determination, prioritization and funding of renewal and replacement needs.

Resource Needs: 40 - 80 hours per system

Outcome: Business Requirements Document(s)

We strongly recommend these steps be completed prior to procuring any software solution(s). This initial investigation will provide the necessary understanding and documentation to justify the requirements, as well as detail the user functionalities required in any software system.

5. SOFTWARE RECOMMENDATIONS

The following software recommendations assume that the preceding data management and business process issues have been resolved and outcomes as described have been achieved.

The optimum asset management state at the Town will be the development of asset centric, evidenced based short to long term capital and operations plans. In order to achieve this state, the Town will require, at an asset level, comparative metrics at an asset level for the following:

- Defined customer and technical levels of service
- Replacement and renewal triggers for assets
- Core attributes for each asset they own (Asset Register)
- Replacement, remediation, maintenance and repair costs
- Risk on a predefined scale
- Capacity
- Condition

To achieve this optimized state, the Town will be required to capture and store information at the asset level, in any system, using predefined master identifiers or id's used within an Asset Register. This will allow for the aggregation and analysis of all metrics, existing "as is" to preferred "to be state. Some examples of the current disconnect with respect to asset id centric information sources include but are not limited to:

- Sewer CCTV which does not directly reference the sewer section relating to the inspection.
- Watermain break records that reference geographical locations or text descriptions e.g. on street name from street to street.
- As built and design drawings for construction of new infrastructure.

GMBP has provided samples of procurement documentation and standards to aid in avoiding this disconnect moving forward.

To facilitate the development of the "to be" state, assuming the CMDM or generic equivalent is used for an Asset Register, the following two systems should be considered. Capital and implementation costs shown are based on recent audit, procurement and implementation projects for the Region of Waterloo, City of Guelph, City of Brantford, City of Welland and others. Costs have been prorated based on our understanding of the estimated number of users for the software, ~50.

Corporate Maintenance Management Work Order System(MMWS)

Timing: **1 to 3 years**

Capital Cost: **$150,000 - $200,000**

Implementation Cost: **$450,000 - $800.000**

Total: **$600,000 - $1.0M**

Annual Cost: **(25 to 30% of Software Purchase Cost)**

Currently the Town lacks a thorough understanding of the type, extent and distribution of maintenance costs at an asset level for the majority of the asset portfolios both within and outside of the scope of this project with the exception of buildings for which Fiix has been purchased and implemented. In addition, the Town does not have a full understanding of the frequency and cause of failure that results in their current largely reactive maintenance state.

The introduction of a modern, geospatial, mobile and web based MMWS will provide significant benefits in the following areas:

- The construction of an ongoing, centralized and staff member independent maintenance corporate memory
- Understanding what maintenance money was spent on, an asset, versus knowing purely what activity was involved.
- Provide core asset information, past and planned maintenance and capital activity data to front line workers allowing them to make better informed decisions in the field.
- Preservation of asset life through proactive, preventive maintenance.
- Efficiencies through the movement away from a reactive to planned maintenance state. Identification of reactive maintenance that can be grouped into a preventive planned maintenance programs with defined resources and budgets.
- Identification of assets that require capital intervention versus repeated maintenance.
- Identification of aggregate maintenance costs and frequency by asset. Understanding the root cause of asset failure or assets that fail to perform at the desired level of service.
- Provide a structured method for operators and maintainers to inform capital and operations budgets and authors.
- Provide a structured environment for asset inspection data and attachment of media.
- Inform level of service key performance indicators

- Standardize and monitor customer response times by activity and ensure that the customer service loop is both auditable and closed.

In most cases modern MMWS software also provides the following:

- Fleet / rolling stock management
- Stores / inventory functionality
- Asset specific condition assessment and analysis functionality – CCTV, OSIM, PM etc.
- GIS work planning
- Financial and time analysis.

The introduction of a new MMWS should be viewed in the context of providing front line worker value first and foremost as all the benefits listed can only be recognized if buy in at this level is achieved and data captured appropriately.

Please note that costs shown are for an “on premise” solution meaning that software would be installed on Town servers. The Town may opt for Software as a Service, (SAAS), web hosted, which provides economies through the use of subscription-based model that does not require capital hardware investment. Ideally the MMWS being considered should include Customer Relations Management functionality to link service requests with inspections and work orders in one seamless and auditable environment.

Again, prior to the introduction of a new MMWS the Town must fully understand their current maintenance processes and streamline these to an optimized state. Failure to do so will result in digital representation of the existing state which will fail to recognize significant value. In addition the Town should construct a functional and technical specification that outlines software needs for inclusion within a suitable RFP. This is not to be confused with a list of Information Technology driven requirements. A suitable example recently constructed by the GMBP for the City of Brantford has been included under separate cover.

Currently there are two types of CMMS available in the marketplace, Tier 1 and Tier 2.

Tier 1 systems are complex, costly and highly configurable systems that are borne out of, and best suited for, manufacturing and or for-profit enterprises and environments. Examples of these systems include Oracle Utilities Work and Asset Management, SAP, IBM Maximo and Aveva Avantis. These systems can be adapted to municipal asset work management. GMBP does not recommend a Tier 1 CMMS for the Town.

Tier 2 systems are less complex and come pre-configured for the municipal marketplace. In contrast to Tier 1 systems, these software applications come complete with predefined data templates for infrastructure assets and in some cases maintenance processes and limited decision support functionality. Currently there are three popular systems with a significant user base in the North American marketplace. These are, in no particular order:

1. Cartegraph OMS - https://www.cartegraph.com/operations-management-software-for-government (In use at City of Niagara Falls, County of Oxford)
2. ESRI Cityworks - https://esri.ca/en/products/cityworks (In use by Town of Oakville, Halifax, Region of York)
3. Lucity - https://www.lucity.com/ - (Recently Purchased by the City of Welland, in use at the Region of Waterloo)

All systems listed would be suitable for use by Town Staff given their stated objectives of a mobile, user friendly and scalable system for work management.

Corporate Decision Support System (DSS)

Timing:	**2 to 4 years**
Subscription / Lease Cost:	**$25,000 to $50,000 per annum**
Implementation Cost:	**$100,000**

This project has provided a non-proprietary SQL Server based DSS and financial tool for the Town's use. The full functionality within this system has yet to be recognized within one commercial DSS system however base functionality with respect to the creation and bundling of projects and programs for budgeting has. The Town can continue to use the installed systems with minor to no support from GMBP.

GMBP has provided peer review and implementation services for many products including but not limited to: Assetic, Power Plan, Copper Leaf and others. Generally speaking these systems provide a more intuitive user interface with base level optimized decision making functionality however most require significant implementation effort around decision making trigger and financial calibration. All these systems do also provide adequate financial modelling.

Non-Proprietary Tangible Capital Asset Reporting System and Templates

Timing:	**1 to 2 Years**
Development Cost:	**$45,000**
Implementation Cost:	**$10,000**
Annual Cost:	**N/A**

It is understood that the Town expends significant effort in the production of TCA reports on an annual basis. This effort appears to be due to the use of a proprietary TCA reporting system that requires:

- Manual synchronization / input of asset inventory records, acquisitions, disposal, write downs etc. between this system and engineering systems and tenders.
- Inordinate amount of effort to translate system output into financial forecasts and reporting. Treasury staff have indicated that this inflexibility also creates a loss of synchronization between the various information sources.

This project would include the development of templates for external and internal service providers to populate that would provide the essential components for financial reporting within a TCA and AM environment. These templates would make these values explicit and would significantly decrease the effort required for both AM and TCA purposes and the effort required to push incoming data into Town existing and future systems.

The second component of this project is the creation of a linked Excel based TCA reporting tool. This tool would connect to the Town's Asset Register, the definitive and singular source for asset information for the portfolios specified, and generate the reporting required for the Town's mandatory financial reporting while informing other AM and financial modelling systems within one nonproprietary and accessible information source.

Core Requirements for Additional Systems

The Town may opt for additional systems to inform their AM process over the short to medium term. The following requirements should be used in evaluating the business fit for any given application.

- Town data input into these systems must be accessible through linkages via an application program interface, (API), to ensure that data is not held captive within a proprietary back end.
- Systems should be web based, mobile device optimized and GIS ready in cases where field staff input / use is required.
- In cases where subscription-based Software As A Service Software is selected, escrow and data ownership/download agreements need to be put in place.
- In all cases the Town should pilot functionality with Town data with the vendor to ensure that the base software requirements are met.
- Standalone encrypted / proprietary core or expert systems should be avoided at all costs due to the fact that these systems promote the ineffective duplication of

data and create an environment where the use of the data is limited to that functionality within the encrypted system.

APPENDIX I: TECHNICAL MEMORANDUM #12 - DATABASE ANALYSIS AND LOGIC

Date:	5/24/2019	File:	618004
To:	Kelly Walsh, P.Eng. Director, Infrastructure Services		
From:	GM BluePlan Engineering		
Project:	Town of Fort Erie Asset Management Plan		
Subject:	Database Analysis and Logic		

TECHNICAL MEMORANDUM #12 – DATABASE ANALYSIS AND LOGIC

1. INTRODUCTION

GM BluePlan (GMBP) has been retained by the Town of Fort Erie (Town) to develop an Asset Management Plan that follows the Province's structure outlined in the Guide for Municipal AM Plans, and will also address requirements from Ontario Regulation 588/17. As a part of this project, GMBP has analyzed the Town's data using their in-house Decision Support System (DSS) which enables the town to understand the relationship between the performance of their infrastructure assets over the next 25 years and the corresponding annual expenditures.

Based on this, the key objectives of this memorandum are as follows:

- ***Asset Management Analysis Strategies*: **Review the asset management analysis strategies that are used to understand the relationship between the performance measure of an asset category and the capital/operating expenditures, and the assessment of risk.
- ***DSS Structure and Logic*: **Explain the logic of how the DSS performs its predictive analysis and provide an overview of the structure of the system.
- ***Future Refinement*: **Describe how the analysis used to support future AMPs can be continually refined by all relevant finance and technical subject matter experts.

2. ASSET MANAGEMENT ANALYSIS STRATEGIES

2.1 Inventory of Asset Information

The best available asset information was compiled for the project by Town staff. During project implementation, additional asset information was identified and obtained through conversations with the Town's subject matter experts. The available asset information was reviewed by the GMBP project team on an ongoing basis throughout the project for suitability for inclusion in the analysis portion of the project.

The asset information was required for the following purposes:

- Establishing the quantities of each type of asset
- Structuring the asset inventories into a consistent hierarchy for the purposes of developing the DSS in a way that can be used to operationalize the Town's asset management strategies
- Developing estimates of the replacement costs of each asset
- Establishing the current performance of each asset
- Developing appropriate lifecycle management strategies that are applicable for a range of performance states of each asset

2.1.1 Approach to Developing Asset Hierarchies from Asset Inventories

The asset information was reviewed to develop the inventories of each type of asset. The inventories were consolidated into a structured hierarchy that serves as an input into the analytical system, which is called the "Asset Register". The purpose of an asset hierarchy is to ensure that the asset register is broken down into logical cohorts to support decisions that are made by the Town's subject matter experts about how, when, and why to spend money on assets.

The analytical system is designed to accommodate a maximum of four levels of asset hierarchies. Asset Level 1 is consistent across all assets, representing the 6 asset categories of the data provided by the Town. Asset Levels 2, 3 and 4 are then used to break down the asset categories. The summary tables in this section show each asset broken down to hierarchy levels 2/3. The strategy for when to further break down assets into the next asset level is based on the practical need to assign different levels of service or lifecycle management strategies to an asset. The following examples are provided to help understand the logic behind how the asset hierarchies were established:

- ***Asset Hierarchy Example 1***
  Asset Level 1 (Facilities) is broken down into Asset Level 2 (Leisureplex, Central Fire Station, Stevensville Hall, etc.) because each of these groups of facilities can have a different target performance – facilities that are public-facing or revenue generating may be maintained to a higher level than a facility such as a works yard. Asset Level 3 is then used to break down each facility according to their standard Uniformat II hierarchy (roofing, interior finished, exterior finishes, etc.) because these groups of assets all have different levels of service and lifecycle management strategies.

- ***Asset Hierarchy Example 2***
  Asset Level 1 (Roads & ROW) is broken down into Asset Level 2 (Roads, Sidewalks and Streetlights) because these asset groups all have a different lifecycle management strategy. Asset Level 2 (Roads) is further broken down into Asset Level 3 (Arterial, Collector and Local) because these asset groups all have different levels of service and lifecycle management strategies. Asset Level 3 (local) is further broken down into an Asset Level 4 based on material (Gravel, Earth, Hot Mix Asphalt and Surface Treated) because the lifecycle management strategies and levels of service for all roads vary depending on the material. Furthermore, Ontario Regulation 588 requirements include reporting on average PCI separately for paved and unpaved roads. Having the material in the asset hierarchy allows for the easy reporting of these metrics.

It should be noted that all four Asset Levels are not used in the hierarchies of all asset categories. Over time, the refinement of the hierarchies to utilize additional asset levels should be considered as the DSS is operationalized throughout the Town's subject matter expert groups. The hierarchy of each asset category should be considered as flexible to ensure that it can evolve as the practical management of the Town's assets changes over time.

2.1.2 Asset Information Included in the DSS

After the hierarchies are established, the DSS compiles the following asset attribute data into the Asset Register for use in decision making by the subject matter experts:

- Asset ID – the current asset ID used in the respective asset management software tool, GIS, or other inventory of assets. Including the asset ID from the native data source ensures that a direct link is practical between the DSS and the native data.
- Description – a text description brought in from the native asset data where applicable.
- Age (years) – the age of the asset calculated using the installation date brought in from the native asset data.
- Start Year – this is the year that each asset will apply its starting parameters into the predictive scenarios. By default, the current year is used to ensure that the DSS will remain up-to-date as it is used over the coming years. This field will be of use if the user wishes to run growth scenarios by installing assets in future years which do not currently exist in the Town's network.
- Decommission Year – this is the year that each asset will be removed from the predictive scenarios. By default, this field is left at 0 and is ignored by the DSS. This field will only be used if the Town decides to sell off or otherwise remove an asset from the Town's network without replacing the asset with something similar. For example, if the Town is planning to sell off an old facility to a private business and not build a new facility elsewhere which performs the same functions, the year in which the facility will be sold can be entered into this field for the corresponding assets.
- Estimated Service Life (years) – the estimated service life either from the native data or populated by GMBP using industry best practices.
- Performance – the current performance of the asset. This is either calculated from condition data provided by the Town by rescaling the condition data in the native data source or calculated from the age relative to the asset's Estimated Service Life.
- Replacement Value – the amount of money required to replace the asset, brought in from the native data or through the application of a unit cost multiplied by the asset quantity. More information regarding how the replacement value field was populated can be found in *Tech Memo 1: Background Review and Gap Analysis*.
- Degradation Curve – the deterioration curve that is used for the asset type. In this iteration of the DSS, all assets degrade linearly according to their Estimated Service Life.
- Other relevant attributes specific to each asset type such as:
    - Length (m)
    - Diameter (mm)
    - Material
    - Number of Impacted Customers (e.g. Annual Average Daily Traffic (AADT))

- Upstream/Downstream Node ID
- Spatial Geometry

The DSS is structured such that it is easy to incorporate new data as the Town obtains this information. In the future, as the Town finalizes their data collection processes required to support any missing Ontario Regulation 588 requirements, the DSS can be easily modified to contain this information.

2.1.3 Leveraging Native Data in the DSS

The information in the DSS is pulled from native data sources (using SQL Server's Import Export Wizard), meaning that all the information described in the above section, where feasible, is directly from the data source where it currently resides. This approach has two primary advantages:

1. It prevents duplication of data management efforts – when a piece of asset information is changed, such as the condition of a road segment, it is stored in the Town's native data, pulled into the DSS, and does not need to be updated in two locations.
2. It maintains currency – the DSS consumes the native data, meaning as the information is in the native source, the DSS will always pull this up-to-date data.

Structuring the DSS in this way increases the ability for it to be operationalized in the Town, because each subject matter expert can proceed on their own to refine their asset registers, collect condition information, or decide how to measure performance, without needing to restructure or redesign the DSS. It puts the focus on the subject matter experts to define how their assets are analyzed, not the keepers of the DSS.

2.2 Asset Performance

2.2.1 Overview of Measuring Asset Performance

Measuring the performance of either an asset category or an individual asset is a complex process. There are many different factors that are integrated into the decision-making processes of the experts who decide when an asset is not achieving its intended performance. The factors that impact the performance of an asset are generally grouped into two categories:

1. **Conditional Performance**
   The physical condition or state of repair of an asset is often the primary factor used to make decisions about when and how it should be renewed (replaced or rehabilitated).

2. **Functional Performance**
   The functional performance of an asset can also impact decisions about when and how an asset should be renewed. Types of considerations that are captured in the functional performance of an asset include:

- The size of an asset (e.g. is it too big or too small?)
- The maintenance cost of an asset
- Whether the asset is functionally obsolete
- Whether the asset is functioning as intended (e.g. greenhouse gas emissions from a facility are greater than an established target)

2.2.2 Measuring Asset Performance in the Analytical System

It is important to recognize that many of the factors that impact the functional performance of an asset do not currently have explicit industry triggers that can be established and analyzed based on specific data. These factors are, however, often implicit in the decision-making processes to decide when and how to renew an asset. For this reason, the approach to measuring asset performance in this iteration of the DSS is to:

- Start with a performance measure that has the best chance of being explicitly quantified based on the available data. In most cases, this is a measure of the physical condition of the asset. Further, in most asset categories the physical condition is still the primary driver for deciding which assets need to be renewed.
- Provide recommendations that will describe how additional functional performance measures can be explicitly incorporated into future iterations of the DSS based on asset data.

Each asset was assigned a Performance State based on calculating a performance score between 0 and 1, where 0 is bad and 1 is good (refer to *Section 2.5 Performance Assumptions* of *Tech Memo 4: State of Local Infrastructure*). Subsequent sections of this report describe how the performance scores were calculated for each asset category in the first iteration of the analytical system. It should be noted that the description of how performance is measured for each asset is explicitly noted below for each asset category. All other potential strategies to measure performance of a particular asset category that are not listed in the relevant sub-section of *Section 2.5* have not been incorporated into the performance measure in the current version of the analytical system.

Table 1 below illustrates how the performance score for each asset is assigned to a performance category that is consistent across all asset groups. These performance categories are used in the performance forecasts.

Table 1: Performance Category Descriptions

Performance Range	Performance Category	Description
0 - 0.2	Very Poor	**Unfit for sustained Service** - These assets are below standard condition with widespread signs of deterioration
> 0.2 - 0.4	Poor	**At Risk** - These assets are mostly below standards and many elements are approaching the end of their service life

Performance Range	Performance Category	Description
> 0.4 - 0.6	Fair	**Requires Attention** - some assets show general signs of deterioration and some deficiencies are starting to show
> 0.6 - 0.8	Good	**Adequate for Now** - Most assets are functioning with a few elements showing signs of deterioration
> 0.8 - 1	Excellent	**Fit for the Future** - Overall condition of assets and their associated elements is good or newly replaced/rehabilitated

2.2.3 Incorporating Implicit Performance Considerations in the Analytical System

Over time, the DSS has been designed to enable the Town to incorporate a more complex quantification of asset performance that considers a range of conditional and functional factors. However, it should be recognized that the DSS has been developed in a way that enables the Town's subject matter experts to incorporate implicit factors for which data is not available. This is achieved by adjusting variables on asset data, such as the estimated service life or current condition score (i.e. if an asset is known to be functionally deficient then the system can be adjusted to reflect that these assets need to be renewed regardless of their state of repair).

2.3 Deterioration Rates

The deterioration of the performance of an asset over time is a fundamental consideration when making infrastructure related decisions. The analysis of deterioration in the conditional performance of an asset is typically articulated as "how much the condition deteriorates each year" and quantified in metrics such as "condition score per year".

Over time it may be feasible to incorporate deterioration rates to the functional performance of the assets – for example if the changing climate will result in a worsening of the severity and intensity of storm events over time, then it would be logical to assume that the functional performance of the storm collection asset will also deteriorate over the same time. However, this is not recommended to be considered until there is an established explicit functional performance measure for an asset category that can be analyzed using asset data. In the shorter term, the impact of factors that will result in decline of the functional performance can be implicitly incorporated into the analytical system using the professional judgement of the Town's subject matter experts and asset management division staff.

2.3.1 Deterioration Rates Based on the Industry's Theoretical Estimated Service Life

In this iteration, all assets in the DSS have a deterioration rate that is based on an industry theoretical estimated service life. The deterioration rate is calculated using the following formula:

$$[Annual\ Deterioration\ Rate] = \frac{1}{[Estimated\ Service\ Life]}$$

Where:

- Annual Deterioration Rate is the performance change per year
- Estimated Service Life is the total number of years the asset is expected to be in service

2.3.2 Ability to Modify the Deterioration Rate

Within the DSS there is the ability to input a modified degradation rate for any asset. This is in the "Inputs_TreatmentTypes" table in SQL. This ability provides the professional user of the system the ability to establish an alternative degradation rate for an asset if the current degradation rate is not deemed to be appropriate after replacement.

Example

A cast iron watermain was built having an ESL of 50 years. Four years from now it is up for replacement. When it is replaced it will not be replaced by another cast iron pipe, rather it may be replaced by a PVC pipe having an ESL of 80 years. Since the performance of the PVC pipe is expected to degrade at a slower rate, a modified degradation rate is required to allow the analytical system to take this into consideration.

2.3.3 Refinement of Degradation Rates

In the current version of the DSS each asset is deteriorating linearly using their ESLs, however if more detailed data collection is done on the condition of each asset then it will be possible to incorporate non-linear performance curves into future iterations of the DSS.

Refinement of the degradation rates used in the DSS should be completed as the system is operationalized in the Town. The refinement of degradation rates should be prioritized in asset categories where the deterioration rate can vary widely across individual assets of the same asset category (i.e. sanitary sewers of different materials). This refinement should also be prioritized in cases where a linear degradation curve is not reflective of the actual manner in which an asset deteriorates. This can be accomplished through the development of non-linear degradation curves for assets based on either the condition/performance history of the asset or an industry-accepted degradation curve.

Example

A performance degradation curve could be developed for a stormwater pond to show how the performance of the pond (i.e. total suspended solids removal) declines over times as sediment accumulates.

2.4 Treatment Categories

Treatment category is a term referring to general types of treatments that may increase performance of the asset. Applying a combination of these categories in a planned approach is an Asset Management Strategy, according to the Ontario Building Together Guide. The following points summarize the major types of treatment categories that are applied to municipal infrastructure. Opportunities to refine the analytical system include formally defining the treatments that are completed on some asset categories as well as quantifying how different treatments affect degradation rates or increase performance.

- **Maintenance** - typically assumes a low cost and low increase in or maintained asset performance. Note that the term "maintenance" may not be standard terminology across asset categories. A cross reference to the term "maintenance" is to be maintained via internal team documentation.
- **Rehabilitation** - typically assumes a medium cost and medium increase in asset performance. Note that the term "rehabilitation" may not be standard terminology across asset categories. A cross reference to the term "rehabilitation" is to be maintained via internal team documentation.
- **Replacement**/**Reconstruction** - typically assumes a high cost and high asset performance increase. Note that the term "replacement" may not be standard terminology across asset categories. For example, an equivalent term used in facilities management is "renovate" while in roads the term is “reconstruction”. A cross reference to the term "replacement" is to be maintained via internal team documentation.
- **Upgrade** - typically assumes a very high cost and a very high increase in asset performance. Note that the term "Upgrade" may not be standard terminology across asset categories. A cross reference to the term "Upgrade" is to be maintained via internal team documentation.

Note that for the current iteration of the DSS, replacement was the only treatment category that was explicitly incorporated into the system apart from Roads, which uses both Replacement and Rehabilitation. Currently, the Town does not have the data required for a more detailed analysis, though this is something that can be incorporated in the future. In the mean time, assumptions can be made regarding the adjustment of ESL values when more or less maintenance is performed on assets.

2.5 Treatment Triggers

The triggers for when each renewal treatment is applied is based on a threshold related to the performance measure of the asset. The triggers can be established for each unique grouping of asset levels 1, 2, 3 and 4 in the hierarchy of each asset category. This hierarchy can be further partitioned by assigning treatment triggers using the “Consequence of Failure” field. This enables the subject matter experts to adjust the target performance at which each cohort of assets should be treated. The following example describes the approach to setting treatment triggers for several asset groups.

Example – Road Assets

A different replacement trigger has been established for arterial versus local roads, with local roads being permitted to degrade to a worse condition before they are replaced compared to arterial roads. This reflects the fact that arterial roads represent a greater consequence to the community if they were to be in a condition state that was below expectations. This is feasible in the DSS because Asset Level 3 for the road assets is set up to be the arterials, collector and local road classification data.

2.6 Treatment Costs

The cost of each treatment is another critical component of the DSS. *Section 2.1* of *Tech Memo 4: State of Local Infrastructure* described the process for assigning replacement costs to all assets. These costs are estimates as actual costs are based on competitive bidding. The costs that have been incorporated are considered to be suitable for asset management planning purposes and have not been adjusted to reflect unique characteristics of individual assets. Subject matter experts can make these adjustments as necessary in future refinements of the DSS.

2.7 Performance Improvement

The performance improvement represents the final component of the DSS. In the current iteration of the system, the only treatment option that is being incorporated for non-road assets is replacement, where the asset is returned to a “like new” performance. The analytical system has therefore been designed to restore the performance score of an asset to a value of 1.00 when the replacement treatment is applied.

For road assets, in addition to the replacement treatment type, the rehab treatment was added in to account for road resurfacing. Roads are typically resurfaced before they are completely replaced, and resurfacing is a fraction of the cost of replacement. For a more accurate prediction of future expenditure needs, the Rehabilitation treatment category was incorporated. This treatment type resets the road’s PQI to 100, and therefore improves the road asset’s Performance to 1.00 when applied, or to a “like new” performance.

However, the DSS is structured in a way that allows the performance increase to change such that treating an asset restores the performance either by a set amount or to a set value. In future iterations of the DSS it will be possible to incorporate rehabilitation or maintenance treatments which increase performance without restoring it to a “like new” performance.

2.8 Impact to Performance from Planned Expenditures

The Town’s *Reserve Funding* spreadsheet was used to inform the DSS of the ten-year capital budget (2018 to 2029). The funding allocated was determined from the Transfer to Capital Program column for each Capital Reserve Fund.

With the information that was provided from the Town, GMBP was unable to assign the Town's funding to individual assets. However, the funding that is going to be spent on these assets is still being incorporated into the DSS at an asset level 1.

2.9 Risk Management

The term risk covers a broad spectrum when used in the context of the infrastructure asset management industry. The information provided in this section has been structured to better articulate how risk has been addressed through this project.

There are three distinct areas in which concepts of risk have been addressed in this project:

1. Asset Risk

Asset risk refers to the traditional infrastructure asset management approach that defines risk as the product of the likelihood/probability and the consequences that would be incurred if an asset was to fail. Asset risk is addressed implicitly in the DSS in two ways:

- The likelihood/probability of failure of an asset is captured in the performance measure of each asset category. For example, an asset that has a performance of 0.00 would be considered to have a high likelihood of failure, while an asset that has a performance of 1.00 would be considered to have a low likelihood of failure.
- The consequences of failure of an asset is captured in the establishment of treatment triggers of each asset. For example, assets with a high consequence of failure would have a higher performance target that would trigger an intervention compared to an asset with a low consequence of failure.

It should also be noted that professionals managing infrastructure have extensive courses on such risk in their undergraduate and graduate programs. This gained knowledge is therefore inherent in the undertaking of daily business and making sure asset risk is minimized and public safety is considered by all public servants.

2. Strategic/Corporate Risk

Strategic or Corporate Risk refers to assessing and utilizing risk in decision making at a corporate level. These processes allow an organization to make decisions, such as the allocation of tax revenues on competing program areas while considering the corporation's tolerance for risk by program or service area. Strategic or corporate risk management:

- Allows an organization to identify both risks and opportunities to address competing priorities in areas such as health & safety, environment, customer perception, corporate liability, corporate reputation or financial implications.
- Can support proactive decision making and can anticipate potential consequences, such as impact of investment or lack of investment on the quality of service delivered to customers.

- Provides explicit values for the assessment of spending impacts that helps build consensus and contributes to greater openness and transparency in decision making and ongoing management processes.

The analytical system can be used to support strategic or corporate risk management activities by providing insight into the relative performance that is expected to be provided through each of the asset categories in the Town. This enables the Town to decide on the best way to distribute their resources across asset categories.

The following points describe an example of how the DSS can be used to help staff decide if more money should be spent on the Town's roads or stormwater assets:

i. The DSS shows the performance that will be achieved in both the roads and stormwater asset categories based on the current set of planned asset interventions.
ii. A relationship can then be made between what the expected performance of both asset categories will mean to corporate level risk considerations such as the community expectations, the impact on new development to the Town, etc.
iii. A new set of planned expenditures can be analyzed in the system to determine the change in expected performance of the asset categories relative to the baseline performance achieved through the current set of planned expenditures.
iv. Staff can then decide if performance achieved in the roads versus stormwater assets through the new set of planned expenditures is preferred over the baseline performance when considering the type of corporate level risks described in Step ii above.

3. Active Asset Management Risk

Active asset management risk is a relatively new concept that refers to the role of asset management planning processes in informing asset related interventions completed by an infrastructure management agency. The term active asset management refers to the ability to generate the performance graphs (i.e. the digital outcomes of the DSS) in a timely manner in response to an infrastructure related question. If the performance graph cannot be generated in a time frame that enables them to inform a contemplated decision, then this would be referred to as an active asset management failure as the decisions will be made without the insight generated from the asset management planning process. The quantification of risk as it relates to active asset management is therefore concerned with the factors that impact the ability to generate the performance graphs in a time frame that enables the outcomes to be used to inform the decisions within the typical duration in which the current processes are completed.

The current structure of the analytical system can generate performance graphs to typical infrastructure related questions such as:

- What happens to the performance of the asset categories if the quantity of expenditures is increased/decreased?
- What happens to the performance of the asset categories if a new innovative rehabilitation technique is applied to specific assets in the system?
- What happens to the performance of the asset categories if resources are relocated from one asset category to another?
- What happens to the performance of the asset category if the process to measure performance is refined from an age-based analysis to one that incorporates new condition assessment data?

This includes several of the required Ontario Regulation 588 questions such as:

- What percent of bridges have loading or dimensional restrictions?
- For bridges in the municipality, what is the average bridge condition index value?
- For structural culverts in the municipality, what is the average bridge condition index value?
- For paved roads in the municipality, what is the average pavement condition index value?
- For unpaved roads in the municipality, what is the average surface condition (e.g. excellent, good, fair or poor)?
- What is the number of lane-kilometres of each of arterial roads, collector roads and local roads as a proportion of square kilometres of land area of the municipality?
- Etc.

Due to data restrictions that currently exist within the Town, there are several Ontario Regulation 588 reporting metrics that the DSS is unable to report on. As this data is collected, it can be easily brought into the DSS to provide the answers to these questions.

The conservative duration to use the DSS to provide the performance graphs in response to the types of questions outlined above is approximately one to two weeks based on its current structure and the business processes that are required to complete the analyses. The system itself can generate performance graphs in response to typical questions (e.g. performance vs. expenditure) instantaneously or up to one hour of processing time depending on the question complexity. The business processes of how the outcomes of the analysis are used for decision making purposes already exist; they are the authoritative and communicative lines of the corporation. Fine tuning may or may not be necessary of typical meeting settings to accommodate visual representations of the system's data and analysis for staff's consideration during discussion.

3. DSS STRUCTURE AND LOGIC

This section provides a comprehensive documentation of the development of the analytical system. The report reflects the status of the analytical system as it was delivered to the Town on November 28th, 2018. Updates of this report will be completed as refinements are made to the analytical system.

3.1 Overview of the Structure of the DSS

The DSS that GMBP is providing the Town is a combination of Microsoft SQL Server and Excel. Using SQL to perform the necessary calculations allows functionality such as integrated right-of-way analysis, or corridor management, which considers the performance of a road, sewer and watermain in the same right-of-way is not feasible in a spreadsheet-only analytical system. However, SQL does not come equipped with easy-to-use graphing capabilities, and so the output from SQL is linked to an Excel document to provide users with the necessary outputs in a format that most staff already recognize.

This approach also has the advantage of providing a progressive system that can help the Town operationalize the processes over the coming years, while being able to continually evolve the structure of the system. The future of asset management in municipalities has a large data analytical component. The final structure is a hybrid of database capabilities and Excel workbooks, with all calculations and data formatting being performed in the database and the end results (digital outcomes) being displayed in Excel.

Our data analytics processes and tools link to (not duplicate) your information, resulting in the minimization of interruption to existing business processes and staff. This also ensures that the analysis always considers any newly available data, and that there is no need to maintain multiple datasets.

3.2 Analysis of an Individual Asset

The best way to illustrate how the DSS functions is to show the outcomes produced for an individual asset. Figure 1 below shows the following:

- A facilities asset that has a current performance of 0.68.
- The asset performance deteriorates each year until it reaches a performance of 0.0 in 2029, at which point it is replaced and the performance is reset to 1.0.
- The asset continues to deteriorate throughout the 25-year analysis period. In the example, the asset reaches a score 0.06 at the end of the analysis horizon in 2043.
- The required capital expenditure is $500 in year 2029.

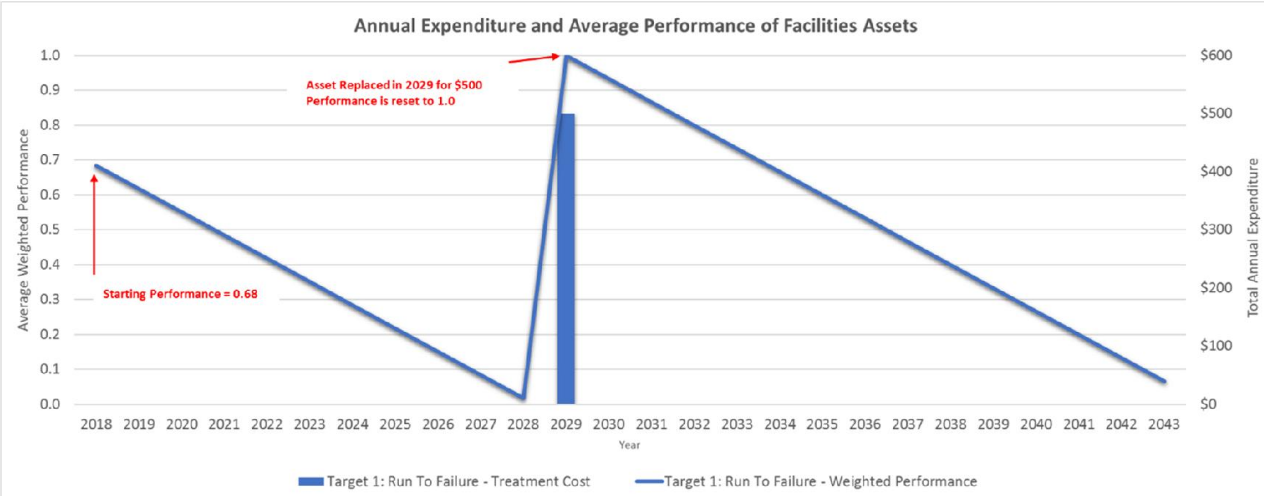


Figure 1: Sample Analysis for a Single Asset

Figure 2 below shows the distribution of the same one asset in each of the condition states:

- The asset starts in a good condition state because the current performance is 0.68.
- The asset condition state deteriorates over time and is reset to a very good condition state when the asset is replaced in 2029.
- The asset's condition state continues to deteriorate until the end of the forecasting period.

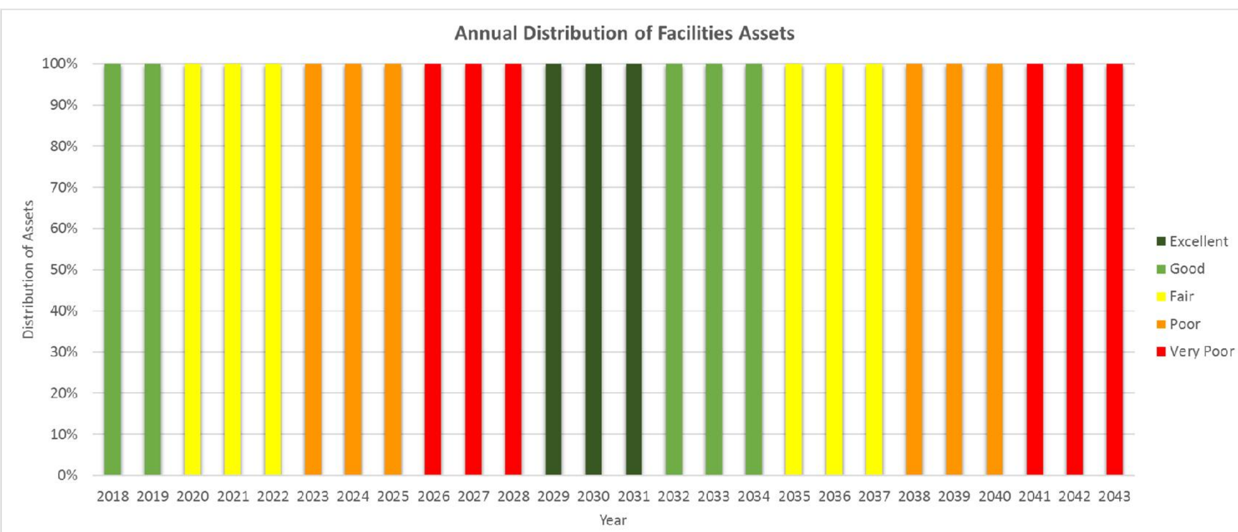


Figure 2: Sample Performance Distribution for a Single Asset

It should be noted that in all cases the DSS operates using performance scores between 0.00 and 1.00 based on the description from *Section 2.2* of this report. The output that is consumed by the subject matter experts can then be converted back into the appropriate subject matter expert performance measure for this asset group to support their decision-making processes.

3.3 Analysis of Aggregate Groups of Assets

The DSS is designed to be able to show the two graphs described above in *Section 3.2* for any Asset Level 1/2/3/4 groupings that are required. The analysis of smaller groups of assets, or individual assets, supports operational-level decisions concerning asset-specific improvement options. The analysis of larger groups of assets to the level of Asset Levels 1 or 2 support more tactical and strategic level decision making processes. However, it should be emphasized that these aggregated analyses are comprised of individual analysis that are done on each asset.

3.4 Structural Overview of the Analytical System

The analytical system is comprised of two main software programs; Microsoft SQL Server, and Microsoft Excel. Data for each of the asset categories are taken from their native data sources (condition assessments for facilities, GIS data for Roads, etc.) and reformatted into one table in SQL called the asset register. The SQL database also acquires the Town's capital budget information from an Excel spreadsheet containing the capital budget information for the next 25 years as recommended by the subject matter experts.

Once the data has been brought into the database, Microsoft SQL allows the DSS operator to make modifications to all information stored in the database (e.g. minimum level of service (LOS), estimated service life (ESL), etc.) as well as execute the stored procedures which allow it to run the performance prediction calculations.

The results of the simulations are stored in Excel spreadsheets which allow the user to visualize the results of each simulation both in tabular and graphical formats, as well as redistribute the results to subject matter experts.

3.5 Overall Structure of SQL Server

SQL server is comprised of many different tables (with relevant rows and fields/columns) and stored procedures which interact with each other in a sequential order. This section will serve to provide a brief overview of the calculations that are performed and to highlight some key items of note which result from the structure of the DSS.

A detailed overview of the relationships between the tables and stored procedures used are provided in Appendix A. This Appendix contains a flow chart showing the internal structure of the DSS and presents an overview of the different data that is imported into the system (red rectangles), the procedures that are performed on them (green ovals), the tables that are stored in the system which remain behind the scenes (blue rectangles), and the final tables containing the results of the scenarios (orange rectangles).

The following steps of the SQL Server component of the DSS are shown in Appendix A:

- The tables required for the DSS inputs and results are created (Phase 1).
- The asset data is input into SQL Server from the native data sources (Phase 2). At the time of the development of the DSS, a number of the asset categories did not have all of the necessary data to fully populate the Asset Register. For this reason, these tables have their data gaps filled using SQL scripts which are stored in the SQL. There are several stored procedures that are run (one for each asset category) all starting with the name "Setup_AssetRegister" which are executed to reformat the data for the Asset Register table.
- The capital budget information is brought into the database (Phase 3). The "Setup_Budget" procedure is used to reformat the data for use in future procedures. Additionally, the treatment types, performance categories, scenario list, and interface tables are all populated with their default values.
- At this point, all the raw data has been formatted. Any changes made in the scripts to the service life, starting performance, replacement cost, etc. will be overwritten the next time that the raw data is imported. All procedures mentioned in this section from this point onward will be using the formatted data stored in the Asset Register, Treatment Type and Budget SQL tables.
- When a new scenario is generated there are several procedures that can be executed to obtain forecasted DSS outputs. They are the "Forecasting_TargetScenario" and "Forecasting_BudgetScenario" procedures (Phase 4).
    - The "Forecasting_TargetScenario" procedure runs all calculations necessary for the Target scenario. Each of the assets located in the Asset Register are degraded until they reach their minimum LOS found in the "Inputs_TreatmentTypes" table, at which point the asset is treated and continues to degrade.
    - The "Forecasting_BudgetScenario" procedure is more complicated since it assumes that the user has a limited amount of money and also allows for a more complex series of treatment category triggers. For an asset to qualify for treatment, the following criteria must be met:
        - The performance of the asset must fall below its' established performance upper limit and above its established performance lower limit; and
        - The money remaining in the treatment budget for the associated asset class must be higher than the treatment cost of the asset.

      When choosing which assets to treat in the Budget scenario, the following steps take place:

      1. The "Inputs_AssetRegister" table has all assets copied in their current state into the results table. These results represent the as-is state (year zero) of the scenario.

2. In an interactive version of the Asset Register, the performance of all assets for the next year is calculated by degrading the performance from the previous year by one degradation step. The degradation rates of linear assets is explained above in Section 2.3 *Deterioration Rates.*
3. Any assets with a "YearOfExclusion" value of the current simulation year are removed from the interactive Asset Register for this scenario.
4. The entries in the "Inputs_Budget" table are broken into categories based on the asset level hierarchy specifications for the corresponding year and the different treatment types that can be applied.
5. A capital budget treatment entry for hierarchy 4 is selected from the subset of the Budget specified in step 4.
6. All assets that qualify for treatment that fall into the chosen asset grouping are selected. The assets in this asset grouping must match the selected asset hierarchy, qualify for the chosen treatment, and be both below the performance upper limit and above the performance lower limit.
    a. If no assets qualify, the next hierarchy level 4 Capital Budget entry is chosen, and the process restarts from step 4. If there are no more entries left in the Capital Budget for hierarchy 4 then the process jumps ahead to step 10.
    b. All assets with a Planned Program for the corresponding year and treatment type are automatically treated. The treatment costs of all assets that the user has chosen to treat is deducted from the spendable budget for this hierarchy level asset grouping. These assets are then removed from the list of assets that qualify for treatment.

    For each planned program, the asset's treatment cost is deducted from the most granular Budget hierarchy asset grouping (i.e. if an asset falls into hierarchy levels 1, 2, 3, and 4 in the capital budget, then the asset's replacement cost is reduced only from asset hierarchy level 4, not 1, 2 and 3).
7. All assets in this asset grouping are ordered by their priority criteria. Currently, each asset is prioritized using the difference between the asset's current performance and its minimum LOS target for the chosen treatment type, where assets which have exceeded their LOS target are prioritized first. If multiple assets are tied for this metric, the asset with the highest COF score will be prioritized first. In the case where there is still a tie, the assets will be prioritized by Asset ID.
8. The highest priority asset is treated (refer to Step 7), its treatment cost is deducted from the spendable capital budget for this hierarchy level

asset grouping, and it no longer qualifies for treatment of any type for the current year.

9. Step 8 is repeated until one of the following two conditions are met:
   a. All assets which have a performance less than their treatment upper limit threshold and higher than their treatment lower limit threshold for the specified treatment type have been treated.
   b. There is not enough money remaining in this hierarchy asset group's capital budget to treat the next highest priority asset.

   The stored procedure that calculates this iterative process is called "Forecasting_BudgetScenario_RecursiveAssetSelection" (Phase 4).
10. Any money remaining in the capital budget for this hierarchy grouping is added to the following year's capital budget for the same hierarchy asset group's treatment type.
11. Repeat steps 5 through 10 until there are no new hierarchy level 4 groupings available in the budget for each treatment type.
12. Select a hierarchy level 3 asset grouping from the capital budget. Repeat steps 5 through 10 but using hierarchy level 3 instead of hierarchy level 4.
13. Select a hierarchy level 2 asset grouping from the capital budget. Repeat steps 5 through 10 but using hierarchy level 2 instead of hierarchy level 4.
14. Select a hierarchy level 1 asset grouping from the capital budget. Repeat steps 5 through 10 but using hierarchy level 1 instead of hierarchy level 4.
15. At this point, all assets which could be treated in the first predictive year have been treated. Repeat steps 2 through 14 until there are 25 years' worth of predictive performance results.

Once all predictive analysis has been completed, the data is reformatted for Excel. This includes formatting the Budget outputs, assigning each asset in each year a performance category, populating fields that Excel requires calculating weighted performance, and pivoting a copy of the results so that each year shows up as columns rather than rows.

3.6 Overview of the Microsoft Excel Interface

Once a scenario has been run in SQL, the results can be viewed in Microsoft Excel. Each asset category has its own Excel workbook and presents information for that individual asset category. In addition to these individual workbooks, there is a system-wide summary of all asset categories in a separate Excel workbook. These Excel workbooks act as an interface to the DSS and provide the digital outcomes for any number of scenarios. Any data in the Excel workbooks will be overwritten each time a scenario is rerun. To save multiple variations of a scenario, each Excel workbook can be duplicated; the data in one interface can be refreshed while the other is left with the older scenario's data. This is primarily useful for archiving the results for each year that an AMP is generated.

The following sections outline the functions and information contained in the Excel workbooks.

3.6.1 Individual Asset Category

For each asset category there exists an Excel workbook containing the asset information for that individual asset category and acts as an interface to the data contained in SQL. All asset category interfaces are similar in structure but several of the asset classes have different fields in some of the tables and can have their graphs weighted by fields other than replacement cost. For example, the Sanitary asset category will have a [Diameter (mm)] field in the "Asset Register" tab while the Roads asset category will not since Roads do not have any diameter measurements in their attribute data.

The tabs in each Excel file are explicitly titled in the following pages along with their associated functions. These tabs are also colour-coded according to their content. **Yellow** tabs contain tables which are linked to SQL. **Blue** tabs contain pivot tables and pivot charts which reference the SQL-linked tables. **Black** tabs contain buttons which can be used to refresh the SQL-linked tables or alter the pivot tables and charts.

3.6.1.1 DSS Guide Tab

Each "DSS Guide" tab contains several buttons, all of which activate VBA macros when pressed, in addition to a table which lists all scenarios currently contained in the Excel workbook. Everything that the user should interact with in this tab has a dark green background and white, bold text. There are three main tasks which this tab executes, and they are as follows:

Refresh Data

To refresh the data in the Excel workbook so that it matches the most up-to-date results in SQL, press the "Refresh Data" button located in cells B3:E7 as seen in Figure 3: **Refresh Data Button** to the right.

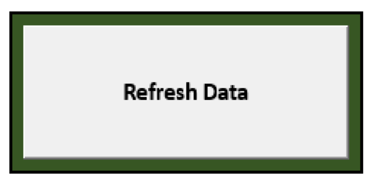


Figure 3: Refresh Data Button

Generate Performance Distribution Chart

The "Performance Distribution" tab shows the performance distribution of an individual asset category, or of any asset grouping created by filtering the data slicers.

By default, this chart is weighted by each asset's [ReplacementValue], however the graph can also be weighted by other factors depending on the asset category. The options for which weights can be applied to each asset's performance can be changed in cell H9.

Unlike the "Annual Expenditure" chart, this chart is only meant to display the results of one scenario at a time. The scenario that this chart will display by default can be changed in cell H10.

Weighted By:	ReplacementValue
Default Scenario:	Budget

Generate New Performance Distribution Table and Chart

Figure 4 Performance Distribution Chart Modifiers

Once these two variables have been entered, the button found in cells G12:H15 can be pressed to regenerate the pivot chart and pivot table in the "Performance Distribution" tab as seen in Figure 4 to the right.

Generate Annual Expenditure Chart

The "Annual Expenditure" tab shows the annual expenditure and resultant average performance of an individual asset category, or of any asset grouping created by filtering the data slicers.

By default, this chart is weighted by each asset's [ReplacementValue], however the graph can also be weighted by other factors depending on the asset category. The options for which weights can be applied to each asset's performance can be changed in cell H9.

Unlike the "Performance Distribution" chart, this chart is meant to display the results of one or more scenarios at a time. Each scenario contained within the Excel workbook is listed in the table found on cell N9, along with the scenario type (Target/Budget), and the RGB colour values that will be used when the results are plotted in the chart. Additionally, there is an "Include/Exclude" column which allows the user to choose whether the specified scenario will be included in the generated "Annual Expenditure" chart.

Once these variables have been entered, the button found in cells K12:L15 can be pressed to regenerate the pivot chart and pivot table in the "Annual Expenditure" tab as seen in Figure 5 below.

Weighted By:	ReplacementValue

Generate New Annual Expenditure Table and Chart

Scenario	ScenarioType	Red	Green	Blue	Include/Exclude
Target 1 Run To Failure	Target	68	114	196	Include
Budget	Budget	84	130	53	Include
Target 2 High COF Replaced Earlier	Target	255	192	0	Exclude

Figure 5 Annual Expenditure Chart Modifiers

3.6.1.2 Performance Distribution Tab

The "Performance Distribution" tab shows the performance distribution of an individual asset category, or of any asset grouping created by filtering the data slicers. Figure 6 below shows an example of the performance distribution chart.

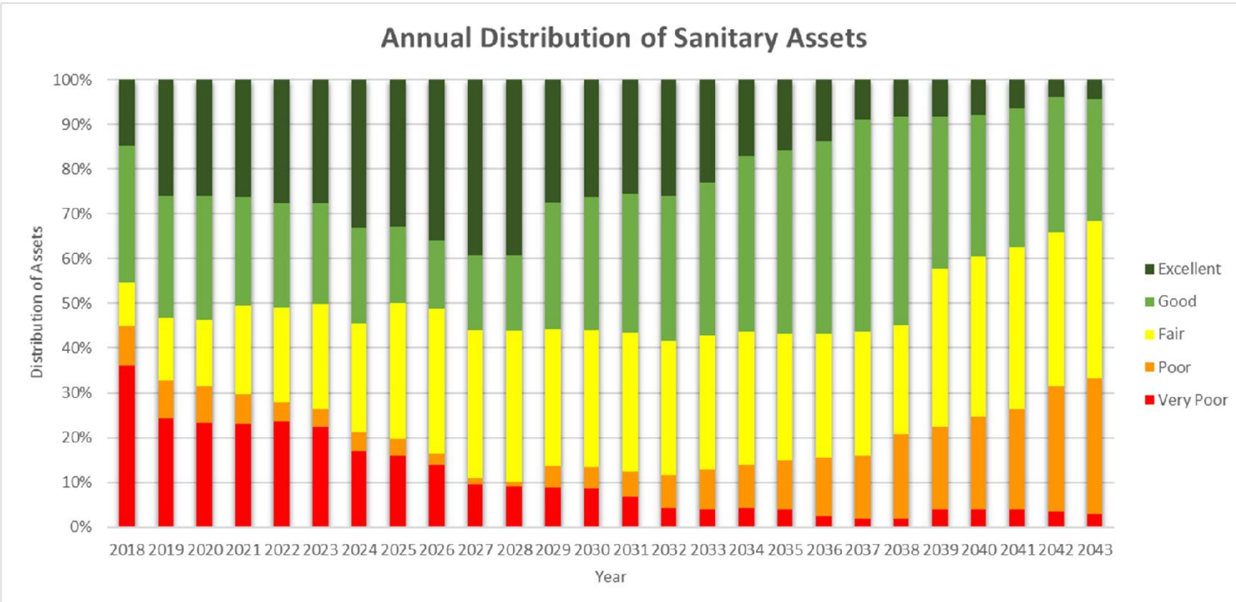


Figure 6: Example Performance Distribution Chart

By default, this chart is weighted by each asset's [ReplacementValue], however the graph can also be weighted by other factors depending on the asset category. The re-weighting of the chart can be done in the "DSS Guide" tab as discussed in *Section 3.6.1.1* above.

Also included in this tab is the pivot table containing the numbers behind the pivot chart. In the case where the chart is weighted by each asset's [ReplacementValue], this table shows the total replacement cost of every asset repeated for every year, but partitioned by the asset's performance category as discussed above in *Section 2.2.2*. These numbers can be used to calculate the percent of assets in each performance category for each year.

It is worth noting that the "Scenario" data slicer should only ever be showing one scenario at once, or else the results shown in this tab become meaningless for the purpose of decision making.

3.6.1.3 Annual Expenditure Tab

The "Annual Expenditure" tab shows the annual expenditure and resultant average performance of an individual asset category, or of any asset grouping created by filtering the data slicers. **Figure 7** below shows an example of the annual expenditure chart.

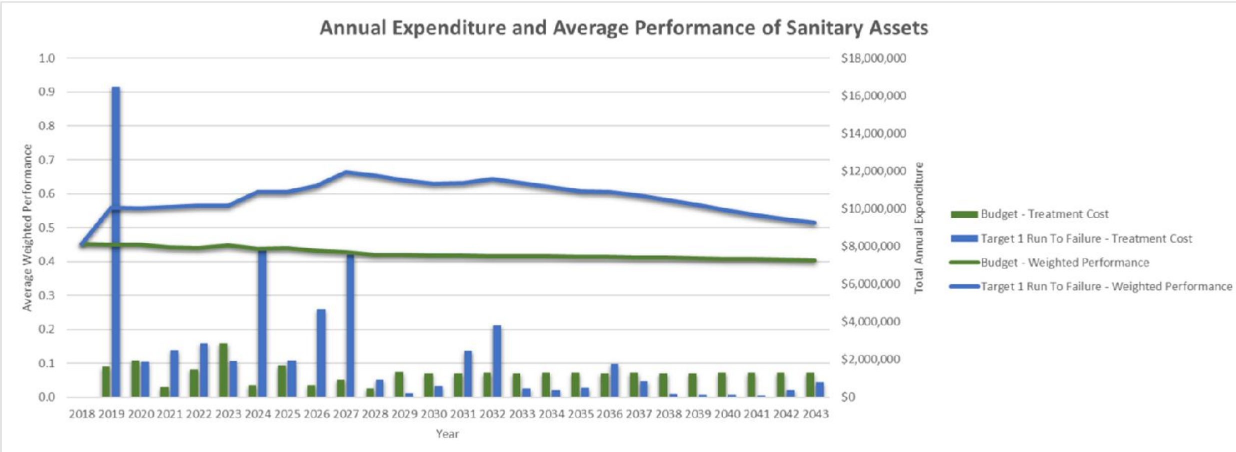


Figure 7: Example Annual Expenditure Chart

By default, this chart is weighted by each asset's [ReplacementValue], however the graph can also be weighted by other factors depending on the asset category. The re-weighting of the chart can be done in the "DSS Guide" tab as discussed in *Section 3.6.1.1* above.

Also included in this tab is the pivot table containing the numbers behind the pivot chart. In the case where the chart is weighted by each asset's [ReplacementValue], this table shows the total annual expenditure (in the "Treatment Cost" column) and the average annual performance weighted by [ReplacementValue] (in the "Weighted Performance" column) for each scenario.

3.6.1.4 Budget Usage Tab

The “Budget Usage” tab shows the capital budget spending results of all Budget Scenario inputs. Specifically, for each scenario and each predictive year, it shows the amount of money that the user entered into the DSS, the amount of money that the DSS tried to use, and the amount of money that remained unspent. These values are all summarized in the pivot table found in cell A1 as seen to the right in Figure 8.

Year	User Input Amount	Model Input Amount	Amount Unspent
2019	$1,616,140.00	$1,616,140.00	$2,333.00
2020	$1,969,000.00	$1,971,333.00	$27,954.20
2021	$560,000.00	$587,954.20	$62,601.45
2022	$1,490,000.00	$1,552,601.45	$56,152.50
2023	$2,864,000.00	$2,920,152.50	$62,498.25
2024	$633,000.00	$695,498.25	$56,374.50
2025	$1,689,000.00	$1,745,374.50	$37,807.45
2026	$673,060.00	$710,867.45	$57,168.55
2027	$926,000.00	$983,168.55	$44,341.05
2028	$500,000.00	$544,341.05	$67,006.55
2029	$1,292,892.64	$1,359,899.19	$20,771.49
2030	$1,292,892.64	$1,313,664.13	$57,229.93
2031	$1,292,892.64	$1,350,122.57	$70,788.77
2032	$1,292,892.64	$1,363,681.41	$42,708.41
2033	$1,292,892.64	$1,335,601.05	$55,934.05
2034	$1,292,892.64	$1,348,826.69	$27,315.69
2035	$1,292,892.64	$1,320,208.33	$19,862.83
2036	$1,292,892.64	$1,312,755.47	$36,233.47
2037	$1,292,892.64	$1,329,126.11	$42,905.41
2038	$1,292,892.64	$1,335,798.05	$50,793.55
2039	$1,292,892.64	$1,343,686.19	$71,402.69
2040	$1,292,892.64	$1,364,295.33	$47,208.33
2041	$1,292,892.64	$1,340,100.97	$38,479.47
2042	$1,292,892.64	$1,331,372.11	$17,300.31
2043	$1,292,892.64	$1,310,192.95	$14,618.45
Grand Total	**$32,313,589.60**	**$33,386,761.50**	**$1,087,790.35**

Figure 8 Example Budget Usage Pivot Table

The [User Input Amount] field shows the amount of money that the user input into the DSS. This funding is used as a baseline for how much additional funding can be spent in each year. Due to the LOS limitations and replacement value of each asset, the DSS is usually unable to spend the exact amount of money which was input.

The [Model Input Amount] field shows the amount of money that the system tried to spend in each year, while the [Amount Unspent] field shows the amount of [Model Input Amount] money that was left over by the end of the year that the DSS was unable to spend. This unspent money is then added to the next year’s [User Input Amount] to obtain a new [Model Input Amount] for that new year.

Using the example shown in Figure 8, the system will attempt to spend $1,616,140.00 to replace sanitary assets in 2019 (since that is the [Model Input Amount]). After replacing the highest priority assets first and removing their [ReplacementValue] from the budget for that year, the DSS will eventually have $2,333.00 left over that it cannot spend. This is likely caused by the next highest priority asset having a replacement cost higher than its remaining funding. This $2,333.00 is then carried over into 2020 where it is added to the [User Input Amount] of $1,969,000.00 to obtain a new [Model Input Amount] of $1,971,333.00 which it will attempt to spend in 2020. This process will repeat throughout each year of the scenario. In the final year, the [Amount Unspent] is $14,618.45 which is the total amount of money that was not spent of the initial $32,313,589.60 that was originally entered by the user.

These results are also shown graphically as shown in Figure 9 below.

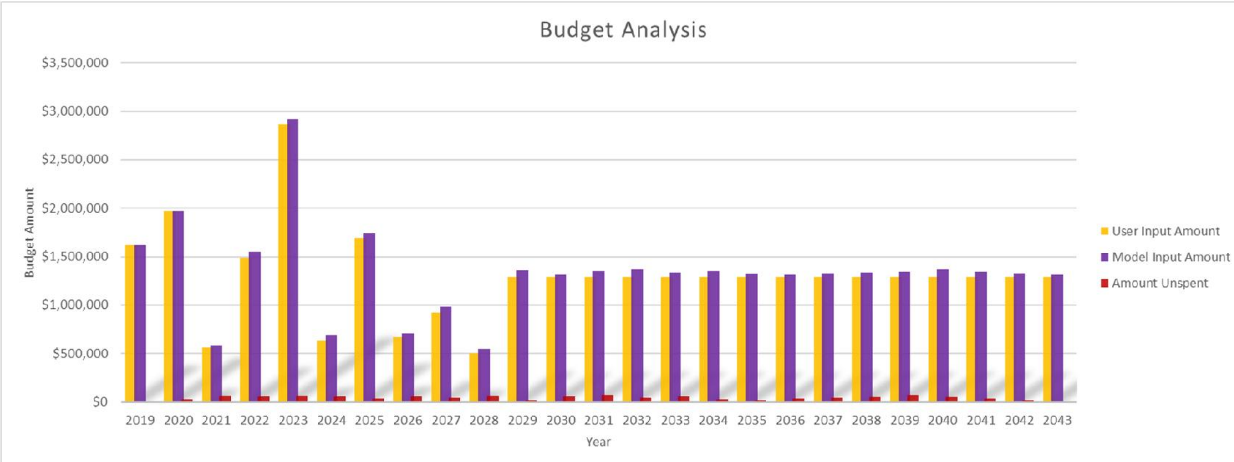


Figure 9: Example Budget Usage Chart

It is worth noting that the "Scenario" data slicer should only ever be showing one scenario at once, or else the results shown in this tab become meaningless for interpreting the results of the scenarios that are run.

3.6.1.5 Asset Register Tab

The "Asset Register" tab contains all the data pertaining to the individual asset category which are in the asset register. The fields incorporated in this table are explained above in *Section 2.1.2*. This table contains all attribute data for each asset as it existed when the asset was initially included in the DSS for each scenario. Due to how scenarios can be run which compare theoretical scenarios, some assets may be in some scenarios but not others. As a result, this table contains the initial state of each asset for each scenario, not just one copy of each asset.

For example, if the sanitary sewer with [AssetID] "SL1-SA01-0010" is included in both a budget and target scenario, and the Excel workbook contains only information pertaining to these two scenarios, then this asset will have two records in the "Asset Register" table; one for each scenario.

3.6.1.6 Planned Programs Tab

The "Planned Programs" tab contains a record of every planned program that was used for every budget scenario in the workbook. Specifically, it lists the following information about each planned program:

- Which [Scenario] the planned program applied to.
- The [GMBPID] of the asset.
- The Town's [AssetID] of the asset.
- The hierarchy ([AssetLevel01], [AssetLevel02], [AssetLevel03], and [AssetLevel04]) of the asset.
- The [Year] that the planned program was implemented.

- The [TreatmentType] that was used.
- The [Cost] to treat the asset.
- Whether or not the asset was correctly paired to a budget ([PairedToBudget]).

3.6.1.7 Treatment Types Tab

The "Treatment Types" tab contains a record of every treatment type that every asset qualified for throughout each scenario. Specifically, this includes:

- Which [Scenario] the treatment applies to.
- The asset's IDs (both [GMBPID] and [AssetID]).
- The asset's hierarchy ([AssetLevel01], [AssetLevel02], [AssetLevel03], and [AssetLevel04]).
- The asset's [ConsequenceOfFailure].
- The [TreatmentType] that the asset qualified for.
- How the treatment cost is calculated ([TreatmentCostType] and [TreatmentCost]).
- The upper and lower performance qualifiers for the specified treatment ([PerformanceUpperLimit] and [PerformanceLowerLimit]).
- The [PerformanceMinimumLOSTarget] used to prioritize treatment order between other assets.
- The [PerformanceIncreaseType] and [PerformanceIncreaseAmount].
- Any changes to the asset's degradation curve which may occur once the asset is treated ([PerformancePostTreatmentDegradationCurve] and [PerformancePostTreatmentDegradationStep].

3.6.1.8 Budget Data Tab

The "Budget Data" tab shows the capital budget spending results of all Budget Scenario inputs. Specifically, for each scenario and each predictive year, it shows the amount of money that the user entered into the DSS, the amount of money that the DSS tried to use, and the amount of money that remained unspent.

This tab is set up to feed into the pivot table in the "Budget Usage" tab discussed above in *Section 3.6.1.4*. It contains all data required to fill in the pivot table values and use the data slicers.

3.6.1.9 Scenario Results Tab

The "Scenario Results" tab contains data for each asset as was required for the DSS forecasting and as a result contains every asset's hierarchy, age, performance, treatment costs, treatment types, and all other data required for each scenario for every predictive year.

This tab is set up to feed into the pivot tables and pivot charts found in the "Performance Distribution" and "Annual Expenditure" tabs discussed above in *Sections 3.6.1.2* and *3.6.1.3*.

Due to the size limitations in Excel, depending on the number of assets and scenarios being shown in each Excel workbook this tab may grow to be too large to fit inside of an Excel workbook. As a workaround to this issue, it is possible to retrieve grouped results from the SQL database instead of per-asset results. In this case, the "Scenario Results" tab will show the data grouped by asset levels 1 through 4 and consequence of failure. This can be done in the "Performance Forecast Generator" Excel file as discussed later in this report in *Section 3.6.2*.

3.6.1.10 Pivoted Scenario Results Tab

The "Pivoted Scenario Results" tab shows the predictive performance, treatment types, and treatment costs of each asset for every scenario similar to the "Scenario Results" tab. However, unlike the "Scenario Results" tab, this tab shows the predictive results for each year in extra columns rather than as additional rows. This allows Excel to always contain per-asset results for each scenario regardless of whether the data in the "Scenario Results" tab is grouped by the asset hierarchy or is displaying per-asset results.

3.6.2 Performance Forecast Generator

The "Performance Forecast Generator" file is used to generate each of the individual asset category files discussed above in *Section 3.6.1*. This Excel workbook contains entry boxes to enter pertinent information required to generate these other files, and one button to press once the information has been entered correctly.

The user can specify the following information pertaining to the files that will be generated:

- Cells C3:C5 contain information regarding the server name, database name, and template file name respectively as seen to the right in Figure 10.

Server:	HAM-SQL2012
Database	FortErie_AMP_618004
Template File Name:	Performance Forecast - Template.xlsm

Figure 10: Performance Forecast Generator External Reference Information

- The table located in cell B10 contains information regarding which asset categories should be included/excluded from the file generation procedure, as well as whether the generated

Asset Category	Include/Exclude	Grouped/Ungrouped
Roads&ROW	Include	Ungrouped
Sanitary	Include	Ungrouped
Stormwater	Include	Ungrouped
Water	Include	Ungrouped
BridgesAndStructures	Include	Ungrouped
Facilities	Include	Ungrouped

Figure 11: Performance Forecast Asset Category Inputs

files should have grouped or ungrouped data in the "Scenario Results" tab of the new file. An example of this table can be seen in Figure 11.

The macro that runs when the "Generate Templates" button located in cells E4:E7 performs the following actions:

1. Read the data in cells C3:C5 containing information regarding the server name, database name, and template file name respectively.
2. Open the template file located in the "Templates" sub-directory with the "Template File Name" specified in cell C5.
3. Save a copy of the template file with a name corresponding to the next Asset Category in the list that has an [Include/Exclude] value of "Include".
4. Change the links to all tables that are connected to SQL Server so that each table references SQL views in the user-specified server and database.
5. Save and close the file.
6. Repeat steps 3-5 until all asset categories which have an [Include/Exclude] value of "Include" have had files generated.

3.6.3 Performance Forecast Template

The performance forecast template is used by the Performance Forecast Generator. It contains the same tables and charts that are in the Individual Asset Category files which were specified in *Section 3.6.1*, but there is no data in any of the tables.

3.6.4 System Summary

The system interface summarizes the scenario outputs for all asset categories on a system-wide level. For consistency, the system-wide summary only allows for weighted distributions based on replacement value. Additionally, due to limitations in the number of records which can be plotted in Excel at once, the system-wide summary can be filtered down to an asset category level but not at a more granular level.

The tabs in this Excel workbook are explicitly titled in the following pages along with their associated functions. These tabs are also colour-coded according to their content. **Yellow** tabs contain tables which are linked to SQL. **Blue** tabs contain pivot tables and pivot charts which reference the SQL-linked tables. **Black** tabs contain buttons which can be used to refresh the SQL-linked tables or alter the pivot tables and charts.

3.6.4.1 DSS Guide Tab

The “DSS Guide” tab contains several buttons, all of which activate VBA macros when pressed, in addition to a table which lists all scenarios currently contained in the Excel workbook. Everything that the user should interact with in this tab has a dark green background and white, bold text. There are four main tasks which this tab executes, and they are as follows:

Refresh Data

To refresh the data in the Excel workbook so that it matches the most up-to-date results in SQL, press the “Refresh Data” button located in cells B3:E7 as seen in Figure 12 to the right.

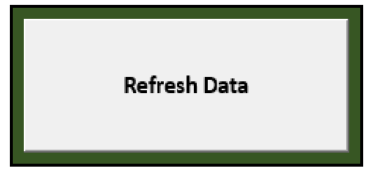


Figure 12: Refresh Data Button

Generate Performance Distribution Chart

The “Performance Distribution” tab shows the performance distribution of all asset categories, or of any combination of individual asset categories created by filtering the data slicers.

Unlike its individual asset category file counterparts, this chart can only be weighted by each asset’s [ReplacementValue]. Options for weight selections are listed in cell H9 but cannot be changed to any other values.

This chart is only meant to display the results of one scenario at a time. The scenario that this chart will display by default can be changed in cell H10.

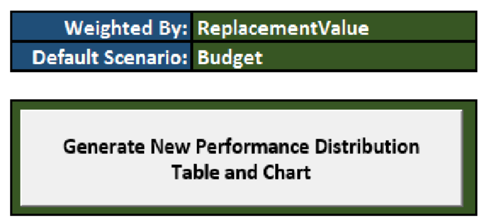


Figure 13: Performance Distribution Chart Modifiers

Once these two variables have been entered, the button found in cells G12:H15 can be pressed to regenerate the pivot chart and pivot table in the “Performance Distribution” tab as seen in Figure 13.

Generate Annual Expenditure Chart

The “Annual Expenditure” tab shows the annual expenditure and resultant average performance of an individual asset category, or of any asset grouping created by filtering the data slicers.

Unlike its individual asset category file counterparts, this chart can only be weighted by each asset’s [ReplacementValue]. Options for weight selections are listed in cell H9 but cannot be changed to any other values.

This chart is meant to display the results of one or more scenarios at a time. Each scenario contained within the Excel workbook is listed in the table found on cell N9, along with the scenario type (Target/Budget), and the RGB colour values that will be used when the results are plotted in the chart. Additionally, there is an “Include/Exclude” column which allows the user to choose whether the specified scenario will be included in the generated "Annual Expenditure" chart.

Once these variables have been entered, the button found in cells K12:L15 can be pressed to regenerate the pivot chart and pivot table in the "Annual Expenditure" tab as seen in Figure 14 below.

Scenario	ScenarioType	Red	Green	Blue	Include/Exclude
Target 1 Run To Failure	Target	68	114	196	Include
Budget	Budget	84	130	53	Include
Target 2 High COF Replaced Earlier	Target	255	192	0	Exclude

Figure 14: Annual Expenditure Chart Modifiers

Cost Breakdown

The "Cost Breakdown" tab shows the amount of money spent in each scenario to treat all asset categories throughout the forecasting period, or of any combination of individual asset categories by filtering the data slicers.

This chart is only meant to display the results of one scenario at a time. The scenario that this chart will display by default can be changed in cell H10.

The button found in cells G17:H20 can be pressed to regenerate the pivot chart and pivot table in the "Cost Breakdown" tab as seen in to the right in Figure 15.

Figure 15: Cost Distribution Generation Button

3.6.4.2 Performance Distribution Tab

The "Performance Distribution" tab shows the performance distribution of all asset categories, or of any individual asset category by filtering the data slicers. This tab functions the same way as its individual asset category files explained above in *Section 3.6.1.2*, however the graph can only be weighted by [ReplacementValue].

3.6.4.3 Annual Expenditure Tab

The "Annual Expenditure" tab shows the annual expenditure and resultant average performance of all asset categories, or of any individual asset category by filtering the data slicers. This tab functions the same way as its individual asset category files explained above in *Section 3.6.1.3*, however the average performance can only be weighted by [ReplacementValue].

3.6.4.4 Cost Breakdown Tab

The "Cost Breakdown" tab shows the amount of money spent in each scenario to treat all asset categories throughout the forecasting period, or of any combination of individual asset categories by filtering the data slicers. An example showing the cost breakdown chart can be seen to the right in Figure 16.

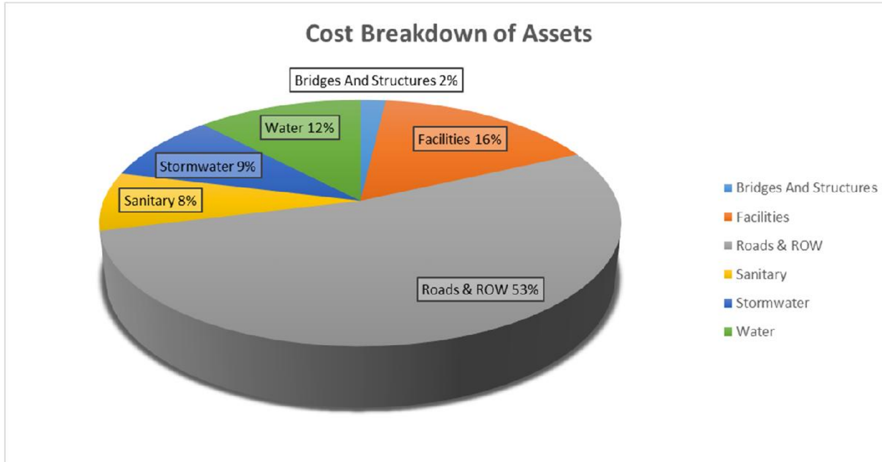


Figure 16: Example Cost Breakdown Chart

This chart is weighted by each asset category's total [TreatmentCost] and cannot be changed.

Also included in this tab is the pivot table containing the numbers behind the pivot chart. Since the chart is weighted by each asset category's [TreatmentCost], this table shows the total treatment cost of every asset that was treated throughout the forecasting period. These numbers are then expressed in the chart to calculate the percent of assets in each asset category that was treated relative to the other asset categories.

It is worth noting that the "Scenario" data slicer should only ever be showing one scenario at a time, or else the results shown in this tab become meaningless for the purpose of decision making.

3.6.4.5 Scenario Results Tab

The "Scenario Results" tab contains data for each asset category for each scenario for every predictive year.

This tab is set up to feed into the pivot tables and pivot charts found in the "Performance Distribution", "Annual Expenditure", and "Cost Breakdown" tabs discussed above in *Sections 3.6.4.2*, *3.6.4.3*, and *3.6.4.4*.

Due to the size limitations in Excel, this table retrieves grouped results from the SQL database instead of per-asset results. In this case, the "Scenario Results" tab will only show the data grouped by asset category.

3.7 Understanding Performance Improvements Caused by Planned Expenditures

The budget inputs to the DSS provide the comprehensive understanding of the total amount of money that the Town is planning to spend on each asset category each year over the next 25 years. The DSS then uses this information in the "Budget Scenario" to determine the expected impact of the planned expenditures to the performance of asset categories or individual assets. The following points describe how the budget information is used in the DSS to understand the impact of the performance:

- The DSS is designed to "spend" the available money in each year for a particular asset group.
  - An asset group can be an entire asset category, or any combination of assets available in the asset hierarchy.
- The system will spend the money on the asset that is furthest below the performance trigger. In cases where there are multiple assets that are the same magnitude below the performance trigger (i.e. several assets with a performance score of 0.0 and a minimum LOS of 0.2), the system will select to spend the money on the asset according to sequential order of the COF and asset ID. Logic around the prioritization of which asset the system decides to replace when faced with a number of potential options is left to the professional user of the system through the "Planned Program" table. This allows the user to decide that the system should replace asset X rather than asset Y, if both assets X and Y have the same performance. The logic to prioritize the assets that are replaced is another opportunity to refine the DSS over the coming years, however the professional judgement of staff will likely continue to be the predominant mechanism for adjusting the specific assets that the system is replacing with the available budget, in cases where external factors are at play.
- The system will replace assets until there is not enough money left to replace the next assets. For example, if there is $200,000 to be spent on asset group X in the year 2019, and each asset in group X would cost $75,000, then the system will replace 2 assets and $50,000 will be remaining unspent because there is not enough money to replace a third asset.
- If it is decided that the unspent money should be spent on asset group X, then the $50,000 is carried forward to the next year. For example, if there was $200,000 available in the year 2020 to spend on asset group X, there would now be $250,000 available in 2020 to replace assets in asset group X.
- If it is decided that the unspent money should be spent on a different asset group that could utilize the unspent money, then the budgets for both asset groups can be adjusted accordingly by the user. For example, the $50,000 could be transferred to the 2019 budget for asset group Y (rather than being carried forward and added to the 2020 budget for asset group X).

The process described in the above points is followed for all asset categories, providing a comprehensive picture of the expected impact of the planned expenditures on the performance of the Town's assets over the next 25 years.

3.8 Public Engagement and the DSS

The structure of the DSS supports engagement activities related to individual assets, an entire asset category, or all asset categories in the Town. The following points describe how the DSS can be used within the context of public engagement activities:

- Public engagement can help the Town's subject matter experts establish how the performance of each asset category is measured. This will require the Town to understand the relationship between the public context of how performance is measured, and the technical performance measures used by each subject matter experts group.
- Public engagement can help the Town develop targets for the proportion of each asset category in very poor through very good performance state.
- Public engagement can help provide understanding as to what level of expenditure is required to achieve the target performance of each asset category and understand the willingness of the public to pay for higher or lower performance objectives.

4. FUTURE REFINEMENT

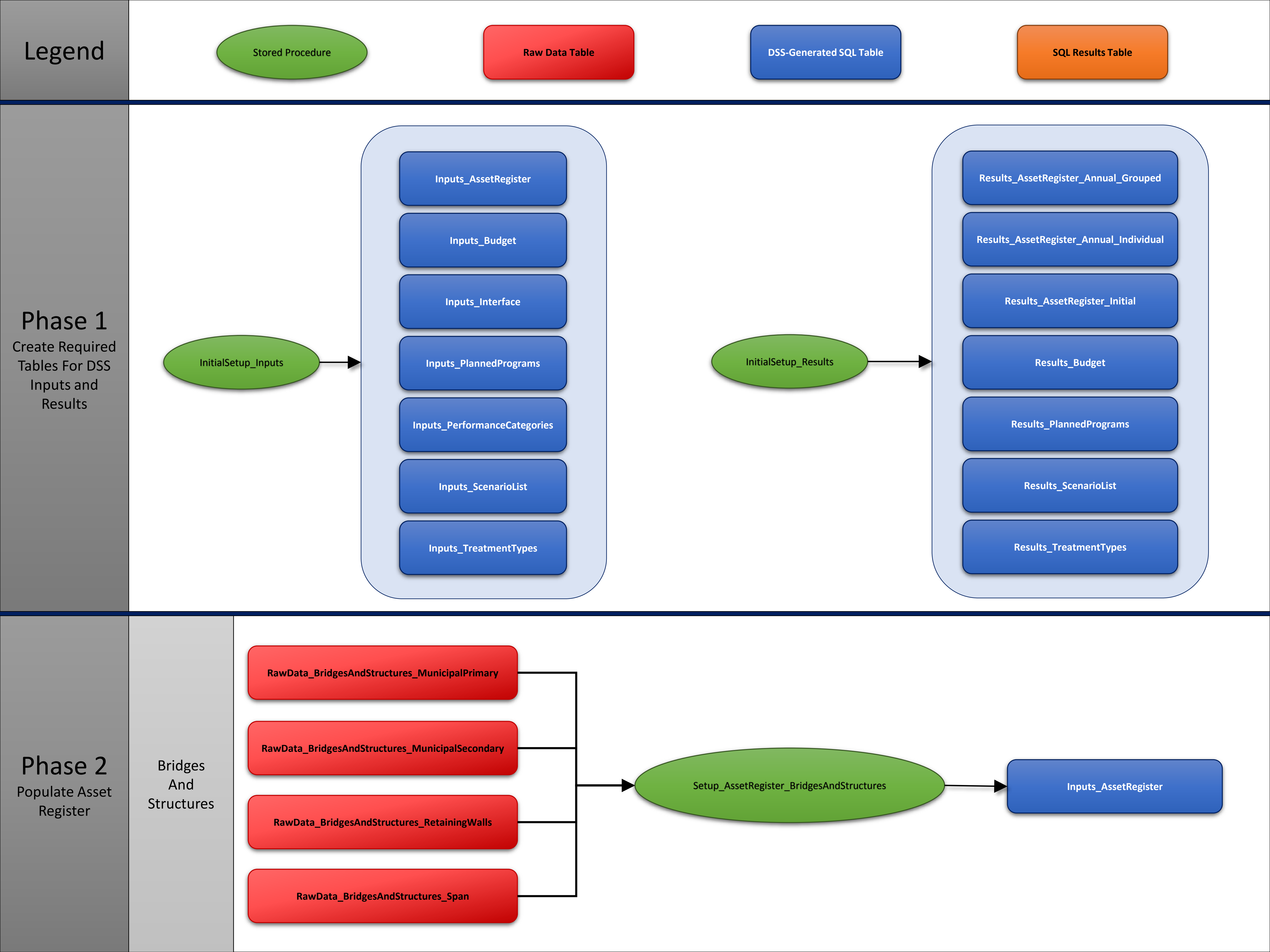
It should be recognized that this report documents the ***current*** methodology for how the best available infrastructure asset data and actual infrastructure management strategies practiced by staff in the Town were incorporated into the DSS. A conscious effort was made to develop the system in a manner that leverages the data and management strategies used by staff, rather than developing the system in a manner that uses manipulated data or incorporates more advanced theoretical/aspirational management strategies that are not actually used by Town staff.

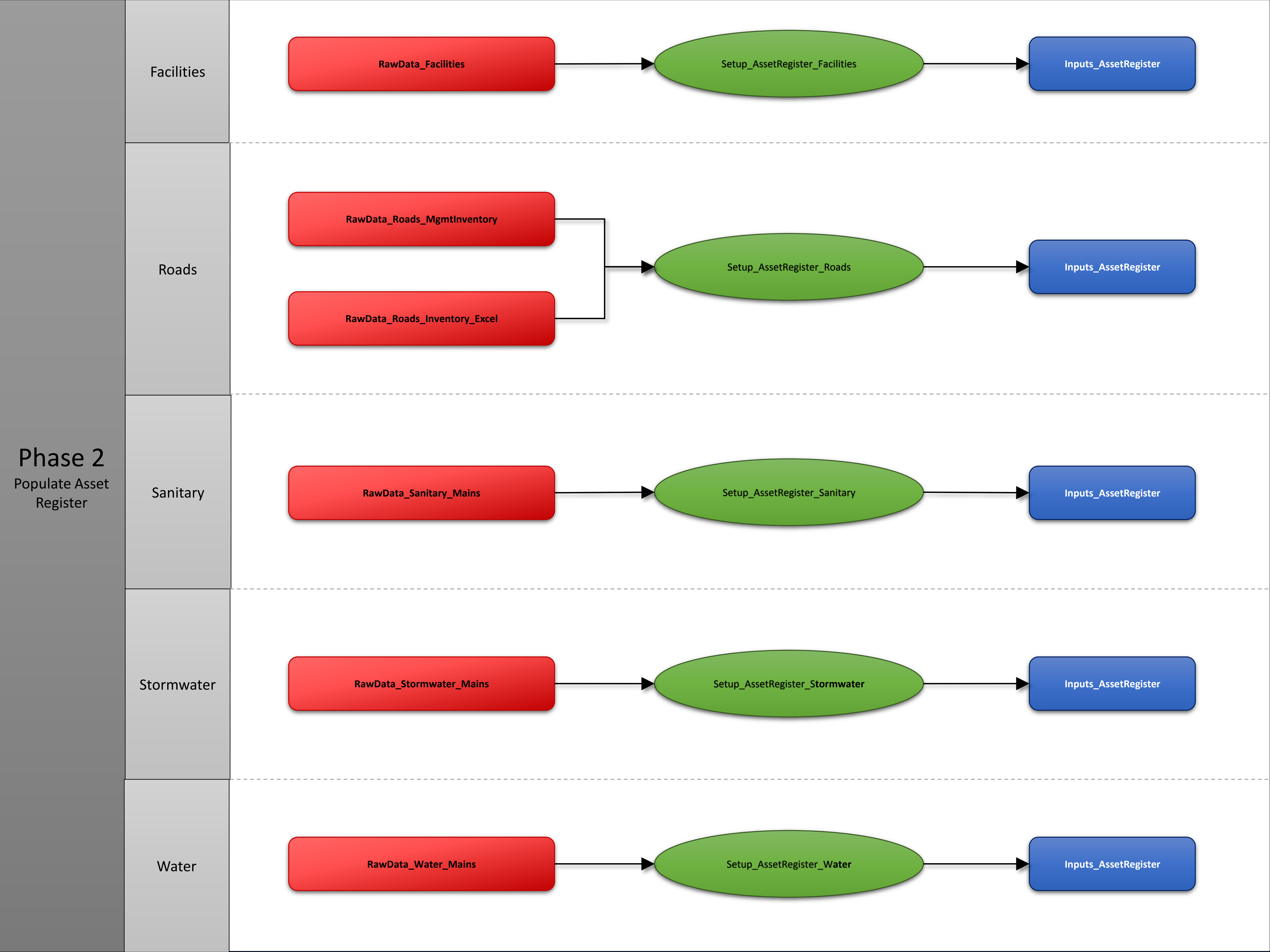
The system is structured to be "Professionally Managed", meaning that it can incorporate the knowledge/expertise of subject matter experts in the Town staff by adjusting a number of independent variables. The reason for structuring the system in this way is to accommodate areas where there is often no readily available data, or it is not time feasible to explicitly quantify the judgement or knowledge of the Town's professional experts. The flexibility of the system enables the Town's subject matter experts to implicitly incorporate their knowledge and experience into the DSS by adjusting some of the explicit variables that are used in the system.

Structuring the DSS in this way supports, and even encourages, the Town's subject matter experts to develop a strategy to refine their respective portion through the collection of additional asset data, developing improved perspectives on how to measure the performance of their asset category, and establish improved infrastructure management strategies.

Appendix A: DSS Flow Chart for SQL Server

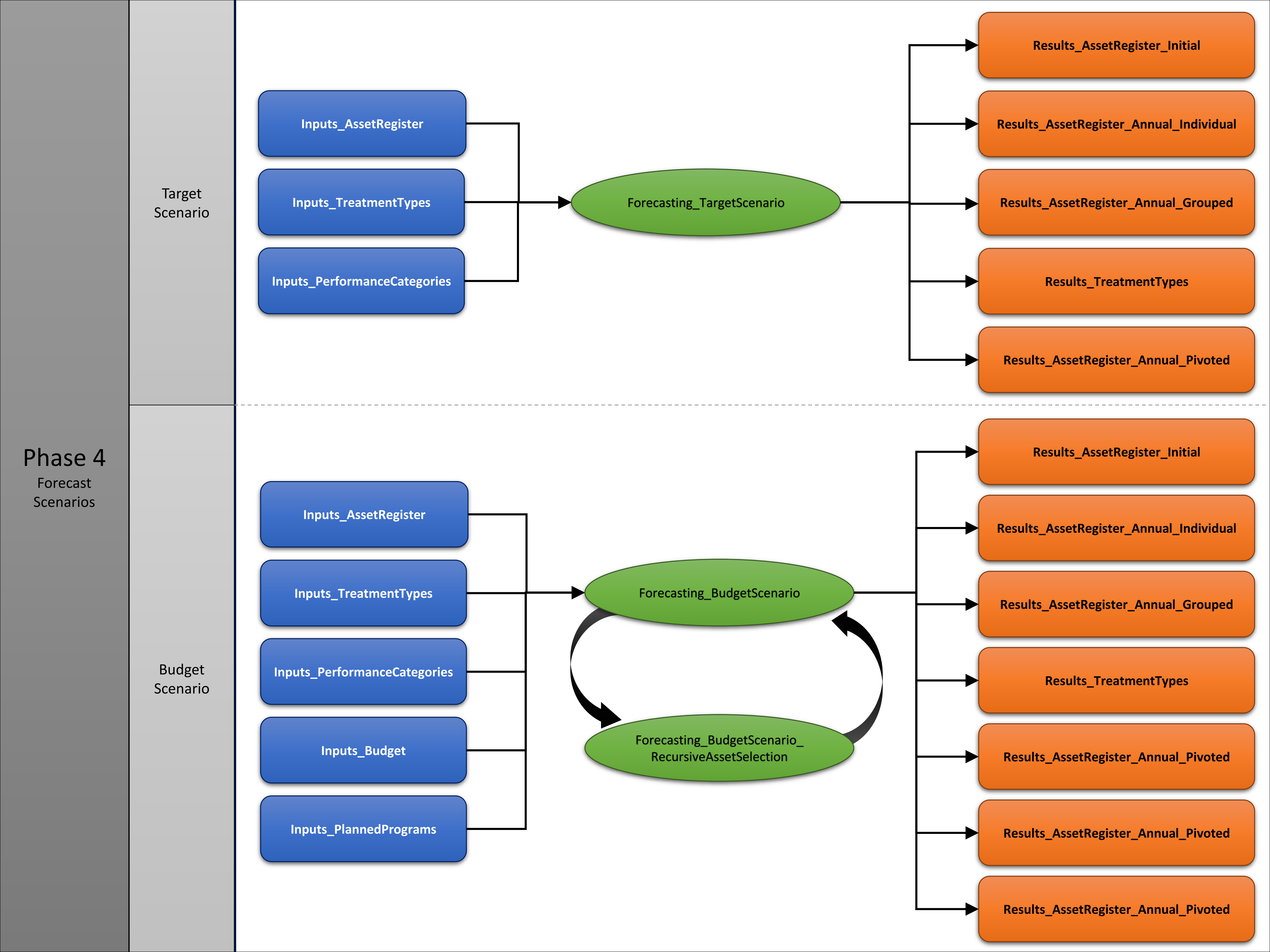
410 LEWIS ROAD, UNIT 18, STONEY CREEK, ON L8E 5Y7 P: 905-643-6688 WWW.GMBLUEPLAN.CA


Legend
Stored Procedure
Raw Data Table
DSS-Generated SQL Table
SQL Results Table
Phase 1
Create Required Tables For DSS Inputs and Results
InitialSetup_Inputs
Inputs_AssetRegister
Inputs_Budget
Inputs_Interface
Inputs_PlannedPrograms
Inputs_PerformanceCategories
Inputs_ScenarioList
Inputs_TreatmentTypes
InitialSetup_Results
Results_AssetRegister_Annual_Grouped
Results_AssetRegister_Annual_Individual
Results_AssetRegister_Initial
Results_Budget
Results_PlannedPrograms
Results_ScenarioList
Results_TreatmentTypes
Phase 2
Populate Asset Register
Bridges And Structures
RawData_BridgesAndStructures_MunicipalPrimary
RawData_BridgesAndStructures_MunicipalSecondary
RawData_BridgesAndStructures_RetainingWalls
RawData_BridgesAndStructures_Span
Setup_AssetRegister_BridgesAndStructures
Inputs_AssetRegister



Phase 2
Populate Asset Register
Facilities
RawData_Facilities
Setup_AssetRegister_Facilities
Inputs_AssetRegister
Roads
RawData_Roads_MgmtInventory
RawData_Roads_Inventory_Excel
Setup_AssetRegister_Roads
Inputs_AssetRegister
Sanitary
RawData_Sanitary_Mains
Setup_AssetRegister_Sanitary
Inputs_AssetRegister
Stormwater
RawData_Stormwater_Mains
Setup_AssetRegister_Stormwater
Inputs_AssetRegister
Water
RawData_Water_Mains
Setup_AssetRegister_Water
Inputs_AssetRegister


Phase 3
Populate Remaining Input Tables
Budget
Treatment Types
Performance Categories
Scenario List
Interface
RawData_Budget
Setup_Budget
Inputs_Budget
Inputs_AssetRegister
Setup_TreatmentTypes
Inputs_TreatmentTypes
Setup_PerformanceCategories
Inputs_PerformanceCategories
Setup_ScenarioList
Inputs_ScenarioList
Setup_Interface
Inputs_Interface



Phase 4
Forecast Scenarios
Target Scenario
Inputs_AssetRegister
Inputs_TreatmentTypes
Inputs_PerformanceCategories
Forecasting_TargetScenario
Results_AssetRegister_Initial
Results_AssetRegister_Annual_Individual
Results_AssetRegister_Annual_Grouped
Results_TreatmentTypes
Results_AssetRegister_Annual_Pivoted
Budget Scenario
Inputs_AssetRegister
Inputs_TreatmentTypes
Inputs_PerformanceCategories
Inputs_Budget
Inputs_PlannedPrograms
Forecasting_BudgetScenario
Forecasting_BudgetScenario_RecursiveAssetSelection
Results_AssetRegister_Initial
Results_AssetRegister_Annual_Individual
Results_AssetRegister_Annual_Grouped
Results_TreatmentTypes
Results_AssetRegister_Annual_Pivoted
Results_AssetRegister_Annual_Pivoted
Results_AssetRegister_Annual_Pivoted