City of St. Catharines

2021 Asset Management Plan

St. Catharines

Foreword

We want our community to be one where citizens' way of life can continue long into the future and one that can withstand unexpected events and adapt to change.

Our success will be measured by our ability to embrace innovation, ensure sustainability, and improve the livability of the city for citizens of all ages, abilities, and backgrounds.

Well maintained infrastructure is a prerequisite to achieving this vision and ensuring a high quality of life in St. Catharines and communities everywhere. Infrastructure assets support the provision of safe drinking water and wastewater capacity; powering economies through efficient movement of people and goods; provide venues for cultural expressions and community interaction; and promote healthy lifestyles.

Asset Management is the coordinated effort of the organization to realize value from infrastructure assets. This includes a systematic approach to managing the asset lifecycles while balancing costs, opportunities, and risks against the desired performance of the assets. This Asset Management Plan documents the current state of City assets, the desired levels of service, the lifecycle activities to support them, and the financing strategy to fund the full asset lifecycle. Ultimately, it supports the City in making the best possible decisions regarding building, operating, maintaining, renewing, replacing, and disposing of infrastructure assets. It also helps achieve the following objectives:

- Ensuring that all City-owned infrastructure assets are sustainable into the future;
- Providing guidance on decisions related to infrastructure asset investment and divestment;
- Providing guidance in the development of standard maintenance and rehabilitation policies;
- Providing a framework for lifecycle and cost / benefit analyses; and
- Promoting better integration of infrastructure decisions within larger strategic, community and land-use goals.

With the development of this Asset Management Plan, the City is well positioned to embark on the next phase of the Asset Management process. This is a key component in achieving the City's vision of St. Catharines being the most dynamic, innovative, sustainable, and livable city in North America.

Table of Contents

Figures

Tables

Abbreviations

The table below provides a summary of the abbreviations referenced in this document.

Acronym	Definition
AM	Asset Management
AMP	Asset Management Plan
AODA	Accessibility for Ontarians with Disabilities Act.
BCI	Bridge Condition Index
BSC	Budget Standing Committee
CAE	Chief Administrative Officer
City	Corporation of The City of St. Catharines (City of St. Catharines)
CLOS	Customer Levels of Service
ESL	Estimated Service Life
FCM	Federation of Canadian Municipalities
KPI	Key Performance Indicators
LCA	Lifecycle Activities
LOS	Levels of Service
MACP	Manhole Assessment Certification Program
OSIM	Ontario Structure Inspection Manual
PACP	Pipeline Assessment Certification Program
PQI	Pavement Quality Index
PRV	Pressure Reducing Valves
ROW	Right-of-Way
SME	Subject Matter Expert
TLOS	Technical Levels of Service
WSF	Wastewater Storage Facilities

Glossary of Terms

The table below provides a summary of the definitions referenced in this document. Terminology within this document has been developed to align with the ISO55000 series of standards where possible.

Term	Definition
Asset	Items, object or entity that has potential or actual value to an organization. These can be physical (tangible) or non-physical (intangible).
Asset Life	Period from asset creation to asset end-of-life.
Asset Management	Coordinated activity of an organization to realize value from assets.
Asset Portfolio	Assets that are within the scope of Asset Management.
Asset Type	Grouping of assets having common characteristics that distinguish those as a group or class.
Continual Improvement	Recurring activity to enhance performance.
Level of Service	Parameter or combination of parameters, which reflect social, political, environmental and economic outcomes that the organization delivers.
Lifecycle	Stages involved in the management of an asset.
Objective	Results to be achieved. These can be strategic, tactical or operational. Objectives can be related to different disciplines.
Organization	Person or group of people that has its own functions with responsibilities, authorities and relationships to achieve its objectives.
Organizational Objective	Overarching objective that sets the context and direction for an organization.
Policy	Intentions and direction of an organization as formally expressed by its top management.
Preventive Action	Action to eliminate the cause of a potential nonconformity or other undesirable potential situation.
Risk	Effect of uncertainty on objectives. An effect is a deviation from the expected positive and/or negative.
Stakeholder	Person or organization that can affect, be affected by, or perceive themselves to be affected by a decision or activity.

Executive Summary

The City of St. Catharines is responsible for delivering core services that support its community while enhancing the quality of life experienced by residents. These services include the distribution of drinking water for consumption; conveying wastewater to reduce the risk of health-related issues and environmental impacts; conveying stormwater runoff to mitigate flooding and erosion; and facilitating movement of people, goods, and services via transportation and structure networks.

The City's engagement in improving and enhancing Asset Management practices dates back over 30 years during which time core asset information has been recorded for internal practices such as tracking water mains breaks and pavement management. By 1999, efforts were underway towards formalizing the collection and retention of assets in a structured spatial repository. In 2007 core asset data was moved to an enterprise database, completing the transition to a standardized infrastructure inventory. The 2013 Corporate Asset Management Plan established an internal governance structure and started the process to incorporate Asset Management Planning into asset owning divisions. Furthermore, the City also undertook the development of a Strategic Plan to define the City's vision to ensure economic prosperity, social well-being, environmental stewardship, and a cultural renaissance for the community. The Strategic Plan and its vision serve as a baseline for defining the Asset Management roadmap. The 2019 Strategic Asset Management Policy further enhanced Asset Management practices to comply with the requirements of O.Reg.588/17.

The City's 2021 Asset Management Plan has been developed to enable the management of infrastructure assets in a way that supports the provision of services to the community. The Asset Management Plan is structured into core services as defined by the Ministry of Infrastructure (water, wastewater, stormwater, transportation, and structures) to provide consistency and ease of understanding for readers. It then concludes with the financial strategy and improvement plan recommendations. Each service included on this plan is subdivided into the following:

- State of Local Infrastructure
- Levels of Service
- Lifecycle Management Strategy
- Data Confidence

This planning document is a strategic guide to support continuous improvement of asset related activities and provide the following:

- Alignment with provincial regulatory landscape;

- Understanding of the current state of City infrastructure necessary to support the core services;
- Defining and measuring key performance indicators that support the provision of core services from a customer and technical perspective;
- Providing an integrated forecast for Asset Management Planning with financial budgeting; and
- Recommending data improvements for enhancement of future iterations of the plan.

Each of the services assessed are dependent on a wide variety of asset categories that have unique functions and components with an estimated value of $5 billion. **Table ES1** provides an overview of the replacement value of assets within each asset category.

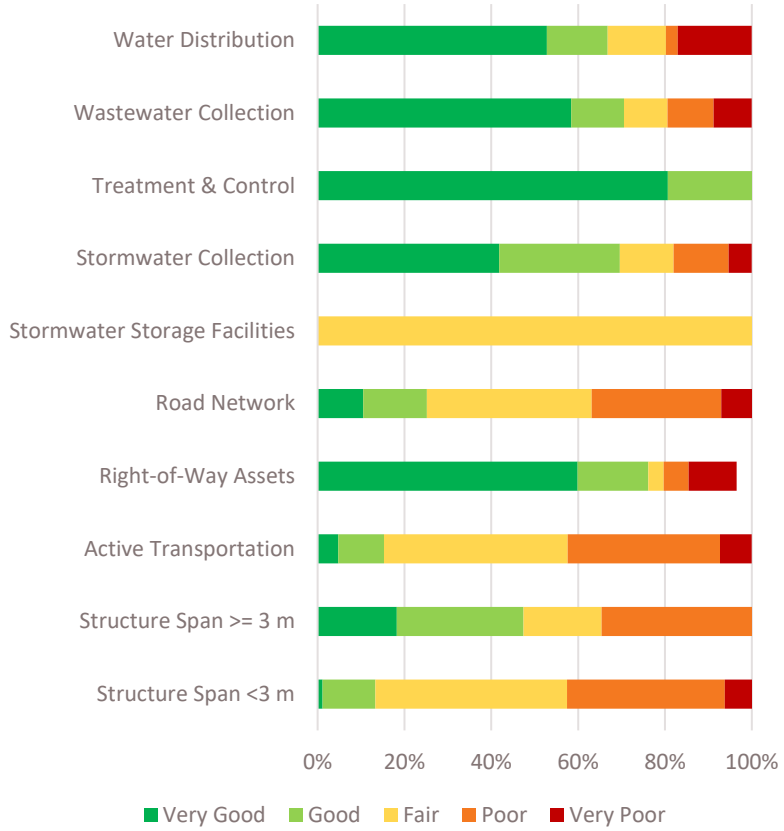
The condition distribution of service functions as a percentage of their replacement value is shown in **Figure ES1.** Overall, the services condition can be summarized as follows: Water, Wastewater, Stormwater and Structures are good and Transportation is fair. It must be highlighted that the Stormwater Discharge category have been excluded from the graph as their condition is unknown.

Table ES1. City's Infrastructure Valuation

Service	Service Function	Replacement Value (2021 Dollars)
Water	Water Distribution	$ 1,366,701,000
Wastewater	Wastewater Collection	$ 1,556,414,000
Stormwater	Stormwater Collection	$ 874,463,000
	Treatment & Control	$ 824,000
	Stormwater Discharge	Cost to be Determined
	Storage Facilities	$ 540,000
Transportation	Road Network	$ 974,445,000
	Right-of-way Assets	$ 45,358,000
	Active Transportation	$ 133,783,000
Structures	Bridges and Culverts with a Span equal or above 3 metres	$ 50,166,000
	Bridges and Culverts with a Span under 3 metres	$ 15, 764,000
	Total	**$ 5,018,458,000**

It must be highlighted that future iterations of this AMP will include non-core asset classes in the assessment.

Figure ES1. Condition Distribution by Category



Level of service metrics are key drivers for decision-making within the City and aim to document service outcomes from a customer perspective. As part of managing levels of service, the City has documented current and past performance for the indicators as well as metrics to be considered in the future once data becomes available for analysis. The defined frameworks for each core service are to be updated annually to reflect improvement on the City's indicators.

Asset lifecycle activities include the maintenance, rehabilitation, replacement, disposal, improvement, and expansion of assets. These activities have been prioritized based on risk and are funded through the operating and capital budgets at the City. **Figures ES2** and **ES3** provide a summary of the forecasted lifecycle investment requirements for the core services; these are based on current activities performed within anticipated budgets and available information. It is understood that as the City improves the AM practices, needs will be revised to match future activities.

There is an investment shortfall for tax-based expenditures of around $20.8M annually to maintain the current condition of the assets that support stormwater, transportation and structures. The City must either reduce service offerings to their residents or increase funding to be able to maintain services at the current level. The anticipated rate-based investments identified in the recent Water and Wastewater Financial Plan, which the City should continue to implement, are sufficient to maintain the current condition and forecast a slight improvement to service, however are still below the optimal renewals identified. To fully fund the tax and rate-based asset portfolios by 2046, an 8.09% and 0.34% compound annual increase would be required respectively. Note that this is in addition to general inflationary increases.

COVID-19 may impact both funding and levels of service which will need to be assessed in more detail. Longer term changes precipitated by COVID-19 that impact City assets will be reflected in updates to the AMP once these changes can be identified and measured.

Figure ES2. Forecasted Asset Portfolio for Tax Based Expenditures

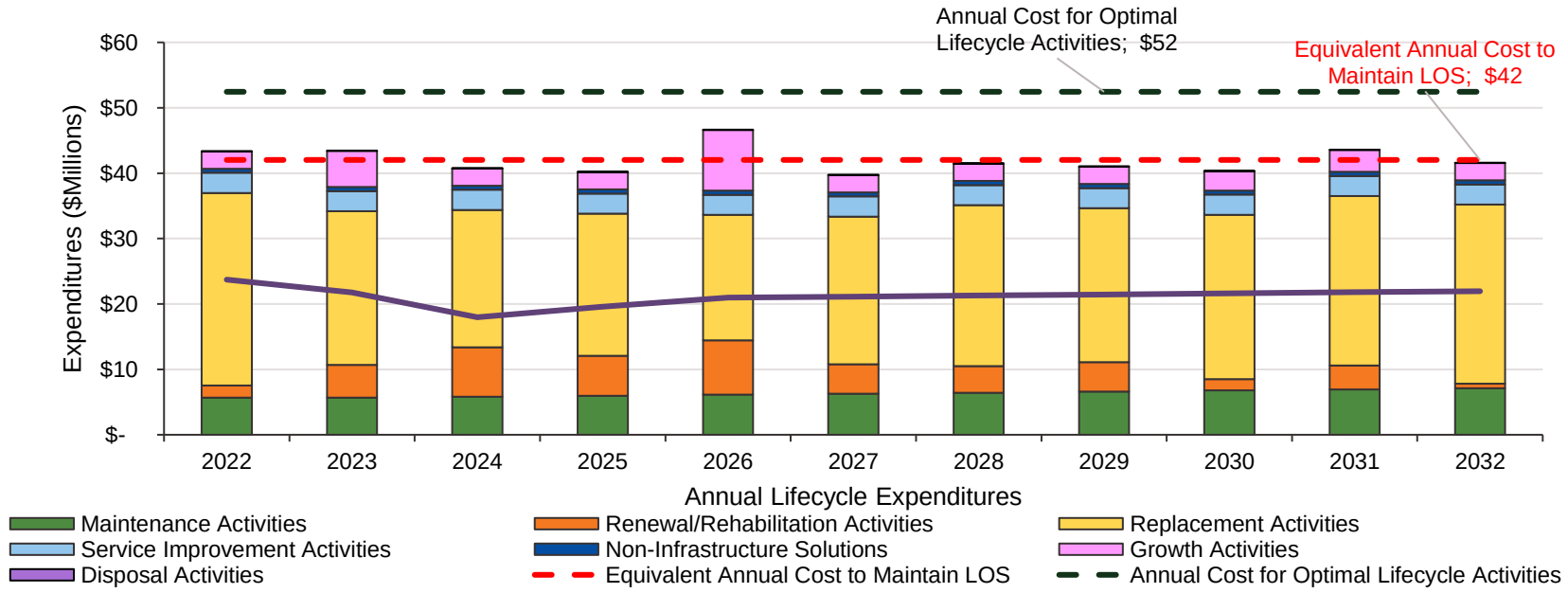
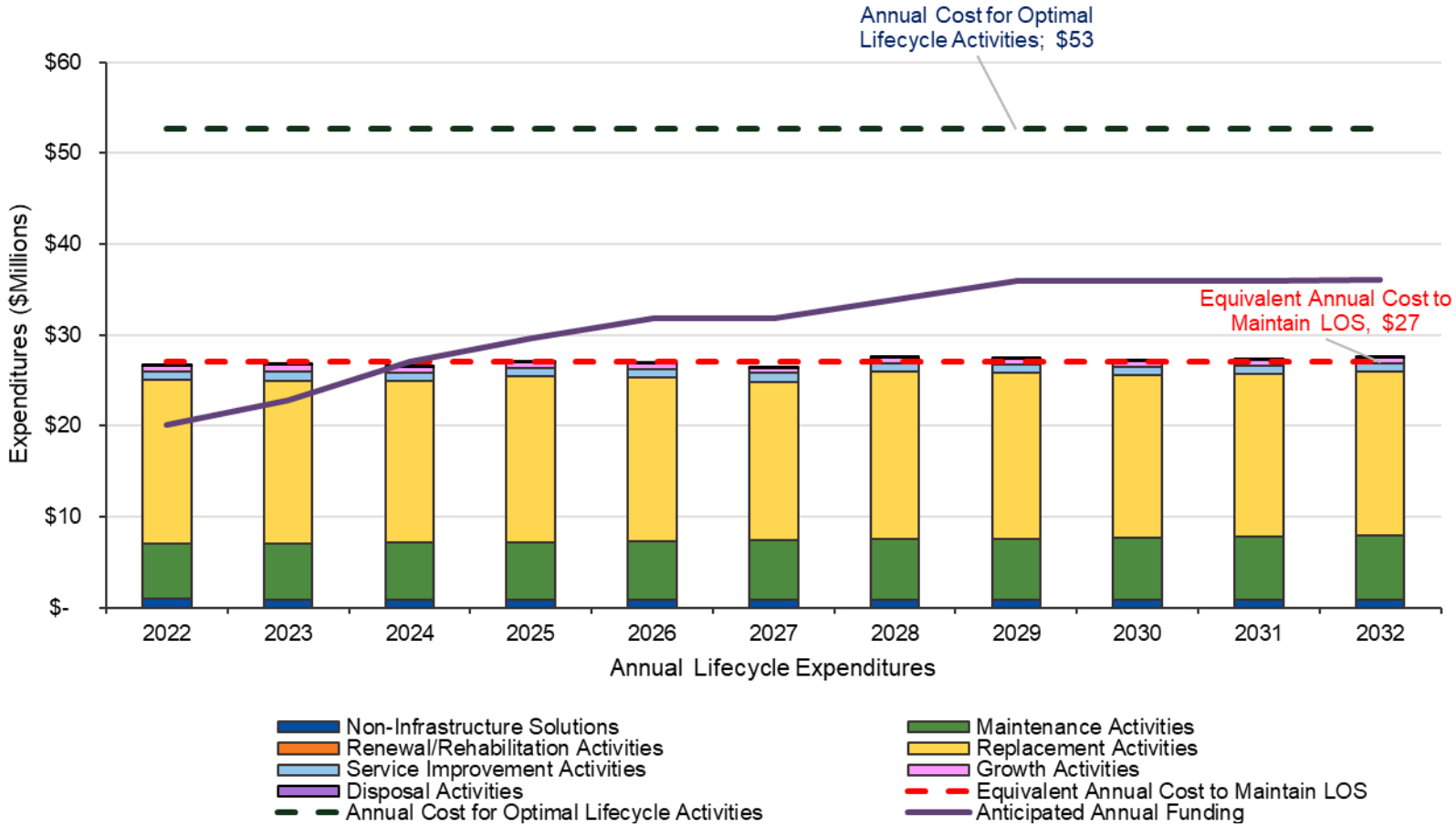


Figure ES3. Forecasted Asset Portfolio for Rate Based Expenditures



An overall data confidence assessment has been conducted as part of this plan. Recommendations for improvements include confirmation of asset inventories and condition, as well as validation of assumptions made throughout the development of the plan.

1.0 Introduction

The Corporation of the City of St. Catharines (City of St. Catharines or City), located within the Niagara Region, has a population of 133,113 as per the 2016 census within a geographic area of 96.1 square kilometres. This Asset Management Plan includes the City's Core Infrastructure with an estimated value of 5 billion distributed between the following core asset classes:

594 kilometres of Water Distribution System

563 kilometres of Sanitary Sewer Collection System

404 kilometres of Storm Sewer Collection System

573 kilometres of Road and 577 kilometres of Sidewalks and Pathways

117 Structures (Bridges & Culverts)

It must be highlighted that the Core Infrastructure has been defined by the Ontario Regulation 588/17– Asset Management Planning for Municipal Infrastructure, as will be further discussed in Section 1.4. Future iterations of this AMP will include non-core asset classes in the assessment.

1.1 City of St. Catharines' Asset Management Journey

The City recognized it needed to improve and enhance its Asset Management practices in 2011 when the *Sustainability Strategy* "*Tending the Garden City*" was developed with considerations on defining the infrastructure inventory and identifying operating and maintenance requirements. In 2013, the City developed its first Asset Management Plan (AMP), establishing an internal governance structure and starting the process to incorporate Asset Management Planning into all asset owning divisions.

The 2013 AMP identified the following goals:

- Ensure all City-owned infrastructure assets are sustainable into the future;
- Provide guidance in the development of standard maintenance and rehabilitation policies;
- Guide decisions related to infrastructure asset investment and divestment;

- Provide a framework for lifecycle and cost/benefit analyses; and
- Promote better integration of infrastructure decisions within larger strategic, community, and land-use goals.

The City of St. Catharines Strategic Plan (2019 – 2028) sets out the City's vision to ensure economic prosperity, social well-being, environmental stewardship, and a cultural renaissance for the community. To achieve the economic prosperity objective, the City has committed to develop a 10-year capital infrastructure plan that includes all major investments to address City needs, priorities, and growth.

The City approved a Strategic Asset Management Policy in 2019 to further enhance the Asset Management practices and comply with the requirements of O.Reg.588/17. The policy applies to all operational areas and defines principles and objectives that will define the City's practices, as well as the roles and responsibilities of staff required to successfully implement Asset Management.

Like many other municipalities in the area, the City is developing long-term forecasts and implementing the necessary tools to support decision making regarding building, operating, maintaining, renewing, replacing, and disposing of infrastructure assets. A significant component of the plan is a long-term financial projection to aid with complex decision-making associated with these activities.

This document updates and replaces the 2013 AMP and aligns the City's Asset Management practices with the requirements of O.Reg.588/17 for core assets. This will enable the City to manage its assets and connect day-to-day infrastructure investment decisions with the services provided to residents.

1.2 The City's Guiding Principles for Asset Management

The City's 2019 Strategic Asset Management Policy (the Policy) applies to all operational areas under the direct authority of St. Catharines City Council which contribute to service delivery using City owned infrastructure or assets that require deliberate management. The Policy highlights the strategic alignment of Asset Management practices with the City's Corporate Strategic Plan.

The following guiding principles from the City's Asset Management Policy were adopted as fundamental for the management of the City's assets:

- **Customer focused**: The City will apply Corporate Asset Management practices including defined levels of service to promote confidence of customers in how the City assets are managed, core services are provided, and community wellbeing is fostered for all.
- **Forward looking**: The City will consider current and long-term needs when making decisions and plans to better enable its assets to meet future demands, including changing demographics and populations, customer expectations, legislative requirements, technology, and environmental factors (climate change).
- **Service based**: The City will take a holistic approach to Corporate Asset Management practices both in assessing levels of service, prioritizing capital spending, and maintaining assets. When assessing levels of service provided by its assets, the City will consider all related assets rather than each asset in isolation.
- **Evidence based**: The City's Corporate Asset Management practices will be based on relevant and reliable information that will form the basis of transparent decision making aimed at reducing asset life cycle costs.
- **Risk based**: The City will take a risk-based approach to prioritizing projects for the acquisition and renewal of assets. Risk will be considered in relation to the likelihood of the asset failing and the impact of asset failure. Asset failures that may impact health and safety shall be ranked as the highest priority for investment.
- **Value based and affordable**: The City will deliver the greatest value from its investment in assets respecting available funding and its customers' ability to pay.
- **Continually evolving**: Corporate Asset Management practices and Asset Management systems will continue to evolve and improve through ongoing evaluation of best practices, innovation, and consideration of future directions, regulations, and requirements.

- **Cooperation and coordination with other governmental plans and strategies**: The City will consider strategies, policies, and plans of other governmental entities established under an act or otherwise to promote integration while providing efficient and effective service delivery for all of our customers and stakeholders.

1.3 City's Mission, Vision and Strategic Goals

To make a positive impact and drive change, in 2015 Council approved the following City mission and vision statements:

Figure 1. City Vision and Mission Statement

A key component of achieving the City's mission, vision and strategic goals is to ensure that the best possible decisions are made regarding the City's infrastructure assets. The following identifies how they are supported by the Asset Management Plan. The Asset Management Plan:

- Provides the necessary data to implement long-term financial plans to manage the City's infrastructure by tracking accountability through performance indicators;
- Improves transparency of the decisions related to services delivered and all the associated risks and costs;
- Allows the City to benchmark practices to identify areas for improvement; and
- Provides business continuity by documenting the management practices applied to the City's infrastructure.

Furthermore, the City's 2019 – 2028 Strategic Plan has set out a clear path to embracing its mission and vision by defining the following strategic goals:

Figure 2. City of St. Catharines Strategic Goals

Economic Prosperity

Support the City's commitment to building and growing a diverse and resilient economy through fiscal responsibility, urban regeneration and collaborative partnerships.

Social Well-Being

Build and support strong, inclusive neighborhoods that provide high quality of life for residents of all ages.

Environmental Stewardship

Adopt innovative approaches and continue responsible community planning and decision-making that balances growth, enhances quality of life, manages emergencies and minimizes the environmental impacts of climate change.

Cultural Renaissance

Celebrate the City's rich history, diversity, arts and cultural assets through leadership, promotion and investments that support measurable, sustainable creative growth.

1.4 Provincial Asset Management Planning Requirements

In 2012, the Province published 'Building Together: Guide for Municipal Asset Management Plans' (Building Together) to encourage and support municipalities in Ontario to develop Asset Management Plans (AMPs) in a consistent manner. The guide describes a general approach to structuring AMPs and provides insight into the content that should be included in sections related to the State of Local Infrastructure, Levels of Service, Asset Lifecycle Management Strategies, and Financing Strategies.

Building Together outlines the information and analysis that municipal Asset Management Plans are to include and was designed to provide consistency across the

province for Asset Management. To encourage the development of AMPs, the Provincial and Federal governments also made an AMP a prerequisite to accessing capital funding grants.

In 2015, Ontario passed the Infrastructure for Jobs and Prosperity Act which affirmed the role that municipal infrastructure systems play in supporting the vitality of local economies. After a year-long industry review process, the Province created Ontario Regulation 588/17– Asset Management Planning for Municipal Infrastructure as the first regulation made under the Infrastructure for Jobs and Prosperity Act. O.Reg. 588/17 further expands on the Building Together guide, mandating specific requirements for municipal Asset Management Policies and Asset Management Plans, phased in over a five-year period. **Table 1** summarizes the general requirements and timelines of O.Reg. 588/17, as well as the status of these requirements for the City of St. Catharines.

Table 1. Regulatory Requirements and Timeline for Asset Management Planning based on O.Reg. 588/17

STRATEGIC ASSET MANAGEMENT POLICY **Timeline:** By January 1, 2019
Update: Every 5 years

A Strategic Asset Management Policy must be developed to articulate specific principles and commitments that will guide decisions around when, why and how money is spent on infrastructure systems.

City Status: Policy FMS-001-2019 was issued April 10, 2019.

MUNICIPAL ASSET MANAGEMENT PLAN – CORE ASSETS **Revised timeline:** By July 1, 2022**, Previously:** July 1, 2021
(PHASE 1)

An Asset Management Plan that documents the current levels of service being provided and the costs to sustain them for the core assets which are defined as: water, wastewater, stormwater, roads and bridges infrastructure systems (i.e., 'core' assets per O.Reg. 588/17).

City Status: This AMP is intended to align with the requirements of the legislation.

MUNICIPAL ASSET MANAGEMENT PLAN – NON-CORE ASSETS **Revised Timeline:** By July 1, 2024**, Previously** July 1, 2023
(PHASE 2)

An Asset Management Plan that documents the current levels of service being provided and the costs to sustain them for the remaining assets (i.e., 'non-core' assets per O.Reg. 588/17).

City Status: GM BluePlan has been retained by the City to assist in developing sections of the AMP to include assets associated with buildings and facilities, corporate infrastructure (including IT), fleet, improved lands (parks, playgrounds and sporting fields), shoreline protection, and watercourses.

MUNICIPAL ASSET MANAGEMENT PLAN **Revised Timeline:** By July 1, 2025**, Previously** July 1, 2024
(PHASE 3) **Update:** Every 5 years

An Asset Management Plan that outlines the desired levels of service, the costs to achieve the desired levels of service, and the financial strategy to fund the expenditures necessary to achieve the desired levels of service for all infrastructure systems in the City.

City Status: Some components such as the performance forecasts are to be addressed during the development of Phase 1 and 2.

1.5 Asset Management Plan: Definition and Purpose

The Federation of Canadian Municipalities (FCM) has defined an Asset Management Plan as, “a plan for the management of one or more infrastructure assets 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 specified level of service.”

The goals of the City of St. Catharines Asset Management Plan are to:

- Develop asset inventory documentation, with any identified gaps filled based on a strategy based on best practices and in consultation with City stakeholders.
- Define current levels of service, targets and key performance indicators (KPIs) that enable the City to quantify and measure efficiency and effectiveness in support of service-centric decision making, as well as communicate the services provided to its residents.
- Provide asset lifecycle strategies to enable the prediction of asset interventions based on condition and strategic business factors such as costs, levels of service, and risks.
- Provide a framework for funding requirements to support levels of service and the lifecycle management strategy.
- Develop a risk management strategy to enable the prioritization of capital investments that will provide the City with a standardized definition of asset criticality and will particularly consider risks related to climate change.
- Recommend improvement actions for data management, resources, and technology.

Part of the complexity with Asset Management is that it is not about doing one thing – it is about building a robust understanding of asset needs and implementing good practices to manage community infrastructure assets. For these reasons, this plan will help support the City’s development of skills and practices in the following competency areas:

- Policy and governance to lead organizational alignment and commitment.
- People and leadership to create and sustain connections across teams.
- Data and information about assets when needed.
- Planning and decision making to ensure policies, objectives, and information consistently guide the organization.

- Contributions to Asset Management practices to support continuous improvement and ensure internal stakeholders are well-informed, especially when communicating and participating in external knowledge sharing.

1.6 City's Asset Management Governance

The City's Asset Management practices are mandated by the Asset Management Plan and directed by the City's Asset Management Policy.

Furthermore, the City's Asset Management practices are intended to support the City's mission and vision statements. This is achieved through ongoing and continuous improvement of the Asset Management Plan. These relationships are illustrated below in **Figure 3**.

Figure 3. City of St. Catharines Governance Framework for the 2021 AMP

1.7 Asset Classes Included in the scope of this Asset Management Plan

This Asset Management Plan includes the City's core assets illustrated below in a parent-child relationship called the asset hierarchy. Using an asset hierarchy provides the City with the ability to organize and manage its asset information and support decision making. The subsequent chapters in this plan will provide information with the same structure that is detailed below.

Table 2. Hierarchy of Assets Included in the City's 2021 Asset Management Plan

City Service	Service Function	Assets and Components Included
Water	Water Distribution	Water mains (including corresponding service connections), in-line valves, pressure reducing valves, hydrants, curb stops and booster pumping station, bulk water station
Wastewater	Wastewater Collection	Sanitary sewer mains (combined or separated), force mains, maintenance holes, service connections, sewage pump station, wastewater storage facilities
Stormwater	Stormwater Collection	Storm sewer mains, maintenance holes, catch basins, service connections, grates, outfalls
	Treatment & Control	Oil grit separators
	Stormwater Discharge	Open channels
	Storage Facilities	Ponds and constructed wetlands
Transportation	Road Network	Roads (including curbs and on-road bike lanes)
	Right-of-way Assets	Streetlights, signalized intersections, guide rails and signs
	Active Transportation	Sidewalks, pathways and multi-use trails
Structures	Bridges and Culverts with a Span equal or above 3 metres	Bridges and culverts that require regulatory inspections every 2 year or provide crossings of natural water courses.
	Bridges and Culverts with a Span under 3 metres	

1.8 Asset Management Plan Stakeholders

The development of this AMP was led by the Engineering, Facilities and Environmental Services and Financial Management Services departments with the support of the City's Asset Management Working Group. Key representatives from all departments were consulted through different stages via workshops and contributed to the development of the data necessary to support this Plan. **Table 3** identifies the roles and responsibilities of the corporate stakeholders for developing, implementing, and approving the City's Corporate Asset Management Plan.

Table 3. City's Asset Management Stakeholders, Roles and Responsibilities

Key Stakeholder	Roles and Responsibilities
Council	• Final Decision maker of all Asset Management decisions including approval of the Asset Management Policy and Corporate Asset Management Plan • Serve as representatives of citizens to set the level of services delivered, considered in conjunction with the cost-of-service provision and associated risks • Approve funding levels for both capital and operating budgets associated with Asset Management through the annual budget
Chief Administrative Officer (CAO)	• Maintains compliance with related Asset Management policy, regulations. • Provides direction that demonstrates commitment to the success of the continued improvement of Asset Management practices and documentation
Asset Management Working Group	• Support the CAO in fulfilling their role • Provide corporate collaboration to guide Asset Management Systems • Champion continuous improvement within their respective service areas and the City
Corporate Asset Manager and Engineering Asset Manager	• Support Asset Management Working Group in their roles and responsibilities • Support development of City Asset Management System • Coordinate with departments to establish corporate work plans and priorities to meet legislated requirements

Key Stakeholder	Roles and Responsibilities
Departmental Directors	• Oversee Asset Management activities that fall within their service area • Contribute in a manner that supports a multi-disciplinary approach to Corporate Asset Management and promotes its ongoing success • Liaise with members of the Asset Management Working Group to ensure they are supporting CAM and that departmental planning is aligned to AMPs
Service Delivery Areas or Asset Operators	• Team of staff who engage with internal and external stakeholders daily to deliver services • Oversee Asset Management Planning activities within their respective area • Help set service objectives and monitoring progress • Offer expertise in the development of city plans, strategies, assessments, and workflows • Collect and track asset information and other data related to assets within their functional area • Apply operation, maintenance, rehabilitation, replacement, and disposal practices to achieve levels of service, mitigate risk, and comply with regulatory requirements
Other City Staff	• Support the development, implementation, and improvement of the Asset Management system in their daily roles and responsibilities • Capture quality data as part of the daily operations

1.9 Developing the Corporate Asset Management Plan

The Asset Management Plan's initial steps of development included data collection, compiling data, developing an analysis tool, and meeting with various asset system working groups to discuss, review and provide feedback on each component of the Plan. The AMP was developed for the core service groups, which are presented as main sections in this report as follows:

- Water
- Wastewater
- Stormwater
- Transportation
- Structures

In addition to the sections on each asset group, the final section of the AMP is a financial strategy. This is one of the Plan's key components, as it puts the document into action. The financial plan provides a way for municipalities to integrate Asset Management Planning with financial forecasting.

As suggested by Building Together – Guide for Municipal Asset Management Plans (Ministry of Infrastructure, 2012), the financial management strategy outlines annual expenditure projections in alignment with the long-term investment forecast developed for the lifecycle activities.

The City acknowledges that COVID-19 may impact both funding and levels of service which will need to be assessed in more detail. Longer term changes precipitated by COVID-19 that impact City assets will be reflected in updates to the AMP once these changes can be identified and measured.

The following provides more details on the key sub-sections that were covered as part of the plan tasks and will be presented for each of the core groups.

1.9.1 State of Local Infrastructure

The State of Local Infrastructure section provides a quantitative assessment of the infrastructure owned by the City. The primary objective is to provide a high-level inventory and insights on the overall age, condition, replacement costs, and key metrics of the assets owned by the City based on provided datasets and documents that were assessed for data maturity (completeness) and confidence (accuracy) and discussed with Subject Matter Experts (SMEs). This section provides the City with:

- A repeatable and consistent methodology to track and report comparative analysis of asset data;
- Transparency in terms of the confidence of the asset data available;
- A consolidated overview of inventory, condition, cost, and performance indicators for each asset class; and
- The ability to track improvements to the background data over time.

The 2013 AMP provided details for bridges, structures, roadways, water mains and service connections, sanitary mainlines, service connections, and maintenance holes. This AMP provides a more detailed discretization of the assets for all core asset groups.

This chapter of the AMP summarizes the inventory of assets and their replacement values and provides the age and condition profiles for each asset category in the City's portfolio. Condition ratings were assigned to all assets across each service area using the condition rating scale shown on **Table 4**. The rating scale is consistent with the Canadian Infrastructure Report Card (2016) to facilitate benchmarking between other Canadian municipalities.

Table 4. Condition Rating Scales Descriptions and Estimated Service Life (ESL) Distribution

Value	Category	Estimated Service Life (Percentage)	Description
0	Unknown	N/A	Not enough data exists to respond.
1	Very Good	80% - 100%	Well maintained, in good condition, new or recently rehabilitated.
2	Good	60% - 79%	Acceptable and generally within the mid-stage of its expected service life.
3	Fair	40% - 59%	Requires attention, it shows signs of deterioration and some elements exhibit deficiencies.
4	Poor	20% - 39%	There is an increasing potential for its condition to affect the service it is intended to provide. It is approaching the end of its service life; the condition is below the standard and a large portion of the system exhibits significant deterioration.
5	Very Poor	0% - 20%	Unfit for sustained service. It is near or beyond its expected service life and shows widespread signs of advanced deterioration. Some assets may be unusable.

1.9.2 Levels of Service

The Levels of Service (LOS) section provides key performance indicators that support the provision of the respective service for each City asset group. Some LOS include mandatory metrics prescribed as part of O.Reg. 588/17. In general, LOS were documented as tables that provided the following information:

- Level of Service Statement: A brief description presented in plain language for public understanding of the service provided to residents based upon the City's core values and mission.
- Key Service Attribute: Provides customer values categorized in terms of safety, reliability, quality, cost efficiency, and environmental stewardship.

- Customer Levels of Service (CLOS): A statement that describes quantifiable metrics of the service delivery outcomes from the perspective of the customer, expressed in non-technical terms that can be easily understood by customer.
- Technical Levels of Service (TLOS): Quantifiable metrics applied against assets that are subject-matter specific inputs or outputs supported by day-to-day activities of the City staff.

Both CLOS and TLOS were defined as current or future metrics based on the City's existing available data. Furthermore, current and target performance were identified and established by City staff. Each Performance Measure should be defined using the SMART acronym (specific, measurable, achievable, relevant, and time-bound).

1.9.3 Lifecycle Management Strategy

The Lifecycle Management Strategy defines the set of planned actions that will enable the assets to provide their desired level of service in a sustainable way while mitigating risks and reducing costs. The goal of this assessment is to capture the deterioration model for each asset category.

Understanding the optimal budget at which lifecycle activities (LCA) sustain the desired LOS at the lowest lifecycle cost is the main objective of this section.

The actions are usually grouped as rehabilitation or replacements and these are supported by the City's operating and capital budgets. Further to the usual maintenance and operations activities, the LCA section is also intended to capture non-infrastructure solutions that extend the asset life (such as policies and procedures) as well as activities that extend beyond the day-to-day operation of the assets such as expansion planning and disposal once end of life is reached. **Table 5** provides a summary of the lifecycle activity types that will be considered for all assets within scope, as defined by the Building Together Guide for Municipal Asset Management Plans.

An Optimal Lifecycle Activities scenario was analyzed for each of the core services. This scenario focused on the cost to achieve optimal renewal. Historic values were used to estimate the maintenance, non–infrastructure solution and expansion and thus may not be optimal. The City can explore those optimal needs and include in this analysis.

Table 5. Lifecyle Activity Type Summary

Lifecycle Activity	Definition
Non-Infrastructure Solutions	Actions or policies that can lower costs or extend useful lives.
Maintenance Activities	Including regularly scheduled inspection and maintenance or

Lifecycle Activity	Definition
	more significant repair and activities associated with unexpected events.
Renewal / Rehab Activities	Significant repairs designated to extend the life of the asset.
Replacement / Construction Activities	Activities that are expected to occur once an asset has reached the end of its useful life and renewal/rehab is no longer an option.
Disposal Activities	Activities associated with disposing of an asset once it has reached the end of its useful life or is otherwise no longer needed by the City.
Service Improvement Activities	Planned activities to improve the asset's capacity, quality, and system reliability.
Growth Activities	Planned activities required to extend services to previously unserved areas or expand services to meet growth demands.

A risk management framework was developed for each of the asset categories in the portfolio to assist with prioritization of investments within the forecasts. Where possible, geospatial scripts were used to establish a consequence of failure score using a triple bottom line analysis approach to evaluate:

- Social impacts of asset failure, including impacts to customers, businesses, and the City's reputation;
- Environmental impacts of asset failure; and
- Economic impacts of failure including the cost to remediate the situation.

In the context of Asset Management, risk is the multiple of the consequence of an asset failing and the likelihood that the event will occur. The risk framework was developed in collaboration with the City's subject matter experts and based on best-in-class practices for risk assessment. The likelihood of failure is expressed as a percentage and calculated for each asset based on available condition data and deterioration modelling. As previously mentioned, the consequence of failure framework is based on the parameters specific to each asset category based on their financial, social, and environmental impact. **Table 6** provides an overview of the criteria used for the risk analysis and the asset classes within which each criterion was included. The final risk score for each asset has been calculated by multiplying the consequence of failure score by the likelihood of failure score.

Table 6. Risk Framework Categories

Criteria	Definition	Water	Wastewater	Stormwater	Transportation	Structures
Financial						
Replacement Cost	The financial expenditure required for the replacement of the asset or remediation of the asset failure.	✓	✓	✓	✓	✓
Social						
Annual Average Daily Traffic	The volume of road users that would be likely to be impacted if the asset fails.	✓	✓	✓	✓	✓
Pipe Diameter	The larger the pipe diameter, the larger the potential discharge or disruption to service.	✓	✓	✓		
Critical Water Users	The number of critical customers that would be impacted if the asset fails.	✓				
Access to critical customer/facilities like hospitals, schools, and long-term care facilities	The number of critical customers that would be impacted if the asset fails.	✓	✓	✓	✓	
Land Use	A representation of the number and type of affected customers, which would be proportional to service disruption. These represent impact to water quality, businesses, potential for flooding.	✓	✓	✓	✓	✓
Redundancy	The ability to maintain supply if there is an asset failure.	✓				

Criteria	Definition	Water	Wastewater	Stormwater	Transportation	Structures
Sewer Type (combined or separated)	The separation of sewer mains provides the system resiliency against climate events.		✓			
Road sharing	Impacts to transit users and cyclists in the event of asset failure.				✓	✓
Escarpment Crossing	If there is a closure of the segment, there would likely be significant detours at escarpment crossings.				✓	
Functional Class	Number of users that would be impacted as well as the speed limits on the road.				✓	
Structure span	Structures with span greater than 3 metres have more significant impacts upon failure or closure.					✓
Structure impact on adjacent infrastructure	Structure failures adjacent to critical infrastructure (such as highways and railways) have significant impacts					✓
Environmental						
Distance to watercourses, environmentally sensitive areas, or habitat.	Environmental impacts as a result of failure including remediation and potential charges.	✓	✓	✓	✓	✓

The cost associated with each lifecycle activity is also considered as part of the strategy. A long-term investment forecast has been developed for each asset in scope to illustrate the capital and operational needs to support current levels of service. **Table 7** provides a summary of the assumptions made to model the costs associated with each lifecycle activity type for all core services.

These are based on current activities performed within historical budgets and available information. It is understood that as the City improves the AM practices, needs will be revised to match future activities.

Table 7. Lifecyle Activities Cost Assumptions

Lifecycle Activity	Model Assumptions
Non-Infrastructure Solutions	Developed based on a review of the historical annual budget and using an average of the 2017-2021 budgets (both operating and capital).
Maintenance Activities	Developed based on a review of the 2021 and historical budget.
Renewal / Rehab Activities	Forecasted based on a lifecycle model applied to each asset in the asset register. This is based on the activities that the City has determined that should be completed.
Replacement / Construction Activities	
Disposal Activities	Generally, disposal activities have been incorporated within the replacement and renewal costs for most assets.
Service Improvement Activities	Developed based on the 2017 to 2021 annual expansion costs as a percentage of the 2021 asset portfolio replacement value.
Growth Activities	

1.9.4 Data Confidence

A summary of the data sources used in the analyses of this AMP are included for reference under each asset category section. For the development of this AMP, the available data was assessed for each asset category and a data quality rating was assigned based on availability and quality of relevant data.

Table 8. Data Quality Rating Scale for all Assets Within Scope

Value	Category	Definition
A	**Very Good**	No assumptions, with available condition data from a reliable data source, and age and value are known.
B	**Good**	Minor assumptions are made for condition, age, or replacement values (e.g., most of condition, age, and replacement values are known).
C	**Fair**	Minor assumptions are made for condition, age, or replacement values from moderately reliable sources.
D	**Poor**	Data comes from significantly out of date documents or two of condition, age, or replacement values come from a moderately reliable source and the third item is unknown or unreliable.

1.10 Integrating Climate Change into Asset Management

Climate change is one of the most complex challenges facing municipalities today. In recent years, Southern Ontario has experienced a significant number of extreme weather events and its adverse impacts such as flooding, ice storms, power outages, and infrastructure damage. Rising average temperatures, shifting historical precipitation patterns with increased intensity, duration and frequency of storm events and periods of drought, increasing windstorms, and fluctuations in lake levels are anticipated to continue into the future and Asset Management Plans must reflect this reality.

The City's Climate Adaptation Plan (2021) evaluated climate impacts, risks, and vulnerabilities the municipal government currently faces, or is expected to experience in the future, due to climate change. Understanding climate related risks and vulnerabilities that impact the City allows municipal operations, policies, and procedures to best align with the future climate. Positioning adaptation planning throughout the municipal government will provide proactive decision-making, climate orientated action and implementation focused on creating a climate responsible and resilient community.

The City has partnered with local experts in climate change and Asset Management to ensure that the City's policies and practices adapt to reduce both immediate and long-term impacts on municipal infrastructure. By assessing the probability and risk associated with various climate factors, various design and operation practices can be altered to proactively build resilience into the systems to help mitigate extreme weather. This strategy will ensure that all asset life is maintained most efficiently.

1.11 Continuous Improvement of the City's Asset Management Program

The City's Asset Management Program is founded on the principles of continuous improvement, transparency, and accountability. Moving forward, the AMP is intended to be a living document that reflects and supports implementation of the Asset Management Policy and Strategic Plan. As a living document, continuous improvement will be driven by:

- Implementing, revising, refining, and reporting Asset Management based on the City's strategic priorities.
- Continual cross-functional collaboration towards identifying AM improvements in processes, systems, data, AMPs, and AMP implementation strategies.
- Monitoring progress on the AMP implementation while quantifying and reporting benefits from AM Program activities.

- Improve with ongoing evaluation of best practices, innovations, and regulatory requirements.

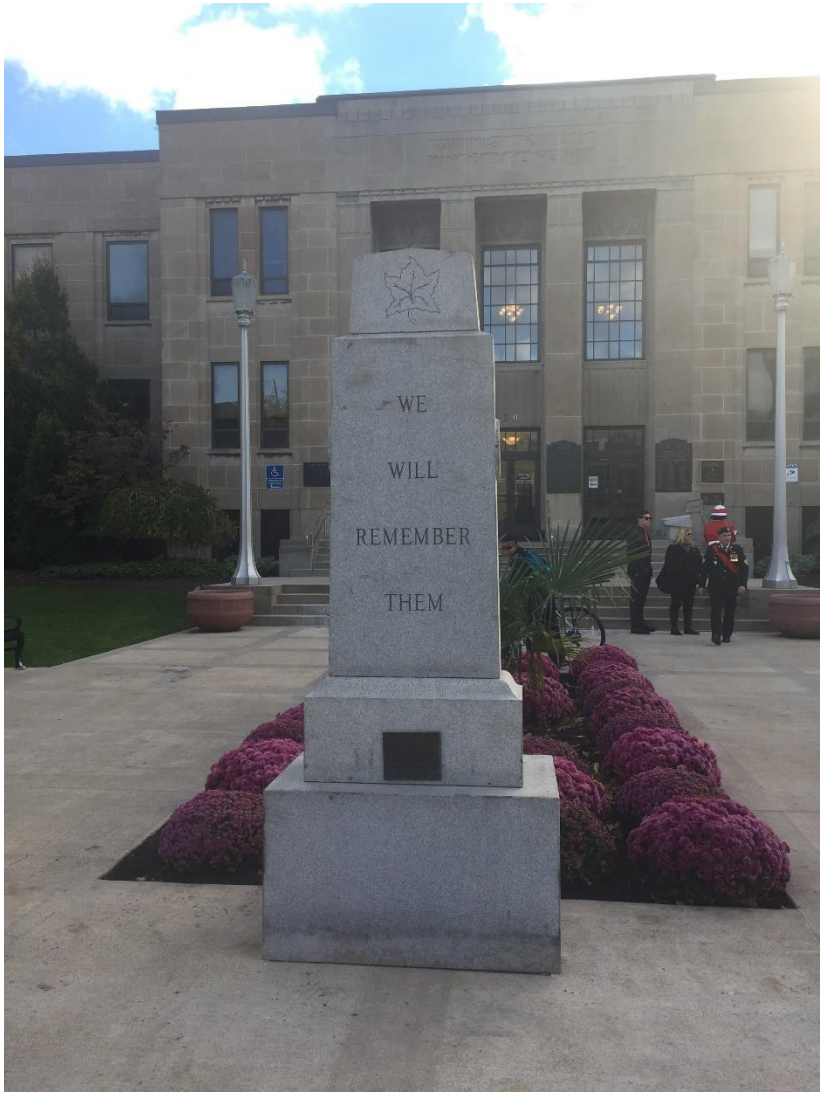
Best practices to achieve continuous improvement include the development of an improvement plan and delivering the improvement plan with defined annual targets, appropriate benchmarks, and responsibilities for internal resources with their associated funding levels, as approved by the City's annual budgeting process. The continuous improvement of the City's AMP is supported by a broader Asset Management strategy that is developed in various forms for guiding the management of the assets to provide governance to City practices.

1.12 Asset Management Plan Assumptions and Limitations

This Asset Management Plan was developed based on the best available information and by employing professional judgement and assumptions to address gaps where necessary. Asset specific assumptions are recorded in the following sections.

Where gaps or opportunities were identified, they have been included in the improvement plan.

Background information and reports related to this AMP are available to the public upon request through the City of St. Catharines.



Water

The City of St. Catharines provides safe drinking water to its residents, businesses, and other consumers. The City owns and operates a Class II residential water distribution system. Drinking water is supplied by the Region of Niagara's Decew Water Treatment Plant which draws water from Lake Erie. As a lower-tier municipality, the City is responsible for the local water distribution system which includes the following assets:

- 594 kilometres of Water Mains
- 3,559 Hydrants
- 5,706 Valves
- 41,816 Water Metres
- 1 Booster Pumping Station
- 1 Bulk Water Station

Estimated Replacement Value

The City's water distribution system is valued at approximately **$1.4 billion.**

Condition Rating

The overall average condition of the assets for the water distribution system is **Good.**

2.0 Water

Water is essential to life. It is a service that supports many uses including consumption as drinking water, service for households and commercial uses, fire protection, other municipal services, and even recreational activities such as pools.

The following section summarizes the asset portfolio associated with the City Water Service.

2.1 State of Local Infrastructure

2.1.1 System Valuation

The City's water distribution system obtains potable water from the Region of Niagara and supplies it to consumers including residents, institutions and businesses; as well as uses it for fire protection and to support City services. The City's water system is distributed into three pressure zones within the urban boundary, which historically has provided consistent service to its users. The water distribution system is divided into linear and vertical asset types.

- **Water Linear Assets** represent the majority of the distribution portfolio as they include mains and appurtenances, as well as hydrants, metres, and service connections.
- **Water Vertical Assets** include the facilities required to pump or distribute water in the system.

For the valuation of the water distribution system, the replacement values considered are intended for the replacement of a similar asset (like-for-like) on a complete and standalone basis. These were calculated based on historical values that the City has incurred as part of previous replacements of similar assets. For certain materials (e.g., Ductile Iron), the replacement values that were applied assumed a more modern material (PVC) would be used in the event of a replacement and thus do not align with the "like-for-like" scenario described above. Furthermore, the estimated value for water facilities was calculated from a bottom-up approach based on the assets located within each facility and industry standard costing for these assets.

Based on the approach taken to calculate the replacement values for each asset category, the data confidence grade for this service is as follows:

- **C** for water mains;
- **B** for the remaining linear assets; and
- **D** for vertical assets.

Table 9. Water System Inventory Valuation

Service Function	Asset Category	Count	Unit	Replacement Value (2021 Dollars)
Water Distribution	Water Mains[a]	594,422	Metres	$ 1,301,682,000
	Hydrants[b]	3,559	Each	$ 33,889,000
	Valves[c]	5,706	Each	$ 13,683,000
	Water Metres	41,816	Each	$ 17,164,000
	Bulk Water Station[d]	1	Each	$ 140,000
	Water Booster Station[e]	1	Each	$ 143,000
Overall Water System Replacement Value				**$ 1,366,701,000**

Notes:

(a) Water mains asset category includes the water service connections associated with these.

(b) Hydrants asset category also includes their associated secondary valve.

(c) The Valves asset category includes only in-line valves, pressure reducing valves, air release valves, and blow-off valves. All other valve types have been recorded under the water main.

(d) Bulk water station replacement cost was based on historical documentation on the replacement cost for the facility.

(e) Replacement values for water booster station show the sum of all process and structural assets within the facilities

The overall distribution of replacement values by asset type for the entire water distribution system is shown in **Table 9**. The water mains have the highest replacement value in the portfolio, totaling 95.24% of the entire system, as shown in **Figure 4**. The remaining assets correspond to 4.76% of the value associated with the water distribution system.

Figure 5 provides a summary of the distribution of replacement values on the water mains based on materials.

Figure 4. Asset Replacement Value for All Water Assets

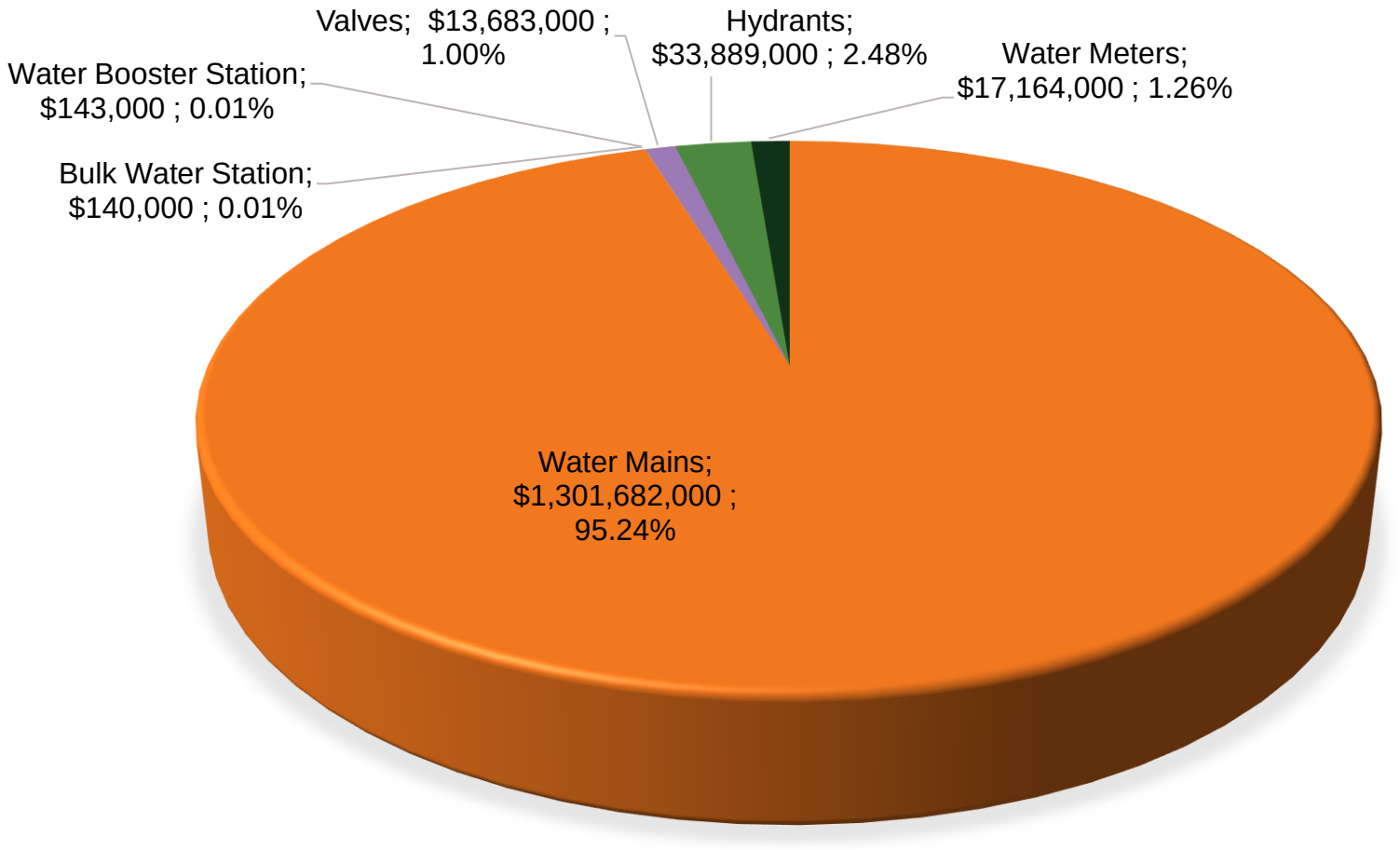
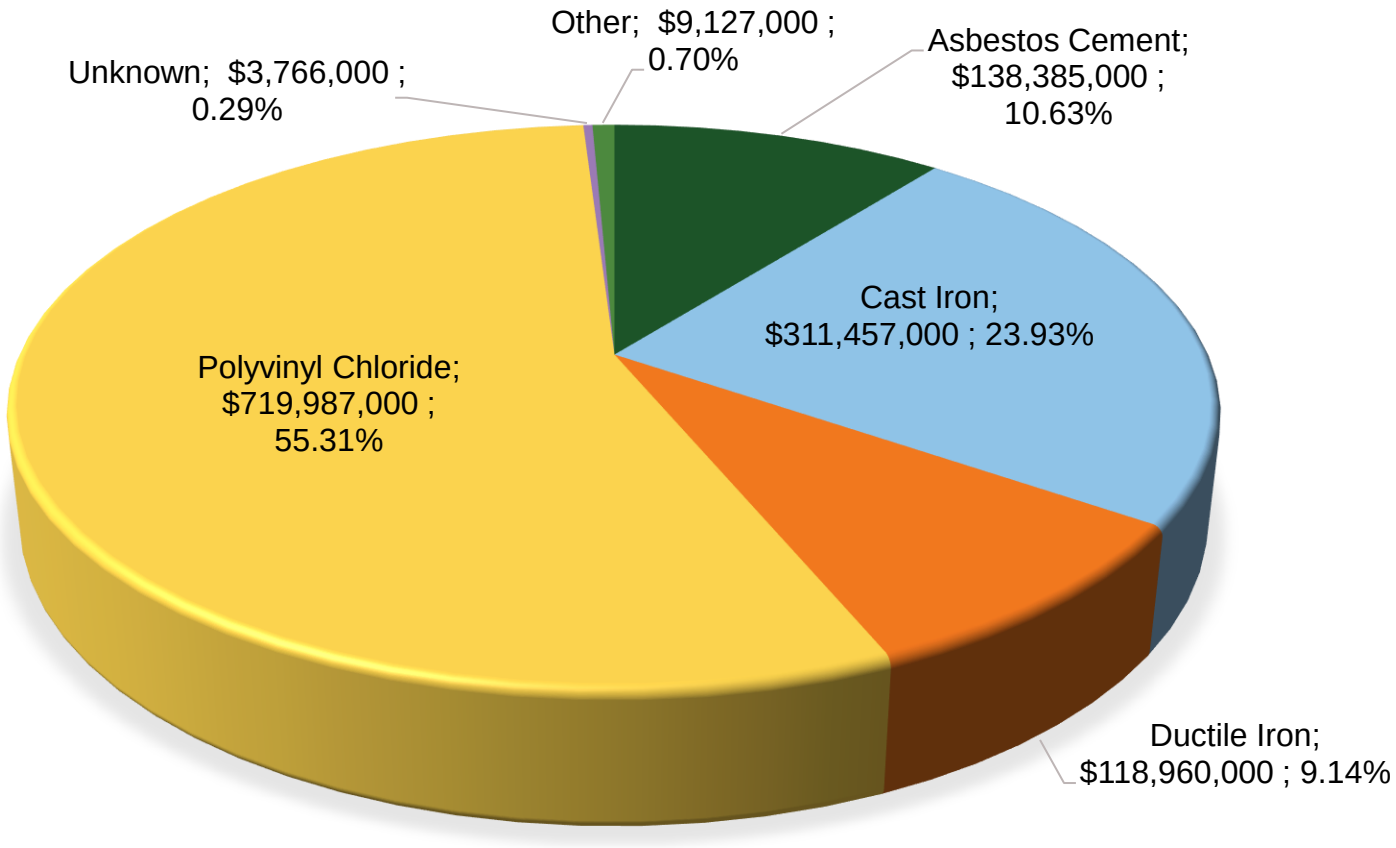
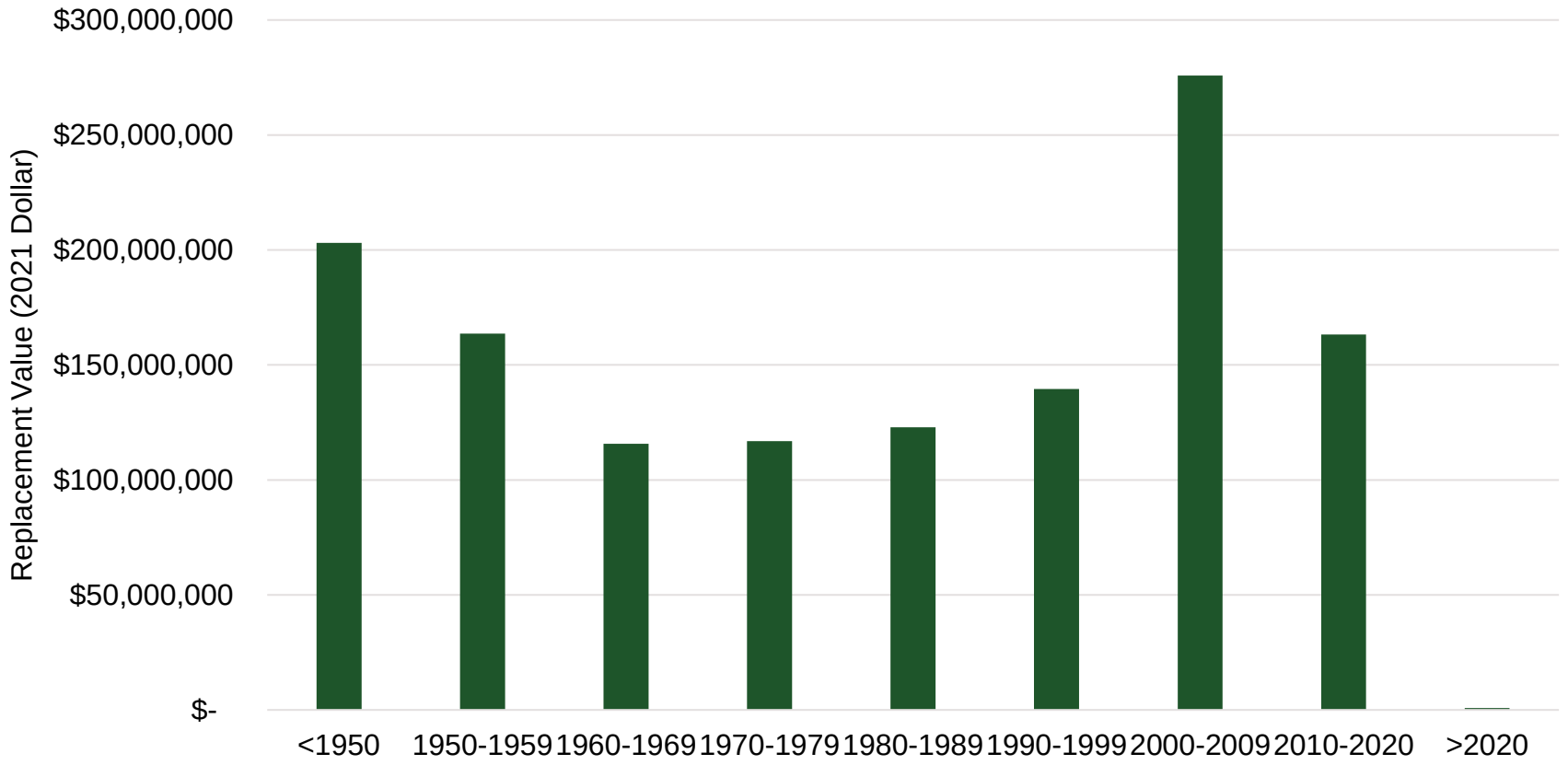


Figure 5. Asset Replacement Value for all Watermains by Materials



The figure below summarizes the replacement value for water mains grouped by installation decade. Based on the distribution, many of the water mains owned by the City are in the relatively early stages of their lifecycles.

Figure 6. Distribution by Replacement Value for all Water mains by Installation Decade



The construction materials for water mains (**Figure 5**) and their age (**Figure 6**) are aligned due to the preferred materials changing over time. For instance, in the mid-1970s Polyvinyl Chloride overtook Ductile Iron as the preferred material for water mains. Thus, since Polyvinyl Chloride was the most popular material while infrastructure spending at the municipal level also began

to increase, it is currently the most prevalent material in the distribution system.

2.1.2 Water System Condition

Condition was assigned to water system assets using diverse approaches depending on the asset category.

For water mains, the historical number of breaks was considered to determine a break index that is based on:

- Break Rate: The historical number of breaks per 100m of main.
- Break Score: Calculated based on the frequency of those breaks.

The break index is then converted into a performance score, condition score, and condition rating as shown in **Table 10**.

Table 10. Water mains Condition Scale

Condition Score	Condition Rating	Water main Break Index	Water main Performance Score
1	Very Good	0	1
2	Good	0.1-0.2	0.8-0.6
3	Fair	0.2-1	0.6-0.4
4	Poor	1-4	0.4-0.2
5	Very Poor	Over 4	Less than 0.2

The age of the main was also considered for determining the condition of water mains, as per **Table 4**.

The final condition score was calculated by taking the highest of the break-index performance score and the age-based performance score. The condition scale was assigned to all segments in the network individually.

Condition scores for all other water system assets were computed using a deterioration curve based on estimated service life remaining and the scores were converted to a rating based on the criteria in **Table 4**.

The current conditions of water distribution assets have been summarized and weighted by replacement value in **Figure 7**. The overall condition of the water facilities is based on the average condition of its components.

As the group representing the majority of distribution assets, the water main condition distribution by diameter is shown in **Figure 8**, and their location is indicated in **Figure 9**.

Overall, 17% of the water assets are in the very poor rating category (based on replacement value) and 3% are in the poor category.

Figure 7. Condition Distribution by Replacement Value for all Water Asset Types

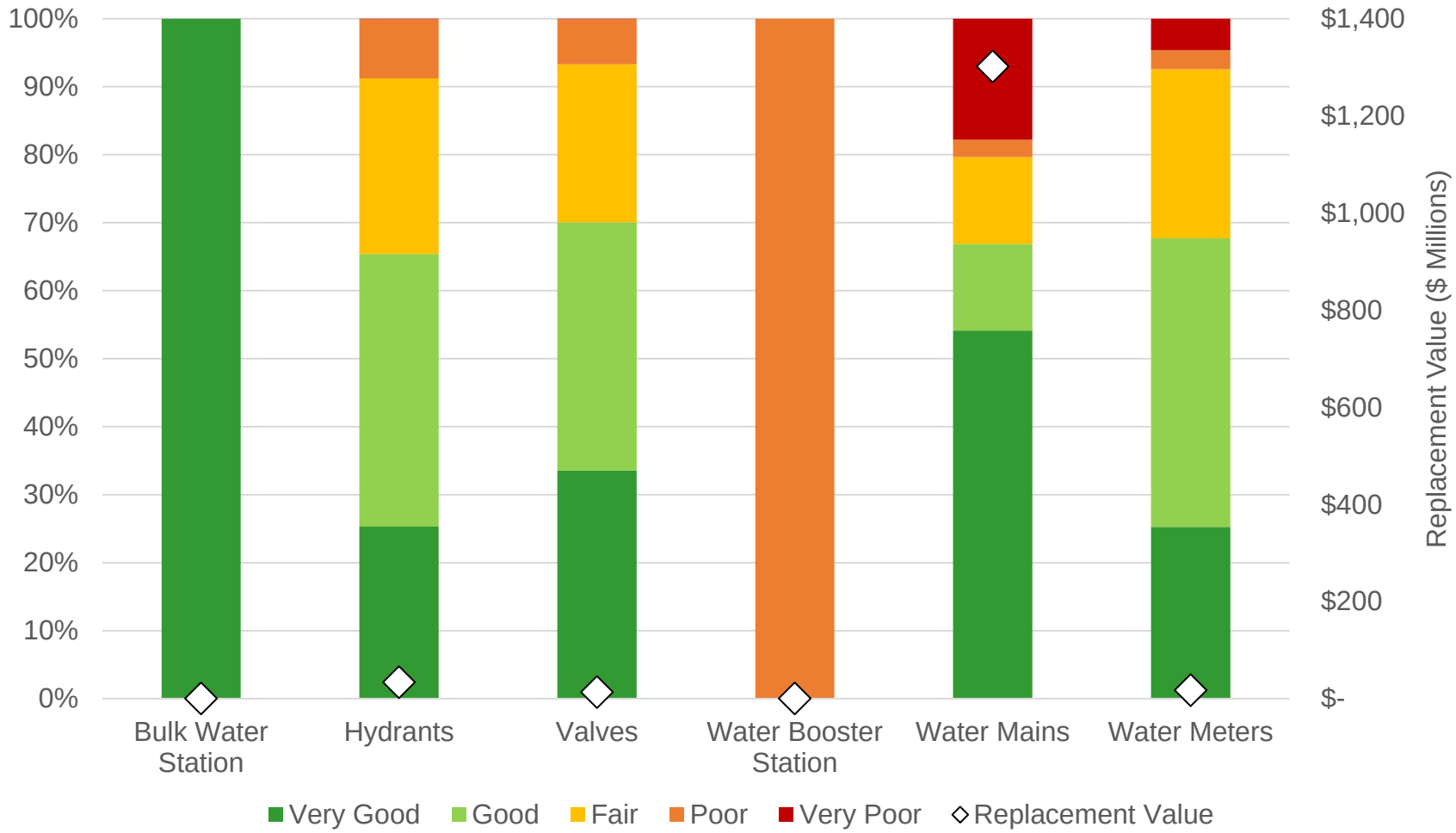


Figure 8. Condition Distribution by Diameter for all Water mains

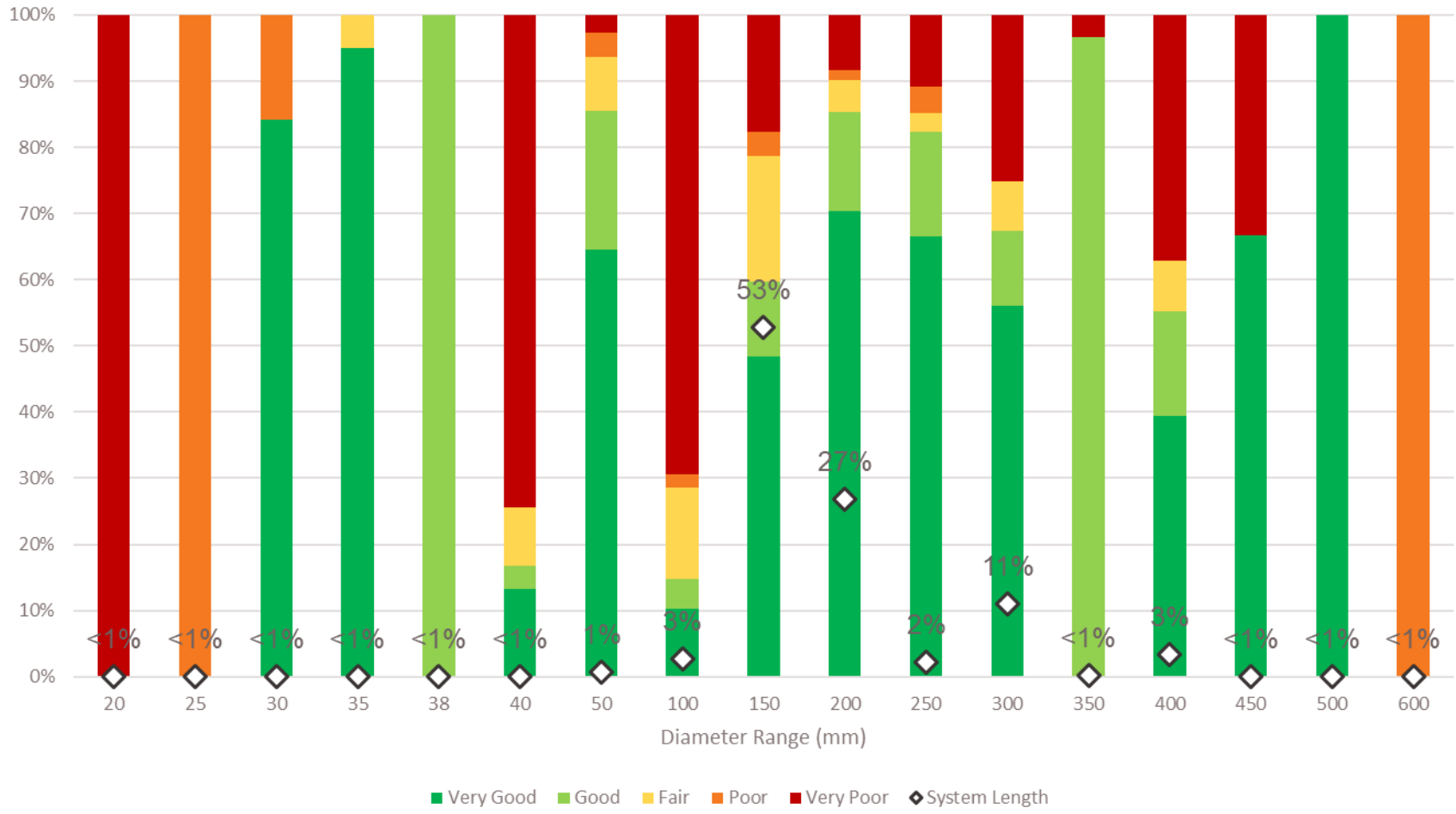
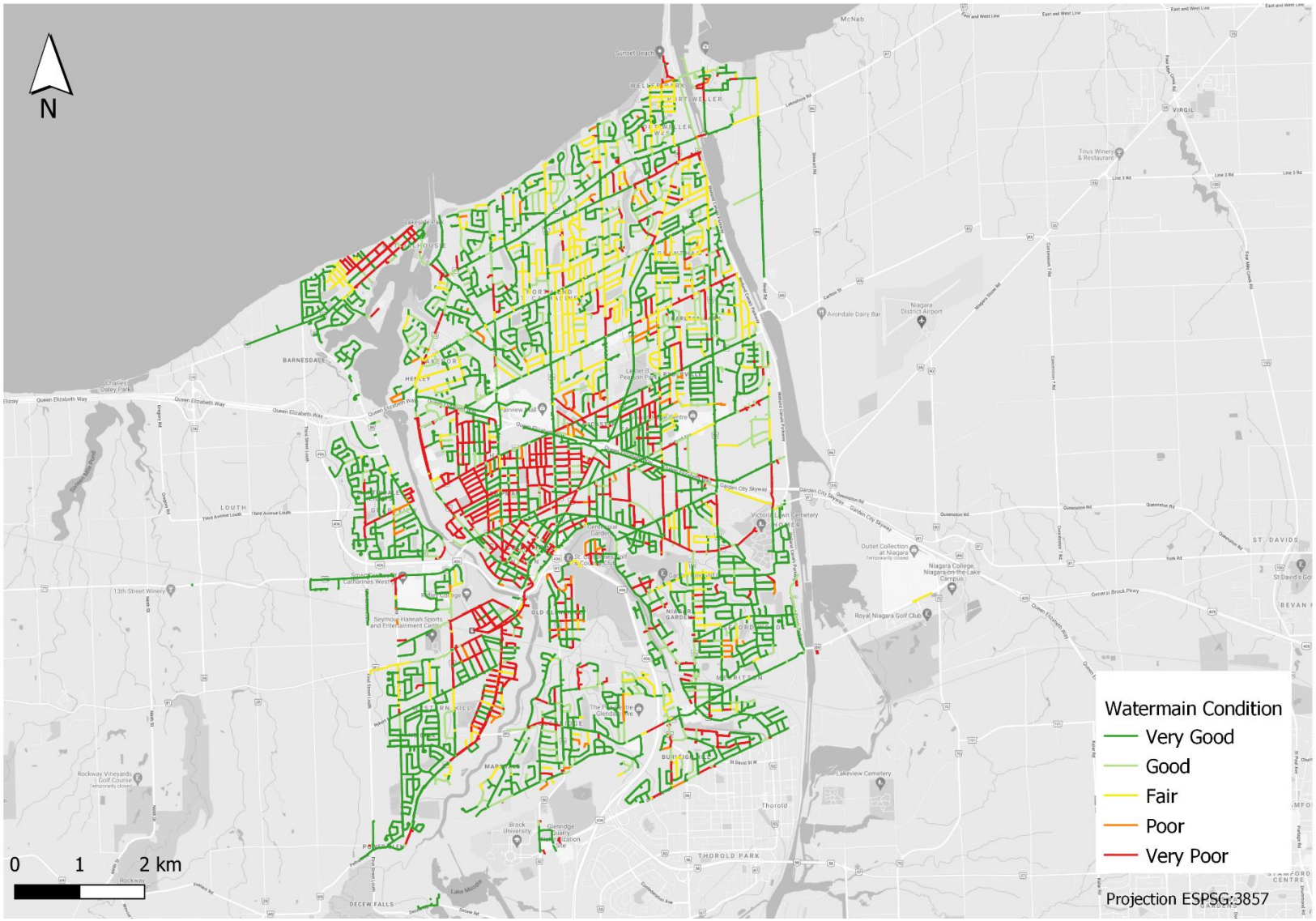


Figure 9. Condition Distribution by location for all Water mains

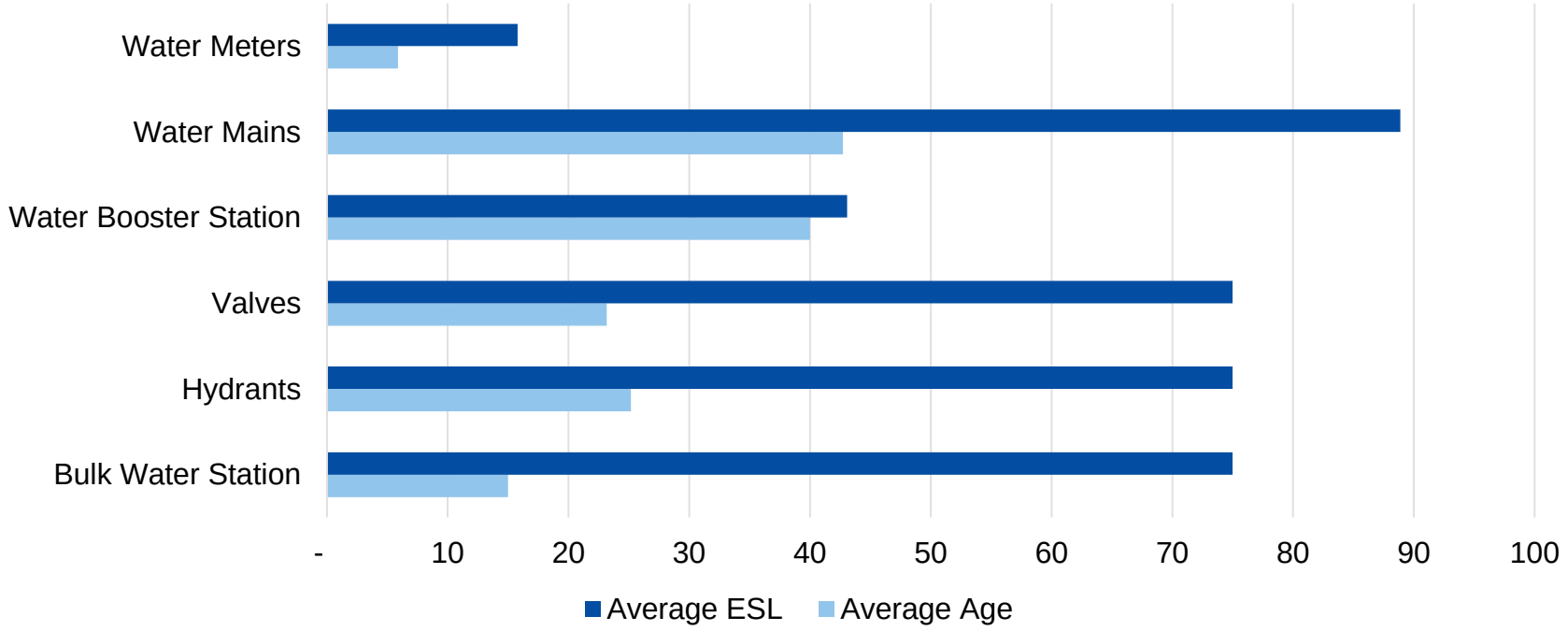


2.1.3 Water Age Summary

Comparing the average age of the assets with the average estimated service life (ESL) provides a representation of the average overall portfolio remaining life. The average age of water asset categories is around half of the average estimated service life, which is in alignment with the Fair and Good condition distribution reported above.

The ESL is based on asset types and their attributes (i.e., material type for water mains).

Figure 10. Average Age as a Proportion of Expected Service Life by Asset Type All Water Assets

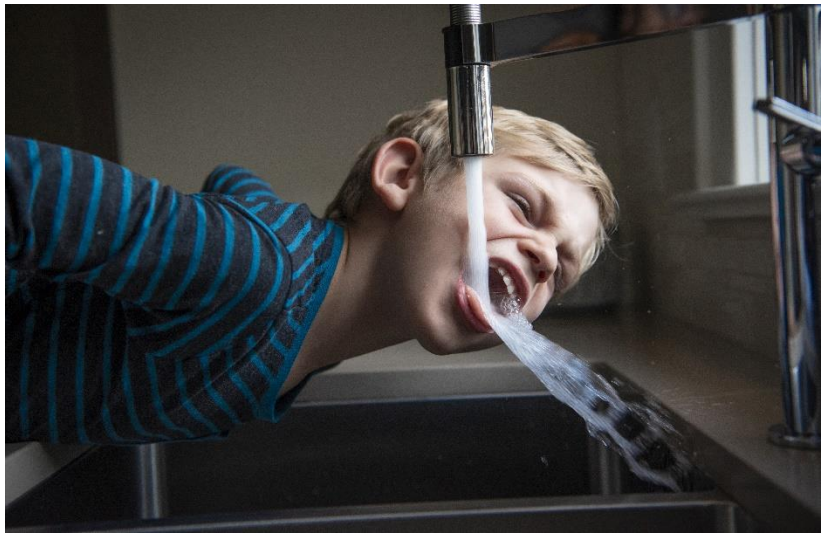


2.2 Water Levels of Service

The City of St. Catharines is committed to providing a sustainable and reliable supply of safe, high quality drinking water in accordance with regulatory requirements.

The Ontario Ministry of Environment, Conservation and Parks (MECP) conducts extensive annual inspections of the City's water distribution system to determine the compliance of the system with requirements under the Safe Drinking Water Act and associated regulations.

The defined levels of service for the City's water system are a key driver for the consistent performance that the City delivers to its residents as these provide the planned outcome from a functional perspective.



The Key Service Attributes associated with the water LOS and their associated statements are defined in the table below:

Table 11. Water LOS Service Attributes

Service Attribute	Attribute Statement
Scope	Providing adequate water services to the community
Safety	Water system provides safe potable drinking water
Quality	Providing high quality water to customers
Reliability	Providing water services with minimal interruptions
Environmental Stewardship	Providing a water service in an environmentally conscious manner
Cost Efficiency	Providing water services in an efficient manner
Capacity	Water system supports community fire protection

The following sections provide a summary of the levels of service for the City's water services including those required by the O.Reg.588/17.

2.2.1 Water Customer Levels of Service

The City's CLOS provides a means to assess the level to which customer expectations are being met. The

following provides a summary of the CLOS associated with St. Catharines water service.

- **Description, which may include maps, of the user groups or areas of the municipality that are connected to the municipal water system (Scope)**
  The City owns and operates a Class II residential water distribution system, that receives its drinking water from the Regional Municipality of Niagara's Decew Water Treatment Plant. The distribution system is comprised of 594 km of water main pipe, 3,559 hydrants, 1 booster station and a bulk water facility servicing, which service a total of 42,566 customers including 145 bulk water customers. See Figure 9 for a map of the water distribution system.
- **Description, which may include maps, of the user groups or areas of the municipality that have fire flow (Scope)**
  Fire flow is provided by 3,559 hydrants within the serviced area.
- **Description of boil water advisories and service interruptions (Reliability)**
  There have been no boil water advisories in 2019 or 2020

Additional customer levels of service are provided in **Table 12**.

Table 12. Water CLOS Indicator

Service Attribute	Customer Levels of Service	2020 Performance
Quality	Number of complaints due to rusty / discoloured water	29
	Average Condition of water mains	Good
Reliability	Length of water mains in Poor or Very Poor condition	121 kilometres
	Percentage of water assets in fair or better condition	80%
Cost Efficiency	Annual cost to provide water service (per customer)	$309.12

The current customer performance is based on billing information, customer service requests received, and the findings from the City's water model.

2.2.2 Water Technical Levels of Service

In addition to setting performance levels associated with customer expectations, the City has also documented

current technical performance indicators that align or support the CLOS presented in **Table 12**.

The following provides a summary of the TLOS associated with the water service at the City of St. Catharines.

Table 13. Water TLOS Metrics

Service Attribute	Technical Levels of Service	2020 Performance
Scope	Percentage of properties connected to the municipal water system[(a)]	94.2%
Safety	Percentage of water sampling meeting Safe Drinking Water Standards	99.9%
Reliability	Percentage of water assets in poor or better condition	83%
	The number 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[(a)]	Zero (0)
	The number of connection-days per year due to water main breaks compared to the total number of properties connected to the municipal water system[(a)]	10.6
	Total number of water main breaks	115
	Percentage of customers where service is interrupted due to a water main break	9%
	Number of water main breaks per 100 km	19
	5 year rolling average water main breaks per 100km	19
	5-year average number of water main breaks	111
Environmental Stewardship	Water loss as a percentage of Water Purchased	15%
Cost Efficiency	Preventative maintenance as a percentage of total maintenance	6%
	Maintenance cost per km of distribution network	$ 8,745
	Capital investment vs sustainable investment forecast	20%
	100-year sustainable investment equivalent annual cost	$ 42,044,939

Service Attribute	Technical Levels of Service	2020 Performance
Cost Efficiency (Cont.)	Water linear (Mains + Appurtenances) Reinvestment Rate - (Annual average of projected lifecycle capital budgets as a % of replacement value)	0.9%
	Total water linear asset replacement value	$ 819,579,254
Capacity	Percentage of properties where fire flow is available[(a)]	98.6%

Notes:

(a) Required by O.Reg. 588/17

2.2.3 Water Future Metrics for Consideration

As part of the definition of levels of service, the City identified possible level of service metrics that could be added to their framework as data becomes available. The following table provides a summary of the metrics that have been proposed for future consideration.

Table 14. Water LOS Future metrics

Service Attribute	Levels of Service Proposed Future Metric	Type of LOS
Reliability	Percentage of system with high or low pressure	Technical

2.3 Water Lifecycle Management Strategy

The levels of service presented in the previous section are supported by the achievement of a variety of lifecycle activities in accordance with the activity types presented in **Table 5**. These activities are targeted to extend the asset life, ensure levels of service are being met, and reduce overall lifecycle costs.

The water service staff implement a variety of lifecycle activities on its entire portfolio. **Table 15** provides a summary of these activities and the risk associated with not doing them.

Table 15. Water Lifecycle Activities, Associated Risk, and Estimated Lifecycle Cost

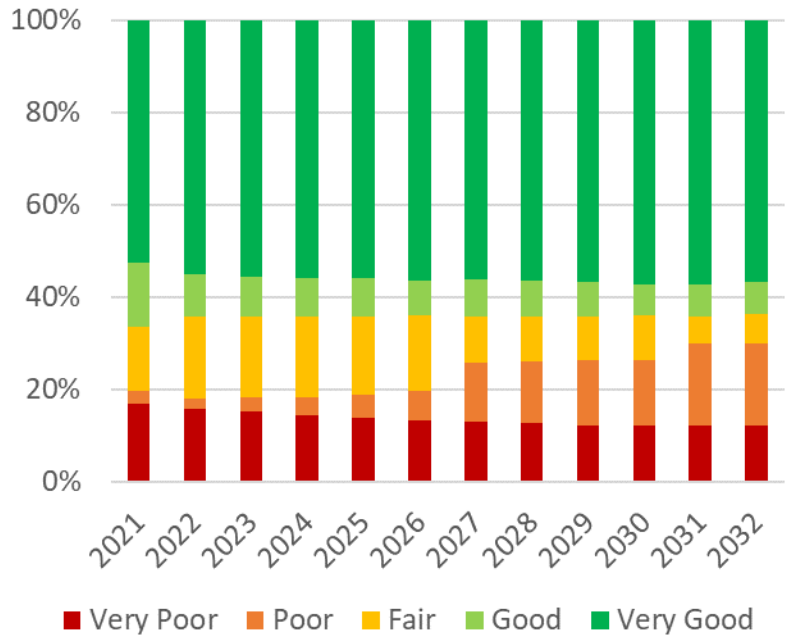
Lifecyle Activity Type	Asset Management Practices	Risk Associated with the Activity	Equivalent Annual Cost (2022 to 2032)
Non-Infrastructure Solutions	• Master plans are developed and updated to provide a baseline for future growth projections in the water system. • Hydraulic analysis is conducted to evaluate the capacity of the linear water system and identify areas that require improvements. • Condition assessments of booster station and bulk water station as required. • The City provides continuous tracking on water quality complaints to ensure customer satisfaction.	• Inaccurate growth numbers lead to inadequate estimations for funding requirements and insufficient capacity. • Asset deterioration is over or underestimated. • Regulatory requirement and standard changes.	$ 120,000 Based on the historical 2017 to 2021 average expenditures. It is recommended that future studies be identified based on best practices and cost estimates be developed.
Renewal / Rehab Activities	• Renewal and rehabilitation as identified through ongoing maintenance, inspection, and condition assessments.	• Incorrect assumptions of the expected improvement in useful life after maintenance is completed. • Increased lifecycle cost if renewal/rehab are done improperly or not as scheduled. • Water loss to the environment.	- Currently done on a reactive basis. A strategy needs to be developed to have a regular program to identify good candidates for the implementation of these technologies at an appropriate time and prior to an asset needing full replacement

Lifecyle Activity Type	Asset Management Practices	Risk Associated with the Activity	Equivalent Annual Cost (2022 to 2032)
Maintenance Activities	**Linear Assets** • Routine maintenance program including flushing of water mains, exercise in-line valves, sampling for lead in service connections, seasonal maintenance of hydrants. • Leak detection program and break repairs as needed. • Repair program for valves and hydrants as required. • Relining (in the future) **Vertical Assets** • Routine maintenance program including inspection and equipment checks.	• Increased lifecycle cost if maintenance is done improperly or without scheduled frequency. • Insufficient maintenance could lead to unplanned and urgent work when there are inadequate resources available (labour, materials, etc.). Insufficient maintenance may contribute to asset failure resulting in service disruptions.	$ 4,825,000 Based on the 2020 to 2021 budget increase applied annually from 2021 onwards. Incorporating the maintenance of growth assets following construction
Replacement/ Construction Activities	• Replacement of deteriorated assets.	• Coordination with other asset classes (if applicable) might delay or advance timeframe of construction activities. • Delays in construction could results on cost over-runs.	$ 28,563,000 Forecasted based on the lifecycle management activities.
Growth Activities	• Asset additions to accommodate for population growth in new sub-divisions within the City. • Linear Appurtenance additions to support changes in system configuration.	• Growth activities are delayed or cancelled resulting in system being unable to accommodate increased growth demands. • Loss of compensation through Development Charges.	$ 224,000 Based on the average between the maximum of 2017 to 2021 average capital growth activities and the projected development charges

Lifecyle Activity Type	Asset Management Practices	Risk Associated with the Activity	Equivalent Annual Cost (2022 to 2032)
Disposal Activities	• Decommissioning assets at the end of their useful life. • Disposal of abandoned or obsolete infrastructure during construction projects. • Salvage and reuse of parts where appropriate. • Hydrants scrapped if barrel is defected and there is a salvage value associated with their disposal and some are salvaged and used for spare parts.	• Improper disposal could lead to environmental impacts and result in cost overruns.	$ 40,000 Based on the 2017 to 2021 average disposals
Service Improvement Activities	• Water service improvements are conducted during water main replacement projects, or when at the request of a customer based on pipe diameter and/ or material type to copper or plastic. • Water main upsizing based on design standard compliance and flow requirements. • Inclusion of water mains looping to minimize dead ends in the water network. • Automatic Meter Reader replacement program for older water meters.	• Lack of improvements can result in health and safety risks. • Loss in efficiency of delivering service.	$ 69,000 Based on the 2017 to 2021 average service improvement activities

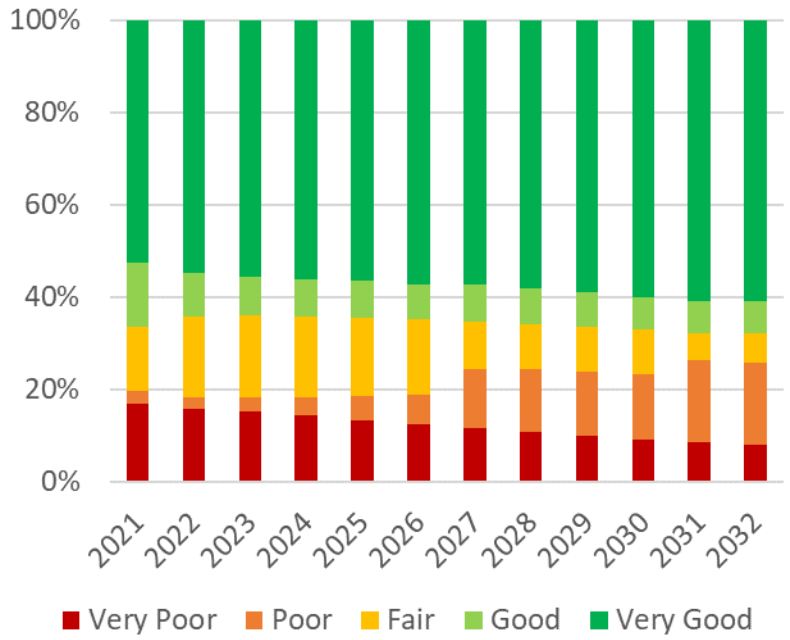
The City uses these strategies to plan work and determine future expenditure needs. The TLOS used in the AM analysis for water assets was defined as maintaining the current portion of assets with poor or better performance. The cost to maintain this scenario was determined to be $16.2M annually over a 25-year period and resulted in the performance forecast shown in **Figure 11**. The percentage of assets in poor or better condition holds around 83% with slight improvement over the 10-year period.

Figure 11. Water Condition Distribution Performance with Cost to Maintain Performance



The current planned budget was also analyzed to determine if a funding gap exists. However, it was identified in the recent water and wastewater financial plan that an improvement to LOS was required to meet the Community's needs. The current planned expenditures, starting around $9M in 2021 and increasing to $19.5M by 2029, resulted in the performance forecast shown in **Figure 12**. The percentage of assets in poor or better condition improves from 83% to 92% over the 10-year period.

Figure 12. Water Condition Distribution Performance with Anticipated Budget



Additionally, an optimal lifecycle scenario was analyzed, which was used to determine the cost to meet all lifecycle strategies described in **Table 15**. This scenario addresses the backlog and ensures no asset reaches very poor performance. The cost to achieve this scenario was determined to be $33.7M annually over a 25-year period and resulted in the performance forecast shown in **Figure 13.**

The costs for the 10-year lifecycle forecast are presented in **Figure 14**. The graph shows the forecasted expenditures by lifecycle category for the cost to maintain scenario. The equivalent annual cost to maintain LOS, the annual expenditures for the optimal lifecycle scenario and the anticipated annual funding is also provided on the graph. The City should continue to implement the recommendations from the water and wastewater financial plan.

Figure 13. Water Condition Distribution Performance with Optimal Lifecycle Activities

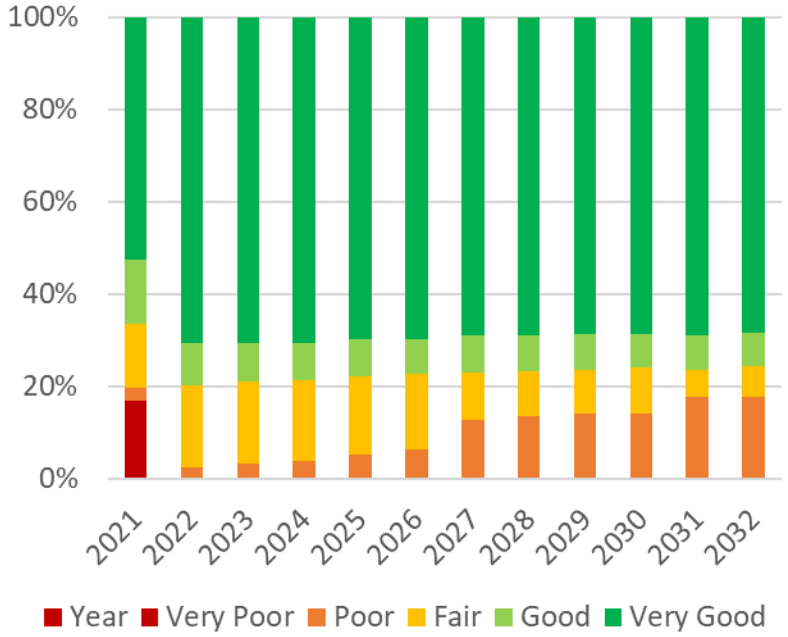
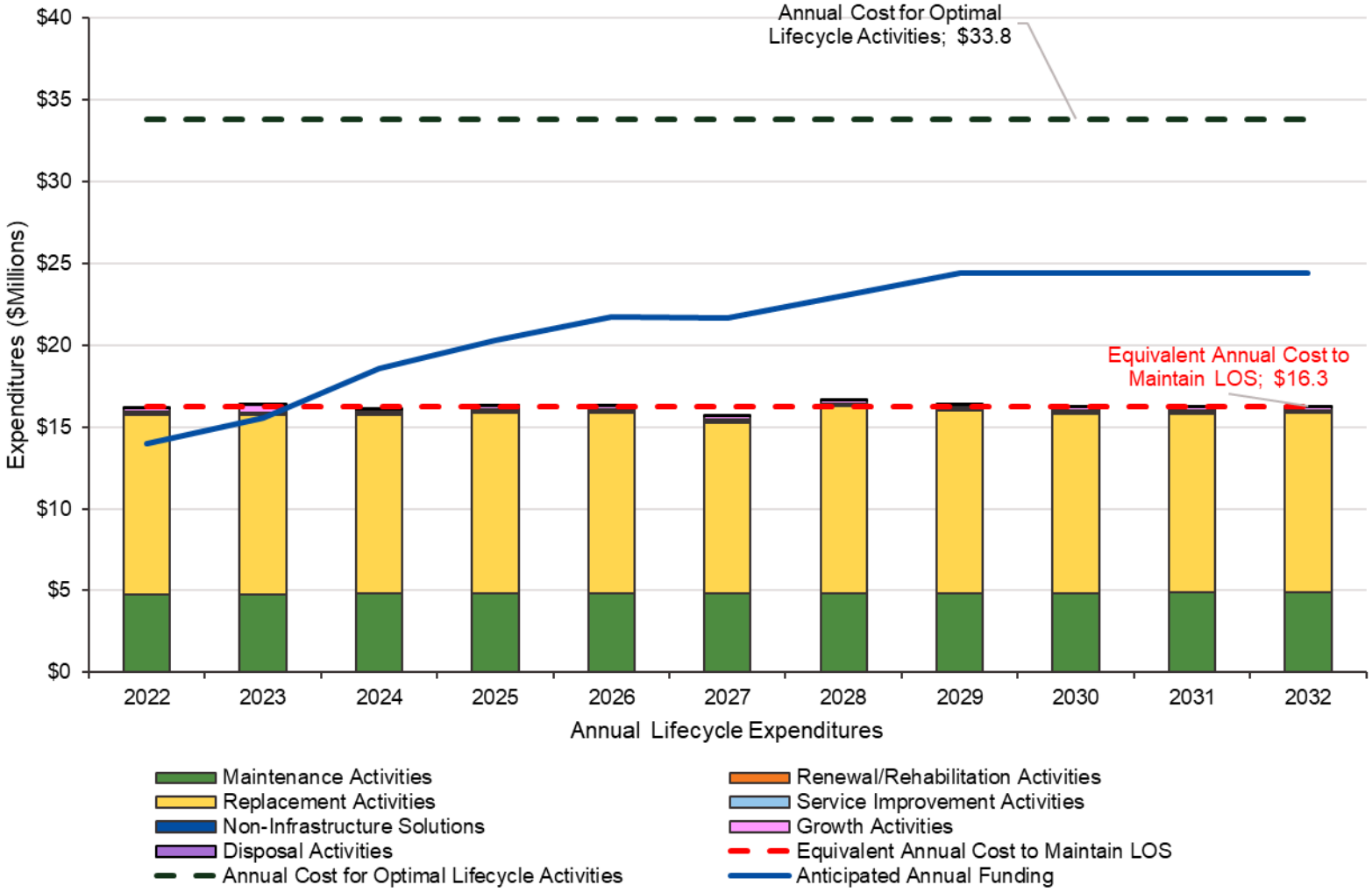


Figure 14. Water Forecasted Lifecycle Needs



2.4 Water Service Associated Risks

As noted, the assets associated with the water service are key to providing clean and safe drinking water to the community. In addition to the risk associated with the lifecycle activities for this service, as shown on **Table 15**, the following are considered general risks with this service:

- Water main breaks resulting in service disruption;
- Hydrant failure resulting in limited fire flow access;
- Revenue loss due to water meter failure, leaks and water main breaks;
- System operational restrictions due to valve failure;
- Inability to isolate parts of the system due to valve failure;
- Third party damage during repair activities
- Service disruptions and reduction of water quality; and
- Service interruptions as a result of water station failure, both booster pumping and bulk water.

2.5 Water Climate Change Considerations

While the City's location by the Great Lakes would seem to assure its water supply source is relatively secure, water quality can be impacted by climate change and pollution. In the past decade, there have been increased incidents of agal blooms in Lake Erie and Lake Ontario which threaten fish and wildlife habitat, interfere with recreational activities, as well as increase costs for treating drinking water. Excess nutrients from stormwater runoff, warm temperatures, and sunlight trigger various types of algae growth which can contaminate water and affect its taste and odour.

With climate change, increasing annual average temperatures and a trend towards more heat waves and summer droughts are expected to continue in the future. Dry weather increases peak demand for water which impacts the sizing of various water infrastructure. Rural residents that rely on non-municipal sources will be impacted by droughts that affect evaporation patterns, groundwater recharge, and agricultural production. Various measures for system design and operation will need to be assessed to deal with these issues.

2.6 Water Data Confidence

The following data sources were used to support this chapter's assessment of the City's water assets.

- Water mains, valves, hydrants, and meters: GIS shapefiles of the full inventory for these categories with their associated key attributes such as installation date, type, size, length;
- Unit Cost Summary documentation provided by the City based on historical data;

- Historical water main break records;
- City Tangible capital asset estimated service life values; and
- Bulk Water Station and Booster Station drawings.

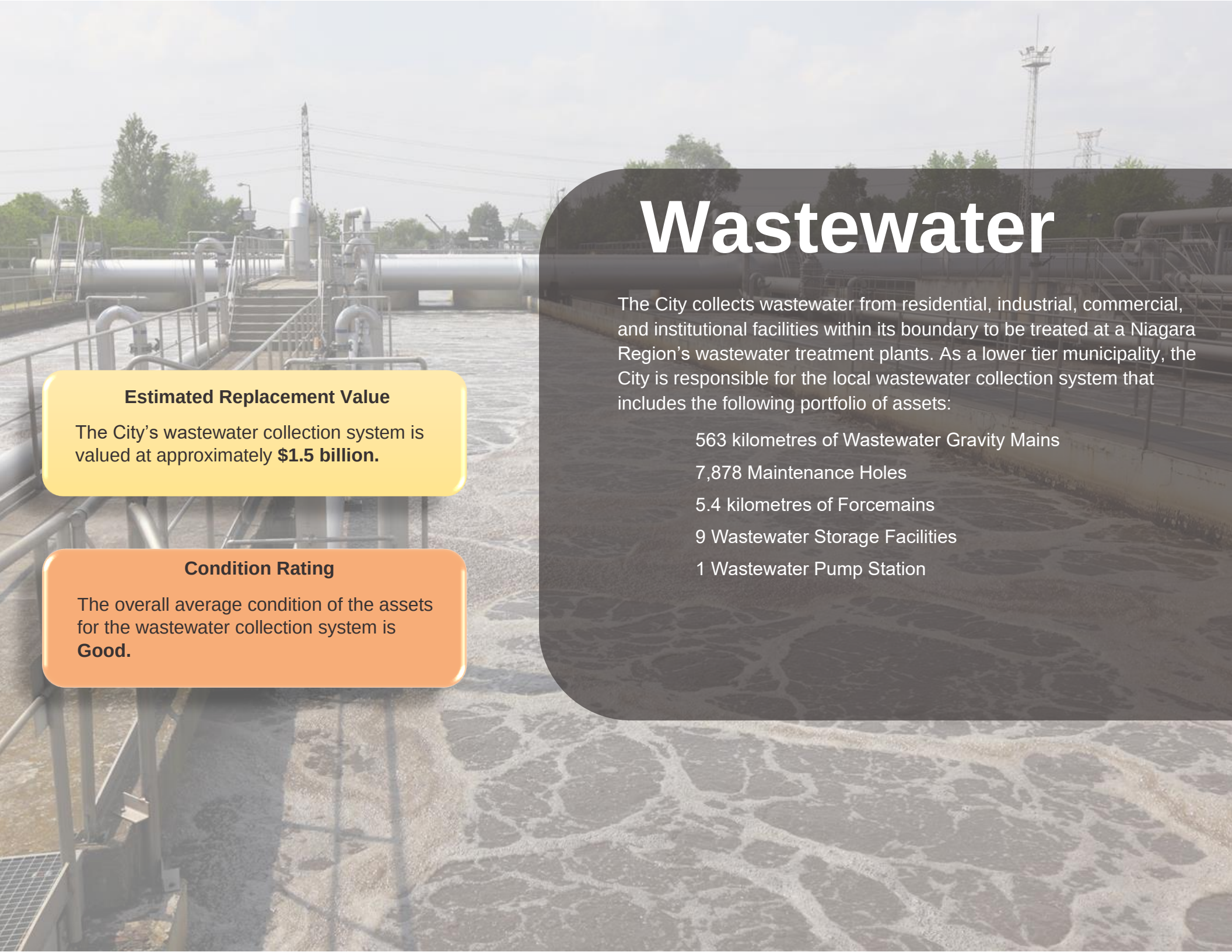
The following assumptions were made during the assessment of the data for the development of the different assessments:

- The water facility inventory was based on high-level information available from the drawings. The cost of these assets was determined based on estimates of similar assets and their age was assumed as per the drawings provided;
- Water main break data from years prior to the initial assessment in the break records were considered with an age approach for condition;
- Missing installation dates in linear assets were filled based on the material standard install date period; and
- Replacement costs were forecasted based on available unit rates for the diameters not included in the original dataset.

A data confidence assessment is provided below:

Table 16. Water Data Confidence Assessment

Asset Category	Confidence Rating	Confidence Data
Water mains	C	Assumptions were made for age, break data, and replacement values from reliable sources.
Hydrants	B	Minor assumptions were made on age and replacement costs
Valves		
Water Meters		
Bulk Water Station	D	Data based on historical information and assumptions on key parameters
Water Booster Station		



Wastewater

The City collects wastewater from residential, industrial, commercial, and institutional facilities within its boundary to be treated at a Niagara Region's wastewater treatment plants. As a lower tier municipality, the City is responsible for the local wastewater collection system that includes the following portfolio of assets:

- 563 kilometres of Wastewater Gravity Mains
- 7,878 Maintenance Holes
- 5.4 kilometres of Forcemains
- 9 Wastewater Storage Facilities
- 1 Wastewater Pump Station

Estimated Replacement Value

The City's wastewater collection system is valued at approximately **$1.5 billion.**

Condition Rating

The overall average condition of the assets for the wastewater collection system is **Good.**

3.0 Wastewater

Conveying wastewater from homes and businesses within the City to the wastewater treatment plants decreases the risk of health-related issues from exposure to bacteria in wastewater, while also mitigating the environmental impact of untreated effluent entering the natural environment.

The following section summarizes the portfolio associated with the City Wastewater Service.

3.1 Wastewater State of Local Infrastructure

3.1.1 Wastewater System Valuation

The City's wastewater collection system is divided into linear and vertical asset types. These serve to convey both wastewater and combined (wastewater and stormwater) flows.

- **Wastewater Linear Assets** represent the majority of the collection portfolio as they include mains, force mains, and service connections. For the purpose of this assessment, service connections were not discretized single asset categories, these were considered components of the sewer mains.
- **Wastewater Vertical Assets** include the facilities required to further pump or store wastewater in the system.

For the valuation of the wastewater collection system, the replacement values considered are intended for replacement of a similar asset (like-for-like) on a complete and standalone basis. These were calculated based on historical values that the City has incurred as part of previous projects for similar assets. Furthermore, the estimated value for wastewater facilities was calculated using a bottom-up approach based on the assets located within each facility and industry standard costing for these assets.

Based on the approach taken to calculate the replacement values for each asset category, the data confidence grade is:

- **D** for the pump station,
- **C** for sewer mains, and
- **B** for the remaining asset categories.

Table 17. Wastewater System Inventory Valuation

Asset Type	Asset Category	Count	Unit	Replacement Value (2021 Dollars)
Wastewater Collection	Gravity Mains	563,128	Metres	$ 1,445,630,000
	Force Mains	5,448	Metres	$ 12,995,000
	Maintenance Holes	7,878	Each	$ 71,877,000
	Pumping Station[(a)]	1	Each	$ 962,000
	Wastewater Storage Facility	9	Each	$ 24,950,000
Overall Wastewater System Replacement Value (2021 Dollar)				**$ 1,556,414,000**

Notes:

(a) Replacement values for pump stations were based on an estimate of the replacement of each of the assets within these facilities

The overall distribution of replacement values by asset type for the wastewater collection system is as shown in **Figure 15**. The wastewater gravity mains have the highest replacement value in the portfolio, totaling 92.88% of the entire system. The remaining assets correspond to 7.12% of the value associated with the wastewater collection system.

As wastewater gravity mains represent the majority of the wastewater collection asset replacement values, **Figure 16** provides a summary of the distribution of replacement values based on materials.

Figure 15. Asset Replacement Value for All Wastewater Assets

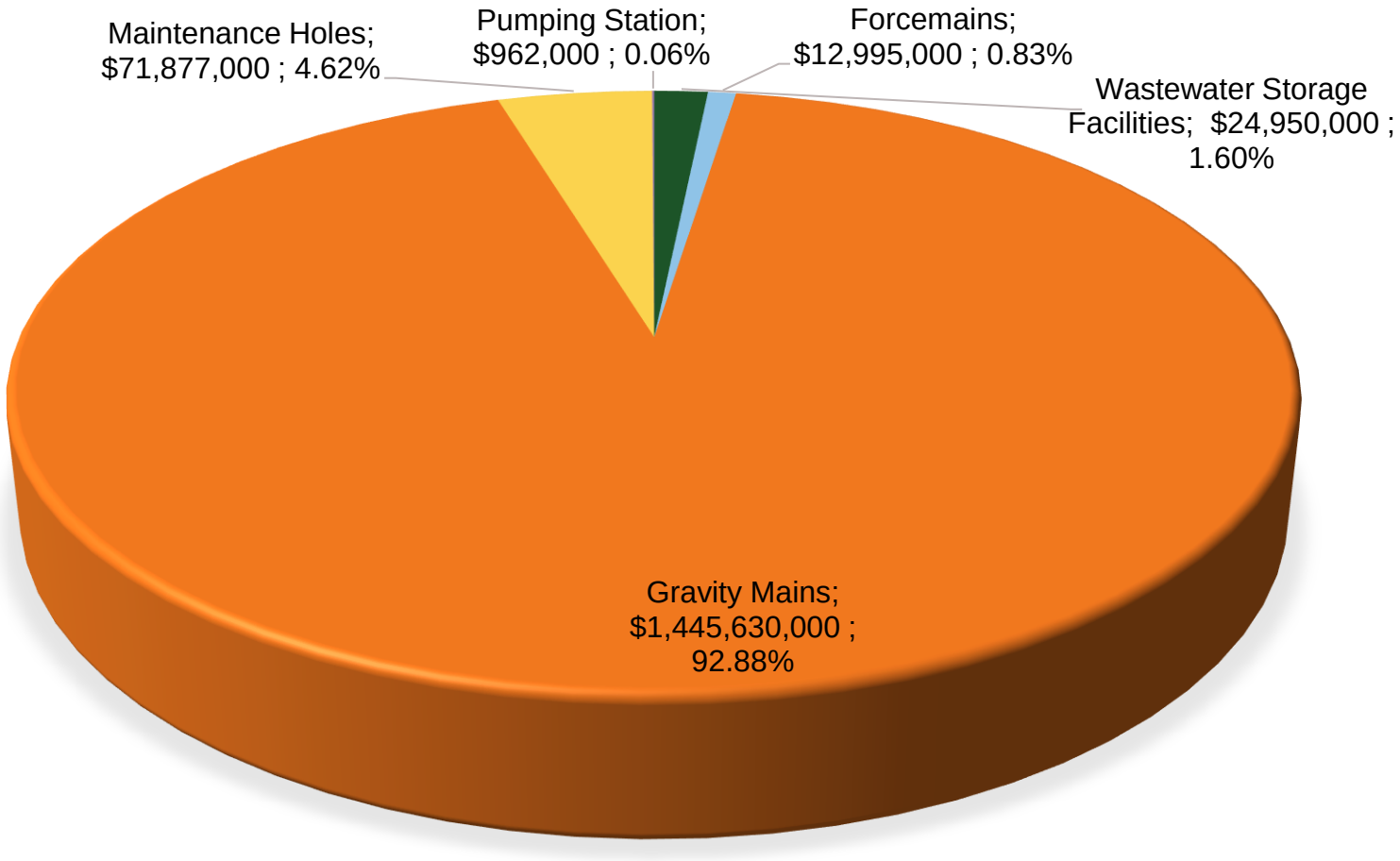
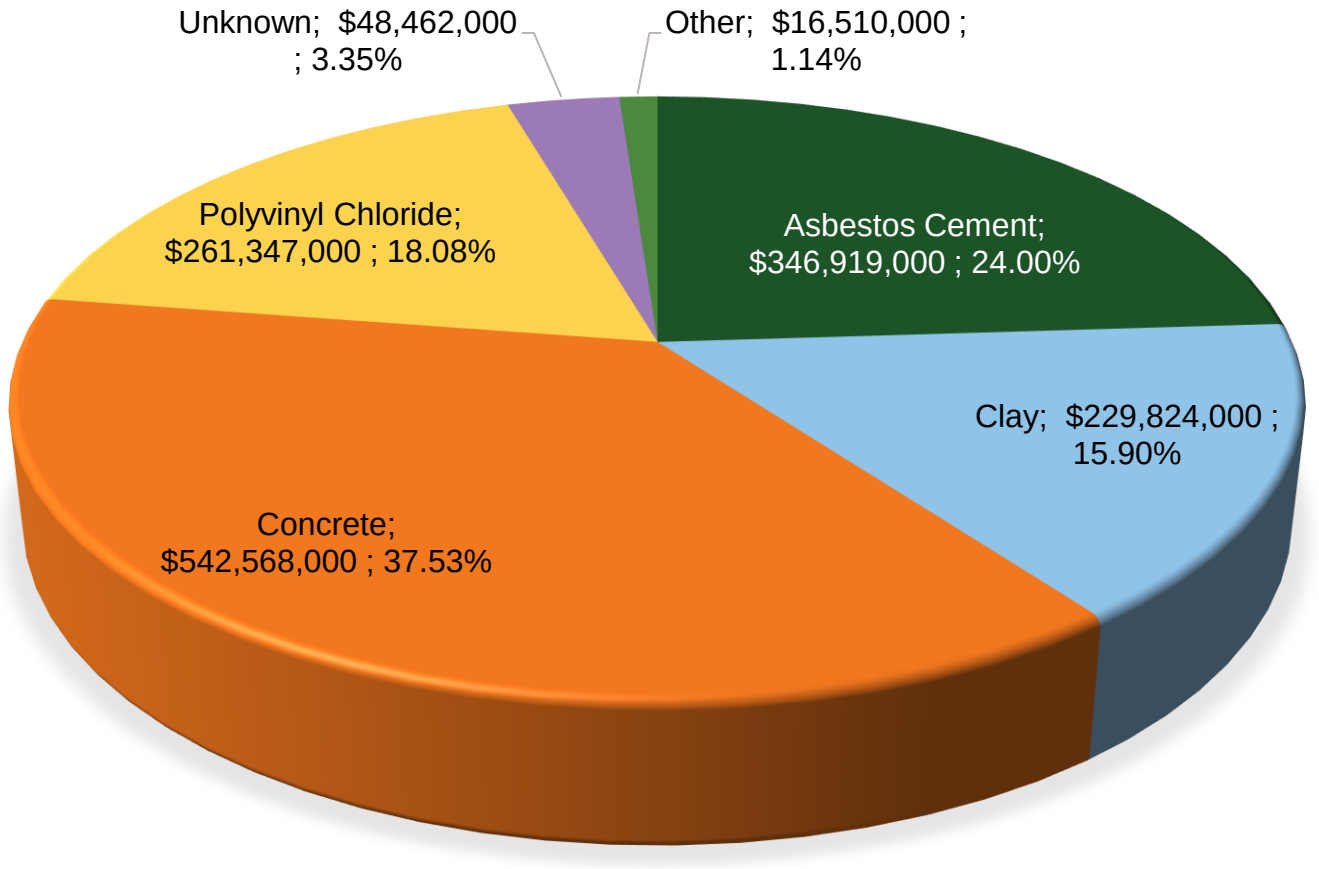
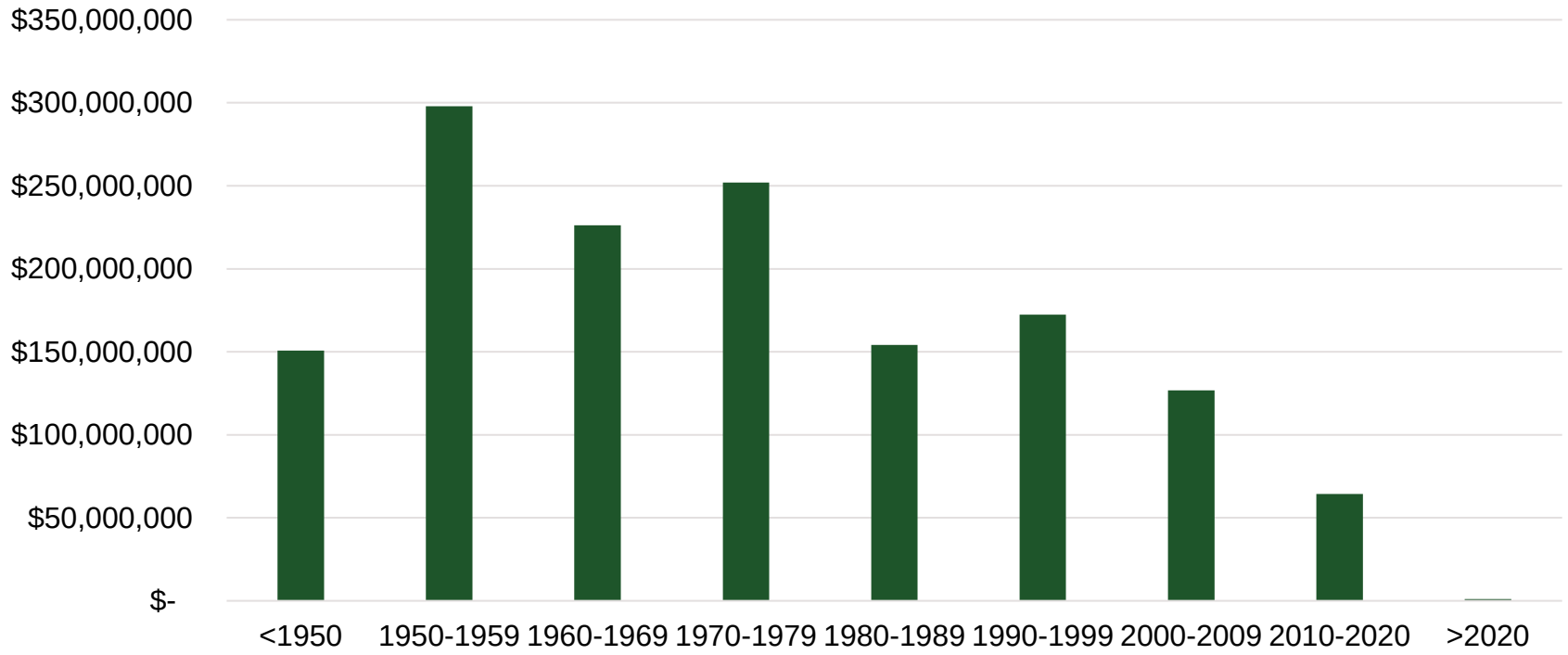


Figure 16. Asset Replacement Value for All Wastewater Gravity Mains by Materials



To further assess the wastewater gravity mains, as the major asset category within the wastewater service, the figure below summarizes the decade of the year of installation by replacement value.

Figure 17. Distribution by Replacement Value for all Wastewater Gravity Mains by Installation Decade



As shown in **Figure 17**, a large portion of the wastewater collection portfolio was constructed over 70 years ago which indicates that these assets will be reaching the end of their useful life in the coming years resulting in increasing capital requirements.

3.1.2 Wastewater System Condition

Using Markov probability distributions based on observed and predicted conditions, a condition score was computed for each asset into five rating categories ranging from Very Good to Very Poor. The City has

completed condition assessments on wastewater sewers and maintenance holes according to the NASSCO PACP standards. The assessments of pipes without a recent CCTV inspection were completed using zoom camera inspections which is limited in that approximately 30% of the pipe is assessed. The assumption is that the observed section is indicative of the remaining pipe, however this may not always be the case. Where the condition assessment scores were available, they have been used to determine the associated condition rating. The recent zoom camera project recommends targeted CCTV inspections to refine the data. **Table 18** provides a summary of the rating scale for sewer mains. The condition of the other wastewater asset classes is based on the scale in **Table 4**.

Table 18. Sewer Mains and Maintenance Holes Condition Scale

Condition Score	Condition Rating	Pipeline & Maintenance Holes Structural Score (PACP & MACP)
1	Very Good	0-1
2	Good	2
3	Fair	3
4	Poor	4
5	Very Poor	5

The current condition of assets has been summarized and weighted by replacement value in **Figure 18**. As the group representing the majority of distribution assets, the condition distribution of gravity mains has been represented by diameter in **Figure 19**, which also indicates the percentage of system length. The condition ratings are visualized in the map shown in **Figure 20**.

It should be noted that the sewers' performance data was assessed using zoom camera and CCTV inspections, each of which has its limitations. Staff have come across many sewers that have been observed to be in good condition through the inspections but were actually in very bad condition when exposed for any reason. Additionally, sewers that were near other construction activity started crumbling and provoked replacements that were not originally scheduled within projects.

The overall condition of the wastewater facilities is based on the average condition of its components.

Overall, 9% of the wastewater assets are in the very poor rating category (based on replacement value) and 11% are in the poor category.

Figure 18. Condition Distribution by Replacement Value for all Wastewater Asset Types

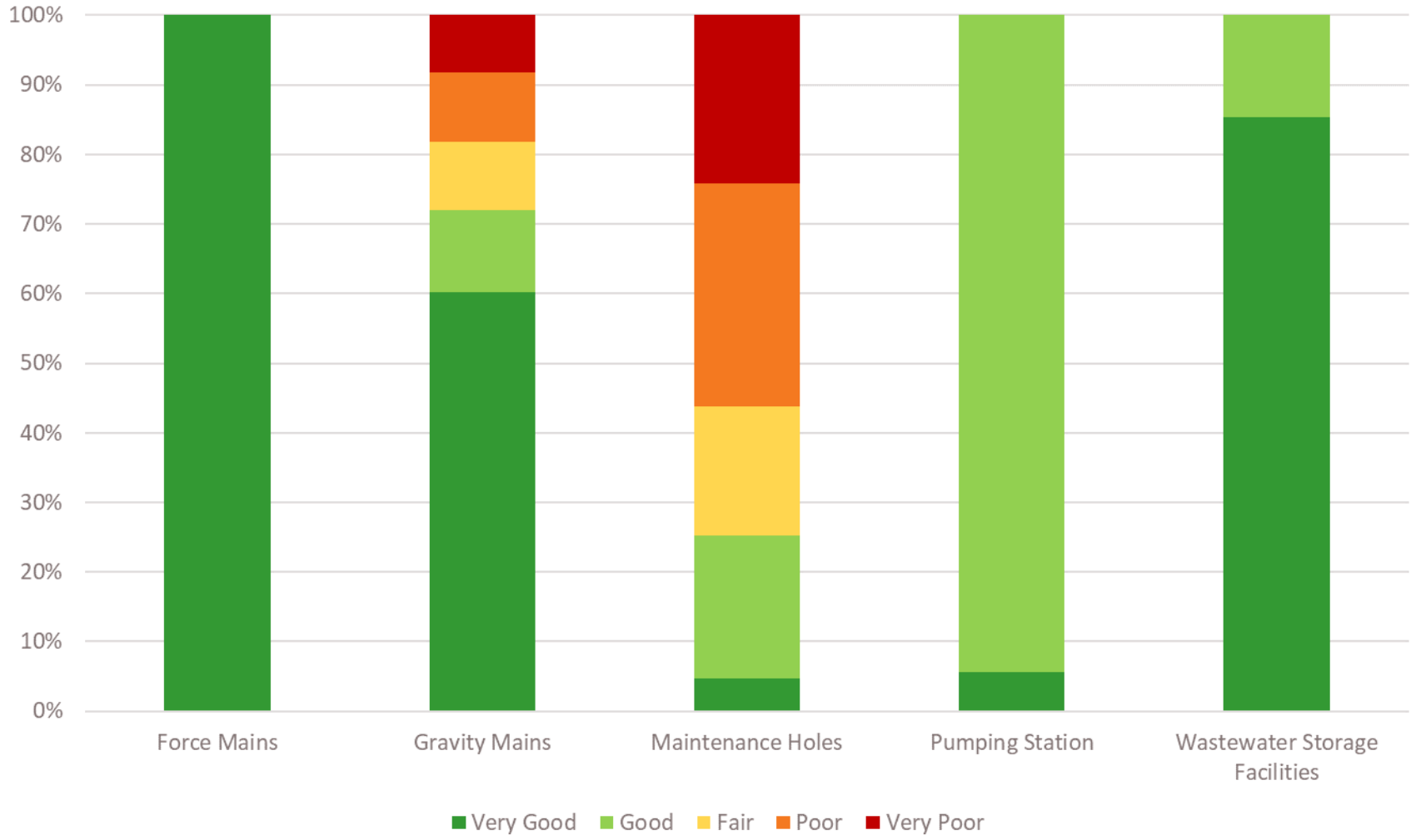


Figure 19. Condition Distribution by Replacement Value for all Wastewater Mains

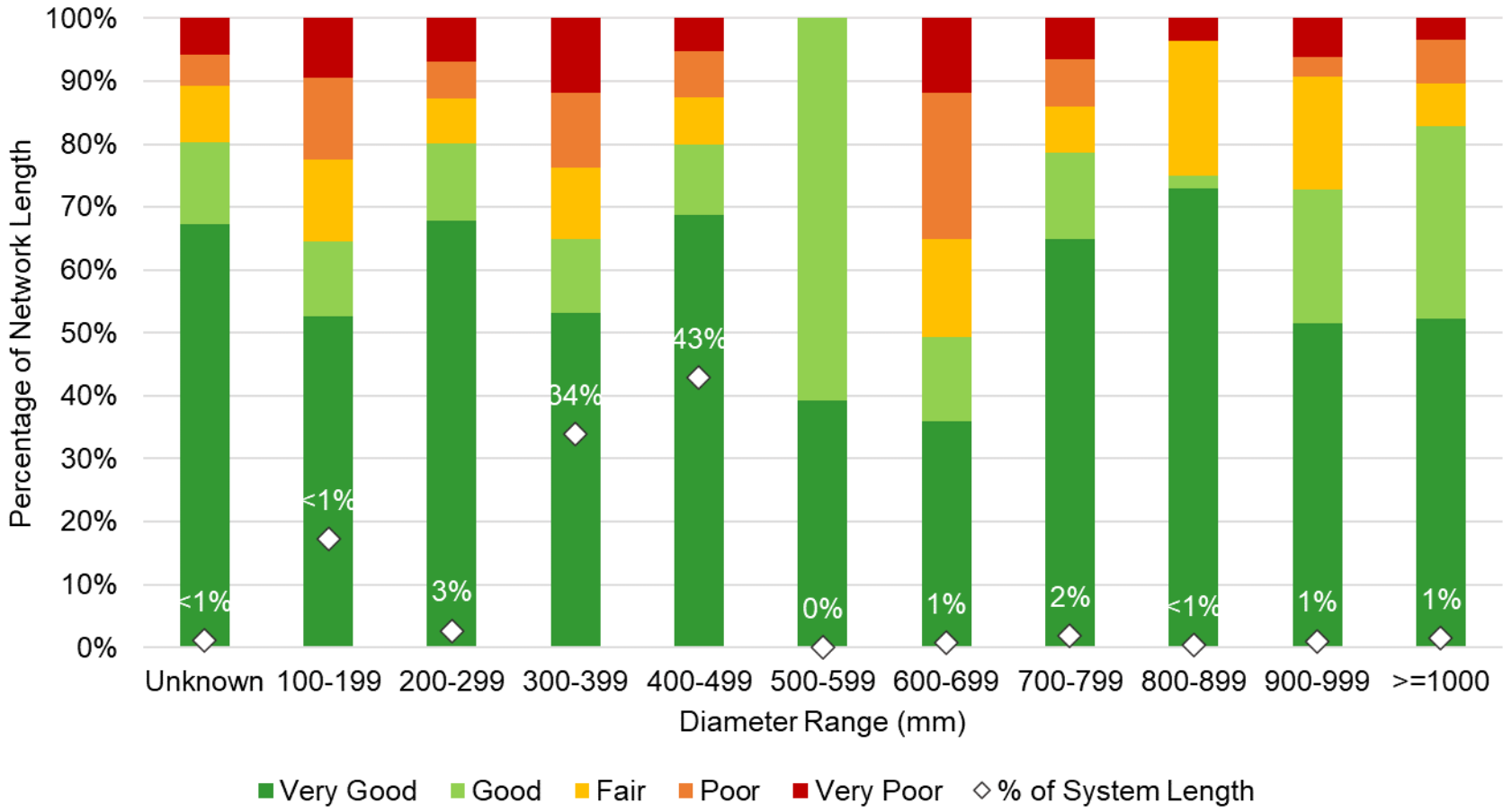
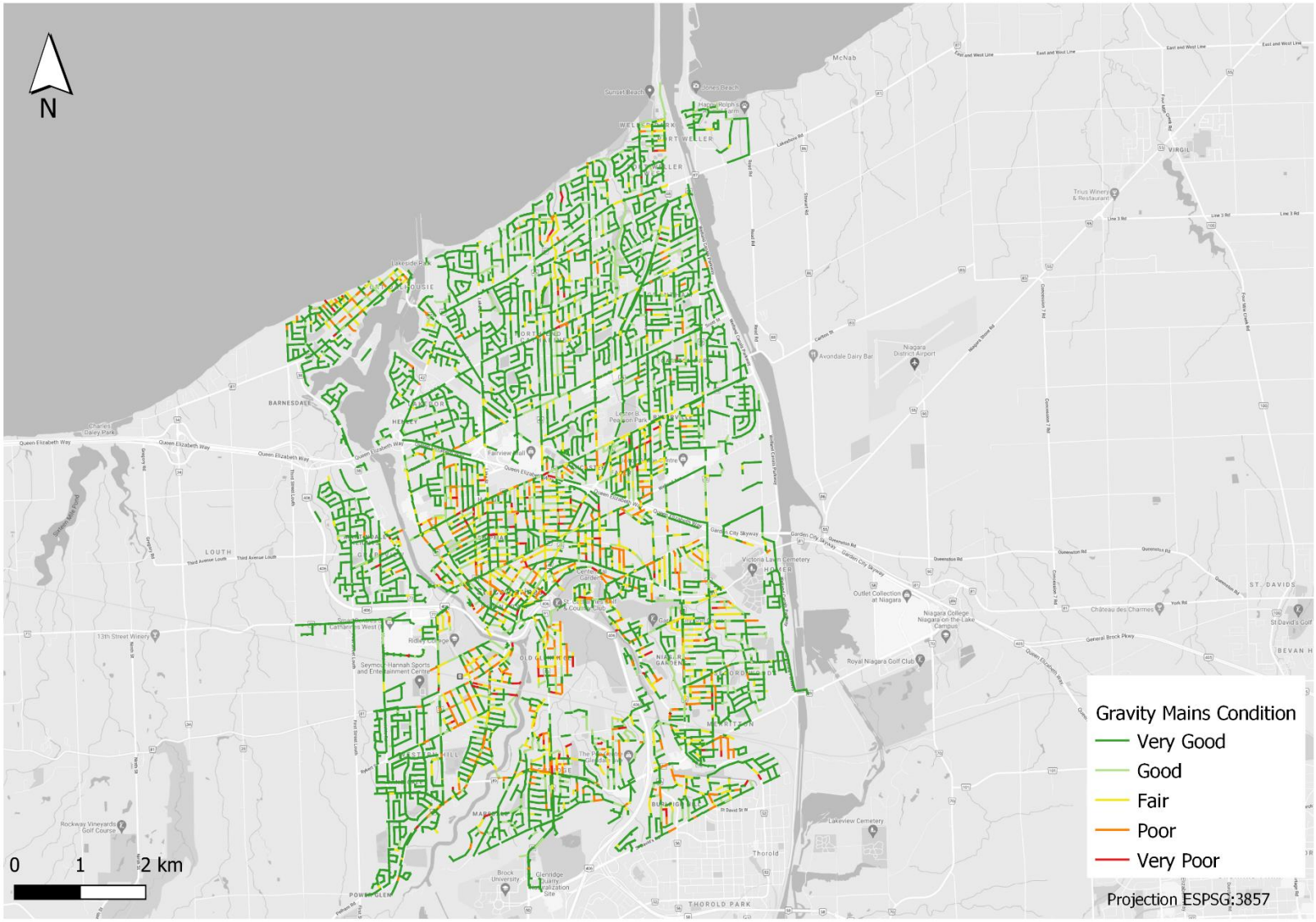


Figure 20. Condition Distribution by Location for all Gravity Mains



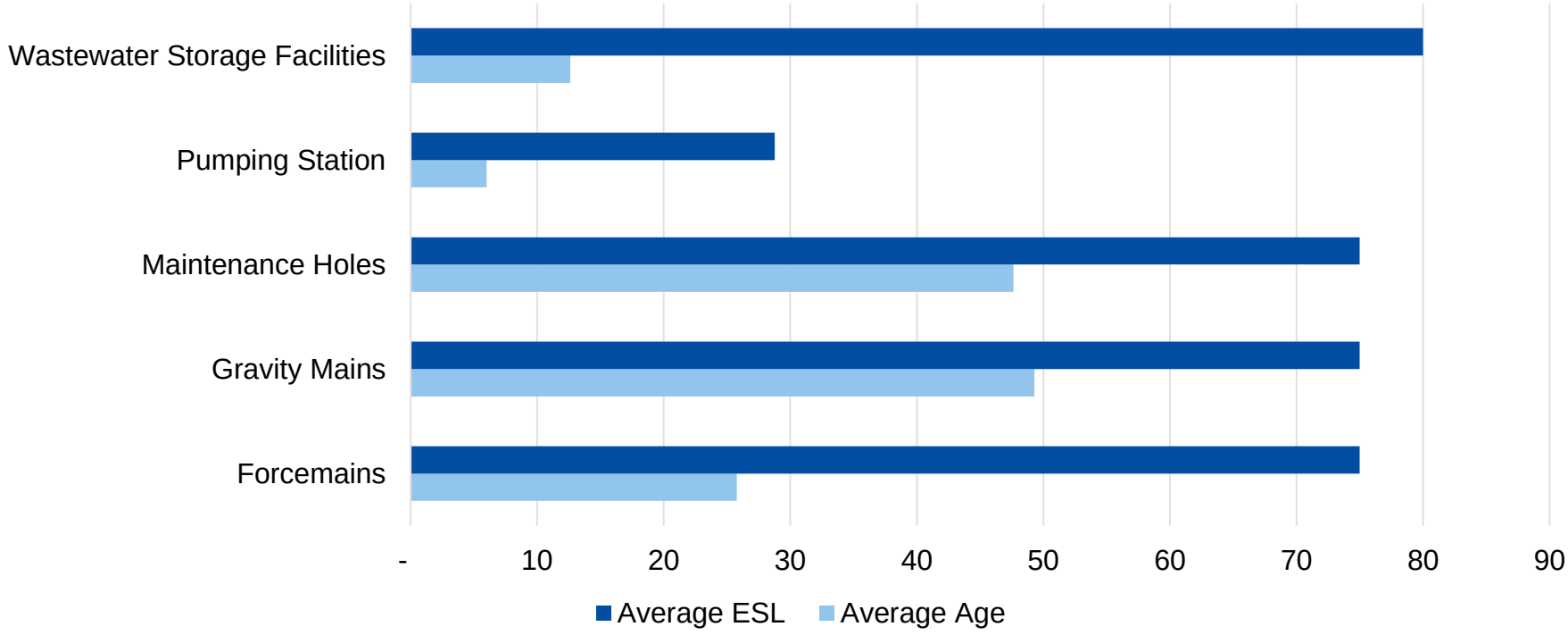
3.1.3 Wastewater Age Summary

Comparing the average age of the assets with the average estimated service life (ESL) provides a representation of the average overall portfolio remaining life.

The figure below summarizes the average ages of each asset type in the wastewater collection system.

It is apparent that the gravity mains are performing better than their age suggests. One concern was that old, vitrified clay sewers could be observed as good from CCTV inspections but are actually very brittle and susceptible to collapse. It is recommended that the staff further review the performance data, especially for older assets.

Figure 21. Average Age as a Proportion of Expected Service Life by Asset Type All Wastewater Assets



3.2 Wastewater Levels of Service

The City wastewater services are based on providing sustainable and reliable collection of wastewater that avoids basement flooding and environmental impacts.

The City follows the Ontario Ministry of Environment, Conservation and Parks (MECP) Design Guidelines for Sewage Works as minimum standard for the design, review, approval and installation of sewage works.

As part of the City's efforts to improve wastewater services, the City has implemented a program to separate combined sewers into individual wastewater and stormwater mains, improving the resiliency of the system. An additional benefit of separating storm and wastewater sewers is that it reduces the quantity of stormwater being treated at the wastewater treatment plants, therefore reducing costs.

The Key Service Attributes associated with the wastewater LOS and their associated statements are defined in the **Table 19.**

Table 19. Wastewater LOS Service Attributes

Service Attribute	Attribute Statement
Scope	Providing adequate wastewater services to the community
Reliability	Providing wastewater services with minimal interruptions
Environmental Stewardship	Providing wastewater services that have minimal impacts on the environment
Cost Efficiency	Providing wastewater services in an efficient manner

The following sections provide a summary of the levels of service for the City's wastewater services including those required by the O.Reg.588/17.

3.2.1 Wastewater Customer Levels of Service

The City's CLOS provides a means to assess the level to which customer expectations are being met. The following provides a summary of the CLOS associated with St. Catharines wastewater service.

- **Description of the user groups or areas of the municipality that are connected to the municipal wastewater system. (Scope)**
  Within the urban boundary there are 563 km of City-owned main sewers that drain to Region-owned trunk sewers which carry wastewater to one of the two sewage treatment plant. The system also has nine wastewater storage facilities to store sewage that cannot be accommodated in the existing sewers during wet weather.

- **Description of how combined sewers in the municipal wastewater system are designed with overflow structures in place which allow overflow during storm events to prevent backups into homes. (Reliability)**
  75% of the City's collection system is combined or partially combined sewers. During large rainstorms, the volume of flow can exceed the capacity of the sewer system. When this happens, a portion of the flow is diverted away from the wastewater plant and untreated sewage, mixed with storm water, is released directly into the environment. The diversions occur at a series of overflow regulator chambers located along the combined sewer system. The strategically located overflow regulators are designed to prevent sewer backups. The system also has nine wastewater storage facilities to temporarily store sewage that cannot be accommodated in the existing sewers during wet weather. The stored sewage is then released into the sewer system at a favorable time when the sewers can accommodate the extra volume.

- **Description of the frequency and volume of overflows in combined sewers in the municipal wastewater system that occur in habitable areas or beaches. (Reliability)**
  There are 53 locations where combined sewers can outlet to the environment. The number of overflows incidences is directly related to the duration and intensity of wet weather. Based on a hydraulic model of the sewer system, there were 21 overflow occurrences resulting in 48 ML discharged to the environment at eight locations in 2020.

- **Description of how stormwater can get into sanitary sewers in the municipal wastewater system, causing sewage to overflow into streets or backup into homes. (Reliability)**
  In areas with combined sewers, water may enter the system directly through catch basins. Other sources of inflow to the sewer main can result from: stairway drains, driveway drains, floor drains/basement sump pumps, uncapped yard

cleanouts and downspouts. Groundwater infiltration can also enter from foundation drains.

Even in areas that are fully separated, water can still flow into the sanitary sewers through maintenance hole covers or infiltrate through pipe defects such as cracks, or offset joints and poor service connections.

- **Description of how sanitary sewers in the municipal wastewater system are designed to be resilient to avoid events that could cause sewage to overflow into streets or backup into homes. (Reliability)**
  Sanitary sewer design follows the Ontario Design Guidelines for Sewer Works and the St. Catharines Engineering Standards Manual.

  CCTV and smoke testing programs identify sources of infiltration and inflow and guide repairs.

- **Description of the effluent that is discharged from sewage treatment plants in the municipal wastewater system. (Reliability)**
  This regulatory metric is not applicable to the City as the sewage treatment plants are owned and operated by the Regional Municipality of Niagara.

Additional customer levels of service are provided in **Table 12**.

Table 20. Wastewater CLOS Indicator

Service Attribute	Customer Levels of Service	2020 Performance
Quality	Average Condition of Sewers	Good
Reliability	Length of Sewers in poor and Very poor condition	48 kilometres
	Percentage of wastewater assets in fair or better performance	81%
Cost Efficiency	Annual cost to provide wastewater service (per customer)	$330

3.2.2 Wastewater Technical Levels of Service

The City has defined technical requirements and key performance indicators that support internal reporting. The following provides a summary of the TLOS associated with the wastewater service at the City.

Table 21. Wastewater TLOS Metrics

Service Attribute	Technical Levels of Service	2020 Performance
Scope	Percentage of properties connected to the municipal wastewater system[(a)]	94%
Reliability	Percentage of wastewater assets in poor or better performance	91%
	Percentage by km of network with issues prone to blockages	6%
	Total number of Wastewater Storage Facilities	9
	The number 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[(a)]	0.00052
Reliability (Cont.)	The number of connection-days per year due to wastewater backups compared to the total number of properties connected to the municipal wastewater system[(a)]	0.0106
	The number of effluent violations per year due to wastewater discharge compared to the total number of properties connected to the municipal wastewater system[(a)]	This metric is not applicable to the City as the sewage treatment plants are owned and operated by the Regional Municipality of Niagara.

Notes:

(a) Required by O.Reg. 588/17

3.3 Wastewater Lifecycle Management Strategy

The levels of service presented in the previous section are supported by the achievement of a variety of lifecycle activities for wastewater assets in accordance with the activity types presented in **Table 5**. These activities extend the asset life and reduce overall lifecycle cost.

The water service staff implement a variety of lifecycle activities on its entire portfolio. **Table 22** provides a summary of these activities and the risk associated with not doing them.

Table 22. Wastewater Lifecycle Activities, Associated Risk, and estimated Lifecycle Cost

Lifecyle Activity Type	Asset Management Practices	Risk Associated with the Activity	Equivalent Annual Cost (2022 to 2032)
Non-Infrastructure Solutions	**Linear Assets** • Capacity analysis to confirm the capacity of the wastewater system in current flow demands. • Hydraulic Analysis is conducted to evaluate the capacity of the linear wastewater system and identify areas that require improvements. • Flow Monitoring program in place to calibrate and confirm estimates related to hydraulic model. • CCTV and maintenance hole inspections. • Smoke testing program in place to identify cross connections between sewer and storm systems. **Vertical Assets** • Annual reports to Ministry on overflows	• Potential risk of sewer backup and basement flooding. • Asset deterioration is over or underestimated. • Regulatory requirement and standard changes. • Reduced ability to understand potential impacts of climate change on the infrastructure.	$ 912,000 Based on the historical 2017 to 2021 average expenditures. It is recommended that future studies be identified based on best practices and cost estimates be developed.

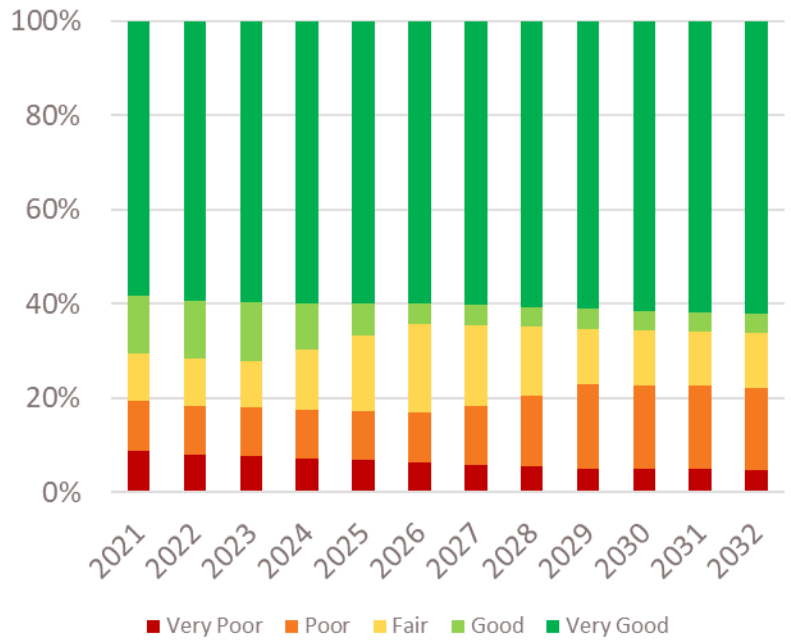
Lifecyle Activity Type	Asset Management Practices	Risk Associated with the Activity	Equivalent Annual Cost (2022 to 2032)
Maintenance Activities	**Linear Assets** • Routine maintenance program including sewer flushing and reaming and spot repairs. • As required clearing of blocked lateral connections. **Vertical Assets** • Routine maintenance program including inspection and equipment checks.	• Increased lifecycle cost if maintenance is done improperly or not with scheduled frequency. • Resource limitations to conduct unplanned, urgent work. • Insufficient maintenance may contribute to asset failure resulting on service disruptions.	$ 1,680,000 Based on the 2020 to 2021 budget increase applied annually from 2021 onwards. Incorporating the maintenance of growth assets following construction.
Renewal / Rehab Activities	**Linear Assets** • Relining of sewer, including laterals. • Plastic maintenance hole inserts are used if the maintenance hole is identified as a major source of infiltration through the pick holes.	• Incorrect assumptions of the expected improvement in useful life after maintenance is completed. • Increased lifecycle cost if renewal/rehab are done improperly or not as scheduled. • Increased costs to treat increased amounts of inflow & infiltration	- Currently done on a reactive basis. A strategy needs to be developed to have a regular program to identify good candidates for the implementation of these technologies at an appropriate time and prior to an asset needing full replacement

Lifecyle Activity Type	Asset Management Practices	Risk Associated with the Activity	Equivalent Annual Cost (2022 to 2032)
Replacement / Construction Activities	• Replacement of deteriorated assets.	• Coordination with other asset classes (if applicable) might delay or advance the timeframe of construction activities. • Delays in construction could result in cost over-runs.	$ 15,068,000 Forecasted based on the lifecycle management activities.
Disposal Activities	• Decommissioning assets at the end of their useful life. • Disposal of abandoned or obsolete infrastructure during construction projects.	• Improper disposal could lead to environmental impacts and result in cost overruns.	$ 2,000 Based on the 2017 to 2021 average disposals
Service Improvement Activities	**Linear Assets** • Annual replacement program to separate combined sewers. • Sewer main upsizing/downsizing based on design standard compliance and flow requirements.	• Lack of improvements can result in health and safety risks as well as negative environmental impacts. • Continued cost to treat inflow and infiltration. • Reduced capacities in the system to accommodate new developments without upgrades.	$ 884,000 Based on the 2017 to 2021 average service improvement activities

Lifecyle Activity Type	Asset Management Practices	Risk Associated with the Activity	Equivalent Annual Cost (2022 to 2032)
Growth Activities	• Asset additions or upsizing to accommodate for population growth in new and existing sub-divisions within the City.	• Growth activities are delayed or cancelled resulting in system being unable to accommodate increased growth demands. • Reduced capacity in the system to accommodate new developments without upgrades • Reduced ability to adapt to increased intensity rainfall events.	$ 396,000 Based on the 2017 to 2021 average growth activities. There were no development charges forecasted for this service.

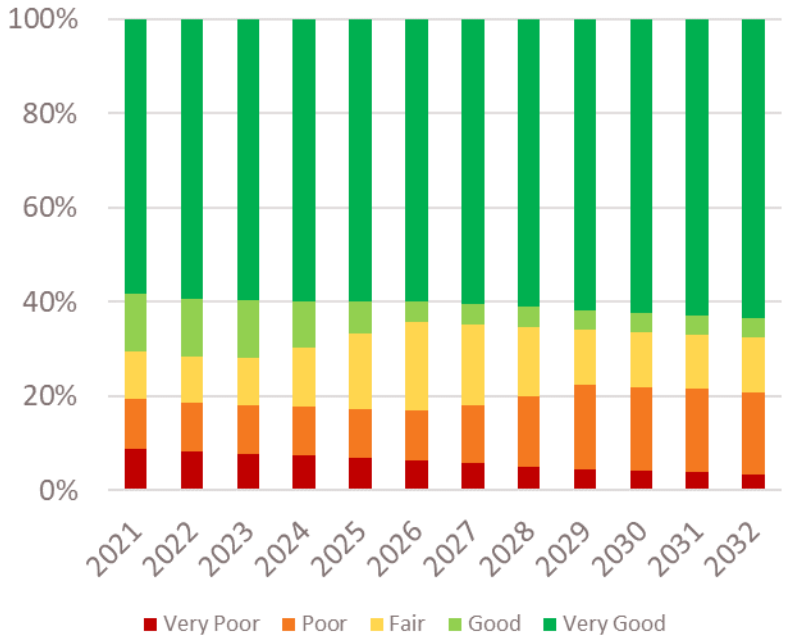
The City uses these strategies to plan work and determine future expenditure needs. The TLOS used in the AM analysis for water assets was defined as maintaining the current portion of assets with poor or better performance. The cost to maintain this scenario was determined to be $10.9M annually over a 25-year period and resulted in the performance forecast shown in **Figure 22**. The percentage of assets in poor or better condition holds around 91%.

Figure 22. Wastewater Condition Distribution Performance with Cost to Maintain LOS



The current planned budget was also analyzed to determine if a funding gap exists. The current anticipated investments go from $6.3M to ~$12M by 2029. This resulted in the performance forecast shown in **Figure 23**. The percentage of assets in poor or better condition increases to 97% by 2032.

Figure 23. Wastewater Condition Distribution Performance with Anticipated Budget



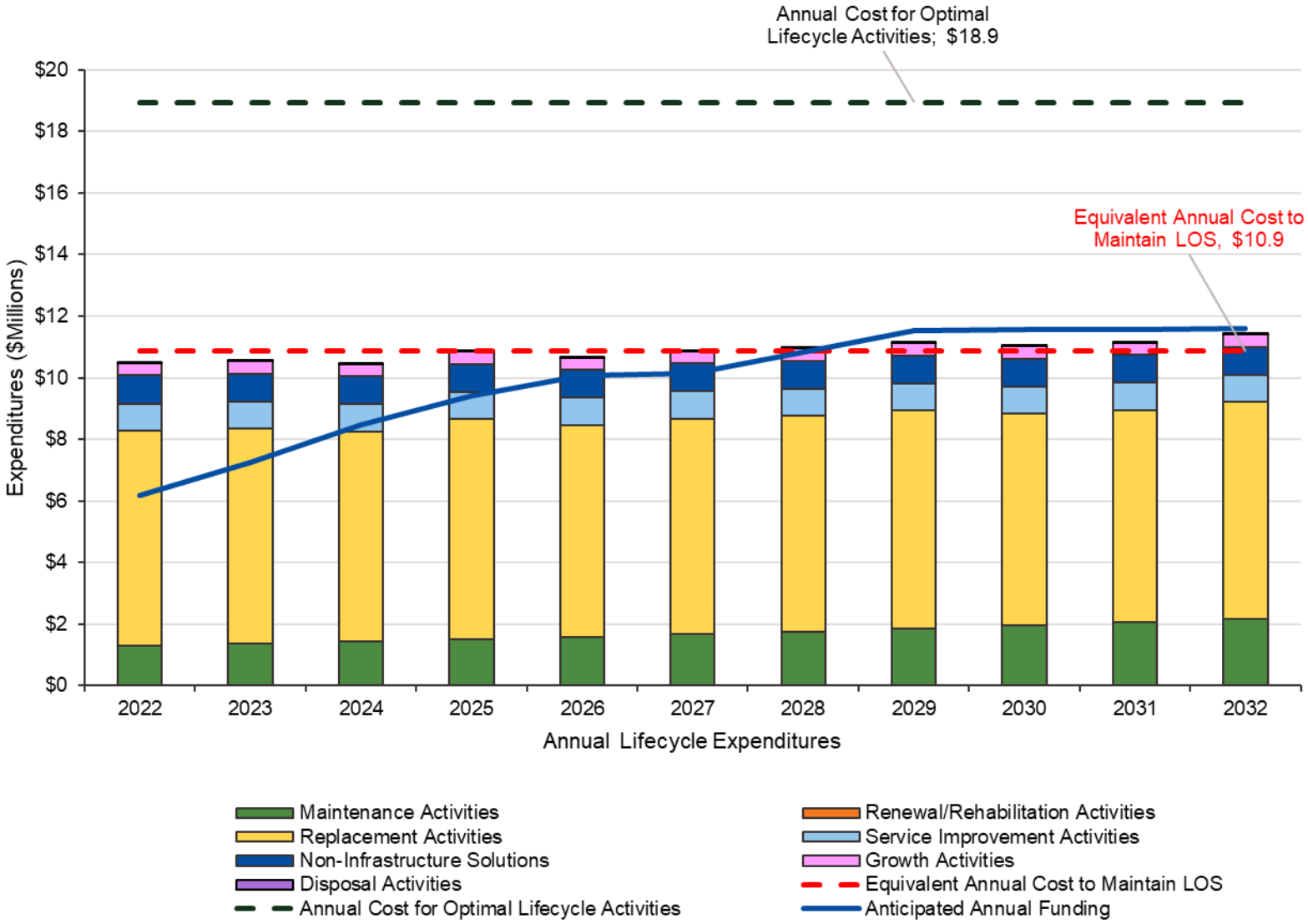
Additionally, an optimal lifecycle scenario was analyzed, which was used to determine the cost to meet all lifecycle strategies described in **Table 22**. This scenario addresses the backlog and ensures no asset reaches very poor performance. The cost to achieve this scenario was determined to be $18.9M annually over a 25-year period and resulted in the performance forecast shown in **Figure 24.**

The reason the anticipated investment levels increase above the annual Cost to Maintain LOS are because the data currently relies on the zoom camera and CCTV condition assessments for the sewers. The City has found that these approaches can overestimate how well the sewers are performing. Recommendations for data review are provided in the conclusions.

The costs for the 10-year lifecycle forecast are presented in **Figure 25**. The graph shows the forecasted expenditures by lifecycle category for the cost to maintain scenario. The equivalent annual cost to maintain LOS, the annual expenditures for the optimal lifecycle scenario and the anticipated annual funding is also provided on the graph. It is recommended that the City should continue with anticipated spending.

Figure 24. Wastewater Condition Distribution Performance with Optimal Lifecycle Activities

Figure 25. Wastewater Forecasted Lifecycle Needs



3.4 Wastewater Service Associated Risks

In addition to the risk associated with the lifecycle activities for this service described in **Table 22**, the following are considered general risks with this service:

- Gravity main deterioration could result in a collapsed sewer, possible sinkholes, third party damage, and environmental contamination;
- Capacity limitations could result in increased releases to the environment;
- Sewer backups could take place as part of failures on the overall system or due to capacity issues;
- The failure of storage facilities could result in system backups or increase release of sewer into the environment; and
- Pump station failure could result in sewer backups including overflows and potential basement flooding.

3.5 Wastewater Climate Change Considerations

The wastewater collection system is greatly influenced by wet weather conditions which cause inflow and infiltration of rainwater into the system, decreasing its capacity for sanitary flow and increasing the cost of treatment. With climate change, increases in the intensity, duration, and frequency of rain events leads to more runoff entering the system and the greater likelihood of basement flooding and discharges of combined flow to local waterbodies. Similarly, more rain and less snow in the winter as well as rain on snow and ice during freeze-thaw cycles increases the chance of flooding.

Preventative maintenance, rehabilitation of wastewater infrastructure, and increased focus on green infrastructure and low impact development which replicates pre-development hydrology are critical to moderate increased flood risk. This includes actions for residents such as disconnecting downspouts and foundation drains from the sewer system to decrease peak flows. This helps reduce the need for expensive wastewater storage facilities which store peak flows to reduce combined sewer overflows. Design and operating modifications and development of emergency response procedures can also help mitigate some predicted adverse impacts.

3.6 Wastewater Data Confidence

The following data was used to support this chapter's assessment of the City's wastewater assets.

- Gravity mains, force mains, and maintenance holes: GIS shapefiles of the full inventory for these categories with their associated key attributes such as installation date, diameter, and length;

- Unit cost summary documentation provided by the City based on historical data;
- City tangible capital asset estimated service life values;
- Pumping station drawings;
- Combined sewage storage facility inventory with install dates and replacement cost for most assets; and
- City zoom camera inspection database.

The following assumptions were made during the assessment of the data:

- Gravity main and forcemain condition data was taken from the zoom camera and CCTV inspection peak structural PACP scores. While zoom camera inspections covered most of the sewer system, there are limited recent CCTV inspection records for a large portion of the system.
- The wastewater pumping station inventory was based on high-level information available from the drawings. The costs of these assets were determined using estimates based on similar assets and their age was assumed as per the drawings provided; and
- Replacement costs were forecasted based on available unit rates for the diameters not included on the original dataset.
- Growth and expansion have been assumed based on projected development charges and historical growth budgets, however the City has a large portion of combined sewers, and expansion needs should be quantified moving forward.

A detailed data confidence assessment is provided in **Table 22**:

Table 23. Wastewater Data Confidence Assessment

Asset Category	Confidence Rating	Confidence Data
Gravity Mains	C	Condition was based on Zoom Camera and CCTV inspections. Age was used where not available.
Force Mains	B	Minor assumptions were made on age, replacement costs, and condition
Maintenance Holes		
Wastewater Storage Facility		
Pumping Station	D	Data based on historical information and assumptions on key parameters

Stormwater

The City of St. Catharines collects stormwater from within its boundary to be released to Lake Ontario. The City is responsible for the stormwater collection system that includes the following assets:

- 404 kilometres of Stormwater Mains
- 31 Oil & Grit Separators
- 6,484 Maintenance Holes & Catchbasins
- 3 Stormwater Ponds
- 1 Constructed Wetland
- 11 Open Channels

It should be noted that stormwater collection is generally the responsibility of the City except in situations where the primary purpose is to drain a Regional right of way. Therefore, all sewer 675mm and less on Regional roads are the responsibly of the Region.

Estimated Replacement Value

The City's stormwater collection system is valued at approximately **$876 million.**

Condition Rating

The overall average condition of the assets for the stormwater collection system is **Good.**

4.0 Stormwater

Stormwater infrastructure collects and conveys rainwater runoff from wet weather events, minimizing flooding and erosion. As we see more frequent and greater intensity storms the importance of the stormwater collection system is ever increasing.

The following section summarizes the portfolio associated with the City's Stormwater Service.

4.1 Stormwater State of Local Infrastructure

4.1.1 Stormwater System Valuation

The City's stormwater collection system is comprised of linear infrastructure that includes stormwater mains, oil and grit separators, stormwater maintenance holes, and catch basins. For the purpose of this assessment, service connections were considered components of the stormwater mains. It should be noted that while roadside ditches provide a service, there is currently limited information on them, and therefore they have not been incorporated into the analysis.

For the valuation of the stormwater collection system, the replacement values are developed based on replacement with similar assets (like-for-like) on a complete and standalone basis. These were calculated based on historical values and market replacement costs for the similar specification assets.

Based on the approach taken to calculate the replacement values for each asset category, the overall data confidence grade is **C** for stormwater mains, maintenance holes, and catch basins and **D** for all remaining assets.

It should be noted that the asset register information is based on the system that is in place and does not take into account identifying the gaps in the performance or needs of the overall system.

Table 24. Stormwater System Inventory Valuation

Asset Type	Asset Category	Count	Unit	Replacement Value (2021 Dollars)
Stormwater Collection	Stormwater Mains [(a)]	403,982	Metres	$ 819,047,000
	Stormwater Maintenance Holes	6,484	Each	$ 55,416,000
Treatment & Control	Oil & Grit Separators	31	Each	$ 824,000
Stormwater Discharge	Open Channels	3,575	Metres	TBC
Storage Facilities	Wetlands	1	Each	$ 540,000
	Stormwater Ponds	3	Each	TBC
Overall Stormwater System Replacement Value				**$ 875,827,000**

(a) Stormwater mains include 13,236 catch basins in the City's portfolio.

The overall distribution of replacement values by asset type for the entire stormwater collection system is as shown in **Figure 26**. The stormwater mains have the highest replacement value in the portfolio, totaling 94% of the entire system. The remaining assets correspond to 6% of the value associated with the stormwater collection system.

As stormwater mains represent the majority of the stormwater collection asset replacement values, **Figure 30** provides a summary of the distribution of replacement values based on materials.

It should be highlighted that stormwater associated operational costs are covered by wastewater; however, as it has been stated, the City is moving toward separating the costs associated with this service.

Figure 26. Asset Replacement Value for All Stormwater Assets

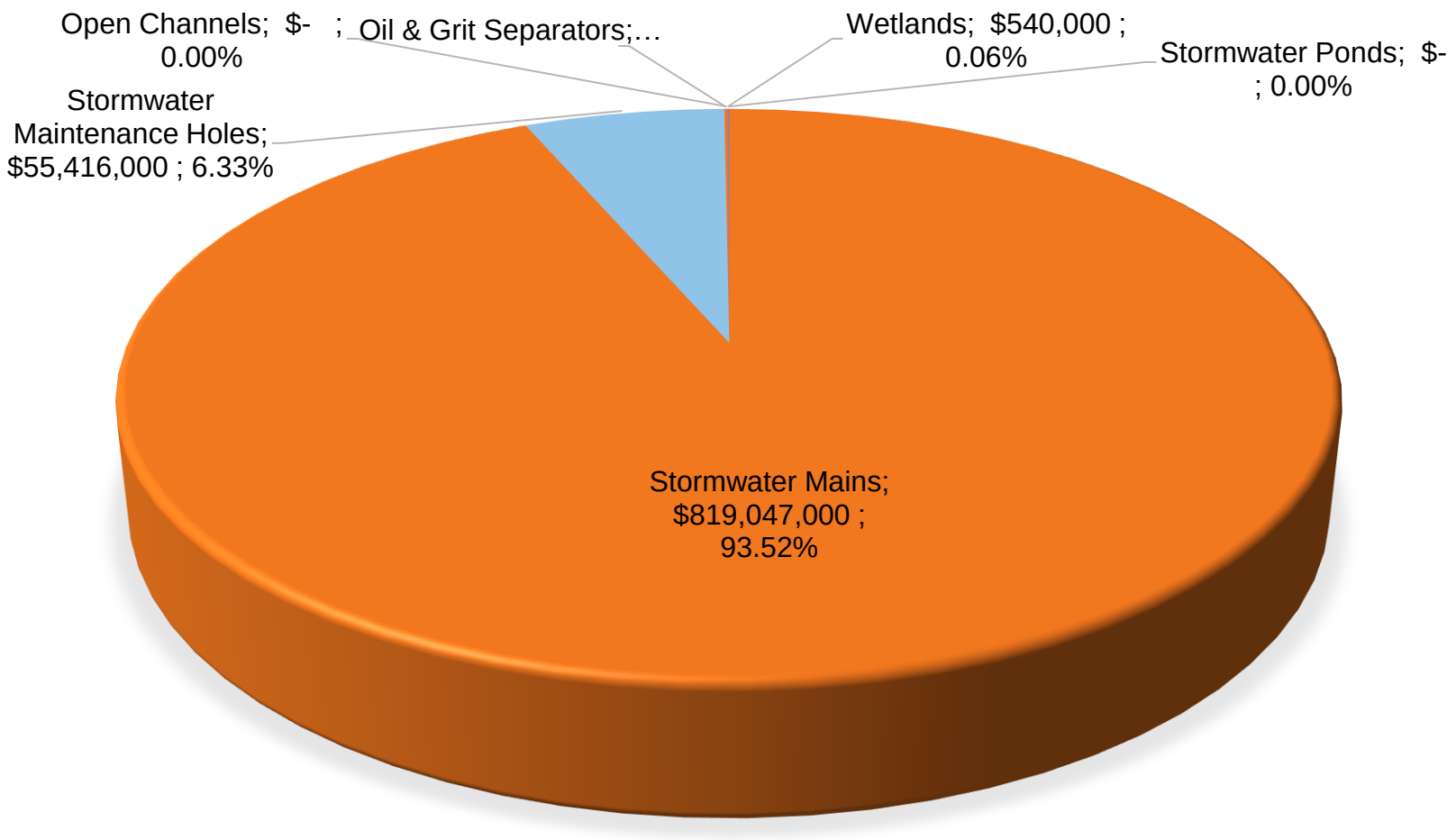
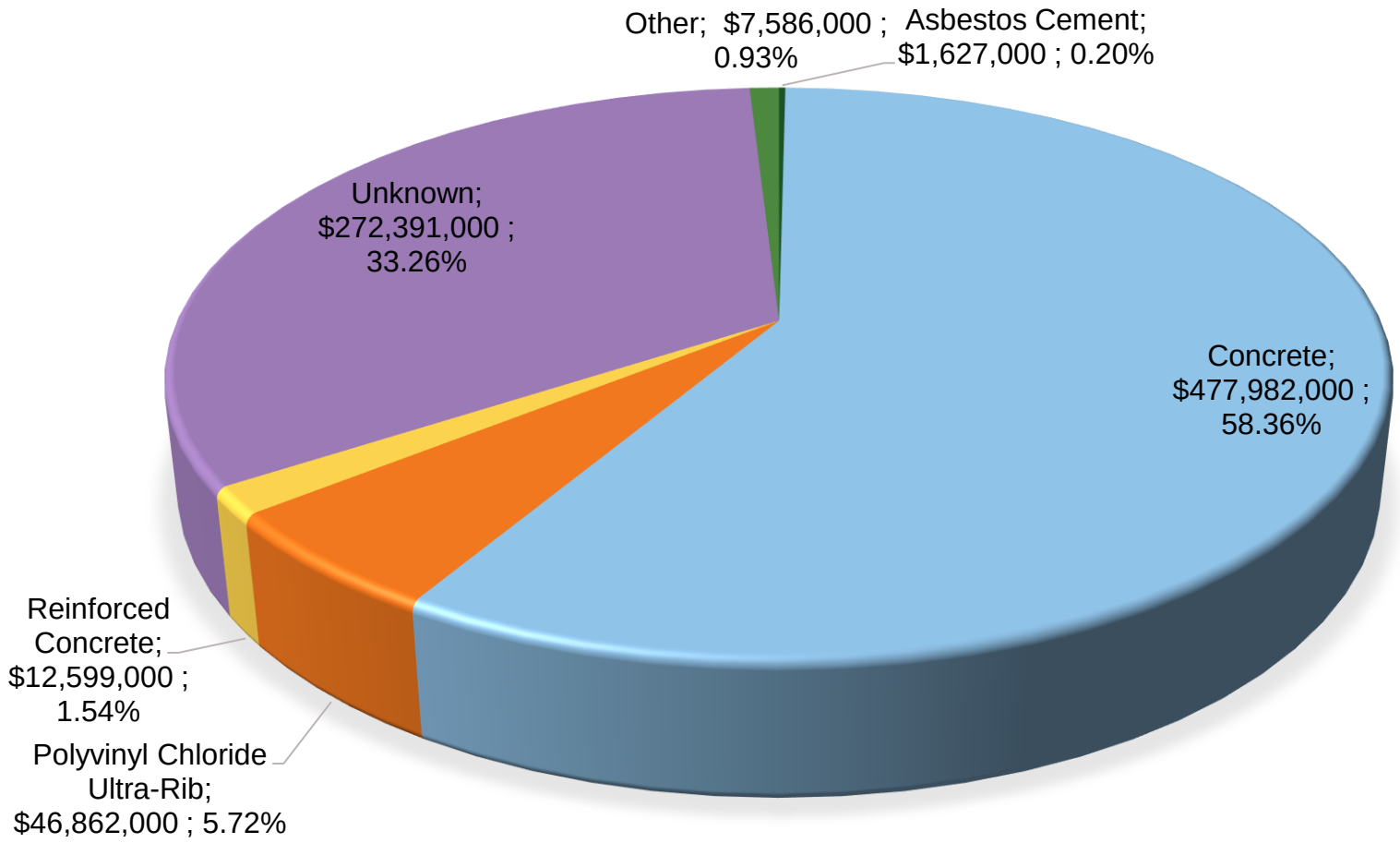


Figure 27. Asset Replacement Value for All Stormwater Mains by Material Type



The figure below summarizes the decade of the year of installation by replacement value.

Figure 28. Distribution by Replacement Value for all Stormwater Mains by Installation Decade

4.1.2 Stormwater System Condition

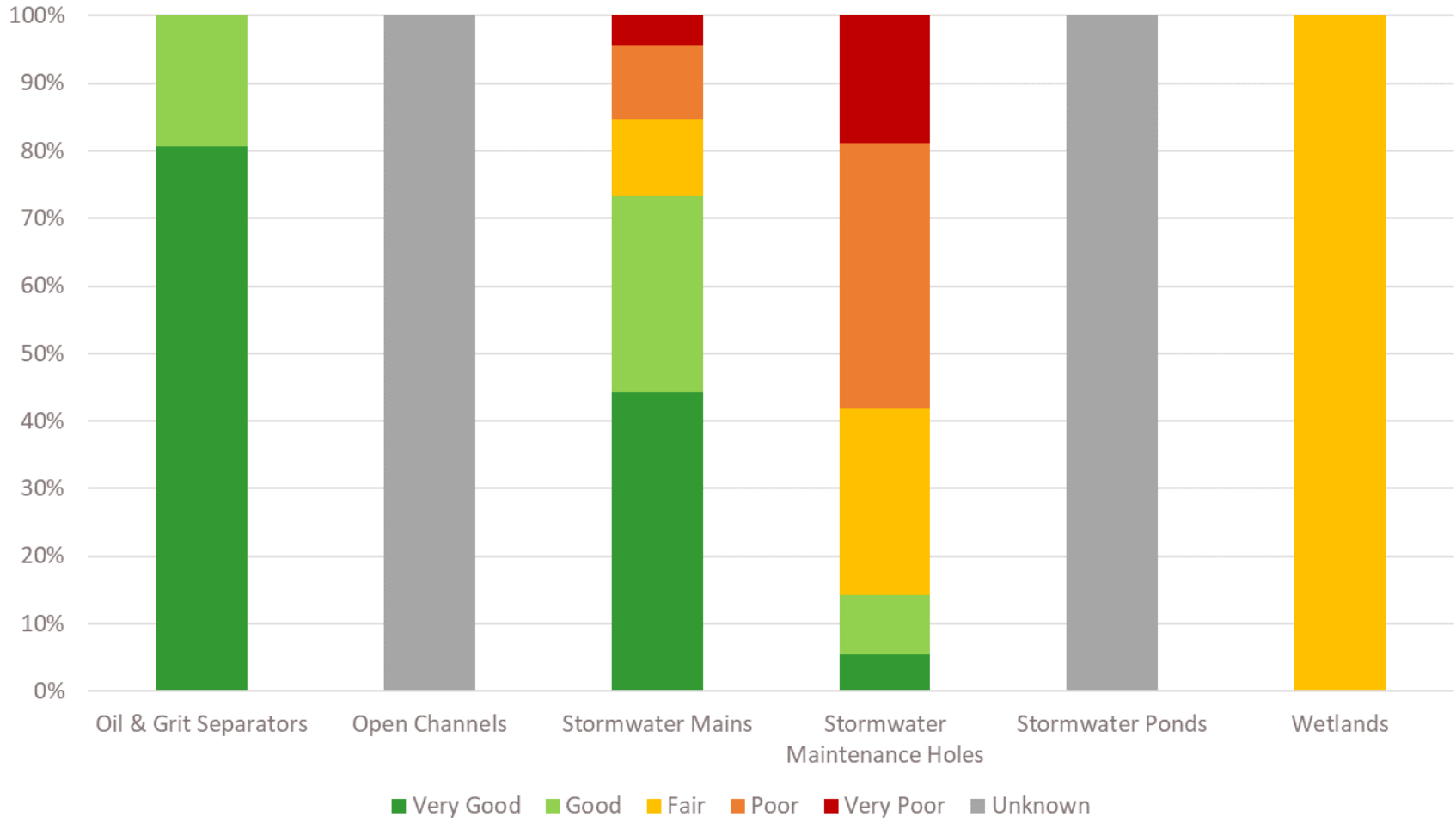
Using deterioration curves based on estimated remaining life as per **Table 4**, a condition score was computed for each asset into five rating categories ranging from Very Good to Very Poor. For storm sewers, where a PACP condition score was available, the score was used to estimate the condition. The assessments were completed using zoom camera inspections which is limited in that approximately 30% of the pipe is assessed.

The assumption is that this is indicative of the remaining pipe, however, it is known that this is not always the case and should be validated in the future. Where that was not available, a Markov deterioration model was used to estimate the condition based on age. The current condition of assets has been summarized and weighted by replacement value in **Figure 29**.

The stormwater main condition distribution has been represented by diameter in **Figure 30** indicating the percentage of system length these represent. The condition ratings are visualized in the map shown in **Figure 31**.

Overall, 5% of the stormwater assets are in the very poor rating category (based on replacement value) and 13% are in the poor category.

Figure 29. Condition Distribution by Replacement Value for all Stormwater Asset Types



Note: *67% of "Stormwater Maintenance Hole" assets are based on condition inspections according to the Manhole Assessment Certification Program (MACP). Where condition data was not available, age has been used to estimate condition.*

Figure 30. Condition Distribution by Replacement Value for all Stormwater Mains

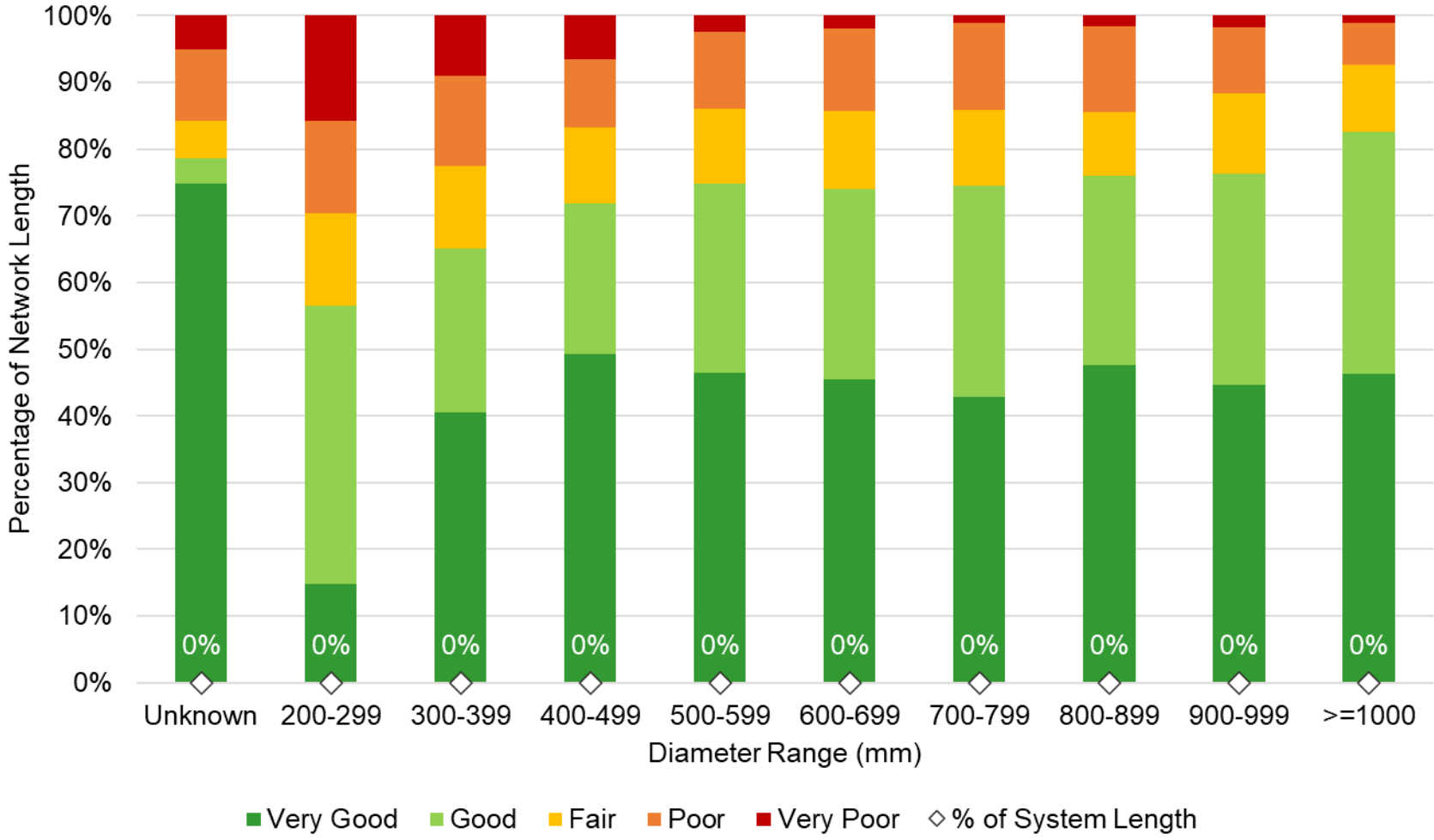
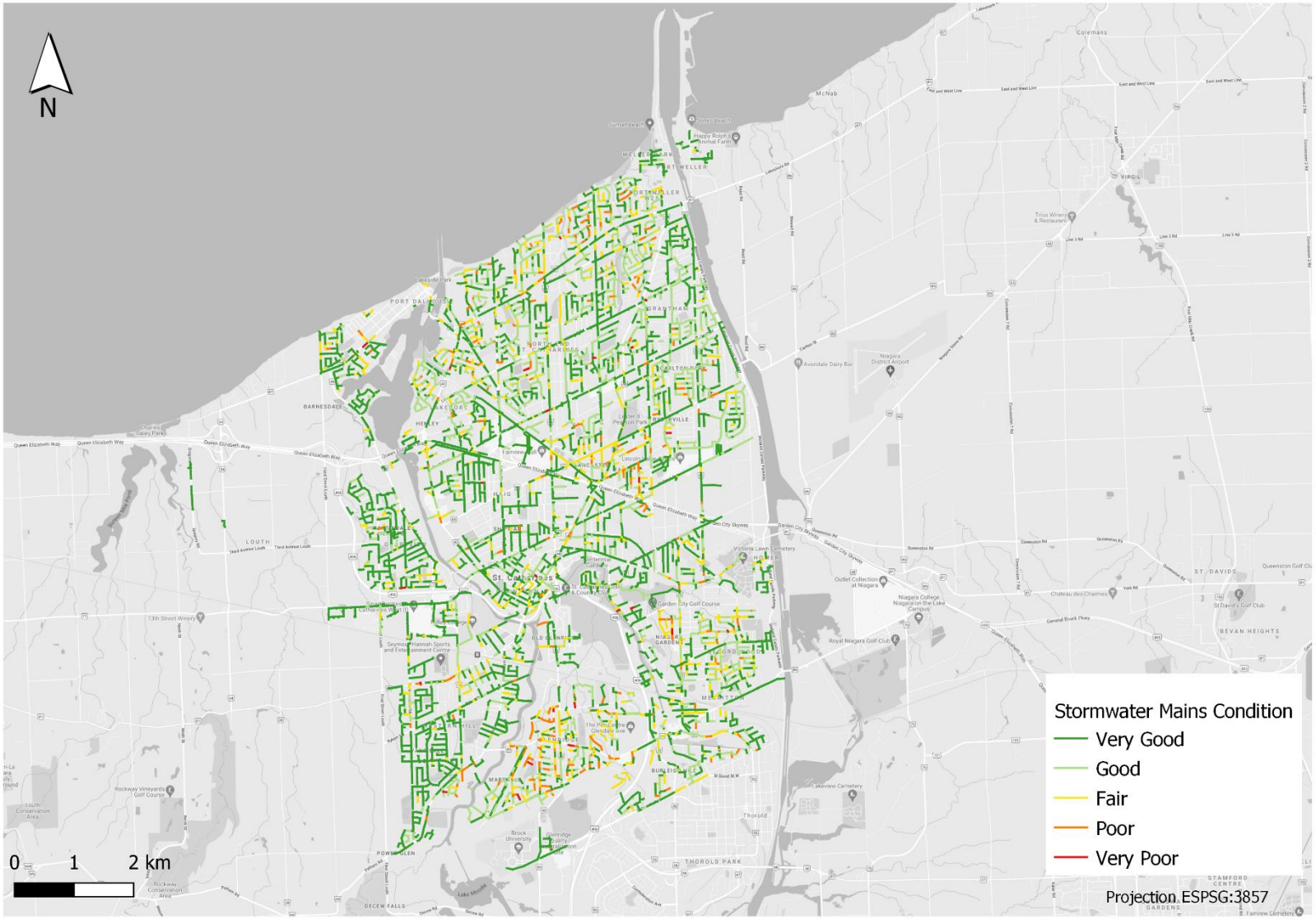


Figure 31. Condition Distribution by Location for all Stormwater Mains

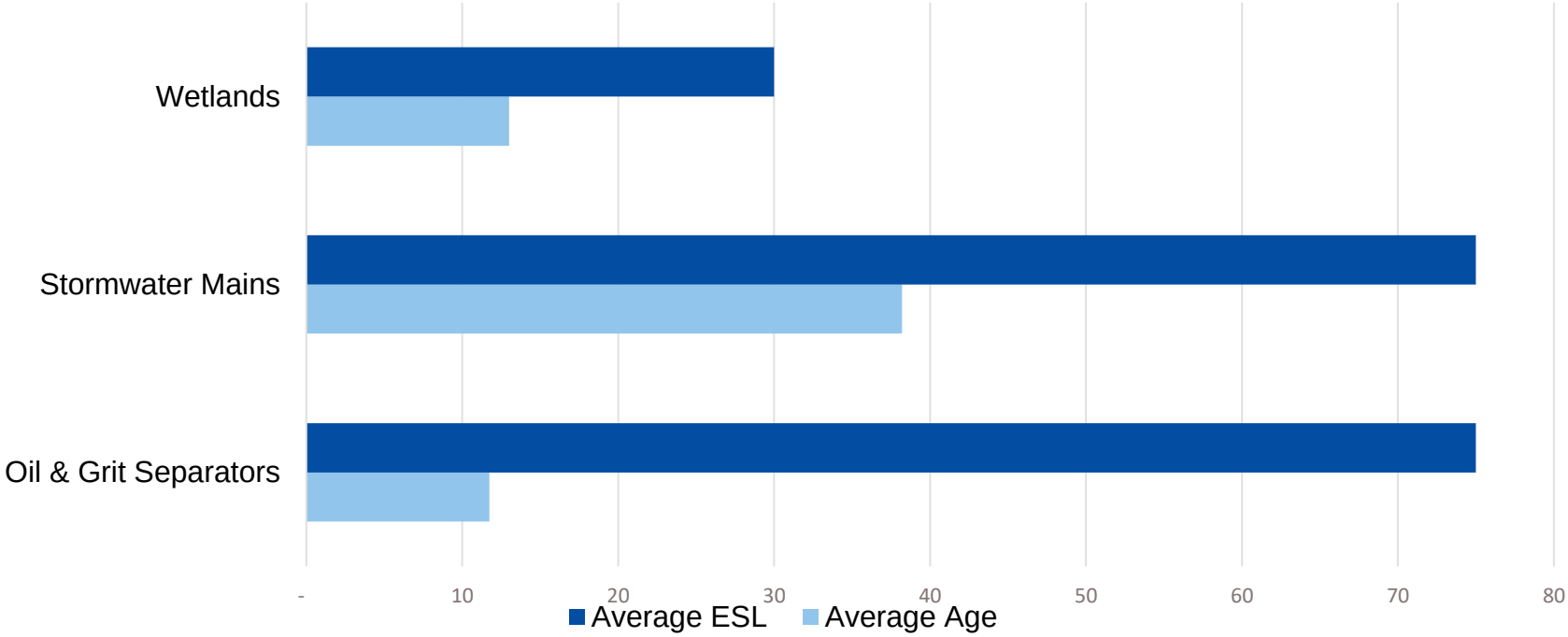


4.1.3 Stormwater Age Summary

By comparing the average age of the assets against the average estimated useful life, an understanding of the asset remaining life can be ascertained. The figure below summarizes the average age of each asset type in the stormwater collection system.

Stormwater Ponds and Open Channels installation dates are unknown and therefore these have been excluded from **Figure 32**.

Figure 32. Average Age as a Proportion of Expected Service Life by Asset Type All Stormwater Assets



4.2 Stormwater Levels of Service

The City is committed to providing effective, sustainable, and reliable drainage of stormwater to both protect and benefit the community and environment.

The Key Service Attributes associated with the stormwater LOS and their associated statements are defined at the table below:

Table 25. Stormwater LOS Service Attributes

Service Attribute	Attribute Statement
Scope	Providing adequate stormwater services to the community.
Reliability	Providing stormwater services with minimal impact to the community.
Environmental Stewardship	Providing stormwater services that protect and benefit the environment.
Cost Efficiency	Providing stormwater services in an efficient manner.

The following sections provide a summary of the levels of service for the City's stormwater services including those required by the O.Reg.588/17.

4.2.1 Stormwater Customer Levels of Service

The City's CLOS provides a means to assess the level to which customer expectations are being met. The following provides a summary of the CLOS associated with the stormwater service at the City.

- **Description, which may include maps, of the user groups or areas of the municipality that are protected from flooding, including the extent of the protection provided by the municipal stormwater management system (Scope)**

  To protect areas from flooding, storm water is conveyed across the City though 404 km of storm water pipes as well as along overland drainage routes, swales, ditches, and natural watercourses. Some older established areas utilize combined sewers to drain storm water; these assets are included in wastewater system. Oil and Grit Separators, stormwater ponds and a constructed wetland help control the quantity and quality of the storm water.

The following table provides additional CLOS metrics for the City stormwater services.

Table 26. Stormwater CLOS Metrics

Service Attribute	Customer Levels of Service	Current Performance
Scope	Total number of catch basins	13,236
	Total length of stormwater network	404 kilometres
Quality	Average Condition of storm mains	Good
Reliability	Length of storm mains in poor or very poor condition	20 kilometres
	Percentage of stormwater assets in fair or better performance	82%
Cost Efficiency	Annual cost to provide stormwater service (per household)	$148

4.2.2 Stormwater Technical Levels of Service

In addition to setting performance levels associated with customer expectations, the City has also defined technical requirements and key performance indicators that align or support the CLOS presented on **Table 26**.

The following provides a summary of the TLOS associated with the stormwater service at the City of St. Catharines.

Table 27. Stormwater TLOS Metrics

Service Attribute	Technical Levels of Service	2020 Performance
Scope	Percentage of properties in municipality resilient to a 100-year storm[(a)]	Currently not available, however the planned budgeted storm water master plan (SWMP) project will be able to partly address this metric. [1]
	Percentage of the municipal stormwater management system resilient to a 5-year storm[(a)2]	54%[2]
Reliability	Percentage of stormwater assets in poor or better condition	95%
	Percentage of catchbasins inspected and cleaned annually.	19%
	Percentage of storm sewers and appurtenances in Poor or Very Poor condition.	5%
	Number of complaints of flooding during a wet weather event.	1
	Percentage of network inspected within last 5 years.	38%
Env. Stewardship	Percentage of inspections & maintenance carried out on oil/grit separators annually	0% in 2020 61% in 2019

[1] *The currently budgeted storm water master plan (SWMP) project will be able to partly address this metric, but it is not yet clear if the SWMP work will fully address this point. The SWMP will not be delivered in time to meet the Core AMPs deadline.*

When storm water design is undertaken consideration is given to 100-year storm events (and other storm events) and any new subdivision or land development are asked to comply with City design standards.

[2] *When storm water design is undertaken, consideration is given to 5-year storm events (and other storm events) and any new subdivision or land development are asked to comply with City design standards. Since 1980 storm sewers have been typically designed to meet a 5-year storm. It is assumed that all sewer constructed since then or a minimum 54% of system is designed to be resilient to the 5-year storm. This number will be further refined with the development of SWMP.*

Service Attribute	Technical Levels of Service	2020 Performance
	Percentage of constructed wetlands in Poor or Very Poor condition	0%
Cost Efficiency	Maintenance cost per 100 km of stormwater network	$72
	Capital investments in comparison with sustainable investment forecast	25%
	Stormwater Conveyance Reinvestment Rate	0.1%

Notes:

(a) Required by O.Reg. 588/17

4.2.3 Stormwater Future Metrics for Consideration

As part of the definition of levels of service, the City identified possible level of service metrics that could be added to their framework in the future as data becomes available. The following table provides a summary of the metrics that have been proposed for future consideration.

Table 28. Stormwater LOS Future metrics

Service Attribute	Levels of Service Proposed Future Metric	Type of LOS
Reliability	Percentage of community with stormwater quality control	Customer
	Percentage of stormwater management facilities in Poor or Very Poor condition	Technical
Env. Stewardship	Percentage of community with stormwater quality treatment control	Technical
	Number of Stormwater management ponds that have exceeded their target dredging frequency	Technical

4.3 Stormwater Lifecycle Management Strategy

The levels of service presented in the previous section are supported by the achievement of a variety of lifecycle activities in accordance with the activity types presented in **Table 5**. These activities are targeted to extend the asset life, ensure levels of service are being met, and reduce overall lifecycle costs.

The stormwater service staff implement a variety of lifecycle activities on its entire portfolio. **Table 29** provides a summary of these activities and the risk associated with not doing them.

Table 29. Stormwater Lifecycle Activities, Associated Risk, and Estimated Lifecycle Cost

Lifecyle Activity Type	Asset Management Practices	Risk Associated with the Activity	Equivalent Annual Cost (2022 to 2032)
Non-Infrastructure Solutions	• Capacity analysis to confirm the capacity of the stormwater system in current flow demands. • Master Plans are developed and updated to provide a baseline for future growth projections in the stormwater system. • Natural watercourses review to include the assessment of channels for stormwater management. • CCTV inspections.[3]	• Growth projections follow an accelerated rate not following planned estimates. • Inadequate planning assumptions can provide incorrect forecasted estimates. • Regulatory requirement and standard changes. • Reduced ability to understand potential impacts of climate change on the infrastructure.	$ 179,000 Based on the historical 2017 to 2021 average expenditures. It is recommended that future studies be identified based on best practices and cost estimates be developed.
Maintenance Activities	• Routine maintenance program including spot repairs, catchbasin sump cleanout, outfall inspections, vegetation removal in culverts, wetlands, watercourses, ponds, and open channels. • As required clearing of blocked lateral connections. • Targeted reactive ditching program.	• Increased lifecycle cost if maintenance is done improperly or not with scheduled frequency. • Resource limitations to conduct unplanned, urgent work. • Insufficient maintenance may contribute to asset failure resulting in service disruptions.	$ 1,051,000 Based on a review of comparable stormwater O&M programs with an average O&M cost of $2,593/km of network. It is recommended that this cost be evaluated based on stormwater maintenance investment needs.

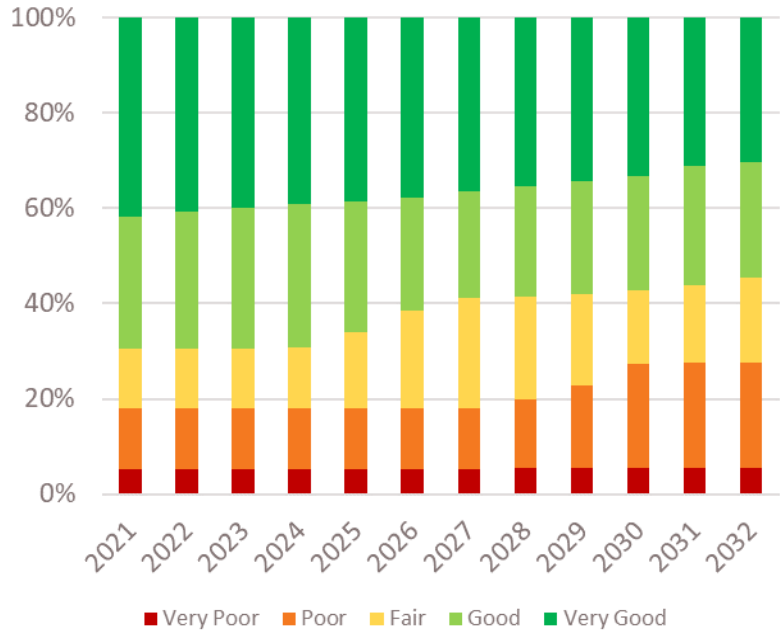
[3] *Historically storm sewers have not been CCTV inspected. Based on recommendations from a recent Zoom Camera Inspections Project, storm sewers are currently being prioritized for CCTV inspections. Once the priority CCTV inspections are completed, a system to periodically inspect and monitor the condition of storm sewers needs to be established and completed on required/necessary cyclical basis.*

Lifecyle Activity Type	Asset Management Practices	Risk Associated with the Activity	Equivalent Annual Cost (2022 to 2032)
Renewal / Rehab Activities	• Relining of stormwater mains. • Coordinated renewal and rehabilitation activities with the stormwater mains. • Dredging, re-grading, and excavating open channels, wetlands, and ponds to ensure the proper flow of water.	• Incorrect assumptions of the expected improvement in useful life after maintenance is completed. • Increased lifecycle cost if renewal/rehab are done improperly or not as scheduled.	$ 25,000 Forecasted based on the lifecycle management activities. Currently done on a reactive basis. A strategy needs to be developed to have a regular program to identify good candidates for the implementation of these technologies at an appropriate time and prior to an asset needing full replacement
Replacement / Construction Activities	• Replacement of deteriorated assets or based on client's complaints. • Replacement of concrete structures for concrete open channels.	• Coordination with other asset classes (if applicable) might delay or advance the timeframe for construction activities. • Delays in construction could result in cost over-runs.	$ 4,793,000 Forecasted based on the lifecycle management activities.
Disposal Activities	• Decommissioning assets at the end of their useful life. • Disposal of abandoned or obsolete infrastructure during construction projects.	• Improper disposal could lead to environmental impacts and result in cost overruns	- Stormwater assets are sometimes left in place or disposal is included within the removals associated with replacement/construction activities

Lifecyle Activity Type	Asset Management Practices	Risk Associated with the Activity	Equivalent Annual Cost (2022 to 2032)
Service Improvement Activities	• Annual program to separate combined sewers. • Stormwater main upsizing based on design standard compliance and flow requirements. • Installation of storm sewers in areas with ditches • Replacement of ditches based on identified needs due to flooding and drainage	• Lack of improvements can result in health and safety risks.	$2,298,000 Based on the historical 5-year capital funded service improvements as a percentage of the replacement value of the network
Growth Activities	• Asset additions to accommodate for population growth in new and existing sub-divisions within the City. • Annual sewer separation provides capacity within the system to accommodate growth.	• Growth activities are delayed or cancelled resulting in system being unable to accommodate increased growth demands. • Reduced ability to adapt to increased intensity rainfall events.	$ 1,020,000 Based the average projected development charges

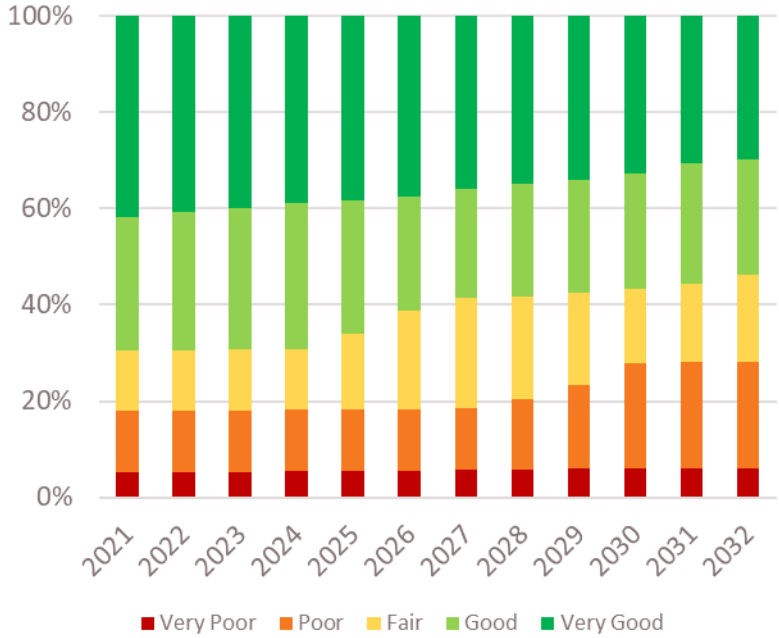
The City uses these strategies to plan work and determine future expenditure needs. The TLOS used in the AM analysis for wastewater assets was defined as maintaining the current portion of assets with poor or better performance. The cost to maintain this scenario was determined to be $5M annually over a 25-year period and resulted in the performance forecast shown in **Figure 33**. However, this is broken down to be $500K annually until 2032 and then $6M annually onwards. The percentage of assets in poor or better condition holds around 95%.

Figure 33. Stormwater Condition Distribution Performance with Cost to Maintain LOS



The current planned budget was also analyzed to determine if a funding gap exists. The current anticipated investments, $4.3M annually, resulted in the performance forecast shown in **Figure 34**.

Figure 34. Stormwater Condition Distribution Performance with Anticipated Budget



Additionally, an optimal lifecycle scenario was analyzed, which was used to determine the cost to meet all lifecycle strategies described in **Table 29**. This scenario addresses the backlog and ensures no asset reaches very poor performance. The cost to achieve this scenario was determined to be $9.3M annually over a 25-year period and resulted in the performance forecast shown in **Figure 35.**

The costs for the 10-year lifecycle forecast are presented in **Figure 36**. The graph shows the forecasted expenditures by lifecycle category for the cost to maintain scenario. The equivalent annual cost to maintain LOS, the annual expenditures for the optimal lifecycle scenario and the anticipated annual funding is also provided on the graph. It is recommended that the City should consider moderate investment increases to address the replacement and operational needs for the existing system.

Figure 35. Stormwater Condition Distribution Performance with Optimal Lifecycle Activities

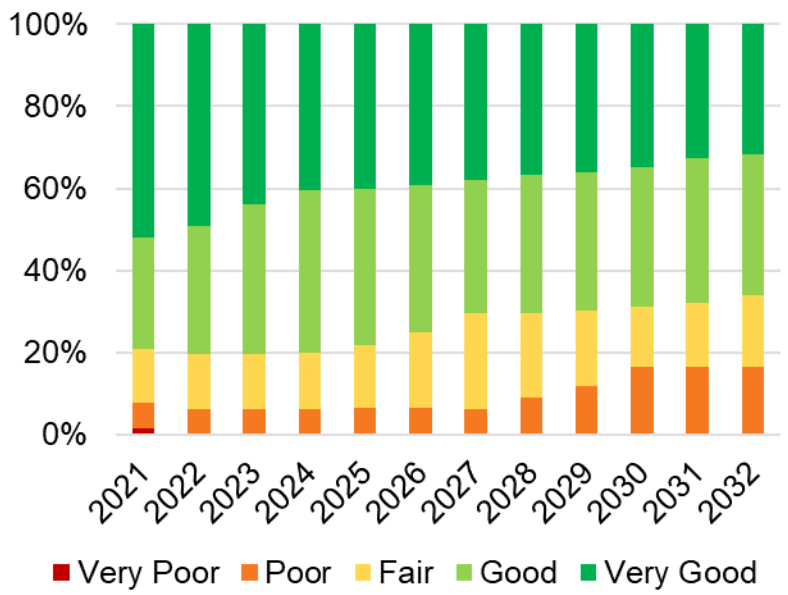
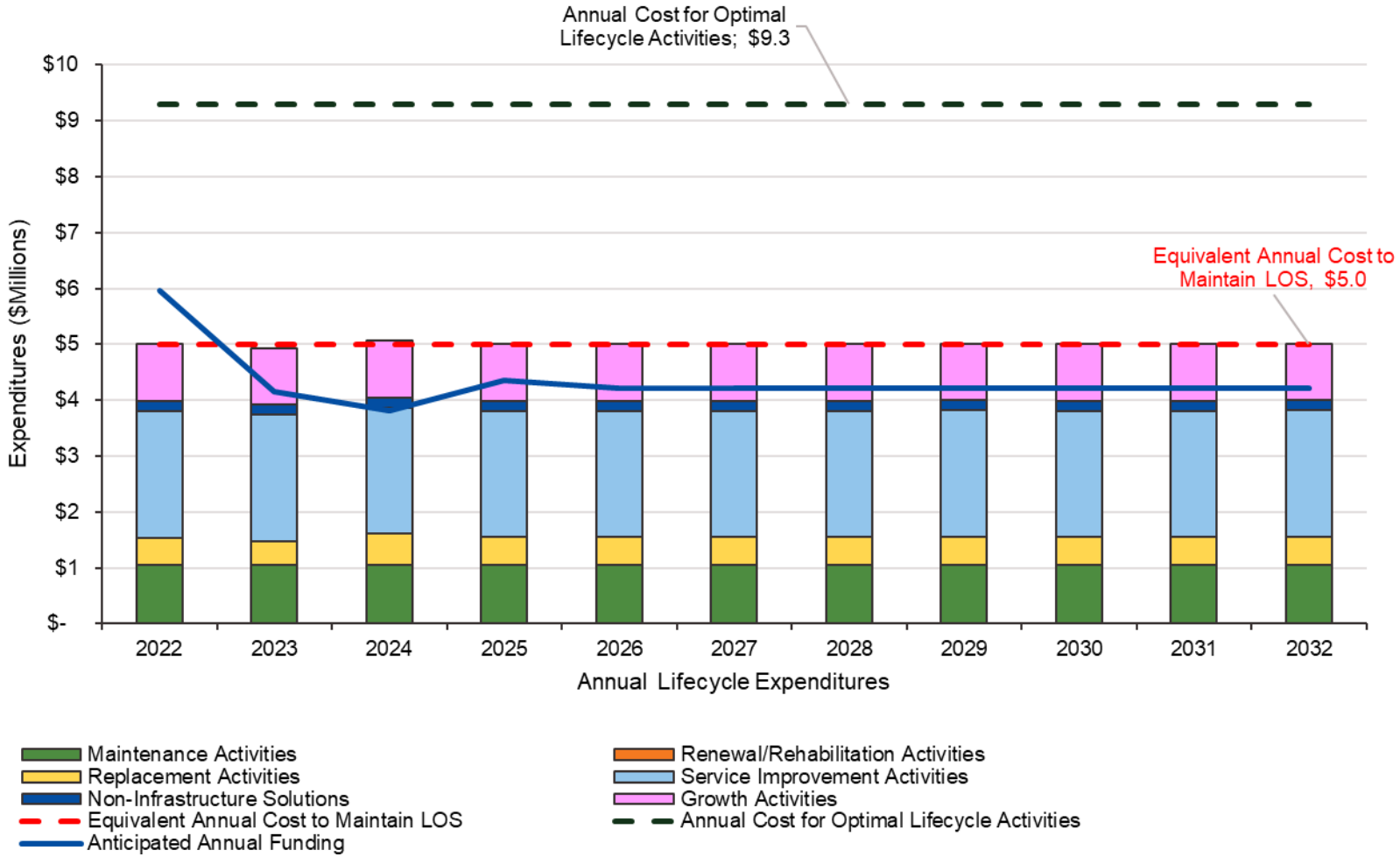


Figure 36. Stormwater Forecasted Lifecycle Needs



4.4 Stormwater Service Associated Risks

As noted, the assets associated with the stormwater service are key to conveying runoff in the community in order to mitigate flooding events. In addition to the risk associated with the lifecycle activities for this service, as shown in **Table 29, t**he following are considered general risks with this service:

- Capacity limitations could result in increased flooding; and
- Infiltration into mains due to structural defects could result in decreased system capacity.

Until a fully separated stormwater system is in place, it should be noted that the risk associated with the stormwater system will also impact the wastewater system.

4.5 Stormwater Climate Change Considerations

While the stormwater collection system is essential for conveying excess runoff, it is also essential to change the way we think about rainwater. In the past, stormwater systems were primarily designed to carry runoff quickly away to the nearest waterbody. It is generally now recognized that rainwater should be considered a valuable resource that is best managed as close to its source as possible to replicate the hydrologic system that was in place prior to development. As municipalities develop and are paved, there is less available ground for runoff to infiltrate and recharge groundwater levels. Furthermore, it is understood that the intensity of rainfall events is likely to increase in the future; this further increases the capacity requirements of both natural and constructed stormwater drainage systems.

Low impact development and green infrastructure policies will contribute to reducing the peak flows of runoff which can lead to flooding issues. As storm system infrastructure is maintained and replaced over time, opportunities for implementing these policies can be encouraged as they can incorporate many social and environmental benefits to the City.

4.6 Stormwater Data Confidence

The following condition data was used to support this chapter's assessment of the City's stormwater assets.

- Stormwater mains, maintenance holes, oil grit separator, wetlands, ponds and open channels: GIS shapefiles of the full inventory for these categories with their associated key attributes such as installation date, diameter and length;
- Unit cost summary documentation provided by the City based on historical data;
- The City's tangible capital asset estimated service life values; and

- The zoom camera inspection database.

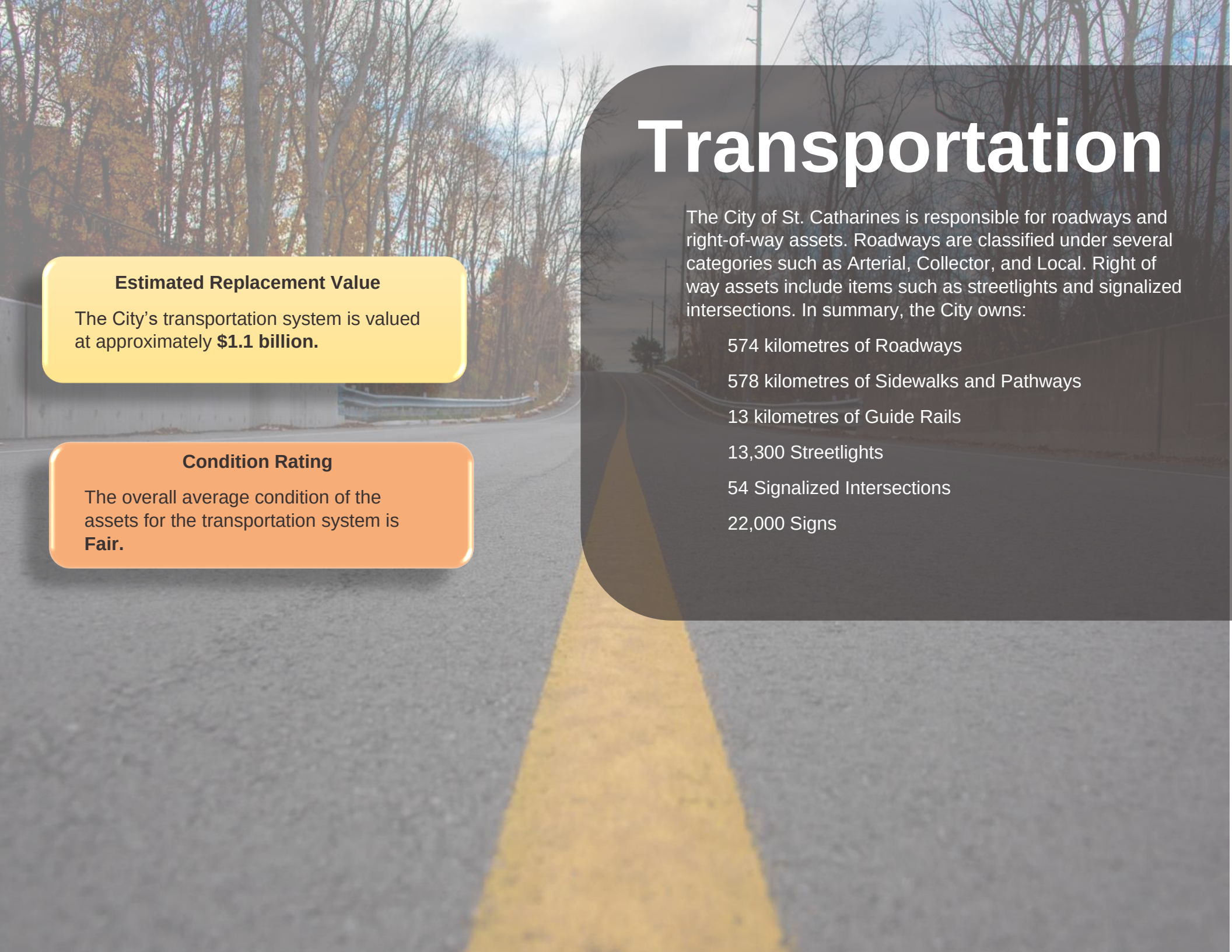
The following assumptions were made during the assessment of the data for the development of the different assessments:

- Stormwater main data was taken from the zoom camera inspection peak structural PACP results;
- Missing installation dates in linear assets were filled based on the install date of nearby related assets (i.e., road for stormwater mains);
- Oil grit separator costs were assumed based on available information;
- Replacement costs were forecasted based on available unit rates for the diameters not included on the original dataset;
- Wetland replacement costs were based on recent construction records; and
- Estimated service lives not available in the City's tangible capital asset database were assumed based on industry best practices.

A data confidence assessment is provided in **Table 30**.

Table 30. Stormwater Data Confidence Assessment

Asset Category	Confidence Rating	Confidence Data
Stormwater Mains	C	Minor assumptions were made on age, replacement costs, and condition from reliable sources.
Stormwater Maintenance Holes & Catch basins		
Oil & Grit Separators	D	Data based on historical information and assumptions on key parameters.
Open Channels		
Wetlands		
Stormwater Ponds		



Transportation

The City of St. Catharines is responsible for roadways and right-of-way assets. Roadways are classified under several categories such as Arterial, Collector, and Local. Right of way assets include items such as streetlights and signalized intersections. In summary, the City owns:

- 574 kilometres of Roadways
- 578 kilometres of Sidewalks and Pathways
- 13 kilometres of Guide Rails
- 13,300 Streetlights
- 54 Signalized Intersections
- 22,000 Signs

Estimated Replacement Value

The City's transportation system is valued at approximately **$1.1 billion.**

Condition Rating

The overall average condition of the assets for the transportation system is **Fair.**

5 Transportation

The movement of people, goods and services is a key component in ensuring quality of life and supporting daily needs of City's customers.

The City's local transportation network is connected to the Provincial highways via the Queen Elizabeth Way (north end) and 406 (downtown area) which are under the jurisdiction of the Ministry of Transportation. Furthermore, the local system also provides linkage to various regional roads that are under the jurisdiction of the Niagara Region.

The following section summarizes the City's Transportation Service.

5.1 Transportation State of Local Infrastructure

5.1.1 Transportation System Valuation

The City's transportation system is comprised of the following roads and right-of-way assets:

- **Road** assets include all road classes as per the Ministry of Transportation (arterial, collector, and local) and sub classifications as identified in the City's Transportation Master Plan. It must be highlighted that attributes recorded against the road indicate those that include bike lanes, or bus routes.
- **Right-of-Way Assets** include those that provide support to other transportation assets, such as traffic signals, signs, guide rails, and streetlights.
- **Active Transportation** include those assets that provide multiple uses (walkways, off-road cycling) associated with transportation assets like sidewalks, pathways, and multi-use trails.

For the valuation of the transportation system, the replacement values are based on the replacement of similar assets (like-for-like) on a complete and standalone basis. These have been calculated based on historical costs and market values.

The overall data confidence grade for road assets is **B**, while the remaining assets' overall confidence is **C**.

Table 31. Transportation System Inventory Valuation

Asset Type	Asset Category	Asset Sub-Category	Count	Unit	Replacement Value (2021 Dollars)
Roads	Arterial	Downtown Corridor	5,245	metres	$ 10,699,000
		Main Mixed Use	39,993	metres	$ 79,502,000
		Main Residential	19,005	metres	$ 36,328,000
		Rural Corridor	12,442	metres	$ 16,141,000
	Collector	Collector Industrial	15,246	metres	$ 27,172,000
		Collector Mixed Use	15,161	metres	$ 28,627,000
		Collector Residential	18,847	metres	$ 31,556,000
	Local	Local Community Street	431,134	metres	$ 726,380,000
		Downtown Community	3,118	metres	$ 5,721,000
		Rural Community	13,601	metres	$ 12,319,000
Right-of-Way Assets	Guide rails	Not Applicable	12,633	metres	$ 1,586,000
	Streetlights [a]		13,358	Each	$ 25,926,000
	Signalized Intersections		54	Each	$14,969,000
	Signs		22,040	Each	$ 2,877,000
Active Transportation	Sidewalks and Pathways	Emergency	430	metres	$ 194,000
		In boulevard Multi-use trail	778	metres	$ 175,000
		Park Access	1,471	metres	$ 331,000
		School Access	1,093	metres	$ 246,000
		Sidewalk - Conventional	474,020	metres	$ 106,654,000
		Sidewalk - Curbface	81,553	metres	$ 22,019,000
		Walkway	18,327	metres	$ 4,124,000
		Other	177	metres	$ 40,000
		Off-Road Trails[b]	109	kilometres	TBC
Overall Transportation System Replacement Value					**$ 1,153,586,000**

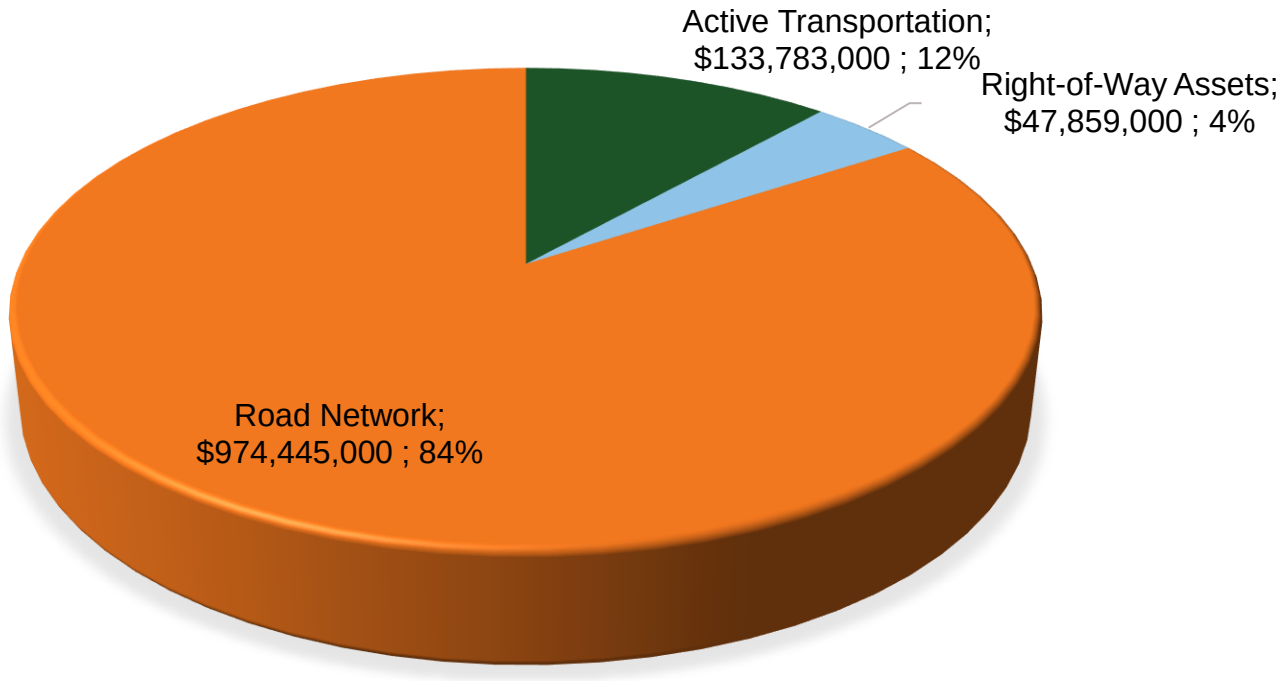
Note:

(a) Streetlights includes only those with recent LED fixtures installed, a total of 1,439 City owned streetlights have been excluded from the assessment at this stage.
(b) The Off-Road Trail network is currently being developed as part of the Transportation Master Plan.

The overall distribution of replacement values by asset type for the entire transportation system is as shown below. The roads have the highest replacement value in the portfolio, totaling 84% of the entire transportation system. It must be highlighted that arterial roads owned by the Region have been excluded from the assessment.

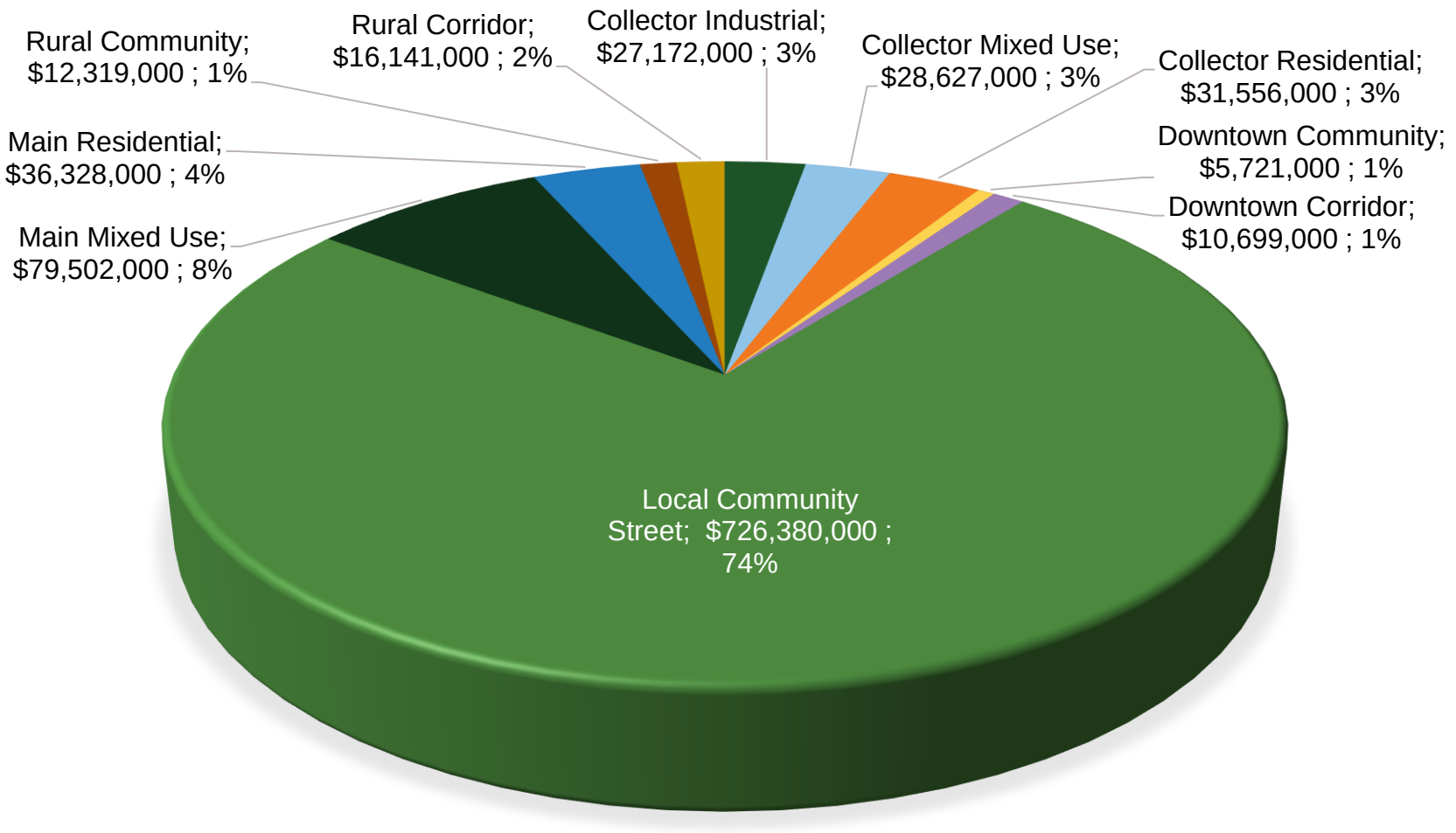
Furthermore, the bike lanes that are part of the road are considered within the road assets as an attribute. This attribute is used to further define risks associated with levels of service and prioritizing capital projects.

Figure 37. Asset Replacement Value for All Transportation Assets



As roads represent the majority of the transportation asset replacement values, the following provides the distribution of replacement values based on road category.

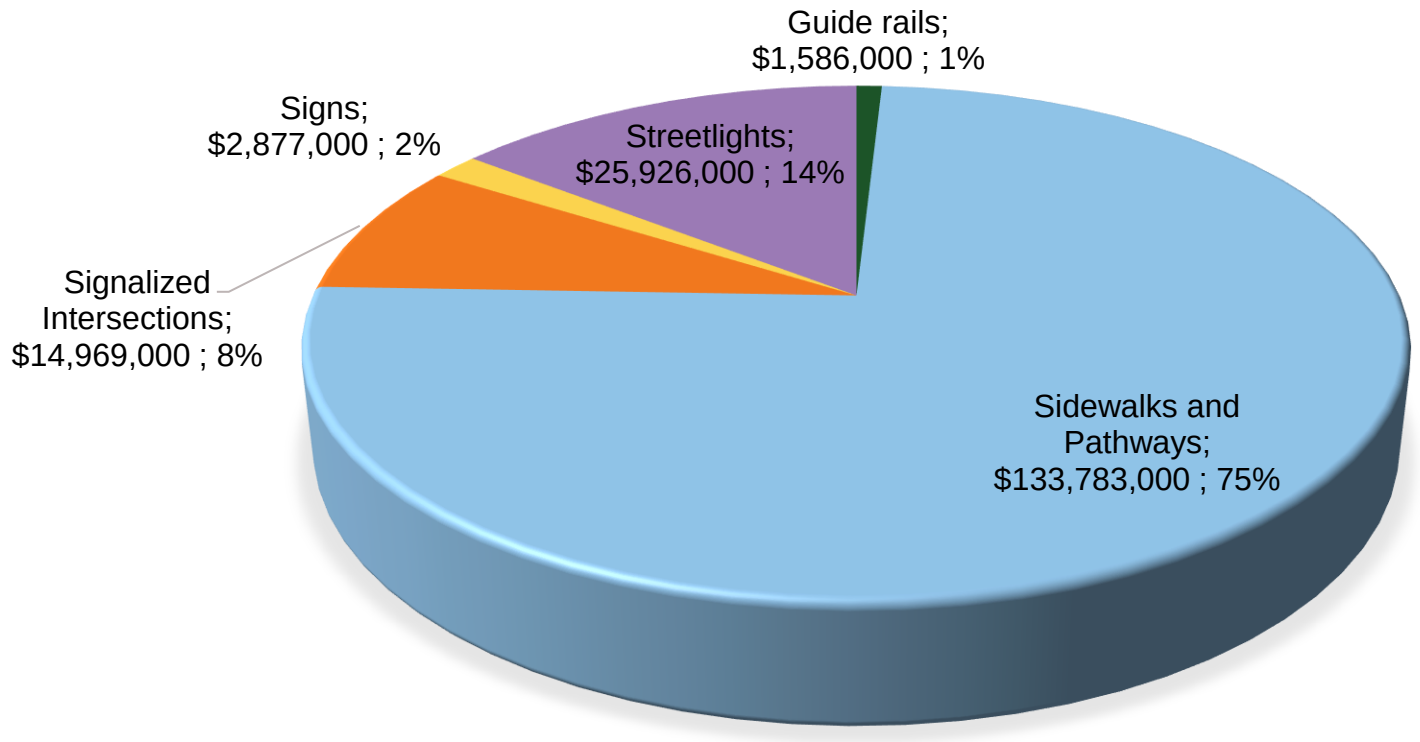
Figure 38. Asset Replacement Value for All Road Assets



As shown in **Figure 38**, the local community streets represent the majority of the replacement values on road assets, followed by main mixed-use roads.

Figure 39 provides a summary for the transportation assets beyond the roadway and indicates that sidewalks and pathways represent the majority of the portfolio (74% of the total).

Figure 39. Asset Distribution Value for All Other Transportation Assets



5.1.2 Transportation System Condition

Using deterioration curves based on estimated remaining life and the condition provided as pavement quality index (PQI), a condition score was computed for each asset into five rating categories ranging from Very Good to Very Poor. **Table 32** provides a summary of the scale for roads.

Table 32. Roads Condition Scale

Condition Score	Condition Rating	PQI: Concrete and Gravel	PQI: Composite and Flexible
1	Very Good	81-100	81-100
2	Good	61-80	61-80
3	Fair	41-60	41-60
4	Poor	21-40	12.6-40
5	Very Poor	0-20	0-12.5

The condition of streetlights was calculated based on the estimated service life of the full structure as one asset; and no discretization was made to separate the condition of the pole and fixtures due to limited data. This approach may result in condition being based partly on the lamp fixture which is the lowest cost portion of the asset. A pole condition assessment that will be completed in the future will provide updated condition estimates with a higher degree of confidence. Only those that have recently have fixture replacement have been included as part of the assessment.

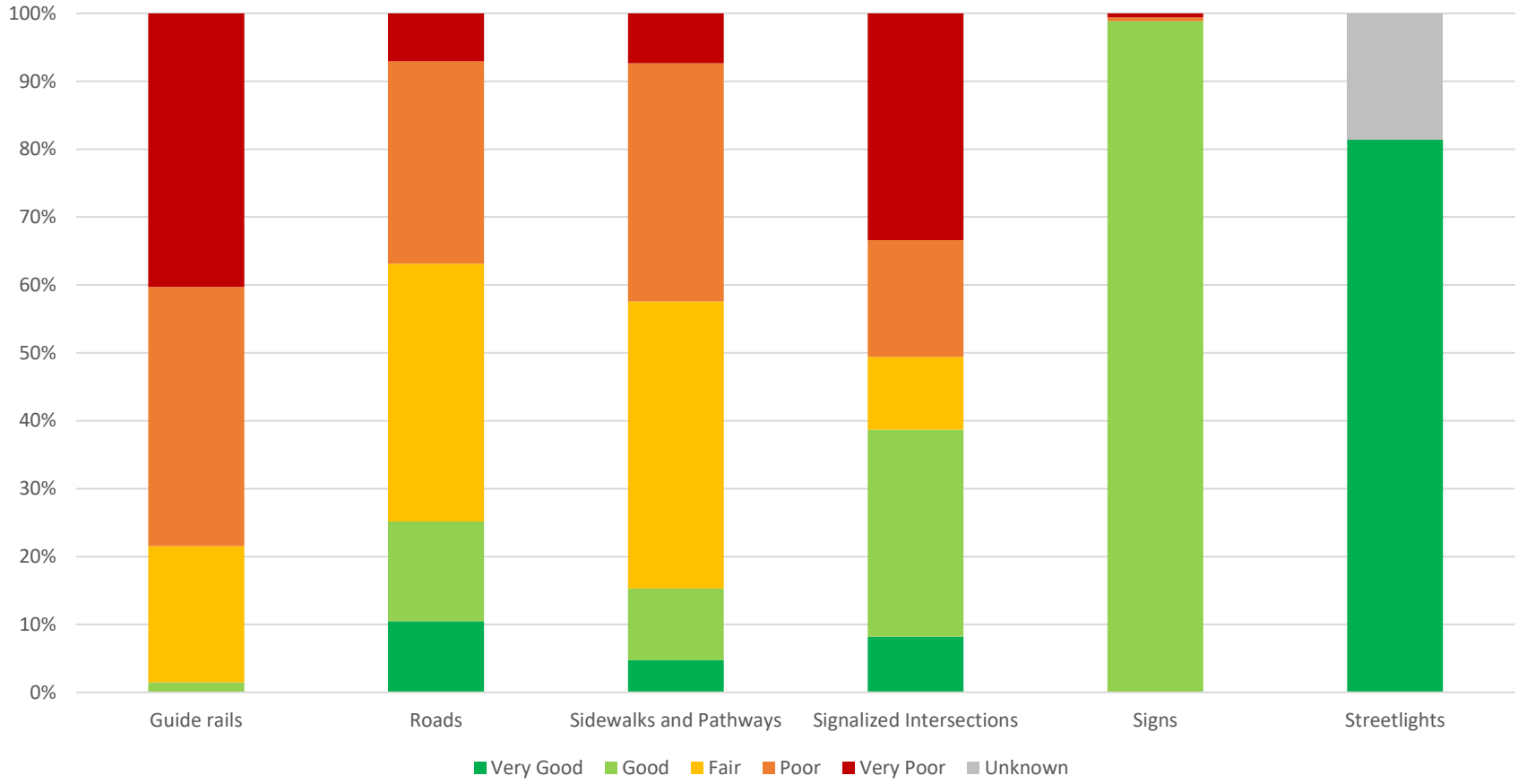
The signs condition and age were projected based on the degradation of the condition assessment results from 2018.

All other transportation assets condition is based on **Table 4** on page 14.

The current condition of all transportation assets has been summarized and weighted by replacement value in **Figure 40**.

Overall, 7% of the transportation assets are in the very poor category, and 30% are in the poor category.

Figure 40. Condition Distribution by Replacement Value for all Transportation Asset Types



Note: *The streetlights category includes streetlights with unknown installation dates. 3,047 of 16,442 streetlight assets do not have an installation date recorded in the data,therefore the condition is unable to be estimated at this time.This estimate also only includes the heads and the condition of poles are unknown.*

Understanding that roads are the major category for the transportation service, **Figure 41** provides the specific distribution of condition for the different road types based on the categories defined in the Transportation Master Plan. As shown in the figure, the majority of the roads are in Fair condition. The geographic distribution of road condition is shown in **Figure 42**.

Figure 41. Condition Distribution by Replacement Value for all Roads Assets

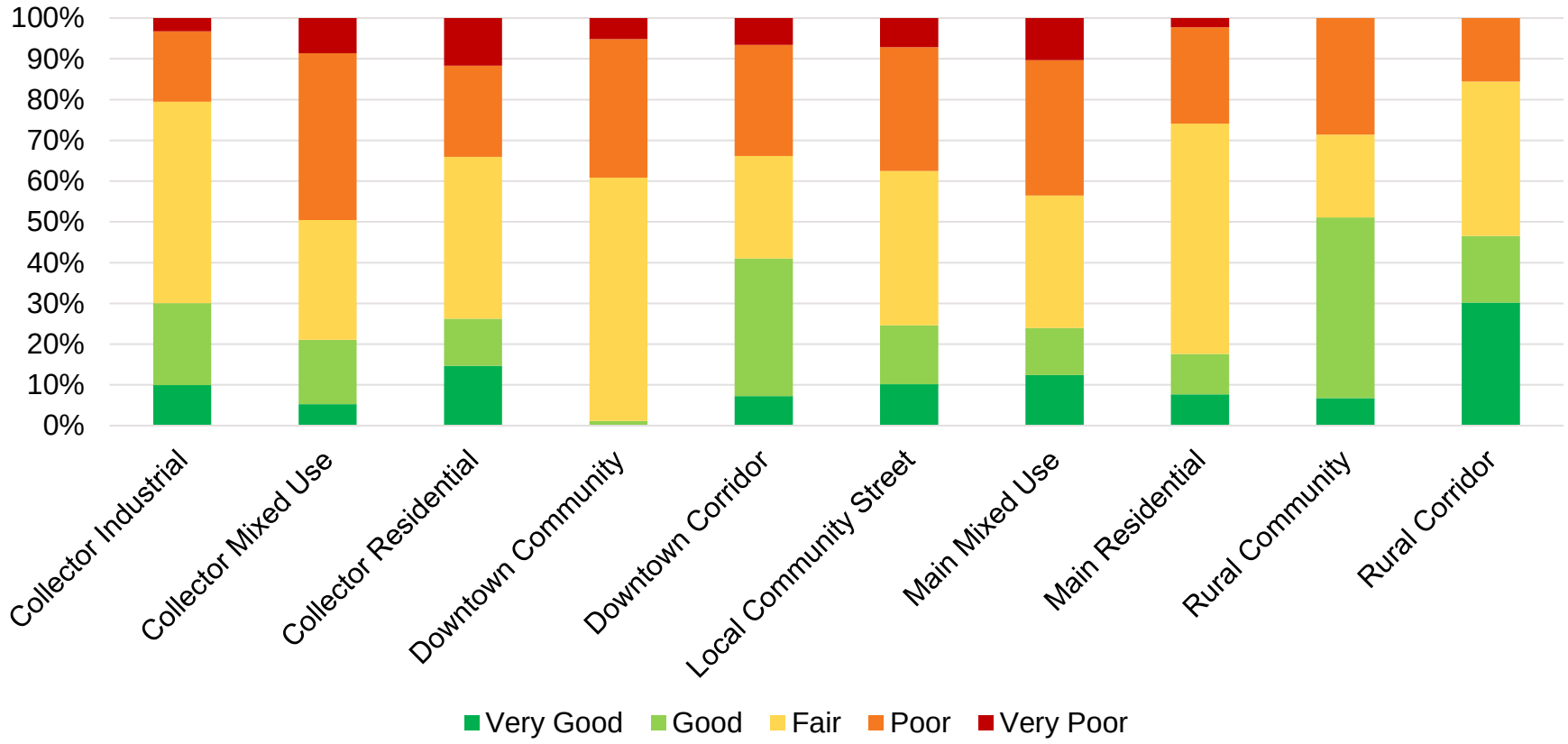
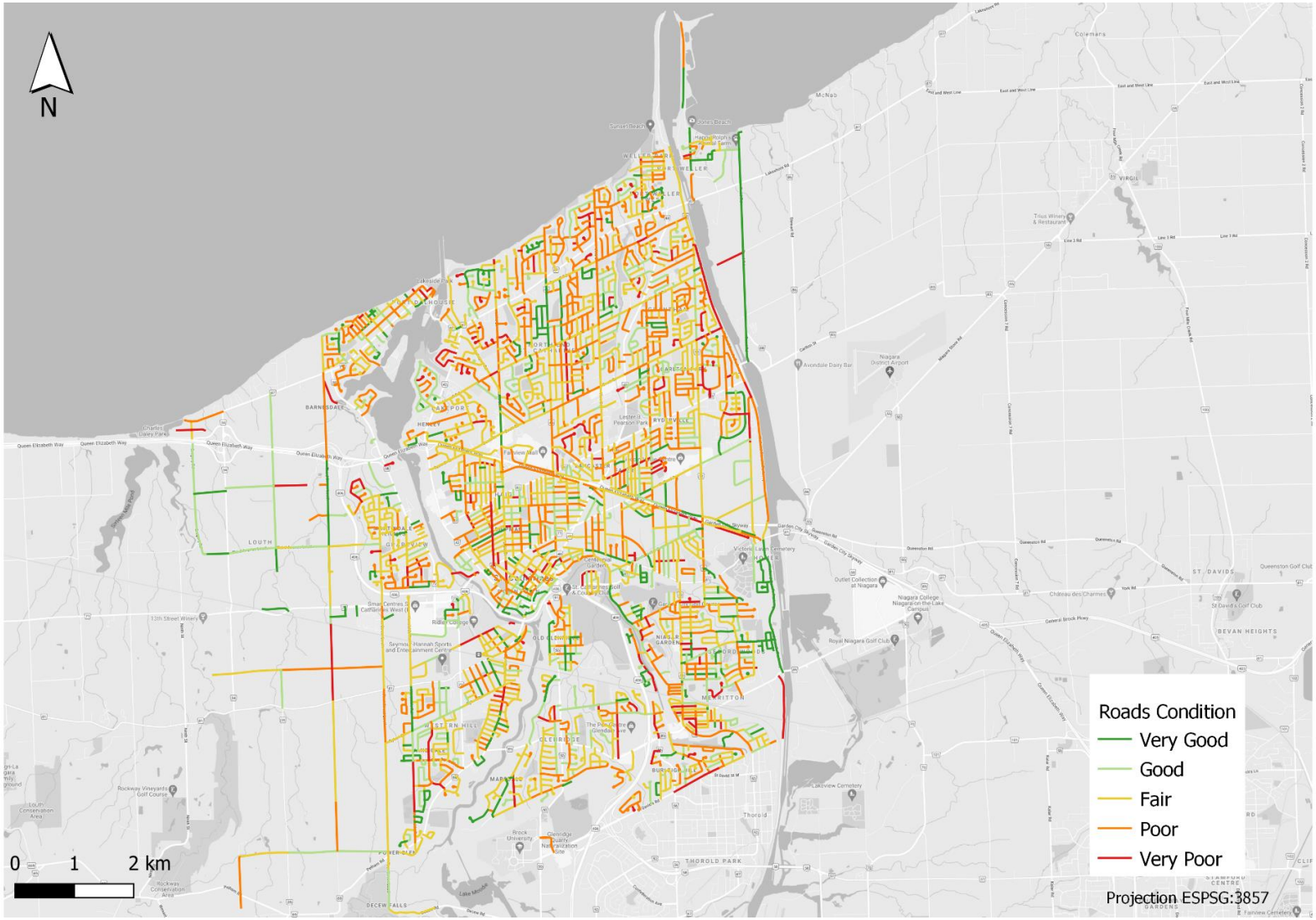


Figure 42. Condition Distribution by Location for all Roads

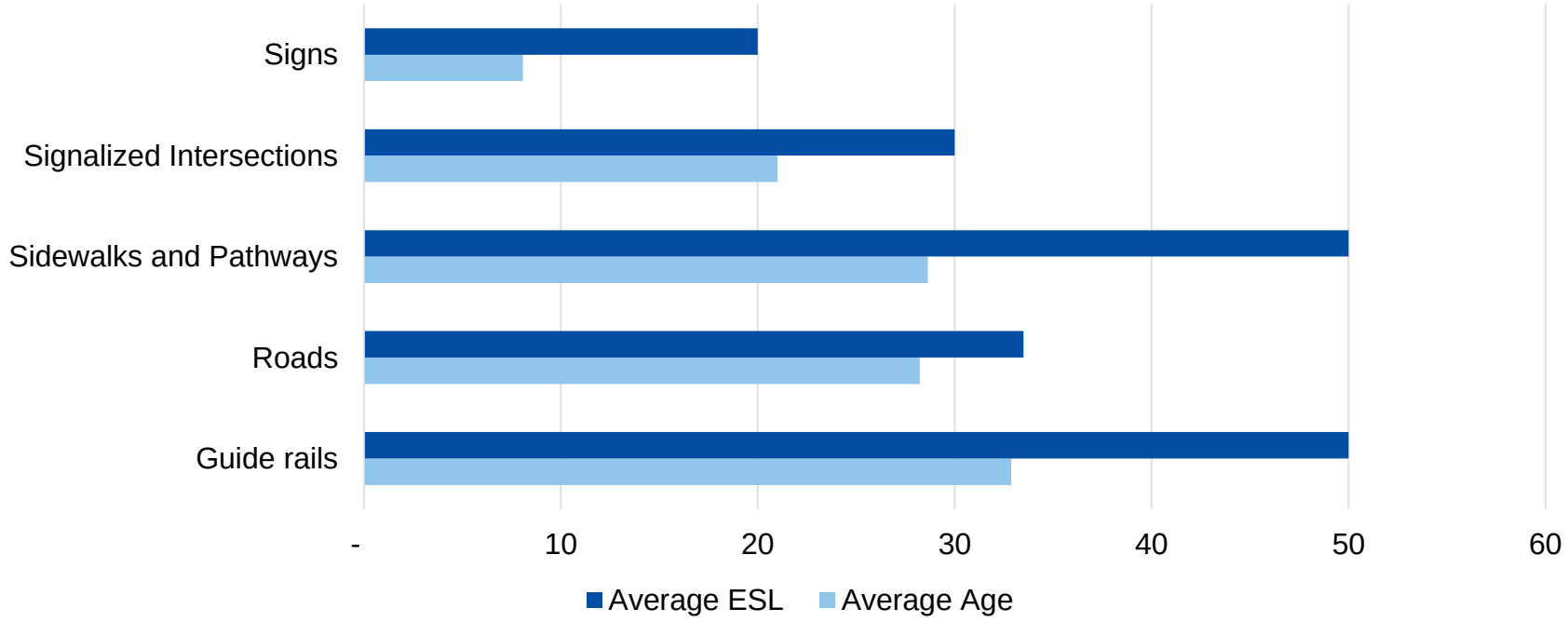


5.1.3 Transportation Age Summary

By comparing the average age of the assets against the average estimated useful life, the overall average remaining life of the assets can be derived.

The figure below summarizes the average ages of each asset type in the transportation system. As can be seen in the figure, the only transportation asset nearing end of their service life are roads. Furthermore, as above noted, the streetlights' age is based on available information and does not represent the differences between poles and recently replaced fixtures and therefore these have been excluded.

Figure 43. Average Age as a Proportion of Expected Service Life by Asset Type All Transportation Assets



5.2 Transportation Levels of Service

The City of St. Catharines is committed to providing a safe, efficient, accessible, and sustainable transportation system for all required uses and modes of transportation in accordance with regulatory requirements and expectations of the community.

The Key Service Attributes associated with the transportation LOS and their associated statements are defined in the table below.

Table 33 Transportation LOS Service Attributes

Service Attribute	Attribute Statement
Scope	Providing adequate transportation services to the community
Safety	Providing an operational and accessible transportation network that is safe for all modes and uses of the transportation network.
Quality	Providing a transportation network at the appropriate material quality with smooth and safe surfaces.
Reliability	Providing a transportation network that is reliable.
Environmental Stewardship	Providing a transportation network that is environmentally conscious.
Cost Efficiency	Providing a cost-efficient transportation network for all modes.

The following sections provide a summary of the levels of service for the City's transportation services including those required by the O.Reg.588/17.

5.2.1 Transportation Customer Levels of Service

The City's CLOS provides a documented measure of customer-focused outcomes. The following provides a summary of the CLOS associated with the transportation service.

- **Description, which may include maps, of the road network in the municipality and its level of connectivity. (Scope)**
  The existing road network in the City of St. Catharines includes provincial, regional, and municipal roads. Municipal roads are classified as either arterial roads, collector roads, or local roads, in decreasing order of size and capacity.
- **Description or images that illustrate the different levels of road class pavement condition. (Quality)**
  The City of St. Catharines adheres to and follows the American Society for Testing Materials Pavement Condition Index (PCI) rating system

model when defining pavement condition. Where a PCI of 100 indicates a perfect surface and zero indicates a surface that has completely deteriorated.

Ride comfort Index (RCI) is also gathered, and Pavement Quality Index (PQI) is based on both ride comfort and/or condition.

These standards are followed by the third-party consultants engaged by the City to perform pavement inspections.

The following table provides additional CLOS metrics for the City transportation services.

Table 34. Transportation CLOS Metrics

Service Attribute	Customer Levels of Service	2020 Performance
Safety	Number of complaints about leaf/debris/snow obstructions in cycling facilities or sidewalks	429
Quality	Average pavement condition of paved roads	Fair
	Percentage of road network with fair or better pavement condition	66%
Quality (continued)	Length of roads in poor and very poor condition	215.4km
	Percentage of Transportation assets in fair or better performance	63%
Env. Stewardship	Percentage of streetlights that are energy efficient	93%
Cost Efficiency	Total cost to provide transportation services (Roadway, Structure, Street Lighting) ($/household)	$350.22

5.2.2 Transportation Technical Levels of Service

In addition to setting performance levels associated with customer expectations, the City has also defined technical requirements and key performance indicators that align or support the CLOS presented on **Table 34**.

The following provides a summary of the TLOS associated with the transportation service.

Table 35. Transportation TLOS Metrics

Service Attribute	Technical Levels of Service	2020 Performance
Scope	Number of lane-kilometres of arterial roads (Class 1 and Class 2 highways) as a portion of square kilometres of land area of the City[a]	0.1
Scope (Cont.)	Number of lane-kilometres of collector roads (Class 3 and Class 4 highways) as a portion of square kilometres of land area of the City[a]	2.7
	Number of lane-kilometres of local roads means (Class 5 and Class 6 highways) as a portion of square kilometres of land area of the City[a]	9.0
Safety	Length of off-road trails [b]	109 kilometres
	Length of roads with dedicated bike lanes [b]	6.2 kilometres
	Length of routes with paved shoulders [b]	16 kilometres
	Length of Signed Route with sharrow [b]	8 kilometres
	Length of Signed Route (no sharrow) [b]	2 kilometres
	Length of in-boulevard multi-use trails	Less than 1 kilometre
	Total length of on-road and off-road cycling facilities[b]	141 kilometres
Safety (Cont.)	Number of complaints that action a by-law ticket related to snow removal on residential areas	26
	Number of complaints about snow removal in downtown core	0
	Number of complaints about leaf/debris obstructions in cycling facilities or sidewalks	429
Quality	For paved roads in the municipality, the average pavement condition index value (PCI)[a]	47

Service Attribute	Technical Levels of Service	2020 Performance
	For unpaved roads in the municipality, the average surface condition[(a)]	Fair
	Average Ride Condition Index (RCI)	42
	Percentage of roads that are paved	99.8%
Reliability	Percentage of Transportation assets in poor or better condition	92%
	Percentage of roads/paved area in poor or very poor condition	37%
	Percentage of Minimum Maintenance Standard Inspections completed on time as per MMS O. Reg 239/02	99%
	Percentage of Minimum Maintenance Standard Repairs completed on time as per MMS O. Reg 239/02	92%
Env. Stewardship	Percentage of streetlights owned by the City with LED or low energy fixtures	93%
	Volume (in Liters) of anti-icing liquids applied to roads per lane-kilometre	15.58
	Volume of sand applied to roads per lane-kilometre	1.22 Ton
	Volume of salt applied to roads per lane-kilometre	4.69 Ton
Cost Efficiency	Total roadway replacement value	$ 974,444,527
	Preventive maintenance as a percentage of total maintenance records	13%
	Maintenance cost per km of road network for non-winter control activities	$ 5,508
	Maintenance cost per km of road network for winter control activities	$ 3,404
	Capital investments in comparison with sustainable investment forecast	20%

Service Attribute	Technical Levels of Service	2020 Performance
	Transportation reinvestment rate	0.9%

Notes:

(a) Required by O.Reg. 588/17

(b) Metrics developed from Transportation Master Plan, which includes Regional roads.

5.2.3 Transportation Future Metrics for Consideration

As part of the definition of levels of service, the City identified possible level of service metrics that could be added to their framework as data becomes available. The following table provides a summary of the metrics that have been proposed for future consideration.

Table 36. Transportation LOS Future metrics

Service Attribute	Levels of Service Proposed Future Metric	Type of LOS
Safety	Percentage by kilometre of sidewalks that are AODA compliant	Technical
	Length of sidewalks that are AODA compliant	Technical
	Percentage of pedestrian crossings and crossings that are FADM/AODA compliant	Technical
	Number of pedestrian crossings and crossings that are FADM/AODA compliant	Technical
	Total number of pedestrian crossings and crossings	Technical
	Number of locations identified for traffic control enhancements	Technical
Reliability	Percentage of guide rails in poor or very poor condition	Technical

5.3 Transportation Lifecycle Management Strategy

The levels of service presented in the previous section are supported by the achievement of a variety of lifecycle activities in accordance with the activity types presented in **Table 5**. These activities are targeted to extend the asset life, ensure levels of service are being met, and reduce overall lifecycle costs.

The water service staff implement a variety of lifecycle activities on its entire portfolio. **Table 37**Table 15 provides a summary of these activities and the risk associated with not doing them.

Table 37. Transportation Lifecycle Activities, Associated Risk, and Estimated Lifecycle Cost

Lifecyle Activity Type	Asset Management Practices	Risk Associated with the Activity	Equivalent Annual Cost (2022 to 2032)
Non-Infrastructure Solutions	• Master Plans are developed and updated to provide a baseline for future growth projections in the transportation network. • Traffic studies and counts are conducted to evaluate the capacity and flow efficiency of the transportation system. • Condition assessments are conducted to determine the condition of the assets on the network such as: roads and streetlights. • Third party assessments are conducted to develop a base inventory for assets such as: roads and guide rails.	• Inadequate planning assumptions can provide incorrect forecasted estimates. • Regulatory requirement and standard changes. • Reduced ability to understand potential impacts of climate change on the infrastructure.	$ 389,000 Based on the historical 2017 to 2021 average expenditures. It is recommended that future studies be identified based on best practices and cost estimates be developed.

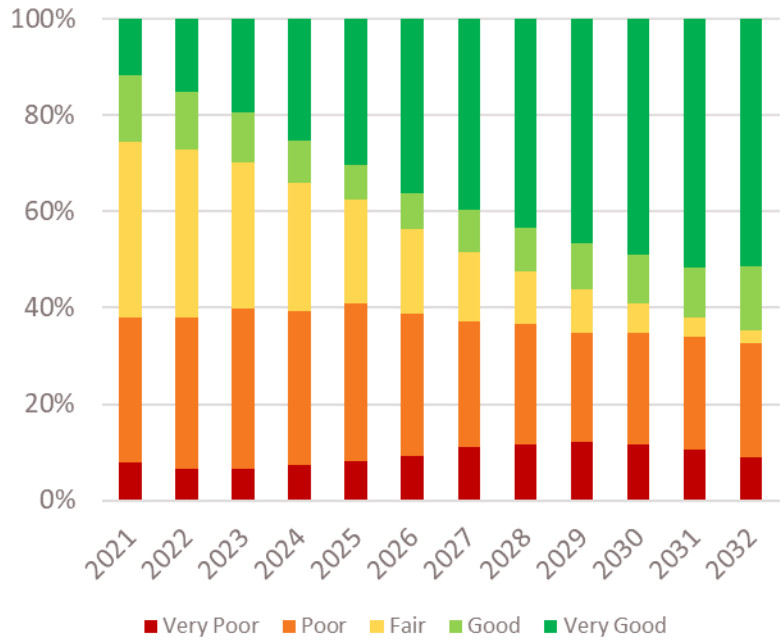
Lifecyle Activity Type	Asset Management Practices	Risk Associated with the Activity	Equivalent Annual Cost (2022 to 2032)
Renewal / Rehab Activities	• Scheduled rehabilitation activities such as resurfacing. • Repair of shoulders and sidewalks.	• Incorrect assumptions of the expected improvement in useful life after maintenance is completed. • Increased lifecycle cost if renewal/rehab are done improperly or not as scheduled.	$ 10,545,000 Forecasted based on the lifecycle management activities.
Maintenance Activities	• Inspections are conducted in accordance with the Minimum Maintenance Standards and the necessary maintenance activities are triggered based on findings. • Sweeping of roads is conducted four times per year to reduce dust and pollutant loadings (all roads swept in spring, curbed roads swept twice in summer, fall leaf pickup all roads in fall). Downtown is swept weekly. • Completion of winter maintenance such as snow plowing and salting. • Grinding, roller patching, crack sealing, spot repairs, and mud jacking.	• Increased lifecycle cost if maintenance is done improperly or not with scheduled frequency. • Resource limitations to conduct unplanned, urgent work. • Insufficient maintenance may contribute to asset failure resulting on service disruptions. • Unsafe road conditions due to insufficient maintenance.	$ 5,019,000 Forecasted based on the lifecycle management activities.

Lifecyle Activity Type	Asset Management Practices	Risk Associated with the Activity	Equivalent Annual Cost (2022 to 2032)
Replacement/ Construction Activities	• Replacement of deteriorated assets.	• Coordination with other asset classes (if applicable) might delay timeframe of construction activities. • Delays in construction could result in cost over-runs.	$ 21,616,000 Forecasted based on the lifecycle management activities.
Disposal Activities	• Decommissioning assets at the end of their useful life. • Disposal of abandoned or obsolete infrastructure during construction projects. • Contaminated soils are disposed in accordance with regulation based on Geotechnical reviews conducted in construction projects.	• Improper disposal could lead to environmental impacts and result in cost overruns.	- Disposal costs are included with replacement costs
Service Improvement Activities	• Retrofit of transportation system to include active transportation facilities. • City is implementing a replacement program to convert streetlight heads to energy efficient components. • Sidewalks program is intended to replace them for AODA compliant ones to improve accessibility in the network based on system condition. • Granular trails maybe converted to hard surfaces. • Fish habitat additions to include fish crossings.	• Lack of improvements can result in health and safety risks. • Increased service expectations come with increased cost implications.	$ 827,000 Based on the 2017 to 2021 average service improvement activities

Lifecyle Activity Type	Asset Management Practices	Risk Associated with the Activity	Equivalent Annual Cost (2022 to 2032)
Growth Activities	• Additions to support changes in demand and as per developments in the area.	• Growth activities are delayed or cancelled resulting in system being unable to accommodate increased demands.	$ 1,986,000 Based the average projected development charges

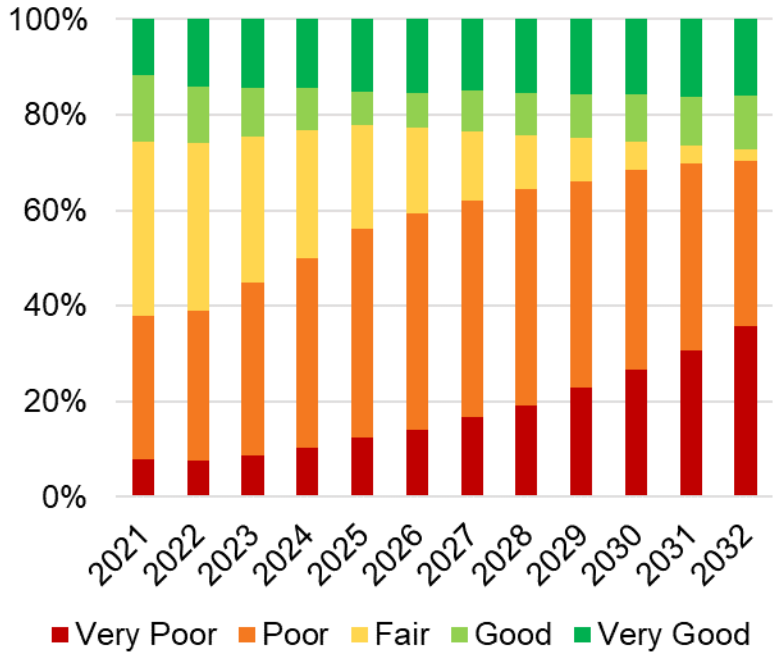
The City uses these strategies to plan work and determine future expenditure needs. The TLOS used in the AM analysis for water assets was defined as maintaining the current portion of asset with poor or better performance. The cost to maintain this scenario was determined to be $35.3M annually over a 25-year period and resulted in the performance forecast shown in **Figure 44**. The percentage of assets in poor or better condition holds around 92%.

Figure 44. Transportation Condition Distribution Performance with Cost to Maintain LOS



The current planned budget was also analyzed to determine if a funding gap exists. The current anticipated investments, $15.8M annually, resulted in the performance forecast shown in **Figure 45**. The percentage of assets in poor or better condition declines to 64% by 2032. This suggested an investment shortfall of $19.5M annually.

Figure 45. Transportation Condition Distribution Performance with Anticipated Budget



Additionally, an optimal lifecycle scenario was analyzed, which was used to determine the cost to meet all lifecycle strategies described in **Table 37**. This scenario addresses the backlog and ensures no asset reaches very poor performance. The cost to achieve this scenario was determined to be $40.4M annually over a 25-year period and resulted in the performance forecast shown in **Figure 46.**

The costs for the 10-year lifecycle forecast are presented in **Figure 47**. The graph shows the forecasted expenditures by lifecycle category for the cost to maintain scenario. The equivalent annual cost to maintain LOS, the annual expenditures for the optimal lifecycle scenario and the anticipated annual funding is also provided on the graph. The City should explore options to increase the investment levels for Transportation assets within the next 2-3 years.

Figure 46. Transportation Condition Distribution Performance with Optimal Lifecycle Activities

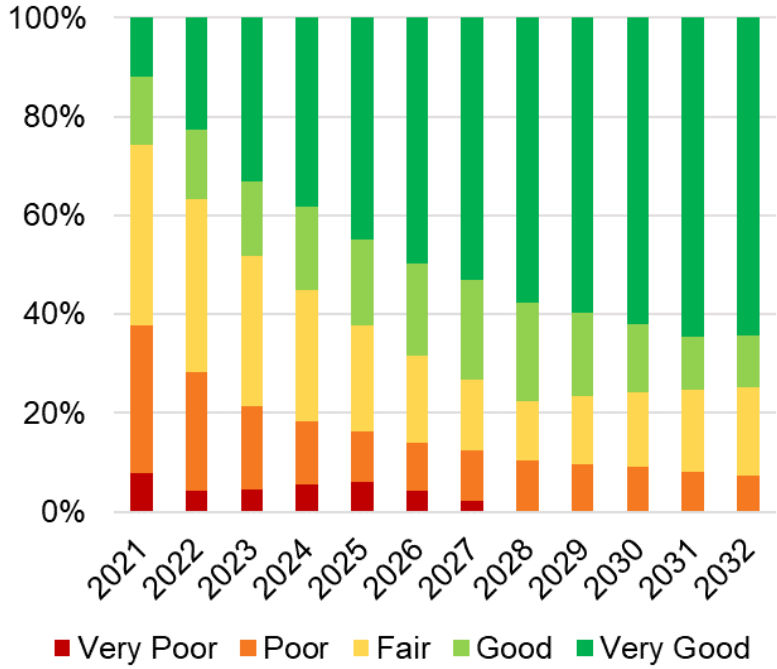
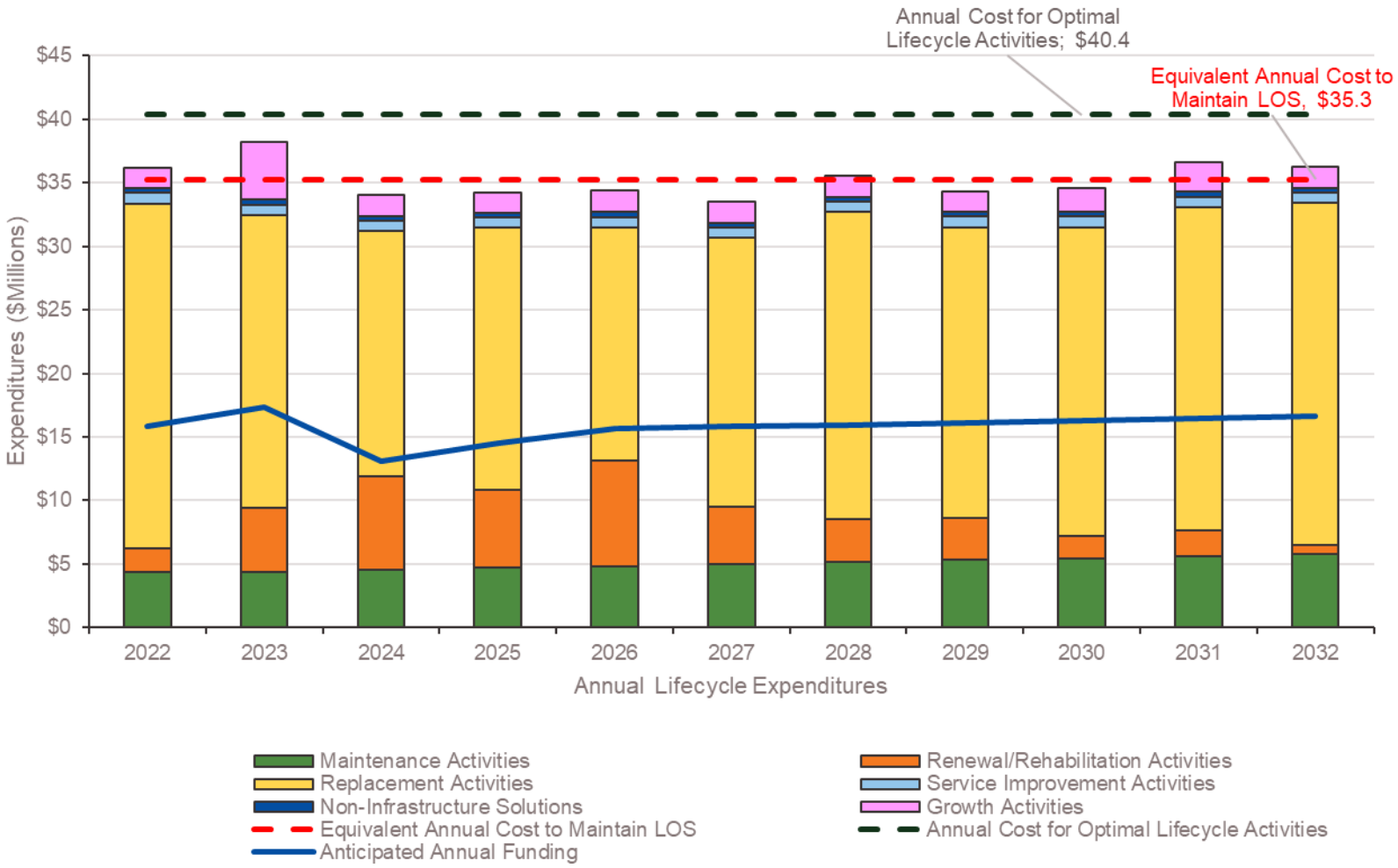


Figure 47. Transportation Forecasted Lifecycle Needs



5.4 Transportation Service Associated Risks

In addition to the risks associated with the lifecycle activities for this service, as shown on **Table 37**, the following are considered general risks with this service:

- Road's deterioration could result in closures and therefore impact the flow of traffic in the City;
- Signalized intersection, streetlight and sign failure could disrupt traffic flow and increase the risk of traffic collision in the area;
- Sidewalk failure could result in reduced accessibility; and
- Guiderail failure could result in increased risk to drivers or pedestrians.

In addition to the above, failure of assets from other services (like underground infrastructure or flooding) could impact the transportation network resulting in increased deterioration, erosion, and potentially full road closures.

5.5 Transportation Climate Change Considerations

The City's road network and related assets are also vulnerable to the impacts of climate change. Extreme flooding can cause structural damage as well as disruptions to traffic as roadways are expected to convey stormwater during 100-year events which may need to be revised as climate change alters the frequency and intensity of extreme events.

Higher summer temperatures can cause pavements to soften and expand, which allows ruts and potholes to form more easily, increasing the need for more frequent maintenance and reconstruction.

Climate change is anticipated to increase the probability of high wind speeds and gusts which may impact the design and maintenance of right-of-way assets which must withstand these forces.

5.6 Transportation Data Sources

The following condition data was used to support this chapter's assessments of the City's transportation assets.

- Roadmatrix database with segment inventory, installation date, and PQI information;
- The guide rail inventory from previous assessment included all the necessary attributes;
- Niagara Region signalized intersection data;

- Signs and streetlights: GIS shapefiles of the full inventory for these categories with some key attributes. Guiderail locations were also provided as a shapefile;
- Unit Cost Summary documentation provided by the City based on historical data; and
- The City's tangible capital asset estimated service life values.

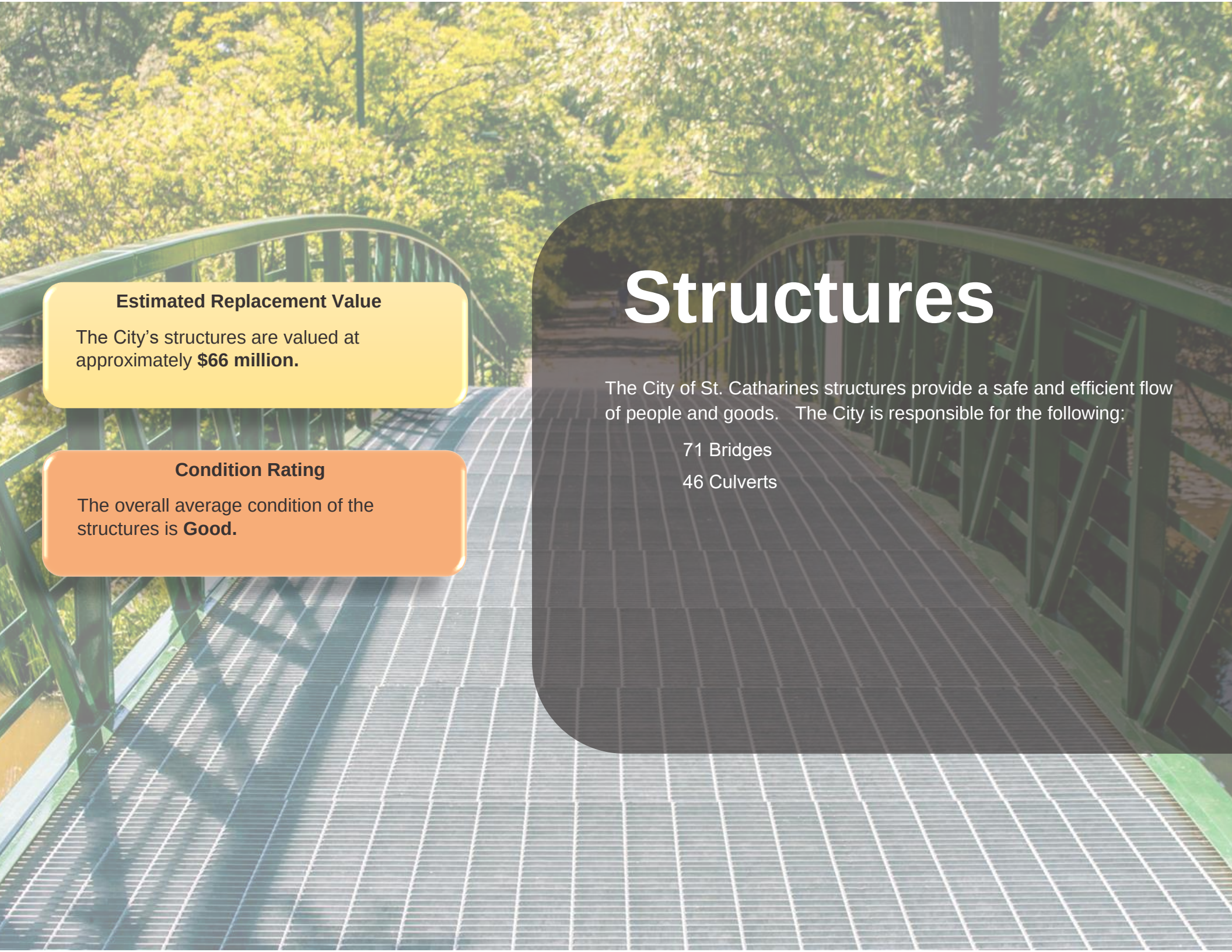
The following assumptions were made during the analysis:

- Signalized intersection replacement costs were assumed based on available data. Their installation date was assumed to be the latest legal drawing date;
- Missing installation dates in linear assets were filled based on the install date of nearby related assets (i.e., mains for roads); and
- Estimated service lives not available in the City's tangible capital asset were assumed based on industry best practices.

A data confidence assessment is provided below:

Table 38. Transportation Data Confidence Assessment

Asset Category	Confidence Rating	Confidence Data
Roads	B	Minor assumptions were made on age, replacement costs and condition from known values.
Guiderail		
Streetlights	C	Minor assumptions were made on age, replacement costs, and condition from reliable sources.
Signs		
Sidewalks		
Signalized Intersections		



Structures

The City of St. Catharines structures provide a safe and efficient flow of people and goods. The City is responsible for the following:

71 Bridges

46 Culverts

Estimated Replacement Value

The City's structures are valued at approximately **$66 million.**

Condition Rating

The overall average condition of the structures is **Good.**

6 Structures

The movement of people, goods, and services is a significant aspect of our everyday life and is supported by the City's Structure assets.

6.1 Structures State of the Local Infrastructure

The following section summarizes the quantity and state of the structures asset portfolio.

6.1.1 Structures System Valuation

The City's structure system is comprised on standard categories based on OSIM requirements, in the following:

- **Span (< 3m)** encompasses bridges and culverts (under 3 metres span)[4]
- **Span (>= 3m)** encompasses bridges and culverts (over 3 metres span)

These have been further divided into vehicular and pedestrian bridges and culverts to indicate the service type they support. It should be noted that the spans <3m category excludes most CSP culverts and all driveway culverts.

For the valuation of the transportation system, the replacement values are based on replacing the asset with a similar asset (like-for-like) on a complete and standalone basis. These were calculated based on costs provided during the latest OSIM inspections completed in 2020. In the absence of OSIM data, historical values from similar projects were used.

Based on the approach taken to calculate the replacement values for each asset category, the data confidence grade is **A.**

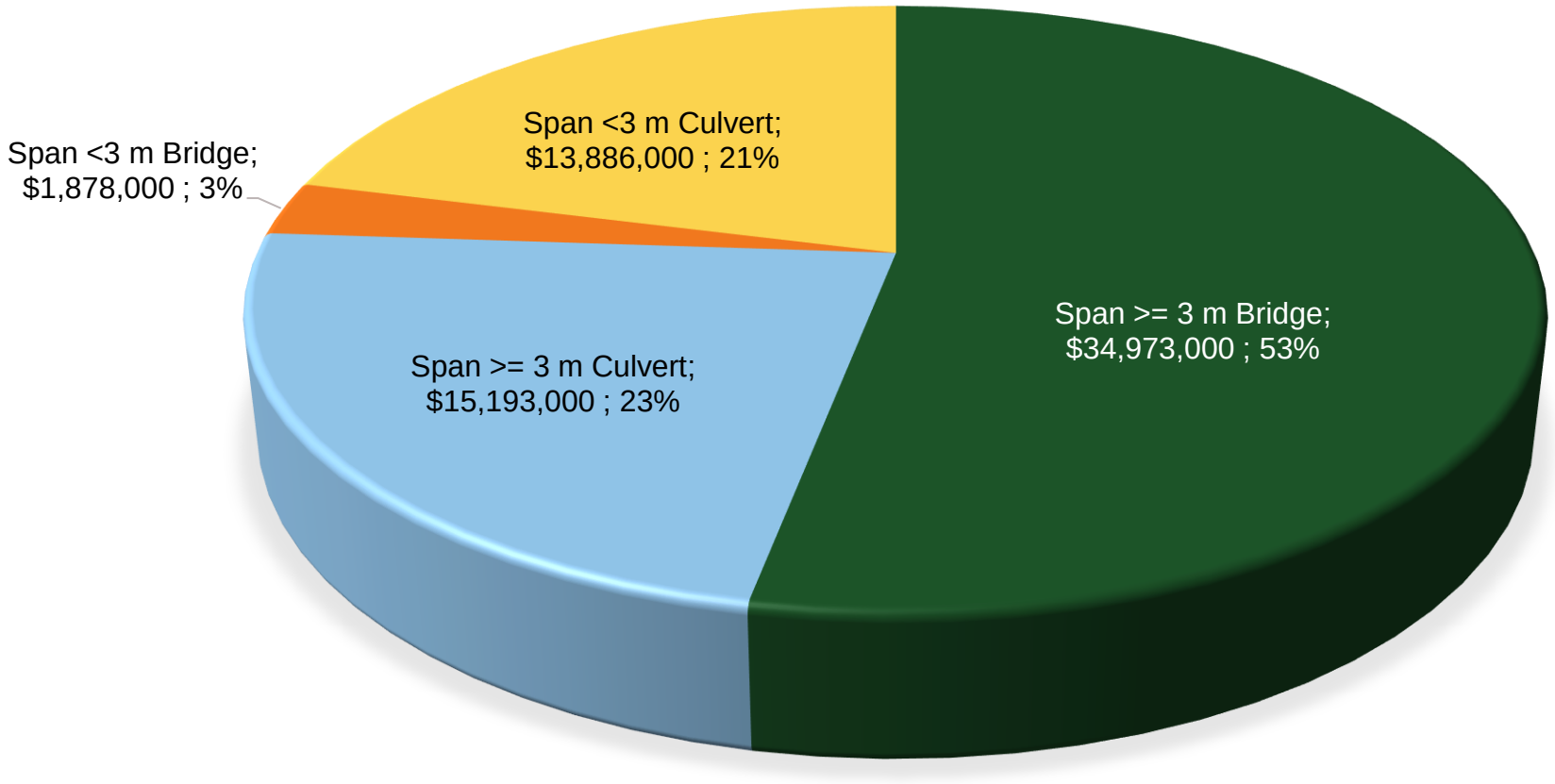
[4] These are culvert that provide crossing of natural water courses. Driveway culverts and other roadside culverts that are part of the ditch system will be inventoried and included with the storm water system in future.

Table 39. Structures Valuation

Asset Type	Asset Category	Count	Unit	Replacement Value (2021 Dollars)
Structures	Span (>= 3m) - Bridge	54	Each	$ 34,973,000
	Span (>= 3m) - Culvert	17	Each	$ 15,193,000
	Span (< 3m) - Bridge	15	Each	$ 1,878,000
	Span (< 3m) - Culvert	31	Each	$ 13,886,000
Overall Transportation System Replacement Value				**$ 65,930,000**

The overall distribution of replacement values by asset type for all structures is as shown below in **Figure 48**. Bridges (>=3m) have the highest replacement value and make up about 53.05% of the portfolio. Culverts in both size categories account for another 44.1% of the portfolio in approximately equal proportions and Bridges (< 3 m) make up the remaining 2.85%.

Figure 48. Asset Replacement Value for All Structures Assets

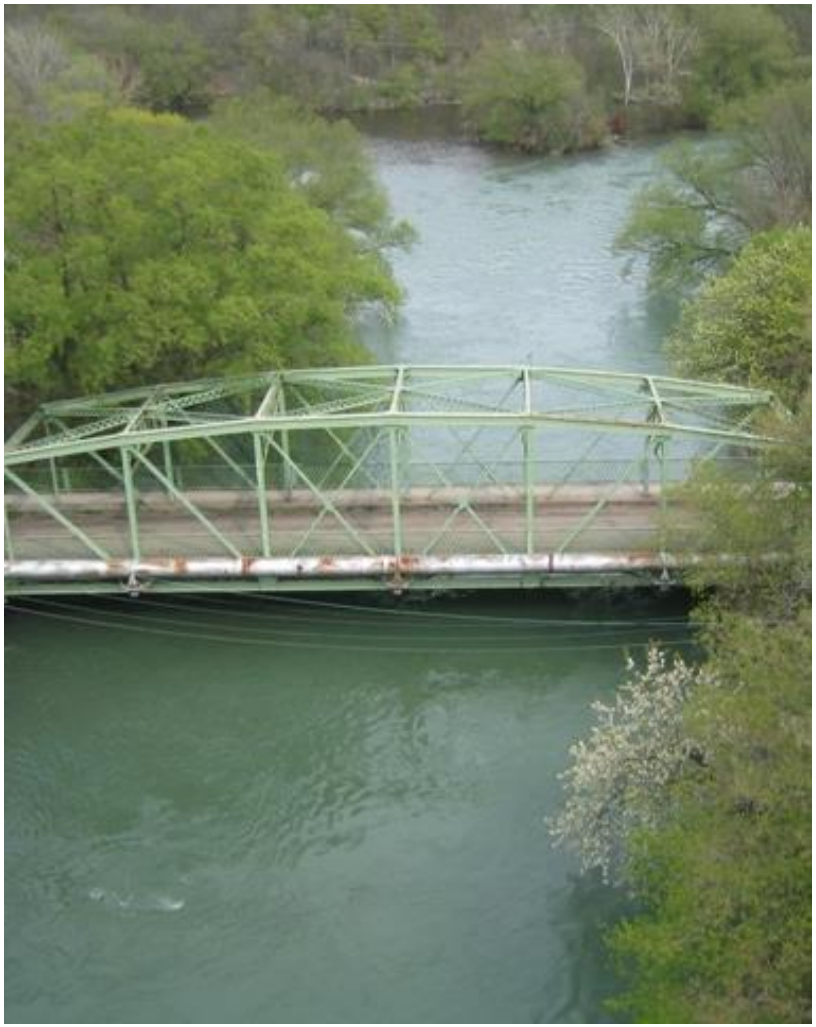


6.1.2 Structures System Condition

Using deterioration curves based on estimated remaining life and the condition provided as part of the OSIM inspection bridge condition index (BCI), a condition score was created for each asset into five rating categories ranging from Very Good to Very Poor as shown below. **Table 40** provides a summary of the condition scale.

Table 40. City of St. Catharines Structures Condition Scale

Condition Score	Condition Rating	BCI
1	Very Good	80-100
2	Good	70-79
3	Fair	60-69
4	Poor	40-59
5	Very Poor	0-39

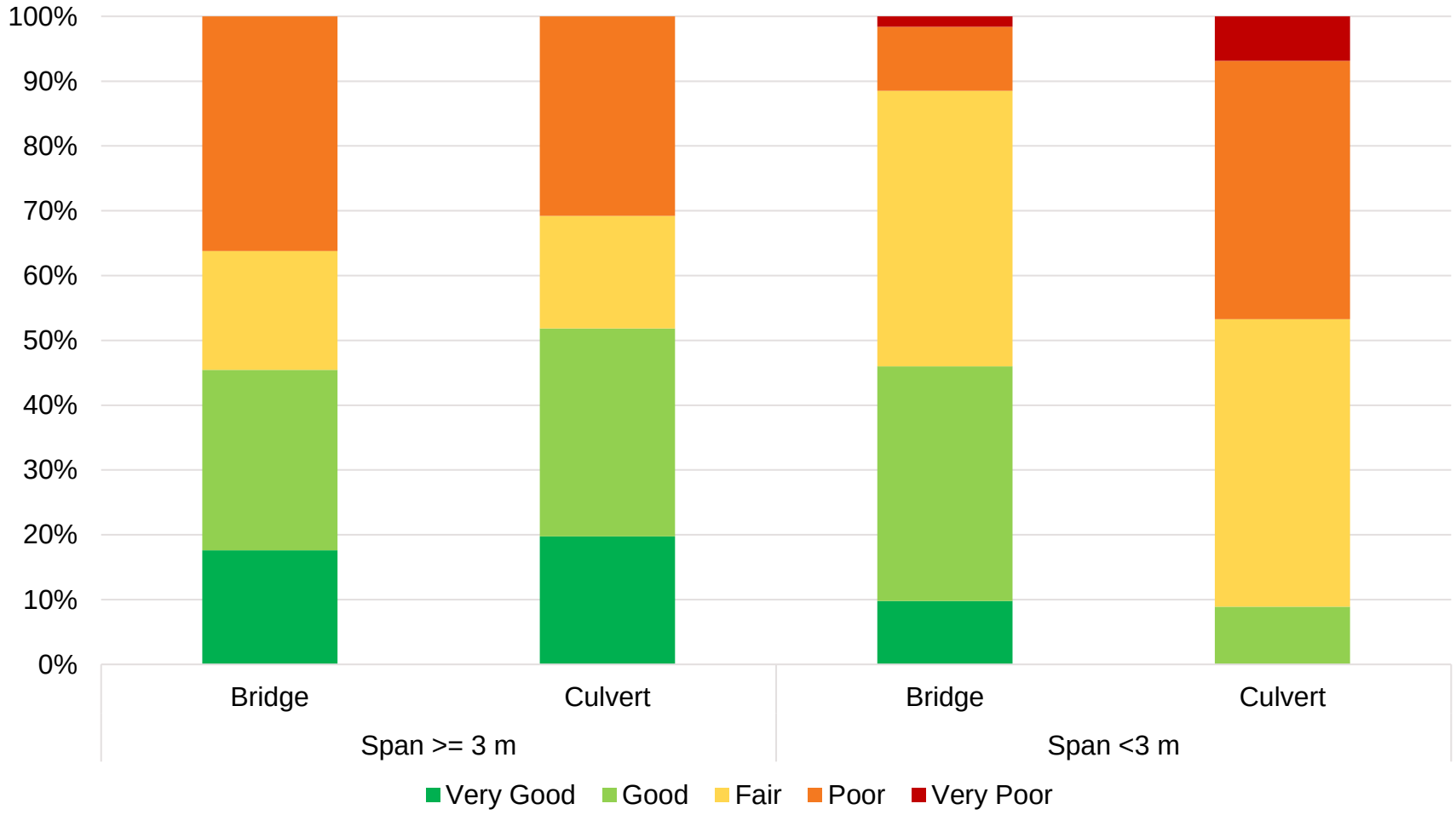


The current condition of assets is summarized and weighted by replacement value in **Figure 49**.

As shown in the figure, the structures with spans over three metres are overall in Good and Fair condition. The structures under three metres also have an average of Good condition.

Overall, 1% of the structure assets are in the very poor category and 35% are in the poor category.

Figure 49. Condition Distribution by Replacement Value for all Structure Asset Types



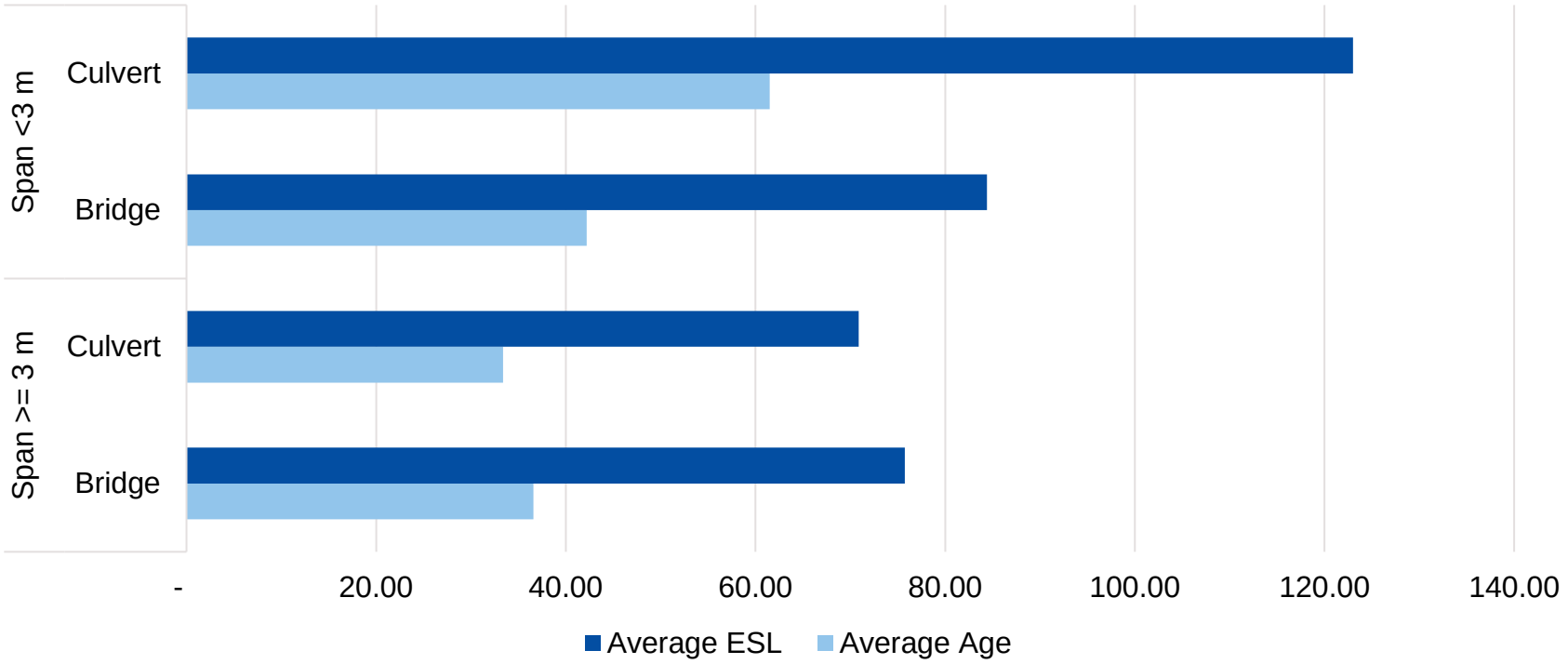
6.1.3 Structures Age Summary

By comparing the average age of the assets against the average estimated useful life, the estimated remaining life of the portfolio from an age perspective can be understood.

The figure below summarizes the average ages of each structure asset type.

The results align with those asset categories that indicated the majority of their assets are in Good and Fair condition as these are around mid-way of their estimated useful life.

Figure 50. Average Age as a Proportion of Expected Service Life by Asset Type All Structures Assets



6.2 Structure Levels of Service

The City of St. Catharines is committed to providing safe, efficient, accessible, and sustainable structures that support the transportation system for all required uses and modes of transportation in accordance with regulatory requirements and expectations of the community.

The City has set a minimum quantitative target for its bridge assets of 60 BCI, which is equivalent to bridge structure being in fair condition. This proactive approach results on bridges not reaching Poor or Very Poor condition states.

The City also strives for no disruptions to vehicular or pedestrian traffic due to load restrictions, and that travel routes are safe with no harmful environmental impacts.

The Key Service Attributes associated with the transportation LOS and their associated statements are defined in the table below:

Table 41. Structures LOS Service Attributes

Service Attribute	Attribute Statement
Scope	Providing adequate transportation services to the community by maintaining accessible structures.
Safety	Providing safe and accessible structures.
Quality	Providing structures at the appropriate material quality.
Reliability	Providing structures that are reliable.
Environmental Stewardship	Providing structures that are environmentally conscious.
Cost Efficiency	Providing cost efficient structures for all transportation modes.

The following sections provide a summary of the level of services for the City's structures including those required by the O.Reg.588/17.

6.2.1 Structures Customer Levels of Service

The City's CLOS documents the asset performance from a customer perspective. The following provides a summary of the CLOS associated with the structures in the City of St. Catharines.

- **Description of the traffic that is supported by municipal bridges (e.g., heavy transport vehicles, motor vehicles, emergency vehicles, pedestrians, cyclists). (Scope)**

  Bridges & Culverts on roads support all classes of vehicles including motor vehicles, heavy transport vehicles, buses, and emergency vehicles, as well

as pedestrians and cyclists. Pedestrian bridges support both pedestrians and cyclists.

- **Description or images of the condition of bridges and/or culverts and how this would affect their use. (Quality)**
  City of St. Catharines follows the standards and best practices outlined in the Ontario Structure Inspection Manual in order to determine the condition of the bridges and culverts Third party consultants who are experts in the design and assessment of bridges are engaged to complete these assessments.

Additional customer levels of service are provided in **Table 42**.

Table 42. Structures CLOS Indicator

Service Attribute	Customer Levels of Service	2020 Performance
Quality	Average Condition of structures	Good
Reliability	Number of structures in Poor or Very Poor condition	34
	Percentage of structures in fair or better performance	64%
Cost Efficiency	Annual cost to provide structure service (per household)	$29

6.2.2 Structures Technical Levels of Service

The City has defined technical requirements and key performance indicators that support internal reporting. The following provides a summary of the TLOS associated with the structures service.

Table 43. Structures TLOS Metrics

Service Attribute	Technical Levels of Service	Current Performance
Scope	Total number of bridges and culverts with a span of 3 metres or greater	71
	Number of pedestrian bridges with a span of 3 metres or greater	38
	Total number of bridges and culverts with a span less than 3 metres	46
	Number of pedestrian bridges with a span less than 3 metres	2

Service Attribute	Technical Levels of Service	Current Performance
Safety	Percentage of bridges in the municipality with loading or dimensional restrictions[(a)]	5%
Quality	Percentage of bridges in poor or better condition	99%
	For structural bridges in the municipality, the average bridge condition index value (span of 3m or greater)[(a)]	69.5
	Smaller bridges in the municipality, the average bridge condition index value (span less than 3m)[(a)]	60.3
	For structural culverts in the municipality, the average bridge condition index value. (span of 3m or greater)[(a)]	72.2
	Smaller span culverts in the municipality, the average bridge condition index value (span less than 3m at water courses)[(a)]	60.3

Notes:

(a) Required by O.Reg. 588/17

6.2.3 Structures Future Metrics for Consideration

As part of the definition of levels of service, the City identified possible level of service metrics that could be added to their framework as data becomes available. The following table provides a summary of the metrics that have been proposed for future consideration.

Table 44. Structures Future Metrics

Service Attribute	Levels of Service Proposed Future Metric	Type of LOS
Safety	Percentage of culverts that meet MTO capacity requirements	Technical

6.3 Structures Lifecycle Management Strategy

The levels of service presented in the previous section are supported by the achievement of a variety of lifecycle activities in accordance with the activity types presented in **Table 5**. These activities are targeted to extend the asset life, ensure levels of service are being met, and reduce overall lifecycle costs.

The structures service staff implement a variety of lifecycle activities on its entire portfolio. **Table 45** provides a summary of these activities and the risk associated with not doing them.

Table 45. Structures Lifecycle Activities, Associated Risk, and Estimated Lifecycle Cost

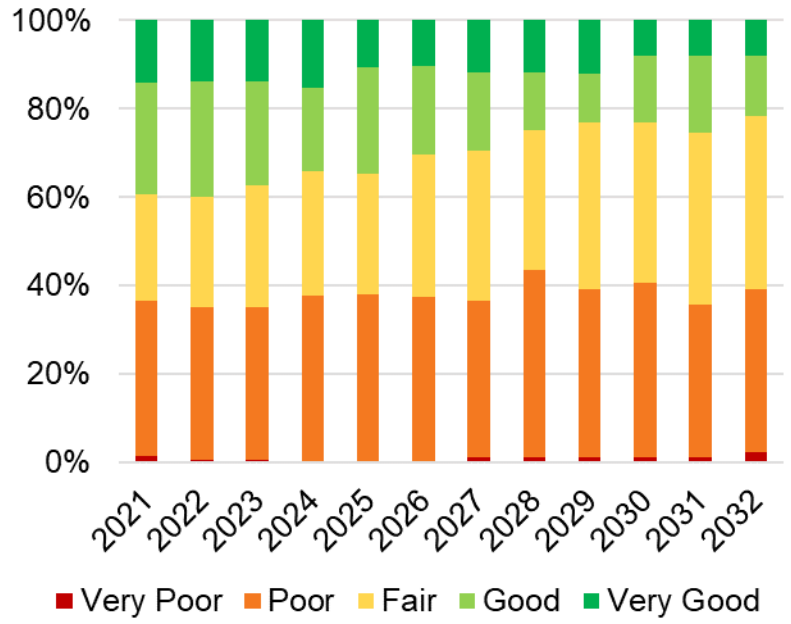
Lifecyle Activity Type	Asset Management Practices	Risk Associated with the Activity	Equivalent Annual Cost (2022 and 2032)
Non-Infrastructure Solutions	• Condition assessments are conducted to determine the condition of the assets above three metres on the network bridges (OSIM inspections).	• Growth projections follow an accelerated rate not following planned estimates. • Inadequate planning assumptions can provide incorrect forecasted estimates. • Regulatory requirement and standard changes. • Reduced ability to understand potential impacts of climate change on the infrastructure.	$ 69,000 Based on the historical 2017 to 2021 average expenditures

Lifecyle Activity Type	Asset Management Practices	Risk Associated with the Activity	Equivalent Annual Cost (2022 and 2032)
Maintenance Activities	• Inspections are conducted in accordance with the Minimum Maintenance Standards and the necessary maintenance activities are triggered based on findings. • Sweeping on bridges is conducted as part of the road sweeping program as presented on Section 5.	• Increased lifecycle cost if maintenance is done improperly or not with scheduled frequency. • Resource limitations to conduct unplanned, urgent work. • Insufficient maintenance may contribute to asset failure resulting on service disruptions.	$ 247,000 Based on the 2020 to 2021 budget increase applied annually from 2021 onwards. Incorporating the maintenance of growth assets following construction.
Renewal / Rehab Activities	• Repairs are conducted as identified in the OSIM inspections.	• Incorrect assumptions of the expected improvement in useful life after maintenance is completed. • Increased lifecycle cost if renewal/rehab are done improperly or not as scheduled.	$ 710,000 Forecasted based on the lifecycle management activities

Lifecyle Activity Type	Asset Management Practices	Risk Associated with the Activity	Equivalent Annual Cost (2022 and 2032)
Replacement / Construction Activities	• Replacement of deteriorated assets.	• Coordination with other asset classes (if applicable) might delay timeframe of construction activities. • Delays in construction could result in cost over-runs. • General deterioration in the condition of the structures and potential safety risks for users. • Potential load restrictions on structure. • Premature failures resulting in potential closures of trails and sidewalks and roads.	$ 1,119,000 Forecasted based on the lifecycle management activities
Disposal Activities	• Decommissioning assets at the end of their useful life. • Disposal of abandoned or obsolete infrastructure during construction projects.	• Improper disposal could lead to environmental impacts and result in cost overruns.	$ 43,000 Based on the 2017 to 2021 average disposals
Growth Activities	• Additions to support changes in demand and as per developments in the area.	• Growth activities are delayed or cancelled resulting in system being unable to accommodate increased growth demands.	$ 591,000 Based on the average distribution of the $ 6,500,000 projected development charges for a new structure in 2026

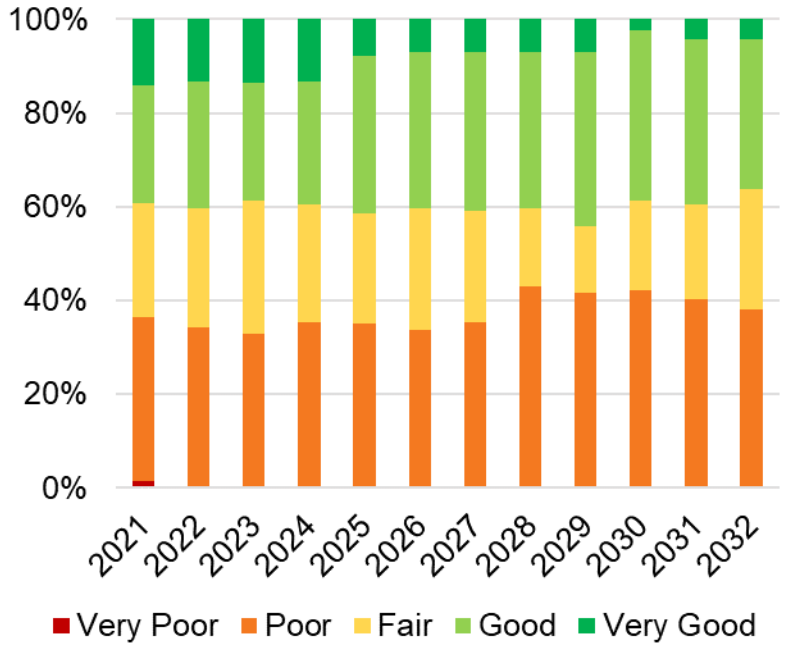
The City uses these strategies to plan work and determine future expenditure needs. The TLOS used in the AM analysis for wastewater assets was defined as maintaining the current portion of asset with poor or better performance. The current planned budget of $1.8M annually appears to maintain LOS and resulted in the performance forecast shown in **Figure 51**. However, this is without adding additional structures, which would require an increase to annual investments. The percentage of assets in poor or better condition holds around 99%. This suggests that the anticipated budget is enough to maintain current LOS.

Figure 51. Structures Condition Distribution Performance with Anticipated Budget



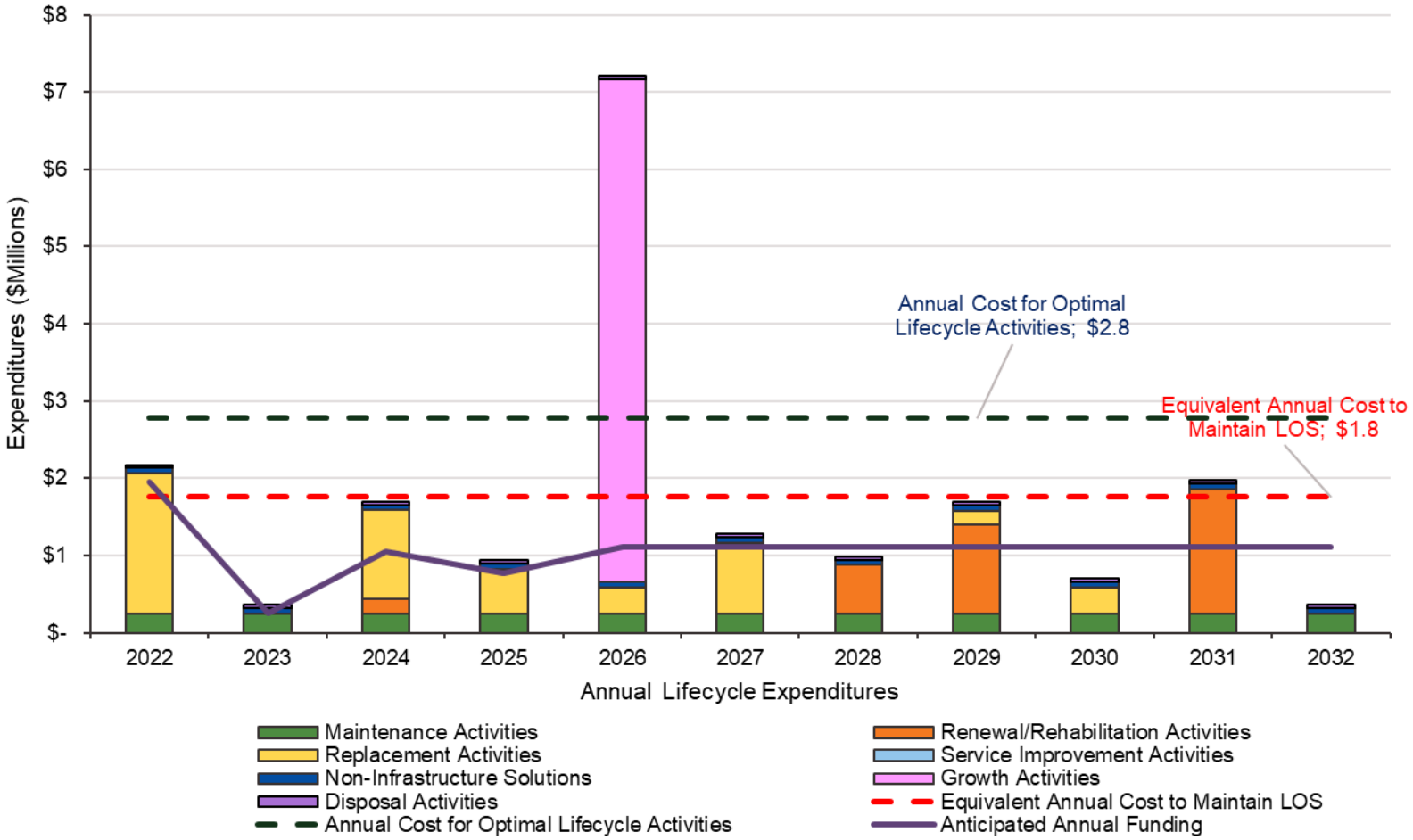
Additionally, an optimal lifecycle scenario was analyzed, which was used to determine the cost to meet all lifecycle strategies described in **Table 45**. This scenario addresses the backlog and ensures no asset reaches very poor performance. The cost to achieve this scenario was determined to be $2.8M annually over a 25-year period and resulted in the performance forecast shown in **Figure 24.**

Figure 52. Structures Condition Distribution Performance with Optimal Lifecycle Activities



The costs for the 10-year lifecycle forecast are presented in **Figure 53**. The graph shows the forecasted expenditures by lifecycle category for the cost to maintain scenario. The equivalent annual cost to maintain LOS, the annual expenditures for the optimal lifecycle scenario and the anticipated annual funding is also provided on the graph. It is recommended that the City should continue with anticipated spending.

Figure 53. Structures Forecasted Lifecycle Needs



6.4 Structures Service Associated Risks

In addition to the risk associated with the lifecycle activities for this service described in **Table 45**, the following are considered general risks with this service:

- Deterioration of structures could result in load restrictions, closure, or potentially collapse; and
- Culvert failure could result in erosion to road bases and sink holes.

6.5 Structures Climate Change Considerations

Depending on their location, various City structures may be more susceptible to the impacts of climate change than others. Culverts are designed to convey flows based on past historical storm events and development projections. As storms increase in intensity, the resulting flows may exceed their capacity, increasing flood risk and the potential for structural damage or collapse during extreme storm events. As these assets are renewed, design modifications may be required to improve their future performance.

Similarly, during extreme storm events, bridges over waterbodies may be subject to high flood levels for which they were not designed. Hot and cold temperature extremes and freeze/thaw cycles may weaken concrete or structural components. It is essential that vulnerable structures be evaluated, and any necessary improvements are planned for future consideration.

6.6 Structures Data Sources

The following condition data was used to support this chapter's assessments of the City's structure assets.

- 2020 OSIM Inspection database

No assumptions were made during the assessment of the data for this asset group.

A data confidence assessment is provided below:

Table 46. Structures Data Confidence Assessment

Asset Category	Confidence Rating	Confidence Data
Span (>= 3m) - Bridge	A	No assumptions
Span (>= 3m) - Culvert		
Span (< 3m) - Bridge		
Span (< 3m) - Culvert		

7 Financial Strategy

The financial strategy of this AMP aims to identify the appropriate funding levels required to provide the intended levels of service. It takes into consideration revenues, operating and capital expenditures, debt, and any future commitment for all the asset classes in the plan.

The City's budgets are developed to allocate the necessary funding to provide services, maintain, and construct infrastructure assets. These are based on required costs (expenditures) and available funding (revenues). The City allocates a portion of their revenues from property taxes and utilities to support current year projects, contribute to reserve funds, and make debt repayments.

Property taxes fund the City's core asset programs and services including stormwater management, road and structure operations, active transportation, and right-of-way maintenance. Water and wastewater are funded by rates.

In terms of expenditures, the City categorizes their budget into the following:

- **Operating budget**: Supports the day-to-day activities and functions conducted to provide City services. Samples of the expenditures funded from the operating budget include staff salaries, equipment maintenance, materials supply, and facilities services. These are expensed within the fiscal year.
- **Capital budget**: Includes large expenditures associated with construction or purchase of infrastructure. It leverages the debt and reserve funds available to manage the financial position over a ten-year period. Defining capital budgets includes the evaluation of long-term investment proposals along with estimating future cash flows.

As part of the annual budget development process, the City ensures continued financial sustainability through effective financial planning and risk management.

The following sections describe the interrelations between the City's infrastructure investment needs and the financing strategies.

7.1 Operating Revenues and Expenditures

The City's operating revenues for core and non-core assets by funding sources are as outlined below:

Table 47. Tax & Non-Tax Operating Revenues by Funding Source ($'000)

Funding Source	2019	2020	2021
General Levy	91,908	95,729	97,678
Urban Service Area Levy	12,690	12,792	13,354
Investment in CIP	(1,200)	(1,250)	(1,250)
Tax Appeals and Write offs	(880)	(920)	(920)
Commercial /Industrial Vacancy Rebate	(320)	(320)	(170)
Supplemental Taxes	665	695	522
Municipal Utilities	549	527	536
Universities and Hospitals	668	676	700
Other Revenues	10,781	11,297	10,810

Source: City Operating Budget 2021 and 2020

The other operating budget revenues include contributions from other governments, rents, concessions, franchises, fines, penalties, and interest, income from investments, surplus from previous year, transfer from reserve, reserves support, and miscellaneous revenues.

An additional source of revenue for the City is via the water and wastewater rates which are dedicated to the provision of the related services. The following provides a summary of rate support between the City and the Niagara Region expenditures.

Table 48. Rates Gross Operating Revenues and Distribution ($'000)

Funding Source	2019	2020	2021
Water and Wastewater Rates Revenue	**50,030**	**54,942**	**55,234**
City of St. Catharines Expenses	17,942	20,954	19,913
Related Region of Niagara Expenses	32,088	33,988	35,261

Source: City 2021 Water and Wastewater Budget Book

The net historical and projected operating budget for the assets included in this plan are shown below.

Table 49. Net Operating Budget by Service ($'000)

Service	2019	2020	2021
Water	3,233	6,027	5,776
Wastewater	4,220	2,955	2,900
Stormwater	-	154	204

Service	2019	2020	2021
Transportation	6,913	5,255	5,341
Structures	317	497	488

Since 2020 discrete budgets for Stormwater for the assets included in this plan have been included in the operating budget. The City has stated that it is moving to further separate the costs associated with this service.

7.2 Capital Financing and Expenditure

The capital budget is used for major investments like construction of infrastructure, supporting non-infrastructure solutions like technical studies and master plans. The capital budget for each service is shown below.

Table 50. Capital Budget by Service ($'000)

Service	2019	2020	2021
Water	6,828	8,166	8,129
Wastewater	2,000	4,786	4,761
Stormwater	3,241	4,367	2,783
Transportation	7,672	10,004	11,388
Structures	3,864	2,420	1,290

It should be noted that the water and wastewater anticipated funding was developed based on the current Water and Wastewater Financial Plan up to 2029. The breakdown of the funding is shown in **Table 51**.

Table 51. Water and Wastewater Funding ($'000)

Year	Water	Wastewater
2021	8,129	4,762
2022	9,166	5,358
2023	10,726	6,262
2024	13,761	7,473
2025	15,420	8,397
2026	16,904	9,033
2027	16,814	9,081
2028	18,151	9,743
2029	19,514	10,418

7.3 Reserves & Reserves Funds

The City has a number of reserve funds that are each used to support the capital program requirements. The source of these includes tax, grants, and Development Charges.

7.4 Debenture Financing

The City debenture funding can be utilized as a source for annual capital investments and is utilized after all other applicable funding has been applied. Debenture financing allows the City to spread the costs of capital over the term of debt rather than requiring funding in the year of construction. Debt management is necessary to ensure that the City maintains an appropriate debt level.

The City has a Council approved debt management strategy that is part of their capital budget; for more detail refer to *Capital Financing Report FMS-B011-2021*. For additional details please refer to Section 4 of the City's capital budget book.

7.5 Projected Financing Strategies

For the purpose of the analysis, the investment needs have been assessed against the projected tax and rate funds for the next ten (10) years. The assumed annual expenditures are based on the lifecycle costing analysis outlined for each asset group.

The expenditure summary provided under each service section and in the following pages is based on the investment required to maintain levels of service, specifically the proportion of assets in poor or better performance.

The future projections were developed using the assumptions shown in **Table 52**.

Table 52. Forecasted Funding Assumptions

Activity Type	Model Assumption
Asset at End of Life	Reflects the current assets that have overdue treatments in 2022 and require replacement.
Non-Infrastructure Solutions	Estimated based on the current five years average for these expenditures.
Maintenance Activities	Developed based on a review of the historical maintenance expenditures as a percentage of the portfolio replacement value.
Renewal/Rehabilitation Activities	Forecasted based on a lifecycle model applied to each asset in the asset register.
Replacement Activities	Forecasted based on a lifecycle model applied to each asset in the asset register.
Disposal Activities	If available, these were calculated as an average of current disposal activities costs.

Activity Type	Model Assumption
Service Improvement Activities	Calculated as a percentage of the replacement cost of the total portfolio based on the average of the service improvement investments of the last five years.
Growth Activities	Calculated as the maximum value between: • Historical 5-year average growth as a percentage of the replacement cost of the total portfolio. • Projected Development Charges. Population and employment forecasts, and resulting impacts on demand from growth, are assessed and documented in the City of St. Catharines Development Charges Background Study (June 2021). Forecasted capital and significant operating expenditures due to increase in demand from growth are assessed in the City of St. Catharines Development Charges Background Study (June 2021). It is assumed that growth projections in the City's financial forecasts, used in the development of this AMP, include and align with the projections from the DC Study.

The resulting graphs reflect the forecasted amounts for each of the activity types and summarize the equivalent annual costs over the 10-year period. **Figure 54** provides the summary of the tax-based expenditures which includes the transportation, structures, and stormwater asset portfolios. This portfolio has an annual equivalent annual cost of $42 million to maintain the current LOS. There is an investment shortfall for tax-based expenditures of around $20.8M annually to maintain the current condition of the assets that support storm, transportation and structures. The City must either reduce service offerings to their residents or increase funding to be able to maintain services at the current level.

Figure 54. Forecasted Asset Portfolio for Tax Based Expenditures

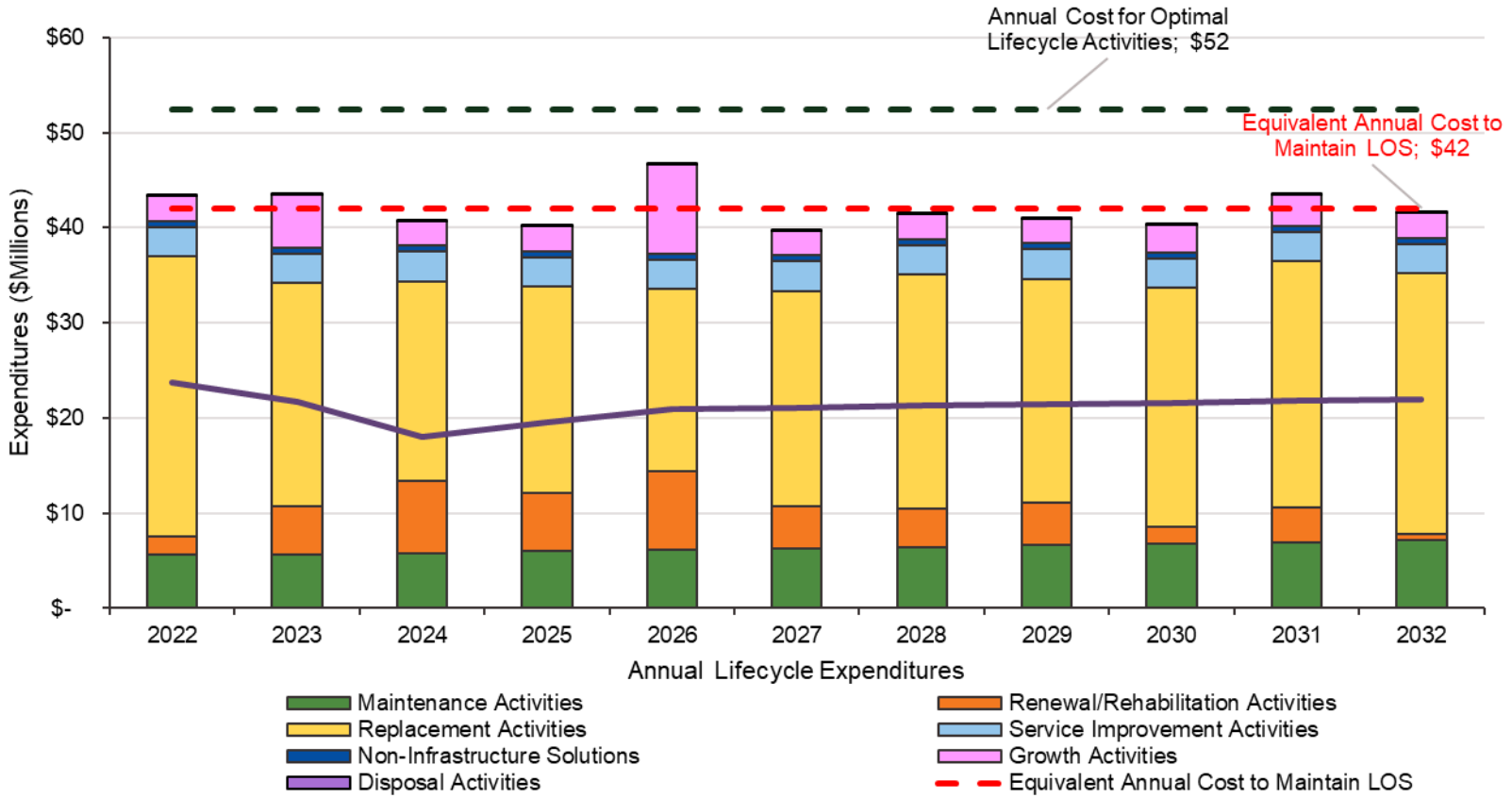
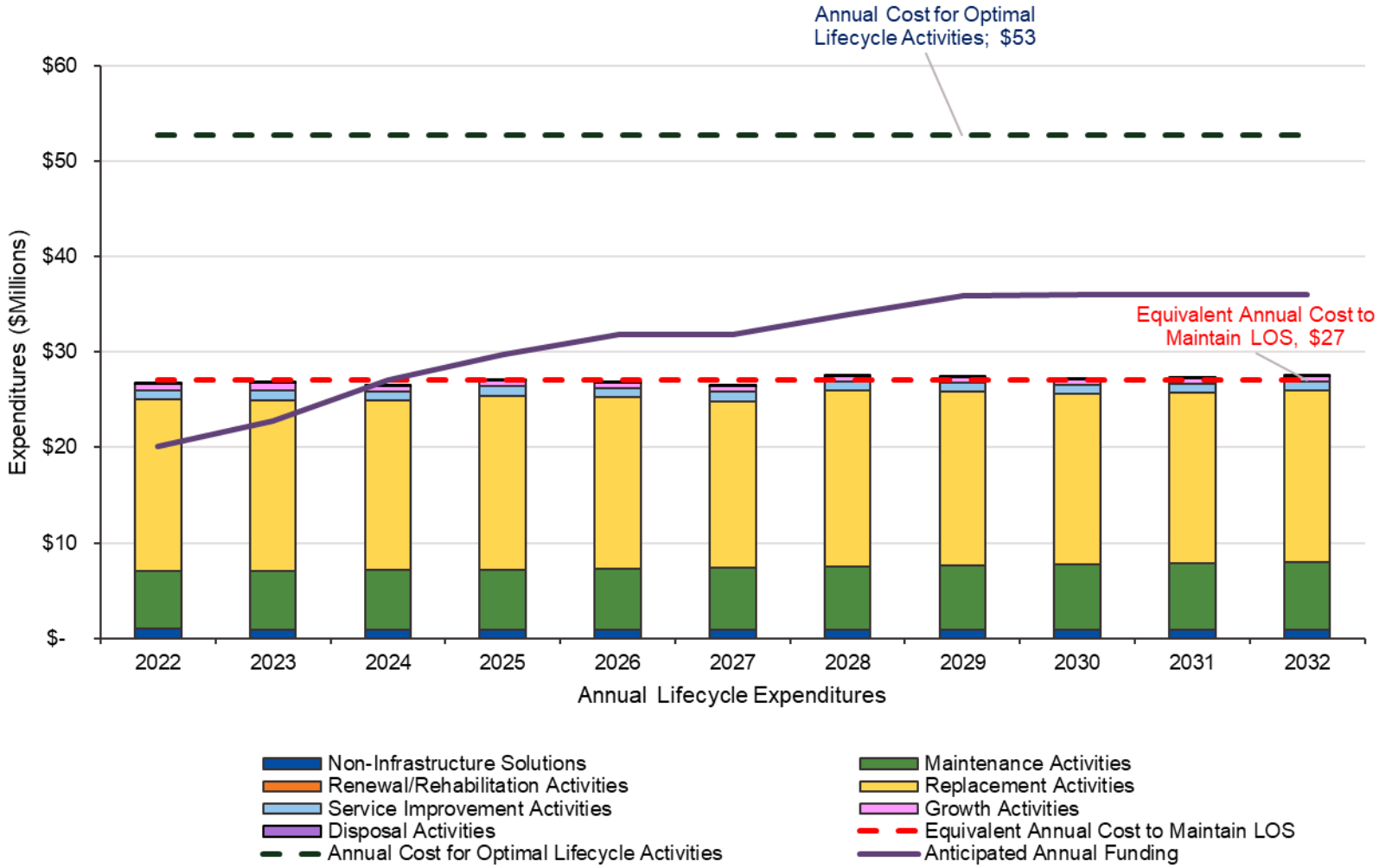


Figure 55 provides the summary of the rate-based expenditures which includes the water and wastewater asset portfolios, which has an equivalent annual cost of $27 million. The anticipated rate-based investments identified in the recent Water and Wastewater Financial Plan, which the City should continue to implement, are sufficient to maintain the current condition and forecast a slight improvement to service, however are still below the optimal renewals identified.

Figure 55. Forecasted Asset Portfolio for Rate Based Expenditures



One method to gain an understanding of the forecasted required funding and the planned available funding is to view the costs cumulatively over time. **Figure 56** and **Figure 57**, provide the cumulative forecasted capital funding needs versus the cumulative available funding for 2022 to 2046. The grey area represents the cumulative capital expenditures, based on the same lifecycle cost estimate information presented in **Figure 54** and **Figure 55.**

The red line on each graph represents the current forecasted funding. The forecasted funding for the tax-based assets is based on the City's currently planned capital funding from 2021 to 2025. Beyond 2025, the average annual 5-year funding has been used. For the rate-based assets, the forecasted funding is based on the water and wastewater financial plan to 2029 (as previously presented in **Table 51**). Beyond 2029, the annual average funding from 2021 to 2029 has been used.

The black line on each graph represents the compound annual budget increase required beyond the currently planned funding to fully fund the cumulative capital expenditures by 2046. It should be noted that for tax assets, the compound annual funding increase starts from 2026 onwards, and for the rate assets, the increase starts from 2030 onwards. The figures show that to fully fund the tax and rate-based asset portfolios by 2046, an 8.09% and 0.34% compound annual increase would be required respectively. Note that this is in addition to general inflationary increases.

Figure 56. Forecasted Cumulative Tax Based Funding

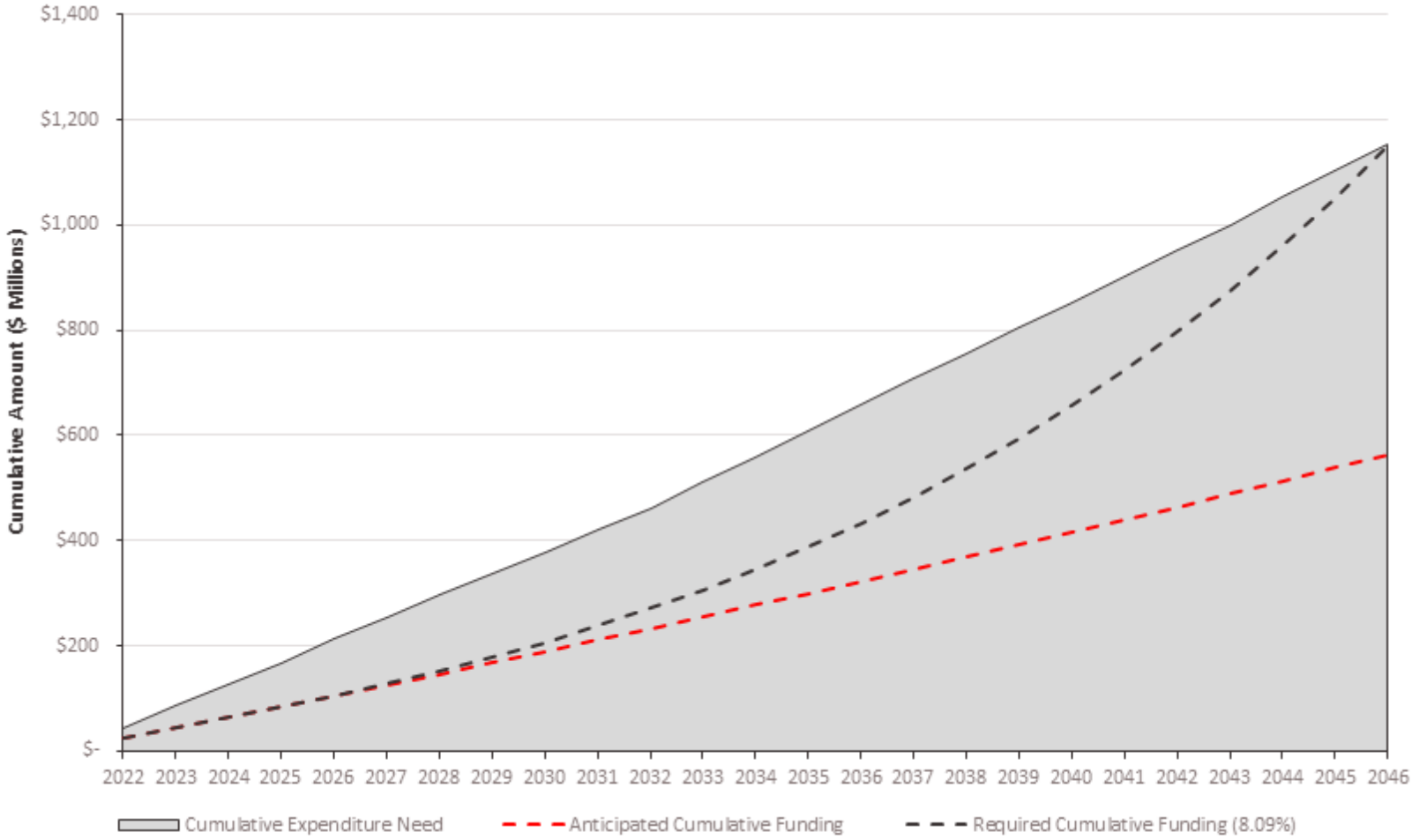
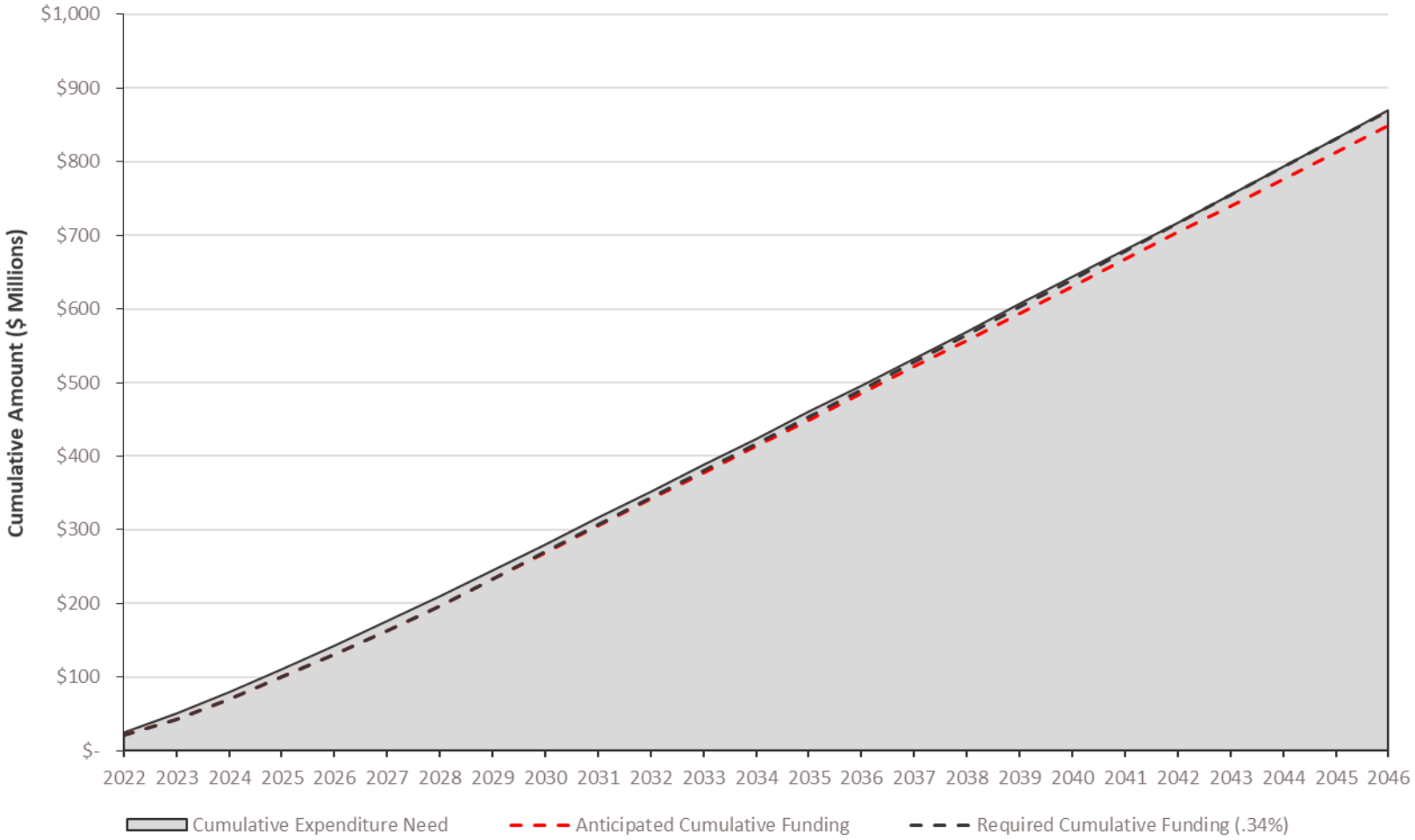


Figure 57. Forecasted Cumulative Rate Based Funding



8 Conclusions

The City is generally managing and planning for the future core asset needs in a successful manner. As described in the sections earlier, only Transportation exhibits an investment shortfall to maintain current LOS.

Additionally, a few recommendations can be drawn:

Explore opportunities to understand the largest operating costs. Significant operating costs are a fundamental lifecycle cost that can be overlooked, and this may be an excellent time to consider updating the existing work management system'. Asset-centric management of work can help the City establish a baseline of costs related to levels of service and assets and may provide opportunity to optimize maintenance as a lifecycle activity. This will enable the City to move towards an optimized and preventative approach to maintenance.

Improve the accessibility of data. A significant amount of data was centralized for this assignment. The City may consider continuing to integrate disparate data sets so that asset management analysis, and other business processes, can be more readily conducted.

Improve data quality, suitability, and confidence. This will continue to be a significant element in asset management. Collecting all data is not the objective – collecting relevant and repeatable data that informs asset managers and decision-makers is the key. The City should continue to define the data that provides the most value for specific tasks, and then focus on enhancing the data suitability and confidence in a strategic sense. Relevant data that is up to date, accurate and fit for use is a fundamental enabler in successful asset management. For example, the current wastewater and stormwater main performance data may not reflect all the parameters that staff use to plan future work.

Build on the success of this AMP. The City can use the annual AM review to both look back and project forward, celebrate successes and learn from efforts made. Some levels of service and performance measures identified in this AMP can provide valuable performance feedback and an opportunity for the City to check in on progress. Performance management programs can also connect to these levels of service.

Continue to prepare for upcoming legislative requirements. In alignment with upcoming legislative asset management deadlines, continue preparations for new asset management prescribed requirements, including new regular asset management effectiveness review and reporting, maintaining public consultation and communication of data, and discussions/negotiations around proposed levels of service, costs and risk using the updating asset management information in the AMP. In particular, the levels of service within this AMP are based on legislative requirements. For the next AMP update, consider setting levels of service first based on corporate goals and objectives, since these define the

City's priorities and guide future spending. Also set levels of service based on citizen needs - the expectations of the public have a direct impact on the level of service demanded from infrastructure.

9 Improvement Plan

Asset Management practices at the City of St. Catharines rely on making the best possible decisions regarding infrastructure. As part of the development of this AMP, opportunities for improvement of asset management practices and the asset management plan were identified. When establishing an improvement plan, it is useful to consider international standards and well-known asset management guidance for advancing Asset Management capabilities including:

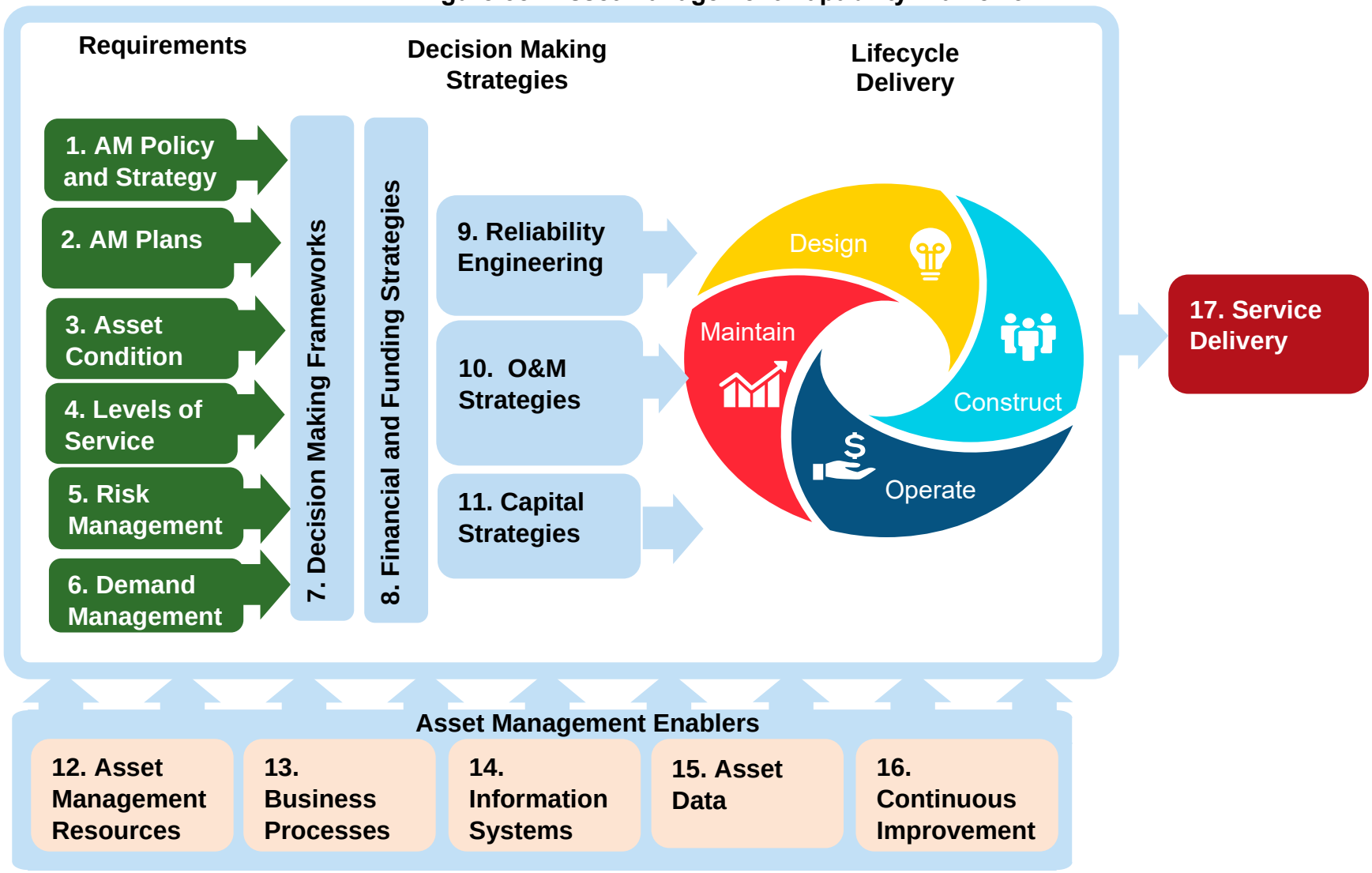
- ISO 55000;
- International Infrastructure Management Manual (IIMM) 2015; and
- BSI PAS55:2008.

These standards were developed over several years with international collaboration and are widely regarded as best practices for the field of Asset Management. Key recommendations have been categorized according to **Figure 58** on the next page, which organizes efforts related to Asset Management into:

- **Asset Management Requirements**: key documentation that defines the governance, objective and direction of the AM practices;
- **Decision Making Strategies**: tools that support decision making with a full asset lifecycle perspective; and
- **Asset Management Enablers**: processes and resources available to ensure Asset Management remains a well-established component of successful service delivery.

Understanding that the City is committed to improving the Asset Management practices over the long-term, the following provides a summary of recommended improvements. These are provided to guide strategic decisions for the City to continually improve levels of service, asset reporting (valuation and condition), risk, and therefore improve future iterations of the AMP for core and non-core assets.

Figure 58. Asset Management Capability Framework



Source: Adapted from IPWEA, 2015 and ISO/IEC 550001

9.1 Asset Management Requirements

As indicated in Section 1, the City has proactively been working on developing the necessary documentation to guide their AM practices. The following sub-sections provide an overview of continuous improvement opportunities for each framework element.

9.1.1 Asset Management Policy and Strategy

As discussed in Section 1, the City has an Asset Management Policy in place and an Asset Management Working Group has been established in which representatives from all departments are part of the decision making associated with AM and with the updates of objectives, policies, and procedures.

A key factor to consider as part of this is the overall City staff buy-in beyond those that are directly involved in the AM working group and AM projects. It is recommended that the City establish communications strategies for the asset management policy and strategy, which may include in-house AM posters, staff on-boarding training that outlines the AM policy, and other practices to promote the role and advantages of Asset Management to all levels of staff.

Outcome: Improved corporate buy-in.

9.1.2 Asset Management Plan

This document and the subsequent non-core AMP will fulfill the requirements for Asset Management Plans as set out by O.Reg. 588/17. It is recommended that ongoing work be conducted to improve background data and the processes for the development of asset management plans.

Outcomes: Meet Provincial legislative requirements for Asset Management Plans.

9.1.3 Asset Condition

To establish continuity between services, it is recommended to develop a standardized condition assessment protocol and templates to ensure condition and capacity information are collected and returned in a defined structure. The protocol would outline the restrictions, assumptions, and requirements of the work as well as how to complete the template. This template would be set up for ease of transfer to an internal or external user and would have the ability to be seamlessly uploaded to the respective system post completion. This of course needs to align with the business processes, City reporting needs, and roles and responsibilities in place; for example, incoming data should be verified prior to upload. The templates may include but not be limited to the following:

- Defining the level of detail required for condition, capacity, and risk;
- Defining the level at which assets will be identified (granularity) for condition assessments;

- Assigning grading standards for each process group for condition as well as performance; and
- Defining the costing methodology, including threshold, defining labour requirements, etc.

Outcomes: High confidence in data that can be used to inform decision-making processes related to capital planning and lifecycle activity planning.

9.1.4 Levels of Service

Both CLOS and TLOS were established for core assets as part of this AMP. However, processes need to be put in place to capture data for LOS metrics identified as future measures. It is recommended to put in place a full LOS program that will allow an annual review, revisions based on data availability and the identification of additional metrics required.

Moreover, in order to understand customer expectations, it is recommended for the City to conduct a customer satisfaction survey to gauge the citizens' feedback and priorities based on funding constraints.

Outcomes: Sets targets for levels of service and provide an understanding of the costs to provide the levels of service.

9.1.5 Risk Management

An enterprise risk management framework and management system will streamline the process of establishing and identifying risks to which the City is exposed. It is recommended to consider a formal risk assessment protocol as part of the condition assessment templates, as per section 9.1.3.

Outcomes: Well defined and repeatable processes to assess asset risk that will aid in decision-making activities at the City.

9.1.6 Demand Management

The completion of Master Plans will help the City develop a greater understanding for the Capital Projects that need to be planned. This can enable the City to ensure there is capacity within its infrastructure systems to accommodate a growing population.

Outcomes: Improved understanding of needs for capital planning initiatives.

9.2 Decision Making Strategies

The City has multiple systems in place to manage the different services; however, limited integrations are in place and the decentralized information increases challenges in the AM review processes.

9.2.1 Decision Making Framework

By establishing formal processes for decision making and choosing and implementing a software system that will support the process, the City will be able to make well-

informed choices and ensure their infrastructure is being managed in a financially sustainable way.

Outcomes: Well established processes and systems to support them so the City can make well informed and defendable decisions.

9.2.2 Financial and Funding Strategies

It is recommended that the City continues to integrate and create alignment between the current financial plans and the asset management plan. This includes developing long-term forecasts for all asset classes in alignment with the lifecycle strategies outlined in the asset management plan. This includes ongoing continuous improvement of asset state of good repair needs (through condition assessments) and capacity needs (through master planning and growth studies).

Outcomes: Aligned funding strategy and asset management plan.

9.2.3 Reliability Engineering

The City is working towards improving the recording of asset failure in their systems. It is recommended that the City establish a plan to acquire the necessary resources (staff and budget) to implement a more proactive approach based on reliability engineering and industry best practices. This will be refined as the potential impacts of climate change on the assets is better understood and strategies to build resilience are developed.

Outcomes: Improved reliability and optimized lifecycle costs.

9.2.4 Operations and Maintenance

As part of this AMP, an asset register was drafted to record key data and a centralized source of asset information for the City. In order to keep the register updated, it is critical to audit and develop comprehensive strategies around all work processes that capture assets and asset information, such as updating asset information and retiring assets while maintaining historical data. For that reason, the City should connect asset data within the Computerized Maintenance Management System, tying asset data to day-to-day activities. In addition, the City should implement integrations to ease the flow of information between specialized systems and their Computerized Maintenance Management System to reduce the manual transfer of information.

It is also recommended to assess the adequacy of current operations and maintenance budgets since the current asset management plan is based on existing budgets which maybe underfunded.

Outcomes: Improved operations and maintenance processes and funding.

9.2.5 Capital Works Strategy

Well established capital planning is a key component of effective service delivery as it provides the opportunity to look forward and identify what projects need to be done in order to maintain levels of service at the City. By implementing an AM system as recommended in Section 9.2.1, the City will be able to establish a baseline of projected investments. A formal prioritization document should be created to standardize the decision-making criteria between the different services.

In addition, it is recommended that the City establishes processes to evaluate assets that are co-located, such as assets within the right of way. Corridor analysis tools, such as the integrated corridor coordination tools currently in place at the City should be utilized to support decision-making.

Outcomes: A prioritized list of projects that will aide in establishing funding requirements.

9.3 Asset Management Enablers

These initiatives form the foundation the City needs to continually be successful in their AM practices.

9.3.1 Asset Management Resources

The City Asset Management Working Group should continue to have frequent meetings and review asset management resourcing requirements across the organization. The City should also evaluate establishing a dedicated asset management team with dedicated asset management staff.

Outcomes: Continuous improvement of asset management practices.

9.3.2 Business Processes

Documenting current and optimized target business processes for all AM capabilities with clear data flow will improve the successful completion of AM activities. Furthermore, establishing roles and responsibilities provides structure and ownership to the continued maintenance of asset information.

This will include a detailed review of processes currently in place at the City to identify ways they can be improved and ensure they reflect new technology systems.

Outcomes: Allows for visibility in business processes, status, and accountability.

9.3.3 Information Systems

The main system to consider is the asset register which provides a complete list of assets in the City, regardless of ownership or status. Accurate, up-to-date, and mineable asset data is key to making informed and defensible decisions with respect to the management of assets in the short and long term. Asset registers are typically structured in a hierarchy for ease of access to information, and to allow for the summary and analysis of data at multiple levels as needed. The main purpose of

this approach is to reduce the need for managing duplicated datasets as this is resource and cost intensive. The City should consider implementing a formal decision support system in conjunction with a CMMS as well as the registry

Outcomes: Provides a Corporate "single source of truth", for asset data, including condition, capacity, cost, and criticality. This would enable a full and complete "cradle to grave" description of a singular asset or system based on accurate data for improved decision making.

9.3.4 Asset Data

As outlined through the asset portfolio sections, assumptions have been made and documented for the development of this plan with the goal of reducing gaps identified in future iterations of the AMP.

It should be highlighted that despite the different levels of data confidence recorded in the document, the information gathered is considered to generate a reliable plan for the City's asset portfolio. Further refinements will provide improved estimates.

The following provides a summary of the recommended asset data improvements for the City:

Table 53. Recommended Asset Data Improvements

Service	Recommendation
Water & Wastewater	Bulk water station, water booster station, and wastewater pumping station inventories were created based on drawings with the associated attributes. To improve the quality of these asset categories, it is recommended that the City implement a condition assessment program for both facilities in order to develop a comprehensive inventory of the structural and process assets with their associated age, condition, and replacement costs. It is also recommended that wastewater storage facilities are assessed, and formalized operations and maintenance schedules are established for these facilities.

Service	Recommendation
Wastewater & Stormwater	Sewer and maintenance holes condition were based on peak structural PACP condition ratings from the zoom camera assessments. It is recommended that the City continue to implement this approach and target detailed CCTV condition assessments based on condition and priority. It is recommended for additional modeling to be completed for wastewater and stormwater to understand capacity needs and potential impacts due to climate change. This includes the completion of Master Plans to identify areas that require service improvements and expansions to the system. Through these exercises, it is recommended to validate all O.Reg. 588/17 level of service measures applicable to the asset class.
Stormwater	Oil grit separator replacement costs were assumed independently of the details of each asset (size, location). To improve the quality of the dataset it is recommended that the City develop a comprehensive inventory for this asset category, including validation of key attributes and detailed cost estimates.
Stormwater	Open channel, wetland, and stormwater pond asset inventories provide high-level details of these assets. To improve the quality of the dataset, the City should develop a comprehensive inventory for these asset categories, including validation of the following key attributes: location, confirmation of the necessary components (i.e., inlet, outlet, and structure for ponds) and detailed cost estimates. It is also recommended to complete an inventory for roadside ditches, culverts, and natural assets that require capital or operating expenditures or require management by the City.
Transportation	The signalized intersection inventory is maintained by Niagara Region, it is recommended that the City coordinate improvement of the install dates information over time.
Transportation	Streetlights are to be considered as a combination of the pole, arm, and

Service	Recommendation
	fixture in terms of condition. The City should conduct a full streetlight condition assessment to get a more accurate representation of the actual condition of these assets. It is recommended to collect condition data for sidewalks to understand overall condition. In addition, it is recommended to establish expansion and service improvement needs to meet the target right-of-way cross section and level of service requirements.
Structures	For future OSIM inspections, it is recommended to align the condition categorization scale with that provided in this AMP in addition to the BCI.
All	Review data gaps and work towards filling/refining the datasets. It is recommended to develop standardized base data across assets and where possible have the data collected in the field to reduce errors
All	Estimated service lives were assumed based on best practices where these were not available in the City's tangible capital asset policy and register. These should be added for future reference.

9.3.5 Continuous Improvements

Asset Management is always evolving and to ensure the City's Asset Management practices are in alignment with best practices it is important to make a concerted effort to continually improve documentation, data, tools, and resource availability. This involves the following:

- Refining and reviewing progress of Asset Management roadmap initiatives; and
- Conducting a full AM maturity assessment as a baseline to set a target maturity for the next years and update it on a set frequency to understand progress against targets.

It is recommended that the City establishes resources and an implementation plan to complete the assessed improvements and prioritize the order of work based on the available resources.

Outcomes: Up to date AM practices that support the needs of the City of St. Catharines.

St. Catharines

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