Corporate Asset Management Plan **2021**

MISSISSAUGA

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Acknowledgements

The development of this document was a significant corporate wide initiative involving staff across the organization. The Corporate Asset Management Office would like to acknowledge the efforts of the Steering Committee, Working Group and all staff in the various Service Areas who participated in asset management workshops, providing their time, expertise and support in developing the 2021 Corporate Asset Management Plan.

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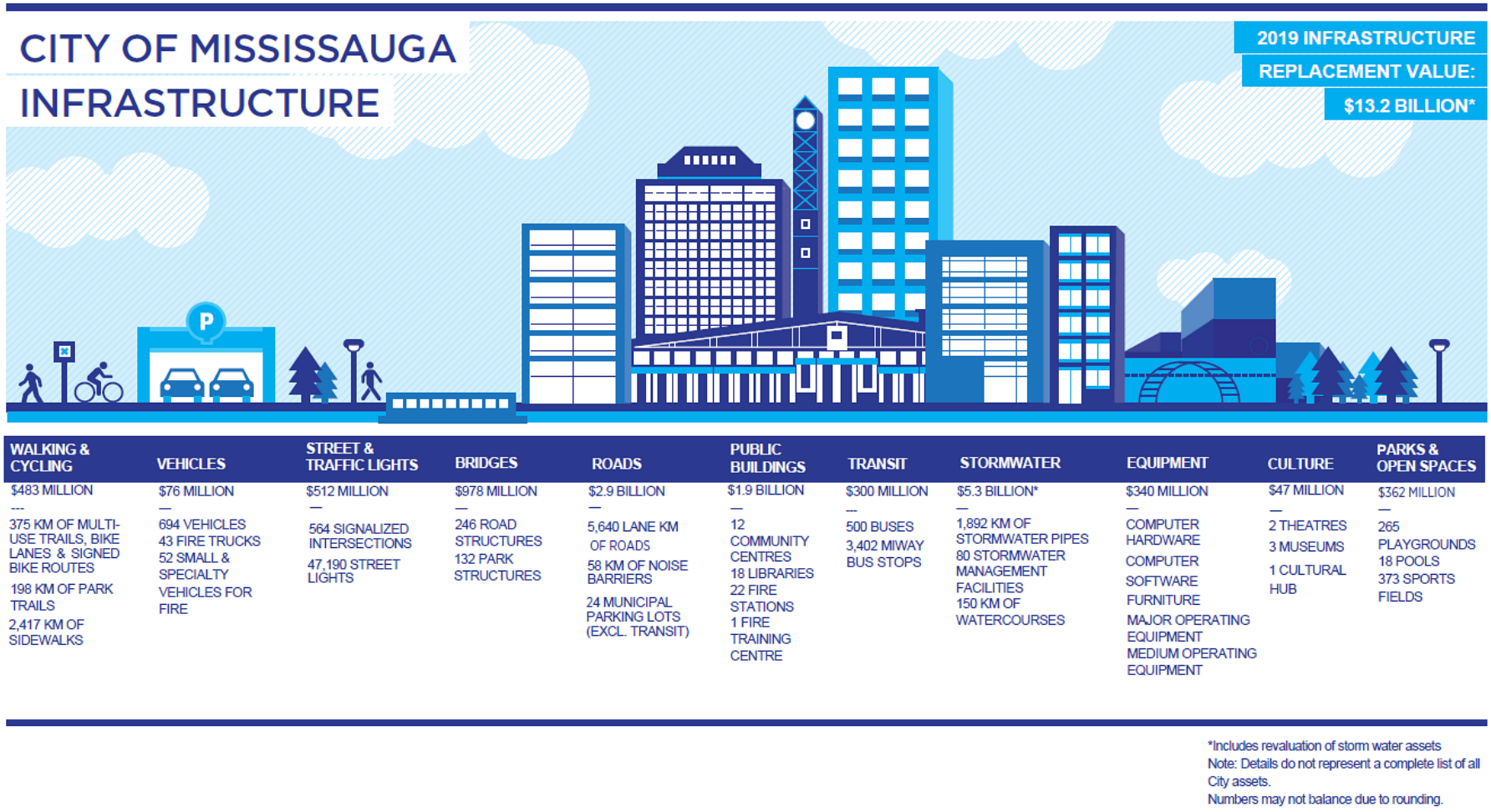
View of Mississauga City Hall from Community Commons Park

Executive Summary

Executive Summary

The City of Mississauga has 779,100 residents and 22,717 businesses. The City provides essential services supported by the five pillars in the City's Strategic Plan (**move**, **belong**, **connect**, **prosper** and **green**). In 2019, the City of Mississauga's combined assets had a replacement value of $13.2 billion. Core assets (roads, structures [bridges & culverts], stormwater management system) were estimated at $9.2 billion and non-core assets (all other assets) at $4 billion. Assets are used to support the delivery of services to Mississauga residents and businesses.

The illustration below represents examples of the wide range of assets owned by the City to provide its services to the public.



*Includes revaluation of storm water assets
Note: Details do not represent a complete list of all City assets.
Numbers may not balance due to rounding.

Executive Summary

Mississauga's Asset Management Plan

Council and City leadership recognize the importance of maintaining the City's assets to ensure that it is delivering the right services in the most cost effective way. The City has embraced Lean principles to ensure that City assets are optimized in delivering the wide range of services that taxpayers have come to rely upon.

In 2014, the City prepared its first asset management (AM) plan for linear infrastructure (roads and stormwater) and building assets with guidance from Ontario's *Building Together: Guide for Municipal Asset Management Plans* (2012). In 2016, transit vehicles (including buses) and major transit equipment were added to the existing plan. AM plans support infrastructure investments funded through provincial and federal funding programs such as gas tax and other infrastructure grant programs.

The Province introduced new legislation through the *Infrastructure for Jobs and Prosperity Act, 2015* and Ontario Regulation *588/17: Asset Management Planning for Municipal Infrastructure* (enacted in 2017). The regulation provides prescriptive elements to be contained in municipal AM Plans. These elements include:

- State of infrastructure for core municipal assets summarized by asset category, detailed asset inventories, replacement costs, asset condition and asset age
- Customer and technical current levels of service (core asset levels of service are prescribed by the Province)
- Estimated capital costs and any significant operating costs related to lifecycle activities as a result of future growth for a ten-year period in the municipality
- Current lifecycle activities and costs including a strategy of planned AM actions, risk mitigation and analysis of costs to maintain current service levels to address the infrastructure gap
- Identification of actions for municipal continuous improvement of AM practices
- Identification of actions that may be required to address climate change impacts on municipal infrastructure

The 2021 AM plan for the City's core assets (roads, bridges and stormwater) has been prepared in accordance with provincial requirements. All asset and budgeting data reported in this plan is as at 2019. Additional City owned non-core assets will be included in a future AM Plan to be completed according to provincial timelines.

Maintaining Mississauga's Core Infrastructure Assets

As core assets age over time, it is important this infrastructure is maintained to minimize disruption in providing services. This includes proactive lifecycle activities such as regular inspections, condition assessment, repairs to extend the life of the asset, cost effectiveness in maintaining the asset in a state of good repair and planning for the eventual replacement when an asset is no longer working or providing the level of service expected.

The City has a range of tools to evaluate its assets. They include a 311 Citizen Contact Centre to manage the receipt of service requests and requests for information, a work order system to plan preventative maintenance activities, routine inspections and activities performed and specific asset analysis software to track asset inventories, their condition to forecast renewal and maintenance activities and budgets to name a few. These tools enable the City to financially plan its expenditures in maintaining, renewing and replacing its infrastructure. The City uses a ten-year capital forecasting approach to plan for these activities.

Executive Summary

Furthermore, the City has adopted a five-point condition rating scale to assess the state of its infrastructure (points are defined in the Navigating the Plan Section). The condition of individual core infrastructure asset classes ranges from "**Fair**" to "**Very Good**" and the overall average condition rating of the City's core infrastructure as "**Good**".

This means that while assets are functioning adequately, some asset elements are displaying general signs of deterioration that require attention and a few asset elements are exhibiting significant deficiencies. Condition assessments for certain assets are indicating that increased investment is required in order to ensure that they are maintained in a state of good repair. Greater detail on the ratings for individual asset classes can be found in the specific core asset sections of this report.

In general, the City's core infrastructure assets are meeting current capacity/demand requirements in an acceptable manner, with occasional operational issues.

The quality of service provided by the City's core infrastructure is validated in the biennial citizen satisfaction survey. The most recent survey was conducted on August 2, 2019 indicating that 69 per cent of residents are satisfied with the road services and 77 per cent expressed satisfaction with the stormwater services.

On an annual basis, residents and businesses are provided the opportunity to submit their opinions on additional investments or reductions to services through the City's online Budget Allocator Tool. The tool allows Mississauga taxpayers to test different spending options for some of the City's core service areas while learning about the relevant service level impacts of their choices. The allocator tool is a valuable information resource for understanding what matters to City taxpayers.

The following table provides a summary of the state of the City's core assets.

Service Area	Asset Class	Asset Type	Replacement Value ($ Million)	Asset Condition
Roads	Road Pavement	• Arterial Road	$ 388	Fair-Good
		• Major Collector Road	$ 473	
		• Minor Collector Road	$ 544	
		• Local Roads	$ 1,473	
	Structures	• Bridges	$ 522	Good-Very Good
		• Culverts (Major)	$ 88	
		• Culverts (Minor)	$ 295	
		• Rail Structures	$ 29	
		• AT Bridges	$ 13	
		• AT Tunnels	$ 2	
Parks, Forestry & Environment	Structures	• AT Bridges	$ 30	Good-Very Good
Stormwater	Storm Sewers Drainage Network	• Sewers, Culverts, Inlet, Junction, Outlet	$ 4,709	Good
	Storm Water Management Facilities (SWMF)	• Cell, Channel, Sewer, Junction, Outlet, Control Structure, Junction, Inlet, Safety, Structure	$ 160	Very Good
	Watercourses Network	• Bank, Instream, Channel	$ 424	Good
Total Valuation for Core Assets			$ 9,150	

AT = Active Transportation

Executive Summary

Mississauga's Infrastructure Funding Challenges

Large infrastructure projects are funded through a combination of different funding sources.

The City relies heavily on the two per cent infrastructure and debt repayment levy as well as, the stormwater charge to provide funding to maintain and replace its infrastructure, valued at $13.2 billion. The City also receives some infrastructure funding from the federal and provincial governments. This type of funding includes Federal and Provincial Gas Tax, one-time funding from the Investing in Canada Infrastructure Plan, the Public Transit Infrastructure Fund and the Clean Water and Wastewater Fund.

An organized and consistent approach to AM across the City will ensure the City continues to focus its limited resources where they are most needed. However, current funding levels are not sufficient. The City is seeking a commitment from all levels of government to continue to assist the City in addressing its infrastructure pressures through ongoing, predictable funding support.

Advancing Mississauga's Asset Management Program

One of the goals of the asset management plan is to identify and document the City's current asset management practices in addition to recognizing areas for improvement. In doing this, it was identified that asset management activities were being performed and reported by each service area but there lacked a standardized approach to asset management as an organization.

A Corporate Asset Management Office was established within the Finance Division to implement new provincial legislative requirements across the organization and develop a standardized approach in the application of AM principles across all service areas. The benefits to this approach include standardizing asset condition reporting metrics, developing a single source of information for all City assets and consolidating asset information at the organizational level, providing guidance to Leadership and Council for making funding investments.

The City's current asset management practices were assessed using a variety of tools including a readiness scale provided by the Federation of Canadian Municipalities (FCM), maturity assessment questionnaire (adapted from ISO 55000), and workshops with City staff responsible for the various service areas.

FCM Readiness Scale

Overall, core service areas have been rated at Maturity Level 2 (developing) competency in knowing the financial situation of their assets. For other asset management concepts (e.g., levels of service, lifecycle management, leadership & commitment, and understanding decision-making), most service areas rated a Maturity Level between 1 (awareness) and 2 (developing), although it should be noted that Maturity Level 3 (competent) has been achieved for some asset classes. A detailed maturity assessment by concept elements for core assets can be found in the Continuous Improvement section of this report under the sub-section entitled "*Core Assets – Asset Management Maturity*".

The 2021 AM Plan serves as the foundation for establishing a list of AM actions to be incorporated into future service area workplans. These continuous improvement (CI) actions will advance a consistent asset management approach across the organization. As CI actions are completed, the City will increase its overall maturity level on the FCM scale.

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Communities of Practice for AM: Inter-municipal Co-operation

The City has partnered with the Region of Peel, City of Brampton, and the Town of Caledon to form an inter-municipal asset management working group. This group was established with the knowledge that each municipality is at a different stage in developing their corporate asset management (CAM) programs and there are several benefits in a collaborative approach to advance individual municipal CAM programs.

The group meets quarterly to share their knowledge and experiences on asset management topics. This accelerates the ability for AM professionals to advance their education levels and share information with other municipal staff within their organizations. It has provided a forum for AM practitioners to gain insight into potential solutions for their own municipal challenges in advancing AM practices across the extensive asset types that municipalities own.

Mississauga's Continuous Improvement Plan

The City fosters a culture of continuous improvement in the delivery of its services. The adoption and practical application of Lean principles have been integrated into the daily work performed by staff.

In the preparation of the core infrastructure CAM Plan 2021, staff have identified improvements to processes, future reporting capabilities, and the potential realignment of functional processes to improve asset information for reporting purposes.

Each asset service chapter in this document targets specific areas for continuous improvement that will be incorporated into future AM Plans, thereby improving asset management capacity and overall maturity as an organization.

Implementing an organization wide enterprise asset management computer system will significantly advance the ability to consolidate the City's asset management information. It is envisioned that an enterprise asset management system will serve as a single source of information for all City assets. The AM enterprise system will enable a shift from a manual reporting exercise to a responsive system-driven process. This will allow for improved analysis and scenario simulations not easily available at this time.

Conclusion

The average state of the City's core infrastructure is identified as "**Good**". Long-standing practices for maintaining core infrastructure are ingrained in the City's employee culture, budget and business plans.

Bridge and culvert structures are aging and in "**Good**" condition. These assets are well managed with regular inspections that follow provincial standards. The Roads and Structure detailed AM Plan identifies structures as critical assets and related projects receive priority funding. Sufficient resources and continuous improvement plans are in place to manage these assets over the next ten-years.

Road pavement assets are currently well managed but aging at a faster rate than the other core assets. Although the overall road network condition is rated between "**Fair**" and "**Good**", long range modeling projections indicate that the overall road network condition is in decline and additional investment is needed over the next 20 years.

In 2019, the average annual infrastructure funding gap was estimated at $20-30 million. Contributing to the gap are cost pressures to deliver the annual Roadway Rehabilitation Program. In recent years, construction pricing has increased between 10% and 20% annually resulting in delays delivering timely pavement renewal for some roads.

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Without an increase in the annual investment for roads, the impact of the deteriorating road system will result in higher operating and maintenance costs, lower levels of customer satisfaction, lower levels of road safety, increased liability and insurance claims, longer times to commute to work and school, and ultimately a lower level of service that residents have come to expect.

Stormwater assets include storm sewers, stormwater management facilities (SWMF) and watercourses. The condition of storm sewers ("**Good**") and SWMF ("**Very Good**") is primarily based on the age and expected useful life of these assets. However, physical inspections and assessments will be leveraged to provide more reliable condition data in future asset management plans. The condition of watercourse assets ("**Good**") is based on reach inspections, which will also be refined in future plans as a more comprehensive watercourse inventory is developed.

The stormwater charge currently provides dedicated funding to maintain the City's stormwater assets. Over the next ten-years there is an estimated $2.1 million average annual funding gap for the stormwater program. Further, over the next 100-years, there is an estimated $29.4 billion average annual funding gap for the storm sewer network. It is recommended that additional data collection and revenue forecasting be completed to identify the 100-year SWMF and watercourse funding gaps. This information will be used to refine the target Stormwater Charge contributions required to maintain the City's stormwater assets sustainably.

Continuous improvements in asset management practices will advance the City's ability to provide more detailed information on all City assets at the organizational level. It will provide enhanced clarity on operational and funding priorities, identify any potential cost savings and ensure right-time investment opportunities.

The current collaborative, interdepartmental AM governance structure ensures the consistent implementation of AM practices across the organization and allows the City to be well positioned for future AM initiatives.

Introduction

Introduction

Our Community

The City of Mississauga is a young, vibrant and diverse community that 779,100 people call home. It is the sixth-largest City in Canada, located just a 30-minute drive from downtown Toronto and a 90-minute drive from the U.S. border.

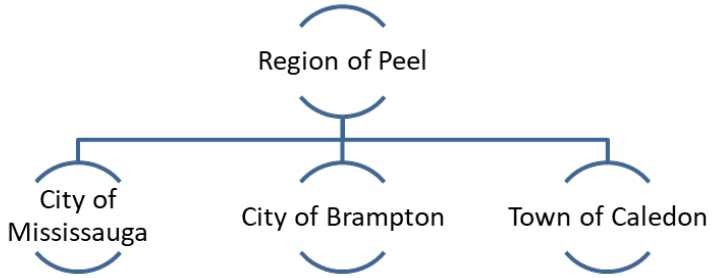
Economy

As the City continues to grow, advance on its priorities and invest in critical infrastructure, Mississauga becomes a place where companies large and small want to locate. This provides local jobs and stimulates economic investment.

Mississauga's population and employment growth forecasts are expected to remain strong over the next 25 years. Mississauga has sufficient land to accommodate projected growth to 2041 and beyond.

City Governance

The City of Mississauga is a lower-tier municipality within the Region of Peel. Mississauga is responsible for managing a complex portfolio of infrastructure assets that support the delivery of a wide range of services to residents and businesses. Governed by the Mayor and 11 Councillors, the City provides services that include Fire & Emergency; Roads; Transit; Parks, Forestry & Environment; Libraries; Recreation; Land Development support; Culture; Regulatory; Legislative; Stormwater, and supporting services such as the 3-1-1 Citizen Contact Centre.



Municipal Asset Infrastructure

The City's infrastructure is aging and maintenance costs are increasing – the City's road pavement infrastructure is aging with many road pavement sections needing repair and/or renewal over the next ten-years, structures are aging but at a different rate than the road network and stormwater assets are relatively new moving towards the middle of their useful service life.

Some assets used by City of Mississauga residents and businesses are owned by the Region of Peel. These assets include regional roads and water/wastewater systems and facilities. These assets are not included in the City's CAM Plan.

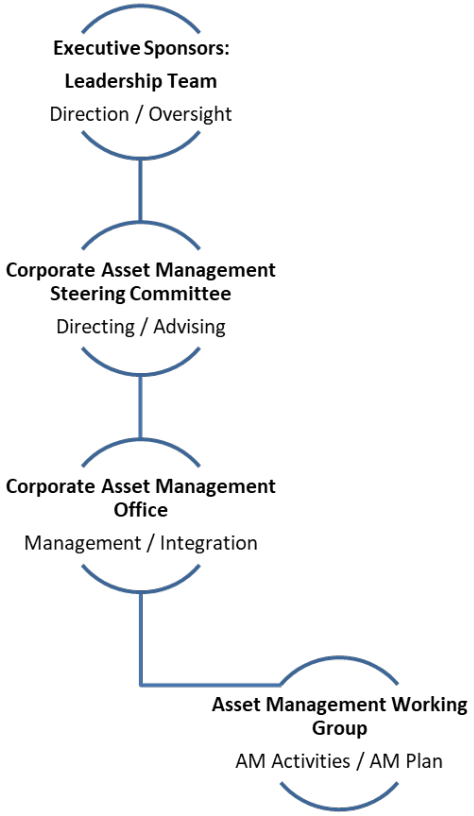
Aerial view of City Hall at night

Introduction

To optimize new asset construction or renewal costs, the City collaborates with the Region of Peel to align future works to minimize service disruption for residents and businesses where the assets affected are owned by both municipalities.

The City's assets play an integral role in service delivery across the entire organization. A formal asset management governance structure has been established to deliver a CAM Plan that addresses provincial requirements contained in *O. Reg. 588/17* over a phased time frame.

The following AM governance structure is approved and supported by Senior Leadership.



The City has established a Corporate Asset Management (CAM) Office. The CAM Office is responsible for the City's Strategic AM Policy, providing AM guidance and ensuring a coordinated and consistent approach for AM Plans across the organization.

Provincial Reporting Requirements

In 2012, the Province published *Building Together: Guide for Municipal Asset Management Plans.* The City at that time prepared Asset Management Plans for buildings, stormwater management, linear transportation and transit.

In May 2017, the Province released a draft Municipal AM Regulation to implement best practices throughout the municipal sector. The City of Mississauga participated in provincial consultations; a report proposing changes to the legislation was adopted by Council on July 5, 2017 and comments were submitted to the Province. Regulations were amended based on feedback by stakeholders, and the Province enacted *O. Reg. 588/17 – Asset Management Planning for Municipal Infrastructure* under the *Infrastructure for Jobs and Prosperity Act* (*IJPA*), 2015. The Regulation provides standard requirements for municipal asset management planning and supports asset resiliency and sustainability as part of developing future AM plans. The regulation came into force on January 1, 2018.


1ST SESSION, 41ST LEGISLATURE, ONTARIO
64 ELIZABETH II, 2015

Bill 6

(Chapter 15
Statutes of Ontario, 2015)

An Act to enact the Infrastructure for Jobs and Prosperity Act, 2015

The Hon. B. Duguid
Minister of Economic Development, Employment and Infrastructure

Royal Assent June 4, 2015

Printed by the Legislative Assembly of Ontario

1re SESSION, 41e LÉGISLATURE, ONTARIO
64 ELIZABETH II, 2015

Projet de loi 6

(Chapitre 15
Lois de l'Ontario de 2015)

Loi édictant la Loi de 2015 sur l'infrastructure au service de l'emploi et de la prospérité

L'honorable B. Duguid
Ministre du Développement économique, de l'Emploi et de l'Infrastructure

Sanction royale 4 juin 2015

Imprimé par l'Assemblée législative de l'Ontario

Introduction

The Regulation requires each Ontario municipality to prepare a Strategic AM Policy and publish AM Plans approved by their Councils in accordance with a set of scheduled deadlines outlined as follows:

***O. Reg. 588/17* AM Implementation Dates**

Date	AM Requirements	Status
July 1, 2019	Strategic AM Policy that articulates guiding principles, commitments, and roles and responsibilities. Five-year review cycle	Completed June 2019
July 1, 2022	Prepare CAM Plan for core infrastructure assets including: asset inventories, age, condition, current customer and technical Levels of Service (LOS), lifecycle costs & strategies, asset demands from growth and continuous improvement actions	Council in Fall 2021
July 1, 2024	Prepare CAM Plan to include all non-core City infrastructure assets containing the same elements as the 2021 AM Plan	In Progress
July 1, 2025	Council-approved CAM Plan for all City assets indicating the proposed service levels for the following ten-years including the financial strategy to maintain assets at the approved level of service Strategic AM Policy five-year review	Planning Stage
July 1, 2026	Annual City CAM Plan progress reports to Council on or before July 1st of each year	Not Started
July 1, 2030	Update CAM Plan on a five-year cycle Strategic AM Policy five-year review	Not Started

Currently, a prescriptive AM Plan for transit services is required in municipal Development Charges (DC) Background Studies until July 1, 2025 under the *Development Charges Act, 1997.* Amendments to *O. Reg. 588/*17 will transition transit services into a future CAM Plan. In the mean time, a transit service AM Plan will be required for the City's 2022 DC Background Study.

Developing the 2021 CAM Plan

The CAM Office developed a workplan of activities to be undertaken to prepare the 2021 Core Infrastructure CAM Plan. The first step in evaluating the City's AM practices involved understanding the current activities being performed by City staff in each of the service areas. Several workshops were held to document where asset information resides, and how; i.e., whether in a formal AM software system, Excel spreadsheet, or other medium. It was determined the most complete information available to develop the 2021 CAM Plan was based on 2019 data and the ten-year capital budget (2019-2028) to meet provincial requirements. The following illustration provides a high-level view of the steps taken to develop and complete the 2021 Core Infrastructure CAM Plan.

Introduction

City's CAM Plan

The City's 2021 CAM Plan serves as a strategic, tactical and financial document ensuring the activities, resources and timelines required for municipal infrastructure are met, while balancing costs, opportunities and risks against the desired performance of assets.

The purpose of this CAM Plan is to:

- Comply with the legislative requirements of *O. Reg. 588/17*
- Support funding applications to the federal and provincial levels of government
- Inform future business cases for infrastructure investments to support municipal services now and for future growth
- Understand the current state of our asset management systems (i.e., documents, processes and procedures, resources, framework, tools, technologies, data and the assets) and inform future workplans for continuous improvement in asset management
- Identify/quantify current levels of service (LOS) to the public
- Support asset lifecycle management strategies and sustainability while addressing service needs
- Quantify the infrastructure gap and develop approaches to address the gap
- Implement AM practices to manage the infrastructure gap, accommodate future growth and maintain the current LOS

Strategic Planning Alignment

The City is regularly engaged in a range of planning processes designed to meet strategic objectives, comply with regulations and communicate the approach to planning for successful outcomes on multiple initiatives.

The following is a description of other City plans and documents that need to align with the CAM plan:

- The City's Strategic Plan, **Our Future Mississauga,** directs the shape of the City in all areas including land use planning, infrastrurcture, service delivery and asset management. It identifies the Vision for the Future supported by five Strategic Pillars for Change: **move**, **belong**, **connect**, **prosper** and **green**.

The Five Pillars in the City's Strategic Plan

- The Official Plan – The CAM Plan incorporates infrastructure related to land-use policies for long-term growth and development.
- Budget and Business Plan – The CAM Plan identifies the infrastructure needs, service levels, policies, processes and budgets.

Introduction

- Master Plans – The CAM Plan uses goals and projections from master plans to align better decision-making.
- Regulations – The AM plans must follow government regulations.
- By-Laws, standards and policies – The CAM Plan will influence policies and by-laws related to asset management practices and industry standards.

CAM Planning Strategic Document Alignment

State of the Infrastructure

The City of Mississauga was incorporated in 1974 with the amalgamation of the Town of Mississauga, and villages of Port Credit and Streetsville together with portions of the townships of Toronto Gore and Trafalgar. The amalgamation consolidated existing infrastructure assets of various types to serve as the foundation for the newly established City. Since then, Mississauga has changed rapidly from a city where there was continuous development of large tracts of greenfield to a city that is experiencing intensification through high-density development.

As a result, the City's infrastructure grew significantly over a relatively short period of time to accommodate Mississauga's rapid growth into Canada's sixth-largest City.

The City's infrastructure is in overall average "**Good**" shape. Some of its core assets such as stormwater are relatively young in their lifecycle, whereas other assets are reaching the end of their lives and are in need of replacement, refurbishment or disposal. A solid asset management plan addresses these needs.

Levels of Service

Mississauga delivers over 200 services including public transit, libraries, recreation programs, snow clearing, parks, street tree maintenance, fire and emergency services, and much more. One of the fundamental priorities for City business planning is to "deliver the right services" to residents, businesses and visitors. This involves optimizing the utilization of its assets to establish service levels that reflect a balance between citizen service expectations and fiscal responsibility.

Existing customer service levels are validated every two years through a Citizen Satisfaction Survey and annually through stakeholder engagement as part of the business planning and budgeting process. In 2019, 81 per cent of the respondents to the Citizen Satisfaction Survey indicated that they were satisfied with the services provided by the City; of these, 26 per cent were very satisfied.

These survey results are a positive indication the City is optimizing its extensive collection of assets to deliver services to Mississauga residents and businesses.

Introduction

Assets Included in the Plan

This CAM Plan includes the core asset types as outlined in *O. Reg. 588/17* owned by the City in 2019. The City's corporate asset management approach is to take a service-focused view to its core assets and present the information in terms of services and service areas rather than solely by asset category. The City has captured and categorized its asset data as follows:

- Service Area - the highest level of asset category, typically representative of a service group
- Asset Class - Aggregate of municipal infrastructure assets that provide the same type of service
- Asset Type - Grouping assets with common characteristics that distinguish those assets as a group

The Roads and Stormwater Service Areas each have a Detailed AM Plan section in this CAM Plan detailing the assets related to their specific infrastructure and services.

Second Line West Active Transportation Bridge over Hwy 401

The following assets are included in this, the 2021 CAM Plan.

Road & Structure Assets

Service Area	Asset Class	Asset Type	Assets
Roads	Road Pavement	Arterial Road	Residential, Non-Residential, Curbs, Surface, Subsurface, Splash Pads, Medians
		Major Collector Road	
		Minor Collector Roads	
		Local Roads	
	Structures	Bridges	Various Sub-Components and Road Classes
		Culvert (Major)	
		Culvert (Minor)	
		Rail Structures	
		AT Bridges	
		AT Tunnels	
Parks, Forestry & Environment	Structures	AT Bridges	

AT =Active Transportation

Introduction

Stormwater Assets

Service Area	Asset Class	Asset Type	Assets
Stormwater	Storm Sewer Drainage Network	Sewers	Main
			Trunk
			Foundation Drain Collector (FDC)
		Culverts	Major/ Minor Culvert
		Inlet	Catch Basin (CB)
			Double Catch Basin (DCB)
		Junction	Maintenance Hole (MH)
			CB Maintenance Hole (CB-MH)
			FDC Maintenance Hole (FDC-MH)
		Outlet	Endwall, Apron, Energy Dissipater, etc.
	Stormwater Management Facilities (SWMF)	Cell	Excavation, Lining, Fencing, Access Road, Vegetation
		Channel	Inlet/Outlet, Overflow, Swales etc.
		Sewer (SWMF Inlet)	Main, Trunk
		Junction (SWMF Inlet)	Maintenance Hole
		Outlet (SWMF Inlet)	Endwalls
		Control Structure (SWMF Outlet)	Non-standard Outlet Structure (Box, Weir, etc.)
		Sewer (SWMF Outlet)	Main, Trunk
		Junction (SWMF Outlet)	Maintenance Hole
		Inlet (SWMF Outlet)	Catch Basin
			Double Catch Basin
			Headwall
		Sewer	Berm Pipe/MH/CB
		Safety	Sign
		Structure	Berm, Retaining Wall, Erosion Control, etc.
	Watercourse Network (Reaches)	Bank, Instream, Channel	To be inventoried

Components of the 2021 Core Assets CAM Plan

The City's Corporate AM Plan for core assets includes the following components:

- **State of infrastructure** for core City assets summarized by asset category, detailed asset inventories, replacement costs, asset condition and asset age.
- **Levels of Service - Customer and Technical** provide qualitative descriptions and technical metrics for City services. LOS **Future Growth** trends are shown for a five-year period. Core asset levels of service are prescribed by provincial regulation.
- **Current Lifecycle Activities** and costs including a strategy of planned AM actions, risk mitigation and analysis of costs to maintain current service levels, otherwise known as an **Infrastructure Gap**.
- Identification of actions for **Continuous Improvement** to City AM practices.
- Actions incorporating **Climate Change** impacts to City infrastructure.

Data Sources and Alignment

The information within this CAM Plan comes from a combination of different City system sources including:

- Infor (Hansen) Computerized Maintenance Management System (CMMS) - used extensively for the operational management of linear and fixed assets
- CityWide Asset Manager Module (Public Sector Digest) – utilized for financial reporting on Tangible Capital Assets (TCA)
- SAP software – runs the business data platform to store and retrieve financial data as requested. This data helps with business planning and decision-making
- Environmental Systems Research Institute (ESRI) software - the City leverages geographic information system to collect,

organize and integrate data to improve asset management practices

- RoadMatrix Pavement Management System (RPMS) – stores the road location, geometric and pavement condition data. It is an analytical tool used to identify road pavement strategies and forecasts for preventative maintenance, renewal and reconstruction timing
- Bridge Total Management System (TMS) – stores bridge and culvert location, geometric, component information and condition information collected through a biennial inspection program in accordance with Ontario Structural Inspection Manual (OSIM). It is an analytical tool used to provide management strategies and forecasts for and the inspection, renewal and replacement of structures or their individual components

CAM Plan Assumption & Limitations

The scope of this Plan covers the core infrastructure assets directly owned by the City of Mississauga in 2019. There are other services that fall within the city's boundaries that are owned, led and managed by other entities. Examples include the Hurontario Light Rail Transit partnership with Metrolinx and services owned and operated by the Region of Peel. Such services are important to Mississauga and its residents but are not City-owned and therefore not addressed in this Plan.

The following items summarize the assumptions and limitations of the 2021 core infrastructure CAM Plan:

- The most complete information available to develop the 2021 CAM Plan is based on 2019 data and the ten-year capital budget (2019-2028).
- This CAM Plan is compliant with the 2021 requirements of *O. Reg. 588/17* for assets directly owned by the City of Mississauga.
- Proposed/desired levels of service and their impacts on associated costs to meet the 2025 requirements are not included.
- The City has not implemented a corporate risk management framework, although such is planned to be reviewed by a consultant in advance of the provincial 2024 CAM Plan deadline.
- The Stormwater asset classes have an asset risk model that was developed through consultative work performed for this plan.
- The City assesses condition information in several ways:
    - Road pavement asset condition is assessed and reported using the Pavement Quality Index (PQI) measure
    - Bridge and culvert structure assets condition is assessed and reported using the Net Asset Salvage Value Index (NASVi) measure
    - Stormwater asset condition is based on age and remaining useful life in this report. Formal condition programs for watercourses and facilities are in place and the development of a program for sewers is underway. Integrating stormwater asset condition programs is identified as a continuous improvement task in this plan
    - Condition may be assumed based on age and remaining Estimated Useful Life (EUL)
    - Condition of an asset may be based on the opinion of a subject matter expert, based on professional experience and industry best practices
- A data review has been completed and has identified several gaps in the asset inventory datasets including imprecise or incomplete information regarding:
    - Some Estimated Unit Cost (EUC) values
    - Some missing and default EUL values
    - Some material types

Introduction

    - Some asset size information
    - Some install date values
- Significant work has been completed to reduce data gaps. Where inventories or unit replacement costs were not available or unknown, the assets have not been included in this Plan.

When assessing AM datasets, a data accuracy and reliability scale has been used to provide transparency to the reader to interpret the data and the quality presented in the CAM Plan (scale is explained in the Navigating the Plan section).

Integrating Climate Change into Asset Management

The implications of not taking action on climate change are significant, and the City of Mississauga is committed to working with the community across all levels to address the risks climate change presents. Within the context of asset management, climate change is a threat to sustainable service delivery as it amplifies the risk of asset failure, reduces asset service life, and can increase the cost of managing risk and delivering levels of service.

Proactive risk and asset management will improve the overall resilience of asset systems. This Plan integrates climate change within the context of other asset risks, costs, and service objectives with the intention of developing an integrated and cost-effective set of actions to maintain and enhance levels of service as a result of changing climate conditions.

The City of Mississauga has already begun to feel the impacts of climate change, including increased seasonal flooding, extreme rainfall, ice storms, and some of the hottest summers on record. By 2050, Mississauga is expected to be hotter at all times of the year, with changes to seasonal precipitation patterns, more rainstorms and more heat waves. Winter, spring, and fall will likely be wetter, while summer will be hotter and drier on average, with an increase in storm activity.[1]

Jack Darling Park Pathway Eroded by Flooding

Current and future climate-related impacts for the City of Mississauga include:

- More frequent and extreme rainfall events leading to flooding
- Increased risk of long-duration freezing rain events leading to ice storms
- Increased frequency of high winds (e.g., gusts of 90 km/h or greater) including tornadoes, microbursts, etc.
- More frequent extreme heat days (over 30 degrees Celsius)

[1] Natural Systems Vulnerability to Climate Change in Peel Region; Tu, C., Milner, G., Lawrie, D., Shrestha, N., Hazen, S. 2017

Introduction

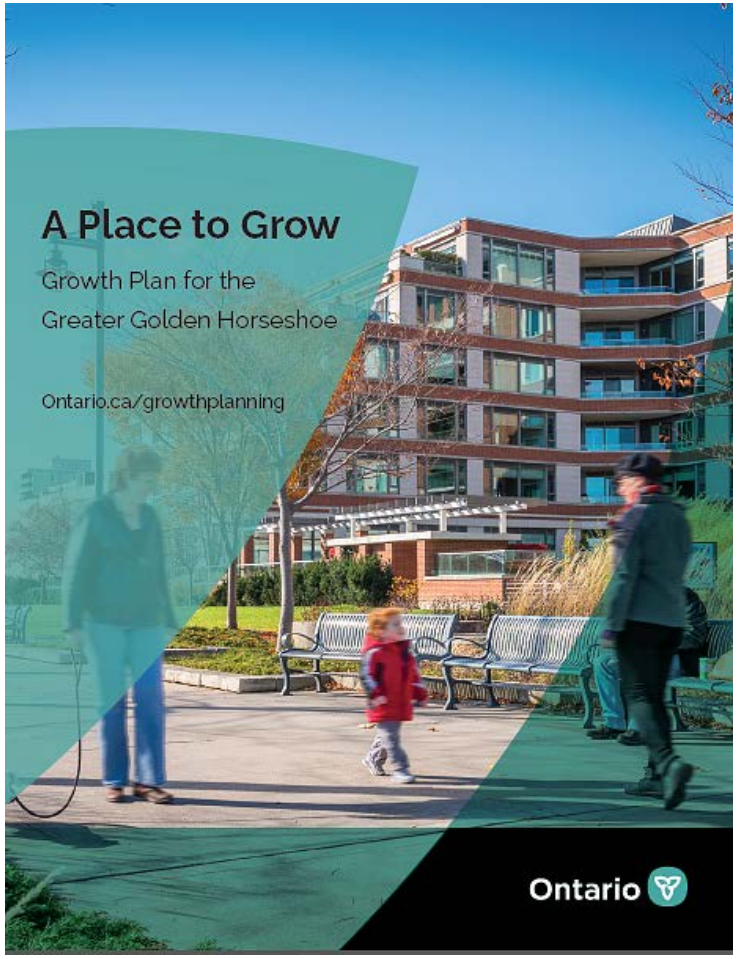
Alignment with the Golden Horseshoe Growth Plan

The Province enacted the *Places to Grow Act* in 2005 and subsequently adopted a framework to build strong and prosperous communities by managing growth within the Greater Golden Horseshoe Area (GGHA). The *IJPA, 2015* and its accompanying asset management regulation *O. Reg. 588/17* are aligned with the GGHA to ensure infrastructure required as a result of growth is planned and managed to optimize infrastructure during the land-use planning process for population and employment growth.

The Region of Peel's population is forecasted to be almost 1.8 million in 2031 and reach almost two million residents by 2041.[2] Employment in the Region of Peel is expected to grow to 880,000 employees by 2031 and 970,000 by 2041.

The Region of Peel projects the City of Mississauga's population to reach 842,000 by 2031 and 920,000 by 2041. The number of people employed in the City is projected to reach approximately 535,000 by 2031 and 565,000 by 2041.[3]

To plan for new infrastructure, the City updates its growth requirements plan every five years in preparation of the City Development Charge Background Study and By-law. Development charge revenues collected during the building permit process fund the construction of growth-related capital infrastructure required to maintain service levels for new residents and business employment in the City.



[2] A Place to Grow –Growth Plan for the Greater Golden Horseshoe, May 2019, Schedule 3

[3] www.Data.peelregion.ca-draft endorsedforconsultation-20162041/data

Roads and Structures

At the core of a vibrant and modern City is its transportation network. Valued at over $5 billion, Mississauga's roadway infrastructure is one of the two largest asset groups owned and operated by the City of Mississauga. Roadways are comprised of a variety of smaller asset components that include road pavements, bridges and culvert structures, sidewalks, multi-use trails, cycle tracks, traffic signals, streetlights, on-street parking facilities, signs, and noise walls.

The City's 2021 CAM Plan focuses on the City's road pavement and structures network, which comprises approximately 77 per cent of total roadway infrastructure, or $3.9 billion.

Road Pavement

At a replacement value of $2.9 billion and a network length of 5,640 lane kilometres, the overall performance of Mississauga's road pavements currently achieves an average rating of between "**Fair**" and "**Good**" with 79 per cent of the pavement network in Fair or better condition.

While road pavement assets are well managed today, they are aging at a faster rate than the other core assets. Modeling projections indicate that the pavement network condition is declining and will continue to decline over time without a significant increase to the annual investment rate. In 2019 the forecasted average annual funding gap for the renewal of road pavements is estimated at $25.3 million.

Many sections of road pavements require repair and/or renewal today and the number of pavement sections that require renewal will continue to grow over the next ten-years. This results in additional cost pressures to deliver the annual Roadway Rehabilitation program. In recent years, the cost to deliver annual renewal has increased by 10 per cent to 20 per cent, resulting in delays for the timely renewal for some roads. In turn, the delay places additional pressure on Maintenance staff to deliver these additional demand-based repairs where road renewal has been delayed due to the lack of available funding.

Structures

At an estimated replacement value of $978 million, the City's 378 bridge and culvert structures connect residents and non-residents alike with services, employment, commerce, recreational opportunities and each other. These structures cross a number of natural and man-made features like creeks, rivers, highways, railways and trails. The City's bridge and culvert structures had an overall average condition rating of "**Good**" in 2019. The 25-year forecast reveals that there will be sufficient lifecycle funding available to continue to maintain these structures in an overall average "**Good**" condition.

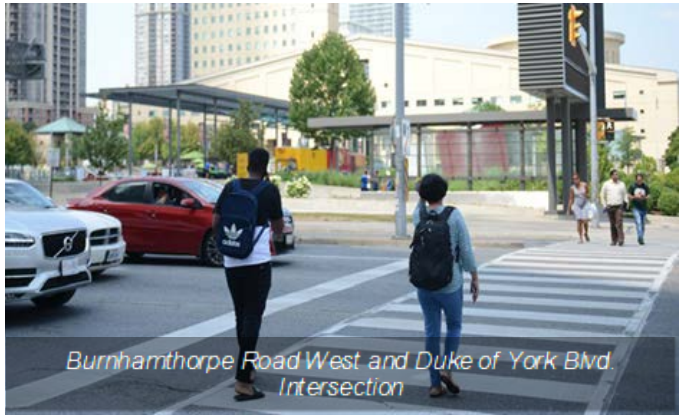
Lakeshore Road West over Clareview Creek Culvert

Roads and Structures

The *Detailed AM Plan – Roads & Structures* provides specific asset information for Mississauga's road pavements, bridges and culvert structures.

The table below provides an overview of the roads and structures core assets replacement value, current condition and ten-year condition trend.

Asset	Replacement Value (millions)	Current Condition	10-Year Condition Trend
Road Pavement	$2,878		
Structures	$978		



Burnhamthorpe Road West and Duke of York Blvd. Intersection

Stormwater

The Stormwater Service Area plans, develops, constructs, maintains and renews the Stormwater Management System, which protects property, infrastructure and the natural environment from erosion, minimizes the risk of flooding and enhances water quality. Stormwater management assets are valued at $5.3 billion and include storm sewers, stormwater management facilities and watercourses. Stormwater is the largest asset group owned and operated by the City.

The condition of storm sewers and SWMF assets has primarily been based on the age and estimated useful life. Physical inspections and assessments will be leveraged to provide more reliable condition data in future asset management plans. The condition of watercourse assets is based on reach inspections, which will also be refined in future plans as a more comprehensive watercourse inventory is developed.

The City has over 1,892 km of main line storm sewer pipes (excluding laterals) in its storm drainage network. If laid out end to end these pipes would connect the City of Mississauga to the City of Winnipeg. In terms of overall condition 18 per cent of the storm sewer assets are rated as "**Very Good**", 79 per cent as "**Good**", and three per cent as "**Fair**" or **less**.

The Stormwater Management System includes 80 stormwater management facilities (SWMF) that help to collect, store and clean a portion of the City's rainwater runoff. In terms of overall facility condition, 58 per cent of the assets are rated as "**Very Good**" and the remaining 42 per cent as "**Good**".

The City is responsible for maintaining approximately 150 km of the watercourse network (reaches) and associated bank, channel and instream assets that help to collect and drain the City's rainwater runoff. In terms of overall network condition, 60 per cent of the assets are rated as "**Very Good**", or "**Good**", 29 per cent as "**Fair**", and the remaining 11 per cent as "**Poor**" or "**Very Poor**".

The *Detailed AM Plan – Stormwater* provides specific asset information for Mississauga's storm sewer drainage network, stormwater management facilities and the watercourse network.

Armourstone erosion control treatments along Sheridan Creek

Stormwater

The table below provides an overview of the stormwater core assets replacement value and current condition.

Asset Class	Replacement Value (Millions)	Condition
Storm Sewer Drainage Network	$4,710	
Stormwater Management Facilities (SWMF)	$160	
Watercourse Network (Reaches)	$424	

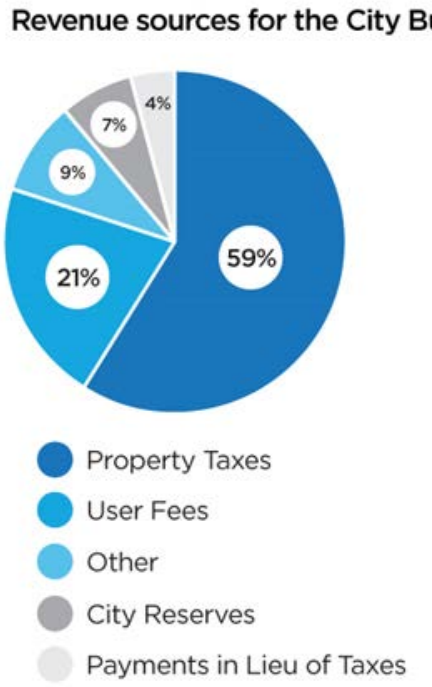
Storm sewers outletting to Sheridan Creek, behind Benedet Drive

Financing Strategy

Financing Strategy

Overview of City Assets

The City uses a combination of tax funds, user fees, investment charges/levies and other revenue to pay for the array of services it provides.



Revenue sources for the 2019 City Budget

Management of the City's services is organized into administrative "Service Areas". These Service Areas produce the individual plans that make up the overall City Business Plan & Budget.

The City works hard to achieve value for money and sound financial stewardship in the development of the annual Business Plan & Budget. All Service Areas prepare individual Business Plans in line with the following four corporate priorities:

1. Deliver the Right Services

Roughly 98 per cent of the City's annual operating budget is allocated to deliver existing services at current levels, and maintain our facilities, transportation systems and other infrastructure to industry standards. City services include public transit, libraries, recreation programs, snow clearing, parks, street tree maintenance, fire and emergency services, and much more.

2. Implement Cost Containment Strategies

The City's business is service delivery. Mississauga has a long history of examining our services to ensure they are being delivered as efficiently and effectively as possible. The City employs a number of strategies to manage costs, work smarter and improve customer service. Through the corporate Lean program, employees are empowered to solve problems and find better ways of working. This drives innovation, cost savings and efficiencies.

3. Maintain our Infrastructure

The City invests in a variety of projects to build, maintain, rehabilitate and remodel our infrastructure. Nearly 70 per cent of our 2019-2028 Committed Capital program is for existing assets to be maintained in good condition or replaced, commonly referred to as State of Good Repair projects. These projects support the maintenance of, and protect taxpayers' investments in, these valuable public infrastructure assets.

The City's 2019-2028 ten-year, $2.8 billion capital program includes investments in road and bridge rehabilitation and construction; new fire stations, fire trucks and equipment; buses; rehabilitation and remodelling of libraries and recreation facilities; waterfront and park redevelopment; trees; and sports fields.

The majority of the capital expenditures identified in the 2019-2028 Business Plan and Budget are required to ensure we maintain or replace our current infrastructure.

Financing Strategy

The value of Mississauga's infrastructure is approximately $13.2 billion. This includes, for example, the current replacement cost of our roads, bridges, trails, stormwater system, all City buildings, the transit system, street and traffic lights, and other equipment. The City maintains these assets in accordance with industry standards, legislative requirements and citizen expectations.

4. Advancing on our Strategic Vision

The City's 40-year Strategic Plan, **Our Future Mississauga**, has Five Pillars for Change: **move, belong, connect, prosper,** and **green.** These guide our activities and help us advance toward achieving the Vision. The pillars are the basis of several master plans and the City's Long Range Financial Plan. These plans guide our Service Areas by setting both short-term and long-term priorities.

Maintaining our infrastructure is a key strategic goal in the City of Mississauga's Strategic Plan as well as a top priority in the City's Business Plan. These goals and objectives are achieved by applying sound asset management practices, inventorying what the City owns, conducting regular inspections, prioritizing work needs, preparing appropriate asset renewal projections and programs to address asset renewal needs, and monitoring and reporting on projected asset conditions.

Capital Prioritization

The City employs a capital prioritization model to assist in the decision-making process for allocating limited capital funds. The prioritization ensures that a balance of lifecycle projects, enhancements and high priority new services are included in the capital program.

Capital projects are classified as either:

State of Good Repair
These projects ensure our existing infrastructure is maintained in good condition, or replaced when necessary.

Improve
These projects provide for service enhancements that increase current service levels or provide for new capital initiatives.

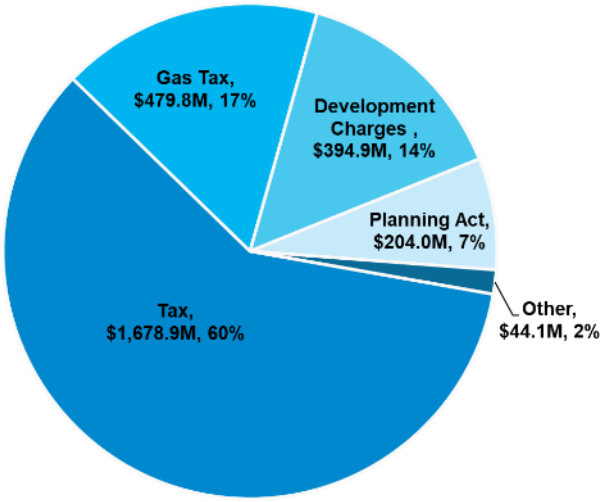
City Infrastructure Includes roads, bridge structures, stormwater, sidewalks, pathway/street lights, parks, trees and City buildings

Financing Strategy

Capital Financing

The City of Mississauga's Capital Program is financed through recoveries from other levels of government, various Reserve Funds, development charges and debt. The amount of funding projected to be available determines the size of the capital program over the next ten-years.

Funding Sources for the 2019-2028 Capital Budget Forecast
$2.8 Billion



Numbers may not balance due to rounding

Recoveries

The City of Mississauga receives federal and provincial grant funding for various programs. For example, the City is currently benefiting from the Public Transit Infrastructure Fund (PTIF), where the federal government is funding up to 50 per cent of eligible projects, up to $56.6 million. This includes purchases for the lifecycle replacement of buses that have reached or surpassed their end-of-useful-life cycle.

Reserve Funds

Capital projects are funded through a variety of Reserve Funds. Reserve funds are established for very specific purposes. Subject to Council approval, capital projects can draw on these reserves for funding. Some funding sources are available for specific services. For example:

- Federal Gas Tax funds – currently used for transit, facilities, roads and bridges
- Development Charges – to fund growth-related infrastructure projects

Tax-based reserve funds are used to finance capital infrastructure needs. The tax-funded Capital Reserve Fund provides the majority of funding for capital projects. The Capital Reserve Fund is funded, in turn, through contributions from the operating budget. These contributions grow annually through the Capital Infrastructure and Debt Repayment Levy.

Capital Infrastructure and Debt Repayment Levy

The City's current funding does not fully fund all capital requirements, but balances the need to maintain our infrastructure, fund new projects as required, and minimize debt. The 2019 Budget and Business Plan identified the total unfunded capital projects to be $676 million for the ten-year period of 2019-2028. This amount is growing each year, and does not fully reflect our capital needs.

Repairing and rehabilitating aging infrastructure requires an increased focus on the funding of the City's asset renewal needs. As such, enhanced infrastructure funding strategies and mechanisms have been developed to assist Mississauga in addressing its infrastructure funding challenges.

Financing Strategy

The City employs a Special Purpose Levy for Capital Infrastructure and Debt Repayment. A Capital Infrastructure and Debt Repayment Levy of two per cent on the prior year's tax levy supports and ensures the City is investing in maintaining its infrastructure. This approach balances the pay-as-you-go philosophy with prudent borrowing within reasonable limits as outlined in the City's debt policy.
One half of the levy is deposited directly into the Capital Reserve Fund. The other half is used for debt management.

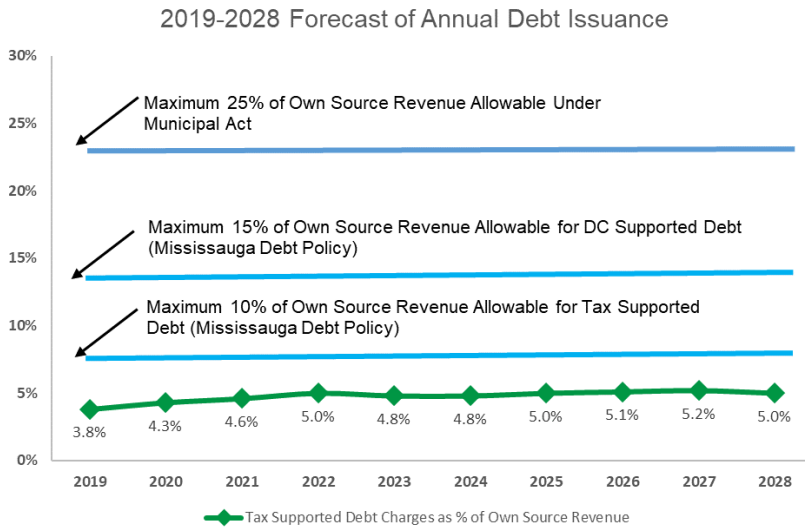
Debt Management

The amount of debt the City issues each year is determined by how much approximately one per cent of the Infrastructure Levy will fund.

The Province limits the amount of debt that any City can hold. Debt repayment costs must remain within 25 per cent of own-source revenues (that is, those revenues that are determined by the City directly, such as the tax levy, and not revenues like provincial or federal grant funding).

The City of Mississauga's debt policy is even more conservative. The City's debt policy states that the annual debt repayment is limited to 15 per cent of own-source revenues. Of this 15 per cent calculation, tax-supported debt repayment is capped at 10 per cent. Non-tax supported debt repayment is capped at five per cent.

The chart below demonstrates the City of Mississauga remains well within its self-imposed debt cap for the next ten-years.



Long-Range Financial Strategy

The City's main source of revenue (whether from fees, taxes, or stormwater charge) is from current residents, and every effort has been made to maintain tax increases at a reasonable rate.

Our debt issuance has remained prudent, and the City ensures any federal and provincial funding is maximized.

However, capital requirements for replacement and new infrastructure has outpaced our funding sources, and the unfunded portion of our capital program continues to grow.

City staff regularly explore and pursue new revenue sources, but many of these are subject to provincial legislation. The City's pre-budget consultation documents annually include a request for the Province to allow the City to have access to new revenue tools.

Financing Strategy

At this time, our means to increase capital funding are limited to increasing debt and increasing special levies.

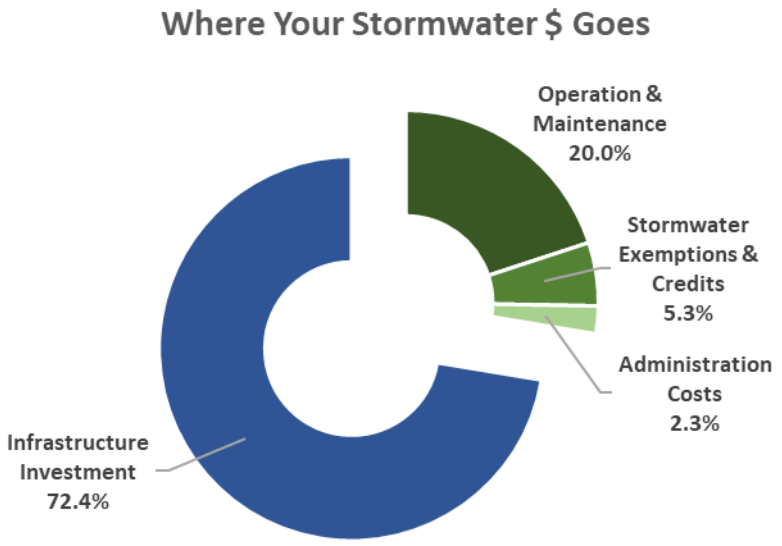
Stormwater Charge

The Stormwater Service Area was established as a standalone Service Area in 2016 with the introduction of the Stormwater Charge. The impetus for the Stormwater Charge was the need to increase the City's investment in its stormwater infrastructure and supporting programs with a fair and dedicated source of funding. The stormwater budget is funded through the stormwater charge, and a separate budget is presented to Council for the approval.

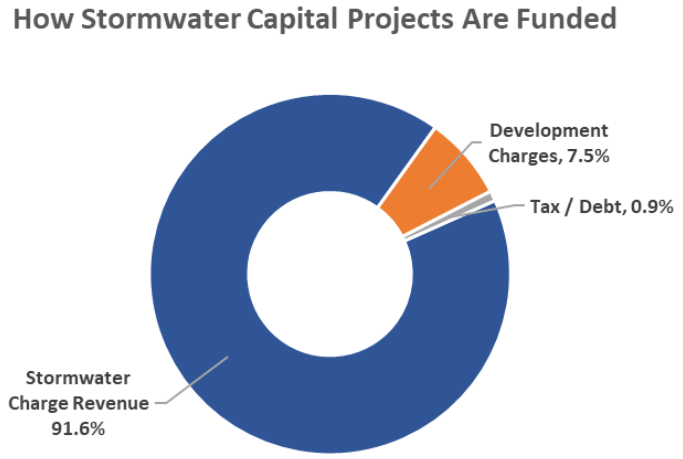
The stormwater rate is evaluated on an annual basis during the budget approval process. The initial stormwater rate was set at $100 per billing unit in 2016, and was $106.10 per billing unit for the 2019 budget year. A founding principle of the stormwater charge is to increase investment to sustainably construct and manage stormwater infrastructure.

The stormwater charge provides funding for operating needs, current capital needs to construct, repair and maintain infrastructure, and long-term needs for future infrastructure replacement. The stormwater infrastructure valuation of $5.3 billion will require a significant investment to ensure the City will be able to renew this infrastructure when necessary. For that reason, a significant portion of the Stormwater Charge collected is being saved in a dedicated reserve fund for future expenditures.

The following chart provides an overview of Stormwater Charge Revenue segregated by the Operating and Infrastructure Renewal Programs for 2019. The Stormwater Charge Revenue allocated to Infrastructure Renewal Programs accounts for 72.4 per cent of the revenue collected.



The 2019 Capital Program for Stormwater of $33.4 million is distributed by funding source.



Financing Strategy

Overview - Financial Needs Core Infrastructure

As mentioned earlier, the City of Mississauga budget has two components: the budget for property tax supported services and the budget for Stormwater Charge supported services.

The following chart is the 2019-2028 capital budget for the roads service area and pedestrian bridge structures in parks. This includes expenditures to maintain existing assets in a state of good repair, acquire new assets for future growth demands and to improve asset service delivery. Capital expenditures over the ten-year period is approximately $873 million.

Roads Service Area and Park Pedestrian Bridges 2019-2028 Capital Budget by Program

Program Expenditures	Total Capital Funding 2019-2028 ($000s)
Roadway Rehabilitation	299,172
Major Road Construction	290,411
Bridge & Structure Renewal	74,225
Active Transportation	60,406
Traffic Management	46,707
Works Fleet and Equipment Management	41,046
Works Improvement	25,420
Noise Wall Infrastructure	9,258
Environmental Management	3,550
Municipal Parking	1,300
Roads Subtotal	**851,499**
Parks AT Bridge Renewal	3,772
Parks AT Bridge Replacement	10,061
Parks AT Bridge Growth	7,854
Parks, Forestry & Environment Subtotal	**21,687**
Total	**873,186**

AT =Active Transportation

The total ten-year capital expenditures to maintain, improve and construct new stormwater infrastructure is $374 million.

Stormwater 2019-2028 Capital Budget by Program

Program Expenditures	Total Capital Funding 2019-2028 ($000s)
Storm Sewers	85,577
Storm Studies	12,370
SWM Facilities and Flood Relief Works	183,660
Watercourse Erosion Control	92,616
Total	**374,223**

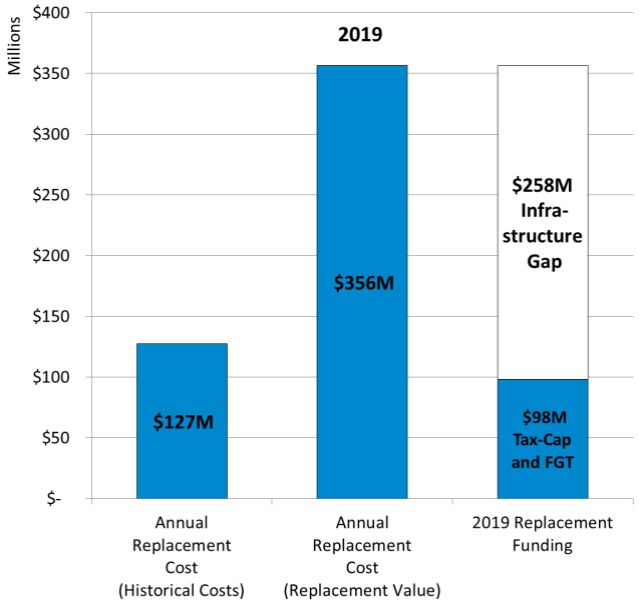
Financing Strategy

Infrastructure Gap

Through prudent asset management practices, service areas ensure that available funds are applied in a prioritized manner. There continues to be, however, an infrastructure gap – the gap between how much is required to maintain our assets and how much funding is currently available.

The 2019-2022 Business Plan and Budget book identified an infrastructure gap of $258M for 2019 excluding the stormwater program which is reported separately. The gap has been defined, by proxy, as the difference between the annual current replacement cost of infrastructure, less the amount of funds assigned to manage these assets in 2019.

City-Wide Asset Infrastructure Gap



Stormwater asset replacement excluded

This has been a useful proxy for the infrastructure gap. The detailed work completed as part of the City of Mississauga's AM Plan development has identified several improvements.

- Using **Annual Replacement Cost** as a proxy for how much should be invested in our infrastructure is not the most optimum approach. Replacement cost has been estimated based on historical acquisition costs, increased by inflation to current dollars. Annual replacement cost has been estimated by dividing the replacement cost for a given asset by the remaining number of useful life years. This assumes costs to maintain assets do not change each year. The AM Plan for each asset identifies this is not the case.
- Identifying the gap at a point in time is not a best practice, since the value of the gap can change over years.

The recommended approach, arising from the detailed AM plan work, is to use capital requirements identified by the city's AM subject matter experts. Service areas identify their total capital requirements. A certain portion is funded, using available funding sources. The unfunded portion represents the infrastructure gap. The annual gap for each of the ten-years in the capital program is averaged out to identify the total infrastructure gap faced by the City.

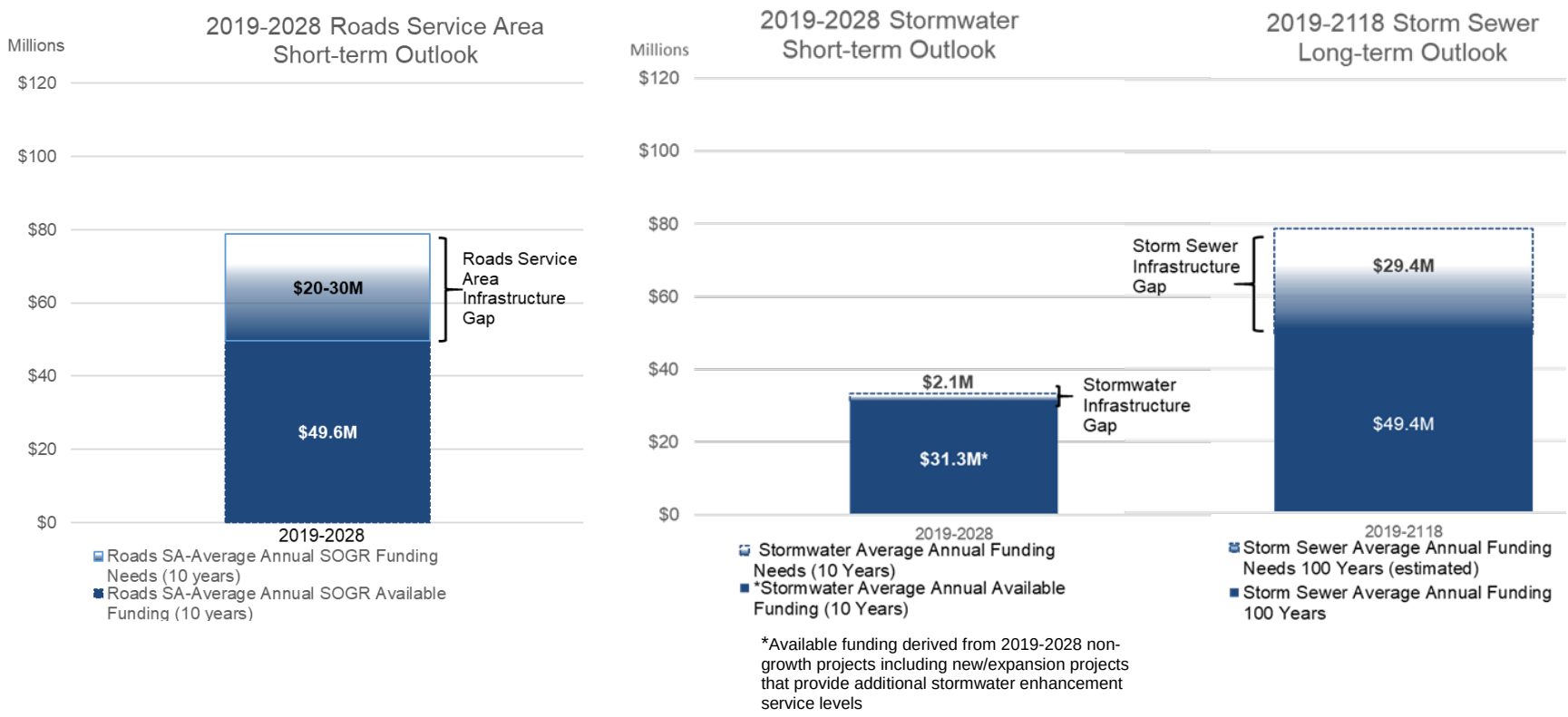
Financing Strategy

Infrastructure Gap for Core Assets

The infrastructure gap for the City's core assets is estimated at $274 million over the 2019-2028 period, or $27.4 million annually. The *Detailed AM Plan - Roads and Structures and Stormwater* sections of this Plan provide a more detailed analysis of this gap.

The current infrastructure gap is projected to significantly increase over the next ten-years. The planned investment in asset lifecycle activities does not sufficiently address the needs of Mississauga's infrastructure. For example, construction costs for road pavement has outpaced inflation in the range of 10 per cent to 20 per cent. As a result, the risk of increased asset failures are possible along with a corresponding drop in the levels of service.

Average Annual Roads and Stormwater Service Area Infrastructure Gap



*Available funding derived from 2019-2028 non-growth projects including new/expansion projects that provide additional stormwater enhancement service levels

Financing Strategy

Approaches to Close the Gap

Common asset management practices can be utilized to reduce or close the infrastructure gap. By implementing additional asset management practices there are opportunities to reduce the size of the infrastructure backlog. The following AM strategies/approaches will be explored to achieve a reduction in the City's infrastructure gap.

AM Practices

Practice	Approach
Improved Data Quality	Ensure asset inventories are comprehensive, contain accurate condition assessments and performance data is available on a more granular level. Current age-based proxies may inaccurately group some assets under the "very poor" condition.
Implement a Standardized Risk Framework	Develop a standardized risk assessment methodology for asset classes across the organization formalized through a Council-approved Corporate Risk Policy. This would establish levels of tolerances for each asset class to prioritize asset investment needs and appropriate levels of service, potentially reducing funding needs.
Enhance Project Co-ordination with Region of Peel and Utility Companies	Explore additional opportunities to enhance co-ordination of capital projects with the Region of Peel and utility companies. Overall cost efficiencies can be achieved during linear asset rehabilitation and replacement (e.g., roads, culverts, bridges and storm sewers) by better aligning capital programs. This approach can also minimize disruption to residents and road users.
Recalibration of LOS	Perform asset assessments to determine if specific current asset class condition ratings could be recalibrated. Recalibrating the standards of a (for certain asset classes)	condition rating would effectively mean the acceptance of reduced standards of service, which in turn could reduce current funding needs until a later date.
Develop Annual Capital Reinvestment Targets	Conduct a review of various asset classes to determine if current asset reinvestment rates are reasonable and establish new targets if required to provide the desired levels of service to stakeholders.
Increase the 2% Infrastructure Levy	To mitigate against a growing infrastructure gap a phased rate increase to the Infrastructure and Debt Repayment Levy could be proposed. This would improve financial sustainability and reduce the size of the gap.

FCM Video – Why invest in asset management

Continuous Improvement in AM

Continuous Improvement

Evolving the Asset Management Process

Since 2018, the City's asset management teams have been rapidly maturing, establishing a baseline of current asset practices, to inform work plans for continuous improvement of the Corporate Asset Management process.

Implementing a Corporate Asset Management program across the organization has advanced the following AM activities:

- Developed the City's first Strategic AM Policy.
- Established a AM governance structure and core working team.
- Established an AM reporting framework.
- Expanded overall awareness and knowledge about AM
- Initiating the development of dashboards for core assets to automate reporting tools
- Develop a business case to engage a vendor using mobile laser imaging, detection and ranging (LiDAR) to scan, map and collect all the right-of-way assets in the City
- Development of Levels of Service (LOS) metrics for all core asset classes and developing knowledge to define target LOS for all core and non-core asset classes
- Development of a stormwater risk management framework
- Completion of inventory and condition assessments for roads, bridges, culverts and stormwater assets
- Successful certification of 15 staff in asset management since 2018
- New staff enrollment in AM certification training programs

Core Assets - Asset Management Maturity

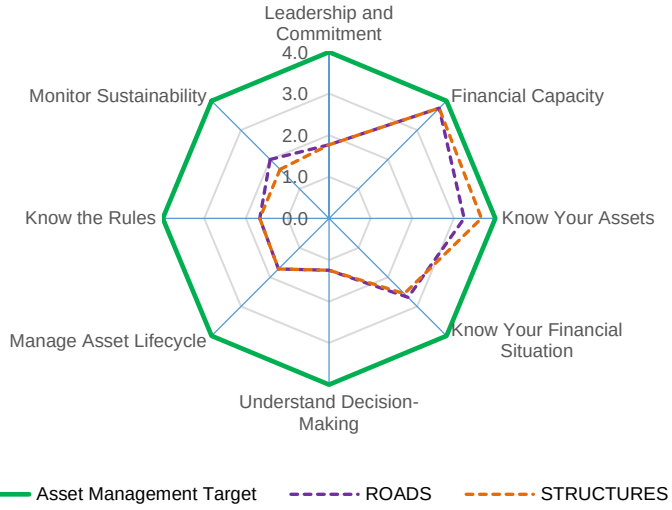
Asset management is an evolution of learning and adopting practices that are put into action to optimize the delivery of services. The very process of preparing the 2021 CAM Plan, has advanced the City's asset management competencies for the core assets. The City has progressed from "Started" (2 out of 4) in December 2019 to "Progressing" (2.3 out of 4) in spring 2021, according to the Four-Point Asset Management Maturity Scale shown here.

Four-Point Asset Management Maturity Scale

The following radar graph provides an illustration of the scores measured against eight criteria for road and structure core assets. It provides a visual tool to evaluate the gaps against targets for the asset management system. The purpose of this self-assessment is to identify where opportunities exist to develop and plan initiatives focused on improving the maturity level for each of the eight criteria.

The green line identifies the ultimate target for reaching a Level Four "Complete" maturity. This means AM practices, standards and outcomes are completed and in use in all business operations.

2019 Roads Core Asset Management Maturity Assessment

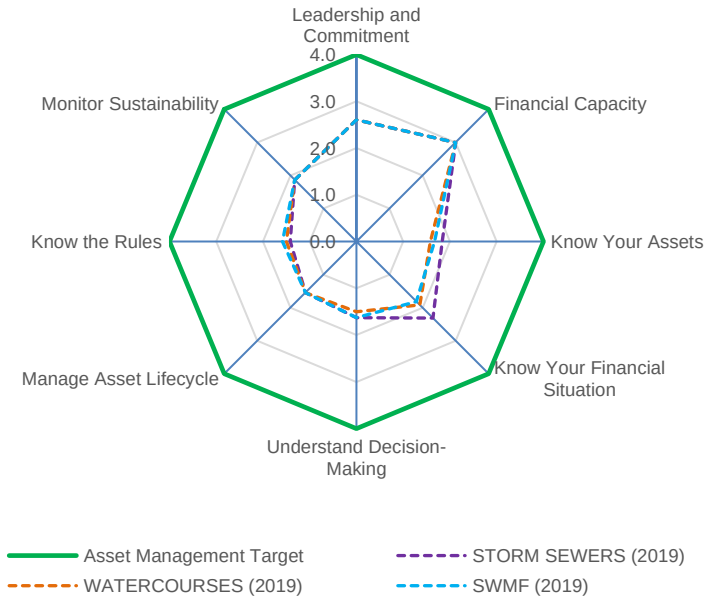


Continuous Improvement

The roads and structures assessment reveals the level of maturity for financial capacity, knowing your assets and knowing your financial situation are quite mature by asset class. Targeted activities through continuous improvement will increase the level of maturity in those criteria where lower scores are observed.

The following radar graph illustrates the asset management assessment for stormwater asset classes.

2019 Stormwater Core Asset Management Maturity Assessment



The stormwater assessment reveals a higher level of maturity in the leadership and commitment, financial capacity, knowing your financial situation and understanding decision-making criteria. The higher level of maturity in these areas is related to the efforts taken for the 2016 establishment of the stormwater charge.

Continuous improvement in stormwater asset management practices and technology advancements will position future asset management maturity assessments to improve scores across the different criteria levels.

AM maturity assessments for core assets will be updated in advance of preparing the next CAM Plan. For the next CAM Plan, a maturity assessment will be conducted for non-core assets that will establish their baseline maturity level.

Adopting new asset management practices will require financial investments in systems and staff to achieve improved reporting and analysis at the asset level. As a result of having better information at the asset level, senior staff and ultimately Council can make more informed decisions for establishing target service levels and focused asset investment decisions.

Continuous Improvement

Corporate Continuous Improvement Recommendations

Continuous improvement is an essential part of any asset management plan. A number of recommendations are presented in this plan to support the development of standardized asset management practices by the Corporate Asset Management Office in the City of Mississauga.

Specific continuous improvement activities/initiatives associated with core asset classes are listed in the Continuous Improvement sections contained within the detailed core asset appendices of this document.

Future Improvements in Asset Management

Category	Recommendation	Status	Strategy
People	Promote adoption of AM policy to support staff working in the AM environment	Ongoing Activity	Conduct strategy sessions with service area teams to address strengths, weakness, opportunities and barriers in fully adopting all components in the AM Policy
	Implement Department Capacity Planning	In Progress	Use information identified within service specific asset management plans to build a business case for resources necessary to deliver annual asset management work plans
	Foster AM training to the Working Group (AMWG), Steering Committee (AMSC), LT and Members of Council	In Progress	Monitor foundational AM courses and AM planning certifications available and distribute information to relevant groups
Business Processes	Continue to update AM Plans for the Service Areas	Ongoing Activity	Deliver a comprehensive AM Plan focussing on the highest priority assets in each service area to comply with *O. Reg. 588/17* requirements
	Evaluate current capabilities and develop a work plan toward AM Maturity	In Progress for Non-Core Assets	Conduct periodic audits on AM system (e.g. business process, resources, tools)
	Implement an Enterprise Risk Management Framework	Not Started	Prioritize critical and vulnerable infrastructure
	Align AM process templates with Financial templates	In Progress	Work with Corporate Finance to standardize templates in an effort to capture relevant asset lifecycle cost information
	Include operational costs when calculating the infrastructure gap	In Progress	Determine operational data to consolidate asset information that can be used for infrastructure gap calculation

Continuous Improvement

Category	Recommendation	Status	Strategy
Assets	Perform ongoing Service Level Agreements (SLA) review	Ongoing Activity	Use the SLA to document roles, responsibilities and expectations between service areas. Liaise with external stakeholders (e.g. Metrolinx) to determine assets ownership, maintenance and renewal responsibilities.
	Conduct Asset Responsibility Review	In Progress	Perform annual reviews to update and document who is responsible for what aspect of the asset lifecycle
	Continue updating Asset Hierarchy and Register	Ongoing Activity	Improve asset database for enabling most asset management functions
Tools/Technology	Procure an Enterprise Asset Management System Technology	Not Started	Conduct ongoing research with suppliers, industry experts and communities of practice to identifying the optimal platform to improve reliability and accuracy of asset data. The aim is to acquire a system that will provide a single source of truth that captures asset registry and metrics across the organization.
	Develop Enterprise Asset Management Reports and Dashboard for Assets	In Progress	Develop a set of standardize dashboards and reports that will reduce the manual tasks required to generate the measures legislated for the AM Plans.
	Use Mobile LiDAR to capture non-core assets in the Right-of-Way	Initiated	Process the data collected by LiDAR to allow assets and features to be imported into GIS for analysis and visualization.
	Develop consistent asset attributes across systems	In Progress	Provide strategic alignment among subsystems (e.g. VFA, RoadMatrix, EMSI, Faster, SAP, CityWide, etc.)

Conclusion

The City of Mississauga's infrastructure supports a wide range of services to residents, businesses and visitors. This infrastructure serves as the critical foundation in achieving the City's Vision: **A Place Where People Choose To Be**.

In 2019, the City's combined assets have a replacement value of $13.2 billion. Core assets (roads, structures [bridges & culverts], stormwater management system) are estimated at $8.4 Billion and are on average in "**Good**" condition. This means some asset elements show general signs of deterioration that require attention. Using a strategic prioritization process, asset renewal, rehabilitation and maintenance projects are identified and included in the Capital Budget.

Road Pavement

The City's 5,640 lane kilometres of road pavement achieves an average rating of between "**Fair**" and "**Good**" with 79 per cent of the pavement network in "**Fair**" or better condition. While road pavement assets are well managed today, they are aging at a faster rate than the other core assets. Modeling projections indicate that the road pavement network condition is declining and will continue to decline over time without a significant increase to the annual investment rate.

In 2019 the forecasted average annual funding gap for the renewal of road pavements is estimated at $25.3 million. Many sections of road pavements are in need of repair and/or renewal today and the number of pavement sections that require renewal will continue to grow over the next ten-years. In recent years, the cost to deliver annual Roadway Rehabilitation Program has increased between 10 per cent to 20 per cent; resulting in delays for the timely renewal for some roads. This results in additional cost pressures to deliver the annual program. In turn, the delay places additional pressure on Maintenance staff to deliver additional demand-based repairs where road renewal has been delayed due to the lack of available funding.

Structures

At City's 378 bridge and culvert structures are critical assets and achieve an over all average condition rating of "**Good**". Modeling projections indicate that there is currently sufficient lifecycle funding available to continue to maintain these structures in "**Good**" condition. Regular bridge and culvert inspections help to ensure that timely maintenance occurs and that bridge and culvert renewal activities are planned for.

The *Detailed AM Plan – Roads & Structures* provides specific asset information for Mississauga's road pavements, bridges and culvert structures.

Stormwater

Stormwater assets include storm sewers, stormwater management facilities (SWMF) and watercourses. The condition of storm sewers ("**Good**") and SWMF ("**Very Good**") is primarily based on the age and expected useful life of these assets. However, physical inspections and assessments will be leveraged to provide more reliable condition data in future asset management plans. The condition of watercourse assets ("**Good**") is based on reach inspections, which will also be refined in future plans as a more comprehensive watercourse inventory is developed.

The stormwater charge currently provides dedicated funding to maintain the City's stormwater assets. Over the next ten-years there is an estimated $2.1 million average annual funding gap for the stormwater program. Further, over the next 100-years, there is an estimated $29.4 billion average annual funding gap for the storm sewer network. It is recommended that additional data collection and

Conclusion

revenue forecasting be completed to identify the 100-year SWMF and watercourse funding gaps. This information will be used to refine the target Stormwater Charge contributions required to maintain the City's stormwater assets sustainably.

The *Detailed AM Plan – Stormwater* provides specific asset information for Mississauga's storm sewer drainage network, stormwater management facilities and the watercourse network.

The City recognizes the importance of maintaining its infrastructure to deliver services. By implementing a two per cent infrastructure levy the City is able to keep most of its assets in good working order. The infrastructure levy is a key funding mechanism for maintaining the City's assets but an infrastructure gap exists. The City leverages federal and provincial funding programs to control the size of the infrastructure gap and minimize the impact to taxpayers.

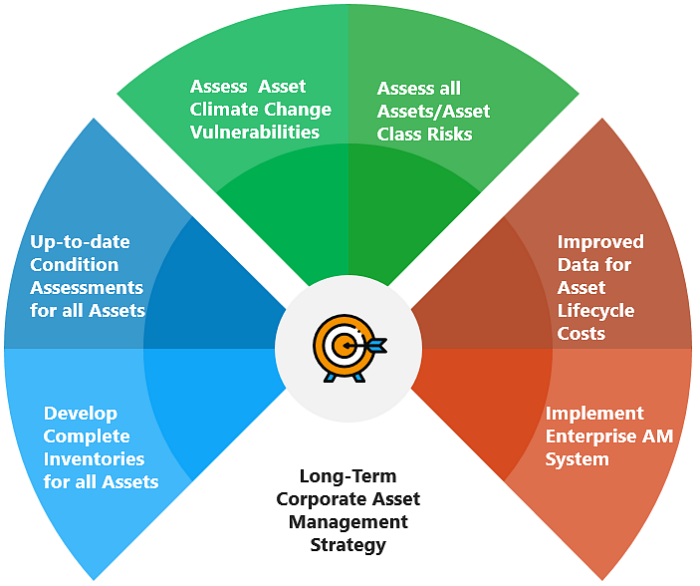
An asset management plan provides information on the current levels of service, complete asset inventories, assets condition, age and the costs involved to operate, maintain, renew, replace, expand, or dispose assets. The ultimate goal is to have a long-term financially sustainable plan that optimizes service delivery and available funding.

Continuous improvements in asset management practices will advance the City's ability to provide more detailed information on all City's assets at the organizational level. This will provide enhanced clarity on funding priorities, identify any potential cost savings and the right time for investment opportunities.

Developing Future City CAM Plans

Applying the lessons learned in preparing this CAM Plan, the CAM Office looked towards the medium to long-term workplan required to improve AM data and practices throughout the organization. Several of the medium to long term workplan items are expected to occur simultaneously with one another. All workplan items are adapted to achieve strategic objectives and comply with the provincial AM timelines contained in *O. Reg. 588/17*.

The following illustration identifies key focus areas for the Corporate Asset Management Program in the medium to long term time horizon.



Navigating the Plan

Navigating the Corporate Asset Management Plan

This section of the CAM Plan defines how to read and interpret the information provided in the Roads and Structures and Stormwater Appendices of the plan.

State of the Infrastructure (SOI)

It is important to determine the physical fitness of an asset to deliver the required service. The condition rating for asset classes is assigned using one of the four following methods to determine the condition rating:

- Existing condition rating systems (e.g., Pavement Quality Index, Bridge Condition Index, etc.)
- Estimated based on age and the remaining estimated useful life of the asset
- Estimated based on the weighted average of physical condition, capacity and functionality
- Estimated based on subject matter expert opinion, in the absence of condition or age

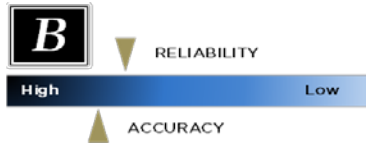
Based on data availability the appropriate method is used to determine the condition of core infrastructure according to the following table.

Five-point Condition Rating Scale Definitions

Condition Rating Scale	Grade Description	Physical Condition (Criteria)
1	Very Good	**Fit for the Future -** The asset is generally in very good condition, typically new, or recently rehabilitated.
2	Good	**Adequate for Now** - Some asset elements show general signs of deterioration that require attention. A few elements exhibit deficiencies.
3	Fair	**Requires Attention -** The asset shows general signs of deterioration and requires attention with some elements exhibiting significant deficiencies.
4	Poor	**Approaching End of Life** - The asset is in poor condition and typically below established standards, with many elements approaching the end of their useful service life.
5	Very Poor	**Requires Renewal -** The asset is below established standard conditions with widespread signs of advanced deterioration. Many components have surpassed the end of its useful service life and requires urgent renewal.

In gathering the data, it is useful to attach a level of confidence grade to each of the customer levels of service measures to provide an indication of the reliability and accuracy in the base data presented in the report.

A data accuracy and reliability rating is provided in the SOI section for the core assets. The data rating scales are defined below.



Navigating the Corporate Asset Management Plan

Data Accuracy & Reliability Definitions

Grade	Confidence Measure	Description
A	Highly reliable	Data based on sound records, procedures, investigations and analysis, documented properly and agreed as the best method of assessment. Dataset is complete and estimated to be accurate ± 2%
B	Reliable	Data based on sound records, procedures, investigations and analysis, documented but has minor shortcomings, for example some of the data is old, some documentation is missing and/or reliance is placed on unconfirmed reports or some extrapolation. Dataset is complete and estimated to be accurate ± 10%
C	Uncertain	Data based on sound records, procedures, investigations and analysis which is incomplete or unsupported, or extrapolated from a limited sample for which grade A or Grade B data are available. Dataset is substantially complete but up to 50% is extrapolated data and accuracy estimated ± 25%
D	Very Uncertain	Data is based on unconfirmed verbal reports and/or cursory inspections and analysis. Dataset may not be fully complete, and most data is estimated or extrapolated. Accuracy ± 40%
E	Unknown	None or very little data held

Levels of Service (LOS)

This component of the AM Plan documents the level of service (LOS) and associated performance metrics for core assets and several non-core assets in two service areas (Roads and Stormwater). Level of service metrics include those prescribed through *O. Reg. 588/17* and advanced metrics developed through discussions with members of the asset management working group.

The structure for all LOS tables is the same for each service area. The customer and technical performance measures include the current performance as well as an indication of performance trends for the next five years. Components of the LOS tables identify: LOS attribute, service area LOS objective, customer LOS measure, and technical LOS measure.

The LOS tables are structured as follows:

- A Service Area LOS objective that briefly describes the kind of service that will be provided to customers. For example, the service statement for stormwater is “providing stormwater services that protect the community.”
- The columns heading consist of:
    - LOS Attribute
    - Service Area LOS Objective
    - Customer Performance Measures (with current performance and trend performance)
    - Technical Performance Measure (with current performance and trend performance)

Each of these headings is defined as follows:

- LOS Attribute: a phrase that describes attributes of the service being provided (i.e., cost efficient, safe, reliable, etc.). These descriptions cover all aspects of the service and are easy for the customer/resident to understand.
- Service Area LOS Objective: a short sentence that describes the outputs of the LOS Attribute. There may be one or multiple LOS statements written for each LOS Attribute (service attribute). The output clearly states customer standards and is measurable.
- Customer LOS Measures: quantifiable metrics expressed in plain language that describes the public’s understanding of services being provided by the City. Customer performance measures are typically related to the service provided by the overall system supporting the service delivery, rather than the specific assets. The customer performance measure can also be referred to as “community, “corporate” or “strategic” performance measures.

Navigating the Corporate Asset Management Plan

- Technical LOS Measures: quantifiable metrics applied against assets that connect highly technical expertise considerations to the Customer Performance Measure. The main categories of Technical Performance Measures are:
    - Legislative/regulated – performance measures legislated by a governing body the City is to expected to achieve, such as stormwater quality targets
    - Service delivery best practices – performance measures that are based on meeting the City's service delivery objectives
    - Industry standards – performance measures based on design standards and maintenance requirements for infrastructure

The rows of the LOS tables consist of different customer values such as cost efficient, operational, quality, accessible, scope, environmental stewardship, health & safety and reliable.

Interpreting LOS Tables

- Current Performance: The current performance is recognized for all metrics for which data is available.
- Future Trend Performance: some metrics provide a future trend performance indicator. This metric provides an evaluation by staff to predict the current performance service level trends for the next five-years based on the 2019-2028 forecasted capital investments.

Legend for Levels of Service Trends

Symbols	Future Trend	Description
	Negative Upward Trend	An upward trend represents a negative outcome for the City and a deterioration in service delivery performance (i.e., higher risk to service delivery)
	Positive Upward Trend	An upward trend represents a positive outcome for the City (i.e., improving LOS)
	Negative Downward Trend	A downward trend represents a negative outcome for the City (i.e., declining LOS)
	Positive Downward Trend	A downward trend for this category to service delivery represents a positive outcome for the City (i.e., lower risk to service delivery)
	Consistent/No Change	No anticipated changes noted at this time

Navigating the Corporate Asset Management Plan

Lifecycle Management Strategy

The lifecycle management strategy is the set of planned actions that will enable the assets to provide the desired levels of service in a sustainable way, while managing risk, at the lowest lifecycle cost. This section of the AM Plan describes the lifecycle activities applied to the asset category, the target budget to achieve the ideal condition profile to maintain the current LOS, and the condition profile expected from the current budget. The lifecycle activities are documented in table below.

The optimal budget to maintain LOS provided by each asset category is forecasted by analyzing the cost of the lifecycle activities that are required to achieve the ideal condition profile. The approach to understand the cost to sustain the current LOS is to achieve the ideal condition profile over the ten-year planning horizon. Subject matter experts employ their professional experience between actual asset performance and industry best practices to determine the optimal timing to intervene to achieve the lowest lifecycle cost management strategy. This allows for the balance of costs, risks and the forecasted change in the condition profile of each asset type.

Examples of Actions and Risk Associated with Asset Lifecycle Activities

Asset Lifecycle Activity	Examples - AM Practices or Planned Actions	Examples -Risks Associated with AM Practices or Planned Actions
Non-Asset Solution	• Optimization of asset management related processes – changes to levels of service • Managing and forecasting the demand for services within the City • Facilitating training courses and fostering cultural change • Flood studies to identify issues and develop mitigation strategies	• AM Plan or proposed network solutions not followed • Asset life is not extended or cost of managing an asset increases rather than decreases • Plans/Reports/ Recommendations
Operations/ Service Activities	• Roads Patrols to check for general safety issues, and visual inspection for blockages at high risk and known problem areas after major storms • Condition assessments (i.e. CCTV Inspections, pond sediment surveys, watercourse inspections, etc.)	• Failure to inspect an asset can lead to unexpected operational and structural issues • Failure to clean an asset can lead to debris accumulation
Maintenance	• Scheduled preventative maintenance • Debris removal from watercourses, inlets, grates, outfalls, etc. • City staff is available to respond and attend to customer request 24/7 on call coverage.	• Completing planned maintenance activities while managing reactive maintenance activities • Premature asset failure due to incorrectly planned maintenance activities
Renewal/ Rehabilitation	• Roadway Rehabilitation Program (includes the renewal of pavement, curbs, boulevards, sidewalks and multi-use trails) • Storm sewer trenchless rehabilitation • Watercourse erosion control projects	• Incorrect assumptions regarding expected useful life after rehabilitation
Replacement	• Full reconstruction of a roadway (includes the installation of new drainage systems, curbs, boulevard treatments, trails and sidewalk infrastructure) • Storm sewer replacement at end of useful life	• Scope creep because of complex design and construction projects • Failure to replace assets on time can lead to unexpected failure, drainage and/or safety issues

Navigating the Corporate Asset Management Plan

Asset Lifecycle Activity	Examples - AM Practices or Planned Actions	Examples -Risks Associated with AM Practices or Planned Actions
Disposal/ Demolition	• Demolition and disposal of structures completed as part of construction	Structures that no longer meet load or capacity requirements can fail and lead to loss of use and puts users at risk.
Expansion/ Rebuild/New Asset	• Installation of a new bridge or culvert where none previously existed • New assets to provide additional flood control, conveyance or erosion control.	• Incorrect asset size design • Service is prematurely expanded

Integrating Risk Management

The term *risk* covers a broad spectrum when used in the context of the infrastructure asset management industry.

Asset management involves understanding and balancing levels of service, cost and risk. An enterprise risk management framework has not yet been properly formulated in the City's public infrastructure management.

The City has undertaken several workshops aimed at developing a corporate risk management framework in order to prioritize action. Hazards that may impact the community and asset condition will be factors that will inform the risk management framework.

Asset Risk

Asset level risks are calculated by multiplying the asset criticality with the likelihood of asset failure as shown in the illustration below. The criticality of an asset is the inherent consequence of the loss of its function, including its impact on the function of a system or network of assets. While the loss of some assets or components may have little impact on service delivery and negligible risk of injury, the loss of others may severely impact services and may lead to fatalities or heavy financial losses.

Asset Risk Calculation

For each of the Stormwater asset classes (e.g., Storm Sewer, Stormwater Management Facilities and Watercourses), criticality criteria are identified for each major asset category (such as size of the asset, type of the asset or location of the asset). Asset Criticality rates how critical the asset is to deliver the required service. A numerical score is assigned for asset type, based on the applicable descriptions.

For stormwater assets the likelihood of asset failure is generally based on the age of the asset compared to its expected useful life, then converted to a five-point score.

Once the asset criticality and failure likelihood have been rated, the risk score can be calculated. The risk matrix in the table below shows the risk ratings from 1 to 25.

Risk Rating Matrix

Risk Score and Rating		Impact				
Likelihood		Very Low	Low	Medium	High	Very High
		1	2	3	4	5
Rare	1	1 Very Low	2 Very Low	3 Low	4 Low	5 Low
Unlikely	2	2 Very Low	4 Low	6 Low	8 Medium	10 Medium
Possible	3	3 Low	6 Low	9 Medium	12 High	15 High
Likely	4	4 Low	8 Medium	12 High	16 High	20 Very High
Almost Certain	5	5 Low	10 Medium	15 High	20 Very High	25 Very High

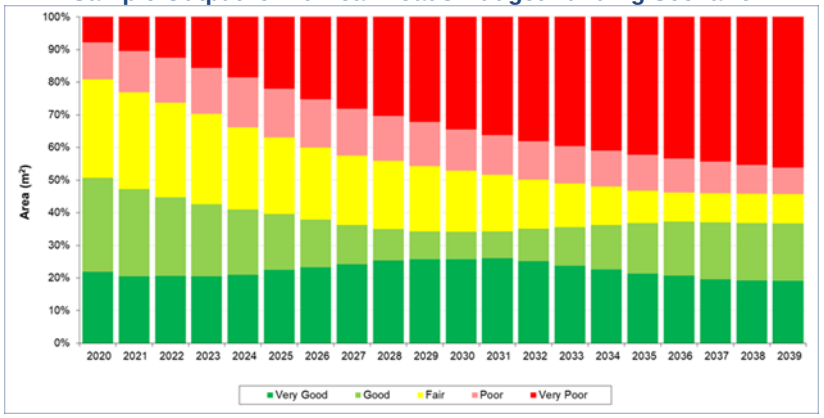
Navigating the Corporate Asset Management Plan

Current Budget Funding Scenario Analysis

The first scenario analysis provided gives a visual representation of the projected performance of the assets based on an assumed budget or set of planned expenditures for each asset group.

The budget scenario can be used to understand the impact of any proposed spending plan. Contained in roads and structures section is an analysis of the budget scenario based on the planned expenditures in the City's current 2020 approved capital budget and forecasted operating budget. The following illustration represents a sample condition profile for road assets over the next ten-years based on the current budget.

Sample Output for 10-Year Roads Budget Funding Scenario



Future growth demands on operating and capital budgets are guided by the City's 2019 DC Background Study. The 2019 DC Background Study contains capital program expenditures required to service growth as a result of new development occurring throughout the City.

The general approach to forecasting the cost of the lifecycle activities that are required to maintain the current levels of service is to ensure that the proportion of assets in poor or very poor conditions remains relatively stable. Staff then considers the optimal combination of each lifecycle activity to achieve the lowest lifecycle costs management strategy that balances costs with the forecasted change in the condition profile of each asset type.

Infrastructure Gap and Challenges

Each core asset section includes a discussion on the current and future challenges in providing the service and an indication of an infrastructure gap if applicable. Graphs for asset types and classes provide a visual representation of the ten-year funding gap with supplementary information.

Continuous Improvement and Monitoring

One of the goals of the asset management plan is to establish a baseline of the current asset management practices, to inform a work plan for continuous improvement of the Corporate Asset Management process.

Each core asset management plan will contain a continuous improvement section that will identify a list of actions that each service area proposes to achieve to advance their management of assets used to deliver services. Continuous improvement actions may involve a range of activities from physical inventory condition assessments and technology solutions for consolidating and analyzing data to developing new key metrics for reporting on levels of service. In addition, the CAM Plan will identify continuous improvement actions initiated at a corporate level that will advance asset management practices throughout the organization.

Navigating the Corporate Asset Management Plan

A proposed work plan example in the following table aims to build upon the City's existing strengths to develop a leading corporate asset management practice that balance costs, opportunities and risk against the desired levels of service, to achieve organizational objectives.

Proposed AM Work Plan

Task No.	Work Plan Task	Asset Class	Timing	Target Benefits	Required Resources
CORP-01	Enterprise AM Implementation	All	2021	• Provides single source for data extraction	External
SOI-01	Consolidate GIS inventory from CCTV assessments	Storm Sewer	2024	• Centralizes GIS inventory and provides single source of information	Internal

Asset Information Summary

Each specific asset service area section concludes with a summary of the state of the infrastructure, replacement value and funding gap if applicable.

Asset Chapter Summary (Example)

Asset	Replacement Value (millions)	Current Condition	2019 Infrastructure Gap (millions)	10-Year Infrastructure Gap (millions)
Road Pavement	$2,878		$22	$253
Structures	$978		No Gap	No Gap
Roads & Structures	$3,856		$22	$253

Advancing Corporate Asset Management Capabilities

In order for the City to evaluate current capabilities and develop a work plan towards asset management maturity, the City plans to conduct periodic internal audits of the asset management system.

A maturity assessment will be completed separately for each of the asset types or asset classes depending of the nature of the asset. The results for these asset types are then weighted by the value of the assets in each asset class grouping, to provide an overall result for Mississauga core service areas.

The questions, scores, analysis, and results are recorded for benchmarking the level of AM practice. This allows staff to re-evaluate their business practice maturity in AM at any time in the future, and report progress achieved.

Navigating the Corporate Asset Management Plan

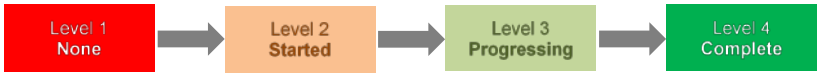
The continuous improvement strategy for asset management is measured against seven elements of AM practices that touch on the various aspects of the plan. The following table provides the definitions of the elements of AM practice.

AM Maturity Assessment Criteria

AM Practice Element	Description
Know your Assets	Basic inventory, data software and data tools
Know your Financial Situation	Current asset investment, operational and maintenance costs, future capital costs, funding sources
Understanding Decision-Making	Decision process, AM Plan
Manage Asset Lifecycle	Asset condition, levels of service, maintenance strategies
Know the Rules	Strategic goals, legislation/regulation
Monitor Sustainability	Sustainability, renewal alternatives, coordinating works
Leadership and Commitment	Commitment on AM strategy and Policy Leadership on AM people management Cultural: Awareness and Decision-Making Data governance AM continuous improvement

A structured interview process was employed to rank the current level of practice against the Asset Management Maturity Assessment Tool (AMMAT) framework delivered via workshops with the asset management working group (AMWG).

The AMMAT assessment uses a similar four-point maturity scale as that of British Standard ISO 55000 as illustrated in the figure below:



Asset Management Maturity Scale

City staff is guided through the designed list of questions about core elements of AM practice for each of the categories listed below. These questions enable staff to grade each element of AM practice into one of the following options:

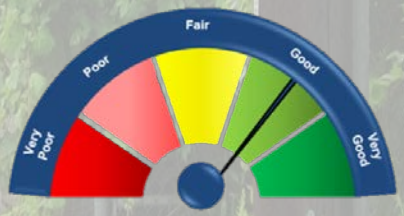
1. **None** (i.e., does not exist or has not been started at this stage)
2. **Started** (i.e., some work has begun, or some parts of the asset management practice are available, but progress is less than 40 per cent complete)
3. **Progressing** (i.e., work is underway, and progress is more than 40 per cent complete but there is still more work to do)
4. **Complete** (i.e., the required targets, standards, and/or outcomes for the asset management practice are completed, available, and in use in the business)

Improving Future Asset Management Plans

The completion of continuous improvement activities identified in specific asset classes and on a corporate perspective will be reflected in future asset management plans.

Detailed AM Plan - Roads & Structures

Quick Facts	
5,640 (lane km)	Roads
378	Bridges and Culverts
2,417 km (linear)	Sidewalks
573 km (linear)	Trails
564	Signalized Intersections
47,190	Street Lights
58 km (linear)	Noise Walls
24	Municipal Parking Lots

Replacement Value	$2.878 Billion	$978 Million
Condition	Fair - Good	Good
	 Roadway Overall Condition	 Structures Overall Condition
10-Year Infrastructure Gap	($253 Million)	No Gap

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Introduction

At the core of a vibrant and modern City is its transportation network. Roadways are a key component of that transportation network and provide many benefits. They support services that are essential for the community in terms of quality of life, public safety, sustainability, and economic benefit. Valued at over $5 billion[1], Mississauga's roadway infrastructure is the second-largest asset owned and operated by the City of Mississauga. Roadways are comprised of a variety of smaller asset components that include road pavements, bridges and culvert structures, sidewalks, multi-use trails, cycle tracks, traffic signals, streetlights, on-street parking facilities, signs, and noise walls. Of the $5 billion, the City's road pavement and structures network comprises approximately 77 per cent or $3.856 billion of that total replacement value.

In Mississauga, the Roads Service Area is responsible for managing the roadway-related infrastructure. The Roads Service Area's mission is to plan, develop, construct and maintain a multi-modal transportation system which safely and efficiently moves people and goods, respects the environment, supports the development of Mississauga as a 21st century city and serves the municipality's social, economic and physical needs.

With a continued focus on urban mobility, asset management, service delivery, and our people and culture, the Roads Service Area will continue to provide responsible road-related infrastructure services. With that said, the goals of the Roads Service Area are:

- **Maintain** our infrastructure in a state of good repair (SOGR), with focus on a safe and efficient urban mobility system
- **Plan, design, and construct** an adaptable transportation network for all users and modes of transport
- **Deliver** quality and timely services
- **Apply** progressive asset management practices to achieve cost containment and value for money
- **Recognize and develop** employees and create an empowered employee culture to meet current and future challenges.

This chapter of the Corporate Asset Management Plan (AMP) will focus primarily on the state of Mississauga's road pavements, bridges and culvert structures. The bridge and culvert structures information will include bridges and culverts also maintained by the Parks, Forestry and Environment Service Area. Future AMPs will be expanded to include additional road-related assets managed by the Roads Service Area.

This asset management plan includes the following:

- **State of the Infrastructure**: Outlines the current state of the infrastructure assets including what the City owns, the condition of the assets and the costs to replace them
- **Levels of Service**: Describes the outcomes the City intends to deliver
- **Future Demand**: Summarizes the expected future demand on the Roads services
- **Lifecycle Management Strategy**: Documents the strategies used throughout the assets' lifecycle to support ongoing service delivery
- **Infrastructure Gap & Challenges**: Describes the forecasted budgets, revenues, capital expenses (growth and non-growth) and reserves and identifies any financial gap
- **Continuous Improvement**: Documents the continuous improvements identified during the development of this Asset Management Plan and maturity assessments

[1] 2019 Tangible Capital Asset Historic Value for all road related infrastructure.

State of the Infrastructure

The foundation of any asset management plan includes an understanding of which assets are owned by the organization, how much the assets are worth, and what condition the assets are in. Without these essential components, it becomes difficult to develop a successful and strategic asset management plan. This section summarizes the state of the City's road pavements and bridge and culvert structures. It includes a summary of the inventory, replacement values, overall condition and the level of reliability and accuracy of the information used in making decisions.

With an estimated replacement value of $2.878 billion and a network size of 5,640 lane km, the overall condition of Mississauga's road pavements is an average rating of between **Fair** and **Good** with 79 per cent of the network in **Fair** or better condition. The City's road pavement infrastructure is aging, with many sections of road pavement requiring repair and/or renewal over the next 10 years. It is critical that the City continue to explore a variety of maintenance strategies to maintain the road network in a state of good repair so it can defer the more expensive renewal activities.

At an estimated replacement value of $978 million, the City's 378 bridge and culvert structures cross a variety of natural and man-made features. From watercourses, rivers and streams to highways and railways, these structures connect our residents to communities, commerce and recreational opportunities. The overall condition of the City's bridge and culvert structures is an average rating of **Good**. Similar to our road pavements, the City's structures are also aging but at a different rate than our road network.

Figure 1 summarizes the overall state of Mississauga's road pavements and structures. While it may appear that these core assets are in reasonably good condition today, the long-term financial analysis shows that to maintain these assets in that condition over their lifecycle will place pressure on the City's future financial resources. The subsequent information contained within this appendix will go deeper into these two core assets and begin the process for developing a management plan.

	Road Pavements	Structures
Replacement Value	$2.878 Billion	$978 Million
Overall Condition	Fair - Good	Good
Asset Inventory		
10-Year SOGR Infrastructure Gap	($253 Million)	No Gap

Figure 1 - Overall Condition of the City's Road Pavements and Structures

The City has grouped its road network, comprised of 5,640-lane km of road pavement, into four distinct classes: arterial roads, major collector roads, minor collector roads and local roads. Classifying roads in this manner informs how the City conducts its transportation planning, road infrastructure design, road maintenance and operations, and traffic management activities.

Arterial and major collector roads carry higher volumes of traffic at higher speeds, while minor collector roads carry lower volumes of traffic at lower speeds. Local roads provide access to residential and commercial properties from collector roads. For the purposes of defining service levels in our asset management plan, the condition of our road pavements is divided into these four classes. A summary of the size and condition of each class is located in Figure 2 below.

The bridge and culvert structures inventory is broken down into seven categories: Road Bridges, Major Culverts, Minor Culverts, Active Transportation Tunnels, Roadway Active Transportation (AT) Bridges, Parks Active Transportation Bridges, and Road/Rail Bridges. The City chose this categorization because it best represents the way bridge and culvert structures are being managed and recognizes the services benefitting from the structures. A summary of the inventory and condition of each type of structure is located in Figure 3 below.

Inventory Data and Systems

The City maintains its road pavements and structures inventory information in various systems, with each system serving a specific function and purpose. Spatial and location information for the City's roadway assets is created and maintained within the City's Geographic Information System (GIS) environment. In recent years, they City has decided to migrate all of its spatial information to ***Esri GIS mapping software***. The Esri software will form the foundation of the City's linear and non-linear transportation assets database. The GIS information is used to populate four computerized systems: ***Infor, RoadMatrix, BridgeTMS*** (Bridge Total Management System) and ***CityWide***.

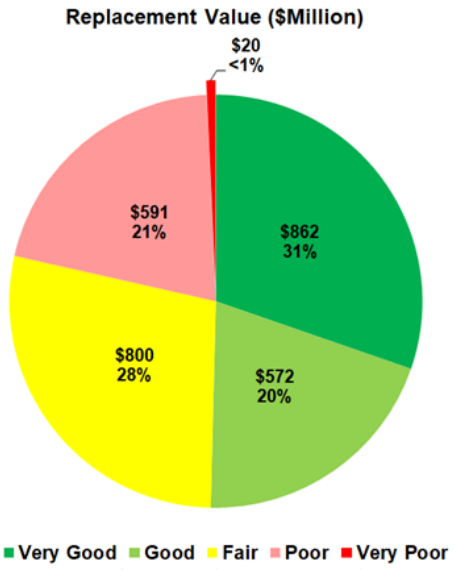
Infor is the computerized maintenance management system used by the Roads Service Area and other services throughout the City to record and manage service requests, work orders and permits. Requests for service are tracked from two primary channels: the offices of the Mayor and members of Council and the 3-1-1 Citizen Contact Centre. Work orders are processed daily for a variety of defined maintenance activities. Details tracked include labour, materials, maintenance contracts, and vehicles and equipment used to perform daily work activities. The ability to track work performed to a specific asset has not yet been fully deployed but it will form part of the overall strategy as the City advances its asset management practices. Infor's permit system enables the City to track and record work performed by third-party utility and construction agencies working within the City's roadway corridors. Collectively, these three modules enable the Roads Service Area to oversee a variety of work activities happening within the roadway corridor. Staff will continue to advance and expand the use of Infor.

RoadMatrix is the asset analysis system used to manage the City's road pavements. The system contains extensive information about the City's road pavement assets including its physical characteristics, classification, age, condition, and major work history information. The RoadMatrix system is used to develop maintenance and long-range capital plans for the renewal of the City's pavement assets. It also enables the City to monitor road pavement deterioration over time, forecast future renewal activities, and determine the financial resources required to sustain the road pavement infrastructure to a certain level of service or condition.

Asset Class	Road Pavement	Replacement Value: $2.878 Billion	Reliability & Accuracy Scale

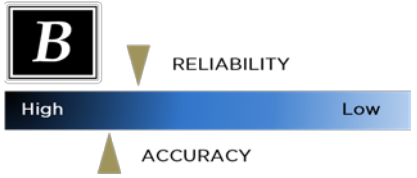
Interesting facts about road pavement assets:

- With a replacement value of over $2.8 billion, road pavement is one of the largest asset classes owned and operated by the City.
- The City's road network is comprised of 5,640 lane km of road pavement. When connected from end to end, it would equal the distance between Mississauga and Juneau, Alaska.
- Mississauga's residents make 420,200 trips per day across the city boundary; people living outside Mississauga make 670,000 trips per day to and from the City.
- Less than 1% of the road pavement is in **Very Poor** condition, 21% is in Poor condition, while 79% is in Fair or better condition.



B Rating. The roads inventory, condition data and investment forecast is reliable and accurate.

The road inventory is stored in the RoadMatrix software and is reconciled against the City's GIS and Infor systems. Pavement condition data is collected every four years and is derived from expert inspections using an objective, formula-based approach. Investment forecasts are based on good engineering practices.



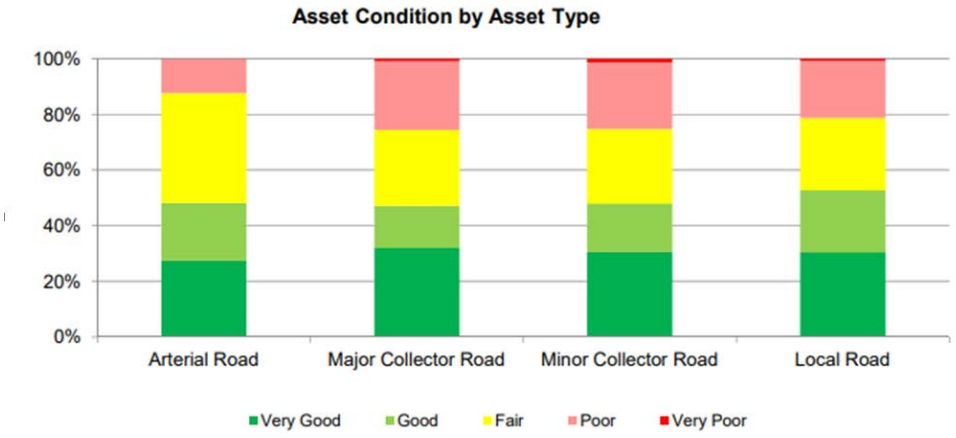
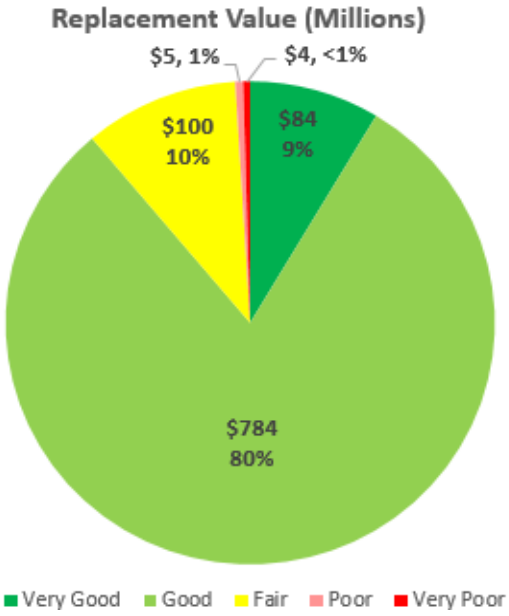


Figure 2 - State of the Infrastructure Dashboard (Road Pavement)

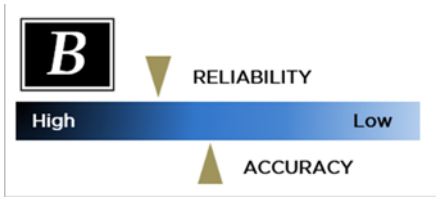
Asset Class	Structures	Replacement Value: $978 Million	Reliability & Accuracy Scale

Interesting facts about structures:

- With a replacement value of $978 million, the City's 378 bridge and culvert structures cross a variety of natural and man-made features from watercourses, rivers and streams to highways and railways. These structures connect our residents to communities, commerce and recreational opportunities.
- The City places a high priority on the maintenance and renewal of structures. Less than 1% of the structures are in Poor or very Poor condition, 14% are in Fair condition, and 85% are in Good or better condition.



B Rating. The structures inventory, condition data and investment forecast is reliable and accurate.
The structures inventory is extensive and stored in the BridgeTMS software. It is reconciled against the City's GIS and Infor systems. Condition data is collected every two years and derived from expert and objective OSIM* inspections. The condition score is based on NASVi** methodology and investment forecasts are based on good engineering practices.



Bridge - Burnhamthorpe over the Credit River

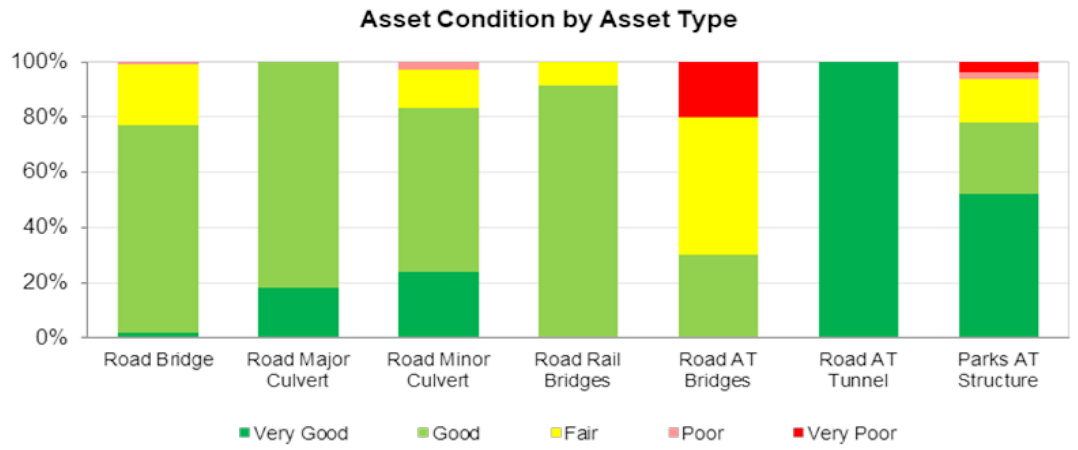


Figure 3 - State of the Infrastructure Dashboard (Structures)

BridgeTMS is the asset analysis system used to manage the City's bridge and culvert structures. Not only does the system contain detailed information about each of the City's bridge and culvert structures, it also contains detailed OSIM (Ontario Structural Inspection Manual) information collected every two years as required under *O. Reg. 472/10*. Similar to RoadMatrix, this system is primarily used to develop maintenance and long-range capital plans for the renewal of our structures. It too allows the City to forecast the future renewal and replacement activities needed to support its long-range capital plans.

CityWide is the City's Tangible Capital Asset (TCA) System. It is used to collect financial information about the City's tangible capital assets. The system was introduced in 2008 to capture infrastructure valuation information about the City's major asset types. The road pavements, bridge and culvert structures inventory information contained within each of these systems is comprehensive, reliable and reasonably accurate.

Each of these systems plays an integral role in supporting decision-making about City services and infrastructure. The information contained within this plan is supported by the information within each of these systems.

Asset Data Assumptions

The data and information illustrated within this chapter reflect 2019 year-end values. The road pavement condition data is based on the 2017 Pavement Condition Survey and modeled to reflect 2019 year-end values, while the bridge and culvert condition data for Roads-related structures is based on the 2019 Biennial Inspection/Condition Survey and the bridge and culvert condition data for Parks-related structures is based on the 2018 Inspection/Condition Survey.

Asset Condition: Road Pavements

The City collects condition and digital image information of its road pavements to populate RoadMatrix every four years. The most recent pavement condition survey took place in 2017, with the next survey planned for 2021. The City procures consulting services to collect the pavement condition data. The consultant typically uses a specialized vehicle called an Automated Road Analyzer (ARAN) to collect pavement surface distresses, defects, and ride quality information. Surface distresses and defects such as cracks and surface distortions are recorded, categorized, loaded into RoadMatrix, and computed into a Surface Distress Index (SDI), which reflects the surface condition of the entire pavement section. The pavement's ride quality, which is a measure of the roughness of the pavement, is collected using a laser profiler on the ARAN Vehicle. The collected data is loaded into RoadMatrix and a Ride Condition Index (RCI) value is computed.

The SDI and RCI are then used to calculate an overall Pavement Quality Index (PQI) that represents the overall condition of the entire pavement section. A PQI score of 100 would represent a perfectly constructed road with no surface distress and excellent ride quality. A score of 20 would represent a road that has been severely compromised and is no longer providing its intended level of service.

In order to standardize the condition scoring across different asset categories, condition and/or lifecycle information is compiled into a five-point grading system. Table 1 generally illustrates how the information is translated into the City's 1 to 5 rating scale. More detailed information on how the PQI data is converted into the 1 to 5 rating scale can be found in the Levels of Service section in Figure 6.

Table 1 - General Asset Condition Rating Scale

Rating	Rating Description	% of Remaining Useful life (RUL)	Rating Description
1	**Very Good:** Fit for the future	RUL ≥ 75%	The infrastructure in the system or network has greater than or equal to 75% of its remaining useful life. It is generally in very good condition, typically new or recently rehabilitated.
2	**Good:** Adequate for now	75% > RUL ≥ 35%	The infrastructure in the system or network has less than 75% (and greater than or equal to 35%) of its remaining service life. It is in good condition.
3	**Fair:** Requires attention	35 > RUL ≥ 13%	The infrastructure in the system or network has less than 35% (and greater than or equal to 13%) of its remaining service life. It is in fair condition.
4	**Poor:** Approaching End of Life	13% > RUL ≥ 3%	The infrastructure in the system or network has less than 13% (and greater than or equal to 3%) of its remaining service life. It is in poor condition and mostly below operable state, with many elements approaching the end of their service life.
5	**Very Poor:** Requires Renewal	RUL < 3%	The infrastructure in the system or network has less than 3% of its remaining service life. It is in very poor, unacceptable condition and should be replaced or rehabilitated.

Asset Condition: Structures

In accordance with *O. Reg. 472/10*, road-related bridges and large culverts are inspected every two years. The inspection and condition information is catalogued and verified using the methodology outlined in the Ontario Structural Inspection Manual (OSIM).

The OSIM inspections visually evaluate each component of the structure and classify their condition. These individual component condition scores are compiled into a Bridge Condition Index (BCI) score, which is an overall measure of the condition or health of the structure. A BCI score of 100 would represent a newly constructed structure, while a BCI score of 20 would represent a structure that requires significant rehabilitation or replacement. In addition to the visual inspection, completed OSIM inspections identify needs for repair and/or further detailed investigation of the structure to inform renewal requirements.

The City uses the Net Asset Salvage Value Index (NASVi) methodology to assess the overall performance of bridge and culvert structures instead of the traditional Bridge Condition Index (BCI) methodology. NASVi is a direct reflection of the dollar value of work anticipated as a percentage of the overall replacement value of the structure. It is quite common for BCI and NASVi results to present different perspectives. As an example, a structure may deteriorate over the next 20 years, lowering its BCI value; however, the type of deterioration will not necessarily demand rehabilitation. This is common with most culverts and rigid frame structures. They tend to deteriorate more slowly compared to other structures and, even when

they do, the types of deterioration are not necessarily significant, such as spalling and delamination on underside surfaces. It is important that the reader understand the difference between BCI and NASVi if trying to draw comparisons between the two methodologies. More detailed information on how the NASVi is converted into the 1 to 5 rating scale can be found in the Levels of Service section Figure 9.

Detailed Inventory, Valuation and Condition for Pavements and Structures

Summaries of the inventory, condition and replacement values for the City's core Roads Service Area assets are provided in Table 2 and Table 3, below. The inventory of the road pavement assets is stored and managed in RoadMatrix, the City's Road Pavement Management System (RPMS), while the inventory for structures is stored and managed in the City's Bridge Management System application, BridgeTMS. These systems are used specifically for asset analysis and forecasting long-range asset renewal plans.

The inventories in each system are cross-referenced against the City's Geographic Information System (GIS) data to ensure that the City has an accurate record of the assets that it owns. As new roads and structures are built, they are added to the City's systems annually. This includes adding these assets into the Infor system, which is used to manage service requests, work orders and permits issued throughout the City.

The replacement values for both road pavement and structure assets are derived from the City's Tangible Capital Asset (TCA) system, CityWide. It is important to note that the replacement values found in the City's TCA system will be different from the values found in the City's Business Plan and Budget. The main reason for this is that the TCA values are based on historic acquisition and construction costs, while the values contained in the City's Business Plan and Budget documents are based on forecasted unit values to replace the assets or their components.

Maintenance and renewal activities represent a significant investment in the City's infrastructure. Understanding the current condition or health of pavement sections and structures allows staff to select the correct rehabilitation treatment and prioritize the construction and maintenance program in a manner that optimizes the available funding.

Table 2 - Detailed Inventory, Condition and Replacement Values for Road Pavements and Structures

Service Area	Asset Class	Asset Type	Units	Inventory	Condition Distribution					Replacement Values ($000s)
					1	2	3	4	5	
Roads	Road Pavement	Arterial Road	Lane km	801	27.5%	20.8%	39.4%	12.3%	0%	$387,890
		Major Collector Road	Lane km	958	31.9%	15.4%	27.2%	24.7%	0.9%	$473,157
		Minor Collector Road	Lane km	1,056	30.6%	17.5%	26.8%	23.9%	1.2%	$544,193
		Local Road	Lane km	2,825	30.4%	22.4%	26%	20.6%	0.7%	$1,473,255

Service Area	Asset Class	Asset Type	Units	Inventory	Condition Distribution					Replacement Values ($000s)
					1	2	3	4	5	
Roads	Structures	Bridges	Each	105	2%	75%	22%	1%	0%	$521,798
		Culverts (Major)	Each	11	18%	82%	0%	0%	0%	$87,587
		Culverts (Minor)	Each	107	24%	59%	14%	3%	0%	$294,971
		Rail Structures	Each	12	0%	92%	8%	0%	0%	$29,482
		AT[2] Bridges	Each	10	0%	30%	50%	0%	20%	$12,712
		AT Tunnels	Each	1	100%	0%	0%	0%	0%	$1,556

Table 3 - Inventory and Valuation (Parks and Forestry Bridges)

Service Area	Asset Class	Asset Type	Units	Inventory	Condition Distribution					Replacement Values ($000s)
					1	2	3	4	5	
Parks	Structures	AT Bridges	Each	132	52%	26%	16%	2%	4%	$30,072

[2] Active Transportation (AT)

Age Summary

Road Pavement

A road pavement structure is typically comprised of granular sub-base materials, asphalt or concrete base materials, asphalt or concrete surface materials, and curbs. While each component deteriorates at a different rate, the City uses the pavement's overall condition rating and age as indicators to determine when maintenance, rehabilitation or reconstruction is required. Figure 4 shows the average age of the City's road surfaces and the average age the overall road pavement structure (by road classification) in comparison to the entire pavement structure's expected useful life. The expected useful life of the overall pavement structure was determined through an internal review and consultation process. The useful life values were derived from the lifecycle information contained within the City's pavement management system along with the professional judgement of the City's engineering, transportation infrastructure management, and maintenance staff that were involved in the review.

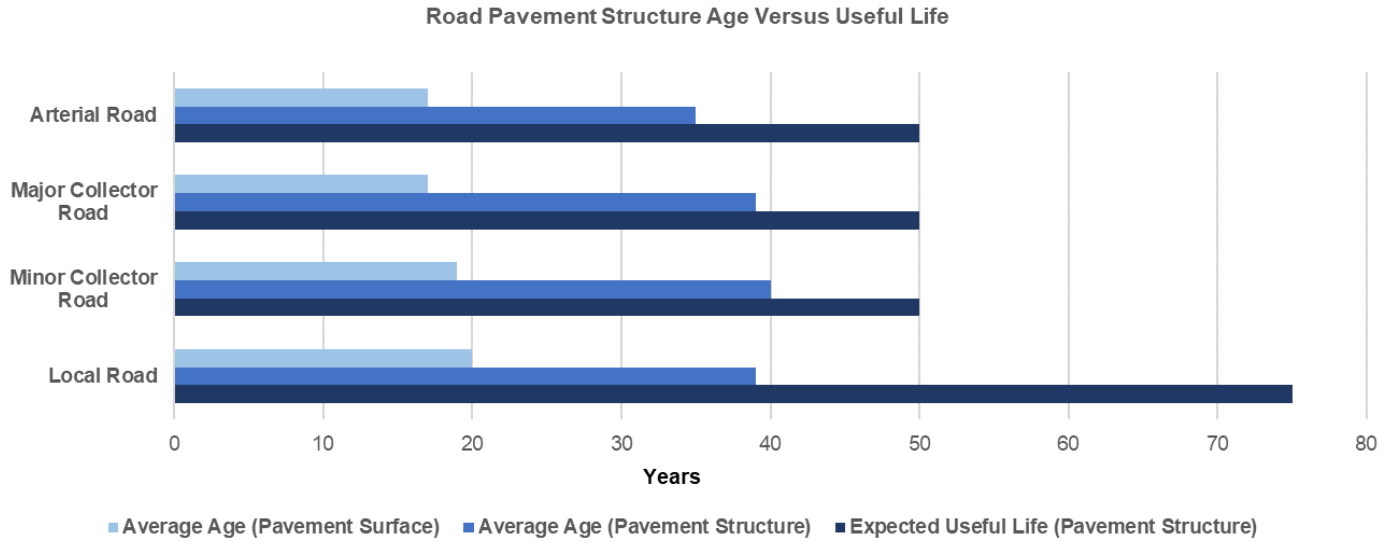


Figure 4 - Pavement Surface and Pavement Structure Age versus the Expected Useful Life of the Pavement Structure

The expected useful life of the overall pavement structure is dependent on the periodic renewal or replacement of the pavement surface and/or base courses of the pavement structure (typically asphalt) and the curb components as required. The useful life of pavement asphalt material ranges from 15 years for arterials, major collectors and minor collector roads to 25 years for local roads. Over the lifecycle of the pavement structure, the City expects to renew a portion of the asphalt and curb components at least twice before full

reconstruction of the entire pavement structure is required. When a road is identified for renewal, the City's engineering and technical staff will determine the extent of pavement, granular materials and curbs that are required to be replaced. With that said, the expected useful life of the entire pavement structure ranges from 50 years for arterial, major collector and minor collector roads to 75 years for local roads.

The graph in Figure 4 shows the average age of the road pavement structure in relationship to its expected useful life. The graph also shows the average age of the pavement surface.

The average age of the pavement surface takes into consideration the last time a major lifecycle event occurred on all of the roads in the network including the year that the road was first built and the last time it was resurfaced. While the overall pavement structure is aging, the road network appears to be much newer because the pavement surface is being replaced multiple times over the life of the overall pavement structure.

It is important to note that the longevity of a pavement structure will depend on a variety of factors, including construction methods, materials used, the local soil and climate conditions, water infiltration into the base and sub-base, and traffic loads and volumes.

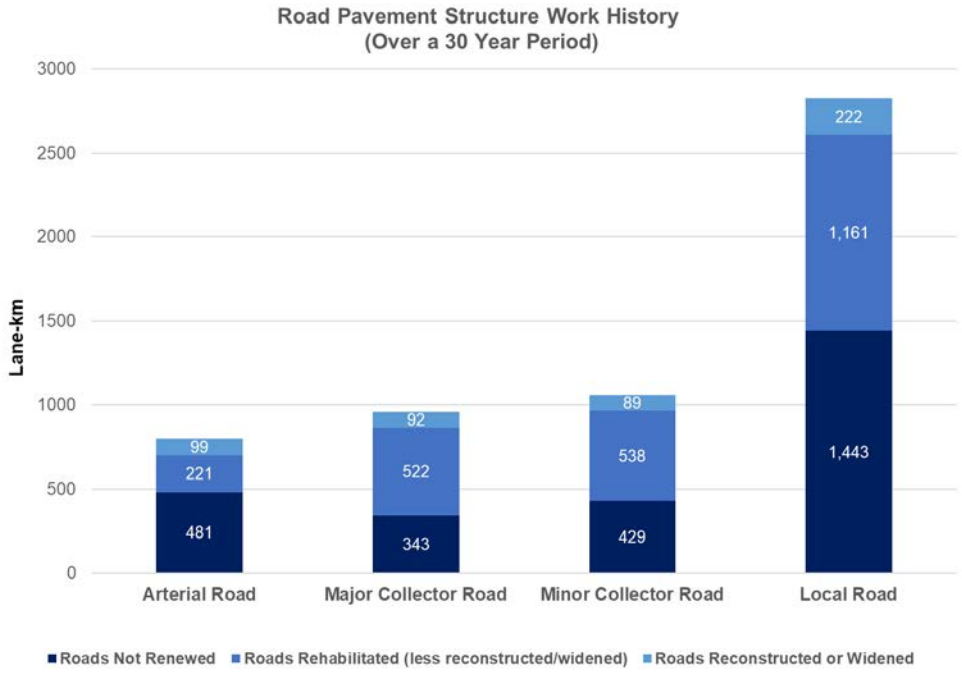


Figure 5 - Road Pavement Structure Work History (Over the last 30 years)

The City has had a formal pavement rehabilitation program since 1985. This program has enabled the City to maintain its road network in a state of good repair. The graph in Figure 5 provides a view into the extent of road pavements that have been renewed over the last 30 years. As the collector and arterial roads approach their expected end of life, one can theoretically expect to see the number of reconstruction activities increase. Transportation Infrastructure Management personnel monitor these trends and update lifecycle models within the RPMS accordingly.

Bridge and Culvert Structures

Bridge and culvert structures come in all shapes and sizes and can be constructed using a number of different materials like concrete, steel and even wood. They are also comprised of a variety of components that require periodic maintenance repair, replacement and rehabilitation. Depending on the type of structure, the components can include footings, retaining walls, parapet walls, abutments, piers, steel, wood or concrete beams, bearing seats, hand-rails, sidewalks, decks, drains, and expansion joints, just to name a few.

The expected useful life for structures varies between 50 and 100 years depending on the type of structure. The useful life values are derived from the lifecycle information contained within the City's bridge and culvert management system. The longevity of bridge and culvert structures will depend on a variety of factors including construction methodology, the materials used, the local climate and other environmental conditions like exposure to chlorides (salts), loads and frequency of use. Taking all factors into account, the expected useful life for the various types of structures is determined through review and consultation, employing the professional judgement of City engineering staff and a structural engineering consulting services retained by the City.

The graph in Figure 6 shows the average age for bridge and culvert structures in relationship to the expected useful life by structure type. The graph also shows the average number of years since the structures were last renewed. The average number of years since the structures were last renewed takes into consideration the last time a major lifecycle event occurred on all of the structures in the network including the year that the structure was first built and the last time it was rehabilitated or replaced. While all of the structures are aging, the bridge and culvert network appears to be much newer because the structures are being monitored regularly and timely maintenance and renewal activities are taking place.

Metrolinx over Hurontario Street Bridge

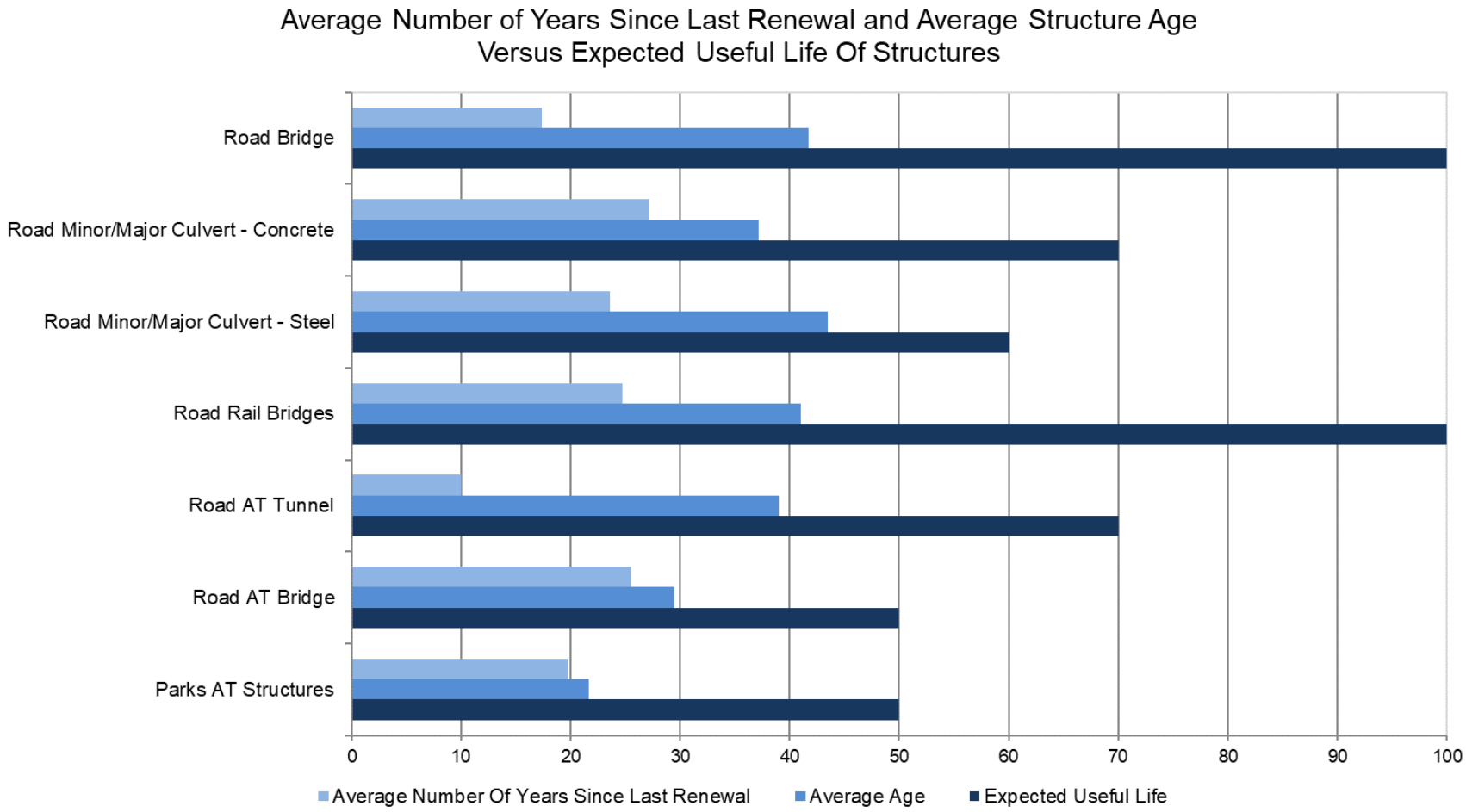


Figure 6 - Average Number of Years Since Last Renewal and Average Structure Age versus Average Useful Life of Structures

The chart in Figure 7 provides a view into the extent of structures that have been renewed or replaced over the last 30 years. Typically, structures are scheduled for renewal when they reach their mid-life and are replaced when they reach their end of life.

Transportation Infrastructure Management personnel monitor these trends and update lifecycle models and treatments accordingly.

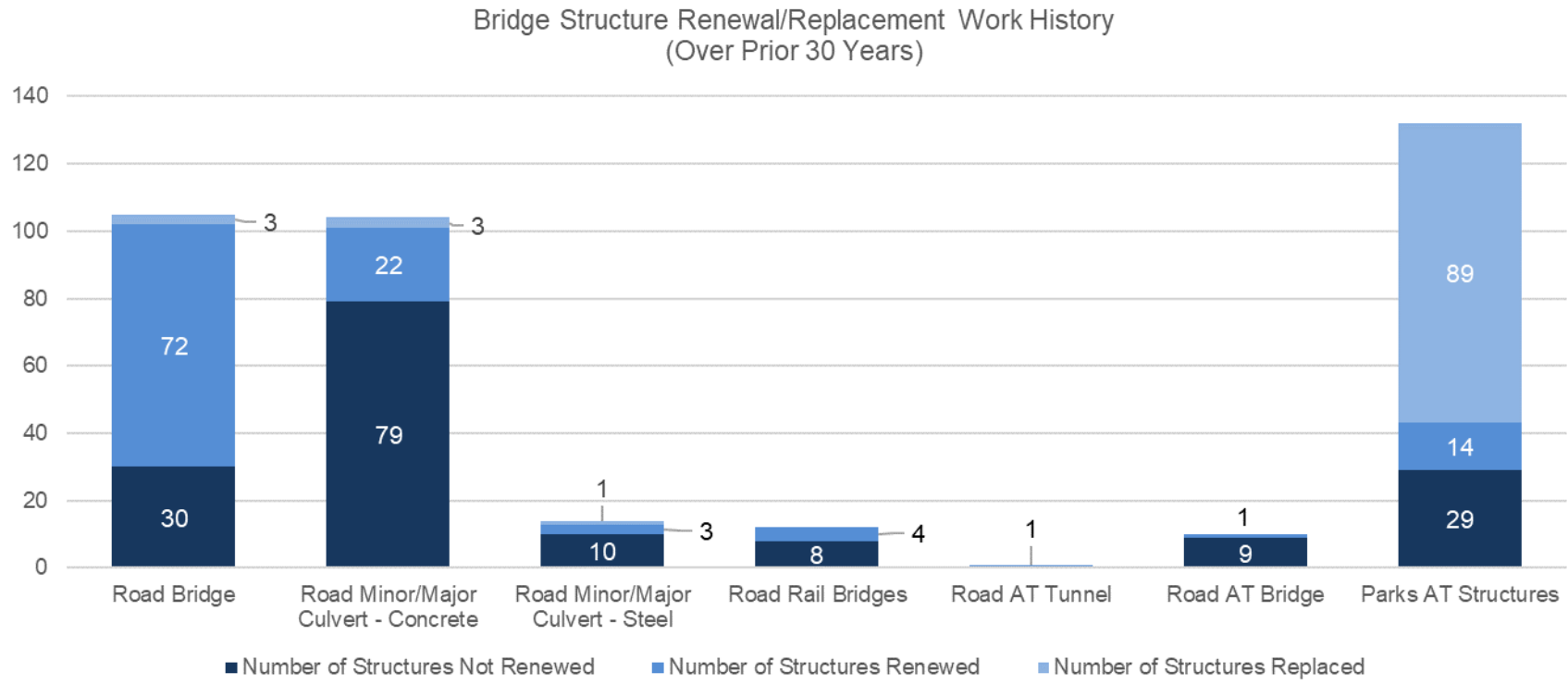


Figure 7 - Bridge and Culvert Structures Major Work History over the last 30 Years

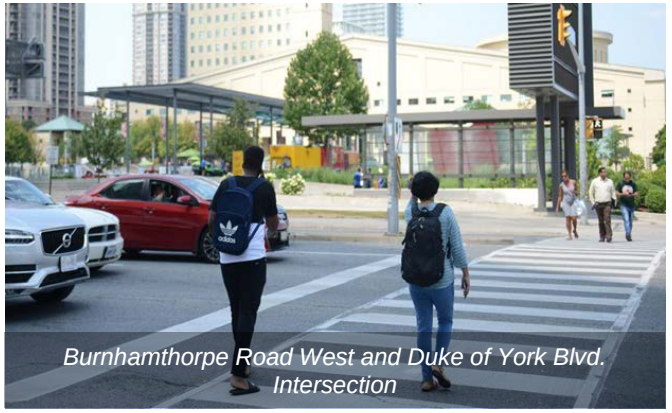
Asset Risk

Asset level risks are determined by assessing the asset's 'consequence of failure' (CoF) with the 'likelihood of failure' (LoF). While the loss of some assets or components may have little impact on service delivery and negligible risk of damage or injury, the loss of other assets such as roads and bridges will severely impact public services and may lead to private property damages or even fatalities. The criticality of an asset is therefore linked to the inherent consequence of the loss of its function, including related impacts on the function of a system or network of assets.

For the purposes of this asset management plan, the overall condition of an asset is used as a proxy for determining risk; in particular, its likelihood of failure. In subsequent updates to this asset management plan, a formal risk assessment tool will be developed to inform decision-making and prioritization for a variety of asset classes and their components.

The Roads Service Area addresses risk information related to road pavement and structures in a number ways, including:

- Professional judgement is used in decision-making throughout all lifecycle activities and takes into consideration aspects of criticality, such as disruption to users, public safety, financial impact, environmental impact, and reputation to the organization
- Road pavements are regularly inspected in accordance with Provincial Minimum Maintenance Standards (MMS) and critical defects are addressed in accordance with prescribed treatments and timelines
- Road pavement condition surveys are performed every four years to monitor the overall pavement performance. Information from the condition survey is fed into the City's RPMS to produce both capital and maintenance plans as well as to determine if a funding gap exists
- Traffic volume data and road classification are entered into the RPMS, along with pavement condition, to inform the priorities for road renewal
- Pavement sections that are at risk of cost escalation are assigned a higher weighting factor, as addressing these sections at the optimal time will minimize rehabilitation costs and maximize the useful life of the asset
- Staff retains structural engineering consulting services to assess the condition of City's bridge and culvert structures every two years, using the Ontario Structure Inspection Manual (OSIM) as a consistent guide, and to assess risks and to inform the priorities for rehabilitation in the Capital Plan
- The City's capital prioritization methodology includes an assessment of each project's importance by taking into consideration the risks associated with not undertaking the project should funding not be approved



Burnhamthorpe Road West and Duke of York Blvd. Intersection

Levels of Service

Regulatory Requirements

A requirement of *O. Reg. 588/17* is that the asset management plan shall include the current levels of service being provided by the asset, determined in accordance with the qualitative descriptions and technical metrics provided in Tables 4 and 5 of the Regulation (for roads and bridge & culvert structures, respectively). The provision of proposed levels of service is required in an update of the asset management plan by July 1, 2025.

The Regulation divides levels of service into two categories - community and technical - with guidance that service attributes "scope" and "quality" be provided for roads and bridge & culvert structures. Qualitative descriptions are required for community level of service attributes, while technical metrics are to be used to describe the attributes of the technical levels of service.

Community Levels of Service

For roads, the Regulation prescribes that the asset management plan include a description of the municipality's road network and its level of connectivity, which may include the use of maps, to establish the scope of the community level of service provided by the asset. In terms of quality of the asset from a community level of service perspective, the asset management plan shall include a description or images that illustrate the different levels of pavement condition.

For bridges & culverts, a description of the traffic that is supported by structures (e.g., heavy transport vehicles, motor vehicles, emergency vehicles, pedestrians, cyclists) is sufficient to establish the scope of the level of service provided to the community. In terms of quality from the community's perspective, descriptions or images of the condition of the assets are required, including how the condition would affect their use.

Technical Levels of Service

For roads, the number of lane km of each road class as a proportion of the total land area of the municipality is to be stated in the asset management plan to describe the scope of the technical level of service provided. In terms of quality, the average pavement condition index value shall be stated for the paved roads in the municipality, and the average surface condition (e.g., very good, good, fair or poor) for the municipality's unpaved roads.

For bridges & culverts, the asset management plan shall state the percentage of structures in the municipality with loading or dimensional restrictions to describe the scope of their technical levels of service. In terms of quality, the average bridge condition index values shall be stated.

Table 4 below includes an index of where the descriptions and technical metrics for the customer and technical levels of service for the road and bridge & culvert structure assets are provided in this asset management plan.

Table 4 - *O. Reg. 588/17* Requirements for Roads and Bridge & Culvert Structures

Customer LOS	Technical LOS
Roads	
Description, which may include maps, of the road network in the municipality and its level of connectivity. **(see Figure 10, Figure 11, Figure 12 and Figure 13)**	# of lane km of arterial roads as a proportion of square km of land area of the municipality. **(see Table 5)**
	# of lane km of collector roads as a proportion of square km of land area of the municipality. **(see Table 5)**
	# of lane km of local roads as a proportion of square km of land area of the municipality. **(see Table 5)**
Description or images that illustrate the different levels of road pavement condition. **(see Figure 8)**	Average surface condition (e.g., very good, good, fair or poor etc.) for paved roads. **(see Table 5)**
	Average surface condition (e.g., very good, good, fair or poor etc.) for unpaved roads. **(Not Applicable)**
Bridge & Culvert Structures	
Description of the traffic that is supported by municipal bridges (e.g., heavy transport vehicles, motor vehicles, emergency vehicles, pedestrians, cyclists). **(see Table 5)**	% of bridges in the municipality with loading or dimensional restrictions **(see Table 5)**
Description or images of the condition of bridges & culverts and how this would affect their use. **(see Figure 9)**	For bridges & culverts in the municipality, average bridge condition index value. **(see Table 5)**

Table 4 provides the basic metrics required by *O. Reg. 588/17*. They indicate that Service Areas have documented planned approaches for the operation and maintenance of infrastructure. The metrics include both the customer and technical levels of service and provide insight into the direction the metric is trending.

Advanced Levels of Service and Performance Metrics

Advanced metrics are listed in Table 6. These metrics go beyond those required by the Regulation.

Table 5 - Customer and Technical Levels of Service for Roads

LOS Attribute	Service Area LOS Objective	Customer LOS Measures			Technical LOS Measures		
		Performance Measure	Current Performance	Future Trend	Performance Measure	Current Performance	Future Trend
Scope	Provide a road network with a reasonable level of connectivity	**RW01**:Include description, which may include maps, of the road network in the municipality and its level of connectivity	Maps are included in Figure 10	Not Applicable	**RW02**: square km of arterial roads (Class 1 and 2) as a percentage of square km of total land area in Mississauga [3]	1.00%	
					RW03: square km of collector roads (Class 3 and 4) as a percentage of total land area in Mississauga	2.40%	
					RW04: square km of local roads (Class 5 and 6) as a percentage of total land area in Mississauga	3.40%	
					RW05: square km of roads (all classes) as a percentage of total land area in Mississauga	6.80%	
					RW06: Lane km of roads identified within the 2041 forecast that require capacity improvements	111 Lane km and Map Showing DC forecast Figure 12	
		RW07: % of residents satisfied with the road service (Citizen Satisfaction Survey)	69%	Not Applicable	Not Applicable		
	Provide a structures network with a reasonable level of connectivity	**BC01**: Include description, which may include maps, of the structures network in the municipality and its level of connectivity	Maps are included in Figure 12		**BC02**: % of bridges/culverts in the municipality that meet loading and dimensional restrictions for traffic (clearance height, load capacity, vehicular capacity)	97%	
	Provide a trail-related bridge network with a reasonable level of connectivity	**BC03**: Description of the traffic that is supported by municipal bridges (e.g., heavy transport vehicles, emergency vehicles, pedestrians, cyclists).	The City road bridges and AT bridges have been designed in accordance with the standards and requirements of the Bridge Design Code at the time of construction. The bridges have been designed to carry heavy transport vehicles, motor vehicles, emergency vehicles, pedestrians, and cyclists.		**BC04**: % of trail bridges in the municipality that meet loading or dimensional restrictions	99%	
Quality	Provide a road network that is operationally safe for drivers, pedestrians and cyclists.	**RW08**: Include description or images that illustrate the different levels of road pavement conditions	Images are included in Figure 8 and Figure 11		**RW09**: Average road network surface condition measured as a function of Pavement Quality Index (PQI) for paved roads	68 PQI (Fair)	
	Provide a structures network that is operationally safe for drivers, pedestrians and cyclists.	**BC05**: Include description or images of the condition of bridges and how this would affect use of the bridges.	Images are included in Figure 9 and Figure 12		**BC06**: For road related bridges/culverts in the municipality, average bridge condition index value	84	
		BC07: Include description or images of the condition of culverts and how this would affect use of the culverts	Images are included in Figure 9 and Figure 12		**BC08**: For trail related bridges in the municipality, average bridge condition index value	83	

[3] Square km of land area in Mississauga: 292.2

Table 6 - Advanced Customer and Technical Levels of Service for Roads

LOS Attribute	Service Area LOS Objective	Customer LOS Measures			Technical LOS Measures		
		Performance Measure	Current Performance	Future Trend	Performance Measure	Current Performance	Future Trend
Operational	Providing a road network that is operationally safe for drivers	**RW10**: % of paved lane km where the condition is rated fair or better	79%		**RW11**: % of Arterial road network that is greater than the 50-PQI condition required to trigger renewal	91%	
					RW12: % of Major and Minor Collector road network that is greater than the 50-PQI condition required to trigger renewal	79%	
					RW13: % of Local road network that is greater than the 40-PQI condition required to trigger renewal	92%	
					RW14: % of winter events in compliance with Minimum Maintenance Standards for Winter Operations	100%	
	Provide pedestrian/vehicular traffic control, appropriate lighting, signage and pavement markings for the safe and effective mobility needs of the public in a cost effective manner	**SL01**: % of streetlights that are functioning and operating in hours of darkness	95%		**SL02**: % of streetlight poles in fair or better condition	98%	
		SL03: Service response time to repair a streetlight where three or less adjoining luminaires are malfunctioning along one or both sides of any roadway	1 to 10 days		Not Applicable		
		TS01: % of traffic signals that are functioning	100%		**TS02**: % of traffic signals repairs that meet municipal road maintenance timeline standards	100%	
					TS03: % of signalized intersections that are in fair or better condition	100%	
					TS04: % of traffic controller cabinets that are in fair or better condition	79%	
	Providing an operational cycling network that is safe for users	**AT01**: % of Parks AT trail related structures rated as fair or better condition	94%		**AT03**: % of structures in compliance with OSIM Standards	100%	
		AT02: % AT structures over road ways where the condition is rated as fair or better condition	80%				
Environmental	Environmental impacts are considered within the operations and maintenance programs	**RW15**: % of City's roads swept at least once per year	100%		**RW16**: % of City's roads swept at least once per year	100%	
Efficiency and Environmental Stewardship	Provide an energy efficient road network	**TS05**: % of traffic signals that are energy efficient LED lighting	100%		**TS06**: % of traffic signals that are energy-efficient LED lighting	100%	
		SL04: % of annual reduction in Greenhouse Gas (GHG) emissions from streetlights	65%		**SL05**: Annual reduction in Greenhouse Gas (GHG) emissions (Tonne CO_2 eq.) from streetlights	772	
Accessibility	Provide an adequate/accessible road network and adequate pedestrian access	**AT04**: % of intersections that are equipped with Accessible Pedestrian Signals (APS) pushbuttons	16%		Not Applicable		

Figures 8 to 13 represent the Customer and Technical Levels of Service described in Tables 4 to 6.

1 to 5 Condition Rating Scale	Condition	Rating Definition	Industry Standard Pavement Quality Index (PQI) Rating
1	Very Good	 Asset is in very good condition or better. It is new or recently rehabilitated. Asset is well maintained. Asset has a remaining service life (RSL) that exceeds 15 to 20 years. Asset is fit for future use.	80-100 PQI
2	Good	 Asset is in good condition. Asset may have received repair or maintenance work. Asset is generally approaching mid-stage of expected service life. Asset has a remaining service life (RSL) 10 to 15 years.	70-79 PQI

Figure 8 - Description or Images that illustrate the different Levels of Road Pavement Condition

1 to 5 Condition Rating Scale	Condition	Rating Definition	Industry Standard Pavement Quality Index (PQI) Rating
3	Fair	 Asset is in fair or adequate condition. Asset shows signs of deterioration with some elements showing defects. Asset requires attention. Asset has a remaining service life (RSL) of 5 to 10 years.	55-69 PQI
4	Poor	 Asset is in poor condition and is at risk of affecting service. Large portion of the asset system exhibits significant deterioration and the condition is below standard. Asset is approaching end of service life. Asset has a remaining service life (RSL) of 1 to 5 years. Asset is not fit for future use.	20-54 PQI

Figure 8 (Continued) - Description or Images that illustrate the different Levels of Road Pavement Condition

1 to 5 Condition Rating Scale	Condition	Rating Definition	Industry Standard Pavement Quality Index (PQI) Rating
5	Very Poor	 Asset is in very poor condition and is in major risk of affecting service. Large portion of the asset system exhibits significant deterioration and the condition is below standard. Asset is approaching end of service life. Asset has a remaining service life (RSL) of 1 to 2 years. Asset is not fit for use.	0-19 PQI

Figure 8 (Continued) - Description or Images that illustrate the different Levels of Road Pavement Condition

1 to 5 Rating Scale	Condition	Rating Definition		Net Asset Salvage Value Index (NASVi)
		Road Structures	AT Structures	
1	Very Good	 		90-100
		The asset is typically new or recently rehabilitated.		
2	Good	 		80-89
		The asset is in good condition. Some elements show general signs of deterioration that may require attention. A few elements exhibit minor deficiencies.		
3	Fair	 		40-79
		The asset shows further signs of deterioration and requires attention. Some elements exhibit moderate deficiencies. Asset is in acceptable condition and components are generally functioning as intended.		

Figure 9 - Description or images of the Structural Condition of Bridges/Culverts

1 to 5 Rating Scale	Condition	Rating Definition		Net Asset Salvage Value Index (NASVi)
		Road Structures	AT Structures	
4	Poor	  The asset is approaching low standards. Many elements are approaching the end of their service life. A large portion of the elements exhibit significant deterioration.		20-39
5	Very Poor	  The asset is an unacceptable condition with widespread signs of advanced deterioration.		0-19

Figure 9 (Continued) - Description or images of the Structural Condition of Bridges/Culverts

The maps provided in Figure 10 through 13 illustrate the City's road network classification, pavement condition, the condition of the City's structures, and future road and bridge improvement projects, respectively.

Figure 10 illustrates the City's current road network, its connectivity, and its distribution of arterial, collector and local roads. The road network will change over time as new roads and communities are built.

Figure 11 illustrates the City's current road pavement conditions. Pavement condition information is temporal. The overall condition of pavement will change over time as it degrades and as lifecycle activities are performed. Pavement condition information is collected every four years.

Figure 12 illustrates the current condition of the City's bridge and culvert structures. Similar to road pavements, structure condition information is also temporal. The overall condition of structures will also change over time as the structures age and as lifecycle activities are performed. Structure condition information is collected every two years during OSIM inspections.

Figure 13 illustrates the future road and structures improvement projects identified within the City's Capital Budget and Business Plan.

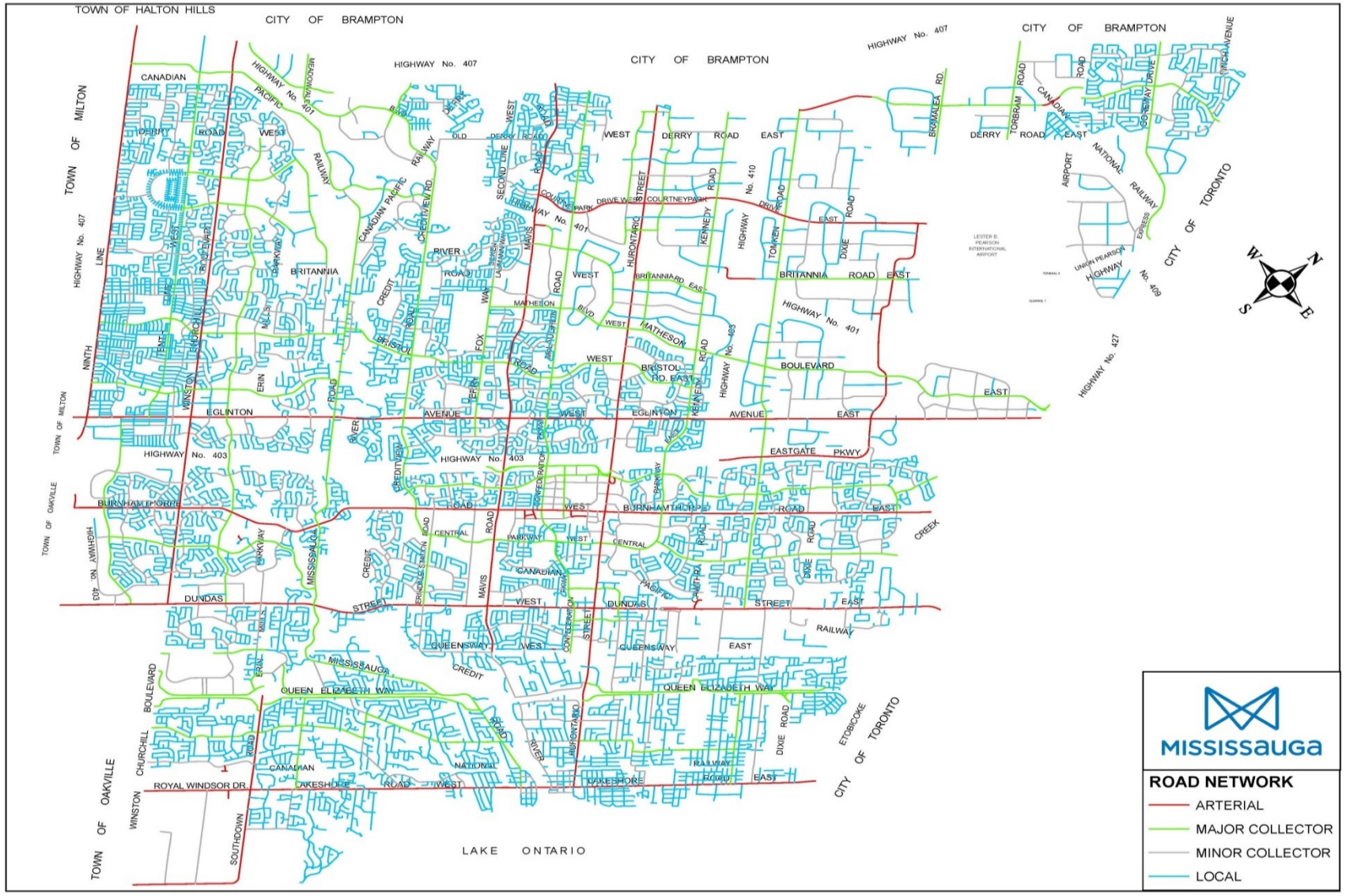


Figure 10 - Mississauga's Road network, Its Level of Connectivity and Road Classification Distribution

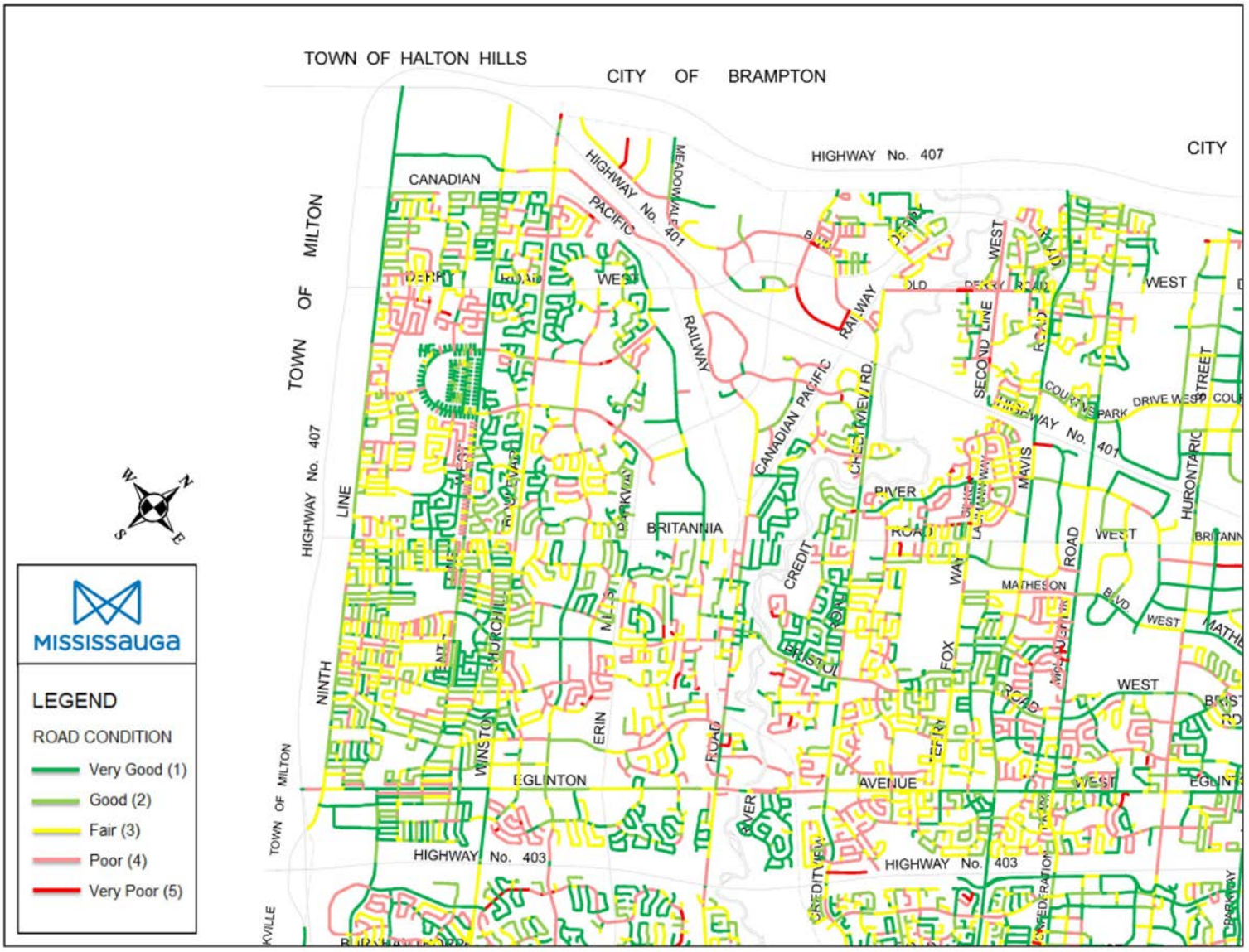


Figure 11 - Mississauga's Current Road Pavement Conditions (North West Quadrant)

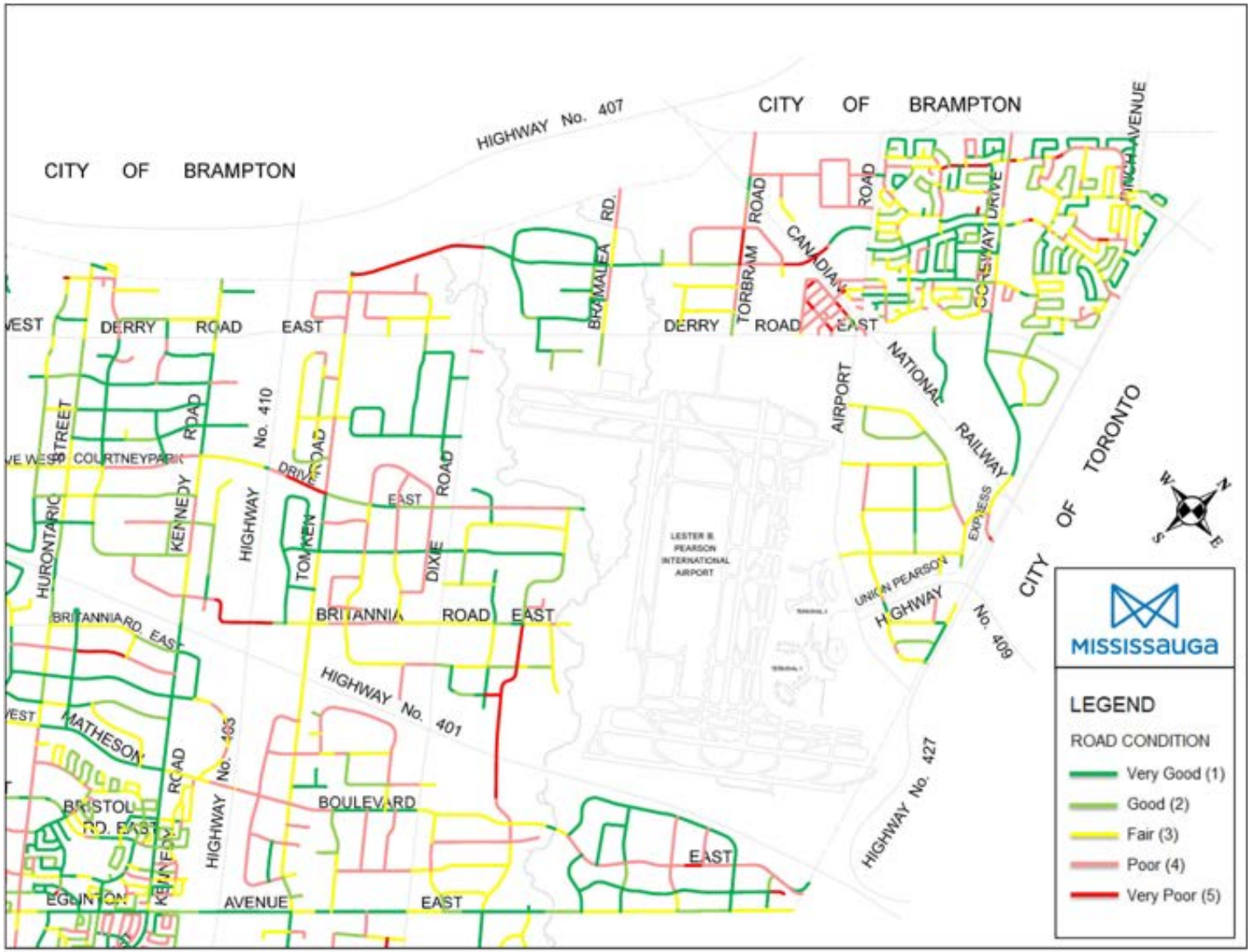


Figure 11 (Continued) - Mississauga's Current Road Pavement Conditions (North East Quadrant)

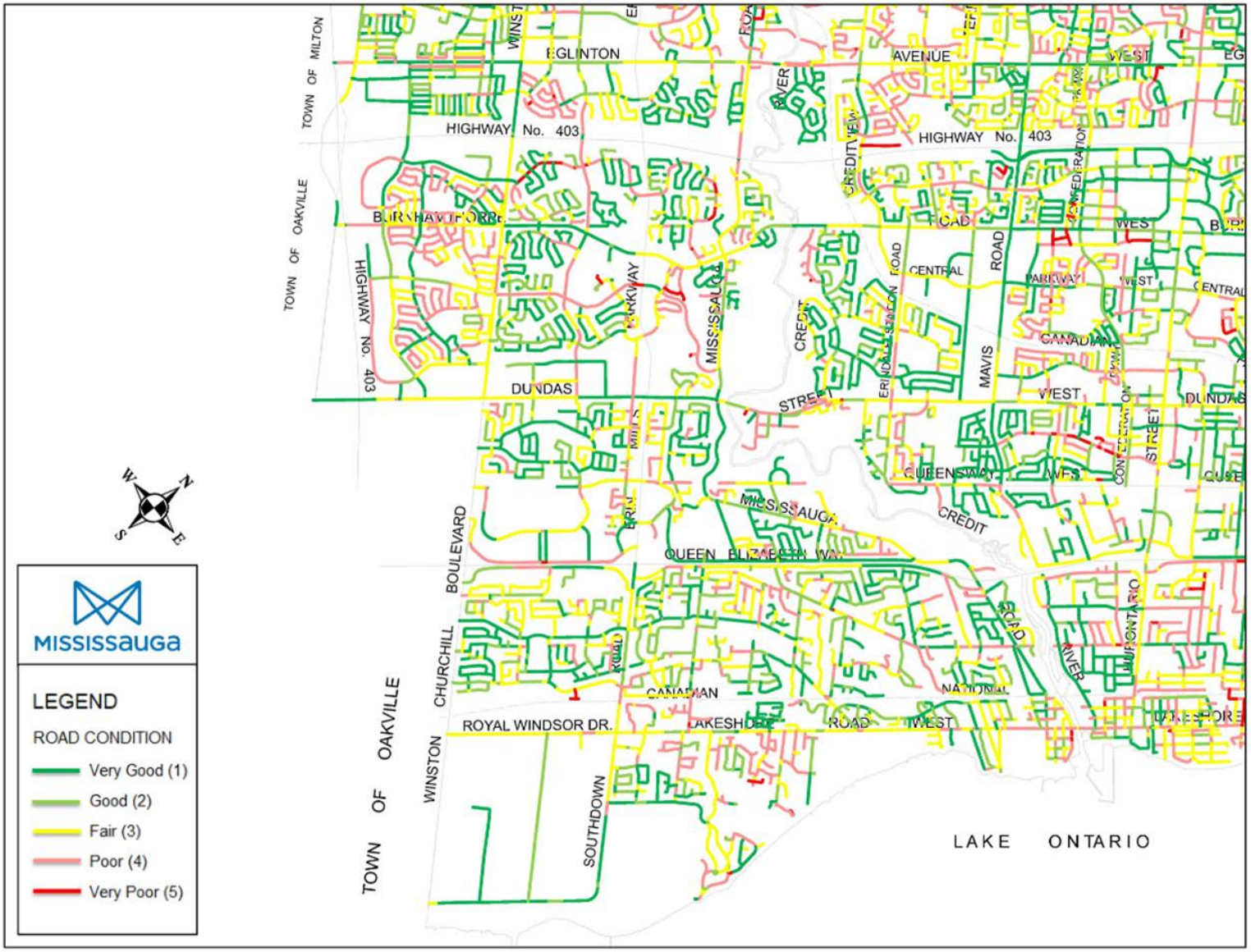


Figure 11 (Continued) - Mississauga's Current Road Pavement Conditions (South West Quadrant)

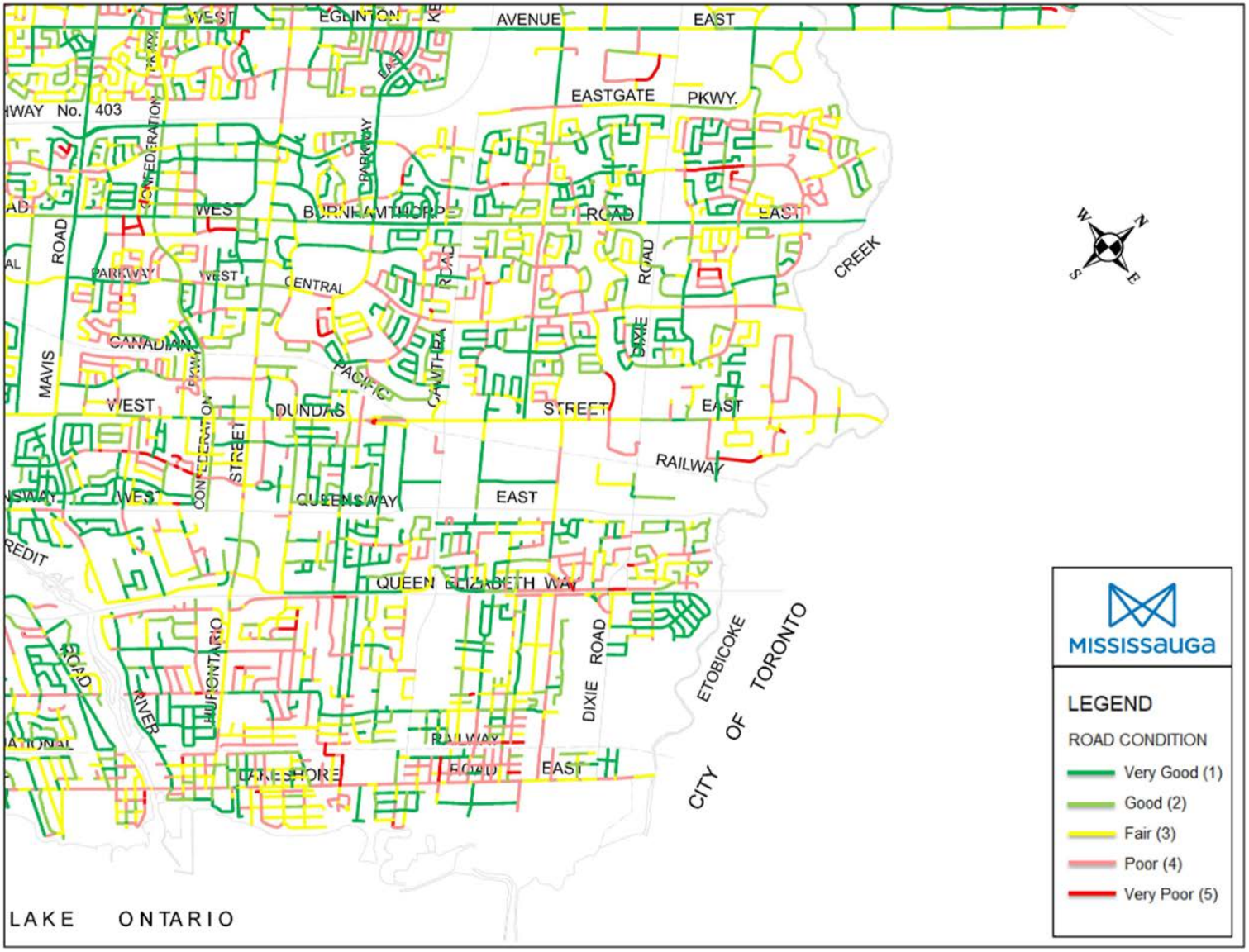


Figure 11 (Continued) - Mississauga's Road Pavement Conditions (South East Quadrant)

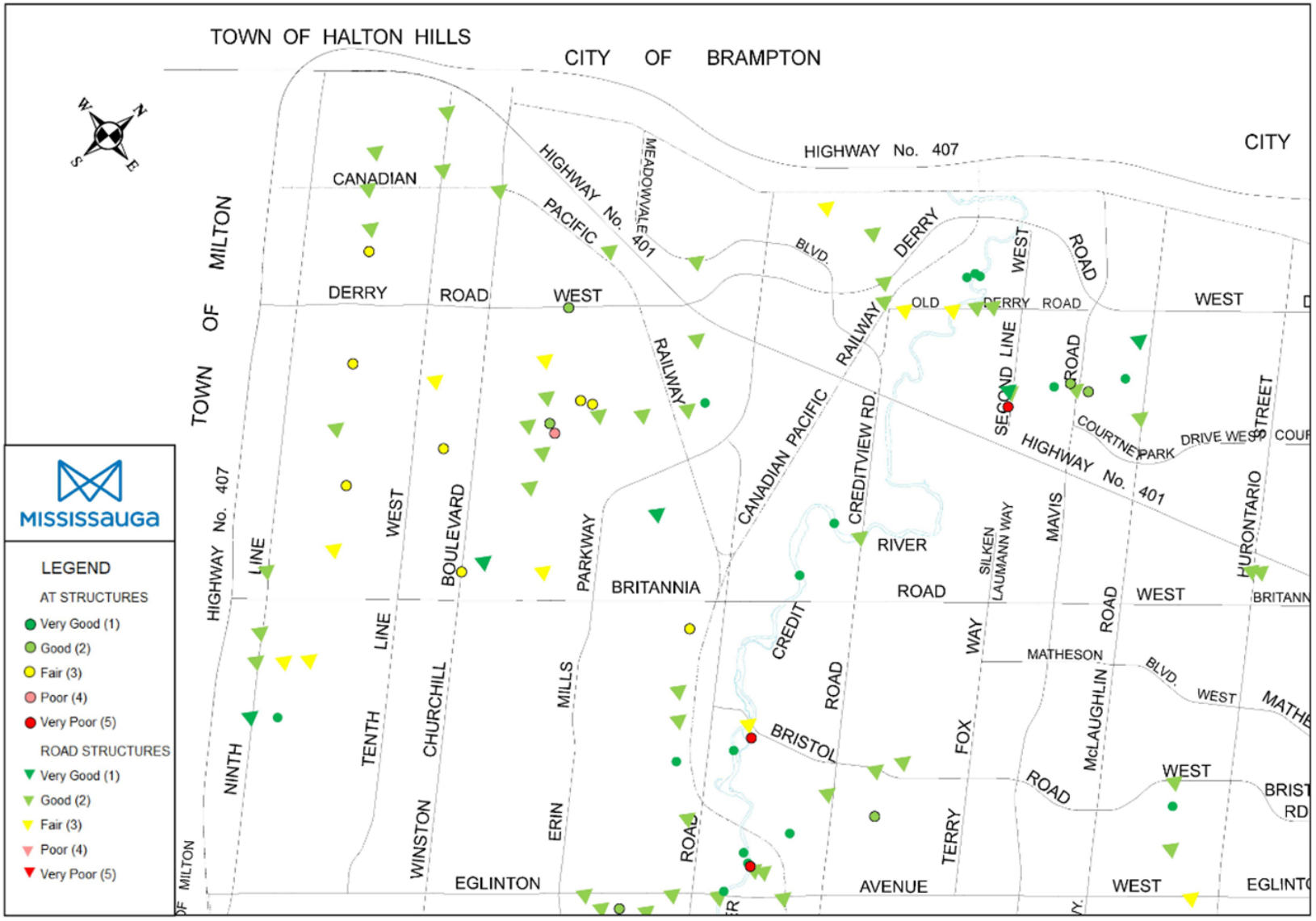


Figure 12 - Mississauga's Current Bridge and Culvert Structure Conditions (North West Quadrant)

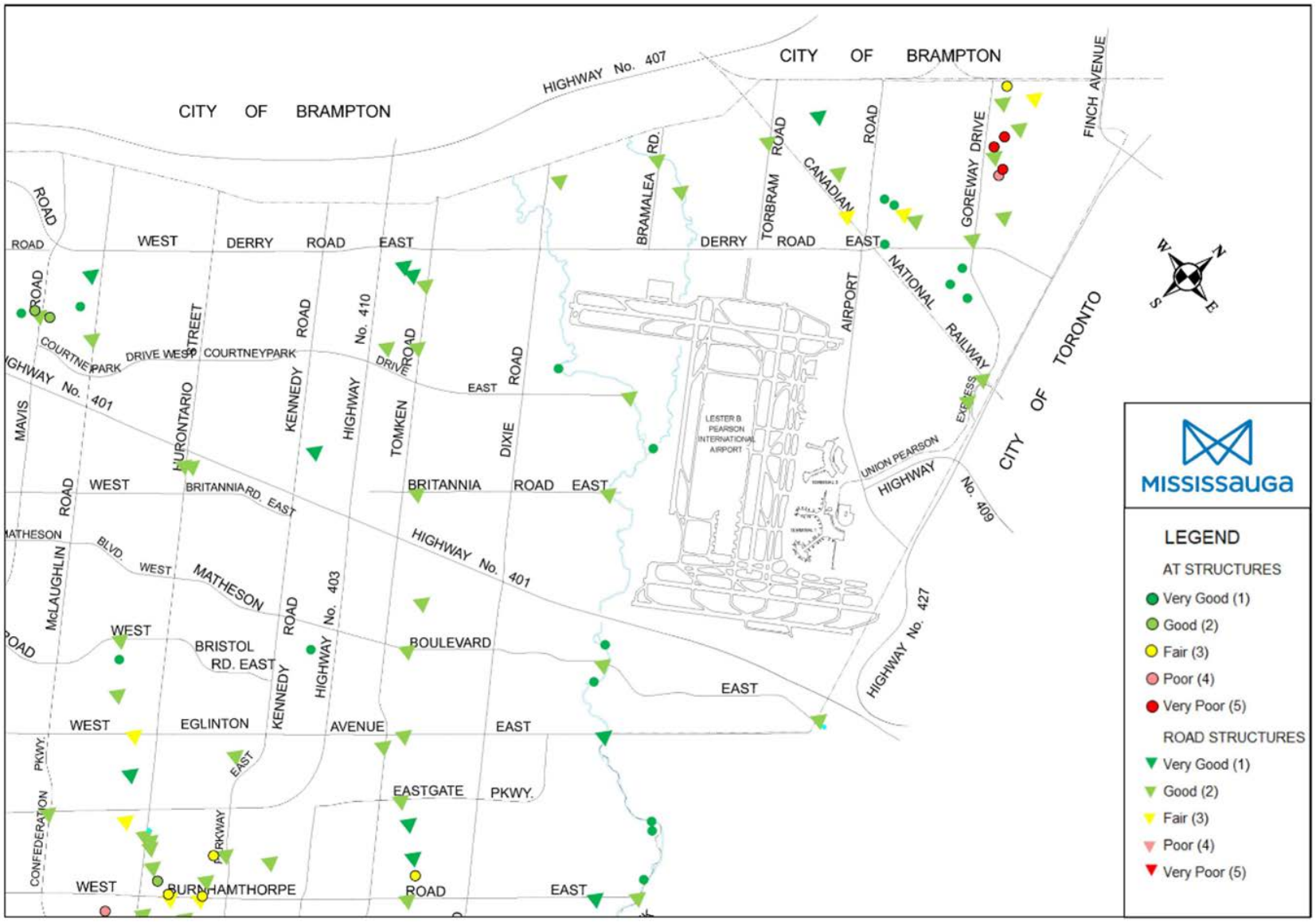


Figure 12 (Continued) - Mississauga's Current Bridge and Culvert Structure Conditions (North East Quadrant)

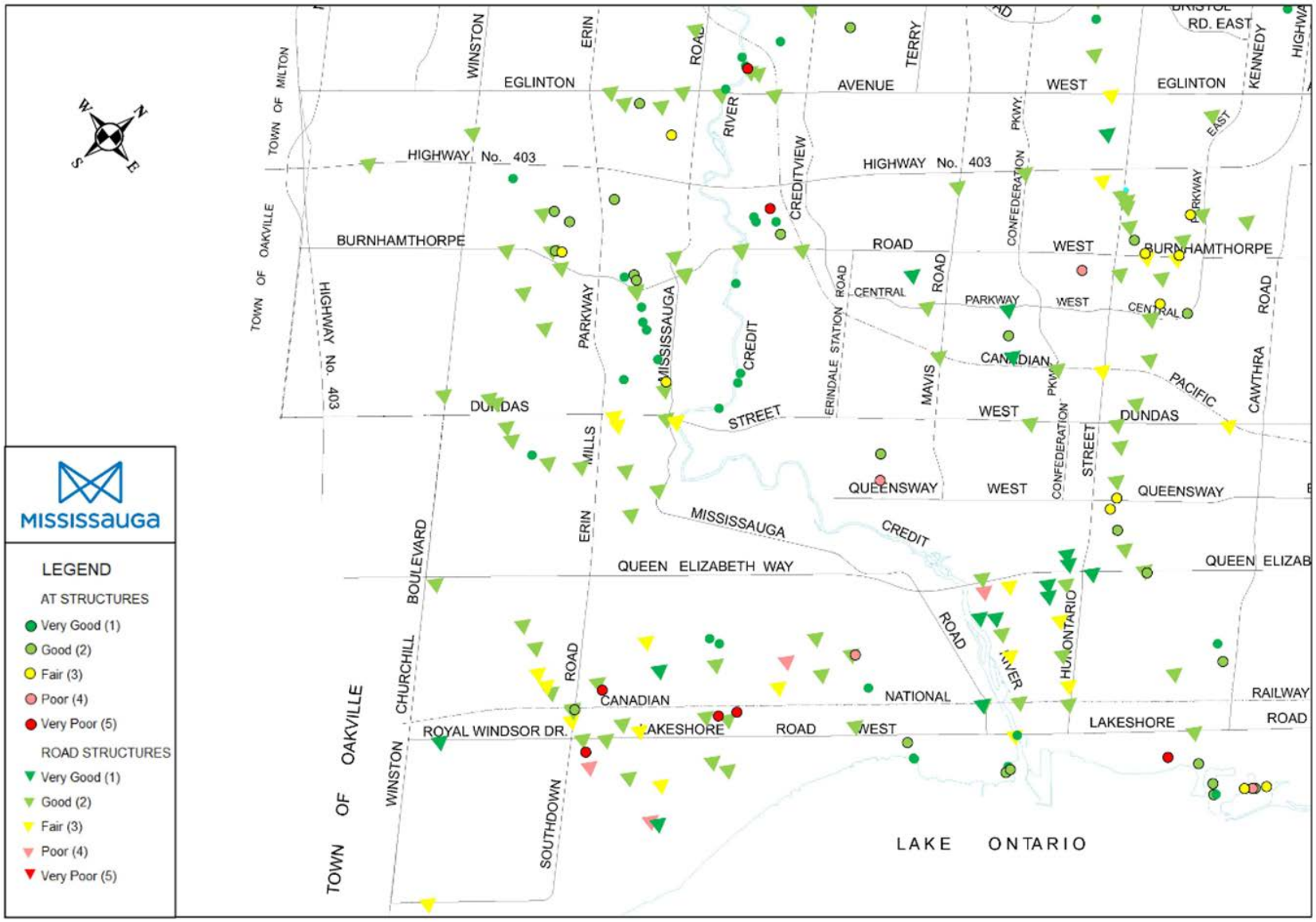


Figure 12 (Continued) - Mississauga's Current Bridge and Culvert Structure Conditions (South West Quadrant)

Figure 12 (Continued) - Mississauga's Current Bridge and Culvert Structure Conditions (South East Quadrant)

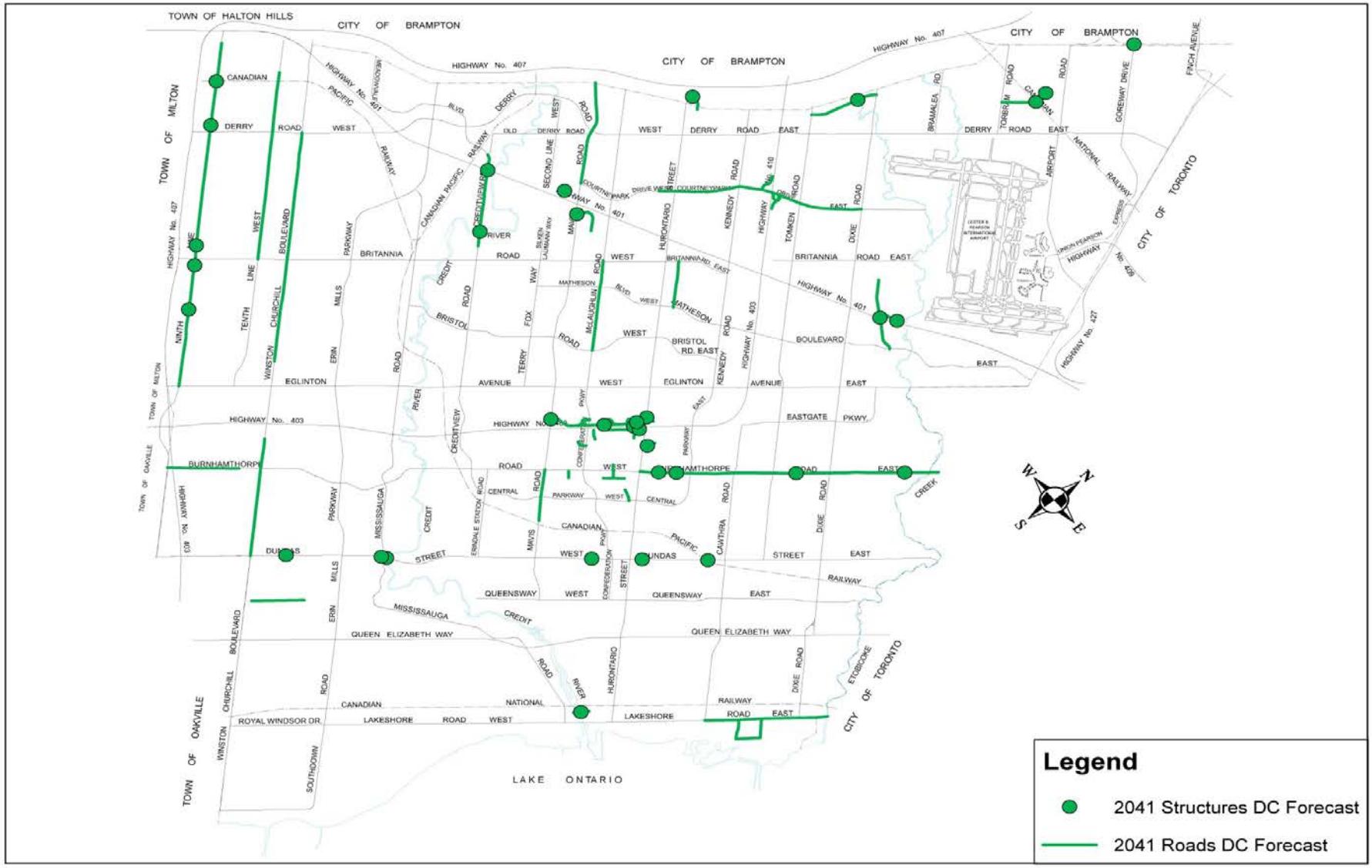
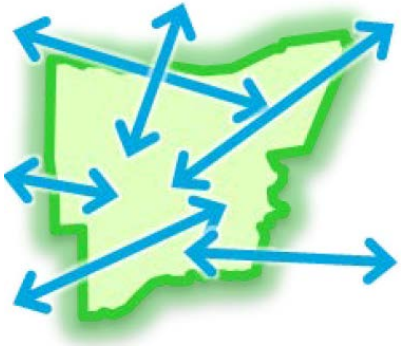


Figure 13 - Planned Improvements to Roads and Bridge & Culvert Structures (based on *2019 Development Charges Background Study*)

Future Demand

Mississauga continues to mature as a city. Aging infrastructure and the need to balance service levels with affordability pose significant pressures and challenges for the Roads Service Area.

The safety of all the City's road users and traffic congestion remain high on the public agenda. Growth within Mississauga and surrounding municipalities continues to put additional pressure on the City's roads and bridges infrastructure.



Mississaugans make 420,200 trips per day across the city boundary; people living outside Mississauga make 670,000 trips per day to and from the city

Vision Zero and the Transportation Master Plan

Adopted by Mississauga in 2018, Vision Zero is a strategy to eliminate all traffic-related serious and fatal injuries. The strategy prioritizes the safety and access of our most vulnerable road users.

The City completed a comprehensive Transportation Master Plan (TMP) in 2019 to guide the planning for Mississauga's transportation networks over the next 25 years. The TMP developed a vision for the future of mobility in Mississauga and established an overarching policy framework and action plan to guide investment in transportation infrastructure and services. The City looks for new ways to enhance its infrastructure to provide people with more options for modes of travel to, from, around and through Mississauga such that past investments continue to serve present needs well into the future.

The TMP complements the City's Vision Zero strategy and outlines a variety of road safety objectives, including:

- Ensuring that roads, sidewalks, and trails are designed to prioritize the safety of pedestrians, cyclists, and other vulnerable travellers
- Ensuring that speeds are well-matched with the types of activity happening in the roadway and along the street
- Ensuring that people feel safe and secure when travelling in Mississauga by any transportation mode

Demand Drivers

Drivers affecting demand on the City's roads and bridges infrastructure include population growth; development patterns leading to denser, more compact neighbourhoods; changes in demographics; climate change; decreasing vehicle ownership rates; increasing use of transit and other mobility options; consumer preferences and expectations; technological changes; economic factors; environmental awareness; and regulatory changes.

Demand Forecasts

The current position and projections for demand drivers that may impact future service delivery and use of assets are routinely assessed by the City through transportation planning exercises, including Development Charges Background Study, Corridor Transportation Study, and other initiatives.

Demand Impact and Demand Management Plan

The impacts of demand drivers that may affect future service delivery and use of assets are described in Table 7 below. Demand for new

services will be met through a combination of managing existing assets, upgrading existing assets, providing new assets, and transportation demand management (TDM). The City's ***TDM Strategy and Implementation Plan (2018)*** contains practices to manage the demand for the use of single occupancy vehicles, including outreach, education, incentive programs, and other non-asset solutions. Opportunities identified to date for demand management are shown in Table 7. Further opportunities will be developed in future revisions of this asset management plan.

Table 7 - Demand Management Plan for Roads and Bridge & Culvert Structures

Demand Driver	Current Position	Projection	Impact on Services	Demand Management Plan
Road users looking for safe roads that eliminate fatal and serious injury collisions	Vision Zero was adopted by Mississauga in 2018. The TMP (2019) identified key recommendations to reduce fatal and serious injury collisions as part of a Vision Zero program	To achieve no collisions that cause death or serious injury	Ensuring that people feel safe and secure when travelling in Mississauga by any transportation mode Shifting the prioritization of vulnerable road users like pedestrians and cyclists over level of service for vehicular traffic	Incorporate the 5 Es of road safety into all lifecycle-planning activities to achieve Vision Zero. The five Es are: 1. Engineering 2. Evaluation 3. Education 4. Empathy 5. Enforcement
Population growth and development intensification throughout the City triggering increased road use and traffic congestion	Mississauga is a popular destination for employment, business and services. The average daily vehicle usage of the arterial & major collector road network currently sits at 5,471 vehicles per lane. This is based on the 10-year historical daily average of vehicles per lane	The average daily traffic volume is expected to reach 6,160 vehicles per lane by 2041	With limited capacity to continue to widen roads and improve roadway bridges in the City, traffic congestion will continue to increase	Introduce, encourage and implement other modes of transportation such as use of higher-order transit, high-occupancy vehicle lanes, ride share, cycling and walking Complete the planned road widenings, grade separations and intersection improvements identified in the *2019 Development Charges Transportation Background Study*
Shifts in modes of transportation	Shifting from a vehicle-oriented right of way to a multi-modal and complete street environment	Increase in cycling and public transportation activity	Need for higher-order transit (BRT and LRT) high-occupancy vehicle lanes and additional cycling and pedestrian infrastructures	Incorporate pedestrian, cycling and transit improvements into major road and bridge construction projects
Increase in commuters and traffic from outside the City	Mississauga is a popular destination for employment, business and services from commuters from outside the City	Commuters will continue to come to the City from nearby municipalities	Need to manage traffic during peak periods and offer options for various modes of transportation	Advocating for regional transit connections, improving transit service and active transportation infrastructure

Demand Driver	Current Position	Projection	Impact on Services	Demand Management Plan
Growing infrastructure needs across the municipalities in the Greater Toronto & Hamilton Area and limited supply of available contractors are driving increased project delivery costs	Construction costs to deliver road-related projects have been increasing at rates significantly higher than the rate of inflation	Project delivery costs are expected to go up by 10% to 15% annually based on recent trends Maintenance and operating costs expected to increase by 5% annually	Reduced number of road-related capital projects that can be funded and delivered annually as cost increases exceed budget increases Reduced number and volume of maintenance initiatives that can be funded and completed annually if budget increases do not keep pace with cost increases	Tender road capital renewal and maintenance contracts early in the year to seek more competive bids
More frequent and extreme rainfall events leading to flooding of roads and the overtopping of bridges and culverts spanning creeks and rivers	When an extreme rainfall event is forecasted, the City's incident manage centre is activated. Work crews are dispatched to inlet and outfall locations to remove debris and blockages. During the event, work crews are dispatched to flood prone areas	The frequency of extreme rainfall events is expected to increase with climate change, which is expected to negatively impact the lifecycles of roads and bridges	Increases in rainfall leading to flooding will interrupt road service and increase the need for demand maintenance In addition to traffic and pedestrian considerations, the design of structures will also need to take into consideration increases in storm water conveyance	Work with the Stormwater Service Area to develop a method of identifying flood-prone areas along road segments that do not meet minimum stormwater design requirements and align storm sewer upgrade projects with road renewal activities Identify bridges and culverts in need of increased hydraulic capacity and creek erosion protection that can be addressed during structure rehabilitation and replacement Adjust maintenance and operating budgets accordingly for road and bridge repairs
Increased risk of long-duration freezing rain events leading to ice storms	When a freezing rain event or ice storm is forecasted, the City activates the incident management centre and the winter response team. Work crews are dispatched to monitor roadways, apply salt accordingly and look for and respond to	The frequency of freezing rain events lasting six hours or more for the typically coldest months could increase in southwestern and south-central Ontario by 40% by the 2050s	An increase in long-duration freezing rain events will disrupt road service and increase the need for demand maintenance on roadside assets. An increase in freezing rain events will draw limited resources away from	Monitor freezing rain activities and adjust maintenance and operating plans and budget accordingly for road repairs and service restoration

Demand Driver	Current Position	Projection	Impact on Services	Demand Management Plan
	fallen tree limbs or other infrastructure assets that have disrupted road services		planned maintenance activities and disrupt road service	Adjust the incident response plan as needed
Changing winter temperatures leading to increasing number of freeze-thaw cycles per winter season	Freeze-thaw cycles lead to increased demand for pothole repairs and crack-sealing efforts. For structure, freeze-thaw events can cause concrete spalling and damage to deck joints, necessitating increased maintenance activities. Heavy rains during rapid thaw cycles can result in flooding due to blocked storm inlets. Work crews are dispatched to clear debris and blockages from inlets and outlets and to minimize the risk of service disruptions.	The number of freeze-thaw cycles has been forecasted to decrease over time due to the effects of climate change (source: Climate Atlas of Canada)	The number of freeze-thaw cycles may fluctuate from one year to the next, and either increase or decrease the need for demand maintenance activities for pothole repairs, crack sealing, and/or other minor asphalt and concrete repairs during a given year. Based on climate modeling predictions, damages and maintenance requirements due to freeze-thaw cycles are expected to decrease over time	Continue to employ best practices for pavement drainage design and timely sealing of surface cracks, potholes and other defects that can promote water seepage into the pavement or concrete Monitor changes to freeze/thaw events, and adjust maintenance and operating programs and budget accordingly
Increased frequency of high winds (i.e., gusts of 70 km/h or greater) including tornadoes, microbursts, etc.	When high-wind events are expected, the incident management centre is activated and work crews are dispatched to patrol, and to monitor and correct damages affecting road service Aside from routine bridge and culvert inspections, the City does not have a plan to monitor the impact of high-wind events on pedestrian and roadway structures	The frequency of wind gusts ≥ 70 km/h is projected to increase in the area from Windsor to east of Toronto by about 17% by the 2050s compared to the historical period 1994-2007	We expect that high-wind events will cause roadway assets such as trees, fences, noise walls and signs to be damaged and an increase in litter clean-up following the events. Service disruption may occur should a tree or branch fall and block the roadway or power lines The City does not foresee a significant impact on structures	Investigate opportunities to improve designs for more wind-resistant fences, noise barriers and sign mounting systems Continue to use biennial inspection of bridge and culvert structures to monitor the impact of high-wind events and adjust maintenance programs accordingly

Demand Driver	Current Position	Projection	Impact on Services	Demand Management Plan
More frequent extreme-heat days (over 30 degrees Celsius)	Extreme-heat days can trigger damages to infrastructure, including the buckling of road pavement, damages to expansion joints and accelerated joint material degradation Work crews are dispatched to make the area safe and to remove any loose debris. Temporary repairs are made, followed by the scheduling of permanent repairs All roadway structures are monitored every 2 years and park structures are monitored every 4 years. Repairs are identified and the appropriate action taken.	As the overall temperature locally increases due to climate change, it is expected with confidence that the frequency and intensity of extreme-temperature events will also increase	Increase in risk to users of roads and bridges Increase in demand maintenance required	Investigate opportunities to improve designs and materials used for pavement and reinforced concrete Monitor changes in extreme-heat day events, and adjust maintenance and operating programs and budget accordingly
Increasing public expectations around road renewal following major water and wastewater works by the Region of Peel	Customers expect the entire road surface to be replaced following water and wastewater works	There are limited financial resources to afford this extremely high level of service	The ratepayer would be paying for improvements to road surface that are not required.	Perform a cost-benefit analysis and study to determine the optimal time and strategies to renew pavement following water and wastewater projects and implement findings City-wide

Ice Storm 2008

St. Lawrence Park High Water Level Damage

Lifecycle Management Strategy

Lifecycle management encompasses a wide range of practices and lifecycle events associated with managing the asset and the services they provide. From the early planning stages to the asset's ultimate disposal, the actions within these events are determined by the outputs of a range of planning processes including asset management planning, master planning, and strategic planning exercises that consider the internal and external drivers for defining the service outcomes required by assets.

Lifecycle Activities

For the purposes of this asset management plan, the lifecycle actions are grouped into one of seven activity types. These major lifecycle categories are defined below.

Non-asset Solutions – These are actions that consider how to influence and manage assets, services or customer demand. These actions can lower costs or extend asset life through better integration or coordination of planning activities, system use and process optimization activities.

Examples include:

- Long-range planning and studies
- Process improvements
- Improvements to stakeholder coordination
- Improved system and technology use

Operations/Services – These actions include activities such as planned inspections, housekeeping activities and automated or manual system monitoring. Operational activities generally occur throughout the asset's life.

The Roads Service Area incorporates the operations activities into its asset management strategies using the following:

- Visual and automated asset condition assessment and inspections
- Legislated maintenance inspections
- Housekeeping activities like litter pick up, snow clearing and street sweeping to maintain an aesthetic appearance of the assets

Maintenance Activities – These are a collection of minor to moderate actions to ensure the longevity of an asset. They are typically identified as repairs. Repair needs can be identified from an inspection, patrol, or by a notification from a user.

There are two broad types of maintenance activities:

- **Preventative Maintenance** - These are regularly scheduled activities, completed while the asset is still in an "operational" condition. The purpose of preventative maintenance is to ensure the asset achieves its expected life (i.e., does not fail early). Not all assets require or benefit from preventative maintenance activities
- **Reactive Maintenance** - These activities are physical repairs to an asset that has broken down or has ceased to function as intended. The repair reinstates the asset to its normal "operating" condition but does not significantly extend the overall life of the asset. Repairs are expected as assets age and are part of the overall lifecycle management to keep the asset operational for as long as physically and economically viable.

Renewal/Rehabilitation Activities – These are defined as larger-scale restorative activities designed to extend the service life of the asset and involve the repair of parts or components of an asset that

have prematurely failed or are close to end of life. Renewal projects can occur at various points in the asset's life.

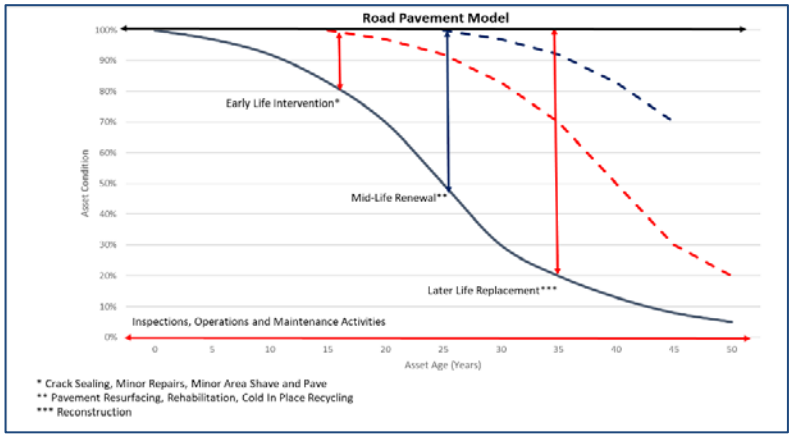
Replacement – These activities are expected to occur once an asset has reached the end of its useful life and renewal/rehabilitation is no longer an option. A replacement is typically intended to provide a new asset with the equivalent size or capacity.

Disposal/Demolition – These are activities associated with the disposal of a decommissioned asset including sale, donation, demolition and abandonment.

Expansion/Rebuild/New Asset – These are planned activities required to extend services to previously unserviced areas or expand services to accommodate growth in system use. These activities provide a higher LOS or a new service that did not exist previously, or an upgrade or improvement to an asset beyond its existing capacity.

Typical Road Pavement Lifecycle Model

For illustration purposes, a typical lifecycle model for the management of road pavements is provided below.



Inspection, Operation and Maintenance activities typically occur throughout the life of the asset. They ensure that the asset is functioning as intended and is safe for users.

Early Life Interventions like crack sealing, minor repairs and minor resurfacing over a localized area or small section of pavement are some of the treatment options considered when an asset is in the first quarter of its life.

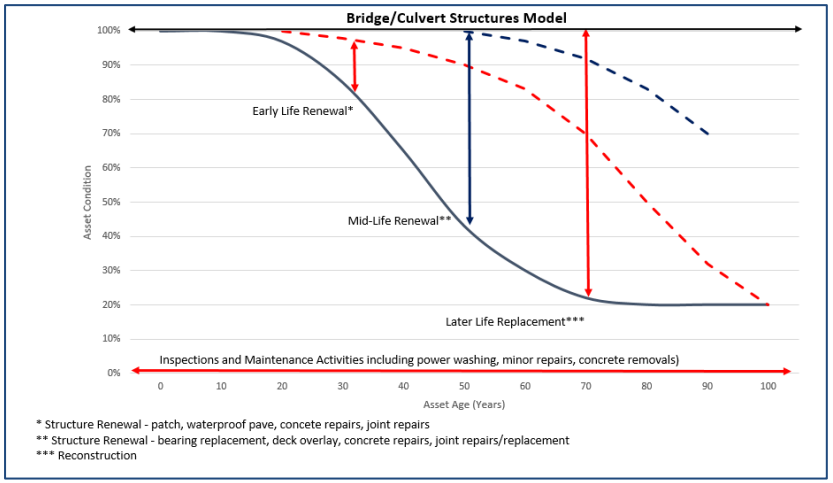
Mid-Life Intervention activities are considered when an asset is in the second or third quarter of its life. For road pavement assets, these interventions would include larger section resurfacing, full roadway rehabilitation and cold in-place recycling rehabilitation.

Later Life Intervention activities are considered when an asset is approaching or at the end of its lifespan. For road pavements, this includes road reconstruction, decommissioning or removing the stretch of roadway that no longer is required, or upgrading the asset to include additional service or service capacity.

Typical Road Bridges Lifecycle Model

For illustration purposes, a typical lifecycle model for the management of bridge and culvert structures is provided below. This is an average representation and does not necessarily illustrate the differences between the various structure types in the City's inventory.

Inspection, Operation and Maintenance activities typically occur throughout the life of the asset. They ensure that the asset is functioning as intended and is safe for users. These activities include biennial OSIM inspections, annual power-washing of critical components, and minor repairs such as broken or loose concrete removals and crack sealing. Maintenance activities on AT structures may also include wooden deck repairs.



Early-Life Intervention activities typically involve a structure rehabilitation. Concrete deck patching, waterproofing and paving, corrosion protection, joint repairs, concrete sidewalk, abutment, parapet wall and soffit repairs are some of the treatment options that may be considered when a structure is in the first quarter of its life.

Mid-Life Intervention activities typically involve a second rehabilitation. Treatments that may be considered when an asset is in the second or third quarter of its life include deck overlay, joint replacement, bearing replacement, sidewalk and parapet wall replacement and concrete patching.

Later-Life Intervention activities are considered when an asset is approaching or at the end of its lifespan. For road structures, this includes bridge replacement, decommissioning or removal of the structure and upgrading the asset to include additional service or service capacity for vehicle travel and/or active transportation.

Cost-Benefit Analysis (CBA) is a process often used by the Roads Service Area staff to determine which strategy, treatment or option is needed to address any variety of pavement concerns. CBA is a process by which treatment options are analysed to gain insight into the related costs of each versus the related benefit for selecting each treatment option. Utilizing treatments with the highest benefit to cost ratio ensures that the City is selecting the right treatment at the right time in a structure's life. Other considerations included in the CBA include pavement condition, its age, its major work history, and impacts on the community.

The Roads Service Area has identified and recorded the activities undertaken throughout the assets' lifecycles, including specific asset management practices and planned actions, as well as the associated benefits and/or risks, as listed in Table 8 and Table 9 below.


Bridge over Cooksville Creek

Lifecycle Management Activities

Tables 8 and 9 below summarize the coordinated set of lifecycle management activities that the City applies to Road and Bridge & Culvert assets, respectively.

Table 8 - Current Lifecycle Management Activities (Roads)

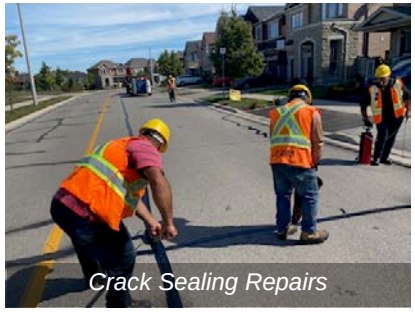
Activities	Specific AM Practices or Planned Actions	Benefit or Risk Associated with AM Practices or Planned Actions
Non-asset Solutions *Actions that consider how to influence and manage assets or customer demand*	• Road Pavement Management System (RPMS), including a spatial database • Infor Maintenance Management System (MMS) • New pavement moratorium practice • Implementing action items of Transportation Master Plan (TMP) and Cycling Master Plan (CMP) • Implementing the road network improvement priorities developed in the 2019 Development Charges Transportation Background Study (DCTBS)	• The RPMS is used to monitor and report on the overall performance of road pavement over time. It is also used to prioritize maintenance and renewal plans and forecasts, improve decision-making and track progress towards organizational goals and service levels • The Infor MMS is used to track service requests, inspections and work orders completed against assets • The pavement moratorium process is utilized to prevent Public Utility Agencies (PUAs) from damaging new pavements during the first 5 years of the pavement's life • The TMP, CMP, and DCTBS are used to plan for growth-related projects and transportation projects that align with the City's strategic goals and objectives
Operations/Service *Strategies that include activities such as planned inspections and automated system monitoring (e.g., visual condition assessments, legislated inspections)*	• Pavement Condition Survey • Coordinate construction and renewal activities with Public Utility Agencies (PUA) and other levels of government • Road Patrols • Minimum Maintenance Standards Inspections including routine patrols, winter weather monitoring, sidewalk inspection and sign testing • Road Sweeping • Debris, waste removal and spills response • Leaf collection • Graffiti removal • Winter Operations including anti-icing, salting, plowing and snow removal • Road Occupancy Permit Administration	• A Pavement condition survey is completed every 4 years to monitor and report on the overall performance of road pavement over time. The information is used to make maintenance and capital planning decisions and included in the City's asset management plans • Coordinating construction activities with PUA members allows stakeholders to identify scheduling conflicts as well as opportunities to partner with agencies to reduce cutting into pavement (which reduces its expected service life) • Maintenance Inspections include routine road patrols to identify and respond to hazards within the roadway; winter weather patrols to ensure winter conditions are documented and adequately responded to; annual sidewalk inspections to document and correct any defects; and roadway sign testing to ensure adequate reflectivity of regulatory signage

Activities	Specific AM Practices or Planned Actions	Benefit or Risk Associated with AM Practices or Planned Actions
	• Warranty inspections on works performed by contractors and others	• Minimum Maintenance Standard Inspections are in place to ensure that the roadway is reviewed on a regular cycle and to identify and manage risks • Routine Roadway Sweeping, debris and waste removal activities at regular intervals prevent storm drains from being blocked, protect the natural environment, and maintain an acceptable aesthetic appearance. Spills response ensures that spilled chemicals and other substances are removed from roadway/structure assets, minimizing damage/safety concerns • Leaf collection is completed in mature parts of the City and assists in keeping catch basins clear as well as removing leaves from the roadway (which can be a safety issue) • Graffiti removal in a timely manner maintains acceptable appearance of roadway/structure assets • Having a winter operating plan and activities allows the City to keep roads safe and passable over the winter season in line with MMS and Council-approved levels of service • Road Occupancy Permit Administration allows the City to ensure activities within the right of way are conducted in compliance with City requirements to ensure that City assets are adequately protected or restored if damaged

Accessibility

Maintenance Standards

Activities	Specific AM Practices or Planned Actions	Benefit or Risk Associated with AM Practices or Planned Actions
Maintenance *Regularly scheduled, timely, standard or normal repairs. Generally, minor actions that ensure longevity of assets in line with their design and operational requirements*	• Crack sealing • Pothole or asphalt patching • Roadway pavement and curb repairs • Sidewalk jacking and replacement • Minor rehabilitation of bridges and culverts • Utility restorations • Road signage repairs and replacement • Pavement marking re-application	• Crack sealing prevents water from getting into the road base, leading to asset failure, especially during freeze-thaw cycles. This practice, when applied properly, will ensure the expected pavement life is achieved • Pothole patrolling and asphalt repairs are undertaken to provide a short term fix for road defects • Timely road and curb repairs can extend the useful life of the roadway asset • Sidewalk deficiencies (such as tripping hazards and poor drainage) identified during inspection or through complaints can be corrected by jacking or grinding, or via replacement of cracked or damaged bays • Completing minor repairs of bridges and culverts ensure they are in satisfactory condition, including safety devices such as guide rails, barrier walls and speed attenuators • Part of the Road Occupancy Permit Administration process includes undertaking permanent hard-surface restorations. This ensures oversight over restorations to keep assets in the best possible condition • Road signs that are damaged can create a safety hazard for roadway users • Pavement markings require re-application annually and ensure visibility to roadway users



Crack Sealing Repairs

Activities	Specific AM Practices or Planned Actions	Benefit or Risk Associated with AM Practices or Planned Actions
Renewal/Rehabilitation *Extensive repair activities designed to extend the useful life of the asset*	• Roadway Rehabilitation Program (includes the renewal of pavement, curbs, boulevards, sidewalks and multi-use trails) • Milling and paving of large sections of pavement up to 90 mm in depth • Cold in-place recycling for arterial and major collector roads	• Failing to renew roadway pavements in a timely manner can put users at risk of injury, can lead to premature asset failure and loss of use of the asset, and increase deferral cost for the reconstruction of the roadway asset at a later date • The use of cold in-place recycling can restore old pavement to the desired profile, eliminate existing wheel ruts, restore the crown and cross slope, and eliminate potholes, irregularities and rough areas. It can also eliminate transverse, reflective, and longitudinal cracks

Roadway Rehabilitation

Activities	Specific AM Practices or Planned Actions	Benefit or Risk Associated with AM Practices or Planned Actions
Replacement *Activities that are expected to occur once an asset has reached the end of its useful life and renewal/rehabilitation is no longer an option*	• Full reconstruction of a roadway (includes the installation of new drainage systems, curbs, boulevard treatments, trails and sidewalk infrastructure)	• Failing to replace the pavement structure in a timely manner can lead to premature asset failure and loss of use of the asset, and can put users at risk of vehicle damage
Disposal/Demolition *Activities associated with the disposal of a decommissioned asset including sale, donation, demolition & abandonment*	• Stop-up and close the road, declare the right-of-way land as surplus, and sell the parcel of land	• Declaring unused road parcels as excess land can allow the City to reduce its liability exposure and generate revenue to support other priorities
Expansion/Rebuild/New *Planned activities required to extend services to previously unserviced areas or expand services to accommodate asset enhancements*	• New Road Construction • Roadway realignment • Road widenings (may be done in conjunction with a renewal activity) • Roadway feasibility studies, Environmental Assessments, and design works	• Timely implementation of new road construction allows the City to manage the growth-related demands on the road network • Roadway realignments are required to improve safety or operational issues • Road widening activities are required to improve service capacity and alleviate congestion • Undertaking a variety of transportation studies enables the City to more thoroughly assess the needs of the road network at every level and determine service improvement requirements

Table 9 - Curent Lifecycle Management Activities (Structures)

Activities	Specific AM Practices or Planned Actions	Benefit or Risk Associated with AM Practices or Planned Actions
Non-asset Solutions *Actions that consider how to influence and manage assets or customer demand*	• Implemented a Bridge and Culvert Management System (BCMS), including a spatial database • Implementing action items of Transportation Master Plan (TMP) and Cycling Master Plan (CMP) • Implementing the road network improvement priorities developed in the 2019 Development Charges Transportation Background Study (DCTBS) • Ongoing implementation of Infor maintenance management system (MMS)	• The BCMS is used to monitor and report on the overall performance of bridge and culvert structures over time. It is also used to prioritize maintenance and renewal plans and forecasts, improve decision-making and track progress towards organizational goals and service levels • The TMP, CMP and DCTBS are used to plan for transportation infrastructure improvement projects that align with the City's strategic goals and objectives • The Infor MMS is used to track service requests, inspections and work orders completed against assets
Operations/Service *Strategies that include activities such as planned inspections and automated system monitoring (e.g., visual condition assessments, legislated inspections)*	• Bridge and culvert (OSIM) inspections every two years (OSIM = Ontario Structure Inspection Manual) • The bridge and culvert power washing and graffiti removal program • Bridge and culvert snow removal and clearing	• Bridge and culvert inspections are completed every two years to identify and prioritize maintenance works and to comply with provincial regulations • Power-washing removes debris, de-icing chemicals and chlorides from bridge structure components to keep the structures clean and operating properly, and extends the life of the structures • Snow removal from bridge and culvert structures allows pedestrians and drivers to cross bridges safely throughout the year

Power Washing of Bearing Seats on Burnhamthorpe Road West Structures

Removed Loose Concrete and Salt

Activities	Specific AM Practices or Planned Actions	Benefit Or Risk Associated with AM Practices or Planned Actions
Maintenance *Regularly scheduled, timely, standard or normal repairs. Generally, minor actions that ensure longevity of assets in line with their design and operational requirements*	• Repair bridge and culvert components (sidewalks, retaining walls, hand-rails, fences and guide-rails) identified from biennial inspections • Reactive/demand maintenance identified by City staff or members of the public	• Failing to repair components of a bridge and culvert may put users at risk of injury • Failing to repair components can lead to premature asset failure and loss of use of the asset • Failing to repair components can lead to an increased cost of renewal of the structure at a later date
Renewal/Rehabilitation *Extensive repair activities designed to extend the useful life of the asset*	• Bridge and Culvert Renewal Program based on the structure's age, condition and deferral cost and the results of the condition survey • Replacing pressure-treated lumber on AT bridge deck surfaces with more slip-resistant materials	• Failing to address potential issues with deck surface materials may put users at risk of injury • Failing to renew structures in a timely manner can put users at risk of injury • Failing to renew structures in a timely manner can lead to premature asset failure and loss of use of the asset • Failing to renew structures can lead to the increased deferral cost of renewal of the structure at a later date or lead to a premature need for the structure to be replaced
Replacement *Activities that are expected to occur once an asset has reached the end of its useful life and renewal/rehabilitation is no longer an option*	• Bridge and Culvert Replacement Program based on the structure's age, condition and hydraulic capacity and the results of the condition survey • Replacing corten steel Active Transportation Structures with galvanized steel structures	• Failing to replace structures in a timely manner can lead to premature asset failure and loss of use of the asset, and puts users at risk of injury • Failing to revise construction materials used in certain applications, such as corten steel on structures subject to salting, can lead to premature end of structure life

Barbertown Bridge

Historic Bridge
Renewed in 2019

Serson Bridge

Replacement in 2019 with Galvanized Steel Structure and Kebony Wood Decking

Activities	Specific AM Practices or Planned Actions	Benefit or Risk Associated with AM Practices or Planned Actions
Disposal/Demolition *Activities associated with the disposal of a decommissioned asset including sale, donation, demolition & abandonment*	• Demolition and disposal of structures completed as part of construction • Closing a structure that is no longer fit for use	• Residual materials remaining from demolition like concrete and metal can be recycled • Structures that no longer meet load or capacity requirements can fail and lead to loss of use, and put users at risk
Expansion/Rebuild/New *Planned activities required to extend services to previously unserviced areas or expand services to accommodate asset enhancements*	• Installation of a new bridge or culvert where none previously existed • Bridge and culvert widenings associated with a road widening or flood mitigation project • Installation of grade separations • New Active Transportation structures and active transportation improvements to existing structures	• Timely implementation of a new structure allows the City to manage the growth-related demands on the road network • Missing opportunities to expand structures to include active transportation improvements can lead to reduced access for and uptake of cycling and pedestrian modes of travel • The installation of grade separation can alleviate congestion at rail crossing locations • Incorrect growth assessments may result in over- or under-utilized asset capacity

Active Transportation Bridge adjacent to Burnhamthorpe Road East

Lifecycle Management Costs

Operating Budget and Forecast

The Roads Service Area spans three Divisions in the Transportation and Works Department: Works Operations & Maintenance (WOM), Traffic Management and Municipal Parking (TMMP), and Infrastructure Planning and Engineering Services (IP&ES). The narrative below highlights a few of the major cost centres and activities required to develop, plan construct, operate and maintain the City's road network. Table 10 breaks down the major components of the Road Service Area's 2019 Operating Budget and three-year forecast, plus the Parks Pedestrian Bridge Maintenance budget. In 2019, approximately 69 per cent of this budget was used to fund the operation and maintenance activities for the road, structures and active transportation facilities (sidewalks, trails and cycling lanes). The remaining budget was used to fund the operation and maintenance of traffic signals, street lighting, crossing guards, municipal parking and municipal fleet.

Table 10 - Roads Service Area and Parks Pedestrian Bridge Maintenance Gross Operating Budget

Description	2019 Budget ($000s)	2020 (Forecast) ($000s)	2021 (Forecast) ($000s)	2022 (Forecast) ($000s)
Winter Maintenance	22,747	22,749	22,752	22,755
Road Sidewalk Maintenance	9,500	9,500	9,500	9,500
Maintenance Control	8,381	8,378	8,384	8,395
Transportation & Infrastructure Planning	5,246	5,260	5,308	5,396
Cleaning and Litter Pick-up	3,685	3,692	3,699	3,706
Survey & Inspection	2,800	2,972	3,082	3,182
Engineering & Construction	501	559	619	680
Bridges & Watercourses	307	307	307	307
Traffic Management	12,589	12,718	12,830	12,944
Crossing Guards	3,323	3,377	3,431	3,487
Streetlighting	6,018	6,088	6,208	6,325
Municipal Parking	2,026	2,039	2,052	2,065
Corporate Fleet Maintenance	87	138	189	242
Parks Pedestrian Bridge Maintenance[4]	50	50	50	50
Expenditures to Deliver Current Services	**77,260**	**77,827**	**78,411**	**79,034**

[4] Winter maintenance for Parks AT structures is not included in this summary.

Winter maintenance is the largest single operating expense within the Roads Service Area and accounts for approximately 29 per cent of its annual operating budget. This expense includes services delivered by both in-house forces and contractors to clear snow from the City's streets, transit stops, sidewalks along arterial and major roads, on-street bike lanes and along multi-use trails. Keeping these facilities clear during the winter season ensures that residents can continue to travel to work, school, appointments and shopping, and businesses can continue to operate.

Managing the traffic signal system and the associated infrastructure is the second-largest expense and represents 16 per cent of the Roads Service Area operating budget. This cost centre is used to manage the 564 City-owned signalized intersections within Mississauga. Public safety and traffic congestion remain high on the public agenda. Growth within the city and surrounding municipalities, along with increased demand for the delivery of goods, continues to put additional pressure on Mississauga's road and traffic infrastructure. Implementation of an Advanced Transportation Management System (ATMS) continues, as well as the development and implementation of the strategies to encourage the use of transit, walking and cycling as alternate modes of transportation.

Repairing road, sidewalk and bridge infrastructure represents 13 per cent of the Service Area's operating budget. Repairs reinstate the road- related infrastructure to their normal operating condition. Depending on the nature and extent of the repair, it can also extend the overall asset life for a brief period, making the infrastructure safe for users and defer the need for rehabilitation.

Ensuring that roads are kept clean and free of debris is very important to this Service Area and the activity is captured within the Cleaning and Litter Pick-up cost centre. Activities within this cost centre include spring and seasonal street sweeping, fall leaf collection, litter pickup/removal and debris clean up.

Spring Street Sweeping occurs in April & May

Vacuum trucks picking up fall leaves

The Survey and Inspection cost centre is an important part of this Service Area's quality assurance program. The services provided by the City's surveyors and inspectors are used throughout the road's useful life. Surveyors are required prior to, during and after construction and maintenance projects to gather information about the property and infrastructure that resides within and around the road right of way. That information is used locate and measure infrastructure components and estimate quantities for these projects. Inspectors are also used throughout a road asset's life. Inspectors

ensure that work performed on behalf of the City meets construction, quality and safety standards established. Inspectors and patrol personnel routinely look for defects along the road surface, curbs and sidewalks. Defects are identified and maintenance crews are dispatched to correct problem areas. Inspectors are also an important part of managing the City's roadway corridor. Inspectors work with utility agencies like the Region of Peel (Water and Waste Water), Enbridge Gas, Alectra, Bell, Rogers, and other utilities to ensure that the work they perform within the road right of way is coordinated, done safely and restores affected areas to the City's satisfaction.

The Infrastructure Planning and Engineering and the Maintenance Control cost centres are responsible for the engineering, planning, construction and overall program management support associated with roadway infrastructure. These cost centres represent the professionals overseeing the operations, inspections, maintenance, planning, design, engineering and construction of the City's roadway infrastructure.

Capital Budget and Forecast

The Roads Service Area is planning to invest over $851 million in road related infrastructure between 2019 and 2028. The investment is a combination of capital maintenance projects, capital renewal/replacement projects, capital expansion/improvement projects, and non-asset related solutions and studies. Table 11 below provides a breakdown of the Roads Capital Budget and Forecast, and the Parks Bridges Capital Budget and Forecast.

Table 11 - 2019 Capital Budget and 2020 to 2028 Forecast by Program

Program	2019 ($000s)	2020 ($000s)	2021 ($000s)	2022 ($000s)	2023 ($000s)	2024 ($000s)	2025 ($000s)	2026 ($000s)	2027 ($000s)	2028 ($000s)	Total 2019-2028 ($000s)
Roadway Rehabilitation	33,285	36,066	25,922	26,858	20,406	31,489	32,674	34,318	28,346	29,809	299,172
Major Road Construction	17,900	29,050	30,927	36,884	63,392	33,650	18,895	20,894	18,498	20,321	290,411
Bridge & Structure Renewal	4,000	7,225	5,583	7,500	8,000	7,500	7,500	7,500	7,500	11,918	74,225
Active Transportation	6,875	10,652	5,975	3,550	2,350	2,577	6,975	6,725	6,725	8,002	60,406
Traffic Management	4,480	7,280	6,530	3,830	4,540	3,980	4,727	3,780	3,780	3,780	46,707
Works Fleet and Equipment Management	3,597	3,561	3,886	3,986	4,086	4,186	4,286	4,386	4,486	4,586	41,046
Works Improvement	50	8,000	6,800	10,150	50	170	50	50	50	50	25,420
Noise Wall Infrastructure	2,665	2,047	1,050	700	600	500	450	425	425	396	9,258
Environmental Management	175	375	375	375	375	375	375	375	375	375	3,550
Municipal Parking	400	100	100	100	100	100	100	100	100	100	1,300
Roads 10-Year Subtotal	**73,428**	**104,357**	**87,148**	**93,934**	**103,899**	**84,527**	**76,032**	**78,553**	**70,285**	**79,336**	**851,499**
Parks AT Bridge Renewal	331	1,324	115	137	228	157	350	350	380	400	3,772
Parks AT Bridge Replacement	434	657	462	548	912	628	1,400	1,900	1,520	1,600	10,061
Parks AT Bridge Growth	0	524	0	466	2,564	3,900	15	135	25	225	7,854
Parks, Forestry & Envr. 10-Year Subtotal	**765**	**2,505**	**577**	**1,151**	**3,704**	**4,685**	**1,765**	**2,385**	**1,925**	**2,225**	**21,687**
Grand Total 10-Year	**74,193**	**106,862**	**87,725**	**95,085**	**107,603**	**89,212**	**77,797**	**80,938**	**72,210**	**81,561**	**873,186**

Capital Renewal/Replacement Projects

The renewal/rehabilitation of roads and bridge/culvert structures comprises approximately 44 per cent of the Roads Capital Budget and Forecast. As noted in the State of Infrastructure section, pavement and bridge management systems are in place to monitor the overall condition and performance of roads and structures over time. These management systems not only keep track of the asset's performance, they are also used to forecast and schedule future road and structure renewal projects.

Capital funding for renewal projects is also available through various program budgets for the traffic signal systems, noise walls, active transportation (sidewalks and trails), municipal parking and works fleet and equipment infrastructure.

Renewal and replacement projects are funded by property tax, the City's Infrastructure Levy, and/or Federal Gas-Tax reserve funds (see Figure 14 and. Figure 15).

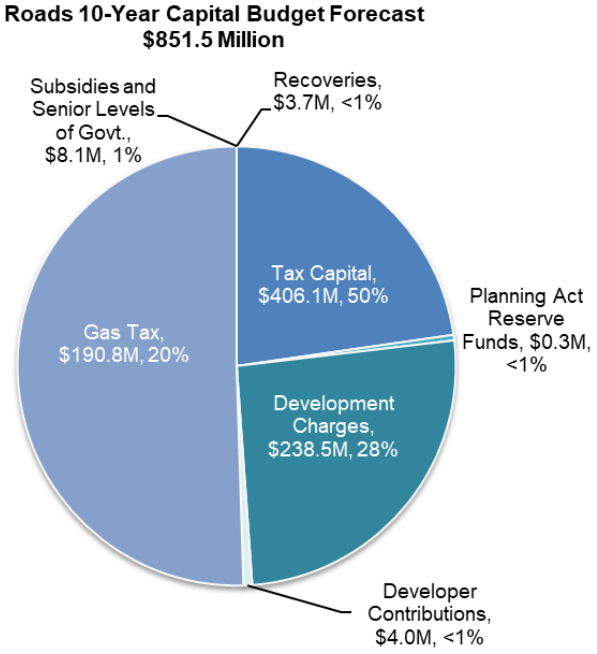


Figure 14 - Funding Sources for 2019-2028 Roads Capital Budget Forecast

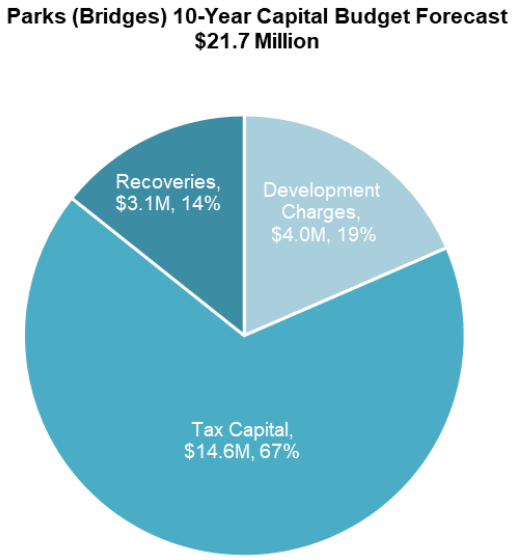


Figure 15 - Funding Sources for 2019-2028 Parks Bridges Capital Budget Forecast

Note: Numbers may not balance due to rounding

One of the benefits of being able to forecast the City's pavement and structure renewal/rehabilitation needs is that locations of these future projects can be coordinated with the renewal and improvement needs of other assets located within the roadway corridor. Roads Service Area staff meet quarterly with utility agencies and stakeholders responsible for stormwater, water/waste water, telecommunications, gas, hydro, urban forestry, and other assets to discuss and schedule future maintenance, renewal and growth plans and to ensure that all infrastructure activities are coordinated to minimize disruption for users, avoid scheduling conflicts, maximize opportunities, and minimize throw-away costs.

Capital Expansion Projects

In addition to targeting and prioritizing the investments needed to maintain existing assets, staff also identify infrastructure expansion or improvement needs in the Capital Plan for roads and structures. These expansion projects, typically identified through a variety of planning studies, may be required to accommodate development growth or service improvements.

Table 12 below lists the road and bridge/culvert structure improvements identified in the Roads 2019-2028 Capital Plan. Table 13 lists the active transportation bridge structures identified in the 2019-2028 Capital Plan for Parks assets.

Table 12 - Priority Road and Structures Improvement Projects Identified in the 2019-2028 Capital Plan

Growth Project Name	Project Timing	Growth Project Name	Project Timing
Goreway Drive Grade Separation Phase 1 of 3	2014 - 2023	Burnhamthorpe Rd W - Ninth Line to Loyalist Drive	2021 - 2023
Square One Drive - Confederation Parkway to Rathburn Road West - Construction Square One Drive E - Hurontario St to Rathburn Rd E	2017 - 2024 2024	Drew Road - Grade Separation - Rail Drew Road - Dixie Road to Tomken Road Drew Road - from Torbram Road to Airport Road (Excluding Rail Bridge)	2021 - 2024
Creditview Road Widening from Bancroft Road to Old Creditview Road	2018 - 2028	Stavebank AT Bridge across QEW	2021 - 2023
Intersection Improvements (Various Locations)	2019 - 2028	Sheridan Park Drive - West Leg to East Leg of Speakman Drive	2022 - 2024
Ninth Line Widening – Eglinton Avenue West to Derry Road West	2019 - 2024	Creekbank Road Extension - North Limit of Creekbank to South of Hwy. 401 Creekbank Road Extension - Matheson Blvd East to North Limit of Creekbank Creekbank Road Extension - Highway 401 Westbound Off Ramp - Highway 401 to Enterprise Road	2021 - 2022 2026 - 2028
Courtneypark Drive East / Highway 410 Interchange Courtneypark Drive East Widening - Kennedy Road to Dixie Road – Design Courtneypark Drive East Widening - Tomken Road to Dixie Road	2020 - 2024	Burnhamthorpe Road East Culvert Widening Over Etobicoke Creek Tributary	2023

Growth Project Name	Project Timing	Growth Project Name	Project Timing
Clarkson Road/Lakeshore Road Intersection - Design & Construction	2020 - 2021	Centre View Drive Improvements - Duke of York to Rathburn Road West	2025 - 2026
Credit River AT Bridge Along North Side Of The QEW	2020 - 2022	Highway 403 - Northern Distribution Road: Hurontario Street to Mavis Road	2025 - 2028
Edwards Boulevard from North of Topflight Drive to Hurontario Street/Hwy. 407	2020 - 2023	Belgrave Drive Ramp Extension & Road Works - Mavis Road to Cantay Road	2026 - 2027

Table 13 - Priority Pedestrian Structures Improvement Projects Identified in the Parks, Forestry & Environment 2019-2028 Capital Plan

Growth Project Name	Project Timing	Growth Project Name	Project Timing
Fletcher's Creek (1) Trail Bridge – ORT[5] 14E	2020 - 2022	Paul Coffey (2) new pedestrian bridges	2022 - 2028
Nine Creeks Trail – ORT 2C – Cooksville Creek Bridge Nine Creeks Trail – ORT 2B – QEW Bridge	2020 - 2024	Lakeview Village (2) new pedestrian bridges	2025 - 2028

The projects identified in the above tables represent the 2019 to 2028 forecast. As these projects advance through the planning and design phases and as the City reviews priorities, funding availability and updates to the master plan, it is expected that the forecast will evolve and change annually. Future Asset Management Plans will reflect those changes.

Infrastructure improvement projects are typically funded by a combination of Development Charges, Developer Contributions, property tax, and/or Federal Gas-Tax reserve funds. The largest capital expansion program in the Roads Service Area is the Major Roads program, which represents 34 per cent of the 10-year capital budget and forecast.

The 2019 Development Charges Transportation Background Study[6] identified approximately $861 million in growth-related projects for the Roads Service Area. The planning horizon for that study was 2019 to 2041. Of the growth-driven needs identified in the study, approximately 72 per cent relate to arterial roads, 13 per cent relate to major collector roads, and the remaining 15 per cent relate to other roads and related infrastructure such as stand-alone signalized intersection improvements, Master Plan studies, signals phasing changes, transit signals, new noise walls, and new sidewalks.

[5] ORT - Off Road Trail
[6] 2019 Development Charges Update, Transportation Background Study, City of Mississauga

Lifecycle Cost Summary

Over the next 10 years, the Roads Service Area is planning to spend an average of $214 million annually on roadway assets. When all of the lifecycle costs are combined into a single graph, they create a picture of the lifecycle activities required to manage the road-related infrastructure and meet service requirements. Lifecycle funding requirements for the Roads Service Area can be found in Figure 16.

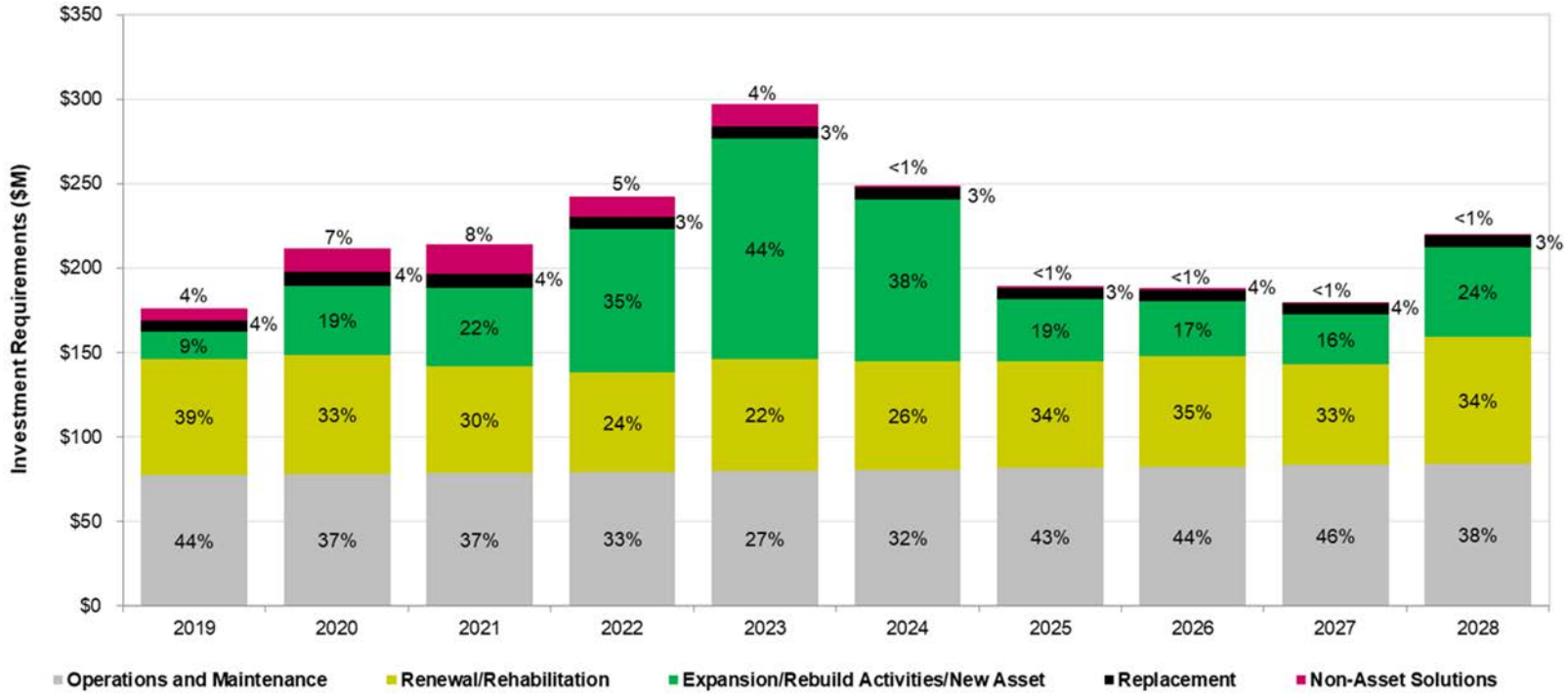


Figure 16 - Forecasted Lifecycle Costs (Roads Service Area)

Figure 17 summarizes the average annual lifecycle costs to maintain road-related assets.

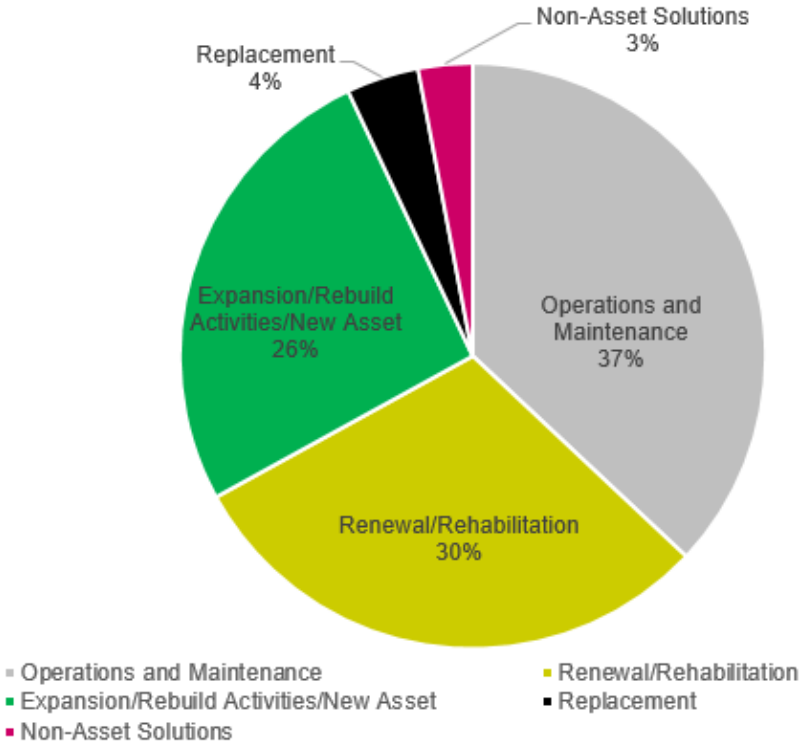


Figure 17 - 10-Year Average Annual Lifecycle Costs

Infrastructure Gap and Challenges

As demonstrated in the state of infrastructure section of this plan, road-related infrastructure is aging. In addition to aging infrastructure, the cost to deliver road-related capital projects is escalating faster than the rate of inflation. City staff have been monitoring construction prices over the past few years and have seen year-over-year increases that significantly exceed rates of inflation (CPI). This means that the City's forecast for future construction projects is outpacing the rate of inflation. As a result, the City's ability to maintain all road pavements in a state of good repair is constrained by the level of investment dollars available to fund this growing pressure.

The City's infrastructure funding gap for roads service is estimated to be $253 million between 2019 and 2028. The City's ability to fund all needs for road infrastructure is constrained: it can only invest approximately $50 million in road-related projects annually, leaving a funding gap of $25 million annually.

This funding gap, illustrated in Figure 18, is comprised of capital investment to support the timely rehabilitation of road pavements.

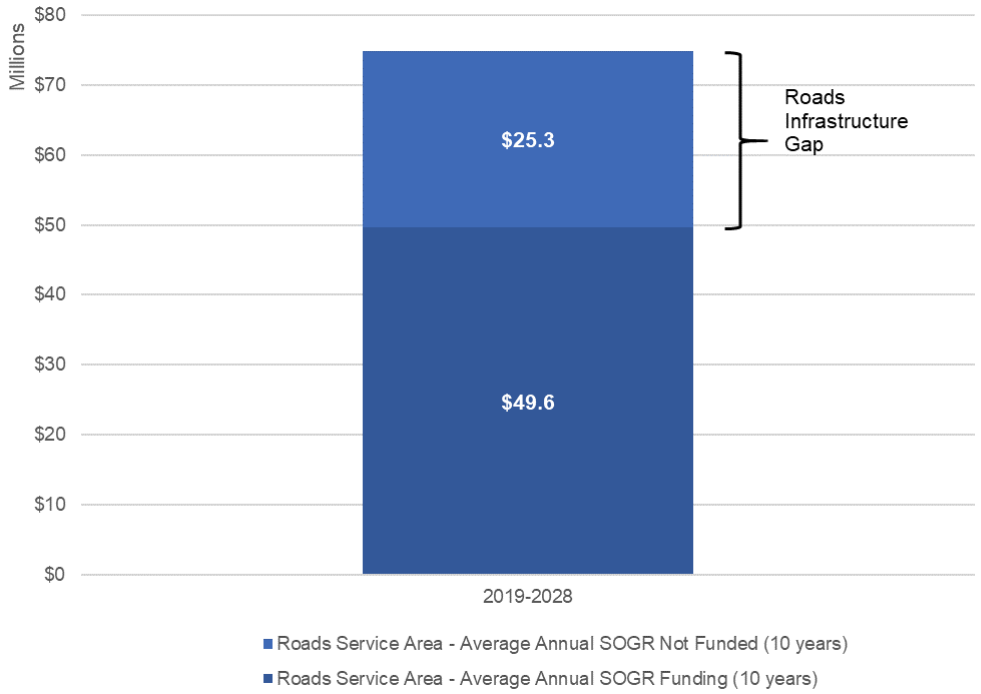


Figure 18 - Average Annual Roads Service Area SOGR Infrastructure Gap

Budget Analysis: "Funded" Roadway Pavement Renewal

Averaging approximately $30 million per year, the Roadway Rehabilitation program is one of the City's largest capital expenditures. The program not only ensures that road pavement structure is renewed, it also ensures that sidewalk and roadside appurtenance assets are renewed or replaced as required. Figure 19 below represents the expected road pavement condition profile over the next 20 years based on the current average annual investment of $30 million in the Road Rehabilitation program. As a result of the annual investment shortfall, the City's RPMS model predicts that the City's road network will reach a state of deterioration whereby the proportion of the road pavements in poor to very poor condition will increase from 19 per cent in 2020 to 50 per cent in 2039.

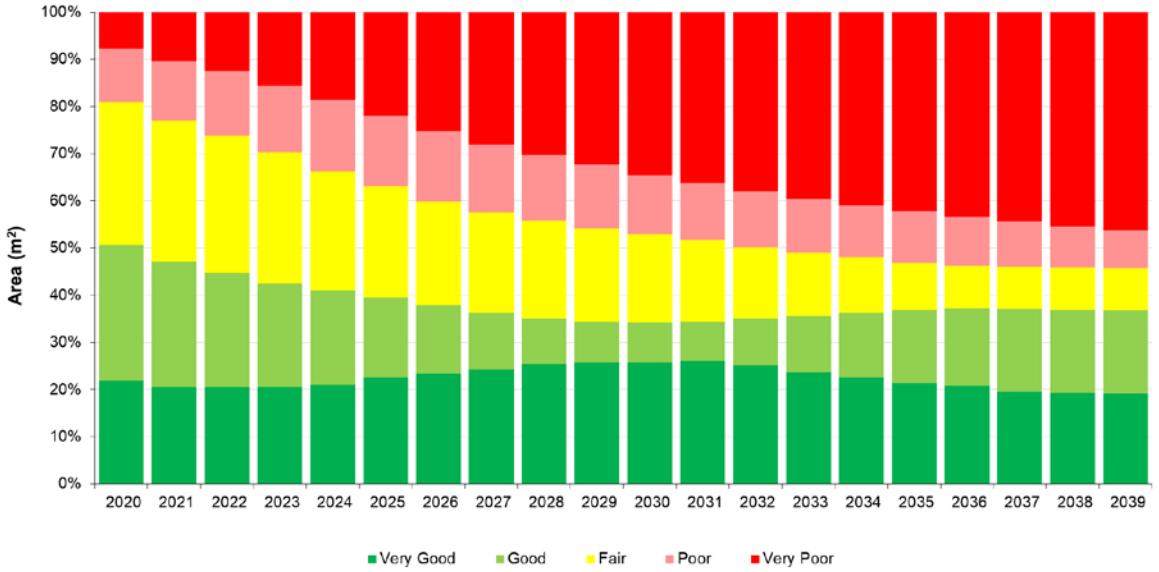


Figure 19 - Forecasted 20-year Condition Profile (Road Pavement) [7]

The forecasted condition profile indicates that the current level of planned capital investment is not sufficient to maintain the City's road pavements in fair or better condition. Should the needs for pavement renewal continue to outstrip available funding, the Roads Service Area will need to increase operating costs to provide repair treatments and increase road patrols to extend the useful life of pavement assets and manage road-user risk. City Maintenance and Operations staff will be monitoring maintenance and repair requirements annually and proposing adjustments to their operating budgets as needed.

[7] 12 km of Transitway infrastructure not included in Condition Profile for Roads Pavement

Service Level Analysis and Options

An approach to establishing the optimal capital investment is to forecast the major lifecycle activities required to maintain the desired road pavement performance or level of service. The graph in Figure 20 below shows the condition profile of road pavement assets changing over the next 25 years. The analysis considers the current condition of pavement, the rate at which the condition is expected to degrade, and appropriate condition triggers for rehabilitation/replacement activities to forecast the condition profile into the future.

For the purposes of this asset management plan, three levels of capital investment for the Roadway Rehabilitation Program were analysed:

1. Maintaining the currently forecasted 10-year funding level of approximately $30 million per year, which would lower the average pavement condition to 56 PQI or approaching an overall **Poor** condition by 2029
2. Investing an additional $10 million per year, which would lower the average pavement condition to 61 PQI or overall **Fair** condition by 2029
3. Investing an additional $25 million per year to maintain an average pavement condition of 72 PQI or overall **Good** condition

The results for all three scenarios are shown in Figure 20 below. The **red** line represents the current funding of $30 million annually and indicates that the average condition of the road network would approach the **Poor** category by 2029. The **orange** line represents an increase of $10 million in the annual funding level and indicates that the average road network condition would deteriorate to the **Fair** category by 2029. The **green** line represents a $55 million additional investment annually, which would result in the average network condition being in the **Good** category.

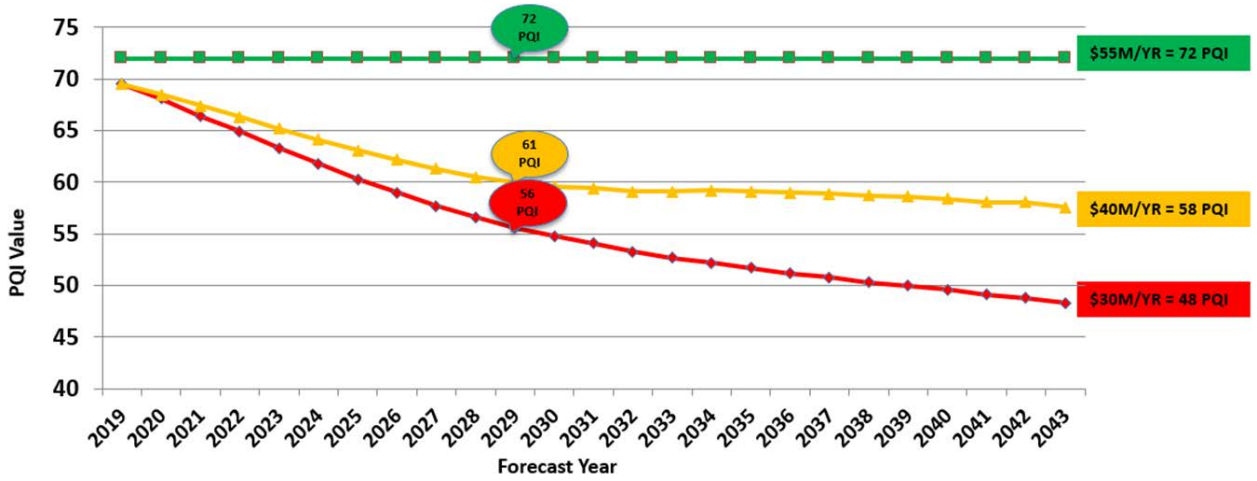


Figure 20 - Roadway Pavement Performance Based on Three Funding Scenarios

Figure 21 shows the percentage of roads that will be deficient under the three funding scenarios discussed above. Roads that are deemed deficient are roads that have reached their renewal period; however, there are insufficient funds available to undertake the needed works. The red line represents the currently projected funding level of $30 million per year and indicates that by 2029, 32 per cent of the road network will fall below the renewal and/or replacement time period. The yellow line represents an additional $10 million per year investment and shows that 27 per cent of the road network would fall below renewal and/or replacement time period. The green line represents an additional $25 million per year investment and shows that the level of defects remains at around 11 per cent. The pavement deficiency levels peak and stabilize for periods of time in the forecast for both the $40 million and $55 million funding scenarios.

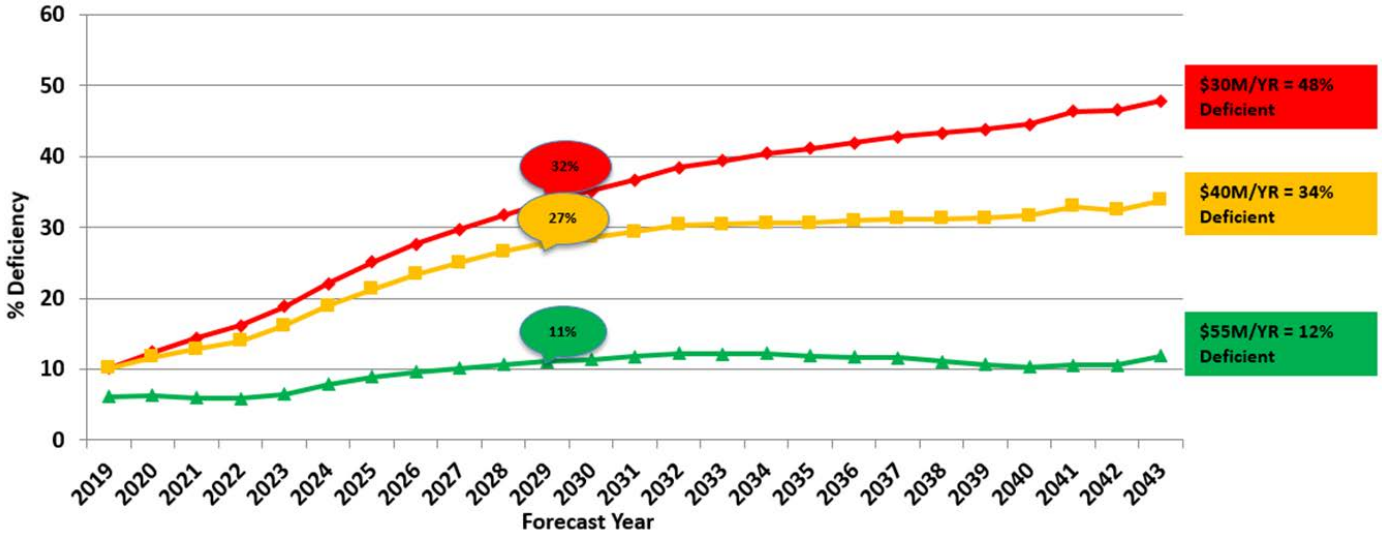


Figure 21 - Percentage of Deficient Roadway Pavement for Three Funding Scenarios

The next pavement condition survey is scheduled for 2021. The data collected by the survey will be reviewed and analysed in 2022 to reassess future pavement condition trends under various annual renewal funding scenarios. These results will be provided during the 2023 Asset Management Plan update cycle.

Figure 22 illustrates the impact of the currently forecasted level of renewal funding (2019 to 2028) on the City's road network. Roads that are expected to be renewed over the next 10 years are shown in **green.** Road sections that are likely to fall on the backlog list are shown in **red.** The roads that are not impacted are shown in **grey**. It is important to note that this is a network-wide view over a 10-year period. Further prioritization and coordination activities with other stakeholders will occur and likely have an impact on the list of roads proceeding towards rehabilitation.

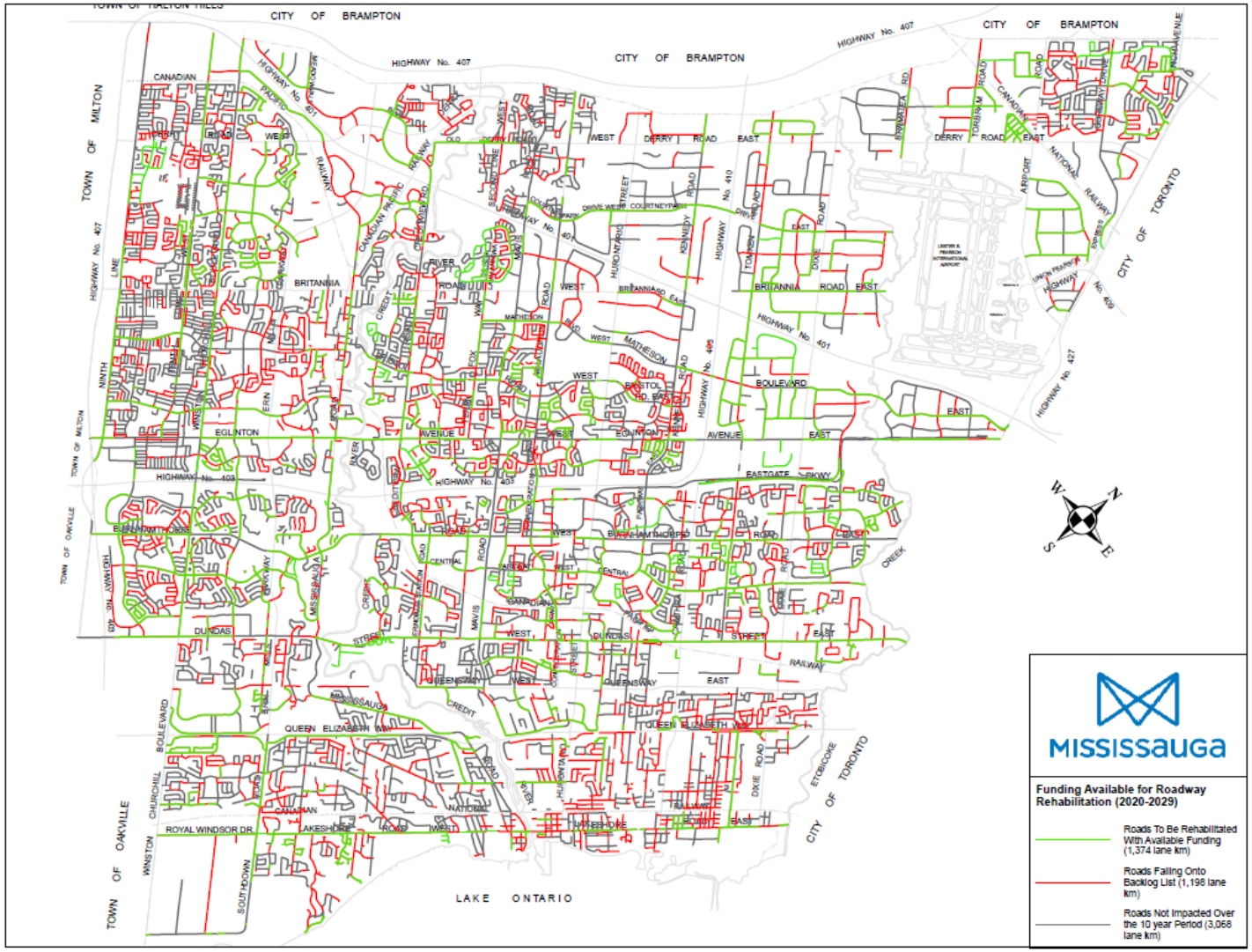


Figure 22 - Impact of the Available 10-Year Funding Envelope (2019-2028)

Budget Analysis: "As Funded" Bridge and Culvert Renewals

The Bridge and Culvert Structures Rehabilitation Program is one of the City's most critical renewal programs. Bridge and culvert structures carry a significantly high risk. If left unmanaged, structural failure could result in catastrophic consequences to human life and property.

In 2019, the 10-year average annual expenditure was expected to be $8.8 million. Taking into consideration a moderate level of inflation to construction costs and the expected rate of structural deterioration, the City's Bridge Management System model predicts that the City is managing bridge and culvert structures to an acceptable and sustainable level. The percentage of bridges in poor to very poor condition remains manageable over a 20-year period, as illustrated in Figure 23 below. The figure illustrates the average long-term condition of the bridge and culvert assets based on the projection of the current level of funding.

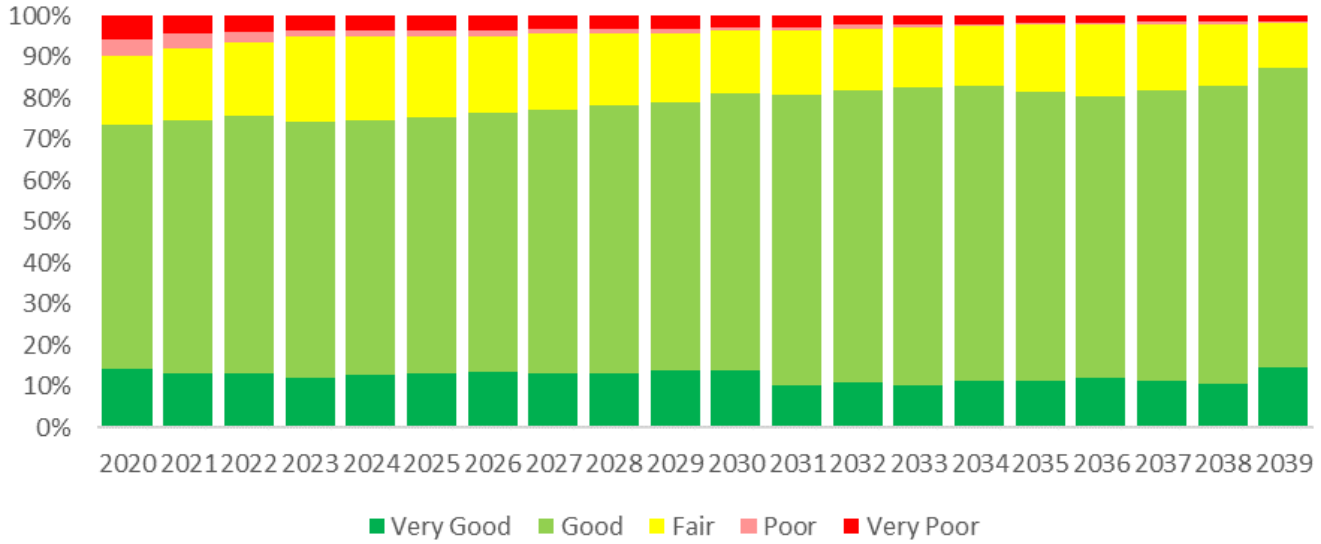


Figure 23 - Forecasted 20-year Current Budget Condition (Structures) [8]

[8] Bridges and culverts related to the Transitway; community services due to active transportation infrastructure as well as road infrastructure

Continuous Improvement and Monitoring

One of the goals of the asset management plan is to establish a baseline of the current asset management practices and to inform a work plan for continuous improvement.

Advancing Corporate Asset Management Capabilities

In order for the City to evaluate current capabilities and develop a work plan towards asset management maturity, the City plans to conduct periodic assessments of the asset management system.

The maturity gap assessment results, shown in Figure 24, were developed for road pavements and structures separately. The results for these asset groups were weighted by the value of the assets in each group to provide an overall result for the City's roads and structures asset classes. The questions, scores, analysis, and results were recorded for benchmarking the level of AM practice. This will allow staff to re-evaluate business practices and maturity at any point in the future and to report on progress achieved.

Figure 24 provides a radar chart that shows the evaluated maturity prior to this AMP update, against the overall maturity target for the City's roads and structures asset management capabilities.

A proposed work plan in Table 14 and Table 15 aims to build upon the Roads Service Area's existing strengths to develop a leading body of practice for asset management that balances opportunities, costs, and risk against the desired levels of service, to achieve organizational objectives. A follow up Maturity Assessment for roads and structures will be completed as part of the 2023 Roads Service Area Asset Management Plan update.

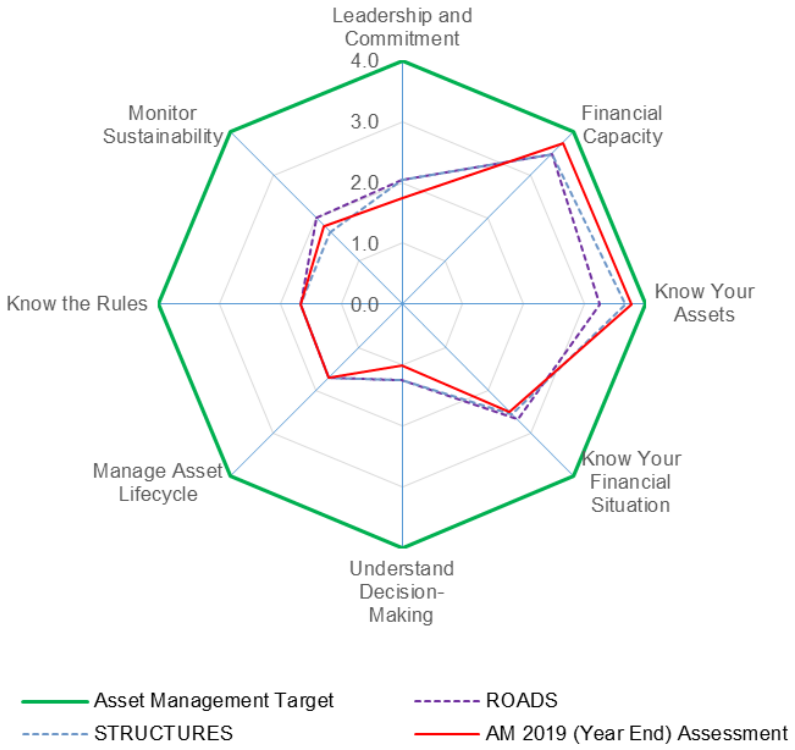


Figure 24 - Maturity Gap Assessment Roads & Structures

Continuous Improvement Initiatives

A proposed work plan is provided in Table 14 below, aimed to build upon the City's existing strengths to develop a leading corporate asset management practice that balances costs, opportunities and risk against the desired levels of service and to achieve organizational objectives.

Table 14 - Asset Management Improvement Plan (Roads Service Area)

Task No.	Work Plan Task	Asset Class	Timing	Target Benefits	Required Resources
SOI-01	Update condition assessment and OSIM Inspection information	Roads/Structures	2021-2022	• The pavement condition survey and OSIM inspection will inform the 2023 AMP for the Roads Service Area	External
SOI-02	Review replacement cost models and develop a sustainable framework for periodically updating and reporting on replacement cost figures	Roads/Structures	2021-2022	• Replacement costs contained within CityWide, the City's Tangible Capital Asset System, are based on historical costs. Replacement and renewal costs change over time and may be significantly understated	Internal/External
RIS-01	Develop a Risk Assessment Framework for roads and structures	Roads/Structures	2021-2022	• A risk framework will enable the Roads Service Area to better prioritize funding availability across asset classes	External
LOS-01	Review condition information and develop level of service targets for the management of roads and structures	Roads/Structures	2022-2023	• In addition to being required to meet *O. Reg. 588/17*, level of service targets enable the service area to track progress against established targets	Internal
DAT-01	Expand Use of Infor to track Capital Delivery Contracts against Roadway Assets	Roads/Structures	2022-2024	• Better asset lifecycle costing and improve processing time for Tangible Capital Asset Reporting	Internal
DMGT-01	Complete Climate Change Vulnerability Assessment and implement action plan	Roads/Structures	2021-2023	• The Climate Change Vulnerability Assessment will guide investments in roads and structures to protect against the impact of climate change	Internal/External
LMGT-01	Utilize the lifecycle information within RPMS and BTMS to	Roads/Structures	2021-2024	• Enhanced and expanded inspection, preservation, repair and renewal strategies	Internal

Task No.	Work Plan Task	Asset Class	Timing	Target Benefits	Required Resources
	explore and develop enhanced repair and preservation approaches and strategies			can extend the life of both road and structure assets and improve overall performance of assets	
IGC-01	Work with Corporate Finance to formalize performance targets and sustainable funding for roads and structures	Roads/Structures	2021-2024	• *O. Reg. 588/17* requires the establishment of Service Level Targets by 2024	Internal
CIM-01	Update the Maturity Assessment and Continuous Improvement Plan and report back to Leadership Team	Roads/Structures	2021-2023	Providing Leadership Team and Council with regular updates on the progress made towards asset management planning will ensure that we continue to mature in our asset management practices	Internal
Enhanced Roads Service Area Asset Management Plan					
CORP-01	Assess the resources required to deliver a comprehensive Asset Management Plan for the Roads Service Area and prepare a business case	Traffic Signal System, Street Lighting, Sidewalks, Trails/Cycling Facilities, Street Signs, Noise Walls, Retaining Walls, Municipal Fleet and Equipment and Municipal Parking Infrastructure	2021-2023	• *O. Reg. 588/17* requires asset management plans for non-core assets by July 1, 2023 • The establishment of management plans for these assets will allow the Service Area to find efficiencies in planning and coordination activities	Internal
SOI-02	Develop the asset hierarchy and data model for the assets within the Roads Service Area	Same as above	2021-2022	• The asset hierarchy is required to establish the relationships between the individual asset types and the service they provide	Internal

Task No.	Work Plan Task	Asset Class	Timing	Target Benefits	Required Resources
SOI-03	Catalogue all high priority asset types within the City's GIS environment	Same as above	2021-2023	• Developing the catalogue, inventory and data model will enable the service area to better manage the data	Internal
SOI-04	Review replacement cost models and develop a sustainable framework for periodically updating and reporting on replacement cost figures	Same as above	2021-2023	• Replacement costs contained within ***CityWide***, the City's Tangible Capital Asset System are based on historical costs. Replacement and renewal costs change over time and may be significantly understated	Internal/External
SOI-05	Develop condition assessment framework for all high priority assets identified	Same as above	2021-2023	• Provides a consistent approach to collect information that will allow service groups to identify and prioritize infrastructure needs	Internal and External
SOI-07	Use of LiDAR for data collection of non-core assets in the right of way	Same as above plus all other assets within the right of way	2021-2024	• Having accurate information about the location of each asset will be used to better plan inspection, renewal and replacement activities • The activity will also serve to validate the accuracy of existing asset inventory information	External
SOI-08	Expanding use of Infor Contract Management and Infor Mobile Technology	Same as above	2022-2024	• This activity facilitates the allocation of capital costs to the appropriate asset type and provides for better lifecycle costing and valuation • Will also reduce processing time for TCA reporting	Internal
RIS-01	Develop a Risk Assessment Framework for all priority assets within the Roads Service Area	Same as above	2021-2023	• A risk framework will enable the Roads Service Area to better prioritize funding availability across asset classes	Internal/External
LOS-01	Define the Customer and Technical Levels of Service	Same as above	2021-2023	• Developing level of service and other metrics enable the City to better	Internal

Task No.	Work Plan Task	Asset Class	Timing	Target Benefits	Required Resources
				communicate asset performance and their impact on the services they provide	
LOS-02	Define target level of service for all major asset categories	Same as above	2024	• In addition to being required to meet *O. Reg. 588/17*, having levels of service established will enable the Service Area to track progress against targets	Internal
LMGT-01	Document lifecycle management activities and strategies for each new asset type	Same as above	2022-2023	• Lifecycle management activities and strategies are required in order to determine the appropriate investment decisions	External/Internal
RIS-01	Develop and implement an asset risk framework for a variety of asset types	Same as above	2022-2024	• Provides weighting factors to enable the prioritization of capital projects against risk	External/Internal
ASA-01	Prepare asset needs analysis to determine long-term capital renewal, replacement and expansion programs for all new asset types	Same as above	2022-2023	• Developing a needs analysis for all major asset types will ensure that the Roads service area is taking into consideration all lifecycle costs	External/internal
LMGT-02	Levering asset management data to drive business plans and budgets	Same as above	2023-2024	• Aligns asset information that directly impacts budget decisions and planning	Internal
IGC-01	Work with Corporate Finance to formalize performance targets and sustainable funding scenarios for non-core assets	Same as above	2021-2024	• *O. Reg. 588/17* requires Service Level Targets by 2024	Internal
CIM-01	Update the Maturity Assessment and Continuous Improvement Plan and report back to Leadership Team	Roads/Structures	2021-2023	• Providing Leadership Team and Council with regular updates on the progress made towards Asset Management Planning will ensure that we continue to mature in our asset management practices	Internal

Improving Future Asset Management Plans

A list of initiatives to improve future updates to this asset management plan is provided in Table below, organized by report section.

Table 15 - AMP Future Improvement Initiatives (Roads Service Area)

Section	Description	Comments
1	Introduction	• Introduce an expanded list of priority road asset categories into the Roads Service Area plan
2	State of the Infrastructure	• Complete inventories and conduct condition assessments on key asset classes. Use age as a proxy for condition when an assessment tool is not readily available • Build on existing asset inventories and ensure they are regularly maintained • Update and improve replacement cost estimates for all key assets
3	Current Levels of Service	• Document levels of service provided for the expanded list of assets • Introduce service level targets for the expanded list of assets • Introduce asset-specific risk assessment tools for the expanded list of assets
4	Future Demand	• Document future demand pressures for the expanded list of assets • Integrate climate change by assessing risk vulnerability
5	Lifecycle Management Strategy	• Operations and Maintenance: document trends (e.g., past expenditures, complaints) and issues • Improve lifecycle analysis tools for more automation
6	Asset Needs Analysis	• Prepare a needs analysis for each major asset type to help to establish service levels and determine if a funding gap exists
7	Infrastructure Gaps & Challenges	• Operations and Maintenance: document trends (e.g., past expenditures, complaints) and issues

Summary

At the core of a vibrant and modern City is its transportation network. Valued at over $5 billion, Mississauga's roadway infrastructure is the second-largest asset owned and operated by the City of Mississauga. Roadways are comprised of a variety of smaller asset components that include road pavements, bridge and culvert structures, sidewalks, multi-use trails, the traffic signal system, streetlights, public parking facilities, signs and noise walls. The focus of this asset management plan is the performance of the road pavements and structures. The replacement value of the City's road pavements and structures network alone represent 77 per cent of the value of the entire transportation asset portfolio.

The Roads Service Area will be spending an average of $214 million annually to operate, maintain, improve, expand, replace and renew a variety of roadway assets over the next 10 years. The figure to the right shows how those lifecycle costs will be distributed over that time period.

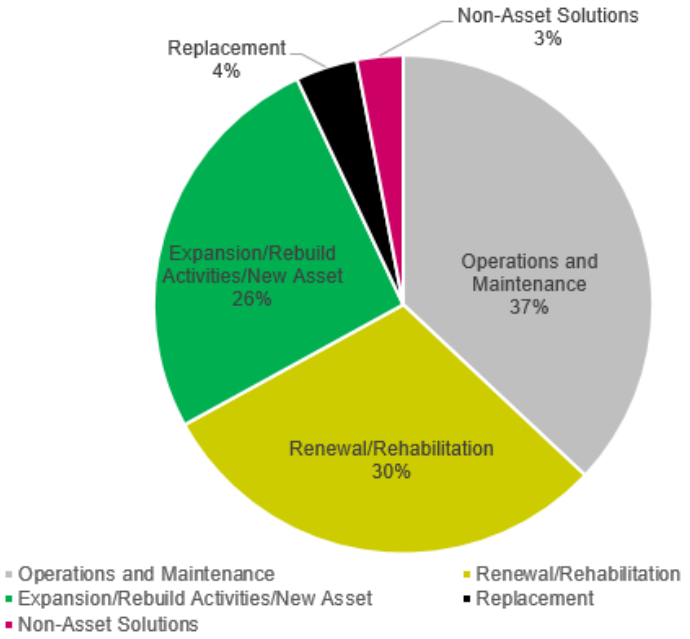


Figure 25 - 10-Year Average Annual Lifecycle Costs

Table 16 - Summary of the SOI and Infrastructure Gap

Asset	Replacement Value (millions)	Current Condition	2019 Infrastructure Gap (millions)	10-Year Infrastructure Gap (millions)	Condition Trend
Road Pavement	$2,878		($22)	($253)	
Structures	$978		No Gap	No Gap	
Roads & Structures	$3,856		($22)	($253)	

Road Pavement

Even with these planned expenditures, the City's road pavement infrastructure is underfunded and deteriorating faster then the service area is able to renew it. Many sections of road pavements require repair and/or renewal today and the number of pavement sections requiring renewal will continue to grow over the next 10 years. At a replacement value of $2.878 billion and a network size of 5,640 lane km, the overall performance of Mississauga's road pavements currently achieves an average rating of between **Fair** and **Good** with 79 per cent of the network in fair or better condition. However, modeling projections indicate that the average condition rating will decrease over time should the annual level of funding not significantly increase.

The Roads Service Area has been using a pavement management system since 1985 to plan for renewal needs. While Figures 4 and 5 illustrate that that the City has been proactively monitoring and renewing road pavements, funding to maintain the road network in **Good** condition is constrained as can be seen in Figure 19. The pavement condition and funding gap analysis reveals that the overall condition of the City's roads will decline unless additional funds are secured to keep the roads safe and in a state of good repair for all users.

At existing funding levels, the cumulative funding gap for roadway renewal will reach $253 million by 2028 and the average network condition will decline to the extent that 60 per cent of roads will be in poor or very poor condition and require additional funds to maintain a safe network. Road users will feel the impact of the deteriorating road system, particularly along arterial and collector roads, many of which are approaching the repair and renewal phase of their lifecycle.

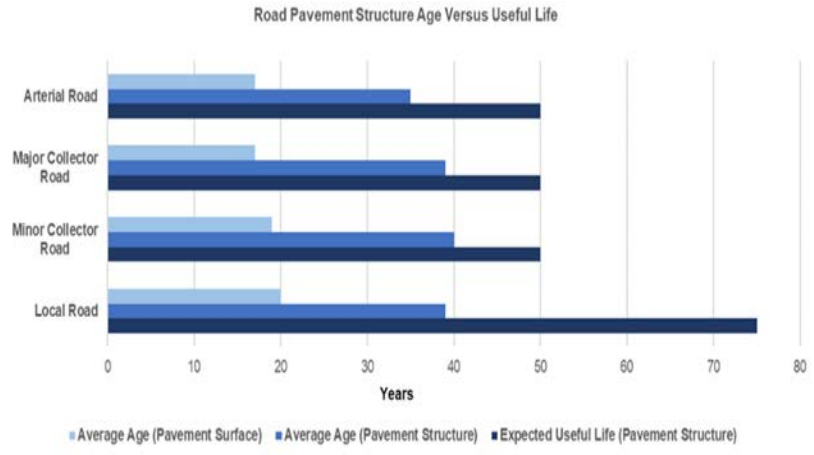


Figure 4 - Pavement Surface and Pavement Structure Age versus Expected Useful Life of Pavement Structure

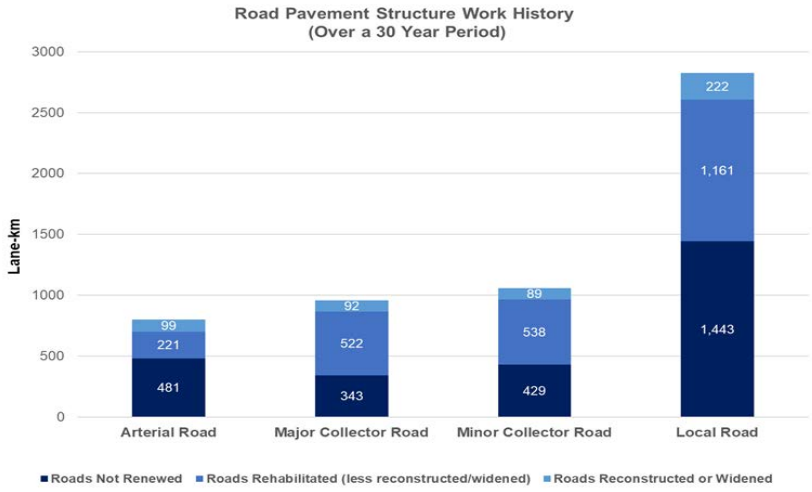


Figure 5 - Road Pavement Structure Work History (Over the last 30 Years)

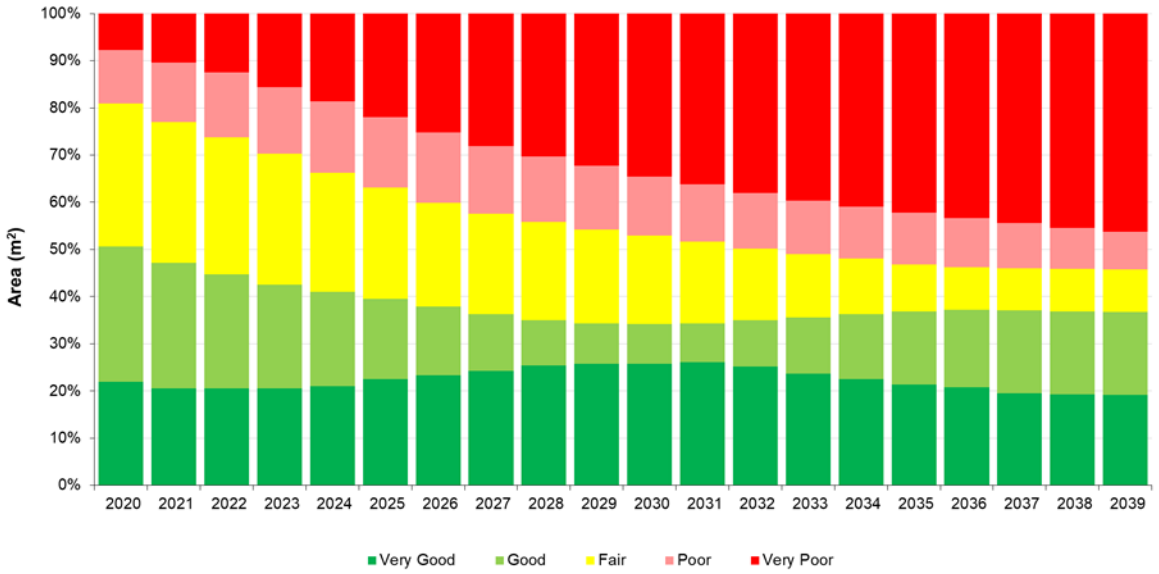


Figure 19 - Forecasted 20-year Condition Profile (Road Pavement)

The impact of the deteriorating road system will result in higher operating and maintenance needs and costs, lower levels of customer satisfaction, lower levels of road safety, increased liability and insurance claims, longer times to commute to work and school, and ultimately a lower level of service than that residents have come to expect. In extreme cases when pavement conditions deteriorate to very poor conditions, temporary lane closures may be necessary.

This asset management plan also recognizes that the Service Area's ability to deliver timely improvement and expansion projects is constrained as well. Delays in delivering road improvement or expansion projects along arterial and collector roadways will result in increased congestion and delays for pedestrians, cyclists, transit users and motorists.

It is critical that the Roads Service Area continue to explore a variety of lifecycle strategies and maintenance delivery tactics to maintain the road network in a state of good repair and to work towards finding efficient and effective ways to deliver services while maintaining public safety. These strategies include increased inspections and patrols resulting in repairs; increased use of preservation tactics like crack sealing; and, proactive maintenance inspections, driven by information contained within the RPMS, to identify candidates for minor repairs and resurfacing activities by the City's Works Operations and Works Maintenance sections. This in turn will put increased pressure on the operations and maintenance components of the Roads Service area budget.

Structures

At an estimated replacement value of $978 million, the City's 378 bridge and culvert structures connect residents and non-residents alike with services, employment, commerce, recreational opportunities and each other. These structures cross a number of natural and man-made features like creeks, rivers, highways, railways and trails. The overall performance of the City's bridge and culvert structures achieves an average condition rating of **Good** in 2019. Similar to road pavements, the City's structures are also aging, but at a different rate.

Since the early 2000s, the Roads Service Area has had a management and monitoring plan to maintain these structures. The historical information contained within Figures 6 and 7 illustrate that the City has been proactively monitoring and renewing structures. The 25-year forecast reveals that there is sufficient lifecycle funding to continue to maintain structures in **Good** overall condition. Figure 23 illustrates that the City is able to maintain structures in a state of good repair. With regular inspections, power-washing, timely repairs and renewals, the designed useful life of these structures is being realized and in some cases exceeded.

This does not necessarily mean that the service area should consider diverting planned funds towards other assets. On the contrary, there is much more work that needs to be done to improve the effectiveness of the structures management program. Work plans are already underway to expand asset management plans and inventories to include other structures like retaining walls and community entrance features. In addition, staff are exploring treatments to mitigate corrosion on the many steel-frame pedestrian structures owned by the City.

The Asset Management Plan for Road Pavements and Structures has established a new reporting standard for all future management plans for the Roads Service Area. In preparation for the 2023 asset management plan reporting cycle, the Roads Service Area will be exploring a number of ways to improve asset management practices across a variety of asset types. A summary of these initiatives can be found in the Continuous Improvement section of this asset management plan.

Eglinton Avenue East over Etobicoke Creek Bridge

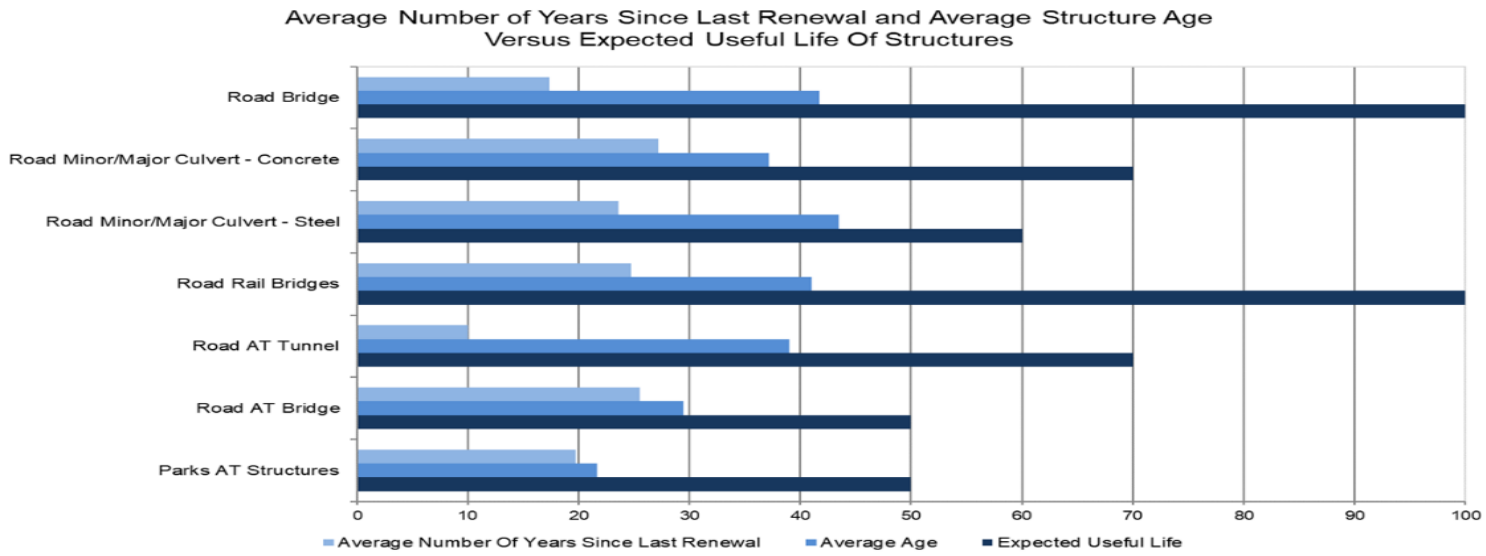


Figure 6 - Average Number of Years Since Last Renewal & Avg. Structure Age versus Avg. Useful Life of Structures

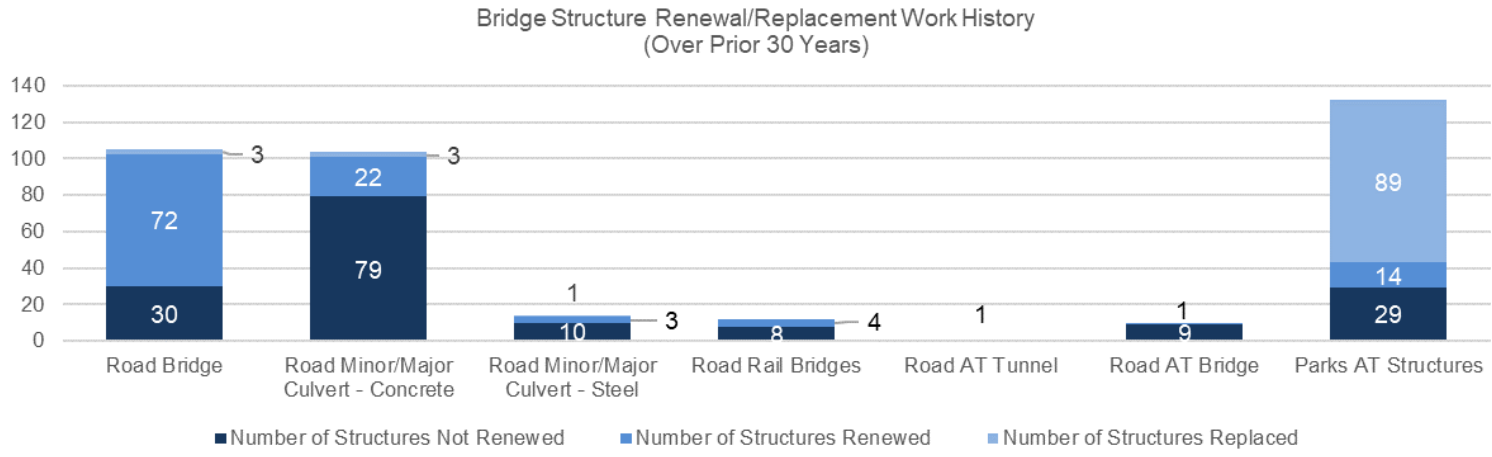


Figure 7 - Bridge and Culvert Structures Major Work History (Over the last 30 Years)

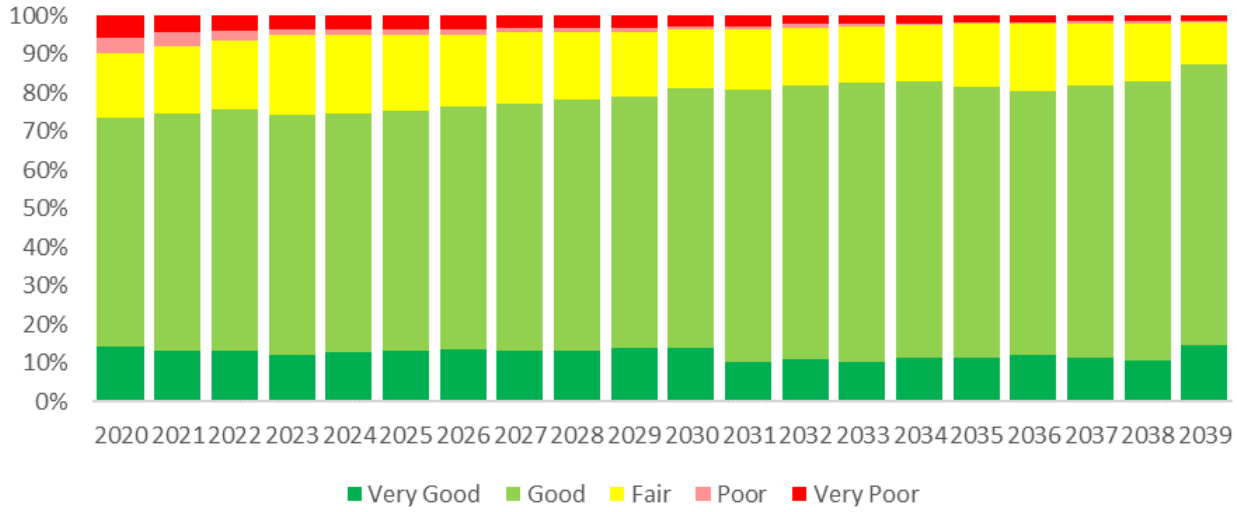


Figure 23 - Forecasted 20-year Current Budget Condition (Structures)

In addition, the three divisions within the Roads Service Area will be working closely with their partners in Finance and the Corporate Asset Management Office to find ways to manage or reduce the infrastructure funding gap pressure. Through the City's annual business planning and budgeting cycle, initiatives to improve the efficiency and effectiveness of operations will be brought forward, along with initiatives to enhance asset management practices to ensure that Mississauga residents can continue to receive the levels of service they have become accustomed to.

As part of the development of future Roads Asset Management Plans, strategies will be developed to manage risk and address funding challenges.

To manage the infrastructure gap, the Service Area will deploy a combination of mitigation and holding strategies in addition to developing a funding strategy for the renewal of roadway assets.

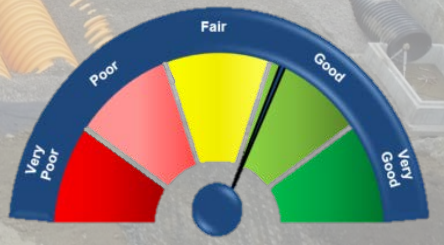
Detailed AM Plan - Stormwater

Quick Facts	
1,892 km	Storm Sewers
80	Stormwater Management Facilities
150 km	Watercourses
$5.29 Billion	Value

	Storm Sewers	Stormwater Management Facilities	Watercourses
Replacement Value	$ 4.71 Billion	$ 160 Million	$ 424 Million
Condition	Good	Very Good	Good

Storm Sewers Overall Condition

Stormwater Management Facilities Overall Condition



Watercourses Overall Condition

Total 10-Year Infrastructure Gap: $20.7 Million

Table of Contents

Introduction

The Stormwater Service Area plans, develops, constructs, maintains and renews the stormwater management system, which protects property, infrastructure and the natural environment from erosion and flooding and enhances water quality. The Stormwater management system includes Storm Sewers, Stormwater Management Facilities and Watercourses and is one of the largest assets owned and operated by the City.

This chapter documents the Stormwater Asset Management Plan and includes the following information:

- **State of the Infrastructure**: Outlines the current state of the infrastructure assets including what the City owns, the condition of the assets and the costs to replace them
- **Levels of Service**: Describes and measures the service performance and outcomes the City currently provides
- **Future Demand**: Summarizes the expected future demand on the Stormwater services
- **Lifecycle Management Strategy**: Documents the strategies used throughout the assets' lifecycle to support ongoing service delivery
- **Infrastructure Gap & Challenges**: Describes the forecasted budgets, revenues, capital expenses (growth and non-growth) and reserves, and identifies any financial gap
- **Continuous Improvement**: Documents the continuous improvements identified during the development of this Asset Management Plan and previous maturity assessments

State of the Infrastructure

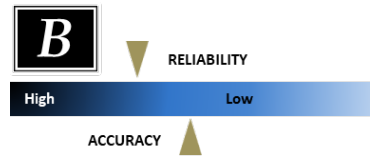
The following section summarizes the state of the stormwater asset classes including the Storm Sewer Drainage Network, Stormwater Management Facilities and the Watercourse Network (commonly referred to throughout the report as *Storm Sewers*, *SWMF* and *Watercourses*). This section also includes the current replacement value and condition rating for the respective asset types or assets. Summary tables, which follow here, are provided for each asset class.

Storm sewers outletting to Sheridan Creek, behind Benedet Drive

Asset Class:
Storm Sewers

Replacement Value:
$4.71 Billion

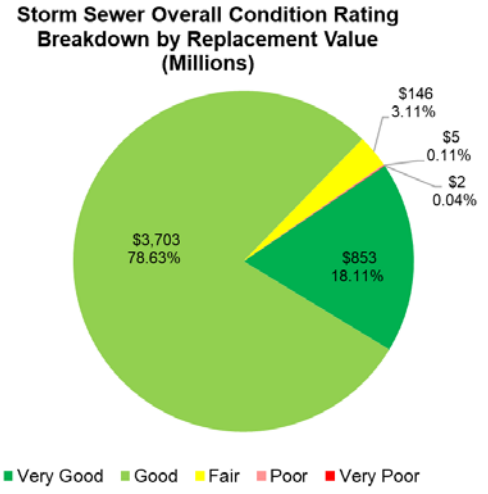
Reliability and Accuracy Scale

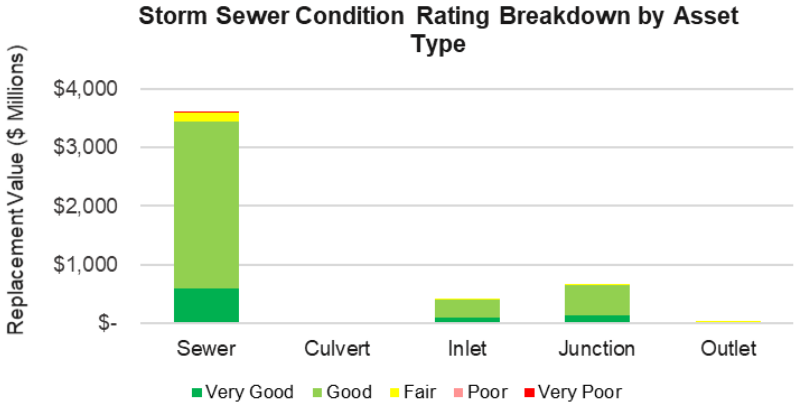


Interesting Facts About the Storm Sewers :

- The City has over 1,892 km of main line storm sewer pipes (excluding laterals) in its storm drainage network. If laid out end to end these pipes would connect the City of Mississauga to the City of Winnipeg
- This asset class includes over 51,000 catch basins that help to collect the City's rainwater runoff before it outlets to the City's Stormwater Management Facilities, watercourses and Lake Ontario
- In terms of overall network condition 18 per cent of the assets are rated **Very Good**, 79 per cent **Good**, three per cent **Fair** and less than one per cent **Poor** or **Very Poor**

Trunk storm sewer under Dundas St W, near Mississauga Rd

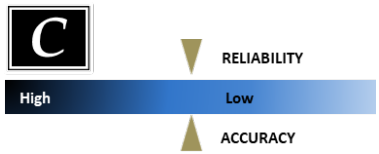




Asset Class:
Stormwater Management Facilities

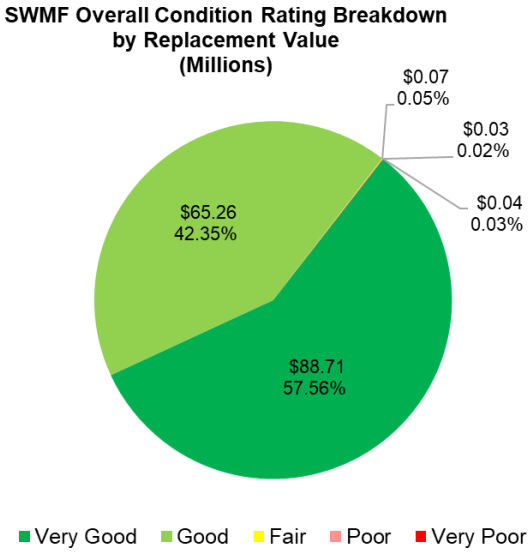
Replacement Value:
$160 Million

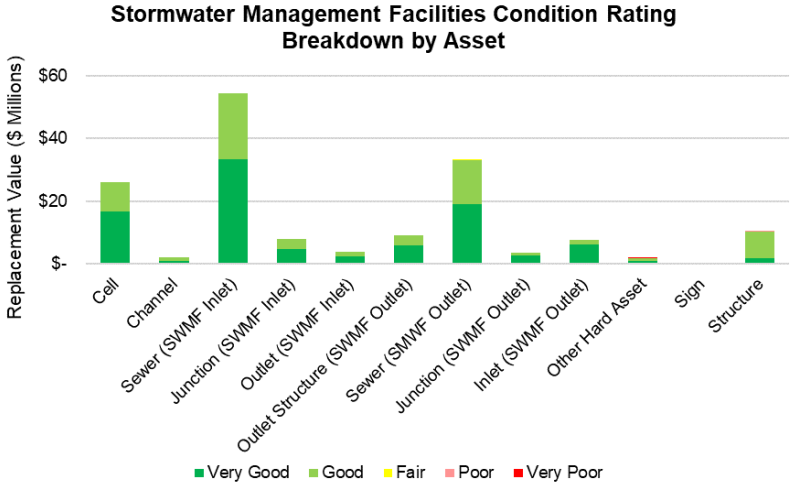
Reliability and Accuracy Scale



Interesting Facts About the Stormwater Management Facilities:

- The stormwater management system includes 80 stormwater management facilities (SWMF) that help to collect, store and clean a portion of the City's rainwater runoff.
- The types of SWMFs vary but typically they provide flood control and/or water quality treatment before discharging to the City's watercourse or storm sewer network.
- In terms of overall facility condition, 58 per cent of the assets are rated **Very Good** and the remaining 42 per cent are rated **Good**.



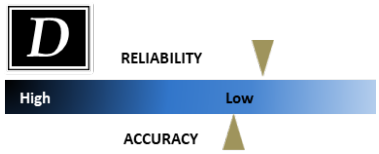


Water Quality & Quantity Control Facility behind Tahoe Blvd

Asset Class: Watercourses

Replacement Value: $424 Million

Reliability and Accuracy Scale

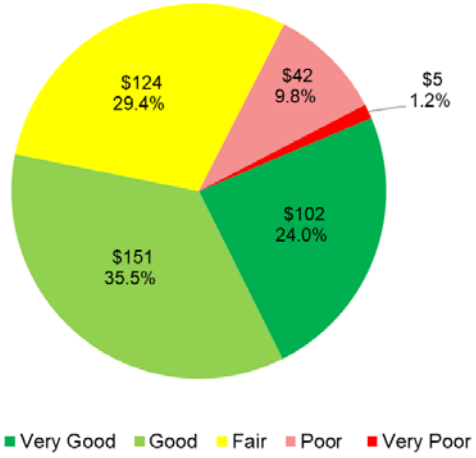


Interesting Facts About the Watercourses:

- The City is responsible for maintaining approximately 150 km of watercourse network (reaches) and associated bank, channel and instream assets that help to collect and drain the City's rainwater runoff.
- In terms of overall network condition, 60 per cent of the assets are rated **Very Good** or **Good**, 29 per cent **Fair**, and the remaining 11 per cent **Poor** or **Very Poor**.

Cooksville Creek, downstream of Burnhamthorpe Rd E

Watercourse (Reach) Overall Condition Rating Breakdown by Replacement Value (Millions)



State of Infrastructure Report

The state of infrastructure report provides a snapshot of the assets that provide stormwater services and are funded by the Stormwater Charge in the City of Mississauga. The report provides the available inventory of assets including their current replacement value, the condition of the assets and the amount of risk the stormwater assets carry. This report also includes an explanation of how condition and risk were assessed along with limitations to this assessment based on the availability of data.

Asset Inventory & Valuation

A summary of the Stormwater asset inventories using the City's available data for each of the asset classes and/or types is shown in Table 1 (Storm Sewers), Table 2 (Stormwater Management Facilities), Table 3 (Watercourses) and Table 4 (all Stormwater).

Replacement values for the storm sewer drainage network and SWMF asset classes were produced by developing unit costs for each of the assets listed below. In lieu of a detailed asset inventory, the replacement values for the watercourse network (reaches) were developed using the methodology described in the State of Infrastructure –Watercourses Overview section later in this document

Table 1 - Inventory and Valuation (Storm Sewers)

Service Area	Asset Class	Asset Type	Assets	Inventory	Unit	Replacement Value ($000)
Stormwater	Storm Sewer Drainage Network	Sewers	Main	1,659	km	2,480,559
			Trunk	133	km	1,054,201
			Foundation Drain Collector (FDC)	93	km	58,468
		Culverts	Major/Minor Culvert	1,146	m	9,968
		Inlet	Catch Basin (CB)	45,727	Ea.	348,695
			Double Catch Basin (DCB)	5,515	Ea.	68,017
		Junction	Maintenance Hole (MH)	25,773	Ea.	613,886
			CB Maintenance Hole (CB-MH)	1986	Ea.	34,585
			FDC Maintenance Hole (FDC-MH)	1276	Ea.	14,575
		Outlet	Endwall, Apron, Energy Dissipater, etc.	716	Ea.	26,246
Total						**4,709,200**

Table 2 - Inventory and Valuation (Stormwater Management Facilities)

Service Area	Asset Class	Asset Type	Assets	Inventory	Unit	Replacement Value ($000)
Stormwater	Stormwater Management Facilities (SWMF)	Cell	Excavation, Lining, Fencing, Access Road, Vegetation	87	Ea.	26,067
		Channel	Inlet/Outlet, Overflow, Swales etc.	2,960	m	1,935
		Sewer (SWMF Inlet)	Main, Trunk	15,273	m	54,412
		Junction (SWMF Inlet)	Maintenance Hole	157	Ea.	7,868
		Outlet (SWMF Inlet)	Endwalls	88	Ea.	3,896
		Control Structure (SWMF Outlet)	Non-standard Outlet Structure (Box, Weir, etc.)	34	Ea.	9,147
		Sewer (SWMF Outlet)	Main, Trunk	6,587	m	33,148
		Junction (SWMF Outlet)	Maintenance Hole	56	Ea.	3,506
		Inlet (SWMF Outlet)	Catch Basin	93	Ea.	1,654
			Double Catch Basin	21	Ea.	1,159
			Headwall	83	Ea.	4,767
		Sewer	Berm Pipe/MH/CB	819	m	1,676
		Safety	Sign	102	Ea.	31
		Structure	Berm, Retaining Wall, Erosion Control, etc.	41	Ea.	10,356
Total						**159,621**

Table 3 - Inventory and Valuation (Watercourses)

Service Area	Asset Class	Asset Type	Assets	Inventory	Unit	Replacement Value ($000)
Stormwater	Watercourse Network (Reaches)	Bank, Instream, Channel[1]	To be inventoried	150	km	423,537
Total						**423,537**

Table 4 - Total Valuation

Service Area	Asset Class	Replacement Value ($000)
Stormwater	Storm Sewer Drainage Network	4,709,200
	Stormwater Management Facilities (SWMF)	159,621
	Watercourse Network (Reaches)	423,537
Total		**5,292,358**

Asset Data Limitations

A review of the current available data has been completed and several gaps were identified, either for missing attributes or missing assets. Of note, 72 per cent of the existing records do not have a material or size (the vast majority of which are CBs, DCBs, CB-MHs, MHs, FDC-MHs and outfalls), and five per cent of the existing recorded assets do not have an installation date as shown in Table 5.

[1] Inventory of asset types is currently not available. An allowance was made for typical assets during the estimation of replacement costs.

Table 5 - Existing Records with Missing Attributes

Asset Class	Number of Records	Asset Condition	Install Date	Replacement Cost	Useful Life	Material Type	Size	Length
Storm Sewers	111,200	100% [2]	5%	0%	0%	73%	73%	1%
SWMF	1,398	100% [3]	0%	0.4%	0%	0%	2.5%	20.1%
Watercourses[4]	231	100%	100%	100%	100%	100%	100%	100%
Total	**112,829**	**100%**	**5%**	**0.2%**	**0.6%**	**72%**	**72%**	**1.1%**

Additionally, some assets have not yet been formally captured in the Stormwater inventories above. These are summarized in Table 6. These known asset types and assets vary in quantity and in their potential impact on the replacement values for each asset class. As the Stormwater Service Area matures, these assets will be considered and integrated into future plans and will ultimately increase the total stormwater replacement value. In addition, continuous improvement tasks to inventory several of these asset types have been identified in the sections that follow, most notably the development of a watercourse asset inventory. For now, these assets have been excluded from this Asset Management Plan but are summarized in Table 6.

[2] Storm Sewers Condition assessments have been partially completed; however, they have not been linked to each asset.
[3] SWMF condition assessments have been completed; however, they have not been linked to each asset.
[4] Watercourse assets have not currently been assigned unique IDs or attributes. The reported information is based on reach assessments.

Table 6 - Stormwater Inventories/Assets not reported in this Asset Management Plan

Asset Class	Asset Type / Assets
Storm Sewer Drainage Network	• Service Connections • Ditch & Driveway Culverts • Major/Minor Culverts (partial) • Catch basin laterals (partial)[5] • Fittings • Overland Flow Routes
Stormwater Management Facilities (SWMF)	• Dry Ponds (partial) • Low Impact Developments (partial) • Underground Storage (partial) • Pumping Stations • Manufactured Treatment Devices (i.e., OGS Units)
Watercourse Network (Reaches)	• Bank – erosion control, toe protection, revetments, etc. • Instream – riffle/pool, drop structures, grade control, flow deflection, etc. • Channel – fully lined, natural, etc.

Asset Data Assumptions

The following assumptions were made where attributes were missing:

Replacement Cost – Replacement costs were calculated based on Estimated Unit Cost (EUC) and include design costs, professional services, engineering services, contingencies, administration, material and labour. They are reported in 2020 dollars.

Useful Life – An Estimated Useful Life (EUL) was assigned based on asset type and material.

Material - The most likely material was assumed (e.g., maintenance holes, catch basins, and outfalls have been assumed to be concrete).

Asset Size – Assets with missing size attributes which could not be estimated have been excluded from the analysis.

[5] The replacement value for catch basin laterals is currently incorporated into the value of individual CB units with an average lateral length of 10.0m.

Asset condition – The condition of assets has been estimated based on age and remaining useful life (RUL) as described in Table 7 on the basis that as an asset reaches its expected life, its condition will deteriorate. This approach is commonly used for assets, where measured condition data is not readily available. Table 7 shows the translation used to assign a 1 to 5 condition rating based on asset age (expressed as the percentage of its lifespan remaining), and a description for each rating.

Install date – Where available, the install date was assumed to be the same as the asset it is connected to (e.g., a maintenance hole was assumed to have been installed at the same time as the connecting pipe). Where there were no connecting assets, or the install date of the connecting asset was also missing, the install date was assumed to be half the EUL (e.g., a catch basin with an EUL of 100 years and missing install date is assumed to have been installed in 1970, 50 years ago).

Remaining Useful Life – RUL was calculated by subtracting the asset's current age from its EUL. The RUL is the expected time remaining before an asset will need to be replaced.

Table 7 - Condition Rating Scale

Rating	Rating Description	% of Remaining Useful life (RUL)	Rating Description
1	**Very Good:** Fit for the Future	RUL ≥ 75%	The infrastructure in the system or network has greater than or equal to 75% of its remaining useful life. It is generally in very good condition, typically new or recently rehabilitated.
2	**Good:** Adequate for Now	75% > RUL ≥ 35%	The infrastructure in the system or network has less than 75% (and greater than or equal to 35%) of its remaining service life. It is in good condition.
3	**Fair:** Requires Attention	35 > RUL ≥ 13%	The infrastructure in the system or network has less than 35% (and greater than or equal to 13%) of its remaining service life. It is in fair condition.
4	**Poor:** Approaching End of Life	13% > RUL ≥ 3%	The infrastructure in the system or network has less than 13% (and greater than or equal to 3%) of its remaining service life. It is in poor condition and mostly below operable state, with many elements approaching the end of their service life.
5	**Very Poor:** Requires Renewal	RUL < 3%	The infrastructure in the system or network has less than 3% of its remaining service life. It is in very poor, unacceptable condition and should be replaced or rehabilitated.

The recommended data improvement actions are listed in the Continuous Improvement Section. Actions include improvement to the asset inventory information to allow for an asset-level analysis of the state of infrastructure to be completed before the next update of this Asset Management Plan (AMP).

Asset Risk

Asset level risks are calculated by multiplying the asset 'consequence of failure' with the 'likelihood of failure' as shown in Figure 1. For this asset management plan, criticality is used as a proxy for 'Consequence of Failure' (CoF) to calculate risk. However, in subsequent asset management plans, the CoF will also consider other aspects such as disruption, safety, financial impact, environmental impact, reputation to the organization, etc., in addition to criticality. The criticality of an asset is the inherent consequence of the loss of its function, including its impact on the function of a system or network of assets. While the loss of some assets or components may have little impact on service delivery and negligible risk of damage/injury, the loss of others may severely impact public services, and may lead to private property damages, significant financial losses or fatalities.

Figure 1 - Asset Level Risk Calculation

For each of the Stormwater Service Area's asset classes (Storm Sewers, Stormwater Management Facilities and Watercourses), criticality criteria have been identified for each major asset (such as size, type or location of the asset). Asset Criticality rates how critical the asset is to deliver the required service. A numerical score is assigned to asset types or assets, based on the applicable descriptions in Table 8.

Table 8 - Asset Criticality Ranking

Criticality	Description	Score
Very Low	• Easy to replace. • Can be non-operational for multiple months without significantly impacting core service delivery to many users.	1
Low	• Somewhat difficult to replace. • Can be non-operational for multiple weeks without significantly impacting core service delivery to many users. • Asset does not perform a safety function or meet a regulatory requirement.	2
Medium	• Moderately difficult to replace. • Outages of more than a couple of days may significantly impact core service delivery to many users. • Asset may perform a safety function or meet a regulatory requirement.	3
High	• Highly mission-sensitive asset with no redundancy. • Mission-critical asset with very limited redundancy. • Significant community investment.	4
Very High	• Mission-critical and unique asset. • Significant service disruption from any outage. • No redundancy. • Significant community investment.	5

Using the outputs from the State of Infrastructure (SOI) analysis and the ranking descriptions in Table 8 the likelihood of asset failure for each asset type or component is assigned. The remaining useful life in Table 9 is used to assign likelihood of failure, where data is available.

Table 9 - Likelihood of Failure Ranking

Likelihood	Description	Score
Very Low	• Remaining useful life is >75% of the asset lifespan. • Assets are generally in very good condition, typically new or recently rehabilitated.	1
Low	• Remaining useful life is between 75% and 35% of the asset lifespan. • Assets are in good condition.	2
Medium	• Remaining useful life is between 35% and 13% of the asset lifespan. • Assets are in fair condition and will be subject to mid-life interventions.	3
High	• Remaining useful life is between 13% and 3% of the asset lifespan. • Assets are in poor condition and mostly below standard, with many elements approaching the end of their service life.	4
Very High	• Remaining useful life is less than 3% of the asset lifespan. • Assets are in very poor, unacceptable condition and should be replaced or rehabilitated.	5

Once the asset criticality and likelihood have been rated, the risk score can be calculated. The risk matrix in Table 10 below shows the resulting range of ratings.

Table 10 - Risk Rating Matrix

Risk Score and Rating		Impact				
Likelihood		Very Low	Low	Medium	High	Very High
		1	2	3	4	5
Rare	1	1 Very Low	2 Very Low	3 Low	4 Low	5 Low
Unlikely	2	2 Very Low	4 Low	6 Low	8 Medium	10 Medium
Possible	3	3 Low	6 Low	9 Medium	12 High	15 High
Likely	4	4 Low	8 Medium	12 High	16 High	20 Very High
Almost Certain	5	5 Low	10 Medium	15 High	20 Very High	25 Very High

State of Infrastructure - Storm Sewers

Overview

The storm sewer drainage network is comprised of main and trunk sewers, foundation drain collectors, culverts, outlets, maintenance holes, catch basin maintenance holes, catch basins, etc. Estimated Unit Costs (EUC) were not available for some assets like fittings or service connections, and as a result, their replacement cost is not included in valuation and renewal estimation.

Table 11 shows the length and quantity of the assets in the storm sewer drainage network, condition distribution and total replacement costs for each asset.

Table 11 - Storm Sewer Summary

Service Area	Asset Class	Asset Type	Assets	Unit	Inventory	Condition Distribution					Replacement Costs ($000)
						1	2	3	4	5	
Storm Water	Storm Sewer Drainage Network	Sewer	Main	km	1,659	20.5%	79.1%	0.2%	0.1%	0.1%	2,480,559
			Trunk	km	133	7.2%	79.5%	13.1%	0.2%	0%	1,054,201
			Foundation Drain Collector (FDC)	km	93	30.1%	69.9%	0%	0%	0%	58,468
		Culvert	Major/Minor Culvert	m	1,146	6.8%	81.1%	12.1%	0%	0%	9,968
		Inlet	Catch Basin (CB)	No.	45,727	24.6%	75.3%	0.1%	0%	0%	348,695
			Double Catch Basin (DCB)	No.	5,515	22.2%	77.8%	0.0%	0%	0%	68,017
		Junction	Maintenance Hole (MH)	No.	25,774	21.5%	78.4%	0.1%	0%	0%	613,886
			CB Maintenance Hole (CB-MH)	No.	1985	18.9%	80.6%	0.5%	0%	0%	34,585
			FDC Maintenance Hole (FDC-MH)	No.	1276	57.0%	43.0%	0.0%	0%	0%	14,575

Service Area	Asset Class	Asset Type	Assets	Unit	Inventory	Condition Distribution 1	2	3	4	5	Replacement Costs ($000)
		Outlet	Endwall, Apron, Energy Dissipator, etc.	No.	716	11.9%	87.7%	0.4%	0%	0%	26,246
Asset Total				**km**	**1,886**	**18%**	**78.5%**	**3.1%**	**0.1%**	**0.2%**	**4,709,200**
				No.	**80,993**						

Condition

The overall age-based condition of the storm sewer drainage network is **Good**. Most of the assets are newer or moving towards the middle of their service lives. There is a small percentage (three per cent) of assets that are rated in **Poor** and **Very Poor** condition, due to the assets moving towards or reaching the end of their expected lifespan. It is recommended that the Stormwater Service Area begin leveraging the available condition inspection records by linking them to the available asset ID. Using this approach will improve the accuracy of the condition profile and better inform the renewal forecast. The age and condition profiles for the storm sewer drainage network are shown in Figure 2.

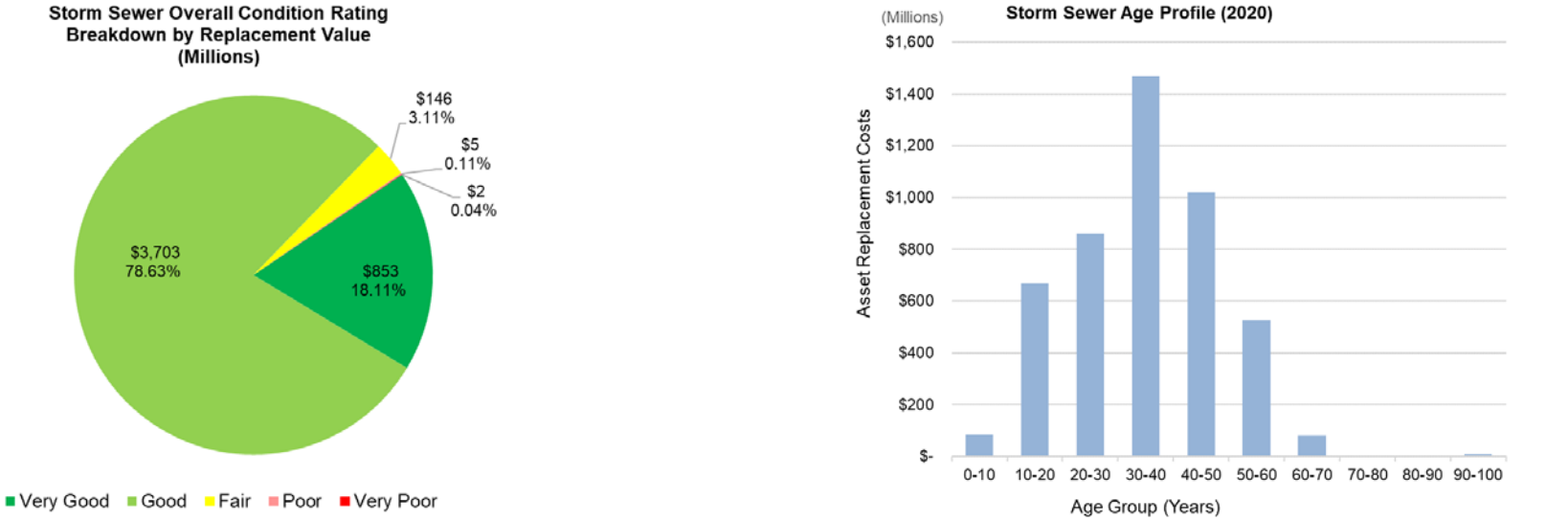


Figure 2 - Storm Sewer Drainage Network - Age and Condition Profiles

Risk

Criticality ratings were developed for all storm sewer drainage network assets. As described earlier in Figure 1, the risk ratings assigned to each asset were calculated by taking the product of consequence of failure and likelihood of failure. Currently, consequence of failure for the storm sewer assets is comprised entirely of the asset criticality score. Further, asset criticality is based on the size of each asset (e.g., pipe diameter).

The likelihood of failure is based on the RUL of each asset. The outputs from the risk ratings in Figure 3 show the percentage of the storm sewer drainage network in each risk category, and the value of the assets in each risk category. The storm sewer drainage network mainly comprises low risk assets, with 94 per cent being rated Very Low or Low criticality. The other six per cent of the network is rated Medium criticality. Less than 0.1 per cent (600 m of sewer mains and trunks) of the assets are rated High criticality.

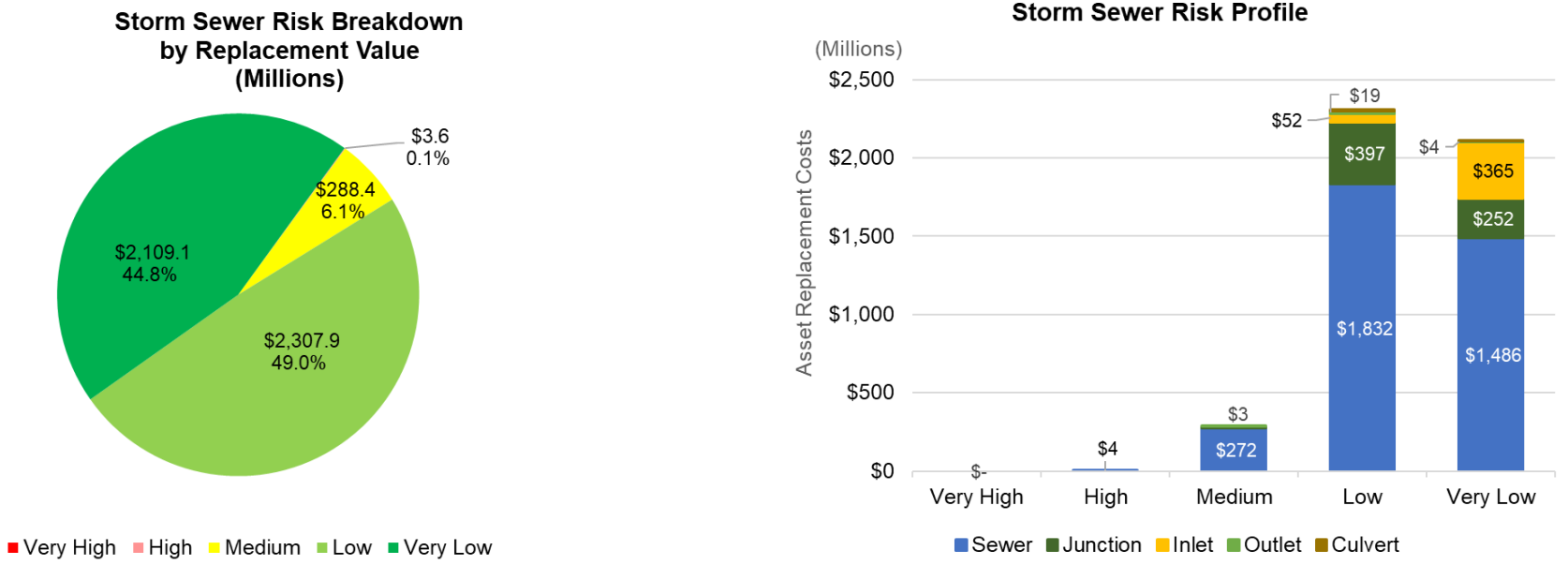


Figure 3 - Storm Sewer Drainage Network - Risk Rating Outputs

State of Infrastructure - Stormwater Management Facilities

Overview

Stormwater Management Facilities (SWMF) are comprised of cells, channels (swales, overflow routes), sewers (SWMF Inlet pipes, SWMF Outlet pipes, Berm pipe), Junctions (SWMF Inlet and outlet MHs), Outlets (SWMF Inlet endwalls), Control Structures (SWMF Outlet structures), Inlets (SWMF Outlet headwalls and catch basins), Safety (signs), and Structures (berms, retaining walls etc.).

Table 12 shows a summary of the length and quantity, condition distribution and replacement costs of the stormwater management facilities for which data is currently available, by asset type. The 80 facilities range in function but are predominantly quantity (dry) and quality control (wet) ponds.

Table 12 - Stormwater Management Facilities Summary

Service Area	Asset Class	Asset Type	Assets	Unit	Inventory	Condition Distribution					Replacement Costs ($000)
						1	2	3	4	5	
Storm Water	Stormwater Management Facilities (SWMF)	Cell	Excavation, Lining, Fencing, Access Road, Vegetation	Ea.	86	64%	36%	0%	0%	0%	26,067
		Channel	Inlet/Outlet, Overflow, etc.	m	2,960	41%	59%	0%	0%	0%	1,935
		Sewers *(SWMF Inlet)*	Main, Trunk	m	15,273	62%	38%	0%	0%	0%	54,412
		Junction *(SWMF Inlet)*	Maintenance Hole	Ea.	157	60%	40%	0%	0%	0%	7,867
		Outlet *(SWMF Inlet)*	Endwalls	Ea.	88	63%	37%	0%	0%	0%	3,896

Service Area	Asset Class	Asset Type	Assets	Unit	Inventory	Condition Distribution					Replacement Costs ($000)
						1	2	3	4	5	
		Control Structure *(SWMF Outlet)*	Non-standard Outlet Structure (Box, Weir, etc.)	Ea.	34	65%	35%	0%	0%	0%	9,147
		Sewer *(SWMF Outlet)*	Main, Trunk	m	6,587	58%	42%	0%	0%	0%	33,148
		Junction *(SWMF Outlet)*	Maintenance Hole (MH)	Ea.	56	79%	21%	0%	0%	0%	3,506
		Inlet *(SWMF Outlet)*	Catch Basin (CB)	Ea.	93	75%	25%	0%	0%	0%	1,654
			Double Catch Basin (DCB)	Ea.	21	88%	12%	0%	0%	0%	1,159
			Endwall	Ea.	83	83%	17%	0%	0%	0%	4,767
		Sewer	Berm Pipe	m	819	56%	42%	0%	0%	3%	1,676
		Safety	Sign	Ea.	102	23%	77%	0%	0%	0%	31
		Structure	Berm, Retaining Wall, Erosion Control, etc.	Ea.	41	17%	83%	0%	0%	0%	10,356
Asset Total				**m**	**25,638**	**59%**	**41%**	**0%**	**0%**	**0%**	**159,621**
				Ea.	**761**						

Condition

All SWMF assets are rated in **Very Good** or **Good** condition. Most of the assets are less than 30 years old and are moving towards the middle of their service lives. The age and condition profiles for the SWMF are shown in Figure 4.

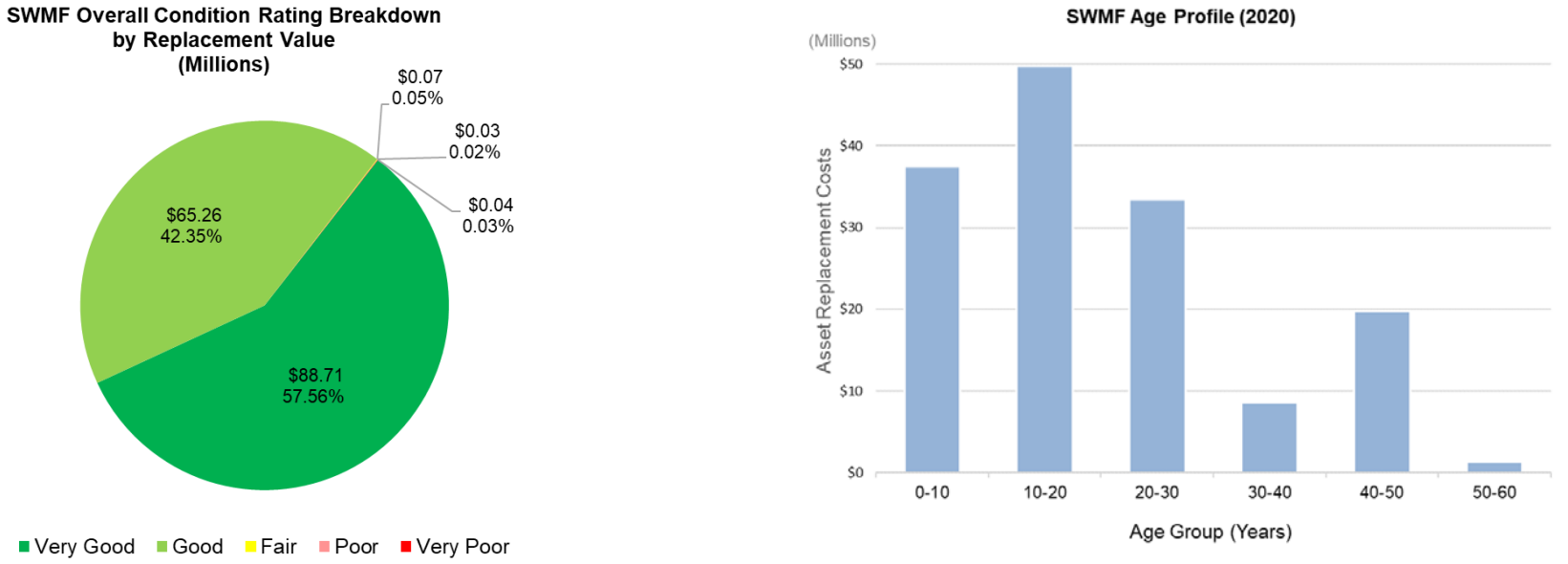


Figure 4 - Stormwater Management Facilities – Age and Condition Profiles

Risk

Criticality ratings were developed for all SWMF assets. The risk ratings were calculated by considering the following metrics: contributing drainage area; water storage volumes; location (proximity to houses and critical infrastructure such as major roadways or rail lines etc.); and function (quality/quantity control provided) of each facility. For each of these metrics, a criticality score was assigned and the average of these criticality scores was used to determine the overall criticality rating of each SWMF. The RUL, or RUL of the inlets and outlets associated to each SWMF was used to determine the likelihood of failure for the facility.

The outputs from the risk ratings in Figure 5 show the percentage of SWMFs and the value of the assets in each risk category. Most of the SWMF are low-risk assets, with over 85 per cent being rated **Very Low** and **Low** criticality. Of the remaining assets, 14.5 per cent are Medium criticality and 0.05 per cent **High** criticality. There are no **Very High** criticality assets.

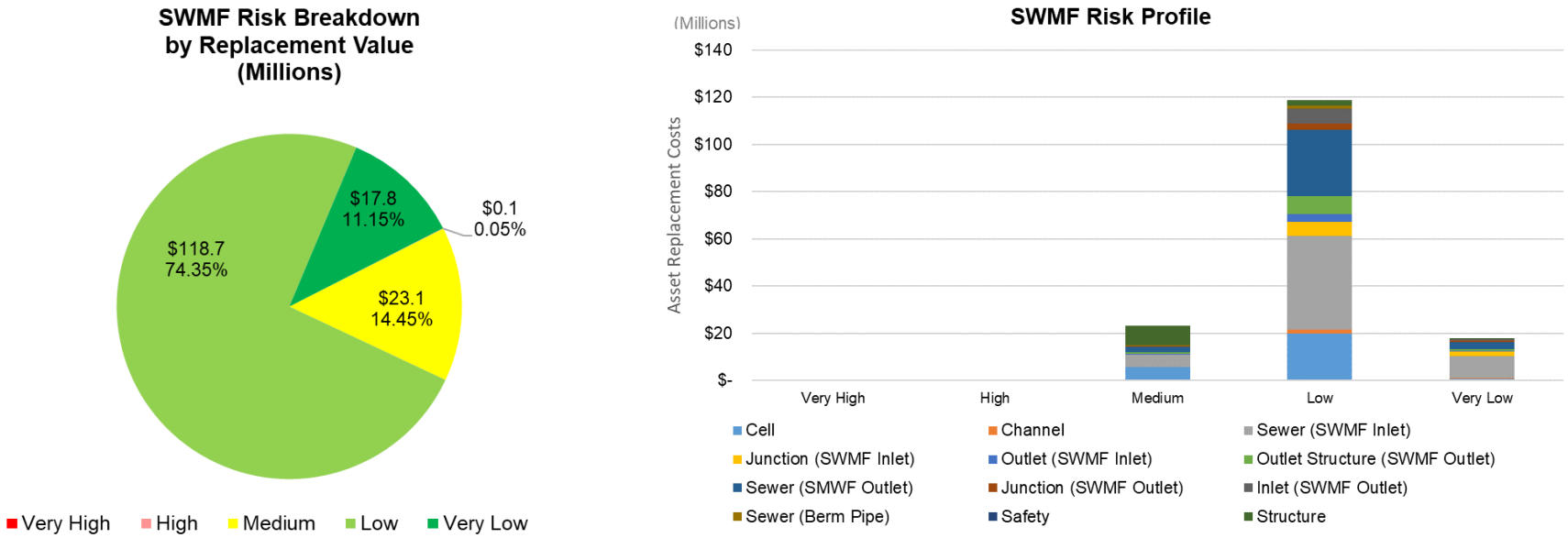


Figure 5 - Stormwater Management Facilities– Risk Rating Outputs

State of Infrastructure - Watercourses

Overview

The watercourse network is comprised of 32 creeks or rivers of which 150 km are City owned/maintained and have been divided into smaller sections called “reaches". In Mississauga, there are approximately 50 km of additional watercourses under ownership of various stakeholders including other government bodies or private lands that are excluded from this AMP. A reach map of the full watercourse network is provided in Figure 10.

The watercourse network includes natural and engineered assets. The engineered infrastructure is generally installed for erosion control or conveyance, and is often comprised of materials like gabion baskets and armourstones. Natural assets include materials like stone, soil and plantings and provide a variety of watercourse functions and services.

The asset inventory for the watercourse network has not been fully developed and componentized at this time. The valuation of the watercourses in Table 13 was completed by applying an average unit cost to the reach length and a cost adjustment factor to estimate the replacement cost of engineered and natural assets based on the known characteristics of the reaches. Future plans will seek to componentize the watercourses for a more accurate inventory and detailed valuation.

Table 13 - Watercourses Summary

Service Area	Asset Class	Asset Type	Unit	Inventory	Condition Distribution					Replacement Costs ($000)
					1	2	3	4	5	
Stormwater	Watercourse Network (Reaches)	Bank, Instream, Channel	km	150	24%	36%	29%	10%	1%	423,537
		Asset Total	**km**	**150**	**24%**	**36%**	**29%**	**10%**	**1%**	**423,537**

Condition

The watercourse asset age information is not currently available because the existing watercourse assets have not yet been mapped or assigned unique IDs and attributes and details of the assets have not been captured. However, Stormwater staff routinely inspect the watercourse network based on the defined reach network (total 231 City reaches) to identify new issues and re-assess known problem sites.

This information is used for Operations, Maintenance and Capital Planning. As part of these inspections, the reaches are given a condition score/stability index based on visual indicators of geomorphic processes. These stability index scores were translated to a 5-point scale to create condition proxy ratings for the watercourse reaches in the interim as shown in Figure 6. Of the 231 reaches, only seven did not have an available stability index score. These were given a default Condition Score of 5 (**Very Poor**). When the condition grades are weighted based on the reach replacement value, this information indicates that 89 per cent of the reaches are in **Fair** or better condition; and 11 per cent are in **Poor** and **Very Poor** Condition.

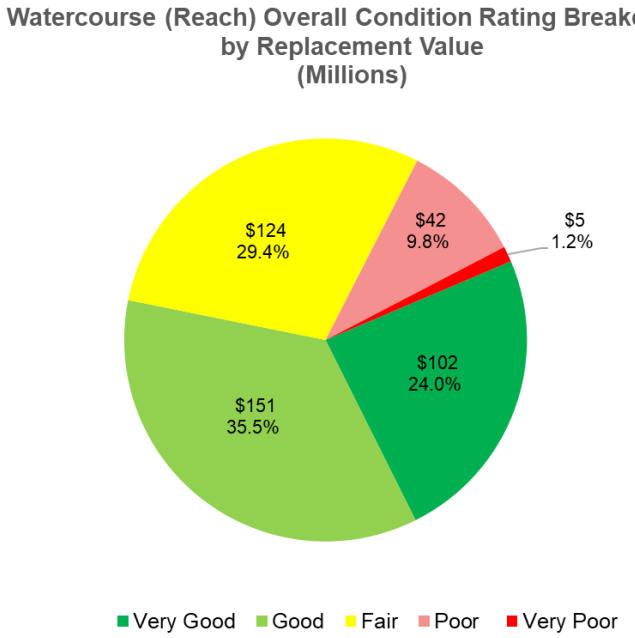


Figure 6 - Watercourse Condition Profile

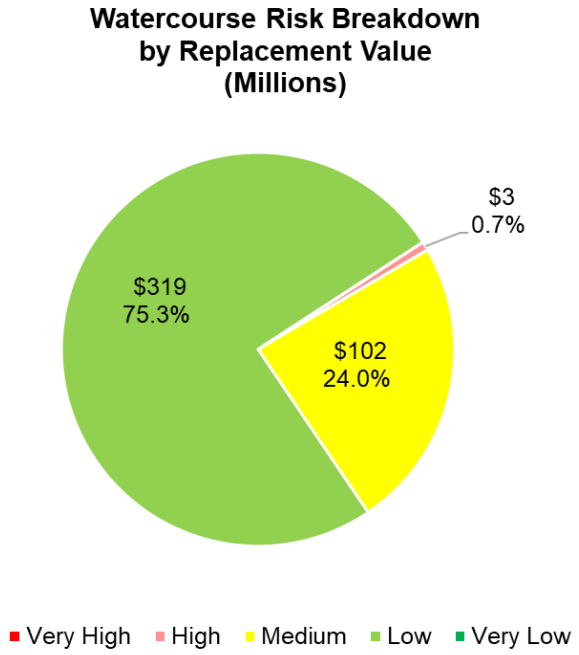
Armourstone erosion control treatments along Sheridan Creek

Risk

In lieu of detailed watercourse attribute information, risk was calculated for each reach in the inventory. The criticality ratings were quantified using the internal assessment scores for 'Problem Site Score' and 'Zone' defined for each reach. The 'Problem Site score' is based on the failure impact of assets within the reach. 'Zone' indicates the position of the reach along the watercourse. It is assumed that flows are expected to increase in lower reach positions, which generally relates to higher criticality.

The Likelihood of Failure for watercourses was quantified using the stability class and flow regime scores developed internally. In general, reaches with higher indicators of instability and a turbulent flow regime have a higher likelihood of failure.

The outputs from the risk ratings in Figure 7 show the percentage of the watercourse assets in each risk category, and the value of the assets in each risk category. Most of the reaches are low-risk assets, with 75 per cent being rated Low criticality.



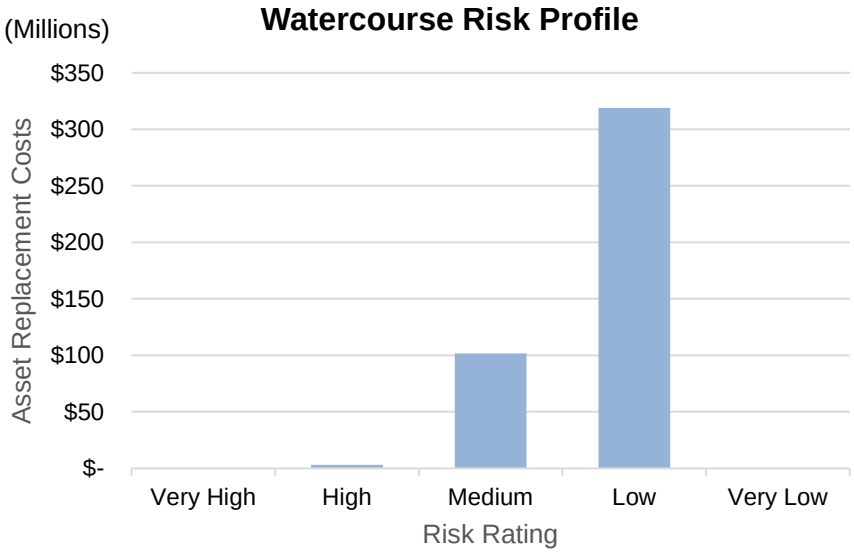


Figure 7 - Watercourse Network (Reaches) – Risk Rating Outputs

Levels of Service

The purpose of this section is to describe the levels of service (LOS) that City staff are currently providing and aim to provide for the Stormwater Service Area.

LOS are the outcomes that an organization intends to deliver to its customers. They should also be utilized as key drivers for making decisions and future investment in infrastructure assets. As such, LOS need to be clearly articulated in terms that end users and decision makers can understand. Having well-defined service levels will allow the City to be transparent with its ratepayers and other stakeholders to find the appropriate balance between affordability and the community's service expectations.

Performance measures indicate what the customers and stakeholders experience from the service that is delivered.

LOS Trends indicate how the performance metric is expected to change over the next five years based on the available data. LOS Targets will be reported in 2024 as required by *O. Reg. 588/17*. This comparison of performance delivered (measured results) to performance intended (target values) will assist the City in strategic planning, operational choices, and investment decisions.

Table 14 presents a summary of the approach to describe levels of service and performance measures. This is based on examples from the 2015 International Infrastructure Management Manual (IIMM) which was written by a consortium of asset management professionals and is widely accepted as the guiding document to implement the ISO 55000 standard for infrastructure asset management.

Table 14 - Level of Service Criteria

Concept	Definition	Example
Levels of Service (LOS)	Specific objectives of the service the organization intends to deliver, from the customer point of view. LOS provide the link between higher level corporate and asset management objectives with more detailed technical and operational objectives.	To provide capture and treatment of Stormwater runoff to minimize damage to public and private property and the environment.
LOS Attributes	LOS attributes of the overall service that are relevant and meaningful to stakeholders.	• Good Stewardship • Reliability • Quality

Concept	Definition	Example
Performance Measures	Criteria that can be measured and provide an indication of how the organization is doing in delivering the intended LOS form performance measures. They can be defined as: *Customer performance measures* - Measures describing how the customer receives or experiences the service. *Technical performance measures* -Technical criteria the organization can measure to indicate how the service is being achieved.	Good Stewardship: Percentage of SWMF inspections completed annually Reliability: Percentage of residents satisfied with drainage of stormwater Quality: Percentage of Watercourse assets in Fair or better condition.
Future Trends	The anticipated trend for the performance metric over the next five years, assuming there is no significant change to the current lifecycle management activities.	The condition of the stormwater infrastructure is not expected to significantly decline over the next five years.

Level of Service Methodology

City staff followed the approach described below to identify key LOS objectives and appropriate performance measures.

Identify Stakeholders

Identify the stakeholders who are affected by the delivery of stormwater services. The stakeholder may use the service, rely on the service to provide their own service, regulate the service, depend on the service as part of their community service provision mandates, or connect to the service.

LOS Objectives and Attributes

Determine the key expectations (LOS objective) of each stakeholder. One or more service attribute is identified for each expectation statement. It is important to note that it is reasonable that the same attribute would apply to more than one expectation.

Legislative Requirements for Levels of Service

Review appropriate legislation and regulations that govern how the City provides stormwater management services. Table 15 identifies legislative acts that are critical or applicable to the provision of Stormwater services and project delivery. In addition to legislative requirements, there are several industry best-practice manuals and guidance documents that inform staff to effectively manage the City's stormwater system.

Table 15 - Governing Legislation

Legislation	Requirements
***Accessibility of Ontarians with Disabilities Act*, 2005**	Provides accessibility standards to benefit all Ontarians.
***Building Code Act,* 1992**	Provides requirements to adhere to construction and safety practices.
***Conservation Authorities Act*, 1990**	Provides guidance for the organization and delivery of programs and services that further the conservation, restoration, development and management of natural resources in watersheds in Ontario.
***Development Charges Act*, 1997**	Provides municipalities the ability to levy charges to fund growth-related municipal infrastructure, on the principle that growth pays for growth.
***Drainage Act,* 1990**	Provides a procedure whereby the municipality may with a valid petition of landowners in the "area requiring drainage", provide a legal outlet for surface and subsurface waters not attainable under common law.
***Emergency Management and Civil Protection Act*, 1990**	Provides requirements for emergency management.
***Environmental Protection Act*, 1990**	Provides for the protection of the natural environment through regulations regarding discharge of contaminates into the natural environment.
***Fish and Wildlife Conservation Act,* 1997**	Regulates hunting, trapping, and fishing practices and aims to preserve at-risk wildlife, as well as the conservation of wildlife.
Fisheries and Oceans Canada (DFO)	Provides guidelines and laws to protect fisheries habitat in proximities to roadways and bridges.
***Lakes and Rivers Improvements Act*, 1990**	Provides legislation for the design, construction, operation, maintenance and safety of dams in Ontario.
Municipal By-Laws	Regulations approved by Council to safeguard and protect persons and properties.
***Municipal Government Act*, 2001**	• Practices and procedures • Accountability and transparency • Finance

Legislation	Requirements
***O. Reg. 472/10* and *O. Reg. 104/97*: Standards for Bridges - Ontario Structure Inspection Manual**	Defines which structures must be inspected routinely.
***O. Reg. 588/17*: Asset Management Planning for Municipal Infrastructure**	Provides policies and guidelines for levels of service considerations in stormwater management assets.
***Occupational Health and Safety Act,* 1990**	Rules governing health and safety in Ontario's workplaces.
***Ontario Heritage Act,* 1990**	Provides guidance for the organization and delivery of programs and services that further the conservation, restoration, development and management of natural resources in watersheds in Ontario.
***Ontario Water Resources Act,* 1990**	Provides guidance in the inspection and maintenance frequency of stormwater management facilities (i.e., storm ponds).
***Planning Act,* 1990**	Provides direction on municipal planning activities.

LOS Measures

LOS measures should identify an appropriate measurement for an attribute and describe how well the City is delivering that service attribute (e.g., how safe/reliable/affordable the service is). A useful LOS measure is quantitative and facilitates the development of "SMART" performance targets (that is, performance targets that are specific, measurable, achievable, relevant, and time-bound). The LOS measure identifies the 'thing' that the City should measure.

LOS measures can be grouped into the following categories:

- **Technical LOS measures:** Technical criteria the organization can measure to indicate how the service is being achieved. For example, minimize sources of pollutants in stormwater runoff.
- **Customer LOS measures:** Measures describing how the customer receives or experiences the service. For example, the amount and type of stormwater services the City provides to protect the community from flooding.

Current Performance
For each LOS measure, the result of the previous year (2019) is reported, unless otherwise stated.

Future Trend
Indicates how the LOS is expected to perform for the next five years, assuming there is no significant change to the service overall, current lifecycle management activities or funding. For this asset management plan, future trends for nearly all measures have been noted to be maintained (no increase/decrease) as there is a lack of historic annual data to forecast trends at this time. However, reporting LOS targets is a 2024 legislated requirement.


Derrydale Wet Pond (SWMF)

Stormwater LOS

Ontario Regulation 588/17 prescribes customer (green) and technical (orange) measures for stormwater as shown in Table 16 (i.e., SW01-SW03). In addition to these requisite measures, staff have also compiled advanced measures in Table 16 (i.e., SW04-SW18). The Stormwater Service Area has defined these LOS and their performance measures to be categorized as **Scope, Reliability, Good Stewardship, Environment and Quality.** The metrics beyond regulatory requirements or foundational metrics are considered advanced.

The LOS measures provided are predominantly from an asset planning perspective rather than operational. Through the Works Operations and Maintenance Division, the Stormwater Service Area also provides or contributes to several operation and maintenance services including, but not limited to, catch basin cleaning, street sweeping, storm sewer repairs and inlet/outlet inspection. City staff have plans to review, formalize and update the operation and maintenance LOS and as such there is potential for additional LOS measures in future Asset Management plans.

Table 16 - Stormwater Levels of Service

LOS Attribute	Service Area LOS Objective	Customer LOS Measure			Technical LOS Measure		
		Performance Measure	Current Performance	Future Trend	Performance Measure	Current Performance	Future Trend
Scope	*O. Reg. 588/17* Requirements	**SW01:** 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.	See maps and descriptions provided in Figure 8, Figure 9, and Figure 10. The resiliency of buildings[6] (via riverine and/or urban flooding) to 100-year storm events was estimated by development age as follows: Pre-1949, 95%; 1950-1969, 93%; 1970-1989, 89%; Post-1990, 95%. The resiliency of the SWM system[7] to 5-year storm events was estimated by development age as follows: Pre-1949, 92%; 1950-1969, 86%; 1970-1989, 89%; Post-1990, 91%.		**SW02**: Percentage of properties in municipality resilient to a 100-year storm.[6]	92%	
					SW03: Percentage of the municipal stormwater management system resilient to a 5-year storm.[7]	94%	
Reliability	Provide stormwater services to the community	**SW04:** Percentage of residents satisfied with stormwater services.[8]	77%		**SW05:** Percentage of municipal stormwater management system in Fair or better condition.[9]	99.0%	TBD[10]
Good Stewardship	Assess the stormwater management system to limit impacts to the community	**SW06:** Percentage of residents satisfied with drainage of stormwater.[11]	77%		**SW08:** Percentage of storm sewer network closed-circuit television (CCTV) inspections completed annually.	9.8%	TBD[10]
		SW07: Percentage of stormwater asset service requests resolved within 3-1-1 service level timelines.[12]	78%		**SW09:** Percentage of watercourse reach inspections completed annually.[13]	58.3%	TBD[10]
					SW10: Percentage of SWMF inspections completed annually[14].	100%	

[6] SW02 is based on Credit Valley Conservation's (CVC) dual-drainage model for the Cooksville Creek watershed. The percentage of buildings resilient to riverine and urban flooding during a 100-year storm was modelled for various development eras (i.e., pre-1949, 1950-1969, 1970-1989, 1990+) and the results were applied City-wide based on the estimated age of development.

[7] SW03 is based on CVC's dual-drainage model for the Cooksville Creek watershed. The percentage of the storm network with 5-year storm or greater capacity was modelled for various development eras (i.e., pre-1949, 1950-1969, 1970-1989, 1990+) and the results were applied City-wide based on the estimated age of development. Storm sewers outside of the Cooksville area that were known to have a smaller capacity were also adjusted for in this estimate.

[8] SW04 is based on Citizen Satisfaction Survey results (2019) reported in the Stormwater Business Plan.

[9] SW05 is derived from condition-distribution for all stormwater asset classes (Storm Sewers, SWMFs and Watercourses) and weighted by replacement value for 2020.

[10] Future trend cannot be reliably forecast as the service level is subject to change.

[11] SW06 is based on Citizen Satisfaction Survey results (2019) reported in the Stormwater Business Plan.

[12] SW07 is based on 2019 Infor records for service codes related to watercourses and stormwater management ponds directed to the Environmental Services section. This excludes service codes that were directed to other service groups or not logged in Infor.

[13] SW09 is based on the 2019 length of reach inspections (87.5 km) relative to the total number of City-owned/maintained reaches (150 km).

[14] SW10 for SWMF inspections are in accordance with inspection and maintenance frequencies prescribed by each individual SWMF's Environmental Compliance Approval (ECA).

LOS Attribute	Service Area LOS Objective	Customer LOS Measure			Technical LOS Measure		
		Performance Measure	Current Performance	Future Trend	Performance Measure	Current Performance	Future Trend
Environment	Provide services to mitigate risk of stormwater pollution	**SW11:** Percentage of storm sewer by-law & spills service requests resolved within 3-1-1 service level timelines.[15]	100%		**SW13:** Number of Storm Sewer By-Law Contraventions mitigated.[16]	54	
		SW12: Percentage of residents satisfied with cleanliness of City's creeks, rivers and streams.[17]	73%				
Quality	Maintain the stormwater management system to protect the community	**SW14:** Level of investment in the stormwater management system through the planning and delivery of Capital and Maintenance Programs	Update Stormwater Business Plan & Budget annually [18]		**SW15:** Percentage of Storm Sewers assets in Fair or better condition.[19]	99.8%	TBD[10]
					SW16: Percentage of Watercourses in Fair or better condition.[20]	89.0%	TBD[10]
					SW17: Percentage of SWMFs in Fair or better condition.[21]	99.95%	TBD[10]
					SW18: Percentage of Stormwater Quality Ponds with Fair or better function (based on sediment volumes)**.**[22]	85%	

[15] SW11 is based on 2019 Infor records for service codes directed to the Environmental Coordinator position. This excludes service codes that were directed to other service groups or those that were not logged in Infor.
[16] SW13 is based on the number of Storm Sewer By-Law Contraventions received in 2019, where pollutants are discharged to the storm sewer system. Every contravention is investigated, mitigated and resolved where possible. This figure excludes storm/sanitary sewer cross-connections, which are addressed separately.
[17] SW12 is based on Citizen Satisfaction Survey results (2019) reported in the Stormwater Business Plan.
[18] The Stormwater Business Plan & Budget documents how and where the City plans to allocate resources/funds to deliver stormwater programs and services.
[19] SW15 performance is based on age-based assessment of storm sewer assets in 2020.
[20] SW16 performance is based on most recent (various years) geomorphic stability class scores for City watercourse reaches.
[21] SW17 performance is based on age-based assessment of SWMF assets in 2020.
[22] SW18 performance is based on 2019 sediment volumes as reported in the Stormwater Business Plan. SWMF sediment volume assessments and removal works are prescribed by each individual SWMF's Environmental Compliance Approval (ECA)

Storm Sewer Network Description:

- The storm sewer network in the City of Mississauga includes over 1,892 km of linear storm sewers (mains, trunks, and FDCs), over 51,000 catch basins and 29,000 maintenance holes.
- The vast majority of the City is serviced by storm sewers and/ or open ditches. However, the ditch and minor (driveway) culvert asset inventories have not been formally established at this time.
- The majority of the City's storm sewer system is designed for a 10-year storm event.

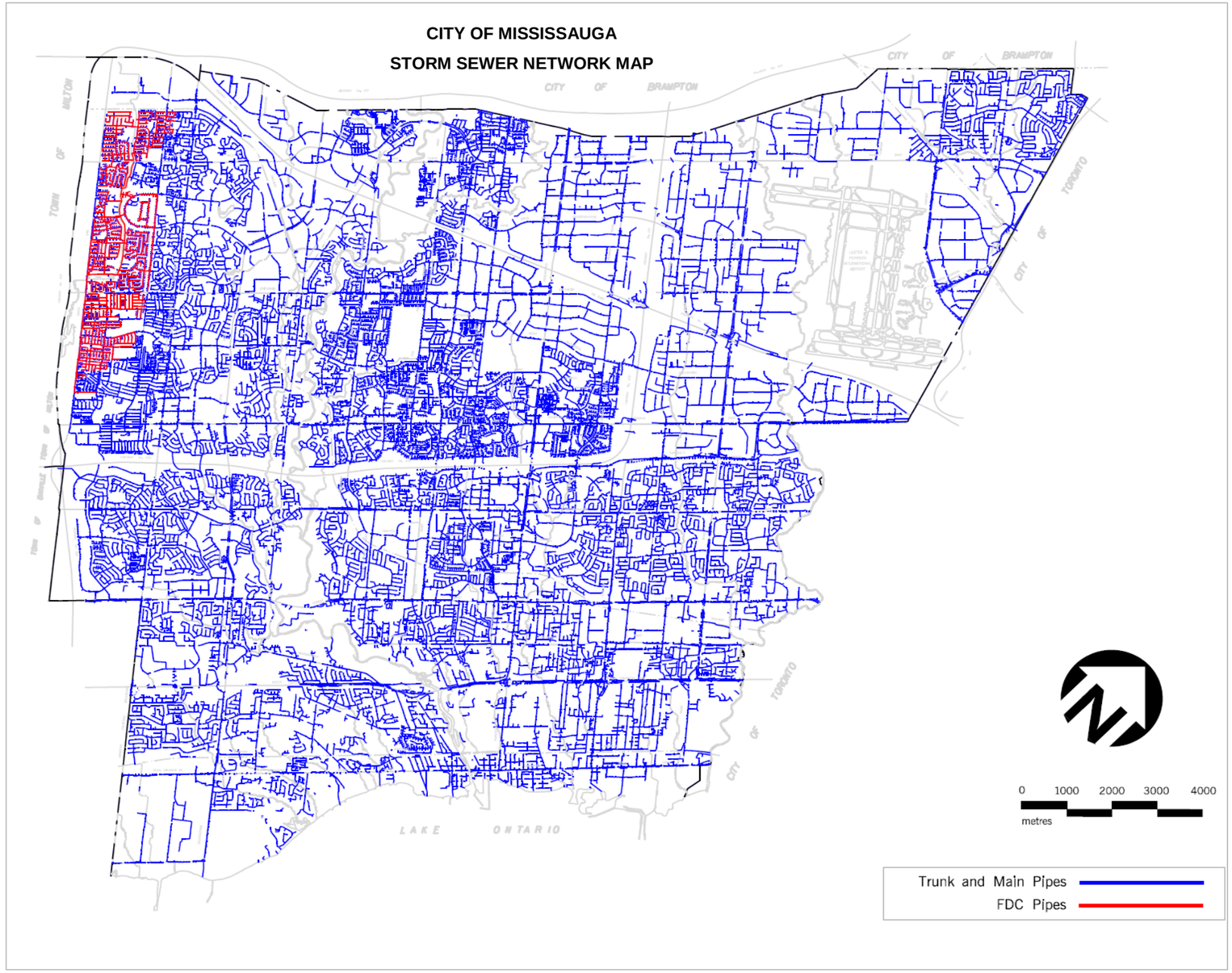


Figure 8 - City-wide Storm Sewer Drainage Network Map as per LOS Measure SW01

SWMF Inventory Description:

- The stormwater management system is comprised of 80 stormwater management facilities (SWMF) including water quality and/or water quantity control facilities, overland flow parks, Low Impact Developments (LIDs) and underground storage facilities.
- These different stormwater controls were implemented over the decades (from the 1960s to present) resulting in some locations in the City lacking quality and/or quantity control, primarily depending on the age of development. The majority of the City's SWM facilities were built in the 1990s or later.
- Overland flow parks for flood control have been implemented in new developments since the late 1970s.
- Water Quantity ponds for flood control have been common in new developments since the 1980s. Some of these facilities have been retrofitted in later years to also provide water quality control.
- Water Quality ponds for water treatment have been common in new developments since the 1990s.
- LIDs and underground Storage facilities have largely been installed as stormwater retrofits in the 2010s and 2020s.

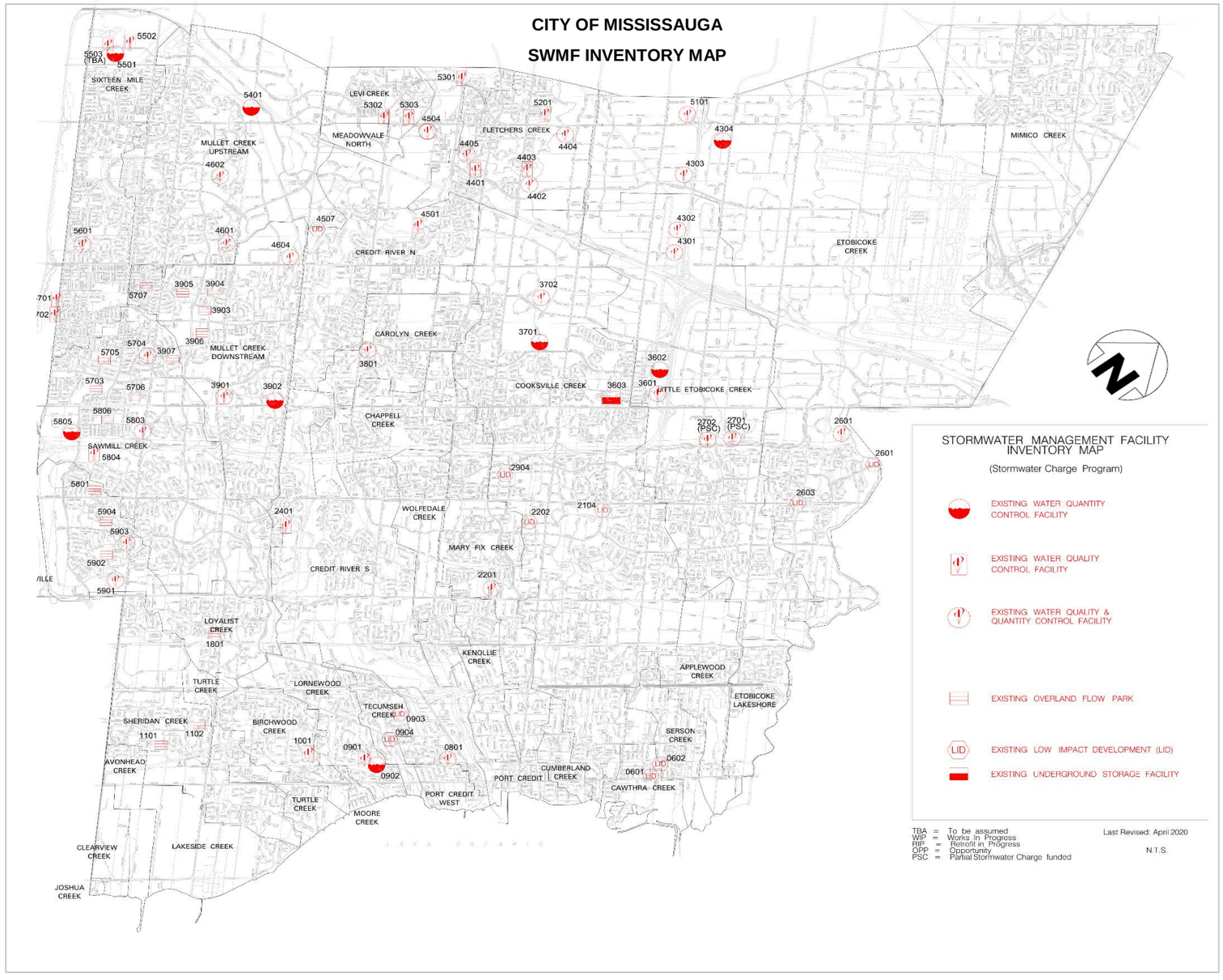


Figure 9 - City-wide SWMF Inventory Map as per LOS Measure SW01

Watercourse (Reaches) Network Description:

- There are approximately 200 km of linear watercourses in the City of Mississauga. The City is responsible for maintaining approximately 150 km of the watercourse network and associated bank, channel and instream assets.
- The majority of these watercourses were existing naturally before the land was developed. However, many of the watercourses have been modified or enclosed for erosion and/ or flood control with materials such as concrete, armourstones and gabion baskets.
- The City has initiated the process of mapping and assigning IDs to these assets.

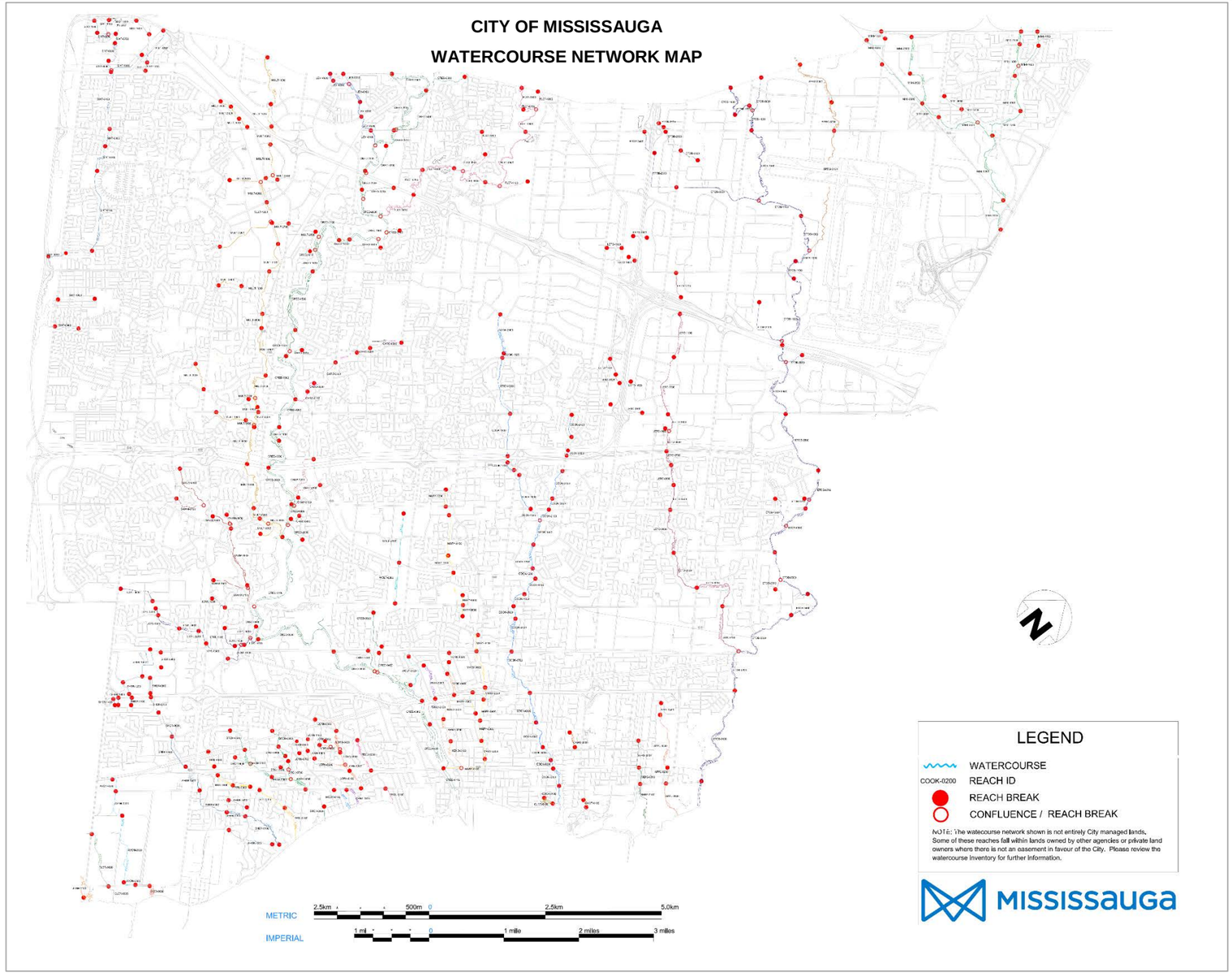


Figure 10 - City-wide Watercourse Network (Reaches) Map as per LOS Measure SW01

1 to 5 Condition Rating Scale	Condition	Rating Definition	Methodology
1	Very Good	 Asset is in very good condition or better. It is new or recently rehabilitated. Asset is well maintained. Asset is fit for the future.	RUL ≥ 75%
2	Good	 Asset is in good condition. Asset may have received repair or maintenance work. Asset is generally approaching mid-stage of expected service life.	75% > RUL ≥ 35%

Figure 11 - Storm Sewer Condition Ratings

1 to 5 Condition Rating Scale	Condition	Rating Definition	Methodology
3	**Fair**	 Asset is in fair or adequate condition. Asset shows signs of deterioration with some elements showing defects. Asset requires attention.	35 > RUL ≥ 13%
4	**Poor**	 Asset is in poor condition and is at risk of affecting service. Large portion of the asset system exhibits significant deterioration and the condition is below standard. Asset is approaching end of service life. Asset is not fit for future use.	13% > RUL ≥ 3%

Figure 11 - Storm Sewer Condition Ratings

1 to 5 Condition Rating Scale	Condition	Rating Definition	Methodology
5	Very Poor	 Asset is in very poor condition and is in major risk of affecting service. Large portion of the asset system exhibits significant deterioration and the condition is below standard. Asset is approaching end of service life. Asset is not fit for use.	RUL < 3%

Figure 11 - Storm Sewer Condition Ratings

1 to 5 Condition Rating Scale	Condition	Rating Definition	Methodology
1	Very Good	 Asset is in very good condition or better. It is new or recently rehabilitated. Asset is well maintained. Asset is fit for the future.	RUL ≥ 75%
2	Good	 Asset is in good condition. Asset may have received repair or maintenance work. Asset is generally approaching mid-stage of expected service life.	75% > RUL ≥ 35%

Figure 12 - Stormwater Management Facility (SWMF) Condition Ratings

1 to 5 Condition Rating Scale	Condition	Rating Definition	Methodology
3	**Fair**	 Asset is in fair or adequate condition. Asset shows signs of deterioration with some elements showing defects. Asset requires attention.	35 > RUL ≥ 13%
4	**Poor**	 Asset is in poor condition and is at risk of affecting service. Large portion of the asset system exhibits significant deterioration and the condition is below standard. Asset is approaching end of service life. Asset is not fit for future use.	13% > RUL ≥ 3%

Figure 12 - Stormwater Management Facility (SWMF) Condition Ratings

1 to 5 Condition Rating Scale	Condition	Rating Definition	Methodology
5	Very Poor	 Asset is in very poor condition and is in major risk of affecting service. Large portion of the asset system exhibits significant deterioration and the condition is below standard. Asset is approaching end of service life. Asset is not fit for use.	RUL < 3%

Figure 12 - Stormwater Management Facility (SWMF) Condition Ratings

1 to 5 Condition Rating Scale	Condition	Rating Definition	Methodology
1	Very Good	 Asset is in very good condition or better. It is new or recently rehabilitated. Asset is well maintained. Asset is fit for the future.	UCA/Stability Index Score: 0.0 – 0.10
2	Good	 Asset is in good condition. Asset may have received repair or maintenance work. Asset is generally approaching mid-stage of expected service life.	UCA/Stability Index Score: 0.11 – 0.20

Figure 13 – Watercourse Condition Ratings

1 to 5 Condition Rating Scale	Condition	Rating Definition	Methodology
3	**Fair**	 Asset is in fair or adequate condition. Asset shows signs of deterioration with some elements showing defects. Asset requires attention.	UCA/Stability Index Score: 0.21 – 0.30
4	**Poor**	 Asset is in poor condition and is at risk of affecting service. Large portion of the asset system exhibits significant deterioration and the condition is below standard. Asset is approaching end of service life. Asset is not fit for future use.	UCA/Stability Index Score: 0.31 – 0.44

Figure 13 – Watercourse Condition Ratings

1 to 5 Condition Rating Scale	Condition	Rating Definition	Methodology
5	Very Poor	 Asset is in very poor condition and is in major risk of affecting service. Large portion of the asset system exhibits significant deterioration and the condition is below standard. Asset is approaching end of service life. Asset is not fit for use.	UCA/Stability Index Score: 0.45 – 1.0

Figure 13 – Watercourse Condition Ratings

Future Demand

The City's stormwater management system is designed to collect stormwater from private and public properties across the city. The system also accommodates stormwater from upstream municipalities (e.g., Brampton, Caledon). The Stormwater Service Area maintains a network of sewers and related assets that transport stormwater to the receiving watercourses (e.g., creeks, rivers) or directly to Lake Ontario. Stormwater Management Facilities support the system by providing water quality and/or quantity control. Together the system helps to protect the water quality of our creeks and Lake Ontario (the City's source of drinking water) and lowers the risk of flooding that can damage property and the environment.

The Stormwater Service Area is planning for the future by recognizing the pressures and challenges ahead resulting from aging stormwater infrastructure, extreme weather events, climate change and new legislation/regulations among other factors. There is an increasing need to plan and deliver effective and timely stormwater services, build a more resilient stormwater management system, and establish sustainable service levels.

Strategies to meet these demands include increasing contributions to the Pipe Reserve Fund, the effective delivery of capital projects and studies and the development of the Stormwater Master Plan and Asset Management Plan. These actions also align with the City's vision and strategic plan.

Demand Drivers

Drivers affecting demand include things such as changes to development form and density, regulations and legislation, technological changes, economic factors, environmental awareness and the direct impact of climate change on stormwater infrastructure. A summary of the internal and external drivers that affect demand for stormwater services is shown in Table 17.

Lake Saigon Stormwater Management Facility (Water Quantity and Quality Control)

Table 17 - Demand Drivers for Stormwater Services

Demand Driver	Current Position	Projection	Impact on Services	Demand Management Plan
Aging Stormwater Infrastructure	The majority (94%) of the stormwater management system is currently in 'Good' or 'Very Good' condition. As such the Operations, Maintenance, Inspection (OMI) and Capital needs are relatively minimal at this time.	As the City's stormwater infrastructure ages, the overall condition will decrease. The operating and maintenance costs are expected to increase as a result.	Aging infrastructure without intervention can lead to more unplanned service disruptions; emergency repairs; and associated budget stresses.	Develop and maintain a comprehensive asset management plan to formalize OMI, and Renewal and Rehabilitation (R&R) activities and maximize the useful service life of stormwater assets. In turn this will inform the level of investment required and Stormwater Charge revenue needed.
New Legislation & Regulations	There are a number of existing laws and regulations which dictate how the City provides stormwater management services. These are identified in Table 15 Current legislation has the greatest effect on capital rehabilitation and renewal projects where there may be significant impacts associated with the work.	In general, environmental awareness is strong and regulations are becoming stricter. Asset management regulations have recently been established and are expected to become more prescriptive. Legislation is subject to change based on changing governments.	New legislation may increase operating and capital pressures. Examples include continuously evolving species-at-risk habitat legislation that can limit construction timing windows, and excess soil management requirements that can add additional delays and costs to infrastructure improvement projects. New legislation could also require additional stormwater management practices to reduce stormwater runoff, improve water quality or implement infrastructure that is more resilient to climate change (e.g., low impact developments (LID) infrastructure, on-site storage, etc.). This could increase the asset service life but potentially increase capital and operating costs. Minimum service requirements (e.g., inspection frequency) or minimum maintenance standards could also be legislated for critical stormwater infrastructure.	Remain informed of changes to legislation and adjust maintenance and operating programs and budget accordingly.
City Growth & Development	The majority of greenfield lands in the City have already been developed. Existing developments from different	Future development will largely be redevelopments of existing sites due to the limited land availability. Land use is also expected to	More intensive development will generally increase the amount of impervious cover on a site. Without effective stormwater management measures to mitigate these impacts, additional stormwater runoff will be produced which will add new stresses to the existing stormwater management system.	Continue to review and update the City's stormwater management requirements for development to mitigate the impacts of stormwater runoff

Demand Driver	Current Position	Projection	Impact on Services	Demand Management Plan
	eras/generations have different stormwater characteristics and infrastructure standards. In general, older neighbourhoods (pre-1950s) have much less impervious cover than today. Storm sewers have been common since the 1950s, however, modern stormwater management practices were established in the 1990s to mitigate the additional runoff caused by additional impervious cover.	intensify (i.e., more units/area). Development applications will be required to meet the latest stormwater management requirements to mitigate the effects of this increased intensification (i.e., by satisfying City's stormwater management criteria).		from increased impervious area. Contemplate opportunities to upsize stormwater infrastructure to accommodate additional runoff.
Environmental Awareness	Environmental awareness is perceived to be generally strong in the younger, upcoming generation.	When the younger generation reaches voting age, they may demand a higher level of service for water quality and water quantity infrastructure (as it affects the environment).	Anticipated increased environmental awareness in future generations could lead to increased demand for a higher service level (e.g., greater expectations that the City make additional investment) for water quality and water quantity infrastructure.	Monitor changes in public satisfaction (e.g., survey, Business Plan) of stormwater services and consider adjusting investment accordingly to meet desired level of service.
Asset Management Planning	Asset Management is a relatively new concept for Ontario Municipalities. Ontario Municipalities are required to develop an asset management plan for core infrastructure by 2021 and all other assets by 2023.	Effective asset management planning is expected to become standard practice.	Effective asset management planning should allow the City to make effective risk-based decisions. The asset management plan should include inspection programs and maintenance strategies to identify problems and intervene at the right times to fund rehabilitation and replacement works. The results should be cost-effective spending on the right assets, at the right time to maximize an assets useful service life.	Continue to implement asset management principles and procedures and identify/ document continuous improvements through updated maturity assessments and Asset Management Plans.

Demand Driver	Current Position	Projection	Impact on Services	Demand Management Plan
Technology	New techniques such as trenchless rehabilitation are expensive and have limited availability in Ontario at this time. The technology and industry are relatively new and few qualified contractors are available.	The cost to rehabilitate aging stormwater assets should become more affordable in the future as the marketplace for qualified contractors becomes more competitive.	Stormwater rehabilitation projects may become more affordable in the future as the technology becomes more available and competitive in the marketplace.	Monitor changes to available renewal technologies. Communicate with other municipalities to discuss changes in best industry practice.
CLIMATE CHANGE DEMAND DRIVERS[23]				
Potential for more frequent and extreme rainfall events leading to flooding	The existing stormwater management system collects stormwater runoff and provides safe conveyance/control via storm sewers, ditches, facilities and watercourses before discharge to Lake Ontario. The capacity of Mississauga's minor system is generally designed for a 10-year storm using historical rainfall data. Where available, overland flow routes collect flows that exceed the capacity of the minor system. Some older developments were designed with now out-dated design standards.	With projected temperature increases of approximately 2°C by mid-century, the frequency of extreme rainfall events and potential flooding could increase (i.e., events which currently occur every 20 years may occur every 14 years).[23]	- Risk of private/public property flood and erosion damage (e.g., damage to private homes, businesses, institutions, public lands and road right-of-way); - Risk of litigation against the City as result of damage to private property; - Infrastructure potentially failing earlier than expected due to increased demand/stress (e.g., pipe/facility failures, erosion control failures) - Existing infrastructure may need to be up-sized or retrofitted to provide the same service level and/or resiliency (e.g., upsizing storm sewers/culverts, improving resiliency of facilities and erosion control works, etc.) - New infrastructure may be required to mitigate risks (e.g., flood storage facilities, storm relief sewers, low impact developments, etc.) - Risk of more unplanned failures/emergency responses (e.g., road washouts, sinkholes, flood related clean-up/repairs)	Coordinate with Roads Service Area to align storm sewer upgrade projects with road renewal activities, where possible. Plan and implement studies to identify priorities and implement system improvements to mitigate risk to the stormwater management system. Leverage development design standards to limit compounding impacts on the receiving stormwater management system.

[23] Auld, H., Switzman, H., Comer, N., Eng, S., Hazen, S., and Milner, G. 2016. *Climate Trends and Future Projections in the Region of Peel. Ontario Climate Change Consortium: Toronto, ON*

Demand Driver	Current Position	Projection	Impact on Services	Demand Management Plan
			- Increased capital, operating and maintenance costs.	
Increased risk of long-duration freezing rain events leading to ice storms	Road salt is applied to roadways to mitigate freezing rain events and as a result is discharged into the stormwater management system.	The frequency of freezing rain events lasting 6 hours or more for the typically coldest months could increase in southwestern and south-central Ontario by 40% by the 2050s.[23]	Additional road salt application may reduce the expected useful life of stormwater infrastructure (e.g., through corrosion, etc.) and further impact water quality in watercourses and Lake Ontario.	Works Operations and Maintenance have begun to use brine as part of their regular winter program to reduce salt concentrations. Monitor impacts of freezing rain and adjust capital and operating programs and budgets accordingly.
Increased frequency of high winds	High wind events can cause tree limbs and woody debris to fall, which can accumulate in watercourses and other stormwater infrastructure	The frequency of wind gusts ≥ 70 km/h is projected to increase in the area from Windsor to east of Toronto by about 17% by the 2050s compared to the historical period 1994-2007.[23]	- More debris (woody organic, urban) accumulating in the stormwater management system (catch basins, sewers, creeks, ponds) poses risks to maintaining network drainage and limiting potential flooding and/or erosion. - Increased risk of debris jams/blockages and associated impacts; additional costs for debris clean-up.	Monitor changes to high-wind events and adjust operating programs and budget accordingly.
More frequent extreme heat days (>30 degrees Celsius)	Extreme heat or drought events could raise temperatures, decrease seasonal baseflow in watercourses and impact water quality. Stormwater management facilities with permanent pools act as a heat sink for solar radiation and discharge into the City's watercourses.	As the overall temperature locally increases due to climate change, it is expected with confidence that the frequency and intensity of extreme temperature events will also increase.[23]	- An increase in extreme heat can lead to warmer water within and being discharged into the City's watercourse network, which can negatively affect water quality/ availability and aquatic habitats.	Monitor changes in extreme heat day events and adjust capital improvement programs and budget accordingly. Consider actions to mitigate this risk (e.g., updates to stormwater management criteria, LID practices, cooling BMPs, increased riparian/pond vegetation, etc.).

Demand Management

In 2016, the Stormwater Charge was implemented primarily to meet the increasing demand associated with aging infrastructure and allow for a dedicated investment in the stormwater management system, including planning and operations, new capital construction and improvement activities.

The Stormwater Service Area has programmed studies, environmental assessments, designs, and construction projects over a 10-year period through the 2019-2028 Capital Budget & Forecast. The Capital Budget and forecast is updated annually to prioritize new projects based on the latest available needs and risks. A one-year Capital and Operating Budget and Stormwater Charge rate is approved annually by Council, through the Stormwater Business Plan & Budget process, to provide the revenue required to accommodate current and future stormwater-related demands.

Figure 14 summarizes the growth and non-growth stormwater projects identified in the 10-year capital program for the Stormwater Service Area. Growth projects are those associated with new assets being constructed to service new developments. Non-growth projects are generally renewals of existing assets, but can also include new infrastructure or services without a development component (i.e., retrofits in an existing developed area).

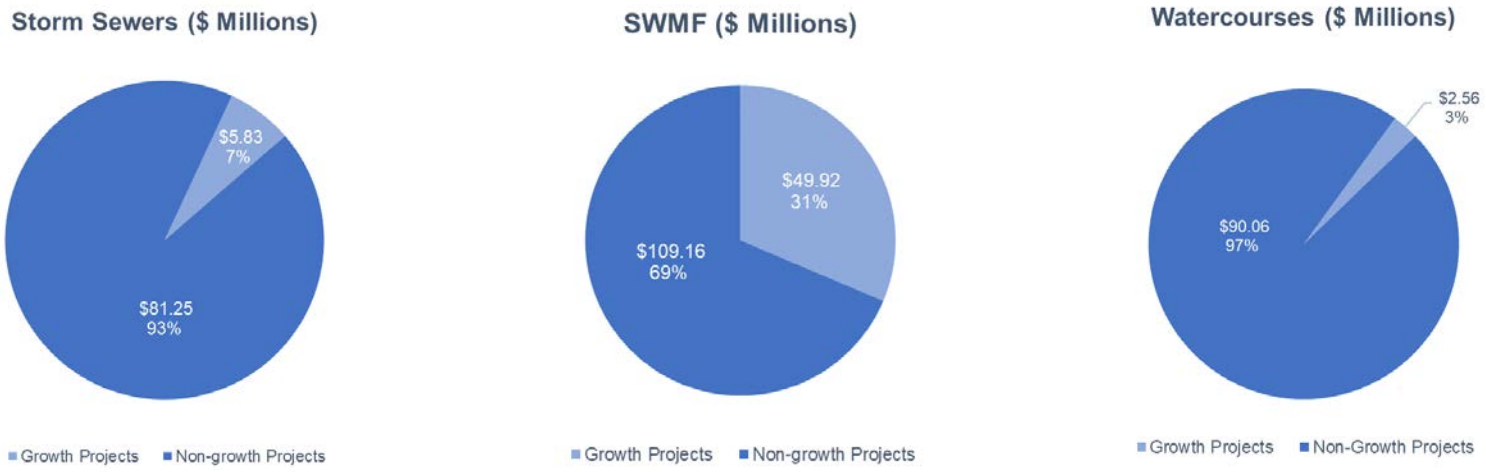


Figure 14 - Percentage of Stormwater Growth and Non-growth Capital Projects

At this time, the Stormwater capital program does not clearly identify renewal and new/expansion projects, which can be used to differentiate state of good repair projects from those increasing the service level. This has been added to Table 30 and
Table 31 as a future improvement task and will be incorporated into future asset management plans.

Storm sewer capital projects include the renewal of existing assets but also expansion of the sewer network often to accommodate development-related growth. During the design phase for renewal projects, the capacity of the storm sewers is also evaluated to determine if the pipe size should be increased.

SWMF and Flood Relief capital projects include new water quality and/or quality control facilities, and rehabilitation of existing assets. New growth facilities are constructed to manage stormwater runoff associated with development. New non-growth facilities provide water quality treatment to areas that have been previously developed without any form of treatment. Retrofit non-growth facilities improve an existing facility that only provides one function (quality or quantity) by adding the second function.

Renewal projects ensure that the facilities continue to function as intended (e.g., pond sediment removal works, etc.). New or retrofit water quality facilities also improve the water quality discharge to the downstream watercourse system.

Watercourse capital projects generally include renewing failed assets or stabilizing natural banks with new erosion control infrastructure, to protect infrastructure and private lands. During the design phase, the flow capacity of the channel is evaluated and channel size/form improvements may be considered to improve conveyance or reduce flood potential. The materials of the channel are also sized to accommodate flows, which may have increased due to demand drivers like climate change or upstream developments.

Stormwater studies often include identifying larger-scale stormwater issues and developing a mitigation plan that will lead to future infrastructure projects, such as described above.

Other initiatives include improvements to data, software, training, and asset condition assessments to support effective stormwater programs and services and the development of better asset management plans and strategies.

Lake Aquitaine SWMF Inlet

Lifecycle Management Strategy

What is a Lifecycle Management Strategy? Assets of different types have different lifecycle durations, deteriorate at different rates and require different strategies for optimum performance and cost-efficiency over their service lives.

A lifecycle strategy sets out the planned actions and intended methods of management for an asset throughout its life. The purpose of lifecycle strategies is to maintain the assets in an appropriate way that will deliver the required level of service for the least overall cost, while keeping risk within acceptable boundaries. The typical lifecycle of an asset and the intervention strategies that occur throughout the lifecycle are shown in the figure on this page.

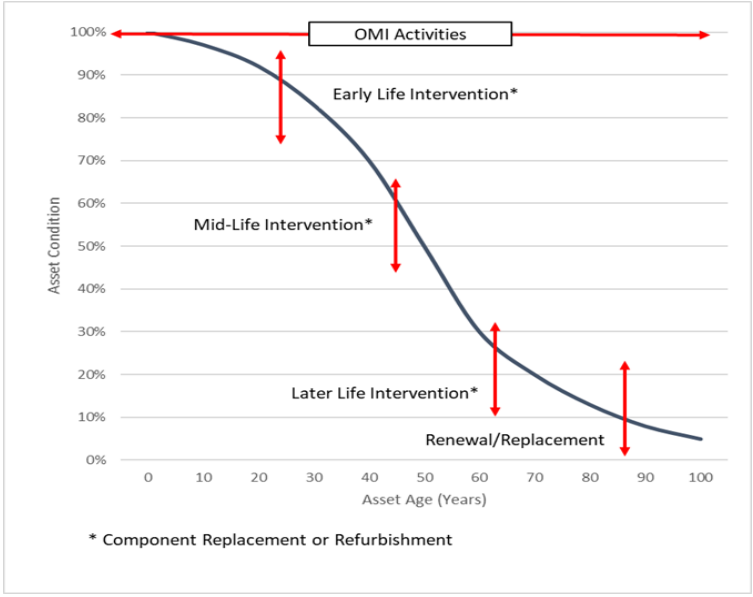
Lifecycle Activities

The current Stormwater business practices for lifecycle management are documented in this section and have been identified under the following work categories; Operations, Maintenance, Inspections and Renewal & Rehabilitation activities.

Operations, Maintenance & Inspection (OMI) Activities

The OMI activities are completed throughout the lifecycle of the asset to ensure that the asset stays in an operational condition whilst achieving its expected life.

Operations - These are routine activities necessary for the assets to function properly. They differ from Preventative Maintenance (PM) activities in that operational tasks are activities that must occur, or the asset will cease to function as intended (e.g., catch basins may fill up with sediments and become blocked if not cleaned, outfall grates may accumulate debris and stop draining adequately). An asset will usually continue to operate even if PM tasks are not done, but the overall lifespan of the asset could be reduced, and the asset may fail early.



Preventative Maintenance - These are regularly scheduled activities, completed while the asset is still in an "operational" condition. The purpose of preventative maintenance is to ensure the asset achieves its expected life (i.e., does not fail early). Not all assets require or benefit from preventative maintenance activities.

Reactive Maintenance - These activities are physical repairs to an asset that has broken down or is not functioning as intended. The repair reinstates the asset to its normal "operating" condition but does not significantly extend the overall life of the asset (i.e., it is a repair, not a full replacement, upgrade, or major rehabilitation). Maintenance repairs are expected as assets age and are part of the overall lifecycle management to keep the asset operational for as long as physically and economically viable.

Inspections - There are different types of inspections that can occur throughout the lifecycle of an asset. Some inspections are meant to evaluate whether the asset is operating as intended, providing early warning for any deficiencies that should then be remedied quickly and at less cost than if the problem remained for some time. Other inspections are for measuring or observing the condition of the assets, or for measuring performance. These inspections provide information for planning renewals and determining if performance targets will be met. Inspections may also be required by legislation, departmental policy, or completed based on industry standard or manufacturer recommendation.

Renewal and Rehabilitation (R&R) Activities

R&R activities involve full replacement of an asset with an equivalent new asset (i.e., renewal) or application of a treatment that reinstates the asset (or a component of the asset) to new or near new condition (i.e., rehabilitation) both of which extend the life of the asset.

Early Life Interventions - These are treatment options that may be considered when an asset is in the first quarter of its lifespan. For stormwater assets, this type of intervention may include the replacement of grates or trash racks on inlet and outlet structures and catch basins.

Mid-Life Rehabilitation - These are treatment options that may be considered when an asset is in the second or third quarter of its lifespan. For stormwater assets, these interventions would include localized erosion protection and minor pipe or concrete repairs.

Later Life Rehabilitation - These are treatment options considered to be still viable even when an asset is in the fourth quarter of its lifespan. For stormwater assets, these types of interventions may be the same as the mid-life interventions or include even larger erosion protection projects or repairs. A Later Life Rehabilitation treatment option should only be undertaken if it is cost-effective given the potentially short remaining useful life of the asset overall.

End of Life - These are treatment options considered when an asset is approaching or at the end of its lifespan. Typical options include:

- Replacement (renewal) of the asset with an equivalent new asset or major rehabilitation that returns the asset to new or near new status,
- Disposal (removal) of the asset without replacement,
- Retirement of the asset (without disposal),
- Divestment of the asset (sale or gift to another's ownership), or
- Upgrading (replacing with a new asset that will provide an increase in level of service, e.g., storm sewer upsizing).

Asset Lifecycle Strategies

Stormwater asset types/assets are listed in Table 18, Table 19, Table 20 and Table 21. Within these tables the Stormwater Service Area has documented the activities undertaken throughout the asset's lifecycle and the key actions planned.

Lifecycle Management Activities

Table 19, Table 20 and Table 21 describe the lifecycle management activities documented for the storm sewers, stormwater management facilities, and watercourses respectively. The Non-asset and Expansion/New Asset activities for all assets are summarized in Table 18.

Table 18 - Current Lifecycle Management Activities

Activities	Asset Type/ Assets	Specific AM Practices or Planned Actions	Specific Risks Associated with Incomplete Lifecycle Activities

Non-asset Solutions
Actions that consider how to influence and manage assets or customer demand
	All Stormwater Assets	• Condition assessment tools and software
		  o CCTV management software
		  o MS Access database for Watercourse and SWMFs
		• Infor to track service request and work orders
		• Utilize geospatial mapping software (ESRI GIS)
		• Master Plans (e.g., Stormwater Master Plan)
		• Flood Evaluation, Prioritization and/or Rehabilitation Studies (e.g., CRAMS, MCRS, etc.) and Water Quality Studies
		• Development Charge (DC) Studies
			• Inability to identify and record asset condition to inform decision-making for maintenance and capital programs
			• Inability to track service requests and works orders, to understand capital/maintenance work has been completed and that customer needs have been addressed
			• Without geospatial mapping staff are unable to visualize, store and maintain large asset inventories and integrate with condition/inspection programs
			• Strategic planning/budgeting, project prioritization and capital costing is not effective without Master Plans and other studies to inform long-term decision making
			• Without DC studies the City cannot collect funding for growth-related projects and satisfy legislated requirements

Expansion/New Asset
Planned activities required to extend services to previously un-serviced areas or expand services to accommodate asset enhancements
	All Stormwater Assets	• Feasibility studies
		• Design and construction of new:
		  o storm sewer assets and pipe upgrades
		  o stormwater management facilities to manage water quantity and quality
		  o watercourse assets to minimize erosion and to increase capacity
		• Maintain effective stormwater management development requirements
			• Inadequate planning and implementation of infrastructure to manage existing and potential growth pressures
			• Inability to mitigate climate change impacts and other demand factors

Table 19 - Current Lifecycle Management Activities (Storm Sewer Assets)

Activities	Asset Type/ Assets	Specific AM Practices or Planned Actions	Specific Risks Associated with Incomplete Lifecycle Activities
Operations/ Inspections/Service *Strategies that include activities such as planned inspections and automated system monitoring (e.g., visual condition assessments, legislated inspections)*	Leads	Inspections (as and when required)	Failure to inspect leads can result in unexpected operational and structural issues
	Mains	• Inspections (10-year cycle) for smaller diameter mains. Inspections for larger infrastructure based on criticality and age. • Operations – Annual street cleaning (Spring)	• Failure to inspect mains can lead to unexpected operational and structural issues • Failure to sweep streets may lead to debris accumulation in the storm system and water quality impacts
	Maintenance holes	• Road Patrols to check for general safety issues • Operations – Annual street cleaning (Spring)	• Failure to inspect MHs can lead to unexpected operational and structural issues • Failure to sweep streets may lead to debris accumulation in the storm system and water quality impacts
	Catch Basins	• Road Patrols to check for general safety issues, and visual inspection for blockages at high risk and known problem areas after major storms • Operations – catch basin cleaning every 3-years and annual street cleaning (Spring)	• Failure to inspect catch basins can lead to unexpected operational and structural issues • Failure to clean catch basins can lead to debris accumulation in the storm system and water quality impacts
	Inlets	• Visual inspection for blockages at high risk and known problem areas after major storms • Operations – Debris and graffiti removal	Failure to inspect inlets can lead to unexpected drainage issues (i.e., ponding water, localized flooding)
	Outlets	• Visual inspection for blockages at high risk and known problem areas after major storms. • Operations – Debris and graffiti removal	Failure to inspect outlets can lead to unexpected drainage issues

Activities	Asset Type/ Assets	Specific AM Practices or Planned Actions	Specific Risks Associated with Incomplete Lifecycle Activities
	Culverts & Ditches	• Road Patrols to check for general safety issues • Operations – Annual street cleaning	• Failure to inspect culverts & ditches can lead to unexpected operational and structural issues • Failure to sweep streets may lead to debris accumulation in the storm system and water quality impacts
Maintenance *Regular schedule or normal, general minor actions that ensure longevity of assets in line with their design and operational requirements*	Leads	Emergency Repairs	Failure to repair broken leads can cause drainage and structural issues in the roadway
	Mains	• Preventative Maintenance - Flush system proactively to prevent blockages. • Reactive Maintenance – Flushing where pipes have blocked, emergency repairs, root cutting, leaf clearing.	• Failure to flush pipes can lead to blockages, ponding water in the streets, potential flooding and premature failure of the assets • Failure to repair pipe emergencies can lead to flooding issues and/or damage to the roadway • Failure to remove intruding roots can lead to blockages, flooding and/or premature failure
	Maintenance Holes	• Preventative Maintenance - Flush system proactively to prevent blockages. • Reactive Maintenance – Flushing where MHs have blocked, emergency repairs, root cutting, leaf clearing, and spill response.	• Failure to flush MHs can lead to blockages, ponding water in the streets, potential flooding and premature failure of the assets • Failure to repair MH emergencies can lead to flooding issues and/or damage to the roadway • Failure to remove intruding roots can lead to blockages, flooding and/or premature failure
	Catch Basins	• No Preventative Maintenance • Reactive Maintenance – emergency repairs	Failure to repair catch basin emergencies can lead to flooding issues and/or damage to the roadway
	Inlets	• No Preventative Maintenance • Reactive Maintenance – emergency repairs	Failure to repair inlet emergencies can lead to flooding issues and/or damage to the roadway
	Outlets	• No Preventative Maintenance • Reactive Maintenance – emergency repairs, spill response, fence repairs/replacements	• Failure to repair MH emergencies can lead to flooding issues and/or damage to the roadway • Failure to provide spill response can detriment water quality and lead to compliance issues
	Culverts & Ditches	• No Preventative Maintenance • Reactive Maintenance – emergency repairs.	Failure to repair culvert emergencies can lead to flooding issues and/or damage to the roadway or private lands
	Leads	No Rehabilitation Activities	N/A

Activities	Asset Type/ Assets	Specific AM Practices or Planned Actions	Specific Risks Associated with Incomplete Lifecycle Activities
Renewal/ Rehabilitation *Repair activities designed to extend the service life of the asset*	Mains	• No Early Life activities. • No Mid-Life activities • Later Life – Trenchless rehabilitation	Failure to rehabilitate storm mains can leads to structural failure
	Maintenance Holes	• No Early Life activities • Mid/Later-Life - Replacement of grade adjustment units as required; Replacement of MH covers as required.	• Failure to adjust MHs can lead to damage to roadway and vehicles • Failure to replace broken MH lids can lead to damage to roadway and vehicles
	Catch Basins	• No Early Life activities • Mid/Later-Life - Replacement of grade adjustment units as required; Replacement of grates as required	• Failure to adjust catch basins can lead to damage to roadway and vehicles • Failure to replace broken catch basin lids/ grates can lead to damage to roadway and vehicles
	Inlets	• No Early Life activities • No Mid-Life activities • Later Life – Local Repairs, erosion protection & Grate replacements	Failure to repair grates can lead to blockages, flooding and/or compliance issues
	Outlets	• No Early Life activities • No Mid-Life activities • Later Life – Local Repairs, erosion protection & Grate replacements	Failure to repair grates can lead to blockages, flooding and/or compliance issues
	Culverts & Ditches	• No Early Life activities. • No Mid-Life activities • Later Life – Trenchless rehabilitation	Failure to renew culverts can leads to structural failure

Activities	Asset Type/ Assets	Specific AM Practices or Planned Actions	Specific Risks Associated with Incomplete Lifecycle Activities
Replacement *Activities that are expected to occur once an asset has reached the end of its useful life and renewal/rehabilitation is no longer an option*	Leads	Replace at End of Life	Failure to replace broken leads can cause drainage and structural issues in the roadway
	Mains	Replace at End of Life	Failure to replace mains can cause drainage, structural and safety issues in the roadway
	Maintenance Holes	• Replacement of grade adjustment units (if broken or compromised) or addition of grade adjustment unit at Mid-Life • Replacement of maintenance hole cover / lid as required at Mid-Life and Later Life • Replace at End of Life	Failure to replace MHs can cause drainage, structural and safety issues in the roadway
	Catch Basins	• Replacement of grade adjustment units (if broken or compromised) or addition of grade adjustment unit at Mid-Life • Replacement of grates as required at Mid-Life and Later Life • Replace at End of Life	Failure to replace catch basins can cause drainage, structural and safety issues in the roadway
	Inlets	Replace at End of Life	Failure to replace inlets can cause upstream drainage and structural issues
	Outlets	Replace at End of Life	Failure to replace outlets can cause drainage, structural and safety issues in the roadway
	Culverts & Ditches	Replace at End of Life	Failure to replace culverts can cause drainage, structural and safety issues in the roadway

Activities	Asset Type/ Assets	Specific AM Practices or Planned Actions	Specific Risks Associated with Incomplete Lifecycle Activities
Disposal/Demolition *Activities associated with the disposal of a decommissioned asset including sale, donation, demolition & abandonment*	Leads	Decommission at End of Life if asset is no longer required	Failure to decommission assets properly can lead to conflicts with other utilities in the right of way
	Mains		
	Maintenance Holes		
	Catch basins		
	Inlets		
	Outlets		
	Culverts & Ditches		

Table 20 - Current Lifecycle Management Activities (Stormwater Management Facility Assets)

Activities	Asset Type	Specific AM Practices or Planned Actions	Specific Risks Associated with Incomplete lifecycle activities
Operations/ Inspections/Service *Strategies that include activities such as planned inspections and automated system monitoring (e.g., visual condition assessments, legislated inspections)*	Cells	• Annual condition inspections • Sediment survey as and when required	• Failure to complete condition inspections can lead to unexpected operational and structural issues • Failure to complete sediment surveys can lead to unexpected loss of water quality and quantity function in ponds
	Channels	• Annual condition inspections • No Operations Activities	Failure to inspect channels may lead to unexpected operational and structural issues (i.e., blockages)
	Structures	• Annual condition inspections • No Operations Activities	Failure to inspect structures may lead to unexpected operational and structural issues
	Signs	• Annual condition inspections • No Operations Activities	Failure to inspect condition of signage may impact the City's compliance with applicable legislation and expose the City to liability risk
	Inlets	• Annual condition inspections, and functional inspections twice annually • Operations – Clean and remove debris twice annually (in-line with functional inspection)	Failure to inspect inlets may lead to unexpected operational and structural issues (i.e., blockages). Can lead to flooding concerns
	Outlets	• Annual condition inspections, and functional inspections twice annually • Operations – Clean and remove debris twice annually (in-line with functional inspection)	Failure to inspect outlets may lead to unexpected operational and structural issues (i.e., blockages). Can lead to flooding concerns

Activities	Asset Type	Specific AM Practices or Planned Actions	Specific Risks Associated with Incomplete lifecycle activities
Maintenance *Regular schedule or normal, general minor actions that ensure longevity of assets in line with their design and operational requirements*	Cells	• Preventative Maintenance – Sediment removal (as and when required) • Reactive Maintenance – Algae treatment, minor repairs, fence repairs, vegetation removal along access routes	• Failure to remove sediment can lead to loss of water quality and/or quantity function in pond and compliance issues • Failure to treat algae issues can lead to water quality and aesthetic issues • Failure to maintain fences can lead to public safety issues • Failure to maintain access roads can lead to increased capital costs
	Channels	• No Preventative Maintenance Activities • Reactive Maintenance – Vegetation and debris removal, emergency repairs, and erosion repairs	Failure to maintain channel can lead to erosion, blockages and/or flooding issues
	Structures	• No Preventative Maintenance Activities • Reactive Maintenance – Emergency repairs, erosion repairs, and graffiti removal	• Failure to maintain structures can lead to blockages, erosion and/or flooding issues • Failure to remove graffiti can lead to aesthetic concerns
	Signs	• No Preventative Maintenance Activities • Reactive Maintenance – Vegetation removal, sign repairs, and graffiti removal	Failure to maintain signs can lead to compliance and public safety issues
	Inlets	• No Preventative Maintenance Activities • Reactive Maintenance – Headwall/grate repairs, graffiti and vegetation removal, rip-rap repairs	• Failure to maintain inlets can lead to erosion, blockages and/or flooding issues • Failure to remove graffiti can lead to aesthetic concerns
	Outlets	• No Preventative Maintenance Activities • Reactive Maintenance – Grate repairs, graffiti and vegetation removal, rip-rap repairs, beaver mitigation	• Failure to maintain outlets can lead to erosion, blockages and/or flooding issues • Failure to remove graffiti can lead to aesthetic concerns • Failure to manage beaver impacts can lead to blockages and/or flooding issues

Activities	Asset Type	Specific AM Practices or Planned Actions	Specific Risks Associated with Incomplete lifecycle activities
Renewal/ Rehabilitation *Repair activities designed to extend the service life of the asset*	Cells	• No Early or Mid-Life Activities • Later Life – Liner Replacement	Failure to replace liners can lead to unintended water infiltration and excavation difficulty during sediment removal projects
	Channels	No Early, Mid, or Later Life Activities	N/A
	Structures	• No Early Life Activities • Mid-Life – Localized patching and repairs • Later Life – Larger scale patches and repairs	Failure to renew/rehabilitate structures can lead to structural failure
	Signs	No Early, Mid, or Later Life Replacement activities	N/A
	Inlets	• No Early Life activities • Mid-Life – localized point repairs of pipes, erosion protection repair • Later Life – inlet grate repair and/or replacement	Failure to rehabilitate inlets can lead to structural failure, blockages, and excess downstream erosion
	Outlets	• No Early Life activities • Mid-Life – localized point repairs of pipes and outlet structures • Later Life – Sluice gate and outlet grate repair or replacement	Failure to rehabilitate outlets can lead to structural failure, blockages, and upstream flooding
Replacement *Activities that are expected to occur once an asset has reached the end of its useful life and renewal/rehabilitation is no longer an option*	Cells	No replacement of cells	N/A
	Channels	Replacement of rip-rap or gabions around channels	Failure to replace channel materials can lead to structural failure of the channel, erosion or flooding issues
	Structures	Replacement of rip-rap or gabions around structures	Failure to replace these materials can lead to erosion or flooding issues

Activities	Asset Type	Specific AM Practices or Planned Actions	Specific Risks Associated with Incomplete lifecycle activities
	Signs	Replacement of sign	Failure to replace signs may lead to compliance or public safety issues
	Inlets	Replacement of inlets	Failure to replace inlets can lead to structural failure, blockages and flooding issues
	Outlets	Replacement of outlets	Failure to replace outlets can lead to structural failure, blockages and flooding issues
Disposal/Demolition *Activities associated with the disposal of a decommissioned asset including sale, donation, demolition & abandonment*	Cells	No disposal activities	N/A
	Channels	Channel materials are generally landfilled at the end of their life	N/A
	Structures	Structures are generally landfilled at the end of their life	N/A
	Signs	Signs are generally landfilled at the end of their life	N/A
	Inlets	Inlet structures are generally landfilled at the end of their life	N/A
	Outlets	Outlet structures are generally landfilled at the end of their life	N/A

Table 21 - Current Lifecycle Management Activities (Watercourse Assets)

Activities	Asset Type	Specific AM Practices or Planned Actions	Specific Risks Associated with Incomplete lifecycle activities
Operations/ Inspections/Service *Strategies that include activities such as planned inspections and automated system monitoring (e.g., visual condition assessments, legislated inspections)*	Watercourse	• Reach inspection program to document and assess the condition of assets and problem sites. Occurs at a frequency varying from 1 to 5 years. • Woody debris program to monitor for debris blockages at established critical locations at least twice per year. • Adaptive Management program to inspect and assess the stability of recently completed maintenance projects. Typically conducted annually for a minimum of three years. • Deposition program to monitor and measure the progression of deposited material (typically stones) in the channel. Occurs at a frequency aligning with the reach inspection schedule. • Beaver program to monitor potential impacts of beavers or their dams on adjacent property and infrastructure. Monitoring frequency is determined on a case-by-case basis but typically occurs at least once per week for the first few weeks and then revised accordingly as needed. • Service Request inquiries are investigated and assessed when received and addressed accordingly.	• The reach inspection program is the primary tool for capital prioritization. Failure to complete the program may lead to unexpected failure of watercourse assets, which can cause flooding and/or erosion issues • Failure to complete woody debris inspections can lead to blockage of critical infrastructure being unreported and associated flooding • Failure to complete adaptive management inspections can lead to undocumented changes in maintenance works • Failure to complete deposition program inspections can lead to undocumented changes at deposition sites • Failure to complete beaver monitoring program can lead to adjacent flooding or erosion • Failure to investigate service requests can lead to poor resident/customer satisfaction and failure to respond to erosion or flooding issues in a timely manner
Maintenance *Regular schedule or normal, general minor actions that ensure longevity of assets in line with their design and operational requirements*	Watercourse	• Preventative Maintenance - Practice to clear debris blockages (including beaver dams) in watercourse to prevent localized erosion and upstream flooding issues. Beaver trapping on an as-needed basis. • Reactive Maintenance – Debris removal	Failure to remove debris blockages from the watercourse can lead to erosion and/or flooding to private or public property

Activities	Asset Type	Specific AM Practices or Planned Actions	Specific Risks Associated with Incomplete lifecycle activities
Renewal/ Rehabilitation *Repair activities designed to extend the service life of the asset*	Watercourse	• No Early Life activities • Mid-Life/Later Life - Minor Erosion Control Works (Partial Replacement of Bank - approximately 20m - 30m length)	Failure to complete works in a timely manner can lead to additional erosion or flooding issues; damage to private or public property
Replacement *Activities that are expected to occur once an asset has reached the end of its useful life and renewal/rehabilitation is no longer an option*	Watercourse	Replacement of entire bank where there is risk to surrounding property and adjacent infrastructure (Capital Works)	Failure to complete replacement works in a timely manner can lead to additional erosion or flooding issues; damage to private or public property
Disposal/Demolition *Activities associated with the disposal of a decommissioned asset including sale, donation, demolition & abandonment*	Watercourse	• The majority of materials left over from watercourse infrastructure are removed and landfilled • Some erosion control materials may be re-used or repurposed during renewal projects (e.g., armourstones, rip rap)	N/A

Proposed Lifecycle Management

Over time, and when the true cost to maintain the current business practices documented in the lifecycle strategies becomes known, the current strategies will be reviewed and adjusted as appropriate to best fit the required level of service for least total cost and appropriately managed risk. Proposed lifecycle strategies currently being considered are identified in Table 22, Table 23 and Table 24.

Table 22 - Proposed Lifecycle Management Activities (Storm Sewers)

Asset Types/ Assets	Inspections	Operations	Maintenance	Rehabilitation/ Renewal	Disposal
Leads	None	None	• Improved emergency response contract/ program • Tophat installation for leak mitigation	• Upon renewal of the asset and resetting of its lifecycle; full inspection to occur within warranty period. Interventions to occur as required • Trenchless rehabilitation (e.g., Cured-In-Place Pipe)	Contemplate and establish best practices for infrastructure abandonment
Mains	• Develop program(s) to inspect highly critical components of storm sewer system with greater frequency than less critical assets (determined through the establishment of Levels of Service) • Inspections for mains to occur in accordance with expected levels of service • Program to account for warranty inspections	None	• Improved emergency response contract/program • Tophat installation for leak mitigation • Investigate whether flushing critical pipes on a regular schedule is justified. Then consider implementing a program accordingly	• Upon renewal of the asset and resetting of lifecycle; inspection to occur within warranty period. Interventions to occur as required • Patches and point repairs: localized fixes of pipes	Contemplate and establish best practices for infrastructure abandonment

Asset Types/ Assets	Inspections	Operations	Maintenance	Rehabilitation/ Renewal	Disposal
Maintenance Holes	• Integrate MH inspections into the various storm main inspection programs, as well as collect asset inventory data for each MH • Inspections for mains to occur in accordance with expected levels of service	None	• Improved emergency response contract/ program • Investigate whether flushing MH on a regular schedule is justified. Then consider implementing a program accordingly • Waterproofing • Sealing connections	• Upon renewal of asset and resetting of lifecycle; inspection to occur within warranty period. Interventions to occur as required • Trenchless rehabilitation (i.e., CIPP, Geospray, etc.)	Contemplate and establish best practices for infrastructure abandonment
Catch Basins	Visual inspection for blockages at select catch basins in high-risk areas and known problem areas (after major storms)	None	• Improved emergency response contract/ program • Waterproofing • Sealing connections	• Upon renewal of asset and resetting of lifecycle; inspection to occur within warranty period. Interventions to occur as required • Patches and point repairs: localized fixes of catch basins • Trenchless rehabilitation (e.g., Geo-spray)	None
Inlets	None	None	Improved emergency response contract/program	• Upon renewal of asset and resetting of lifecycle; inspection to occur within warranty period. Interventions to occur as required • Patches and point repairs: localized fixes of inlet structures	None

Asset Types/ Assets	Inspections	Operations	Maintenance	Rehabilitation/ Renewal	Disposal
Outlets	None	None	Improved emergency response contract/program	• Upon renewal of asset and resetting of lifecycle; inspection to occur within warranty period. Interventions to occur as required • Localized fixes of outlet structures	None
Culverts & Ditches	None	None	Improved emergency response contract/program	• Upon renewal of asset and resetting of lifecycle; inspection to occur within warranty period. Interventions to occur as required	None

Table 23 - Proposed Lifecycle Management Activities (SWM Facilities)

Asset Types/ Assets	Inspections	Operations	Maintenance	Rehabilitation/ Renewal	Disposal
Cells	Sediment Survey to occur on a 5-year cycle - Visual inspection for blockages after major storm events	Vegetation removal along the access routes and cell banks as a regular program	• General litter/debris cleanup as needed (dictated by annual inspections) • Repair major slope erosion of cell, as needed	None	None
Channels	Visual inspection for damage and blockages after major storm events	Vegetation removal in channels as a regular program	None	Minor erosion control works	None
Structures (Retaining Walls & Berms)	Visual inspection for damage after major storm events	Debris removal from berms as a regular program	None	Minor retaining wall and berm improvements after a project has been completed, outside of warranty period or coverage	None
Signs	None	Clean signs seasonally	None	Update sign wording, as required	None
Inlets	Visual inspection for blockages after major storm events	Clear vegetation at a regular interval	• Clean and grease grate hinges • Flush inlet pipes to prevent blockage/ damage • Flush inlet pipes when debris is present	• Patches and point repairs: localized fixes of pipes • Lining/trenchless rehabilitation (i.e., CIPP, Geo-spray)	Replace headwall with Ontario Provincial Standard Drawing (OPSD) designs when possible

Asset Types/ Assets	Inspections	Operations	Maintenance	Rehabilitation/ Renewal	Disposal
Outfalls	Visual inspection for blockages after major storm events	Clear vegetation at a regular interval	Open maintenance gates and valves at a regular interval to prevent seizing	Localized fixes of outlet pipes and structures	Replace outlet structures with OPSD designs when possible

Table 24 - Proposed Lifecycle Management Activities (Watercourses)

Asset Types/ Assets	Inspections	Operations	Maintenance	Rehabilitation/ Renewal	Disposal
Watercourse (Reaches)	None	None	• Preventative: Stabilization of existing natural assets using bioengineering techniques (live-staking, seeding etc.) • Reactive: Stabilization of existing engineered assets (resetting displaced armourstones, rip-rap adjustments, fortify or install new toe protection, etc.)	Minor bank improvements after a project has been completed, outside of warranty period or coverage	None

Lifecycle Management Current Budget

Operating Budget

The lifecycle management costs using the 2019-2022 stormwater operating budgets are shown for the Stormwater Service Area overall and each asset class in Figure 15.

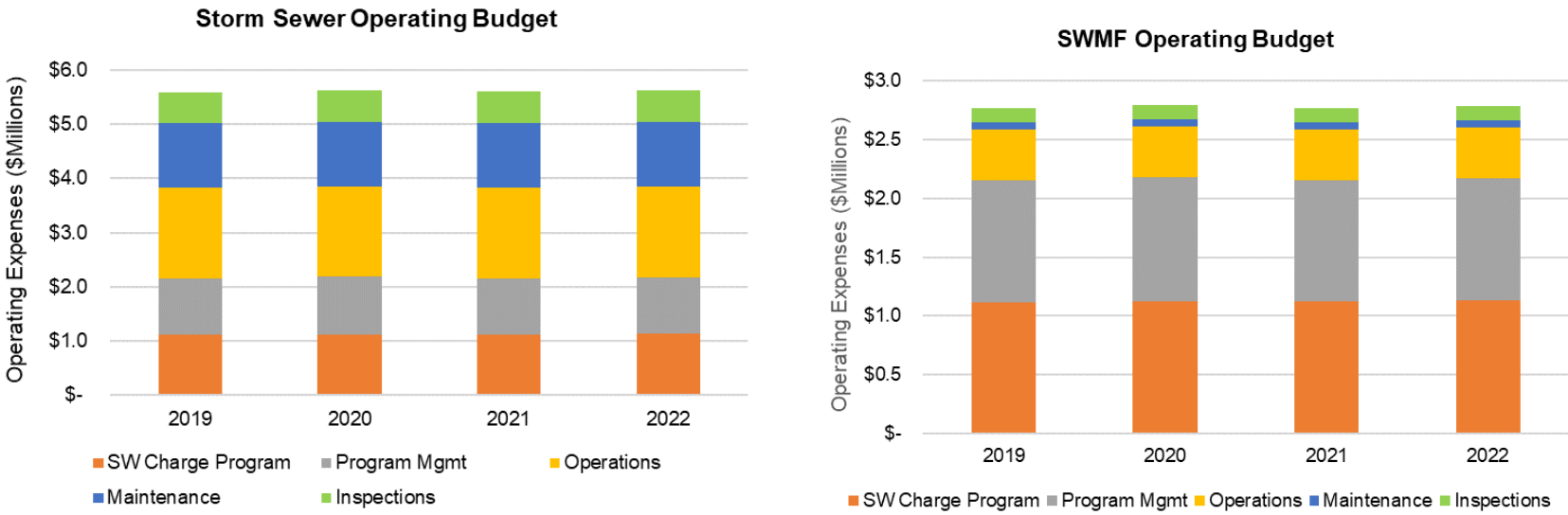


Figure 15 - Forecasted Operating Budget Costs

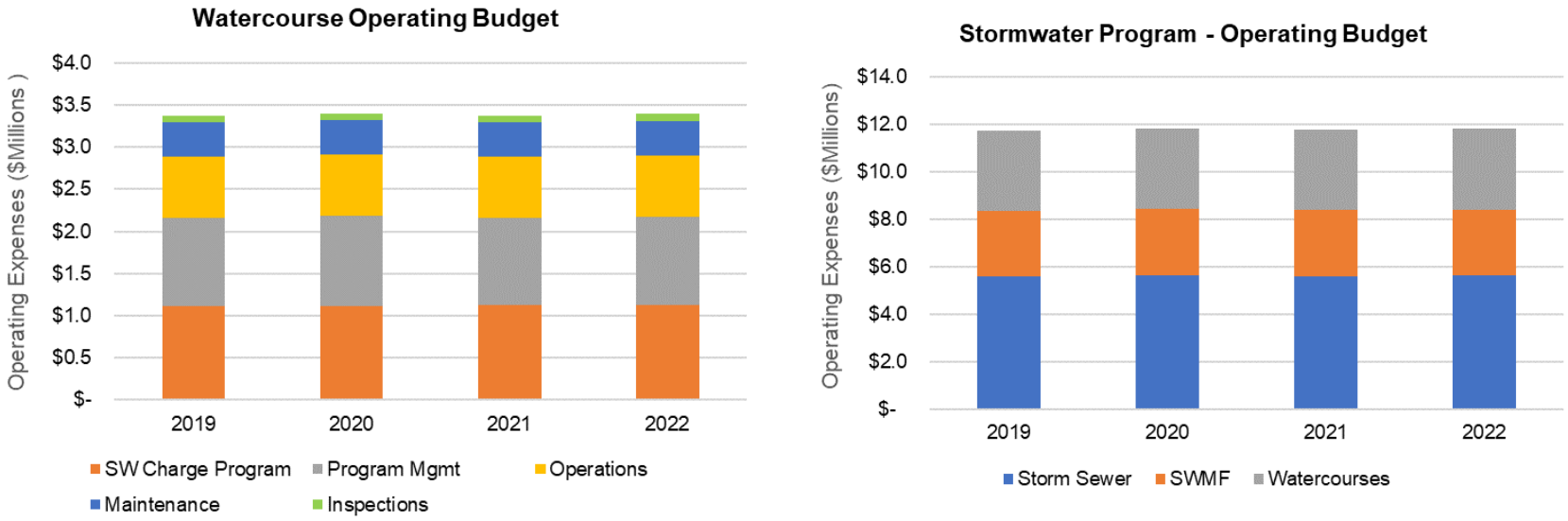


Figure 15 - Forecasted Operating Budget Costs

The total stormwater operating budget is approximately $12 million per year, which includes 25 unique cost centres for various stormwater-funded activities. These cost centres are used primarily by staff in the Environmental Services section and the Works Operations & Maintenance (WOM) Division. For this asset management plan the cost centres were sorted by 'Asset Class' (storm sewers, SWMF or watercourses) and 'Activity' (Operations, Maintenance, Inspections, Stormwater Charge Program or Program Management). The 2019 Stormwater Operating Budget is summarized in Table 25.

Table 25 - 2019 Stormwater Operating Budget

Operating Program Activity	Storm Sewers ($000)	SWM Facilities ($000)	Watercourses ($000)	Total ($000)
Operations	1,672	430	726	**2,828**
Maintenance	1,191	61	411	**1,663**
Inspections	580[24]	121[24]	81	**782**
SW Charge Program	1,113	1,113	1,113	**3,339**
Program Management	1,042	1,042	1,042	**3,126**
Total	**5,598**	**2,767**	**3,373**	**11,738**

Operations cost centres include routine activities necessary for the correct operation of the asset. This includes activities such as litter and woody debris removal, inlet and outlet cleaning, spill clean-up, flushing and street sweeping.

Maintenance cost centres include physical repairs to stormwater assets that are not functioning as required or expected. The repair reinstates the asset to its normal operating condition but does not significantly extend the overall asset life. This includes activities such as repairs to headwalls, ditches & culverts, inlets & outlets, safety fencing, maintenance holes and catch basins, which primarily relate to storm sewer assets. There are also cost centres dedicated to watercourse maintenance and SWMF maintenance. Some maintenance activities (e.g., SWMF sediment dredging and watercourse minor erosion control works) are also captured in the capital program, which are not identified here.

Inspection activities are used to check that an asset is operating as planned and/or to measure or observe the condition of the asset. The storm sewer inspections include CCTV condition assessments and routine WOM inspections of critical infrastructure (e.g., inlets and outlets). Additional CCTV sewer inspections are also completed as part of the capital program, which are not captured here. SWMF inspections include condition assessments of the SWM facilities by internal staff. Additional SWMF sediment survey (bathymetry) assessments are also undertaken but are typically captured through the capital program rather than through the operating budget. The Watercourse reaches receive inspections and condition assessments by internal staff.

[24] Note: Additional inspections (i.e. CCTV inspections and sediment surveys) are funded through the capital program and so are not identified here.

SW (Stormwater) Charge Program activities include the fees associated with administering the stormwater charge program (~$3.3 million annually), including exemptions & credits and recoveries from other departments (e.g., IT, Finance, Legal and Realty).

Program Management activities include staff salaries, vehicles, equipment, facility rental and consulting fees for the Stormwater Service Area to administer its various stormwater programs. A more detailed description of the current lifecycle activities is provided above in Table 18, Table 19, Table 20 and Table 21.

Lornewood Creek Storm Sewer Outlet to Lake Ontario, Richards Memorial Park

Mary Fix Creek Storm Sewer Inlet, Queensway W

Lifecycle Management Forecasted Costs

Capital Forecast

Figure 16, Figure 17, Figure 18 and Figure 19 shows the lifecycle management costs based on the 10-year capital budget and forecast (2019-2028) for each asset class and then totaled for the Stormwater Program overall. The figure also indicates the costs for growth and non-growth projects for each asset class.

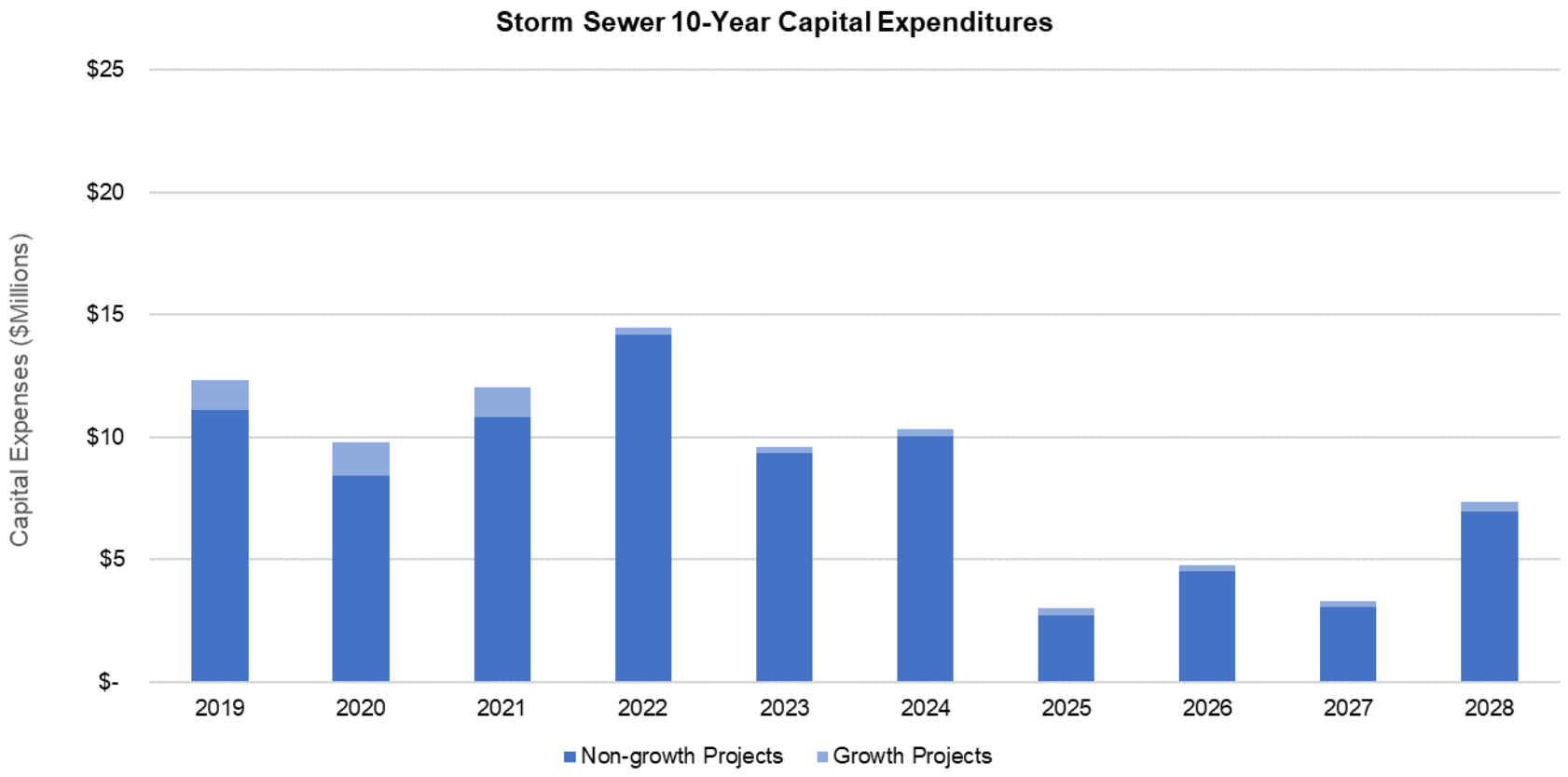


Figure 16 - Forecasted Capital Costs (Storm Sewers)

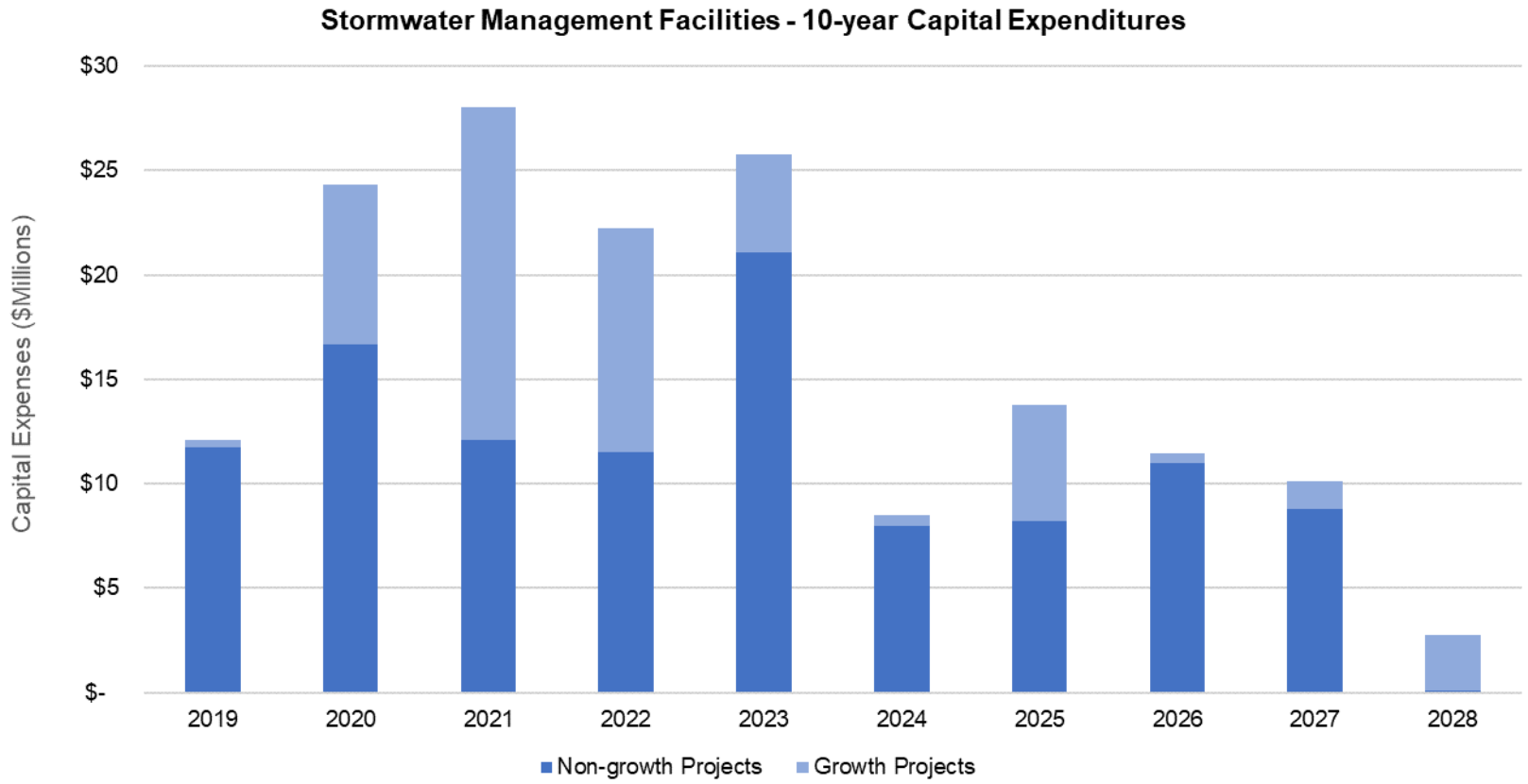


Figure 17 - Forecasted Capital Costs (SWMF)

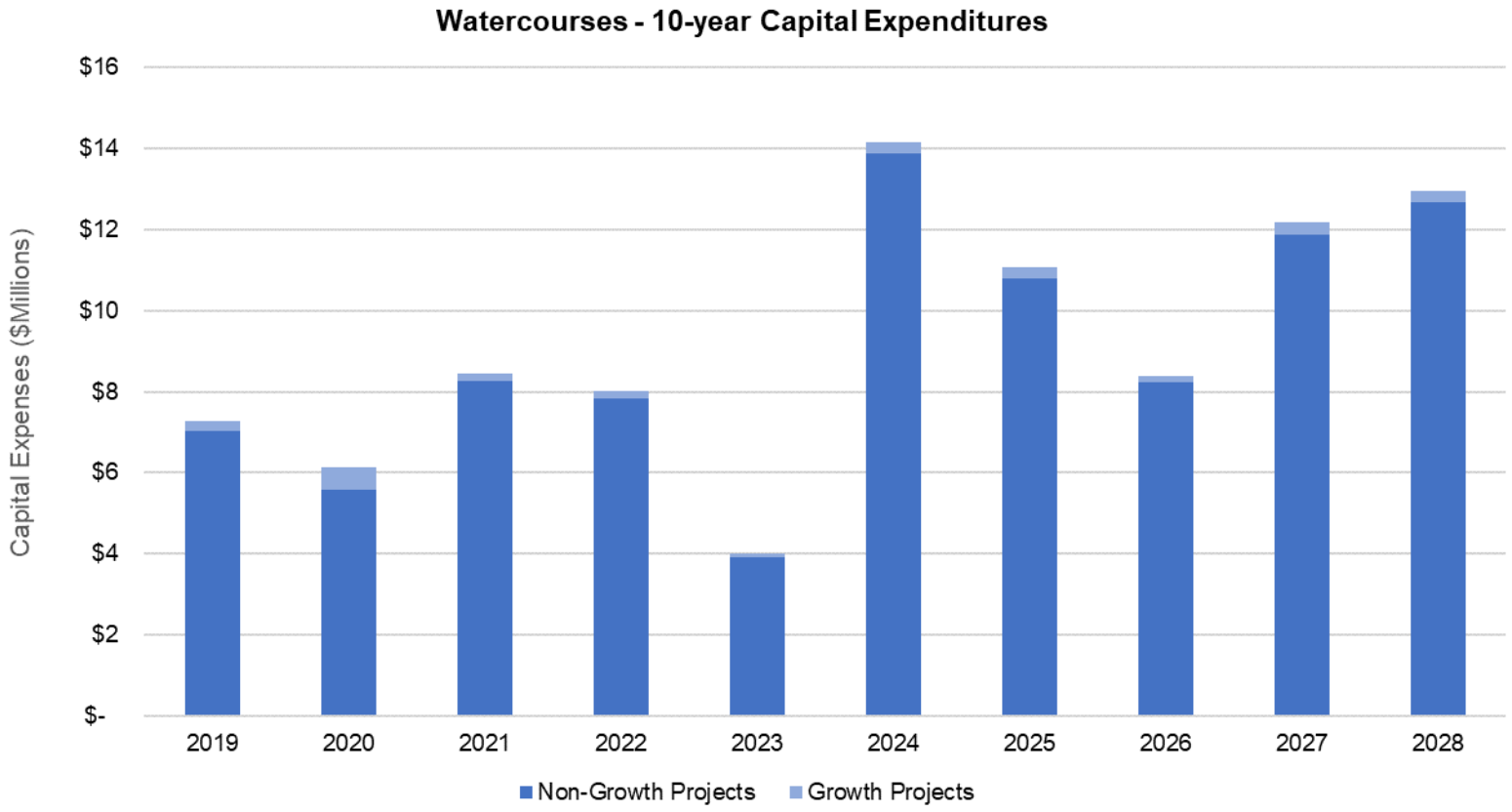


Figure 18 - Forecasted Capital Costs (Watercourses)

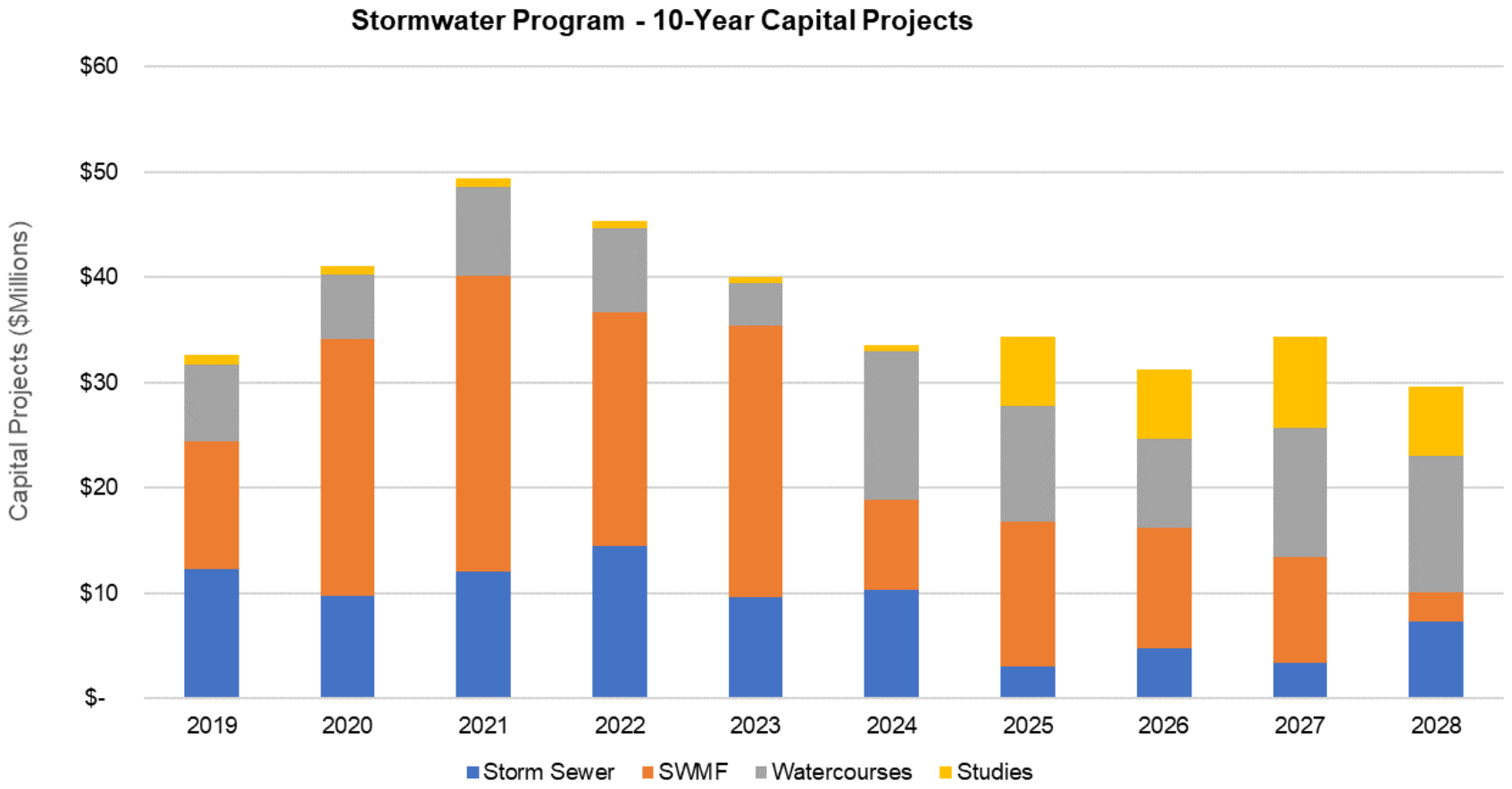


Figure 19 - Forecasted Capital Costs (All Stormwater)

The majority (93 per cent) of the capital storm sewer projects in the forecast are non-growth. Non-growth projects include renewals (replacements or rehabilitations), drainage improvements, and flood mitigation works. The remaining growth projects (seven per cent) are primarily storm sewer oversizing.

SWMF and flood relief projects include a large portion of non-growth (69 per cent) and growth (31 per cent) projects. Non-growth projects are primarily rehabilitation/renewal of existing facilities and retrofits in developed areas to enhance stormwater management services or provide drainage improvements. Growth projects are typically new

water quality/quantity control facilities in developing areas. A small number of renewal projects are also funded by growth revenue (e.g., development charges), based on the remaining developable lands in the applicable watershed.

The majority (97 per cent) of the capital watercourse projects in the forecast are considered non-growth. These projects are essentially all renewal projects to provide erosion control treatment throughout the watercourse network. However, a small portion (approximately three per cent) of each project is considered growth based on the remaining developable lands in the applicable watershed.

Stormwater studies include Master Plans, Flood Evaluations, Capital Prioritization, Condition Assessments, Asset Rehabilitation, Water Quality or Development Charge (DC) Updates. These studies primarily inform asset decision-making (e.g., strategic goals, project prioritization, capital costing and forecasts). DC studies indicate the amount of growth and DC funding available for capital projects and are updated regularly. Changes are reflected in the capital budget and forecast.

The 10-year capital program for growth and non-growth projects is further summarized in Table 26. For the entire stormwater capital program, 83.7 per cent ($313.4 million) of projects are non-Growth. Conversely, 16.3 per cent ($60.9 million) of these projects are considered growth and 15.7 per cent ($58.5 million) are eligible for funding via development charges. The remainder of the growth projects (0.6 per cent: $2.3 million) are funded by developer contributions.

Table 26 – 2019-2028 Capital Program Summary

Capital program	10-year Capital Program (2019-2028)			
	Capital (Growth) ($000)	Capital (Non-growth) ($000)	Total ($000)	% Growth
Storm Sewers	5,832	81,245	87,077	6.7
Watercourse Erosion Control	2,559	90,057	92,616	2.8
SWMF and Flood Relief works	49,918	109,162	159,080	31.4
Storm Studies	2,540	32,910	35,450	7.2
All	**60,849**	**313,374**	**374,223**	**16.3**

Current Budget Scenario - What does it look like?

Analysis of the Stormwater Service Area's current budget scenario is based on the planned expenditures from the approved capital and operating budgets and forecasts. The total 2019 operating and capital budget expenditures (growth vs. non-growth) separated by asset class are shown in Table 27. Figure 20 shows the capital and operating budget across the 10-year forecast period (2019-2028).

Table 27 – Stormwater Operating and Capital Budgets (2019)

Asset Class	Operating Budget[25] ($000)	Capital (Growth[26]) ($000)	Capital (Non-growth[27]) ($000)
Storm Sewer Drainage Network	5,712	1,217	11,113
Stormwater Management Facilities/Flood Relief Works	2,861	317	11,761
Watercourse Network (Reaches)	3,164	239	7,031
Stormwater Studies	-	750	950
All	**11,737**	**2,523**	**30,855**
Program Total	**45,115**		

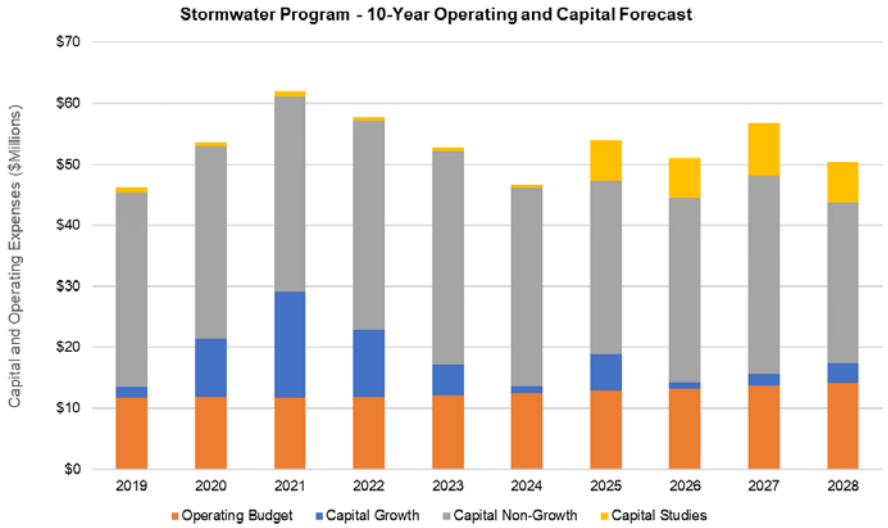


Figure 20 - 10-year Operating/Capital Budget and Forecast - Stormwater Program

[25] Operations, Maintenance, Inspections and Administration Activities

[26] Growth capital projects are new assets primarily constructed to accommodate additional development

[27] Non-growth capital projects are assets primarily constructed to renew or retrofit existing infrastructure

Infrastructure Gap & Challenges

Infrastructure Renewals

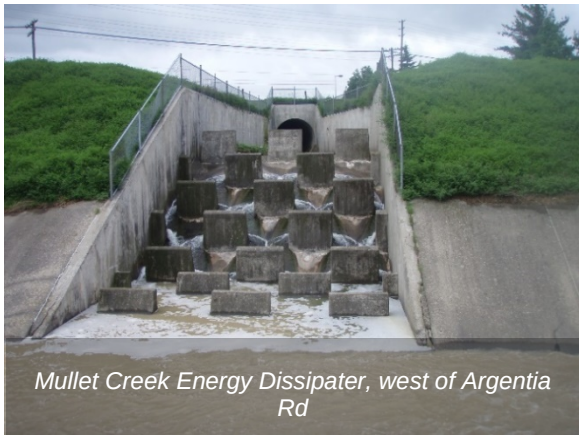
Future funding of the Stormwater Management Program will need to address asset renewals (replacement and rehabilitation) for the current infrastructure base in addition to new capital assets constructed and assumed. Renewal forecasts for the Storm Sewer and SWMF asset class are discussed below. A renewal forecast for the Watercourses is currently unavailable due to insufficient information at the asset level (no formal inventory).

Storm Sewer Renewal Forecast

The 100-year Storm Sewer renewal forecast, based on age, is shown in Figure 21. The renewal forecast for the complete storm sewer drainage network reports an annual average renewal cost of approximately $950,000 for the first five years. Starting around 2030, the initial replacement needs are predominantly for the trunk sewers. To fund a sustainable renewal program over the 30-year period, the Stormwater Service Area should have sufficient budget to renew approximately $10 million of sewer assets per year.

Annual renewal costs start to increase significantly around 2048 and continue to escalate for the next 40+ years. Over the 100-year period, it is anticipated that on average $50 million a year is necessary to sustainably replace all storm sewer network assets. Due to the asset quantities and large replacement value of storm sewers, compared to the other stormwater assets, it is critical that maintenance, inspection and renewal programs mature to meet this demand. It is recommended that the Stormwater Service Area implement a thorough inspection program to quantify condition more accurately, and based on the results, revise the estimated useful lives of the assets to align with the rate of deterioration that is occurring.

Alternatively, staff may opt for staged replacements of assets to occur over a multi-year period. These management strategies, among others, require further consideration but ultimately are intended to potentially extend the assets' useful lives, thereby delaying significant renewal costs; in other words, lowering the peak renewal needs from 2050 to 2090 and reducing the 100-year average renewal costs as shown in Figure 21.



Mullet Creek Energy Dissipater, west of Argentia Rd

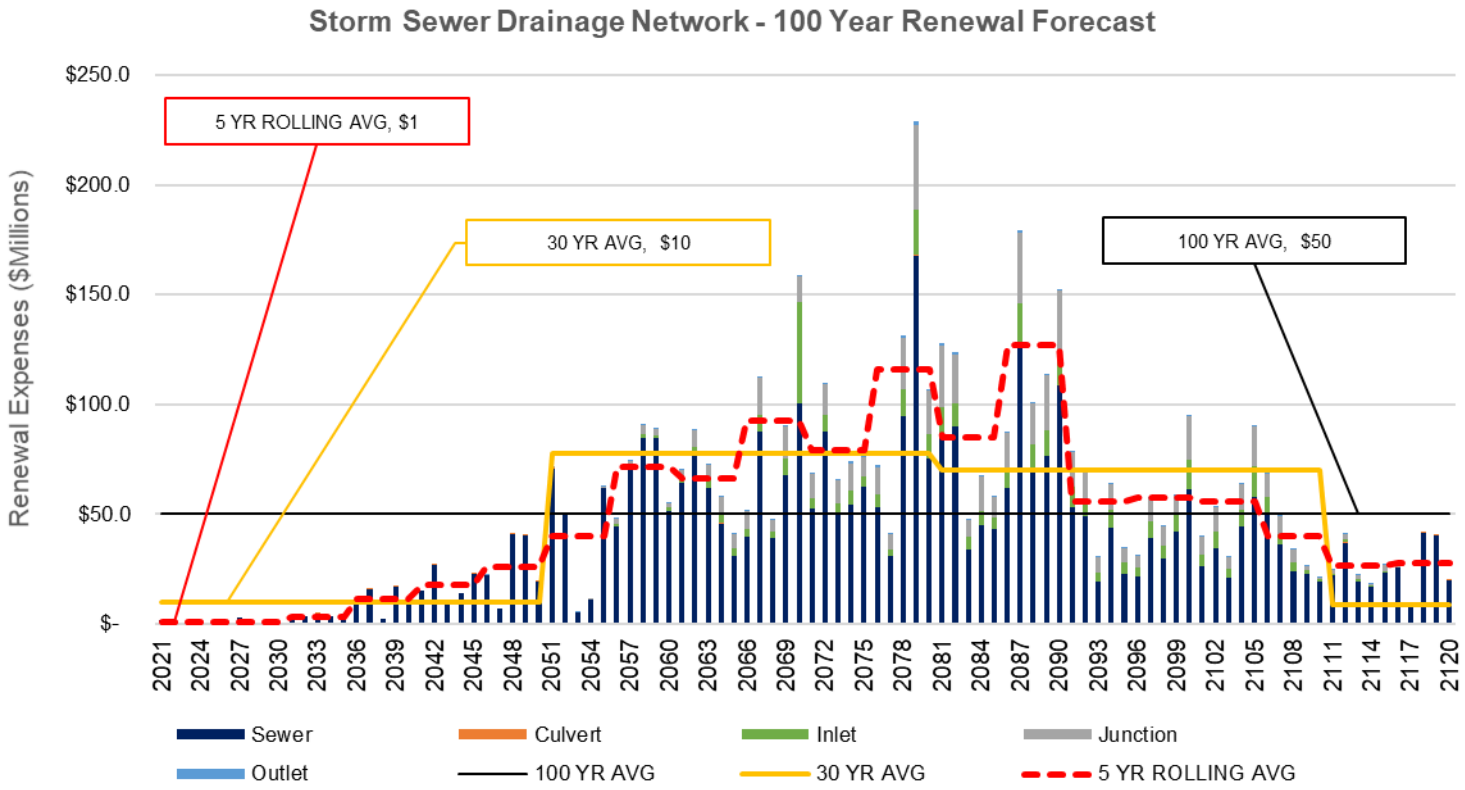


Figure 21 - Storm Sewer Drainage Network - 100-Year Renewal Forecast

SWMF Renewal Forecast

The 100-year SWMF renewal forecast, based on age, is shown in Figure 22. The renewal forecast for the storm management facilities reports an annual average of approximately $9,000 for the first five years. This is partly comprised of two forebay berm pipes, which are indicated to be beyond their useful lifespan. For the medium-term, 30-year period, there are very few asset replacements identified based on the age of the facilities assets. The assets that may require replacement include a few outlet structures and various components. The 100-year annual average is $1.4 million, which indicates that most renewals will occur beyond the 30-year horizon or long term, and renewal costs will be more significant.

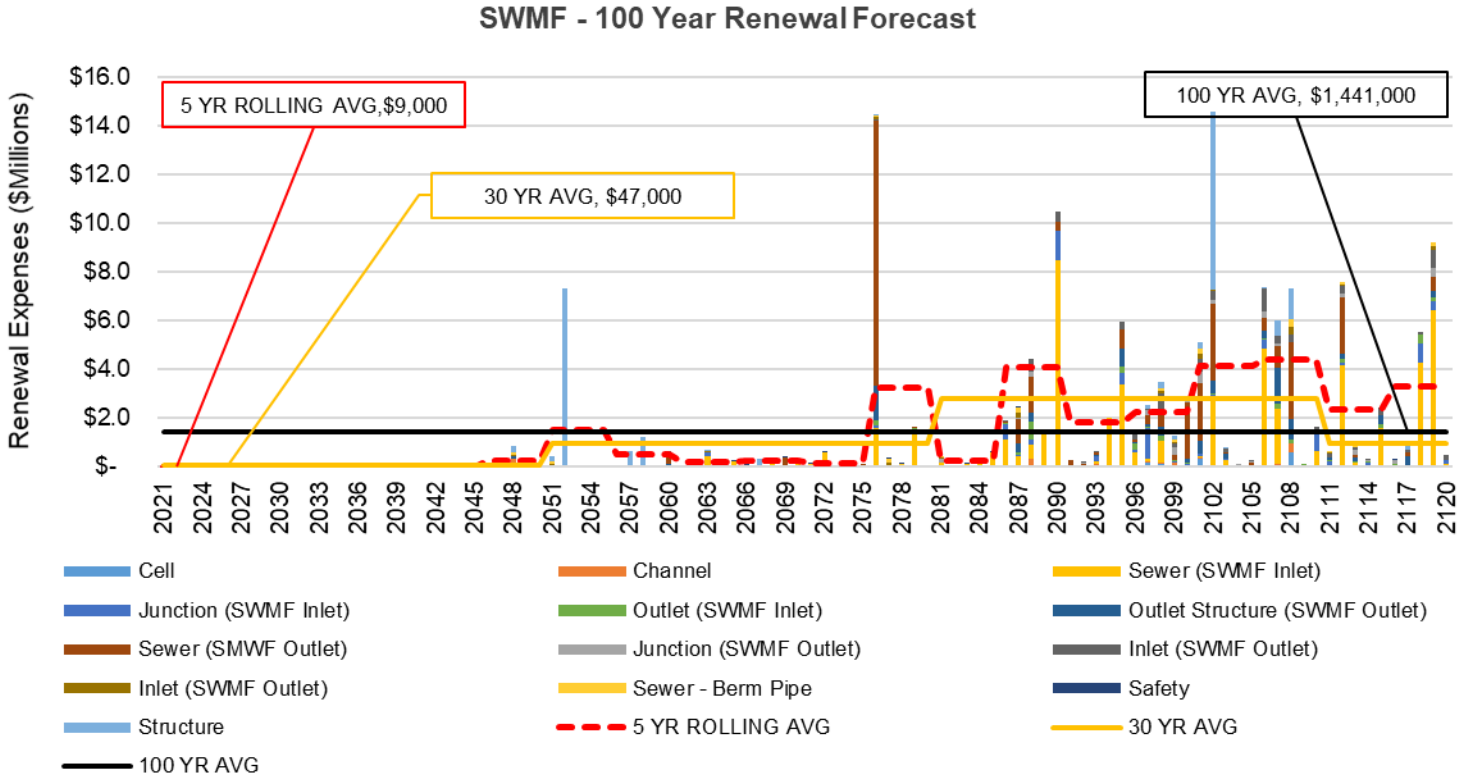


Figure 22 - Stormwater Management Facilities – 100-Year Renewal Forecast

Short-Term Infrastructure Funding Gap

The short-term infrastructure funding gap is the difference between the stormwater needs and the available revenue over the 10-year period based on the current capital, operating and pipe reserve programs. The analysis documented in Table 28 below shows the funding analysis for the Stormwater Management Program from 2019-2028. This analysis considers only non-growth-related expenses. Growth-related expenses are not included as they are assumed to be fully funded by other revenue sources (i.e., development charges and developer contributions). The funding assessment includes the operating budget required along with the annual contributions and expenditures to the Pipe Reserve Fund. Based on maintaining current revenue with forecasted inflation over the ten-year period, the Stormwater Program has an infrastructure funding gap of $20,692,000.

Table 28 – Short-Term Funding Gap - Stormwater Management Program (2019-2028)

Service Area	Funding Program	Stormwater Management Program	10-Year (2019-2028) Funding Needs ($000)	10-Year (2019-2028) Forecast Revenue ($000)	10-Year (2019-2028) Funding Gap ($000)
Stormwater	Capital Reserve Expenditures	Storm Sewer (Non-growth)	253,684[28]	**459,480**	**(20,692)**
		SWMF/ Flood Relief (Non-growth)			
		Watercourses (Non-growth)			
		Studies (Non-growth)			
	Pipe Reserve Contributions/ Expenditures	Pipe Reserve Contributions/ Expenditures	106,000		
	Operating Budget	Operating Budget	120,488		
		Total	**480,172**		

[28] Excludes Tax-funded projects, Capital Growth Projects and Pipe Reserve expenditures

The Stormwater Service Area plans and forecasts the Stormwater Management Program (Operating and Capital) over ten-year periods to effectively build and maintain stormwater infrastructure and services. The program is primarily funded by the Stormwater Charge Program and the charge funds all aspects of the non-growth Stormwater Management Program (Capital, Operating and Pipe Reserve Contributions). Based on the analysis of the Stormwater Charge revenue anticipated over the next 10 years, and an annual stormwater charge increase of two per cent (which has been approved each year since its inception in 2016), the Stormwater Management Program has an infrastructure funding gap of $20.7 million, as shown in Table 28.

To address this funding gap, additional investments in the Stormwater Management program are required through increases in Stormwater Charge revenue. Increases to the Stormwater Charge are forecast and proposed for Council's approval through the annual Stormwater Business Plan and Budget.

Long-Term Infrastructure Funding Gap

The long-term infrastructure funding gap considers the 100-year renewal forecast of existing stormwater infrastructure compared to the projected available funding over this same period. The Storm Sewer renewal program is funded from the Pipe Reserve. Watercourse and SWMF renewals are funded primarily by Capital reserves, and partially by development charges. Capital reserves also fund new infrastructure projects, so it is expected that this reserve fund will need to increase to adequately fund additional renewal projects as a result of system growth.

Table 29 shows the long-term forecast funding needs for the storm sewers. The information for this analysis came from the state of the infrastructure report (above) and financial forecast scenarios.

Table 29 - Long-Term (100-Year) Funding Gap for Storm Sewer Assets (2021-2120)

Asset Class	100 Year (2021-2120)		
	Pipe Reserve Contributions[29] ($000)	Renewal Cost[30] ($000)	Infrastructure Funding Gap ($000)
Storm Sewer	2,040,635	5,003,929	(2,963,294)

Storm Sewers

To manage the long-term needs for planning and replacement of storm sewer assets a Pipe Reserve Fund has been established. The fund is only used to renew existing storm sewer infrastructure. Figure 22 below shows the current estimated replacement needs over the next 100 years compared to the forecasted contributions to the Pipe Reserve. The resulting cumulative pipe reserve contributions, identifies the long-term infrastructure gap for storm sewers. This forecast shows that initially funding is available to fund the required renewals for storm sewer assets. However by 2058 the Pipe Reserve Fund has been fully depleted leaving a $2.963 billion gap after the 100-year period.

[29] Based on $1 million annual increase in pipe reserve contributions until 2034, after which the annual contribution remains constant at $21.1 million

[30] Based on State of the Infrastructure assessment and renewal needs over the next 100 years

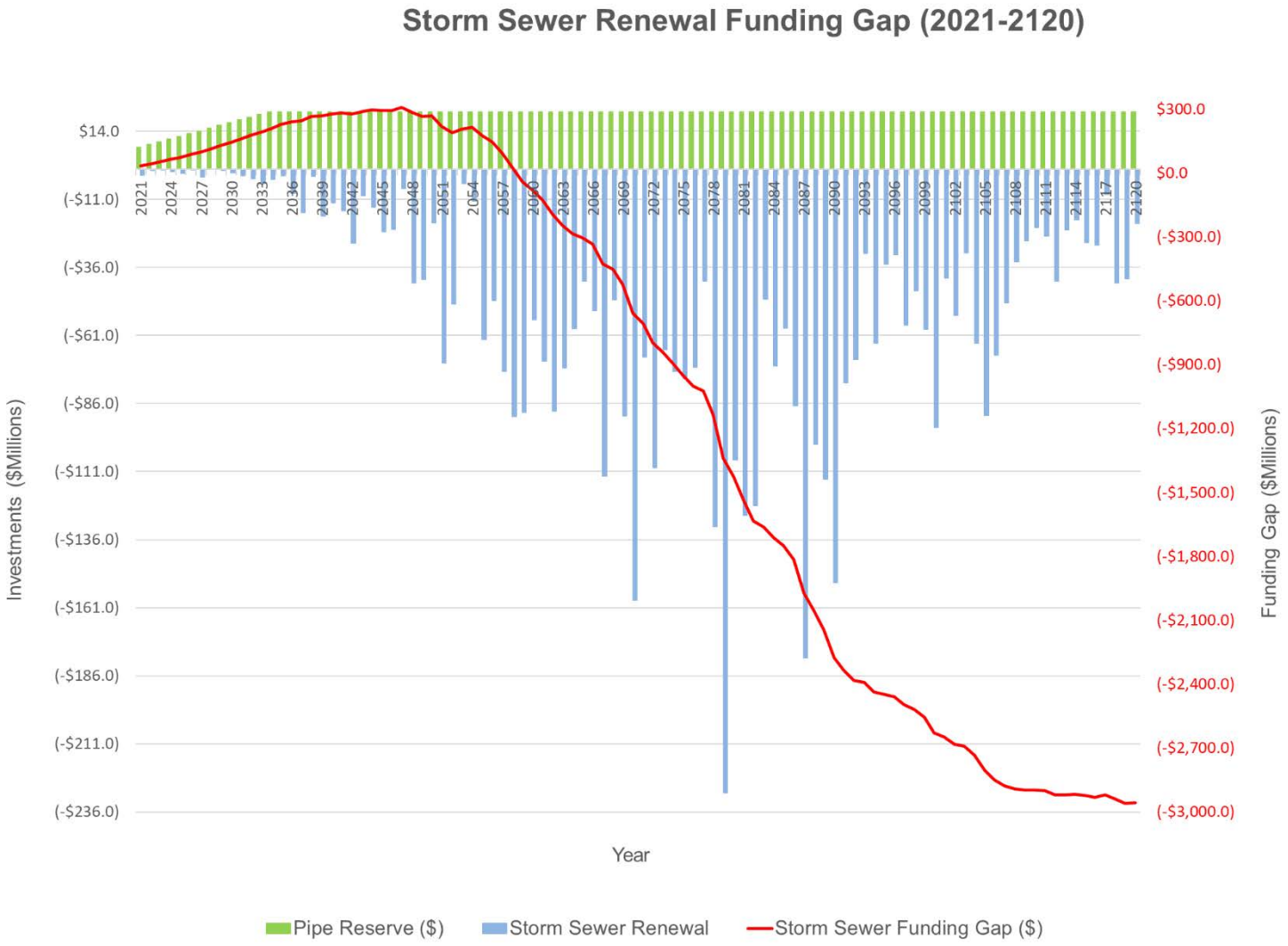


Figure 23 - Long-term Funding Forecast for Storm Sewers

The Stormwater Management Program's current strategy for funding the pipe reserve proposes to increase contributions by $1 million annually (i.e., $6.1 million in 2019, $7.1 million in 2020, etc.) until reaching approximately $21 million and then maintaining that contribution moving forward, with adjustments for inflation.

The annual contribution amount and preliminary target was established at the onset of the Stormwater Charge and was based on initial estimates of a one per cent annual contribution of the total replacement value (approximately $2.1 billion in 2019) which equates to roughly $21 million per year.

Through the completion of the State of the Infrastructure and efforts to more accurately quantify total replacement value, the Stormwater Service Area acknowledges the preliminary replacement value and related contribution target was grossly underestimated.

Today's pipe replacement value is estimated at $4.71 billion and staff intend to better quantify and plan for Stormwater's long-term infrastructure needs. In this regard, the combination of collecting additional sewer condition data, development of asset management strategies and Stormwater Charge revenue forecasting from the Stormwater Business Plan and Budget will allow for further refinement of the long-term funding gap and establishing the target Pipe Reserve contribution required.

Stormwater Management Facilities (SWMF) and Watercourses

As mentioned above, Stormwater Management Facility renewals are primarily funded through the capital reserve with minor contributions from development charges. As shown in Figure 22, SWMF renewals are forecast to experience more peaks and valleys over the next 100 years based on the quantity and types of assets when compared to storm sewer assets. This allows the reserves more time to recover after large expenses.

To meet the infrastructure reinvestment needs the City needs to reinvest $1,441,000 every year for the next 100 years. The current funding structure appears to meet this need. However, due to the complexity of the current funding structure for both SWMF and Watercourses the forecast 100-year funding gap could not be calculated with an appropriate degree of confidence.

With respect to Watercourse assets, there is neither a formal inventory nor any age-distribution information currently available. This means that forecasting renewals and investment needs cannot yet be completed. In future asset management plans, the Stormwater Service Area will look to develop a process to understand the future investment requirements for renewing Watercourses assets.

Continuous Improvement

One of the goals of the asset management plan is to establish a baseline of the current asset management practices to inform a work plan for continuous improvement.

Advancing Corporate Asset Management Capabilities

In order to evaluate service area capabilities and develop a work plan towards enhanced asset management maturity, the Corporate Asset Management office plans to conduct periodic internal audits of service area asset management practices.

A service area's progress in delivering or advancing asset management practices can be measured through a maturity assessment which has been completed for each Stormwater asset class (Storm Sewers, SWM Facilities and Watercourses). The results for each asset class and an overall result for the Stormwater Service Area are scored from 0.0 to 4.0 based on eight key improvement categories:

- Leadership and Commitment
- Financial Capacity
- Know Your Assets
- Know Your Financial Situation
- Understand Decision Making
- Manage Asset Lifecycle
- Know the Rules
- Monitor Sustainability

Recording the questions, scores, analysis, and results allow for benchmarking the level of asset management practices. This also allows staff to re-evaluate their business practice maturity at any time in the future, and report the progress achieved.

Figure 24 provides a radar chart that shows the maturity scores of the Stormwater asset classes in 2019 and the overall target maturity of the Stormwater Service Area. As the service areas mature in each of the eight categories, they will expand outwards towards the outer ring (Target).

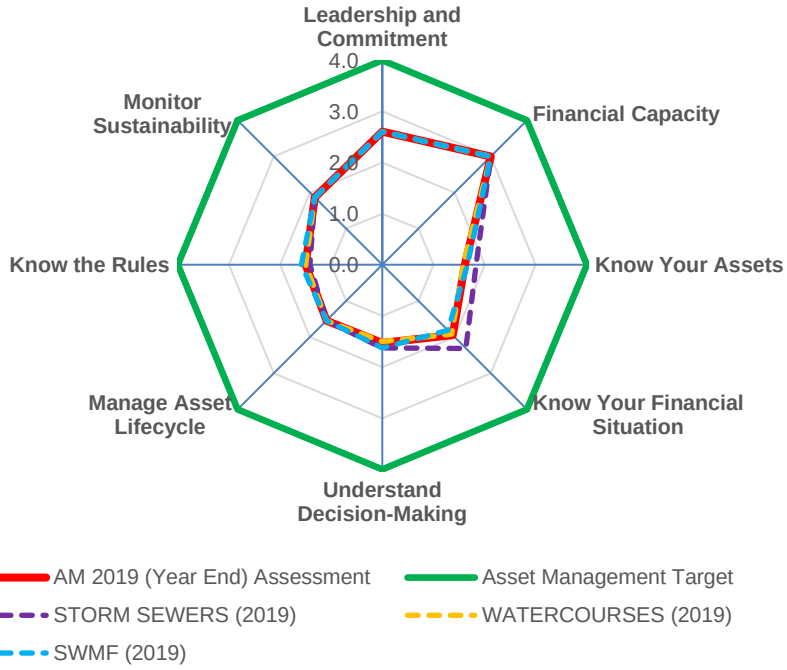


Figure 24 - Maturity Assessment - Stormwater Service Area (2019)

Figure 25 shows a comparison of the Stormwater maturity scores reported in 2018 and 2019, indicating progress that has been made. The overall maturity scores are derived from a detailed assessment survey that tracks progress of high-level tasks. The Improvement Plan based on the original 2018 assessment is included in the Appendix - List of Asset Management Strategy (2019) Improvement Tasks. As a result, the assessment can be reviewed and updated to reflect progress in Stormwater asset management overall and ultimately demonstrate the service area's maturity at a corporate level.

Figure 25 - Maturity Assessment Comparison - Stormwater Service Area (2018-2019)

Advancing Service Area Asset Management Capabilities

The proposed work plan in Table 30 was developed in consultation with City staff through the development of the asset management plan. Tasks are coded from the section of the plan it relates to (e.g., SOI = State of Infrastructure). These tasks may differ from those in the maturity assessment improvement plan, as they are predominantly internal tasks to the Stormwater Service Area that provide the foundation for a better asset management program/plan and support greater maturity in the corporate level improvement categories.

Through the maturity assessment and associated work plans, the Stormwater Service Area aims to build upon existing strengths to develop leading asset management practices that balances costs, opportunities and risk with the desired levels of service, to achieve both service area and corporate objectives.

Sawmill Creek, Upstream of Burnhamthorpe Rd W

Table 30 - Work Plan – Stormwater Service Area

Task No.	Work Plan Task	Asset Class	Estimated Timing	Target Benefits	Required Resources
SOI-01	Consolidate CCTV assessments into GIS inventory	Storm Sewer	2020-2022	Centralizes condition data and provides single source of information	Internal
SOI-02	Develop process to update asset register from the latest CCTV condition database	Storm Sewer	2022	Ensures that database is up to date at the conclusion of each new CCTV inspection project	Internal
SOI-03	Conduct visual condition assessments for culverts, MHs, CBs, inlets and outlets and a condition assessment program for all culverts	Storm Sewer	2023	Improved tracking of assets	Internal
SOI-04	Conduct city-wide review of asset ownership (e.g., Storm Sewer, Stormwater Management Facilities, Watercourse, Transportation assets)	All	2020-2021	Improved tracking of assets and responsibility to maintain/manage assets	Internal
SOI-05	Identify major and minor culverts	Storm Sewer	2022	Some culverts are large in size and require condition inspections, which should be differentiated from the rest of the culverts	Internal
SOI-06	Formalize inventory, assign unique IDs and create assets/features by asset component (GIS)	SWMF, Watercourses	2021-2023	Improved completeness and accuracy of the information within the database to improve tracking and management of assets and identifying funding requirements	Internal
SOI-07	Underground facilities and pump stations, LID features,	SWMF	2021-2023	Provides a more complete database	Internal

Task No.	Work Plan Task	Asset Class	Estimated Timing	Target Benefits	Required Resources
	dry ponds – establish inventory				
SOI-08	Roll-up scores of individual component condition assessments to an overall assessment score	SWMF, Watercourses	2021-2024	Ensures all assets are considered in overall assessment score of parent assets	Internal
SOI-09	Enhance condition assessment method to account for built and natural components within the reach	Watercourses	2021-2024	Ensures all assets are considered in overall assessment score of parent assets	Internal
SOI-10	Link condition and inspection data to asset ID	All	2020-2024	Provides a complete, digitized inventory	Internal
SOI-11	Expand condition scoring system to a 5-point scale (to align all 3 Stormwater Groups)	All	2021-2024	Establish consistency in scoring and comparability among assets in the Stormwater Department	Internal
SOI-12	Identify and populate missing attribute data (type, size, material)	All	2021-2024	Provides a complete, single source of information	Internal
SOI-13	Link EUL to asset ID	SWMF, Watercourses	2021-2024	Provides a more complete data register to monitor, track and analyze	Internal
SOI-14	Link work and failure history data to asset ID	All	2023-2025	Links the history of the asset to its identifying information for improved monitoring	External

Task No.	Work Plan Task	Asset Class	Estimated Timing	Target Benefits	Required Resources
SOI-15	Populate Infor Inventory from GIS Datasets (Asset IDs)	All	2023-2025	Improved monitoring of assets	External
SOI-16	Review and Improve Risk Factors (Impact/Criticality)	All	2021-2025	More accurate risk assessment, as more data becomes available	Internal
SOI-17	Complete valuation for culverts, fittings, and pipe/null inlets in future AMP update	Storm Sewer	2023-2025	Improved accuracy of valuation	Internal
SOI-18	Separate the cost of lateral pipes and service connections for future valuation assessment	Storm Sewer	2023-2025	Improved accuracy of valuation	Internal
SOI-19	Attribute all node IDs to an associated pipe ID	Storm Sewer	2021-2022	Improved valuation and risk assessment of nodes based on the size and criticality of connected linear assets	Internal
SOI-20	Consider contracting out condition assessment for structures (control outlets) and formalize valuation and remaining useful life	SWMF	2021-2022	Improved tracking and renewal needs based on observed remaining life rather than age-based remaining life	Internal
SOI-21	Develop unit costs for asset types/materials and establish formal process for maintaining rates	All	2021-2022	Improved accuracy of valuation	Internal
LOS-01	Consider implementing additional recommended customer and technical levels of service metrics	All	2023-2024	More accurate measurement of level of service achieved	Internal

Task No.	Work Plan Task	Asset Class	Estimated Timing	Target Benefits	Required Resources
LOS-02	Review operations and maintenance LOS	All	2021-2022	Allow for improved accuracy of operations and maintenance funding needs to meet LOS	Internal
LMGT-01	Implement recommended lifecycle management strategy improvements	All	2021-2025	Improve management of assets, which can increase the lifespan of assets and better prepare the City for replacement and rehabilitation	Internal
LMGT-02	Improve Operating Budget cost center codes	All	2023-2025	Align cost center names with defined Operations and Maintenance tasks for easier reporting.	Internal
LMGT-03	Develop a predictive performance model to forecast assets future condition based on budget, levels of service and/or lifecycle strategies changes	All	2023-2025	Improve understanding of impact on assets resulting from budgetary, lifecycle strategies or LOS changes	External
IGC-01	Develop a process for understanding renewals and funding needs for Watercourse assets	Watercourses	2024-2026	Understand funding needs and any potential gaps in current funding	Internal
IGC-02	Increase confidence in long-term funding strategy for Watercourses and SWMF and report infrastructure gaps if they exist	SWMF, Watercourses	2024-2026	Understand future revenue structure for SWMF and Watercourses	Internal
RIS-01	Assess appropriate criteria for facility signs when assessing criticality	SWMF	2021	Improved risk assessment	Internal

Task No.	Work Plan Task	Asset Class	Estimated Timing	Target Benefits	Required Resources
RIS-02	Develop likelihood of failure criteria to assess risk of natural assets	Watercourses	2024-2025	Improved accuracy of risk rating and avoided assumptions	Internal
RIS-03	Collect data required to improve asset criticality criteria	All	2023-2025	Improved criticality rating of assets	Internal
RIS-04	Develop methodology and collect data required to improve asset likelihood of failure criteria	All	2023-2025	Improved likelihood of failure assessment	Internal
FDEM-01	Assign Capital Program attributes to each project: Renewal(%), Expansion(%) and Lifecycle Activity	All	2021	Improve capital budget information and future AM reporting	Internal

Improving Future Asset Management Plans

Overall improvement initiatives to minimize gaps in future asset management plans are categorized by section and structured as follows:

Table 31 - Future Improvement Initiatives

Section	Description	Comments
1	Introduction	None at this time
2	State of the Infrastructure	Complete inventory reporting for all asset classes; update cost estimates for all assets based on tenders and unit costs
3	Levels of Service	Provide further details on operational and maintenance levels of service; Estimate 10-year predicted condition of assets by 2023
4	Future Demand	Assign additional attributes to projects in the capital program to improve tracking of spends for renewal and expansion of the municipal stormwater system
5	Lifecycle Management Strategy	Improve cost center codes for easier tracking and reporting of lifecycle activities
6	Infrastructure Gaps & Challenges	Increase confidence in asset renewal needs (Watercourses) and long-term funding strategies (Watercourses and SWMF)

Summary

The State of the Infrastructure section summarizes the inventory quantities and replacement values for the three main asset classes (storm sewers, SWM facilities and watercourses) in the Stormwater Service Area. This section also identifies the data limitations and data assumptions required to develop these quantities. A risk distribution was also developed for each asset class. The majority (nearly 100 per cent) of Stormwater assets were assigned a risk rating of Very Low to Medium. The total Stormwater replacement value ($5.290 billion), average stormwater management system condition ("**Good**") and overall data confidence rating scale (**B-**) are summarized in Table 32.

The Levels of Service section includes 18 metrics that were developed as part of this asset management plan or leveraged from the Stormwater Business Plan and Budget. This includes those prescribed in *O. Reg. 588/17* and additional advanced metrics to benchmark and monitor Stormwater Service Area performance. Overall, the stormwater service attributes, objectives, customer measures, technical performance and future trends were compiled in Table 16. The information will serve as a tool to benchmark and track future performance for the Stormwater Service Area. Performance targets, per 2024 legislation, will also be established in subsequent asset management plans.

The Future Demand section identifies various demand drivers that may affect stormwater service in the future. This list of drivers includes: aging stormwater infrastructure, new legislation and regulations, city growth and development, environmental awareness, asset management planning, technology and climate change impacts (e.g., frequency of extreme rainfall, freezing rain events, etc.). It also describes the City's plans to monitor and mitigate these drivers.

The Lifecycle Management Strategy section describes the Operations, Maintenance, Inspection (OMI) and Rehabilitation and Renewal (R&R) activities currently used for maintaining the stormwater assets. A number of proposed activities were also identified that may be implemented in the future to improve the management of the stormwater system. The section includes a breakdown of the 2019-2022 Operating Budget (Operations, Maintenance, Inspection, Stormwater Charge Program and Program Management activities) for the three defined asset classes. A review of the 2019-2028 Capital Budget & Forecast for storm sewers, SWMFs/flood control, watercourses and stormwater studies is also provided.

The Infrastructure Gap and Challenges section first identifies the 100-year infrastructure renewal costs for storm sewers and SWM Facilities (note: Watercourses renewals were excluded due to a lack of inventory information). The section also evaluates the short-term (10-year) infrastructure funding gap (needs versus revenue) for the Stormwater Program. This information is summarized in Table 32. The long-term (100-year) infrastructure funding gap is also reviewed for the storm sewer drainage network and was estimated as $2.963 billion based on the current pipe reserve funding scenario and the estimated renewal costs.

The Continuous Improvement section includes results of the Stormwater Service Area maturity assessment as shown in Figure 24 and Figure 25. The assessment indicates the continuous improvement in stormwater asset management maturity for eight key improvement categories. Also provided is a work plan for each asset class, with estimated timelines to complete, which shall be used to improve the information and reporting in subsequent asset management plans.

Table 32 - Summary of Stormwater Replacement Value, Condition and Infrastructure Gaps

Asset Class	Replacement Value (Millions)	Condition	10-Year Funding Needs (Millions)	10-Year Infrastructure Gap (Millions)
Storm Sewer Drainage Network	$4,710		$480	($21)
Stormwater Management Facilities (SWMF)	$160			
Watercourse Network (Reaches)	$424			
Stormwater Management System	$5,290		$480	($21)

List of AM Strategy (2019) Improvement Tasks

Task #	Improvement Category	Desired Improvement	Task Type
1	**Asset Data**	*Audit what you have and define what you need. Design a data capture/improvement plan and improve existing asset information including as appropriate condition assessment. Develop asset information updating procedures.*	
1.1		Develop prioritized Data Capture Program including key asset attribute data as well as condition data.	Start-up
1.2		Develop and implement standard operating procedure (SOP) document for editing, updating, and maintaining asset data registry.	Start-up development of SOP transitioning to Business as Usual (BAU) for implementation
1.3		Implement Data Capture Program according to prioritization and available funding.	Ongoing
2	**Leadership**	*Establish a cross-functional asset management team and senior champion and manage the implementation of the AM improvement plan, including an annual update.*	
2.1		Implement a departmental cross-functional asset management steering group to make collaborative decisions on asset management issues such as: the oversight for development of AM governance and guidance documentation; the responsibility for managing the AM improvement program and reporting on AM performance and effectiveness; and the evaluation and procurement of any AM support tools and overseeing implementation. The implementation of the cross-functional team should include senior leadership approval of membership and development of terms of reference.	Start-up transitioning to BAU for ongoing group meetings and actions
2.2		Provide management oversight to AM Improvement Plan.	Ongoing
3	**Decision Processes**	*Progress toward evidence-based decision-making, review and document decision processes, track data and performance measures to decisions.*	
3.1		Consult cross-functional AM steering group to list key decisions that require data support. Prioritize the decisions listed based the degree of evidence-based support that each decision requires.	Start-up

Task #	Improvement Category	Desired Improvement	Task Type
3.2		Review decision processes for each decision listed (refer to Task 3.1) beginning with the decisions of highest importance; document current process (including detailing the data and analysis required, the people who need to be involved or consulted, and the process for approval of the decision, and reporting/recording outcomes); and design improved processes where needed.	Start-up transitioning to BAU for periodic reviews and improvement
3.3		Implement improved decision processes.	Ongoing
4	**Data Governance**	*Identify roles and responsibilities for data management.*	
4.1		Develop Data Governance Policy, including definition and assignment of data governance roles and responsibilities, and submit for approval.	Start-up
4.2		Implement approved Data Governance policy. This will require communication and training, and development of business processes or SOP documents, detailing roles, responsibilities, and accountability.	Start-up transitioning to BAU for ongoing implementation
5	**People**	*Identify your resource needs short-term and longer-term for implementing AM practices and set up an AM training program.*	
5.1		Develop AM Resource Plan for implementing AM Improvement tasks and quantify short-term and long-term resource needs for ongoing AM within service areas.	Start-up
5.2		Identify AM Roles and Responsibilities and include as part of AM support tool implementation and as part of AM Improvement tasks, to assign roles and responsibilities and require information feedback for reporting on both outcomes/achievements and effectiveness of activities.	Start-up
5.3		Cross-reference AM Resource Plan requirements (refer to Task 5.1) and assignment of AM Roles and Responsibilities (refer to Task 5.2), identify AM skill levels required and compare with current skillsets to identify gaps and the AM training required to support staff to be successful in AM roles and to promote organizational sustainability in AM practices.	Start-up

Task #	Improvement Category	Desired Improvement	Task Type
5.4		Develop AM Training program, prioritize required training, and submit program for senior leadership approval. On approval, implement training according to prioritization and available funding.	Start-up transitioning to BAU for implementation and periodic review/update
6	**Lifecycle Management**	*Begin process of documenting lifecycle strategies beginning with maintenance strategy and preventative maintenance schedules. Incorporate PM schedules into new AM tool.*	
6.1		Complete a Lifecycle Strategies workshop for each major asset group (i.e., storm sewers, SWMFs, watercourses, etc.) to identify the preventative maintenance activities, scheduled/routine operations activities, and planned inspections throughout the asset lifecycle, and the treatment/rehabilitation options to extend the lifespan or to replace the asset at end of life.	Start-up
6.2		Following the Lifecycle Strategy workshops begin developing detailed preventative maintenance, scheduled operations, and planned inspection activity lists by asset, asset location, or asset type as applicable. This work may take some time to complete (depending on what ratio of internal to external resources are used). Therefore, the most important assets, asset locations, and activities should be prioritized for completion first.	Start-up transitioning to BAU periodic review/update
6.3		Develop an asset renewal strategy documenting approach for evaluation of renewal options, and the decision process to be applied including criteria and issues to be considered, calculation and reporting requirements, and the approval and implementation process.	Start-up transitioning to BAU periodic review/update
7	**Cost Tracking**	*Look at how things are done now, identify needs and options. Implement cost tracking of work orders against relevant assets in conjunction with the new asset management tools (refer to Task 1.)*	
7.1		Review current cost tracking and recording. Compare the current state with the data needs for asset management tracking and planning. Identify data or process gaps and potential solutions. Consult on potential solutions, agree on actions to take, and provide recommendation for approval. On approval, add next steps to improvement plan and prioritize the work against the other tasks in the improvement plan. Note: This task must be completed before the AM Support Tool is implemented (refer to Task 15.6).	Start-up

Task #	Improvement Category	Desired Improvement	Task Type
7.2		Implement approved changes as required to capture necessary cost-tracking information in a format suitable for performance analysis and investment decision-making.	Start-up transitioning to usual business for ongoing cost tracking
8	**AM Governance**	*Make a start on getting key documents in place.*	
8.1		Develop key documents for AM governance and operation such as (1) AM Policy, (2) AM Strategy, (3) AM Program Guide or Manual (i.e., the framework for managing consistency across multiple service areas.	Start-up for first documents transitioning to BAU for periodic review/update
8.2		Design AM performance measures and reporting requirements to track, measure, and report on three areas of AM performance: (1) progress in implementing improvements; (2) performance in achieving AM objectives and targets; and (3) effectiveness of AM to achieve desired outcomes.	Start-up for design transitioning to BAU for measure/report, review/update
8.3		Develop business process for annual and three-yearly reviews and reporting of AM performance measures.	Start-up for developing Business Process
8.3		Develop business process for annual and three-yearly reviews and reporting of AM performance measures.	Start-up for developing Business Process
9	**Risk**	*Identify options for risk management and the measurement of risk to include in decision-making and define functional requirements to integrate risk considerations into AM analysis.*	
9.1		Develop a Risk Framework suitable for Mississauga's Stormwater assets. Consider the variety of asset types and service areas. Consider also, what risk information will be of benefit to decision-makers and how risk information should be used in various AM analyses. Finally, also consider how risk scores need to be reported and what risk information needs to be communicated.	Start-up
9.2		Implement risk framework and begin assessing risk. This will require communication and training, and development of business processes or standard operating procedure documents, detailing roles, responsibilities, and accountability. Also, the assets and services need to be prioritized for completion of risk assessments to ensure that the highest priority areas are risk rated first.	Start-up for SOP and initial implementation transitioning to BAU for ongoing implementation

Task #	Improvement Category	Desired Improvement	Task Type
9.3		Develop or update decision processes and the analysis to support those decisions, to include consideration of risk and risk rating data.	Start-up
10	**Awareness**	*Identify communication plan, stakeholders, and what reporting you need.*	
10.1		Develop a communication preparation plan for stakeholder communications. Identify who the stakeholders are (both internal and external); what information will be of interest to different groups; what information is of interest to COM to communicate to different groups; develop a plan and timeline to obtain this information, including any analysis required and appropriate reviews; identify roles and responsibilities for tasks.	Start-up to develop plan, transitioning to ongoing implementation of AM Improvements
10.2		Develop a stakeholder communication plan to implement after the relevant information to be communicated is available (refer to Task 10.1)	Start-up to develop plan, transitioning to ongoing for implementation
11	**Levels of Service**	*Define levels of service and document operations and maintenance activities that impact the level of service delivered. Begin linking level of service and cost of service in tangible ways that can be measured and monitored.*	
11.1		Complete a workshop for each service area to define current levels of service and current (or required) service performance measures. The process includes: identify stakeholder groups with an interest in the service; define what each group is primarily wanting from the service (LOS - level of service statements); identify criteria that could be measured and would be good indicators for whether the service was delivering what each stakeholder group is wanting (KPI - key performance indicators); define the method of measurement for each performance indicator; document whether the performance measure is existing or new; and define the performance target value for each indicator.	Start-up
11.2		Develop standard operating procedures for service performance management, including measuring, recording, reporting, and periodic review and if necessary updating, of service performance indicators and targets. Include roles, responsibilities, and accountability.	Start-up
11.3		Implement procedures for service performance management including at least annually to review level of service statements, performance indicators, and performance targets.	Ongoing (new usual business task)

Task #	Improvement Category	Desired Improvement	Task Type
11.4		Complete a workshop for each service area to define and document operational level of service activities (to include documenting scope of task, frequency, cost, reason/requirement, relationship to existing LOS, and impacts on assets, organization, and customer; and whether activity is completed more frequently or less frequently). Use the outcome tool (spreadsheet) to develop needs-based operational budgets and manage delivery of required level of service with available budget.	Start-up to define operational LOS and develop tool, transitioning to ongoing for use of tool
11.5		When sufficient information is available, i.e.: (1) after AM improvement tasks for cost tracking, risk assessment, and defining operational LOS are completed; and (2) staff have a detailed understanding of the relationship between costs, risks, and level of service; and (3) staff have identified options for sustainable service delivery (i.e., a balance between costs, risks, and service targets), then develop and implement a communication strategy to consult with key stakeholders and elected representatives on the options and the agreed (sustainable) balance between costs, risks and level of service.	Start-up to define communication strategy and to undertake first consultation, transitioning into ongoing periodic review and re-consult
12	**Strategic AM Goals**	*Establish AM and business goals.*	
12.1		Design business goals and asset management (AM) goals for each service area that support COM strategic goals and align with AM improvement plan priorities. Identify and document appropriate performance measures to track whether goals are achieved. Document the procedure and timing for regular reporting of performance achieved, and the review and updating of business goals.	Start-up
12.2		Communicate business goals to all service area staff; demonstrate how achievement of business goals supports achievement of both AM and COM strategic goals; implement procedures for performance tracking and reporting, and review and update of goals.	Ongoing (new usual business task)
13	**Optimized Work Programs**	*Design decision processes for coordinating work and assessing alternative treatment/construction/material options.*	
13.1		Develop an asset renewal strategy that includes analysis and decision processes for: coordinating work across different service areas and asset groups; considering alternative treatment/construction/material options; and finding an optimal cost/risk/benefit balance between (1) maximizing the lifespan of assets, (2) practical funding and resource limitations for maximum work that can be achieved in a fiscal year and (3) achieving service targets.	Start-up to develop and document strategy and to undertake first analysis, transitioning into BAU for implementation

Task #	Improvement Category	Desired Improvement	Task Type
14	**AM Plans**	*As improvement tasks are completed and when the relevant asset data is available, begin doing asset management plans. Include in plans for establishing AM and business goals that are linked to strategic goals.*	
14.1		Begin development and documentation of AM Plans. These plans are business plans that support decision-making, and provide key direction and critical information for operational activities and tactical planning. Completing all the AMPs required/desired may take some time: therefore, all asset groups and service areas requiring an AM Plan should be listed and prioritized to ensure effort is spent to complete the AM Plans in order of importance and as resources and funding are available.	Start-up to develop first AMP for each service area, transitioning into BAU for annual review/update
15	**AM Tools**	*Identify functional requirements and evaluate options then implement a best-fit solution for an asset management support tool to provide for needs and within available funding.*	
15.1		Identify functional requirements for tool (i.e., what do all interested parties need the tool to do or need to be reported out of the tool). Agree on priority ratings for each functional requirement. This can be completed in one day using a facilitated workshop approach.	Start-up
15.2		Determine initial procurement process (RFI [Request for Information] or EOI [Expression of Interest], one-stage, two-stage, RFP [Request for Proposal] with or without demonstrations, evaluation methodology for each phase, etc.). Develop and issue initial solicitation documents (relating to agreed procurement method) for AM Support Tool options.	Start-up (once only task)
15.3		Evaluate/review submissions (RFI or EOI) and determine next steps (e.g., Proceed to RFP depending on initial response). [If required] develop and issue an RFP Document for AM Support Tool options. Evaluate RFP submissions (confirm demonstration scenarios, short-list, complete demonstrations and evaluate results).	Start-up (once only task)
15.4		Identify data needs for support tool and data structure and content needed for reporting to support decision-making. Consider both current and future AM analysis needs. Recommend subject matter expert advice for future AM needs.	Start-up (once only task)
15.5		Work with successful vendor and AM subject matter expert to implement selected AM Support Tool.	Start-up
16	**Whole-of-Life costs**	*Develop financial data for whole-of-life costs (this has to follow after Task 7 Cost Tracking is done and measured cost data is available for at least one year's activities).*	

Task #	Improvement Category	Desired Improvement	Task Type
16.1		Design business process to assess total cost of service. Include in the calculation of total cost of service to (1) calculate the cost of operations, maintenance repairs, preventative maintenance work, replacement costs, and disposal costs for the whole lifecycle of each asset divided by the asset's expected lifespan (to obtain an average annual cost for each asset); (2) sum the annual costs for all assets; and (3) add an average annual allowance for all non-asset specific operational, planning, overhead, and administration costs.	Start-up
16.2		Implement the process to calculate the total cost of service for each service area (after the end of each fiscal year), based on available asset and cost data.	Ongoing (new usual business task completed once a year)
16.3		Annually analyze the comparative results of (1) true total cost of service and (2) required level of service, with (3) actual level of service delivered; provide recommendations for investment planning, level of service targets, and performance metrics. NOTE: The three elements for this analysis are tracked and measured under separate tasks and this task is to look at those results together to better understand the relationship between true total cost of service (expressed as an average annual value), the required level of service (expressed as service performance targets), and the achieved level of service (i.e., measured performance results and overall performance outcomes).	Ongoing (new usual business task completed once a year)
17	**Asset Valuation and Forecast Renewals**	*Set up lifespan and unit rate tables to complete replacement cost valuations on existing assets and establish business processes to keep replacement cost values up to date to support long-term financial forecasting. Develop long-term renewal plans for assets and services and compare funding needs to funding sources and revenue forecasts to identify any gaps and measure financial sustainability.*	
17.1		Develop reference tables for asset unit cost and lifespan information.	Start-up
17.2		Complete a valuation of current assets (using the asset unit cost and lifespan information) and report outcomes.	Start-up
17.3		Design and implement business process to maintain asset unit cost and lifespan information up to date.	Start-up to develop business process, transitioning to ongoing to implement process

Task #	Improvement Category	Desired Improvement	Task Type
17.4		Develop long-term renewal plan and cost forecasts for assets and services. The accuracy of forecast renewals will be influenced by the accuracy of the asset data, understanding the asset lifecycle, having an asset renewal strategy, and the accuracy of asset unit cost and lifespan information. The renewal plan should be optimized based on a detailed understanding of (1) level of Service to be provided, (2) options for rehabilitation treatments to extend the useful life of assets, and the relevant timing, cost, and lifespan of such options, and (3) options for asset replacement and the relevant timing, cost and lifespan for those options. This work may take some time to complete (depending on what ratio of internal to external resources are used). However, an initial estimate should be undertaken as soon as the first estimate of asset unit rates and lifespan is completed. This will provide early indication of any major work plan and cash flow issues. Thereafter the asset renewal plans and forecast costs should be updated at least annually to include improved data. This way, both the work plan and financial forecasts will progressively improve in accuracy.	Start-up to develop initial renewal plan and cost forecasts, transitioning to ongoing for annual review/update
17.5		Develop needs-based asset renewal budgets and reserve fund contributions, from optimized long-term renewal plan and cost forecasts for assets and services.	Ongoing for annual review/update
17.6		Compare needs-based budgets with revenue projections, identify issues/gaps, establish a measure for the state of financial sustainability, and report outcomes.	Ongoing new usual business annual task
18	**Continuous Improvement**		
18.1		Develop an AM Program to complete high-priority AM improvement tasks, based on the AM improvement plan and the AM resource plan. Include to define budgets, timelines, and accountability for all tasks and projects included in the program. Submit the program for approval and secure both funding and agreement for staff time (or external resources as necessary) to complete it according to schedule. NOTE: This is only for designing the initial program and submission for funding. The annual review and updating of the improvement program will be a new business process undertaken annually under the oversight of the AM steering group.	Start-up

Task #	Improvement Category	Desired Improvement	Task Type
18.2		Design, document, and implement a new business processes for AM continuous improvement. The process should include to (1) review and update the status of AM practice at least annually; (2) update AM Improvement plan, adding new improvement tasks and re-prioritizing uncompleted tasks based on updated AM practice results; (3) update AM Resource plan, adding resources for new improvement tasks and updating resource estimates for uncompleted tasks based on achievements to date; (4) update AM Program and submit for approval and funding; and (5) if funding in full is not provided, modify the AM program and communicate back to staff.	Start-up to develop initial business process, transitioning to ongoing for implementing the annual review/update
19	**Sustainable Service Delivery**	*Start building the data foundation for assessing long-term triple-bottom-line sustainability. This includes developing the financial data to measure true whole-of-life costs and begin the process to more clearly define the relationship (and trade-off options) between level of service, cost, and risk.*	
19.1		Identify relevant criteria (indicators) and develop and document calculations/analysis process that will provide a measure of financial sustainability.	Start-up
19.2		Identify relevant criteria (indicators) and develop and document calculations/analysis process that will provide a measure of environmental sustainability in relation to the services provided.	Start-up
19.3		Identify relevant criteria (indicators) and develop and document calculations/analysis process that will provide a measure of social sustainability as relevant to the level of service provided.	Start-up
19.4		Complete an analysis of total cost of service in relation to level (or quality) of service provided and the risks associated. Identify (and compute) a range of trade-off options, and the related cost/risk/level of service impacts that relate to each trade-off option.	Start-up to complete initial analysis and define options, transitioning to ongoing for review/update
20	**Legislation**	*Move to active management of compliance.*	
20.1		Develop a compliance management plan including a full list of compliance requirements; definition and assignment of roles and responsibilities for measurement, recording, monitoring, and reporting; and business procedures to support active compliance management. Implement compliance management plan.	Start-up to develop plan, transitioning to ongoing for implementation

Glossary

Term	Acronym	Description
Asset		An item, thing, or entity that has potential or actual value to the City, including but not limited to tangible assets, natural assets, heritage or culturally significant assets and information assets
Asset Lifecycle		A series of five stages involved in the management of an asset • Acquire/Construct • Operating/Maintaining • Rehabilitating • Replacing • Disposal
Asset Management	AM	Co-ordinated activities by the City to realize value from its assets in the achievement of its organizational objectives
Asset Management Plan	AMP	Documented information that specifies the activities, resources and timeframe required for an individual asset, or group of assets, to achieve the City's asset management objectives
Asset Management Steering Committee	AMSC	Committee comprised of Directors and/or Senior Managers across the organization
Asset Management System	AMS	Set of interrelated or interacting elements used to meet the objectives of the City in managing its assets. The elements of the Asset Management System include but are not limited to documents, processes and procedures, resources, framework, tools, technologies, data and the assets
Asset Management Working Group	AMWG	Cross-departmental/divisional team of subject matter experts that governs and maintains the City's assets in compliance with the Strategic Asset Management Policy
Accessibility for Ontarians with Disabilities Act	AODA	Legislative act describing the public's ability to access buildings and spaces
Bridge Condition Index	BCI	Measure to identify the condition of bridge assets
Budget		Planned expenditures for a specified time period along with the proposed means of financing these expenditures
Capital Budget		Multi-year program adopted by Council comprised of an approved capital program for the current year and a planned program for the succeeding nine years. The multi-year plan covers longer-term and one-time expenditures for capital assets

Glossary

Term	Acronym	Description
Climate Change		Change in global or regional climate patterns, in particular a change apparent from the mid to late 20th century onwards; includes greater extreme weather events
City		Corporation of the City of Mississauga
Close Circuit Television	CCTV	Used to monitor and assess infrastructure assets
Continuous Improvement	CI	Specific actions taken to advance asset management reporting, data collection etc.
Consequence of Failure	CoF	An element of a risk framework that identifies an asset failure that has the highest potential on impacting the delivery of services
Core Asset Infrastructure		Defined in *O. Reg. 588/17* as the following municipal infrastructure of assets • stormwater management asset that relates to the collection, transmission, treatment, retention, infiltration, control or disposal of stormwater • road, or bridge or culvert
Corporate Asset Management	CAM	Program developed in the Corporate Services Department, Finance Division
Development Charges	DC	Fees collected by the City for new development and redevelopment of land. Collecting development charges is the City's primary revenue tool for funding growth-related capital costs
Existing Infrastructure		Typically refers to renewals of existing City infrastructure, where the investment driver is to maintain or enhance the current level of service provided. In some instances, there are also investments within existing infrastructure that are intended to address new regulatory requirements or to support growth. In scenarios where an existing asset is at the end of its useful life or it no longer meets its intended use, the replacement of that asset is considered existing infrastructure if there is no new asset being added to the City's inventory
Geographic Information System	GIS	System for spatially mapping assets
Greenhouse Gas Emissions	GHG	A gas that contributes to the greenhouse effect by absorbing infrared radiation, e.g., carbon dioxide and chlorofluorocarbons
Growth		Planned activities required to extend service to previously unserviced areas of the City or to expand services to meet growth demands

Glossary

Term	Acronym	Description
Key Performance Indicator	KPI	Defined service measurement
Leadership Team	LT	All City Department Heads and the City Manager
Lean		Philosophy and methodology to maximize customer value and staff engagement while minimizing waste
Levels of Service	LOS	Defined measure(s) for a particular activity or service. LOS will be either technical or community in nature
Light Detection and Ranging	LiDAR	Mapping solution that incorporates sensor, cameras and GPS to collect survey grade point data quickly and accurately. This data is then processed to allow assets and features to be imported into a GIS for analysis and visualization
Lifecycle		The phases involved in the management of an asset from acquisition to disposal
Lifecycle Costs		The total cost over the life of an asset, which includes but is not limited to capital, operating, maintenance, renewal, replacement, environmental, and retirement and/or repurposing costs
Likelihood of Failure	LoF	The probability of an asset to fail in the short-or long-term
New Infrastructure		The acquisition of a new asset required by the City to support new regulatory requirements, growth, or to enhance a level of service not currently provided by an existing asset
Non-Core Asset Infrastructure		Any asset that is not defined as a core asset in *O. Reg. 588/17*, such as, general service fleet vehicles, transit buses, parks, buildings, fire vehicles, equipment, sidewalks and active transportation pathways
Pavement Quality Index	PQI	A numerical index between 0 and 100, which is used to indicate the general condition of a pavement section
Rehabilitation		Restoring an asset to its former condition
Resilience		The ability to anticipate, endure, adapt, respond and thrive within a disruptive and changing situation or event
Risk		A culmination of the likelihood and consequence of an unforeseen event occurring
Risk Management		A formal process to assess risk to an asset in order to determine risk tolerance, a range of outcomes, and the probability of occurrence, to determine required actions to mitigate risk exposure
RoadMatrix	RPMS	A software system that consolidates pavement condition information

Glossary

Term	Acronym	Description
Service		The delivery of an output that addresses the needs of a client or a community
State of Good Repair	SOGR	The condition where a capital asset is able to operate and maintain the expected levels of service
State of the Infrastructure	SOI	The summary of asset class, asset type, quantity, location, historical and replacement cost valuation, useful life and condition
Stormwater		Portion of liquid precipitation generated during rain storms or by snow and ice melt that does not naturally soak into the ground or evaporate
Stormwater Charge		Fee authorized by ordinance(s) established to pay operations and maintenance expenses, extension and replacement costs, and debt service, and assessed on developed properties with impervious areas within the City; this revenue is used to fund the costs of stormwater management and of operating, maintaining, and improving the stormwater system in the municipality
Stormwater Management	SWM	Techniques, methods, and policies for control planning, maintenance, and regulation of stormwater runoff to reduce the potential for flooding and erosion, to ensure the safety of the public will not be threatened, and to achieve water quality and quantity objectives
Strategic Plan		Document outlining long-term goals, critical issues and action plans which will increase the organization's effectiveness in attaining its mission, priorities, goals and objectives; starts with examining the present, envisioning the future, choosing how to get there and making it happen
Tangible Capital Asset	TCA	An accounting measurement for the acquisition, improvement, betterment, disposal and amortization value for City assets