



Report

Report to:	Mayor and Council
Date:	March 22, 2022
Title:	Draft Asset Management Plan - Core Assets

Recommendation(s)

That Council receive the Draft Asset Management Plan - Core Assets, report for information.

Executive Summary

The City of Niagara Falls (the City) provides a range of services to residents, businesses and visitors, including transportation, stormwater management, water, wastewater, parks and recreation, fire protection, and municipal administration services such as by-law enforcement and development planning. To deliver these services, the City relies on a wide range of infrastructure assets.

The City released its first asset management plan (AM Plan) documents in 2013 when the Province introduced asset management planning requirements through the "Building Together - Guide for Municipal Asset Management Plans" program. The 2022 AM Plan is an update to the City's 2013 AMP and it serves to fulfil the requirements of Ontario Regulation 588/17: Asset Management Planning for Municipal Infrastructure, approved under the Infrastructure for Jobs and Prosperity Act, 2015.

The 2022 AM Plan describes the actions required to manage the City's core infrastructure assets in a way that meets service levels, while managing risks and costs. The City's core infrastructure assets include roads, bridges and culverts, and stormwater management, water and wastewater systems. The City's core assets have an estimated replacement value of \$2,121.2 million (\$2.12 Billion 2022\$). The 2022 AM Plan for Core Assets focuses on the 10-year period from 2022 to 2031 and provides a framework for continuously improving the City's AM practices.

To maintain compliance with O.Reg 588/17 the City's AM Plan for Core assets must be endorsed by City Council and submitted to the Ontario Ministry of Municipal Affairs and Housing by July 01, 2022. Compliance with the legislation helps to ensure that the City remains eligible for future funding opportunities including provincial grant programs related to municipal infrastructure.

This report and corresponding presentation delivers the draft AM Plan to council and members of the public for consumption and review. The final AM Plan will be brought to Council for endorsement in June 2022 to ensure regulatory reporting timelines are met.

Background

As mentioned previously the City released its first asset management plan documents in 2013 when the Province first introduced asset management planning requirements through the "Building Together - Guide for Municipal Asset Management Plans" program. Following on the 2013 work the Ontario government approved Ontario Regulation 588/17, "Asset Management Planning for Municipal Infrastructure" under the Infrastructure for Jobs and Property Act, 2015 which outlines specific reporting requirements for municipalities across Ontario.

There are several key reporting requirements set forth by O.Reg 588/17 which as follows:

- **July 01, 2019** - Every municipality shall prepare its first strategic asset management policy (SAMP) which needs to be reviewed and updated every 5 years. City staff brought the SAMP to council in 2019 via Policy #: 340.01.
- **July 01, 2022** - Every municipality shall prepare an asset management plan in respect of its core municipal infrastructure assets by July 1, 2022
- **July 01, 2024** - Every municipality must complete an asset management plan for all of its other municipal infrastructure assets.
- **July 01, 2025** - For each asset category provide proposed levels of service the municipality proposed to provide for each of the 10 years of the plan

O.Reg 588/17 also stipulates the on-going review and update of asset management plans - most notably the following criteria:

- Every municipality shall **review** and **update its asset management plan** at least **5 (five) years** after the year in which the plan is completed
- Every AMP prepared under O.Reg 588/7 must be **endorsed by** the executive lead of the municipality and **approved by** a resolution passed by **municipal council**
- Every municipal council shall conduct an **annual review** of its asset management progress on or before July 1 in each year, starting the year after the municipality's asset management plan is completed
- Every municipality shall post its current strategic asset management policy and asset management plan on a website that is available to the public, and shall provide a copy of the policy and plan to any person who requests it.

The 2022 AM Plan is an update to the City's 2013 AM Plan, and describes the actions required to manage the City's "core" portfolio of assets in a way that supports established service levels, while managing risks and costs. The City's core assets include roads,

bridges, and water, wastewater and stormwater systems. The 2022 AM Plan focuses on the 10-year period from 2022 to 2031 and provides a framework for continuously improving the City's AM practices.

Specifically, this AM Plan outlines current (2021) Levels of Service (LOS) performance for core assets, recommended actions, and costs associated with sustaining that LOS.

This AM Plan – Core Assets includes four (4) service areas which provide municipal services to the City's more than 33,000 combined residential, commercial, industrial, and institutional customers.

- **Transportation Service:** The City provides and manages the local transportation network, with the following core assets: roads, bridges, structural culverts, and barriers.
- **Stormwater Management Service:** The City manages stormwater drainage through a network of collection, conveyance, and storage assets including municipal drains, roadside ditching, sewer network, and ponds.
- **Water Service:** The City distributes quality water through a network of drinking water treatment, storage and transmission facilities, and linear infrastructure.
- **Wastewater Service:** The City collects wastewater in a network of sewers, pumping and transmission facilities and infrastructure. The majority of the system consists of separated sanitary sewers, but approximately 26% of the network is serviced by combined sewers.

For review purposes the full AM Plan has been appended; this staff report will provide a summary of each of the key sections of the proposed 2022 AM Plan.

Analysis

In alignment with O.Reg 588/17 requirements the City of Niagara Falls 2022 AM Plan has been organized into the following seven (7) sections which have been summarized below. The full AM Plan draft document has been appended and should be read in conjunction with this council report.

1. Introduction
2. State of the Infrastructure
3. Levels of Service
4. Risk Management Strategy
5. Lifecycle Management Strategy
6. Financial Strategy
7. O.Reg 588/17 Compliance & Improvement Opportunities

1.0 Introduction

The introduction section outlines both the organization and context of the document; describes the purpose of the AMP, outlines how the plan meets regulatory requirements and how the document aligns with and supports the City's Vision, Values and Key Strategic Objectives. The plan also documents how the AMP supports key City planning issues including growth and climate change response.

The AM Plan introduction identifies the following four (4) service areas included in the AM Plan which provide municipal services to the City's more than 33,000 combined residential, commercial, industrial, and institutional customers

- Roads, Bridges and culverts
- Stormwater management
- Water distribution
- Wastewater collections

2.0 State of the Infrastructure

The City provides a range of services to its residents, businesses and visitors, including core services that rely heavily on a portfolio of asset systems. Understanding the assets owned by the City is the critical to developing a plan to best manage them.

In order to understand and responsibly manage the City's assets Section 2.0 of the AM Plan attempts to answer 4 fundamental asset management questions:

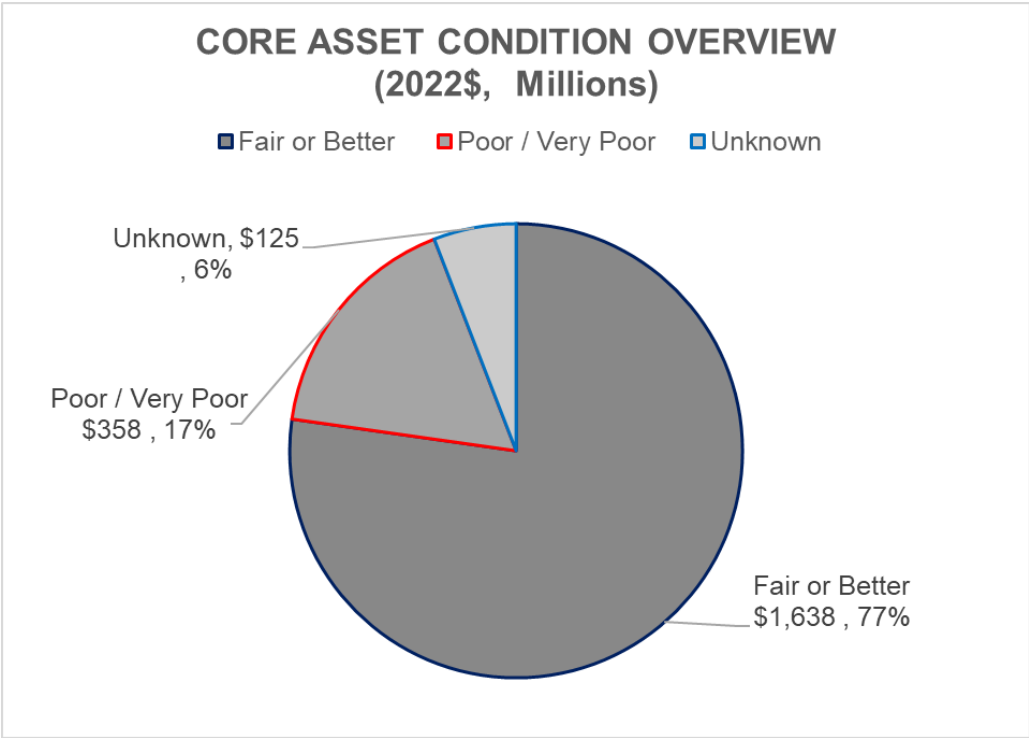
1. What assets do we own?
2. Where are the assets located?
3. What condition are the assets in?
4. What does it cost to replace the assets?

The following table outlines the estimated replacement value of the City's core assets and includes a breakdown of the inventory by service area and (2022\$) replacement value.

Service	Asset Categories	Replacement Value (2022\$, millions)	Replacement Value %
Roads & Related	Roads, sidewalks, medians, barriers	\$714.9	34%
Bridges & Culverts	span bridges, span culverts, municipal structures	\$171.5	8%
Stormwater Management	Storm sewers, ponds, appurtenances	\$335.4	16%
Water	Water mains, facilities, appurtenances	\$477.6	23%

Wastewater	Sewer Mains, facilities, appurtenances	\$421.9	20%
Totals		\$2,121.2	100%

As outlined in the following figure 77% or \$1,638 million of the City’s core assets are in Fair condition or better, 17% or \$358 million are in Poor or Very Poor condition, and 6% or \$125 million in assets are of unknown condition either because the install date is not known or a condition assessment has not yet been undertaken. Knowing the condition of assets is important to understanding the risks and costs of meeting stated service delivery objectives.



Core infrastructure details by asset class (inventory, condition, replacement cost) are detailed in Section 2.0 - State of the Infrastructure in the attached AM Plan.

3.0 Levels of Service

Levels of Service (LOS) are statements that describe the outputs and objectives the City intends to deliver to its residents, businesses, and other stakeholders. Developing, monitoring, and reporting on LOS are all integral parts of an overall performance management program aimed at improving service delivery and demonstrating accountability to the City’s stakeholders.

The requirements under O.Reg 588/17 current levels of service include, for each core asset category, the current levels of service being provided determined in accordance

with the qualitative descriptions and technical metrics for roads, bridges and culverts, stormwater management, water, and wastewater provided in a set of tables.

The body of the AM Plan provides Levels of Service statements and indicators, current (2021) performance and proposed performance (i.e., targets) by service. Indicators include those defined by O.Reg. 588/17, as well as indicators defined by the City to reflect specific priorities and concerns related to core assets. In general, targets were established in alignment with those seen in peer municipalities and are considered “draft” at this time.

The following table summarizes the City's community service performance against indicators specified in O.Reg. 588/17. The AM Plan has approximately 50 TLOS or KPI's that staff are proposing to monitor, measure, and report on moving forward.

Community Objectives	Service	Community Service Measure	2021 LOS
Capacity & Use	Roads	Adequate road network connectivity and capacity	Good
	Sidewalks	Adequate sidewalk network connectivity and capacity	Fair
	Stormwater	Adequate stormwater system capacity	Fair
	Water	Adequate availability of water service and fire flow to properties	Good
	Wastewater	Adequate wastewater system availability to service properties, including combined sewer flow	Fair
Functionality	Roads	Road network contributed to an enhanced environment and supports a sustainable City	Fair
	Bridges	Bridges and culverts are safe and meet customer needs	Good
	Water	Drinking water is safe	Good
	Wastewater	Sewer network meets City design standards	Fair
Reliability	Roads	Roads are kept in a state of good repair	Fair
	Bridges	Bridges are kept in a state of good repair	Good
	Stormwater	Stormwater assets are kept in a state of good repair	Very Good
	Water	Water assets are kept in a state of good repair	Good
	Wastewater	Wastewater assets are kept in a state of good repair	Fair

4.0 Risk Management Strategy

The City's key asset management principle is to **meet service levels** and **manage risk**, while **minimizing lifecycle costs**. The City's risk framework quantifies the risk exposure of the City's assets to enable prioritization of needs across asset categories and services.

The relative importance of the assets to support service delivery, referred to as asset criticality, is a key driver in selection of the most appropriate asset management strategy for each asset. Criticality is evaluated as an asset's impact upon service delivery, health and safety, the environment, financial position, and reputation. Risk exposure is the multiplication of the criticality or consequence of failure (CoF) by the probability of failure (PoF), which is the likelihood or chance that an asset failure may occur.

The City is proposing the development of a risk framework for quantifying the risk exposure of its assets to enable prioritization of projects across asset classes and services. Risk exposure is the multiplication of the criticality or consequence of failure (CoF), which is the direct and indirect impact on the City if an asset failure were to occur, by the probability of failure (PoF), which is the likelihood or chance that an asset failure may occur:

Risk Exposure = Consequence of Failure x Probability of Failure

Based on those assets with known condition, 0.4% or \$7.76 million of the City's core assets are in the Very High risk category related to provision of reliable services. These assets are comprised of the Beck Road Bridge (\$4.36 million), six road segments namely Kalar Road, Kitchener Street, Allendale Avenue, Buchanan Avenue, Fallsview Boulevard, and Reixinger Road (\$2.94 million), and road medians (\$0.45 million).

5.0 Lifecycle Management Strategy

Lifecycle management strategies are the planned lifecycle-based activities that the City needs to undertake to meet its service levels.

- To meet demand for services and functional requirements of stakeholders, the City adds, expands and upgrades assets and services, and developments add assets that are donated to the City.
- To meet reliability service levels and provide quality programs, the City performs thousands of inspections, and maintenance and operational activities, and undertakes asset rehabilitation and replacement activities.

The City prioritizes lifecycle activities to manage risk of not meeting service levels and to optimize costs. To achieve its objectives, the City builds new infrastructure assets to meet capacity needs, upgrades assets to meet new functional needs and manages existing assets to meet reliability needs – all with limited funds. Asset lifecycle management strategies are planned activities that enable assets to provide the defined levels of service in a sustainable way, while managing risk, at the lowest lifecycle cost.

Based on the planned asset lifecycle management strategies, the City's total needs (operate, maintain, renew, upgrade and grow) are forecast at \$935 million for the period 2022-2031, for an average expenditure of \$93.5 million per year. This figure includes the total operations and maintenance, renewal, growth, and upgrade needs forecast for the City over the next 10 years to sustain current levels of service.

6.0 Financial Strategy

The financial strategy considers how the City will fund the planned lifecycle management activities to maintain current service levels. The City's main sources of revenue include property tax, debt, federal gas tax, third party grants, casino revenue, development charges, and user fees and charges. The City currently approves one-year capital and operating plans and budgets. Note that O.Reg. 588/17 requires that AM Plans for proposed LOS (due by July 1, 2025) provide lifecycle management strategies, forecast annual available funding, and any funding gaps for each of the next **10 years**.

The City's ability to deliver the levels of service outlined in the Asset Management Plan is impacted in large part by:

- aging infrastructure and the associated need for operations, maintenance, and renewal investments to sustain it
- forecast future population growth and the associated need for additional infrastructure to serve it
- changing functional, legislative and sustainability requirements and the associated need for existing assets to be upgraded to continue to be fit for purpose
- available funds and the associated need for assets to be provided at lowest cost for both current and future customers.

To achieve its objectives, the City builds new infrastructure assets to meet capacity needs, upgrades assets to meet new functional needs and manages existing assets to meet reliability needs – all with limited funds. Asset lifecycle management strategies are planned activities that enable assets to provide the defined levels of service in a sustainable way, while managing risk, at the lowest lifecycle cost.

For core asset renewal needs, the City's services can be categorized into two groups:

1. those that are funded through property taxes and other sources (i.e. roads, bridges and culverts, stormwater management), and
2. those that are funded through user fees or rates (i.e. water and wastewater).

The largest funding gap was found for roads, bridges and culverts, and stormwater assets with a 10-year average gap of \$6.0 million annually plus a \$40 million backlog. If annual available funding remains steady at 2022 funding levels the current \$40 million backlog will grow to over \$100 million at the end of the 10-year period.

Water and wastewater assets are much closer to being fully funded with a 10-year annual renewal funding gap of \$1.5 million and an annual operations and maintenance funding gap of \$1.5 million for 2022.

Opportunities to close the financial gaps have been proposed for each of the tax and rate-supported service areas:

Tax Supported

- Reduce near term renewal needs by deferring capital renewal projects on lower risk assets, thereby lengthening the period in which the backlog is addressed beyond the 10 year of the plan -> will likely cause increased maintenance costs
- Increase available funds through property tax increases leveraging third party grants, drawing on reserves or, issue debt
- Change the funding source for stormwater management from property taxes to a dedicated and stable, stormwater fee to recover the full cost of stormwater management.

Rate Supported

- Reduce near term renewal needs by deferring capital renewal projects on lower risk assets
- Increase available funds through water and wastewater user fee increases and by leveraging third party grants

7.0 Regulatory Compliance & Improvement Opportunities

The draft AM Plan as presented is compliant with Ontario Regulation 588/17 for current levels of service.

Development of AM Plans is an iterative process that includes improving processes, data, systems, and staff skills over time to gain more and more confidence in the information presented. In order for the City to continue to improve upon it's current asset management planning and programming the following activities or initiatives are recommended.

Regulatory Compliance

In order to ensure that the City of Niagara Falls maintains regulatory compliance the following activities must be undertaken:

- Have the City's AM Plan for Core Assets prepared under O.Reg 588/7 endorsed by the executive lead of the municipality and approved by a resolution passed by the municipal council by July 01, 2022
- Have the City's AM Plan for Non Core assets prepared under O.Reg 588/7 endorsed by the executive lead of the municipality and approved by a resolution passed by the municipal council by July 01, 2024
- Provide the proposed levels of service for each asset category for each of the 10 years of the AM Plan by July 01, 2025

- Every municipal council shall conduct an **annual review** of its asset management progress on or before July 1 in each year, starting the year after the municipality's asset management plan is completed
- Every municipality shall post its current strategic asset management policy and asset management plan on a website that is available to the public, and shall provide a copy of the policy and plan to any person who requests it.

Opportunities for Improvement

Asset Knowledge

Improve knowledge of asset replacement costs and current conditions of the City's assets specifically by:

- Completing bathymetric surveys for stormwater management ponds
- Undertaking sidewalk, median and barrier condition assessments based on a standardized rating scale
- Continue the sanitary sewer CCTV inspection program and implement for storm sewers
- Continue inspections during watermain breaks and document condition with a standardized rating scale
- Undertake inspections of water, wastewater and stormwater facilities and appurtenances based on a standardized rating scale
- Improve installation year data for critical assets and infrastructure
- Continue to close/ fill in minor data gap improvements

Levels of Service & Lifecycle Management

Continue to review levels of service metrics that support lifecycle asset planning activities for specific asset types. Adjust or develop new measures related to the operations and maintenance of municipal infrastructure such as:

- % annual planned MMS (Minimum Maintenance Standards) inspections completed
- % preventative maintenance work orders completed on time
- % 10-year available funding vs. needs at each asset category

Understanding & Documenting Asset Lifecycle Activities

Optimize the lifecycle activities by searching out and testing various operations, maintenance and renewal activity and timing options, and then evaluating the benefits against the costs of each option over time to determine the lowest cost option for the required benefits. Specific improvements include:

- Updating master plans to improve growth forecasts and potentially lower levels of service to reduce costs

- Monitor build-out of developments and continue to adjust expansion activities in master plans to suit
- Review severe weather risks and the City's climate change responses, particularly for stormwater management
- Separately budget and track operating (maintenance and operations) and capital (growth, upgrade and renewal) costs by asset category (e.g. portion of project cost to road, sidewalks, stormwater management, water, wastewater), including staff time.

Financial Planning & Tracking

- Explore maximizing funding sources such as grants to mitigate funding shortfalls and to use risk-based prioritization to address the most critical needs in years with limited funding
- Prepare 10-year operating and capital plans and budgets as required by O.Reg. 588/17 for AM Plans for proposed LOS (due by July 1, 2025)
- Update rate studies for water and wastewater to achieve full cost recovery, as required
- Investigate changing the funding source for stormwater management from property taxes to a dedicated and stable stormwater user fee to recover the full cost of stormwater management
- Increase operations and maintenance activity budgets as required to accommodate the growing asset portfolio.

Follow-Up Activities

At this time staff are bringing forward the draft AM Plan to council and members of the public for consumption and review. Members of the executive steering team and asset managers will work to refine and finalize the document before bringing the final AM Plan for Core assets to Council in June 2022 for endorsement. This timeline has been developed to ensure that the City meets the July 01, 2022 provincial reporting deadline.

Budgets and resource requirements have been developed to allow the City to complete the AM Plan for Core Assets and to begin the work required to develop the AM Plan for the City's Non-Core assets by the prescribed timeframe(s) required under O.Reg 588/17.

- **July 01, 2022** - Every municipality shall prepare an asset management plan in respect of its core municipal infrastructure assets by July 1, 2022
- **July 01, 2024** - Every municipality must complete an asset management plan for all of its other municipal infrastructure assets.
- **July 01, 2025** - For each asset category provide proposed levels of service the municipality proposed to provide for each of the 10 years of the plan

Operational Implications and Risk Analysis

Bringing forward the draft 2022 Asset Management Plan for Core Assets does not have any direct operational implications at this time.

The risk of not completing the provincially mandated asset management plan by the required timeframe(s) may negatively impact the City's eligibility for future provincial grant programs. Council endorsement of the final AM Plan by the prescribed timelines will lower this potential risk exposure.

Financial Implications/Budget Impact

There are no direct financial implications related to the presentation of the draft Asset Management Plan.

Strategic/Departmental Alignment

The AM Plan for Core Assets align with the City's Vision, Values and Strategic Priorities (2019-2022). Specifically the following priorities:

- Vibrant & Diverse Economy - supported by good infrastructure planning
- Convenient & Accessible Transportation - ensuring our roads and related assets are maintained in a state of good repair
- Responsible & Transparent Financial Management - financially sustainable infrastructure planning
- Strong & Resilient Infrastructure - assets are good for current and future use and are resilient to impacts of climate change
- Engaging & Accountable - Regulated AM Planning requires that AM documentation and related materials are accessible to the public and are posted on the City's website.

List of Attachments

[NIAGARA-FALLS-AMPlan-2022-rev2-2022-02-28 DRAFT](#)

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Status:

Approved
- 11 Mar
2022

Approved
- 16 Mar
2022

Draft Document



**City of Niagara Falls
2022 Asset Management Plan
Core Assets
Current Levels of Service**

Prepared by
SLBC Inc.
February 28, 2022
Rev. 2, Draft v 1.0

Executive Summary

Introduction

The City of Niagara Falls (the City) provides a range of services to residents, businesses and visitors, including transportation, stormwater management, water, wastewater, parks and recreation, fire protection, and municipal administration services such as by-law enforcement and development planning. To deliver these services, the City relies on a wide range of infrastructure assets.

This Asset Management Plan (AM Plan) describes the actions required to manage the City’s core infrastructure assets in a way that meets service levels, while managing risks and costs. The City’s core infrastructure assets include roads, bridges and culverts, and stormwater management, water and wastewater systems. The City’s core assets have an estimated replacement value of \$2,121.2 million (2022\$) as outlined in Table ES-1 below.

Table ES-1 Inventory of the City’s Core Assets

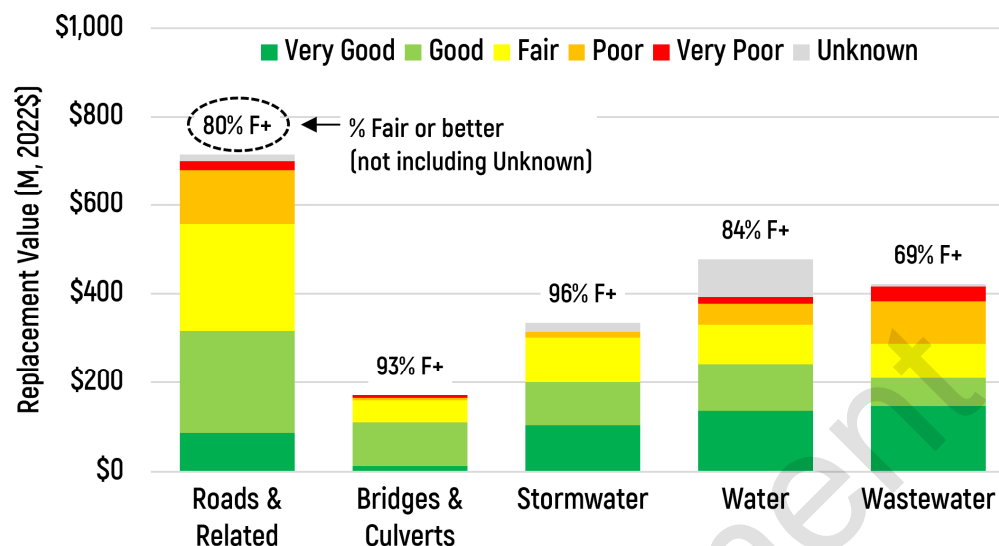
Service	Asset Categories	Replacement Value (2022\$, millions)	Replacement Value (%)
Roads & Related	Paved roads, unpaved roads, sidewalks, median, barriers	\$714.9	34%
Bridges & Culverts	Span bridges, span culverts, municipal structures	\$171.5	8%
Stormwater Management	Storm sewers ponds, appurtenances	\$335.4	16%
Water	Water mains, facilities, appurtenances	\$477.6	23%
Wastewater	Sewer mains, facilities, appurtenance	\$421.9	20%
TOTAL		\$2,121.2	100%

This AM Plan focuses on the 10-year period from 2022 to 2031 and fulfils the AM Plan requirements defined by Ontario Regulation 588/17 Asset Management Planning for Municipal Infrastructure for the year 2022 (O.Reg. 588/17). Note that all costs presented in the AM Plan are in 2022 dollars (2022\$) unless otherwise stated.

State of the Infrastructure

The current (2021) condition distribution of the City’s core assets is shown in Figure ES-1 below, by service. The colours that make up each vertical bar represent the condition of the assets that support each service from very good to very poor, with those for which the condition is unknown shown in grey.

Figure ES-1 Condition Distribution of the City's Core Assets



According to asset management best practice, to adequately meet service levels and manage risk while minimizing whole-of-life costs, most assets – about 80% – should be preserved in fair or better condition. Overall, 77% or \$1,638 million of the City's core assets are in Fair condition or better, 17% or \$358 million are in Poor or Very Poor condition, and 6% or \$125 million in assets are of Unknown condition either because the install date is not known or a condition assessment has not yet been undertaken. Knowing the condition of assets is important to understanding the risks and costs of meeting stated service delivery objectives. Most of the assets of unknown condition are stormwater catchbasins and ponds, and property water services and curb stops.

Based on those assets with known condition, the Figure ES-1 above shows that most roads, bridges and culverts, stormwater, and water assets are in Fair or better condition (80%, 93%, 96% and 84%, respectively). However, only 69% of the wastewater assets are in Fair or better condition. Depending on the potential impact of a failure, assets in Poor and Very Poor condition may be managed differently than those in Fair or better condition. Assets in Very Poor condition (3.8% or \$75.5 million) are due or overdue for repair or replacement and generally represent the City's renewal backlog. The assets in Very Poor condition include wastewater sewers, maintenance holes and laterals (\$33.9 million), water mains (\$10.8 million), roads (\$6.7 million), sidewalks (\$13.1 million), and bridges and culverts (\$6.6 million). Note that the confidence in "condition" data shown for wastewater maintenance holes and laterals, and sidewalks is moderate as it is based on calculated age rather than inspected condition.

Levels of Service

The body of the report provides Levels of Service statements and indicators, current (2021) performance and proposed performance (i.e., targets) by service. Indicators

include those defined by O.Reg. 588/17, as well as indicators defined by the City to reflect specific priorities and concerns related to core assets. In general, targets were established in alignment with those seen in peer municipalities and are considered “draft” at this time.

Table ES-2 shows the City’s community service performance against indicators derived largely from O.Reg. 588/17. In general, the City’s current performance is meeting service levels.

Table ES-2 Current Community Service Measures and Performance of the City’s Core Assets

Community Objectives	Service	Community Service Measures	2021 LOS
Capacity & Use Services have enough capacity and are accessible to everyone	Roads	Adequate road network connectivity and capacity	Good
	Sidewalks	Adequate sidewalk network connectivity and capacity	Fair
	Stormwater	Adequate stormwater system capacity	Fair
	Water	Adequate availability of water service and fire flow to properties	Good
	Wastewater	Adequate wastewater system availability to service properties, including combined sewer flow	Fair
Functionality Services meet customer needs while limiting impacts to health, safety, security, nature and heritage	Roads	Road network contributes to an enhanced environment and supports a sustainable City	Fair
	Bridges	Bridges and culverts are safe and meet customer needs	Good
	Water	Drinking water is safe	Good
	Wastewater	Sewer network meets City design standards	Fair
Reliability Services are reliable and responsive to customers	Roads	Roads are kept in a state of good repair	Fair
	Bridges	Bridges are kept in a state of good repair	Good
	Stormwater	Stormwater assets are kept in a state of good repair	Very Good
	Water	Water assets are kept in a state of good repair	Good
	Wastewater	Wastewater assets are kept in a state of good repair	Fair

Risk Management Strategy

The City’s key asset management principle is to meet service levels and manage risk, while minimizing lifecycle costs. The City’s risk framework quantifies the risk exposure of the City’s assets to enable prioritization of needs across asset categories and services.

The relative importance of the assets to support service delivery, referred to as asset criticality, is a key driver in selection of the most appropriate asset management strategy for each asset. Criticality is evaluated as an asset’s impact upon service delivery, health and safety, the environment, financial position, and reputation. Risk exposure is the multiplication of the criticality or consequence of failure (CoF) by the probability of failure (PoF), which is the likelihood or chance that an asset failure may occur.

Based on those assets with known condition, the figure below shows that 0.4% or \$7.76 million of the City’s core assets are in the Very High risk category related to provision of reliable services. These assets are comprised of the Beck Road Bridge (\$4.36 million), six road segments namely Kalar Road, Kitchener Street, Allendale Avenue, Buchanan Avenue, Fallsview Boulevard, and Reixinger Road (\$2.94 million), and road medians (\$0.45 million).

Figure ES-2 Reliability Risk Exposure of the City’s Core Assets

PoF	Cdn						Risk	CRV (\$)	CRV (%)
5	VP	\$0.26	\$27.13	\$38.15	\$3.39	\$0.00	Very High	\$7.76	0.4%
4	P	\$4.30	\$68.00	\$164.61	\$43.18	\$4.36	High	\$98.82	5.0%
3	F	\$1.95	\$100.51	\$362.71	\$82.79	\$17.49	Moderate	\$335.46	16.8%
2	G	\$0.52	\$81.99	\$353.70	\$102.85	\$60.93	Low	\$989.94	49.6%
1	VG	\$0.00	\$143.72	\$306.82	\$24.93	\$1.91	Very Low	\$564.2	28.3%
		Insignificant	Minor	Moderate	Major	Catastrophic	Total	\$1,996.2	100.0%
		1	2	3	4	5			
		Criticality (CoF)							

Lifecycle Management Strategy

Lifecycle management strategies are the planned lifecycle-based activities that the City needs to undertake to meet its service levels.

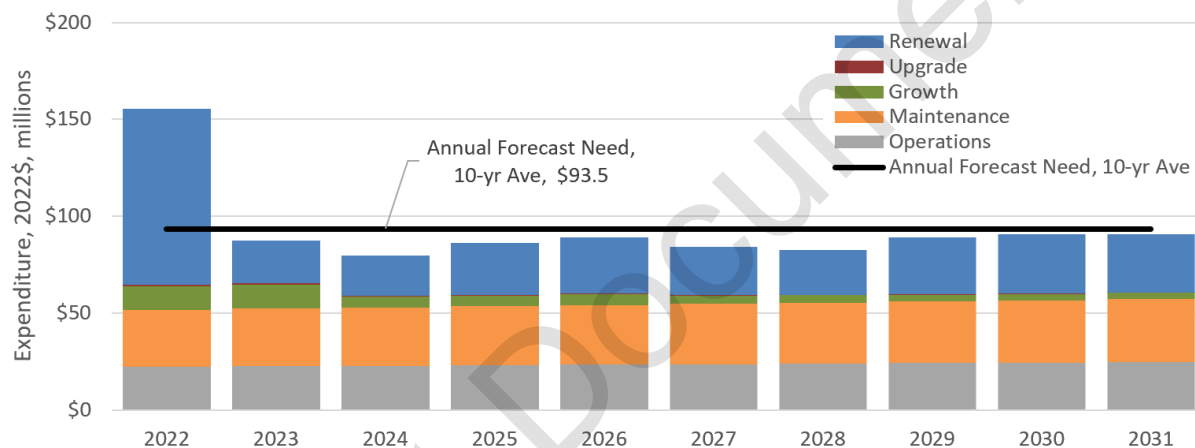
- To meet demand for services and functional requirements of stakeholders, the City adds, expands and upgrades assets and services, and developments add assets that are donated to the City.
- To meet reliability service levels and provide quality programs, the City performs thousands of **inspections, and maintenance and operational activities, and** undertakes asset rehabilitation and replacement activities.

The City prioritizes lifecycle activities to manage risk of not meeting service levels and to optimize costs.

Based on the planned asset lifecycle management strategies, the City’s total needs are forecast at \$935 million for the period 2022-2031, for an average expenditure of \$93.5 million per year. Figure ES-3 shows the total operations and maintenance, renewal, growth and upgrade needs forecast for the City over the next 10 years to sustain current

levels of service. The high cost of renewal needs shown in the first year (2022) is due to the backlog of assets in Very Poor condition as identified in the State of the Infrastructure section above. Recall that these assets are comprised mostly of wastewater sewers, maintenance holes and laterals, water mains, roads, sidewalks, and bridges and culverts. The annual forecast need includes addressing the existing backlog over the next 10 years and sustaining other assets as they deteriorate over the same time period. As noted above, the confidence in the “condition” data for wastewater maintenance holes and laterals (\$10.2 million Very Poor), and sidewalks (\$13.1 million Very Poor) is moderate as it is based on a theoretical calculation of life consumed rather than inspected condition as is the case for wastewater sewers, road pavement, and bridges and culverts.

Figure ES-3 10-Year Forecast Lifecycle Strategy Needs for the City’s Core Assets, 2022 to 2031



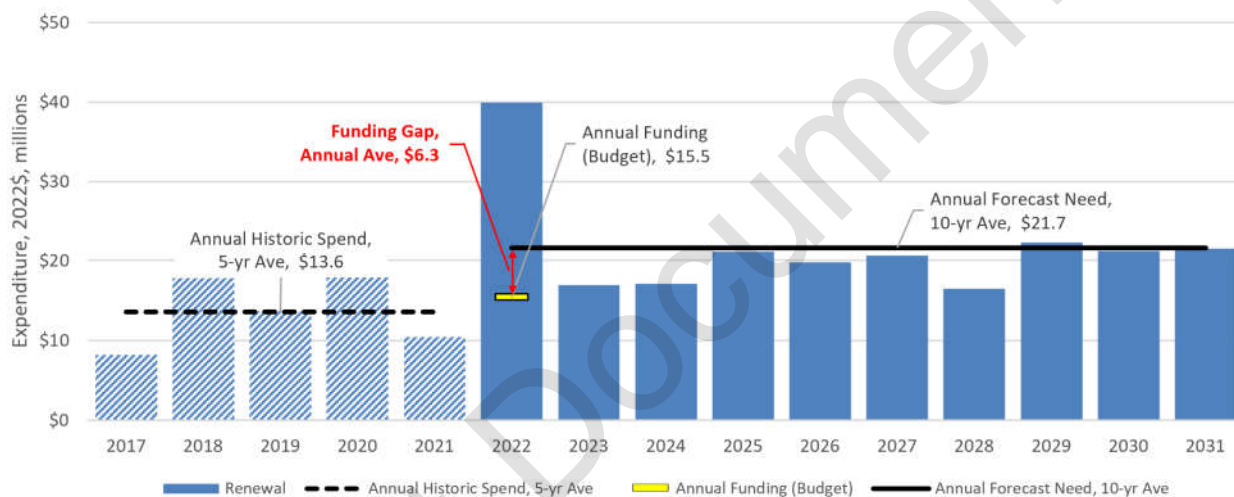
Financial Strategy

The financial strategy is informed by the preceding sections of the AM Plan: the state or condition of the assets, the current levels of service, the risks to service delivery, and the lifecycle activities needed to reduce the risks to meeting service delivery targets to acceptable levels. The financial strategy considers how the City will fund the planned lifecycle management activities to maintain current service levels.

The City’s main sources of revenue include property tax, debt, federal gas tax, third party grants, casino revenue, development charges, and user fees and charges. There are restrictions on the use of funds from various sources (e.g. development charges, user fees). The City currently approves one-year capital and operating plans and budgets. Note that O.Reg. 588/17 requires that AM Plans for proposed LOS (due by July 1, 2025) provide lifecycle management strategies, forecast annual available funding, and any funding gaps for each of the next 10 years.

For core asset renewal needs, the City’s services can be categorized into two groups: i) those that are funded through property taxes and other sources (i.e. roads, bridges and culverts, stormwater management), and ii) those that are funded through user fees or rates (i.e. water and wastewater). The largest funding gap was found for roads, bridges and culverts, and stormwater assets. For these assets, Figure ES-4 shows historic spending (dashed black line at \$13.6 million), and compares the 2022 budget (yellow line at \$15.5 million) to the 10-year average annual need forecast (solid black line at \$21.7 million) to show, in red text, an annual funding gap for each of the next ten years of \$6.3 million (a total of \$63 million over the 10-year period).

Figure ES-4 10-Year Annual Renewal Funding Gap for Transportation and Stormwater Assets



If annual available funding were to remain at \$15.5 million over the 10-year period, at the end of the 10 years, the current \$40 million backlog will grow by \$63 million to over \$100 million. Also, in addition to the annual renewal funding gap, the AM plan identified an annual operations and maintenance funding gap for these assets of \$0.5 million for 2022, growing over time due to growth and upgrade of the asset portfolio.

Water and wastewater assets are much closer to being fully funded with a 10-year annual renewal funding gap of \$1.5 million and an annual operations and maintenance funding gap of \$1.5 million for 2022.

Strategies to Close Funding Gaps

The transportation and stormwater management funding gaps may be closed by one or more of the following strategies:

- Reduce near term renewal needs by deferring capital renewal projects on lower risk assets, thereby lengthening the period in which the backlog is addressed beyond the 10 years, but likely increasing maintenance costs.

- Increase available funds through property tax increases, leveraging third party grants, drawing on reserves, or use of debt
- Change the funding source for stormwater management from property taxes to a dedicated and stable, stormwater fee to recover the full cost of stormwater management.

The water and wastewater services funding gaps may be closed by one or more of the following strategies:

- Reduce near term renewal needs as described above
- Increase available funds through water and wastewater fee increases and leveraging third party grants.

O.Reg.588/17 Compliance and Improvement Opportunities

This AM Plan is compliant with Ontario Regulation 588/17 for current levels of service.

Development of AM Plans is an iterative process that includes improving processes, data, systems, and staff skills over time to gain more and more confidence in the information presented. The City will continue to improve its asset management practices to best realize value from its assets and meet the requirements of Ontario Regulation 588/17 for proposed levels of service prior to July 1, 2025.

Opportunities for improvement include the following:

- State of infrastructure: Improve understanding of asset condition as a significant input to the AM Plan
- Levels of service: Consider additional performance measures to track financial sustainability
- Lifecycle management: Update master plans to improve growth forecasts and potentially lower levels of service to reduce costs, and separately track costs by asset category and lifecycle management strategy
- Financial management: Prepare 10-year operating and capital plans and budgets as required by O.Reg. 588/17 by July 1 2025, investigate changing the funding source for stormwater management from property taxes to a dedicated and stable stormwater user fee to recover the full cost of stormwater management, and update rate studies for water and wastewater to achieve full cost recovery, as required.

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1 Introduction

1.1 Context

The City of Niagara Falls (the City) provides a range of services to its residents, businesses and visitors, including core services that include local roads, bridges and culverts, stormwater management, water distribution, and sanitary sewer collection.

The City proactively and responsibly manages its infrastructure portfolio. As infrastructure ages and demands increase, so will the challenge of ensuring the needs of the community are effectively met with the limited resources available. This Asset Management Plan (AM Plan) seeks to address this concern by providing direction for effective management of City infrastructure to best achieve established goals and objectives. As an integrated AM Plan, it considers the lifecycles and needs of all infrastructure assets within scope, providing a sustainable, holistic view of the asset portfolios. The resulting AM Plan is intended to provide the optimal allocation of resources towards meeting prescribed goals, objectives, and levels of service. The AM Plan is focused on managing the condition and performance of complete asset systems through a systematic decision-making process. Development of AM Plans is an iterative process that includes improving processes, data, systems, and staff skills over time to gain more and more confidence in the information presented.

1.2 Purpose of the Plan

The 2022 AM Plan is an update to the City's 2013 AM Plan. It describes the actions required to manage the City's "core" portfolio of assets in a way that supports established service levels, while managing risks and costs. The City's core assets include roads, bridges and culverts, and stormwater management, water, and wastewater systems. This AM Plan also includes sidewalks as an integral part of the roadway which are not considered core assets. The 2022 AM Plan focuses on the 10-year period from 2022 to 2031 and provides a framework for continuously improving the City's AM practices.

This AM Plan fulfils the requirements of the Ontario Regulation (O.Reg.) 588/17 Asset Management Planning for Municipal Infrastructure for AM Plans to 2022. Specifically, this AM Plan outlines current (2021) Levels of Service (LOS) performance for core assets, recommended actions, and costs associated with sustaining that LOS. For details on how this AM Plan complies with content requirements defined by O.Reg. 588/17, see section 7.

In accordance with the requirements of O.Reg. 588/17, this AM Plan is posted on the City's website and will be updated at least every 5 years. Starting the year after the City's Proposed Levels of Service AM Plan is completed (required by 2025), City Council must conduct an annual review of its asset management progress on or before July 1st each year which addresses progress in implementing the City's AM Plan, any factors impeding the City's ability to implement the AM Plan, and a strategy to address these factors.

Background information and reports for the State of Infrastructure section may be provided by the City upon request.

This AM Plan is a medium to long range planning document that is used to support the City's strategic priorities and other goals by providing a rational strategy for proactively and effectively managing the City's core assets. It provides a guide to understanding key items such as:

- The size, replacement value, and condition of City's core asset portfolio
- The current levels of service standards and the City's performance against them
- The assets that will be needed in the future to support core service delivery objectives and mitigate vulnerabilities
- The planned activities to sustain current and future core assets throughout their lifecycles at minimal cost, while mitigating vulnerabilities
- The funding sources for planned lifecycle activities
- The steps to improve future iterations of the AM Plan.

This AM Plan is intended to improve the City's ability to achieve its corporate goals and objectives in a way that best serves its customers. It provides a rational framework that enables systematic and repeatable processes to manage costs, risks and levels of service for the City's core asset portfolio.

1.2.1 This AM Plan meets Regulatory Requirements

This AM Plan aligns with the City's Strategic Asset Management Policy (<https://niagarafalls.ca/city-hall/administration/strategic-priorities.aspx>) and fulfils the requirements of Ontario Regulation 588/17 Asset Management Planning for Municipal Infrastructure (O.Reg. 588/17) to report financial implications associated with current and proposed levels of service for core infrastructure.

Figure 1-1 shows the required sections of the AM Plan down the left side. The columns to the right show O.Reg. 588/17 requirements for current levels of service (centre column) and proposed levels of service (right column).

Figure 5 Ontario Regulation 588/17 Requirements Overview

	Current Levels of Service AMP July 2022 (core), 2024 (non-core)	Proposed Levels of Service AMP July 2025 (core, non-core)
State of Infrastructure (asset register)	<ul style="list-style-type: none"> • Inventory of assets, by category • Replacement cost of assets • Average age of assets • Condition of assets • Approach to assessing condition 	<ul style="list-style-type: none"> • Inventory of assets, by category • Replacement cost of assets • Average age of assets • Condition of assets • Approach to assessing condition
Levels of Service (performance)	<ul style="list-style-type: none"> • Current LOS (performance) provided: <ul style="list-style-type: none"> - To community (qualitative metrics) - By assets (quantitative metrics) • For core assets as per Tables 1 to 5 in O.Reg. 588/17 (as minimum), and as established by City for other assets 	<ul style="list-style-type: none"> • Proposed LOS (performance) for the next 10 years <ul style="list-style-type: none"> - For community (qualitative metrics) - By assets (quantitative metrics) • And why appropriate based on risk and affordability assessment
Lifecycle Management Strategy	<ul style="list-style-type: none"> • Population and employment forecasts per 2019 Growth Plan • Lifecycle activities needed for each of the next 10 years to: <ul style="list-style-type: none"> - Meet demand caused by growth or upgrade of existing assets - Maintain the current LOS at least cost and acceptable level of risk 	<ul style="list-style-type: none"> • Population and employment forecasts per 2019 Growth Plan • Lifecycle activities needed for each of the next 10 years to: <ul style="list-style-type: none"> - Meet demand caused by growth or upgrade of existing assets - Provide proposed LOS at least cost and acceptable level of risk
Financing Strategy	<ul style="list-style-type: none"> • Cost of lifecycle activities needed for each of the next 10 years to: <ul style="list-style-type: none"> - Meet demand caused by growth or upgrade of existing assets - Maintain the current LOS 	<ul style="list-style-type: none"> • Cost of lifecycle activities needed for each of the next 10 years to: <ul style="list-style-type: none"> - Meet demand caused by growth or upgrade of existing assets - Provide proposed LOS • Funding projected to be available to undertake needed lifecycle activities • For funding shortfalls which activities will not be funded and associated risks
Implementation and Key Assumptions	<ul style="list-style-type: none"> • Statement on how all State of Infrastructure background information and reports will be made available to the public 	<ul style="list-style-type: none"> • The risks and mitigation strategies associated with implementing the AM Plan • Explanation of key assumptions underlying the AM Plan that have not previously been explained

Both this AM Plan and the Strategic Asset Management Policy will be posted on the City’s website. This AM Plan will be updated at least every five (5) years.

1.2.2 This AM Plan supports the City’s Vision, Values and Key Strategic Objectives

The City’s Strategic Priorities, 2019 to 2022, provide focus to the Council term and direct the allocation of resources through the budget process.

VISION: The City of Niagara Falls is committed to being accountable for the provision of high quality municipal services, and enhancing quality of life in our community through service excellence, teamwork, and dynamic leadership.

VALUES: The City of Niagara Falls is committed to enhancing the quality of life of, and service to, its customers through a corporate culture that embraces and rewards our core values of leadership, teamwork, respect and accountability.

STRATEGIC PRIORITIES: The City of Niagara Falls will concentrate on addressing the pressures we are facing, getting the most out of the opportunities in front of us, and unlocking the full potential of our community. The City's strategic priorities include:

- **Vibrant & Diverse Economy:** We are committed to being a city that creates a diverse economy, and a vibrant, welcoming environment that attracts families, high quality jobs, investment and entrepreneurship.
- **Intelligent & Innovative City:** We are committed to embracing technology and innovation to make municipal government more effective and efficient, and to improve residents' lives through digital equity.
- **Diverse & Affordable Housing:** We are committed to addressing the need for quality and affordable housing as a necessary component of a city in which people want to live and invest.
- **Convenient & Accessible Transportation:** We are committed to a safe, accessible, convenient, integrated and fiscally responsible transportation network, accessible to locals and visitors.
- **Responsible & Transparent Financial Management:** We are committed to being financially responsible to the residents of Niagara Falls by practicing prudent fiscal management of existing resources, and by making sound long-term choices that allow core City programs and services to be sustainable.
- **Strong & Resilient Infrastructure:** We are committed to provide a strong and resilient infrastructure that ensures high quality-of-life for Niagara Falls residents and provides the foundation needed to support a sustainable community.
- **Engaging & Accountable Government:** We are committed to being transparent and accountable to our residents, providing easy access to information, a great customer service experience and meaningful opportunities to participate in the democratic process.
- **Healthy, Safe & Livable Community:** We are committed to making Niagara Falls a livable, affordable and inclusive city with a strong sense of place.

Municipal services in the City of Niagara Falls are provided by two tiers of government. The Region of Niagara is the "upper tier" and the City of Niagara Falls is the "lower tier".

1.2.3 This AM Plan supports City Planning

Asset management planning is a key tactical (medium term) planning activity that relies on input from strategic and master planning activities and informs shorter-term planning,

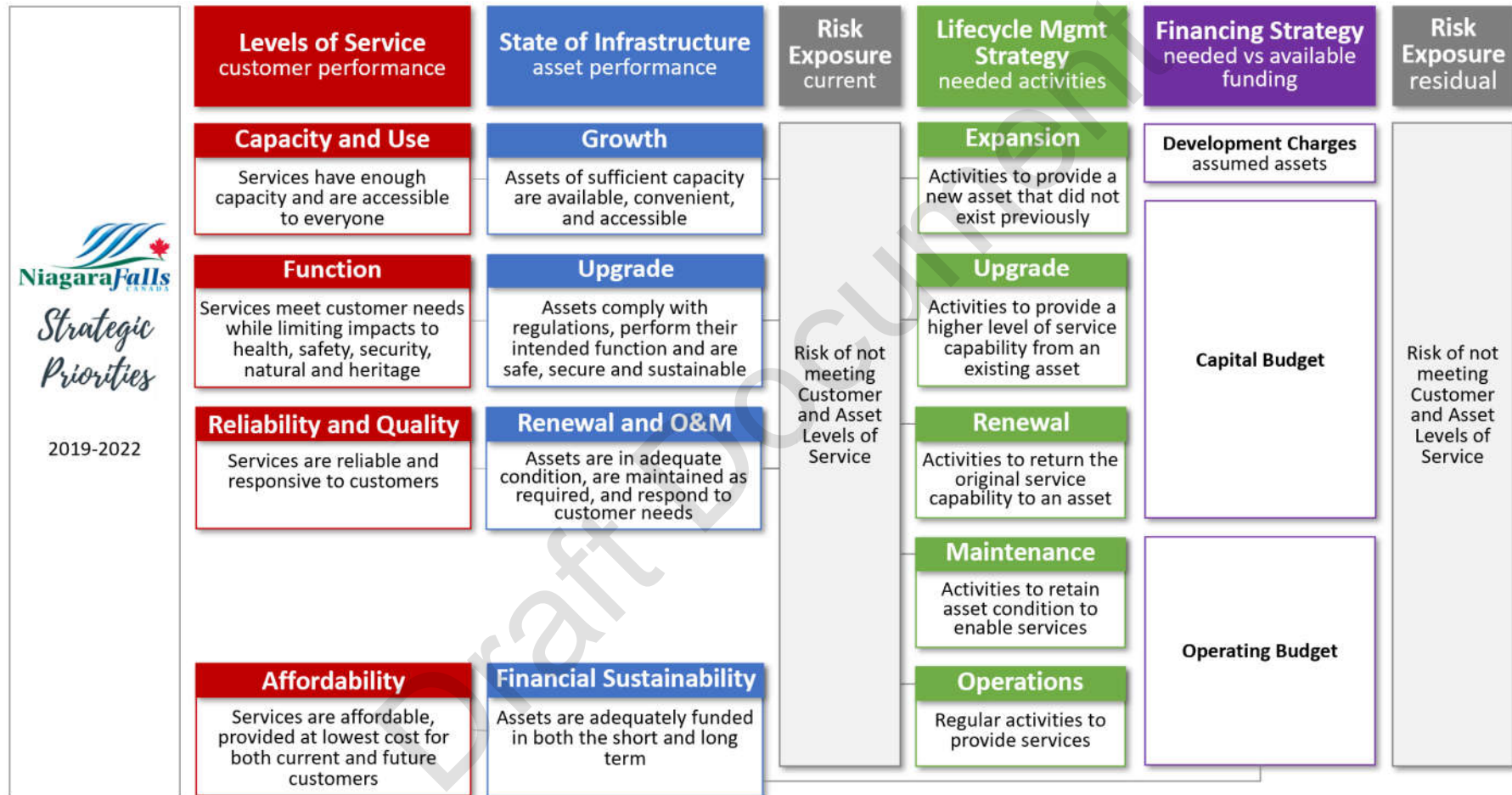
budgeting and programming decision-making. Figure 6 shows that Corporate strategic priorities, along with the legislated levels of service (LOS) referenced by them, drive the definition of more specific Community LOS which are categorized according to the following service attributes:

- **Capacity and Use:** Statements on whether services have enough capacity and are accessible to customers
- **Function:** Statements on whether services meet customer needs while limiting impacts on health, safety, security, natural and heritage
- **Reliability and Quality:** Statements on whether services are reliable and responsive to customers
- **Affordability:** Statements on whether services are affordable and provided at the lowest cost for both current and future customers.

Qualitative Community LOS are translated into quantitative Technical LOS: Capacity and Use LOS drive the need for asset growth, Function LOS drive the needs for asset upgrade, Reliability and Quality LOS drive needs for asset renewal, maintenance and operations, and Affordability LOS drive needs for financial sustainability.

The risks of failing to achieve the defined Community and Technical LOS are assessed, and lifecycle activities are prioritized to address those risks. Lifecycle activities may include expansion, upgrade, renewal, maintenance or operational activities, depending on the service attribute to be addressed. The nature of the lifecycle activity determines whether it will be funded through development charges, or capital and operating budgets. As shown in the figure, even after the lifecycle interventions, some residual risks may remain.

Figure 6 Asset Management Planning Framework



The outputs of the AM Plan include the current levels of service, the risks to service delivery, the lifecycle activities needed to reduce the risks to service delivery to acceptable levels, and the associated funding. Shorter term operating and capital plans are informed by the AM Plan and provide more detailed programs comprised of projects and work.

The AM Plan is intended to be read with the following City planning documents, including the corporate Strategic Asset Management Policy and Asset Management Strategy.

- Council’s Strategic Priorities, 2019-2022
- Official Plan, 2019
- Structure Asset Management Cost Forecast, 2021
- Development Charges Background Study, 2019
- Pollution Prevention & Control Plan Study Update, 2017
- Water and Wastewater Long-Range Financial Plan, 2019
- Niagara Region’s Climate Change Discussion Paper, 2019
- Operating and Capital Budgets

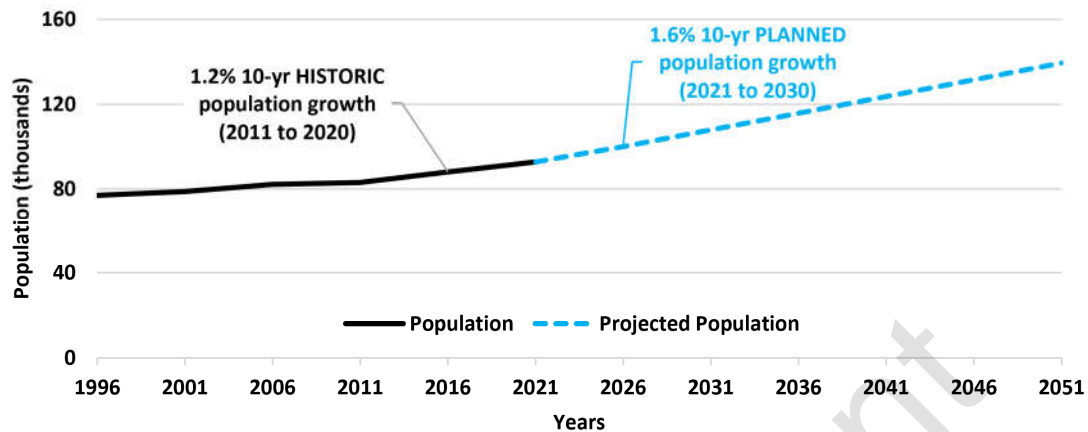
1.2.4 This AM Plan supports Growth at the City

One main factor that municipalities must consider in asset management planning is the impact of future growth on meeting goals and objectives. The City monitors trends in its population to ensure that its impacts on service levels are well understood and that strategies are developed to address additional demands due to growth and demographic changes. The City’s historic and forecast future population and employment growth is summarized in Table 1-1 and shown in Figure 7. Historic population data is based on Census information up to 2021, at which time the population in the City was 92,830.

Table 1-1 City Population and Employment Forecasts

Year	Population	Population Growth Rate	Employment
2006	82,184	0.8%	40,669
2011	82,997	0.2%	39,512
2016	88,071	1.2%	40,419
2021	92,830	1.1%	43,064
2026	99,990	1.5%	45,881
2031	107,860	1.5%	48,663
2036	115,730	1.4%	51,445
2041	123,600	1.3%	54,226
2046	131,470	1.2%	57,008
2051	139,340	1.2%	59,790

Figure 7 City Population History and Forecast to 2051



1.2.5 This AM Plan supports Climate Change Response

Climate change is a change in global or regional weather patterns that persists for an extended period including changes in the frequency and intensity of extreme events that may impact precipitation patterns, temperature, and water levels. For asset intensive services, climate change makes it more difficult to deliver desired levels of service, amplifies risk and increases costs required to manage these risks. The greatest potential impacts on the City’s core assets are as follows:

Roads, Bridges and Culverts

- Soil instability, ground movement, and slope instability, leading to road and bridge damage from erosion and embankment failure and increased frequency/severity of pavement cracking, rutting, and frost heave
- Increased runoff volume leading to more frequent washout

Stormwater Management

- System capacity more frequently exceeded leading to more frequent exceedance of culvert and storm sewer system capacity causing damage to property and other infrastructure systems

Water Systems

- Infrastructure damage from flooding and fires
- Reduced source water quality including water-borne health effects from increased flooding and summer taste/odour problems in potable water supply

Wastewater Systems

- Increased inflow and infiltration leading to system capacity more frequently exceeded leading to surface surcharging and basement flooding

- Changes to wastewater effluent characteristics
- Buildings, tankage, housed process equipment affected by flooding
- Increased energy costs due to increased pumping.

Climate change responses include:

- **Climate change mitigation strategies** that reduce the magnitude and rate of climate change, typically by reducing greenhouse gas emissions
- **Climate change adaptation strategies** that increase the resilience of a community to the impacts of climate change
- **Recovery strategies** that wait for the impacts of climate change to happen, and then react, typically involving remediation of damages or moving towards lower levels of service as a choice.

The City is one of seven regional municipalities in Niagara that are collaborating on climate change adaptation through a partnership called Niagara Adapts. The City's Climate Adaptation Plan has five main goals, each with associated actions. The five main goals are:

- Increasing climate change literacy among staff and the public
- Investing in infrastructure and assets that are prepared for the impacts of climate change
- Encouraging green methods of transportation
- Creating and implementing energy conservation strategies for city facilities
- Mitigating consequences of extreme weather, emergency events and safety risks to the community.

1.3 Scope

This AM Plan includes all core assets owned by the City and for which asset data was available, and provides recommendations for the period 2022-2031, inclusive. Where data gaps were encountered, recommendations for closing data gaps are provided in Section 7. This will enable the City to continually improve its AM planning capabilities.

This AM Plan includes five (5) services which provide municipal services to the City's more than 33,000 combined residential, commercial, industrial, and institutional customers.

- **Roads and Related Service:** The City provides and manages the local road network, which includes roads, curbs and gutters, and barriers as core assets and sidewalks and medians as non-core assets. Other roadway jurisdictions within the City include Niagara Region (major arterial roadways and connection links), the Province of Ontario (Provincial highways) and the Government of Canada (Niagara Parks Commission roadways).

- **Bridge and Culvert Service:** The local transportation network also includes bridges and structural culverts.
- **Stormwater Management Service:** The City manages stormwater drainage through a network of collection, conveyance, and storage assets including municipal drains, roadside ditching, sewer network, and ponds.
- **Water Service:** The City distributes quality water through a network of drinking water treatment, storage and transmission facilities, and linear infrastructure. The Region of Niagara owns and operates the water treatment, pumping and transmission facilities and associated infrastructure.
- **Wastewater Service:** The City collects wastewater in a network of sewers, pumping and transmission facilities and infrastructure. The majority of the system consists of separated sanitary sewers, but approximately 26% of the network is serviced by combined sewers. The Region of Niagara owns and operates the wastewater treatment, pumping and transmission facilities and infrastructure. The City owns and operates two sanitary pumping stations and a number of minor wastewater storage facilities.

1.4 Organization of the Document

The AM Plan is organized to meet the requirements of Ontario Regulation 588/17 (Current Levels of Service) and the Province’s “Guide for Municipal Asset Management Plans”. The contents of this AM Plan follow the recommended elements of a detailed AM Plan:

- **Executive Summary:** Summary of AM Plan
- **1 - Introduction:** Outlines scope, background information, relationship to other municipal documents and plans, and applicable legislation
- **2 – State of the Infrastructure:** Summarizes the inventory, valuation, condition and remaining life of the assets in the inventory by service and asset type
- **3 - Levels of Service:** Defines levels of service through performance indicators and proposed targets, and outlines current performance
- **4 – Risk Management Strategy:** Defines the framework for identifying critical assets and quantifies risk exposure to enable prioritization of lifecycle activities and optimization of lifecycle activities
- **5 – Lifecycle Management Strategy:** Summarizes the planned activities to manage the assets that will enable them to provide the required levels of service in a sustainable way, while managing risk, at the lowest lifecycle cost
- **6 – Financing Strategy:** Summarizes the available funding for the asset management strategies and any forecast funding gaps
- **7 – AM Plan O.Reg. Compliance & Improvement Opportunities:** Summarizes the next steps including monitoring of AM Plan implementation progress, and improving future iterations of the AM Plan.

- [Appendix A – Asset Service Life and Replacement Cost](#): Summarizes the life and cost information used to develop the state of infrastructure section of the AM Plan.

With the exception of the Executive Summary and Introduction, each of the above sections provides a City-wide overview followed by details for each service or lifecycle management strategy.

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2 State of the Infrastructure

2.1 City-Wide Core Assets Overview

The City provides a range of services to its residents, businesses and visitors, including core services that include mobility along local roads, bridges and culverts, stormwater management, drinking water distribution, and wastewater collection and conveyance. These services rely heavily on a portfolio of asset systems.

Understanding the assets owned by the City is the starting point to developing a plan to best manage them. The replacement value represents the expected cost to replace an asset to the same functional standard with a new version based on current market conditions and construction standards. Replacement value estimates assume that replacements are conducted as part of planned and bundled capital projects where applicable, rather than as individual unplanned replacements, which would typically be more costly. Table 2-1 shows the estimated replacement value of the City’s core assets as \$ 2,121.2 million (2022\$), and includes a breakdown of the inventory by service including current (2022\$) replacement value.

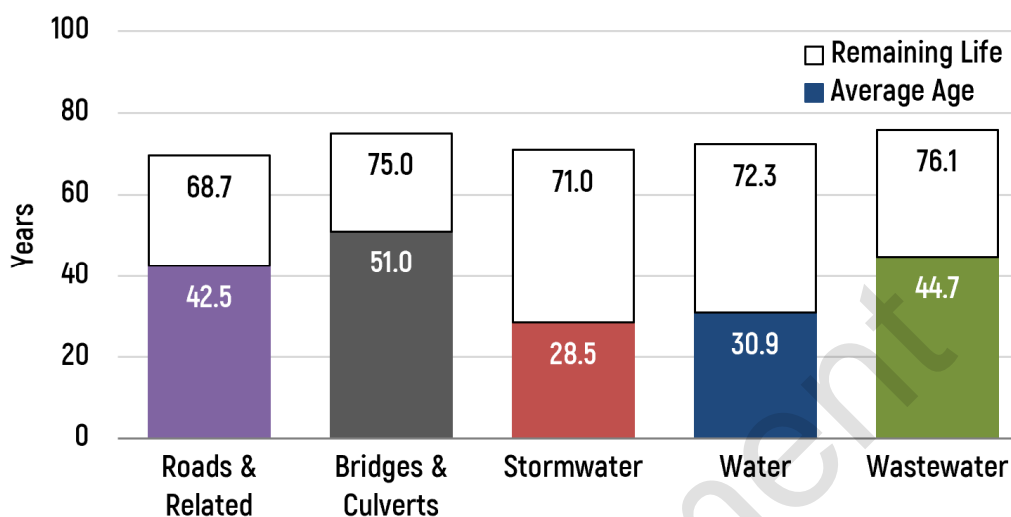
Table 2-1 Inventory of the City’s Core Assets

Service	Asset Categories	Replacement Value (2022\$, millions)	Replacement Value (%)
Roads & Related	Roads, sidewalks, medians, barriers	\$714.9	34%
Bridges & Culverts	Span bridges, span culverts, municipal structures	\$171.5	8%
Stormwater Management	Storm sewers, ponds, appurtenances	\$335.4	16%
Water	Water mains, facilities, appurtenances	\$477.6	23%
Wastewater	Sewer Mains, facilities, appurtenances	\$421.9	20%
TOTALS		\$2,121.2	100%

The average age and estimated service life of the City’s core assets, by service, weighted by replacement value, is summarized in Figure 8. The top number in each bar is the average of the estimated service life of the assets in the service, while the bottom number is the average age of the assets in the service. Assets with unknown install date are omitted. On average, the City’s assets are in the middle of their service lives. This is

important as assets generally require less investment during the beginning of their service lives and more as they approach the end of their lives.

Figure 8 Average Age and Estimated Life of the City's Core Assets



Observed condition provides more confidence in the state of the assets than the age and remaining life information presented above. Condition ratings are defined in Table 2-2 and are aligned with the International Infrastructure Management Manual's (IIMM) five-point condition scale.

Table 2-2 Condition Grading Criteria

Grade	Description	Condition Criteria
VG	Very Good	Asset is physically sound and is performing its function as originally intended. Required maintenance costs are well within standards and norms. Typically, asset is new or recently rehabilitated.
G	Good	Asset is physically sound and is performing its function as originally intended. Required maintenance costs are within acceptable standards and norms but are increasing. Typically, asset has been used for some time but is within mid-stage of its expected life.
F	Fair	Asset is showing signs of deterioration and is performing at a lower level than originally intended. Some components of the asset are becoming physically deficient. Required maintenance costs exceed acceptable standards and norms and are increasing. Typically, asset has been used for a long time and is within the later stage of its expected life.
P	Poor	Asset is showing significant signs of deterioration and is performing to a much lower level than originally intended. A major

Grade	Description	Condition Criteria
		portion of the asset is physically deficient. Required maintenance costs significantly exceed acceptable standards and norms. Typically, asset is approaching the end of its expected life.
VP	Very Poor	Asset is physically unsound and/or not performing as originally intended. Asset has higher probability of failure or failure is imminent. Maintenance costs are unacceptable, and rehabilitation is not cost effective. Replacement / major refurbishment is required.

For this AM plan, condition assessment data was incorporated where available, specifically for:

- Roads based on PCI assigned to pavement segments by City staff, 2019
- Bridges and culverts, both span (≥ 3.0 m) and municipal (< 3.0 m), OSIM Bridge Condition Inspection, 2020
- Watermains based on the most recent observed condition during watermain break repair
- Wastewater sewers based on CCTV structural scores.

For the remaining assets, condition was calculated from remaining life based on age and estimated service life.

Table 2-3 shows how the five-point scores from Very Good to Very Poor were determined from the available asset data, including remaining useful life and other condition scoring systems, such as Pavement Condition Index (PCI) and Bridge Condition Index (BCI).

Table 2-3 Conversion Table for Condition Grades of the City's Core Assets

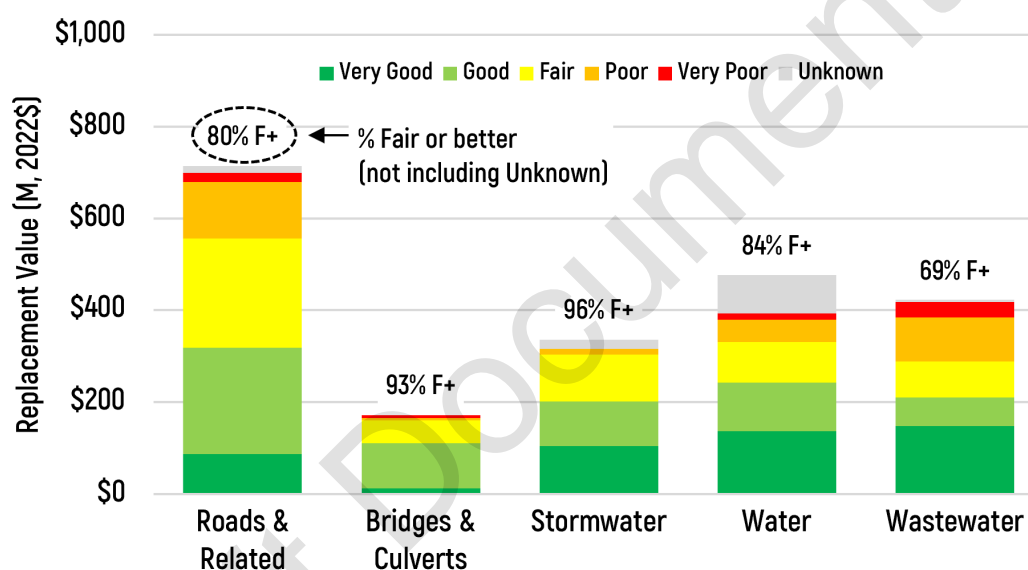
Condition Grade	% Remaining Useful Life (all asset types)	Pavement Condition Index (roads)	Bridge Condition Index (bridges & culverts)	Watermain Break Observed Condition	CCTV Structural Score (wastewater sewers)
Very Good	>75 – 100%	90 – 100	80 – 100	Excellent / Very Good	0 or 1
Good	>50 – 75%	80 – 89	70 – 79	Good	2
Fair	>25 – 50%	70 – 79	60 – 69	Fair / Okay	3
Poor	>0 – 25%	50 – 69	40 – 59	Poor	4
Very Poor	$\leq 0\%$	< 50	< 40	Very Poor / Bad	5

The 2016 Canadian Infrastructure Report Card (CIRC) provides an assessment of the health of municipal infrastructure as reported by cities and communities across Canada. The CIRC summarizes the physical condition state of Canadian municipal infrastructure as qualitatively assessed by the study participants using a generic five point condition grading scale (Very Good, Good, Fair, Poor and Very Poor). To adequately meet service

levels and manage risk while minimizing whole-of-life costs, generally, most assets should be preserved in fair or better condition. The next section of this AM Plan, Levels of Service, sets general physical condition performance targets at 80% fair or better condition. Lower targets may be set for less critical assets (e.g. shorter span bridges and unpaved roads).

The current (2021) condition distribution of the City’s core assets is shown in Figure 9 below, by service. The colours that make up each vertical bar represent the condition of the assets that support each service from very good to very poor, with those for which the condition is unknown shown in grey. The number on the top of the bar for each service provides the percentage of the assets within that service that are in fair or better condition, not including assets of unknown condition.

Figure 9 Condition Distribution of the City’s Core Assets



Overall, 77% or \$1,638 million of the City’s core assets are in Fair condition or better, 17% or \$358 million are in Poor or Very Poor condition, and 6% or \$125 million in assets are of unknown condition either because the install date is not known or a condition assessment has not yet been undertaken. Knowing the condition of assets is important to understanding the risks and costs of meeting stated service delivery objectives. Most of the assets of unknown condition are stormwater catchbasins and ponds, and property water services and curb stops.

Based on those assets with known condition, the figure above shows that most of roads, bridges and culverts, stormwater and water assets are in Fair or better condition (80%, 93%, 96% and 84%, respectively). However, only 69% of the wastewater assets are in Fair or better condition. Depending on the potential impact of a failure, assets in Poor and Very Poor condition may be managed differently than those in Fair or better condition. Assets in Very Poor condition (3.8% or \$75.5 million) are due or overdue for repair or replacement and represent the City’s renewal backlog. The assets in Very Poor condition

include wastewater sewers, maintenance holes and laterals (\$33.9 million), water mains (\$10.8 million), roads (\$6.7 million), and sidewalks (\$13.1 million).

Table 2-4 provides a summary of data sources for inventory, replacement cost and condition for this AM Plan and indicates lower confidence in source data with pink highlighting. The highest confidence in data is for bridges and the lowest is for stormwater assets.

Table 2-4 Data Sources and Confidence for the City's State of Infrastructure

Service	Inventory Unknowns (%)	Replacement Value	Age → Condition	Condition Assessments
Roads & Related	Paved Urban Local Roads (3.1%), Medians (24.7%), Barriers (98.5%)	Unit costs aligned with historical tender costs and peer municipalities	sidewalks, medians, barriers	paved roads, unpaved roads
Bridges & Culverts	None	2020 OSIM Bridge Condition Inspection		all bridges and culverts
Stormwater Management	SWM Ponds (47.8%), Storm Appurtenances (31.1%)	Same as Roads & Related except <u>SWM Ponds</u> (unit construction costs based on storage volume)	storm sewers, ponds, appurtenances	
Water	Water Mains (2.1%), Water Appurtenances (47.2%)	Same as above except <u>Water Facilities</u> (purchase costs recorded in TCA register, inflated to 2022)	water facilities, appurtenances	water mains
Wastewater	Wastewater Facilities (12.3%), Wastewater Appurtenances (1.1%)	Same as above except <u>Wastewater Facilities</u> (purchase costs recorded in TCA register, inflated to 2022)	wastewater facilities, appurtenances	sewer mains

■ Indicates lower confidence in source data (with pink highlighting)

2.2 Details by Service

2.2.1 Roads and Related Assets

Road and related assets include paved and unpaved roads, sidewalks, medians and barriers. By replacement value, paved roads make up the largest proportion of assets that support this service and are reported by functional classification (arterial, collector, local) and cross section type (urban, semi urban, rural). Functional classification refers to two primary travel needs: mobility and access to/egress from specific locations. Arterial roads provide the greatest mobility and local roads the greatest opportunity for entry and exit. Cross section type designates the presence of roadway and boulevard elements such as curb and gutter, sidewalks, medians, and barriers.

Table 2-5 shows the estimated replacement value of the City’s roads and related assets as \$714.9 million (2022\$), and includes a breakdown of the inventory by asset category. Paved Urban Local Roads make up more than one third (38.8%) of the portfolio by replacement value.

Table 2-5 Inventory of the City’s Roads and Related Assets

Asset Category	Quantity	Replacement Value (millions, 2022\$)	Replacement Value (%)
Paved Urban Arterial Roads	395,512 m2	\$81.1	11.3%
Paved Urban Collector Roads	794,400 m2	\$109.6	15.3%
Paved Urban Local Roads	1,969,272 m2	\$277.7	38.8%
Paved Semi Urban & Rural Arterial Roads	466,279 m2	\$51.3	7.2%
Paved Semi Urban & Rural Collector Roads	484,410 m2	\$53.3	7.5%
Paved Semi Urban & Rural Local Roads	233,726 m2	\$25.7	3.6%
Unpaved Roads	177,872 m2	\$6.4	0.9%
Sidewalks	848,262 m2	\$102.5	14.3%
Medians	19,695 m	\$3.2	0.4%
Barriers	480,774 m	\$4.2	0.6%
TOTALS		\$714.9	100.0%

The average age and estimated life of the City’s roads and related assets, weighted by replacement value, is summarized in Figure 10. On average, the City’s Paved Urban Roads are in the first half of their service lives as are sidewalks and barriers. Note that Paved Semi Urban & Rural Local Roads and Unpaved Roads show age greater than the

estimated service lives. This is because these road categories are continually rehabilitated, rather than “replaced”. For example, the City does not “reconstruct” a gravel road, it replaces gravel.

The condition distribution of the City’s roads and related assets is shown in Figure 11

The figure graphically shows the relative replacement value, by asset category, and the proportion of assets by condition grade. Pavement condition is based on Pavement Condition Index (PCI). On average, 80% or more of paved urban roads (all functional classes) are in Fair condition or better and 73% of the remainder of paved roads are in Fair condition or better. On average, 74% of sidewalks are in Fair condition or better. However, only 34% of unpaved roads and 45% of medians are in Fair condition or better – but the City has a small inventory of these asset categories. Barriers of known condition are all in Fair condition or better – however, most barriers are of unknown condition.

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Figure 10 Average Age and Estimated Life of the City's Roads and Related Assets

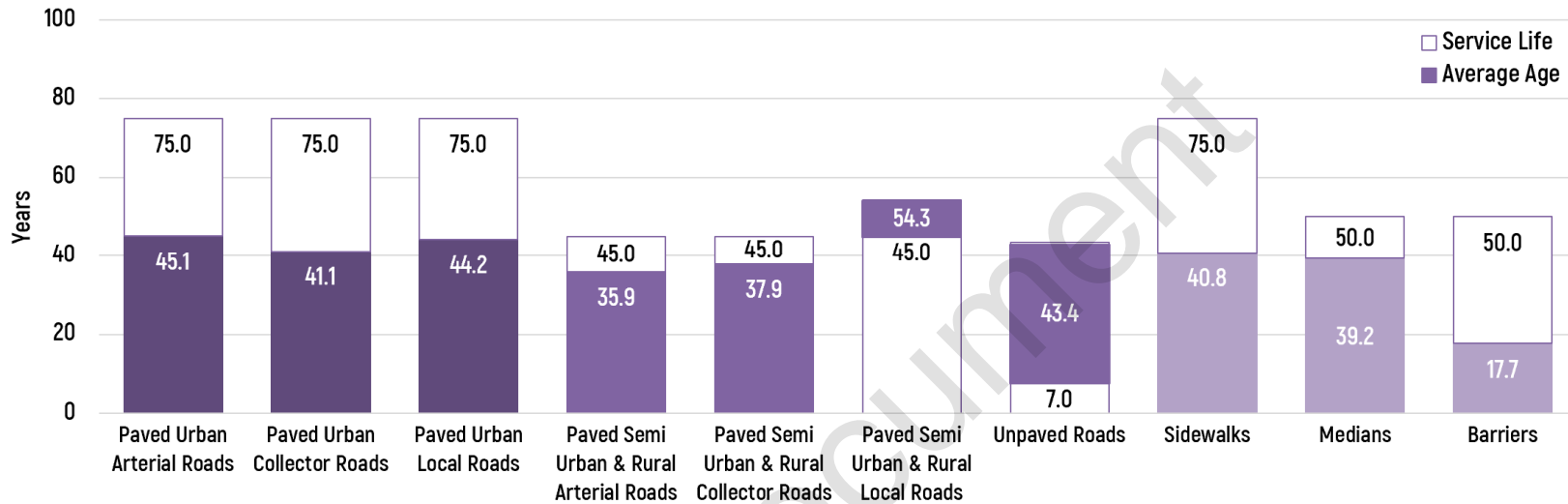


Figure 11 Condition Distribution of the City's Roads and Related Assets

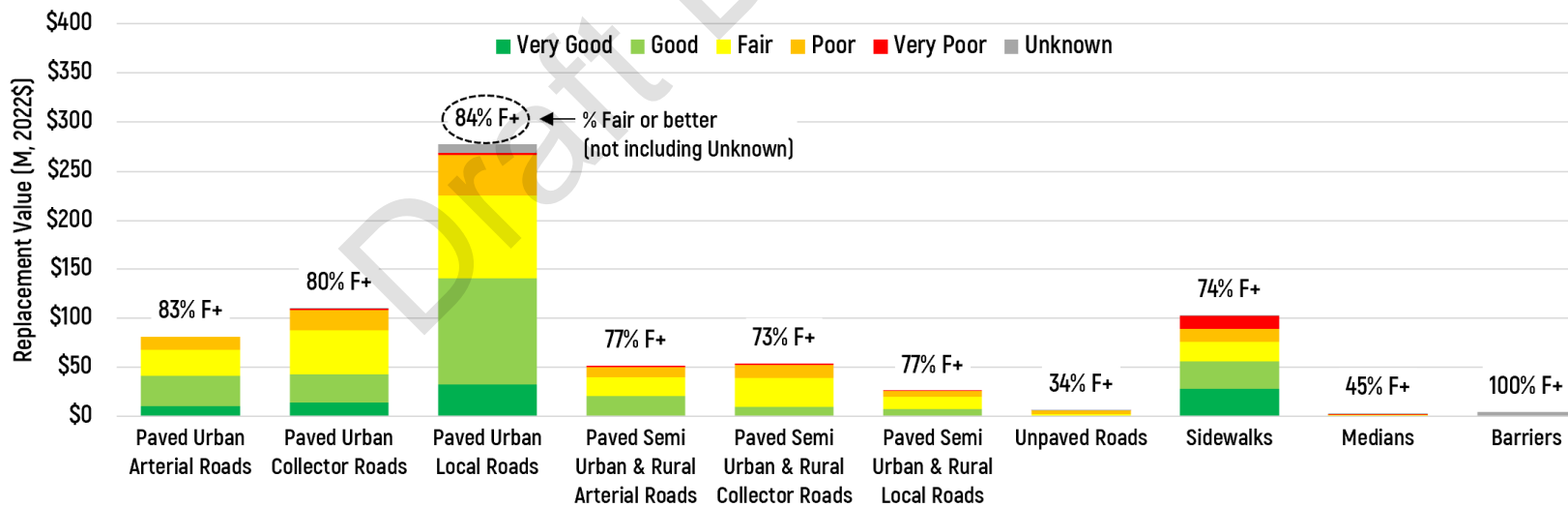


Table 2-6 provides a summary of data sources for inventory, replacement cost and condition and indicates lower confidence in source data with pink highlighting. The highest confidence in data is for bridges and the lowest is for stormwater assets.

Table 2-6 Data Sources and Confidence of the City’s Roads and Related Assets SOI

Asset Category	Inventory Data Source	Source of Replacement Value	Condition
Roads	Roads excel inventory with Pavement Condition Index 3.1% of Paved Urban Local Roads with unknown install date	Unit costs aligned with peer municipalities; includes curb and gutter costs	PCI assigned to pavement segments by City staff, 2019
Sidewalks	GIS: installation date is assumed to be the same as the associated road subbase install date	Unit costs aligned with historical tender costs and peer municipalities	Age based on assumed installation date
Medians	GIS: installation date is assumed to be the same as the associated road	Unit costs aligned with historical tender costs and peer municipalities	Age based on assumed installation date
Barriers	GIS 98.5% with unknown install date	Unit costs aligned with historical tender costs and peer municipalities	Age based on assumed installation date

■ (pink highlighting) indicates lower confidence in source data

2.2.2 Bridges and Culverts

Bridges and culverts are comprised of span bridges and span culverts, which includes all bridges and culverts with spans of 3.0 metres or greater, and municipal culverts include all bridges and culverts with spans less than 3.0 metres. Table 2-7 shows the estimated replacement value of the City’s bridges and culverts as \$171.5 million (2022\$), and includes a breakdown of the inventory by asset category. Span bridges make up approximately one half (49.9%) of the portfolio by replacement value.

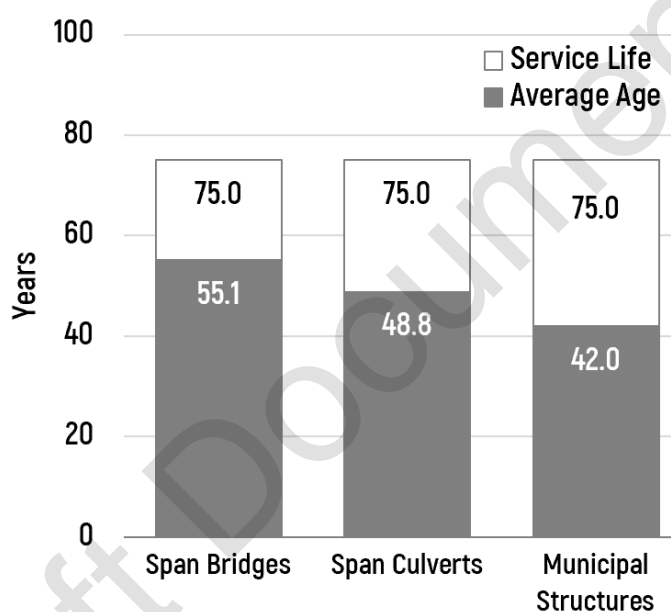
Table 2-7 Inventory of the City’s Bridges and Culverts

Asset Category	Quantity	Replacement Value (2022\$, millions)	Replacement Value (%)
Span Bridges	47 structures	\$85.7	49.9%
Span Culverts	22 structures	\$63.6	37.1%
Municipal Culverts	81 structures	\$22.3	13.0%

Asset Category	Quantity	Replacement Value (2022\$, millions)	Replacement Value (%)
TOTALS	150 structures	\$171.5	100.0%

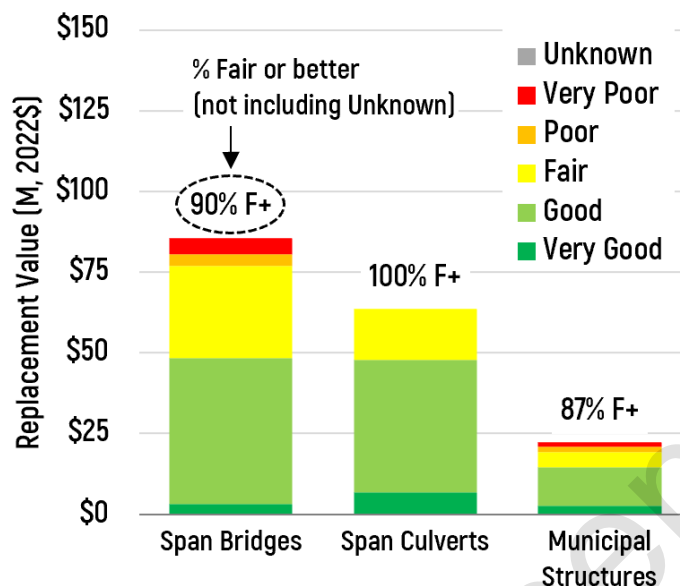
The average age and estimated life of the City’s bridges and culverts, weighted by replacement value, is summarized in Figure 12. On average, all of the City’s bridges and culverts are in the last half of their service lives.

Figure 12 Average Age and Estimated Life of the City’s Bridges and Culverts



The condition distribution of the City’s bridges and culverts is shown in Figure 13. The figure graphically shows the relative replacement value, by asset category, and the proportion of assets by condition grade based on the Bridge Condition Index (BCI). On average, 100% of span culverts, 90% of span bridges and 87% of municipal structures are in Fair condition or better. No bridges or culverts are of unknown condition.

Figure 13 Condition Distribution of the City’s Bridges and Culverts



The source of inventory, replacement value and condition information is sourced from the inspection and assessment reports prepared by Ellis Engineering Inc. As this information was derived from physical condition inspection and assessment in 2021 in accordance with the Ontario Structures Inspection Manual (OSIM), the confidence in the information is high. Copies of the bridge and culvert inspection and assessment reports have been provided in **Appendix B**.

2.2.3 Stormwater Management System

Assets that support stormwater management include storm sewers, stormwater management ponds, maintenance holes, catchbasins and catchbasin leads. Table 2-8 shows the estimated replacement value of the City’s stormwater management system as \$335.4 million (2022\$), and includes a breakdown of the inventory by asset category. Storm sewers make up approximately three quarters (76.3%) of the portfolio by replacement value.

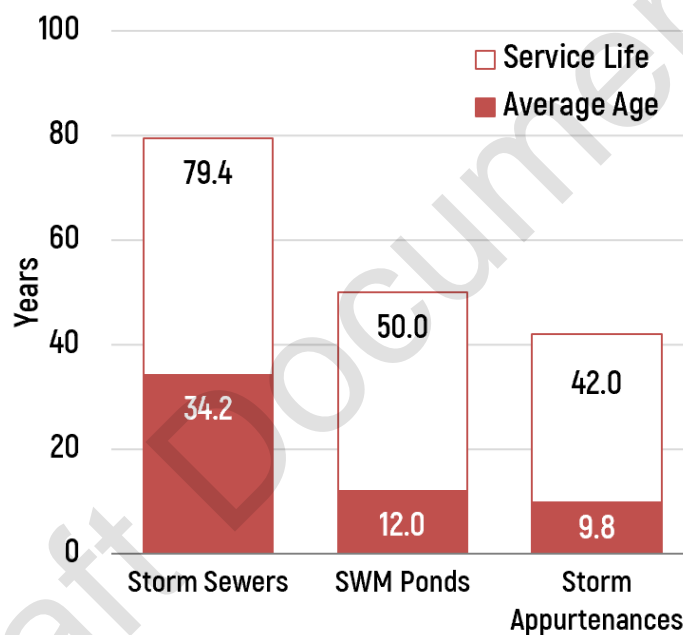
Table 2-8 Inventory of the City’s Stormwater Management System

Asset Category	Quantity	Replacement Value (2022\$, millions)	Replacement Value (%)
Storm Sewers	314,758 m	\$255.8	76.3%
SWM Ponds	27 ponds	\$19.4	5.8%
Stormwater Appurtenances	4,778 Maintenance Holes	\$12.5	3.7%
	7,400 Catchbasins	\$19.4	5.8%

Asset Category	Quantity	Replacement Value (2022\$, millions)	Replacement Value (%)
	54,575 m Catchbasins	\$28.3	8.4%
	Leads		
		\$335.4	

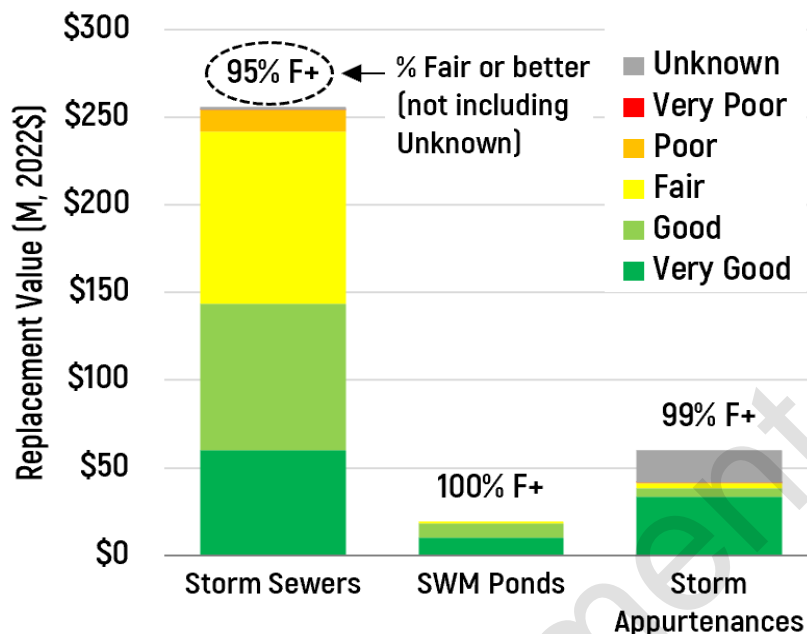
The average age and estimated life of the City’s stormwater management system, weighted by replacement value, is summarized in Figure 14. On average, the City’s stormwater management system assets are in the first third of their service lives.

Figure 14 Average Age and Estimated Life of the City’s Stormwater Management System



The condition distribution of the City’s stormwater management system is shown in Figure 15. The figure graphically shows the relative replacement value, by asset category, and the proportion of assets by condition grade. On average, 96% of stormwater management assets are in Fair condition or better. Assets of unknown condition include 46% or \$12.5 million of maintenance holes and 67% or \$19.4 million of catchbasins.

Figure 15 Condition Distribution of the City’s Stormwater Management System



The sources of inventory, replacement cost and condition data for the State of Infrastructure (SOI) are outlined in the following table. The confidence in stormwater management system data is moderate.

Table 2-9 Data Sources and Confidence of the City’s Stormwater Management System SOI

Asset Category	Inventory Data Source	Replacement Value Source	Condition Source
Stormwater Sewers & Catchbasin Leads	GIS	Unit costs aligned with historical tender costs and peer municipalities	Age and install date
Stormwater Management Facilities	GIS	Unit construction costs based on storage volume	Age and install date, currently collecting and assessing bathymetric survey data
Appurtenances (Maintenance Holes & Catchbasins)	GIS 31.1% with unknown install date	Unit costs aligned with historical tender costs and peer municipalities	Age and install date

2.2.4 Water and Wastewater Systems

Assets that support water service include water mains, water facilities, and water appurtenances including hydrants, valves, meters, services and curb stops. The top part of Table 2-10 shows the estimated replacement value of the City’s water system as \$477.6 million (2022\$), and includes a breakdown of the inventory by asset category. Water mains make up approximately two thirds (65.0%) of the portfolio by replacement value.

Assets that support wastewater service include sewer mains, a treatment facility, a storage and pumping facility, maintenance holes, laterals, cleanouts and a storage tank. The bottom part of Table 2-10 shows the estimated replacement value of the City’s wastewater system as \$421.9 million (2022\$), and includes a breakdown of the inventory by asset category. Sewer mains and laterals make up approximately 80% of the portfolio by replacement value.

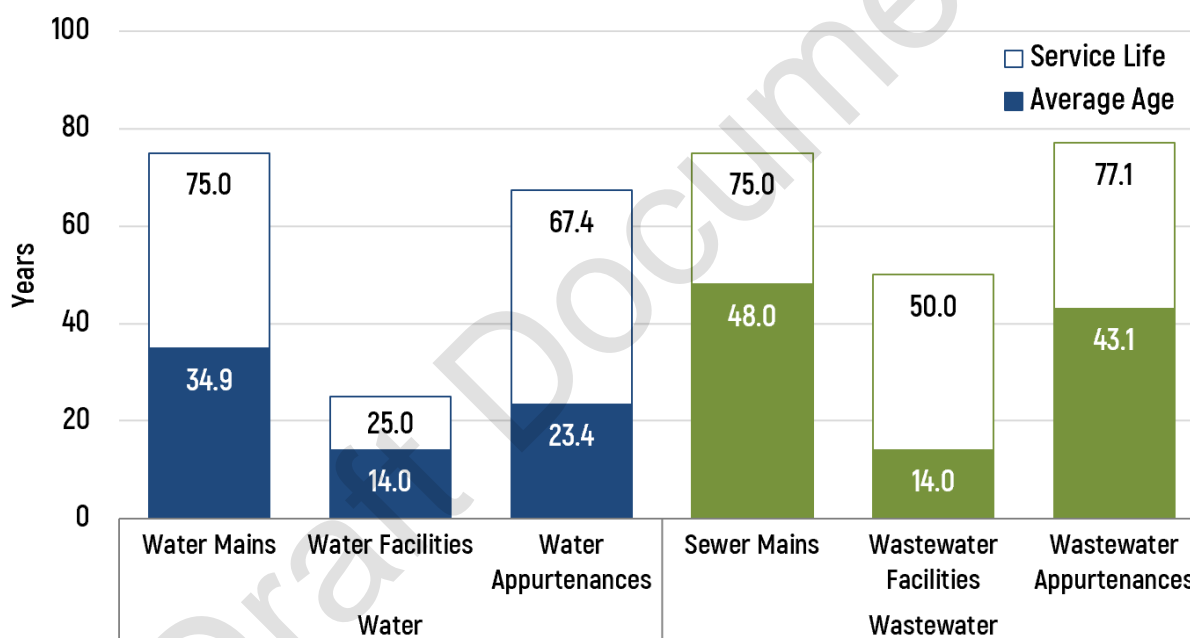
Table 2-10 Inventory of the City’s Water and Wastewater Systems

Asset Category	Quantity	Replacement Value (2022\$, millions)	Replacement Value (%)
Water Mains	480,774 m	\$310.6	65.0%
Water Facilities	2 Water Facilities	\$0.3	0.1%
Water Appurtenances	3,046 Hydrants	\$28.8	6.0%
	4,955 Valves	\$18.2	3.8%
	34,643 Meters	\$18.2	3.8%
	289,658 m Services	\$85.7	18.0%
	31,412 Curb Stops	\$15.7	3.3%
TOTALS		\$477.6	100%
Sewer Mains	434,235 m	\$243.4	57.7%
Wastewater Facilities	1 High Rate Treatment Facility	\$14.8	3.5%
	1 Storage & Pumping Facility	\$2.1	0.5%
Wastewater Appurtenances	5,984 Maintenance Holes	\$64.3	15.2%
	301,560 m Laterals	\$95.6	22.7%
	1,188 Cleanouts	\$1.2	0.3%
	1 Storage Tank	\$0.4	0.1%

Asset Category	Quantity	Replacement Value (2022\$, millions)	Replacement Value (%)
TOTALS		\$421.9	100%

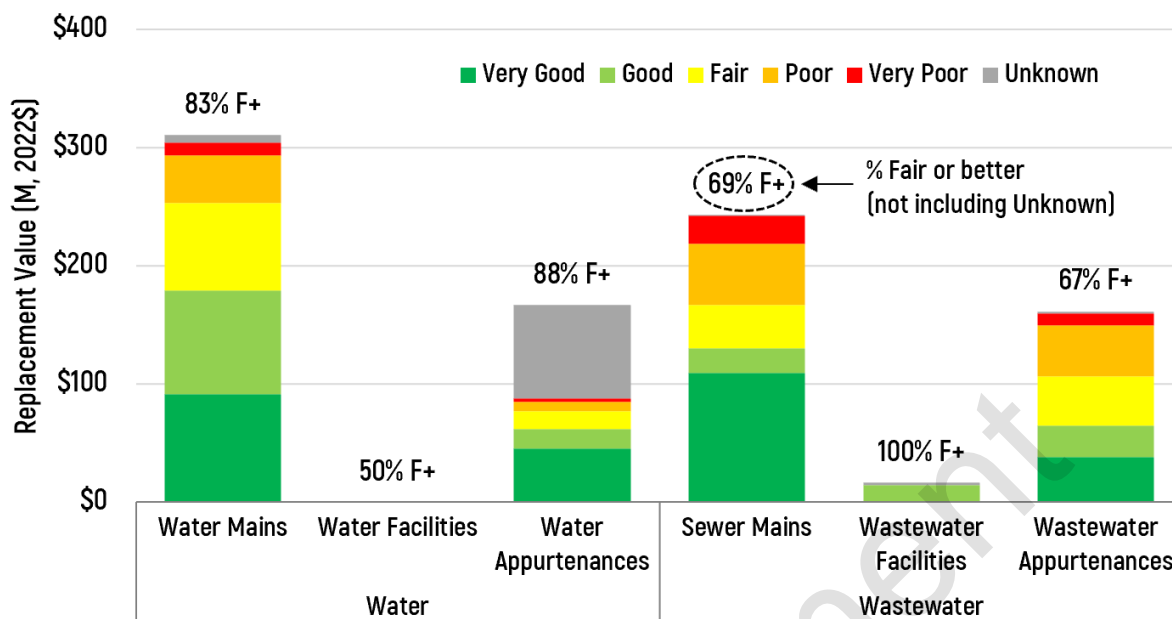
The average age and estimated life of the City’s water and wastewater systems, weighted by replacement value, are summarized in Figure 16. On average, the City’s water system assets are in the first third of their service lives and the wastewater system assets are in the middle of their service lives.

Figure 16 Average Age and Estimated Life of the City’s Water and Wastewater Systems



The condition distribution of the City’s water and wastewater systems are shown in Figure 17. The figure graphically shows the relative replacement value, by asset category, and the proportion of assets by condition grade. On average, 84% of water system assets and 69% of wastewater system assets are in Fair condition or better. For the water system, significant portions of the asset portfolio are of unknown condition: 24% or \$18.1 million of meters, 76% or \$85.7 million of services, and 51% or \$15.7 million of curb stops due to unknown install date.

Figure 17 Condition Distribution of the City's Water and Wastewater Systems



The sources of inventory, replacement cost and condition data for the State of Infrastructure (SOI) are outlined in the following table. The confidence in water and wastewater facility and appurtenances data is moderate.

Table 2-11 Data Sources and Confidence of the City's Water and Wastewater Systems SOI

Asset Category	Inventory Data Source	Source of Replacement Value	Condition Source
Water Mains	GIS	Unit costs aligned with historical tender costs and peer municipalities	Most recent observed condition during watermain break repair
Water Facilities	Tangible Capital Asset register	Purchase costs recorded in Tangible Capital Asset register, inflated to 2022	Age and install date
Water Appurtenances (Hydrants & Valves, Meters, Services, Curb Stops)	GIS: Unknown meter sizes assume 5/8", Unknown curb stop sizes assume 25mm	Unit costs aligned with historical tender costs and peer municipalities	Age and install date

Asset Category	Inventory Data Source	Source of Replacement Value	Condition Source
Wastewater Sewers	GIS	Unit costs aligned with historical tender costs and peer municipalities	CCTV structural scores
Wastewater Facilities	Tangible Capital Asset register 12.3% with unknown install date	Purchase costs recorded in Tangible Capital Asset register, inflated to 2022	Age and install date
Wastewater Appurtenances (Maintenance Holes, Laterals, Cleanouts, Storage Tanks)	GIS: Assume maintenance holes are 1200mm. Unknown lateral sizes assume 100mm	Unit costs aligned with historical tender costs and peer municipalities	Age and install date

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3 Levels of Service

3.1 Introduction

Levels of Service (LOS) are statements that describe the outputs and objectives the City intends to deliver to its residents, businesses, and other stakeholders. Developing, monitoring, and reporting on LOS are all integral parts of an overall performance management program which is aimed at improving service delivery and demonstrating accountability to the City’s stakeholders.

The requirements under O.Reg 588/17 current levels of service include, for each core asset category, the current levels of service being provided determined in accordance with the qualitative descriptions and technical metrics for roads, bridges and culverts, stormwater management, water, and wastewater provided in a set of tables.

In general, LOS are guided by a combination of customer expectations, legislative requirements, and internal guidelines, policies, and procedures. In many cases, LOS are also implied based on past service delivery, community expectations, and infrastructure system design. Effective asset management requires that LOS be formalized and supported through a framework of performance measures, targets, and timeframes to achieve targets, and that the costs to deliver the documented LOS be understood.

3.2 City-Wide Core Assets Overview

Legislated requirements define the standards by which the City is obligated to provide services. Legislative requirements are a significant business driver for most municipal services.

3.2.1 Customer LOS

In setting customer performance measures, the focus is on measuring how the customer receives the service and ensuring that the City is providing customer value. These may be qualitative or quantitative measures. O.Reg. 588/17 refers to Customer LOS as “Community LOS”, and outlines these LOS as qualitative descriptions. In this AM Plan, the following O.Reg. 588/17 Community LOS for core assets are used as the Customer LOS, and similar qualitative descriptions are developed for non-core assets. Current performance is provided in Section 3.3 Details by Service, below.

Table 3-1 O.Reg. 588/17 Community LOS Requirements

Asset Type	Service Attribute	Community Levels of Service
Roads and Related	Scope	Description, which may include maps, of the road network in the municipality and its level of connectivity

Asset Type	Service Attribute	Community Levels of Service
	Quality	Description or images that illustrate the different levels of road class pavement condition
Bridges and Culverts	Scope	Description of the traffic that is supported by municipal bridges (e.g., heavy transport vehicles, motor vehicles, emergency vehicles, pedestrians, cyclists)
	Quality	Description or images of the condition of bridges and how this would affect use of the bridges
		Description or images of the condition of culverts and how this would affect use of the culverts
Stormwater Management System	Scope	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
Water System	Scope	Description, which may include maps, of the user groups or areas of the municipality that are connected to the municipal water system
		Description, which may include maps, of the user groups or areas of the municipality that have fire flow
	Reliability	Description of boil water advisories and service interruptions
Wastewater System	Scope	Description, which may include maps, of the user groups or areas of the municipality that are connected to the municipal wastewater system
	Reliability	Description of how stormwater can get into sanitary sewers in the municipal wastewater system, causing sewage to overflow into streets or backup into homes
		Description of the effluent that is discharged from sewage treatment plants in the municipal wastewater system

3.2.2 Technical LOS

Technical LOS translate customer expectations and legislative requirements into technical objectives, performance measures, and targets. Technical levels of service define what the City must do to deliver services that meet customer and legislated LOS. Similar to Customer LOS, O.Reg. 588/17 outlines specific Technical LOS for core assets. Current performance against the O.Reg. 588/17 Technical LOS for core assets are provided in the following table.

Table 3-2 O.Reg. 588/17 Technical LOS Requirements for Core Assets

Service	Service Attribute	Technical Levels of Service	2021 Performance
Roads and Related	Scope	Number of lane-kilometres of each of arterial roads, collector roads and local roads as a proportion of square kilometres of land area of the municipality	Paved Arterial: 989 Paved Collector: 1,616 Paved Local: 2,645 Unpaved: 361
	Quality	For paved roads in the municipality, the average pavement condition index value	69.1
		For unpaved roads in the municipality, the average surface condition	Fair
Bridges and Culverts	Scope	Percentage of bridges in the municipality with loading or dimensional restrictions	9%
	Quality	For bridges in the municipality, the average bridge condition index value	70.2
		For structural culverts in the municipality, the average bridge condition index value	71.4
Stormwater Management System	Scope	Percentage of properties in municipality resilient to a 100-year storm	78%
		Percentage of the municipal stormwater management system (trunk system) resilient to a 5-year storm	83%
Water System	Scope	Percentage of properties connected to the municipal water system (within the Urban Boundary)	100%
		Percentage of urban properties where fire flow is available	89%
	Reliability	The number of connection-days per year where a boil water advisory notice is in place compared to the	0

Service	Service Attribute	Technical Levels of Service	2021 Performance
		total number of properties connected to the municipal water system	
		The number of connection-days per year due to water main breaks compared to the total number of properties connected to the municipal water system	0.0475
Wastewater System	Scope	Percentage of properties connected to the municipal wastewater system (within the Urban Boundary)	99.0%
	Reliability	The number of connection-days per year due to wastewater backups compared to the total number of properties connected to the municipal wastewater system	2 breaks per 30,467 properties
		The number of effluent violations per year due to wastewater discharge compared to the total number of properties connected to the municipal wastewater system	N/A for local municipality

3.3 Details by Service

The following sub-sections provide qualitative details on customer (community) levels of service required by O.Reg. 588/17 and quantitative details on technical LOS measures or indicators, 2021 performance and draft proposed service standards – both those required by O.Reg. 588/17 as provided in the table above, and those set by the City. The technical LOS are organized by service attribute: capacity, function and reliability. The tables also provide the grade associated with the 2021 performance, and the confidence in the performance assessment which is a reflection of data availability and/or control over the measure by the City.

Performance grade colour codes are provided in the following table.

Table 3-3 Performance Grades

Very Good	Good	Fair	Poor	Very Poor
-----------	------	------	------	-----------

The confidence assigned to the 2021 performance was assessed using the following three grades.

Table 3-4 Confidence Grades

Grade	General Meaning	Business Risk
High	Performance based on sound records, procedures, investigations and analysis, documented properly 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 $\pm 10\%$	Serves business process well. Clearly informs decisions, with no perceived risk
Moderate	Performance based on sound records, procedures, investigations and analysis which is incomplete or unsupported, or extrapolated from a limited sample for which grade VH or H data are available. Dataset is substantially complete but up to 50% is extrapolated data and accuracy estimated $\pm 25\%$	Enables business process to function. Minor uncertainty around decisions, resulting in small risk
Low	Performance is based on confirmed verbal reports by knowledgeable staff. Dataset may not be fully complete and most data is estimated or extrapolated. Accuracy $\pm 30\%$	Compromises business process. Compromises decision certainty (i.e., creates risk)

Table 3-5 provides a summary of data sources for determining performance for levels of service measures in this AM Plan and indicates lower confidence in source data with pink highlighting. The highest confidence in data is for bridges and the lowest is for stormwater management assets. The City is currently working to improve the data to support LOS performance reporting for stormwater management. Measures for bridge capacity and stormwater management function, including resiliency to climate change impacts, will be considered in the future.

Table 3-5 Data Sources and Confidence for Performance on the City's LOS Measures

Service	Capacity and Use	Function	Reliability
Roads & Related	Road network exceeding AADT counts -> Anecdotal rating -> to be updated via 2023 Transportation Master Plan Update Presence of sidewalks from GIS	Presence of dedicated/shared bicycle lanes based on GIS	Road condition is based on PCI, while sidewalks, medians, barriers are age-based
Bridges & Culverts	N/A	Structure loading or dimensional restrictions based on inspection	All structure conditions are based on assessed condition (BCI)
Stormwater Management	Resiliency based on trunk system only Responsibility not solely the City's, shared with Region	N/A	All stormwater asset condition is age-based (storm sewer and SWM pond assessments planned or under way)
Water	Fire flow based on hydraulic model or GIS (proximity to hydrant) Operating pressure based on evaluation against design standard	Water quality based on complaints captured in database	Water main condition is based on age, material and break history captured in database Water facilities and appurtenance condition are age-based
Wastewater	Water main backups based on issues capture in database	Sanitary sewer meeting minimum slope requirements from hydraulic model	Sanitary sewer main condition is based on assessment of CCTV data Wastewater facilities and appurtenance condition are age-based

■ indicates lower confidence in source data (with pink highlighting)

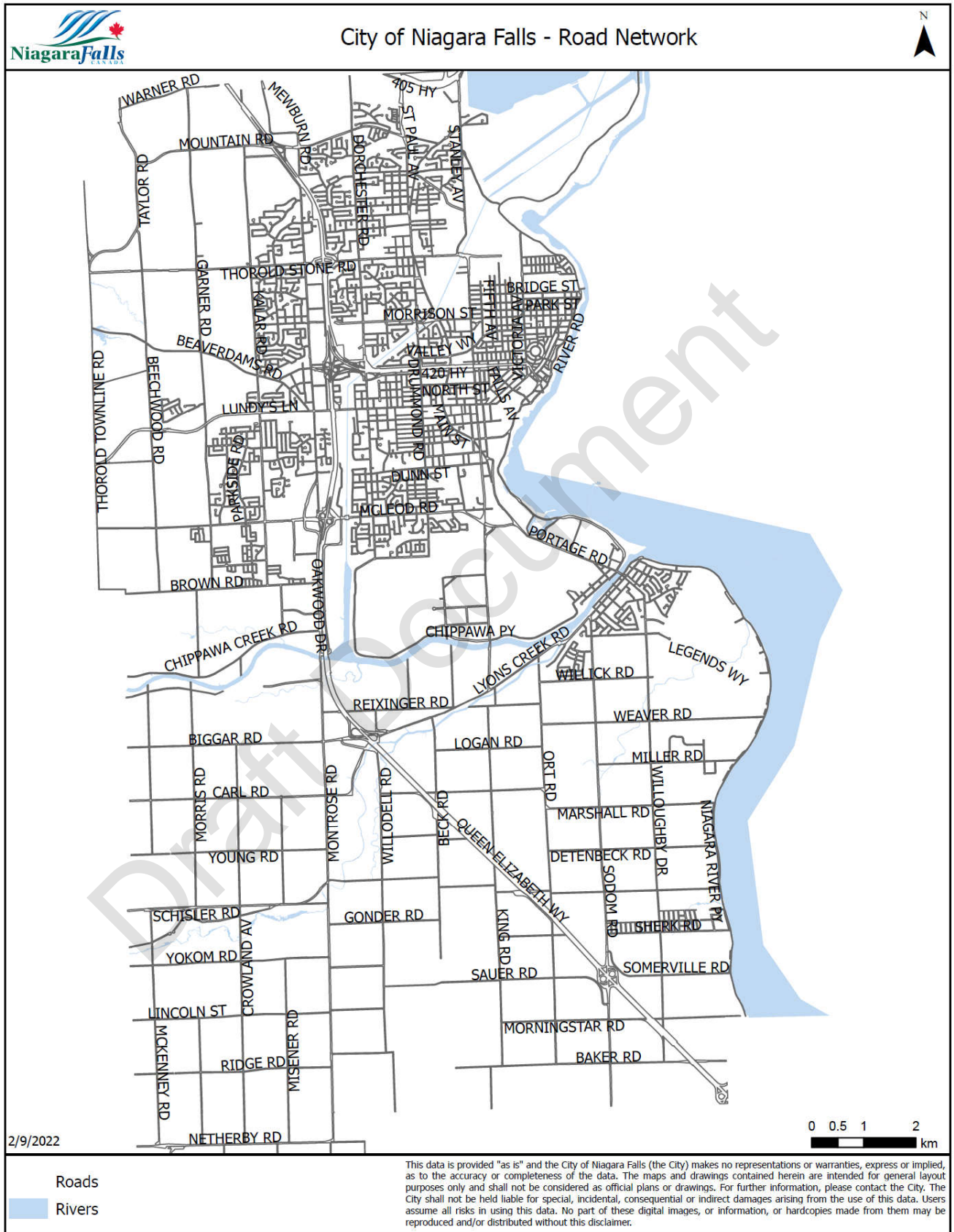
3.3.1 Roads and Related Assets

CUSTOMER LOS: Road network description and connectivity

The City's roads provide connections to and within neighbourhoods, city centres, commercial sites, and industrial lands. They also facilitate regional travel over Niagara Region major arterial roadways and connection links, and provide access to provincial highways and federal Niagara Parks Commission roadways. Provincial highways are regulated by the Ontario Ministry of Transportation, while federal roadways are regulated by the Government of Canada. Development and access in close proximity to these roadways are subject to Provincial or Federal permitting and approval. The following map illustrates the City's road network.

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Figure 18 City of Niagara Falls Road Network







CUSTOMER LOS: Different levels of road class pavement condition and the impact on use

Pavement condition data is collected on the entire road network every two to three years by City staff. Staff assess the type, extent and severity of distresses (cracks and rutting) and smoothness or ride comfort of the road and assign an overall Pavement Condition Index (PCI) which is used as an input into the annual road resurfacing and reconstruction program. The index is scaled from zero to 100 and has been divided into ranges to assess condition. Examples of roads in each of the PCI rating categories are provided in the following figures – one figure for urban road pavement and another for rural road pavement.

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Figure 19 Condition Grade Examples – Urban and Rural Road Pavement

PCI Score	Urban Road Example	Rural Road Example
<p>Very Good PCI 90 - 100</p>	<p>Fallsview Boulevard</p> 	<p>Stanley Avenue</p> 
<p>Good PCI 80-89</p>	<p>Chrysler Ave</p> 	<p>King Road</p> 

PCI Score	Urban Road Example	Rural Road Example
<p>Fair PCI 70-79</p>	<p>Forest Glen Drive</p> 	<p>Young Road</p> 
<p>Poor PCI 50-69</p>	<p>Lewis Avenue</p> 	<p>Marshall Road</p> 

PCI Score	Urban Road Example	Rural Road Example
<p>Very Poor PCI <49</p>	<p>Allendale Avenue</p> 	<p>Lyon's Creek Road / Schisler Road</p> 

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The following table provides the technical LOS for roads and related assets. 2021 performance ranges from fair to good, with a high degree of confidence in all performance ratings.

Table 3-6 Technical LOS for Roads and Related Assets

Service Attribute	Technical Levels of Service	2021 Performance	2021 Grade	Confidence in Performance	Proposed Target
Capacity	% road network exceeding expected AADT counts	Good	Good	High	Good
	% of arterial and collector roads with sidewalk on both sides	54%	Fair	High	70%
	% of local roads with sidewalk on at least one side	82%	Fair	High	90%
Functionality	% of lane-kms of dedicated/shared bicycle lanes as a proportion of roadway lane-kms	3%	Fair	High	3%
Reliability	For paved arterial roads, the average PCI value	64.7	Fair	High	70
	For paved collector roads, the PCI value	63.4	Fair	High	70
	For paved local roads in the City, the average PCI value	65.7	Fair	High	70
	For unpaved roads, the average surface condition *	47.5	Fair	High	60
	% of arterial roadway in fair or better condition based on PCI	80.5%	Good	High	80%
	% of collector roadway in fair or better condition based on PCI	77.8%	Fair	High	80%
	% of local roadway in fair or better condition based on PCI	83.3%	Good	High	80%
	% of unpaved roadway in fair or better condition based on PCI *	71.6%	Fair	High	90%

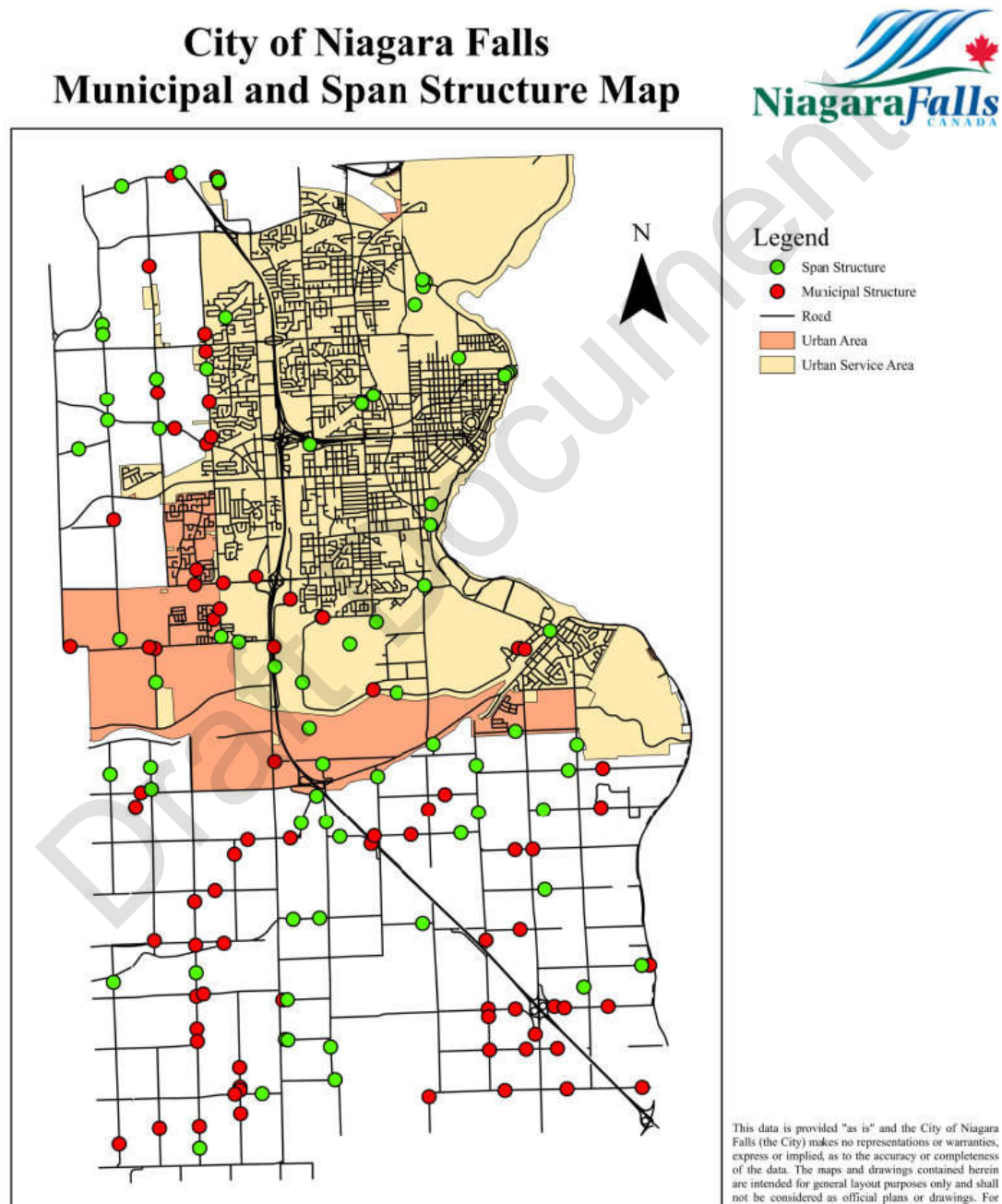
* Excludes un-opened road allowances (Class 6 roads)

3.3.2 Bridges and Culverts

CUSTOMER LOS: Traffic supported by municipal bridges

The City's bridges and culverts are designed to support heavy transport vehicles, transit vehicles, motor vehicles, emergency vehicles, cyclists and pedestrians. A map of the City's was bridge and culvert inventory is shown in the following figure.

Figure 20 Bridge and Culvert Location Map







ELLIS Engineering Inc.
Date: 02/04/2022

CUSTOMER LOS: Levels of bridge and structural culvert condition and the impact on use

The need for mobility requires that the City’s roadway system be kept in a state of good repair, and structures are a vital part of this system. An effective structure management system involving the systematic inspection of is required to achieve this. In accordance with O. Reg. 104/97 Standards for Bridges, the City conducts detailed inspections of all of its span bridges, span culverts and municipal structures every two years. An overall Bridge Condition Index (BCI) is calculated from all collected data and informs the annual bridge and structural culvert rehabilitation and reconstruction program. The index is scaled from zero to 100 and has been divided into ranges to assess condition. The BCI is not used to rate or indicate the safety of a bridge or culvert. Any safety issues are immediately reported by the inspector to supervising engineers and maintenance crews. Condition grade examples are provided in Figure 21.

Figure 21 Condition Grade Examples –Bridges and Culverts

Condition Grade	Sample Span Structures Conditions	Sample Municipal Structures Conditions
<p>Very Good BCI 80 - 100</p>	 <p>Mewburn Bridge (BCI=95)</p>	 <p>Kalar Culvert (BCI=90)</p>
<p>Good BCI 70 - 79</p>	 <p>Dorchester Culvert (BCI=75)</p>	 <p>Lyons Creek Culvert (BCI=77)</p>
<p>Fair BCI 60 - 69</p>	 <p>Koabel Bridge (BCI=65)</p>	 <p>Garner Culvert (BCI=65)</p>

Condition Grade	Sample Span Structures Conditions	Sample Municipal Structures Conditions
Poor BCI 40 - 59	 Crowland Bridge (BCI=59)	 Weaver Culvert (BCI=52)
	 McKenney Bridge (BCI=47)	 Marshal Culvert (BCI=39)
Very Poor BCI < 40		

The following table provides the technical LOS for roads and related assets. 2021 performance ranges from fair to very good, with a high degree of confidence in all performance ratings.

Table 3-7 Technical LOS for Bridges and Culverts

Service Attribute	Technical Levels of Service	2021 Performance	2021 Grade	Confidence in Performance	Proposed Target
Functionality	% of span bridges in the City with loading or dimensional restrictions	9%	Fair	High	0%
	% of span culverts in the City with loading or dimensional restrictions	0%	Very Good	High	0%
	% of municipal structures in the City with loading or dimensional restrictions	0%	Very Good	High	0%
Reliability	For span bridges, the average BCI value	70.2	Good	High	70
	For span culverts, the average BCI value	71.4	Good	High	70
	% of span bridges in fair or better condition based on BCI	89.8%	Good	High	80%
	% of span culverts in fair or better condition based on BCI	100.0%	Good	High	80%

Service Attribute	Technical Levels of Service	2021 Performance	2021 Grade	Confidence in Performance	Proposed Target
	% of municipal structures in fair or better condition based on BCI	87.2%	Very Good	High	70%

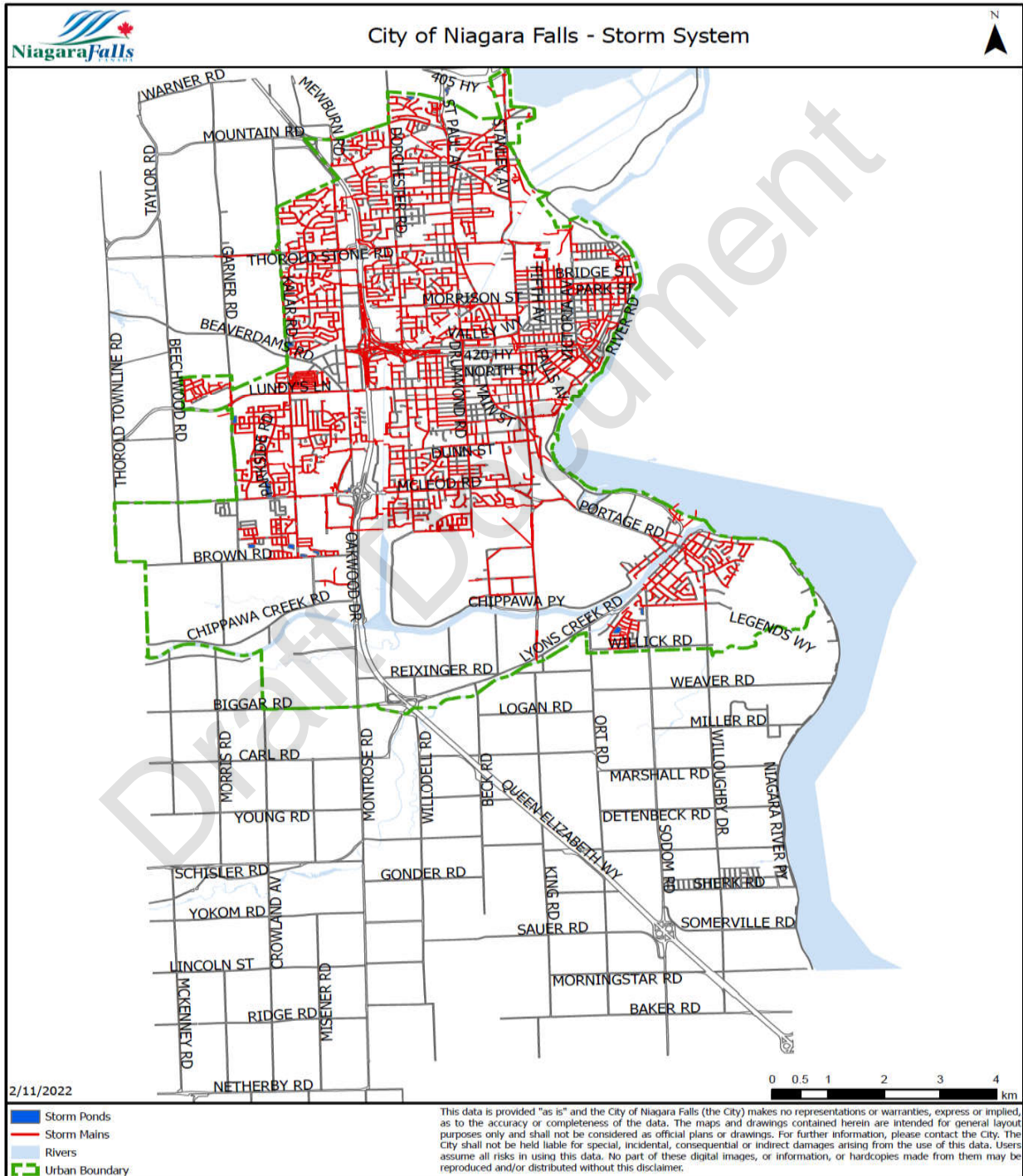
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3.3.3 Stormwater Management System

CUSTOMER LOS: Areas protected from flooding

The City manages stormwater drainage through a network of collection, conveyance, and storage assets including municipal drains, roadside ditching, sewer network, and ponds. A map of the City's stormwater management system is shown in the following figure.

Figure 22 Stormwater Management System



The following table provides the technical LOS for the stormwater management system. 2021 performance ranges from fair to very good, with a low degree of confidence in all performance ratings. The low confidence in the capacity performance is due to shared responsibility with Niagara Region and that some trunk system designed to be resilient to a 2-yr storm. The low confidence in the capacity performance is due to condition being age-based rather than condition based (plans are in place to conduct CCTV inspection to improve the confidence).

Table 3-8 Technical LOS for Stormwater Management System

Service Attribute	Technical Levels of Service	2021 Performance	2021 Grade	Confidence in Performance	Proposed Target
Capacity	% of municipal stormwater management trunk system resilient to a 5-year storm	83%	Good	Low *	80%
	% of properties resilient to a 100-year storm	78%	Fair	Low *	80%
Reliability	% of storm sewers and appurtenances in fair or better condition based on age and material	95.6%	Very Good	Low **	80%

* Some trunk system designed to be resilient to a 2-yr storm

** Low due to condition being age-based rather than condition based (plans are in place to conduct CCTV inspection to improve the confidence)

3.3.4 Water System

CUSTOMER LOS: Areas connected to the municipal water system

The City distributes quality water through a network of drinking water treatment, storage and transmission facilities, and linear infrastructure. The Region of Niagara owns and operates the water treatment, pumping and transmission facilities and associated infrastructure.

CUSTOMER LOS: Areas of the City with fire flow

The City's engineering design standards require the provision for fire flow in the urban areas.

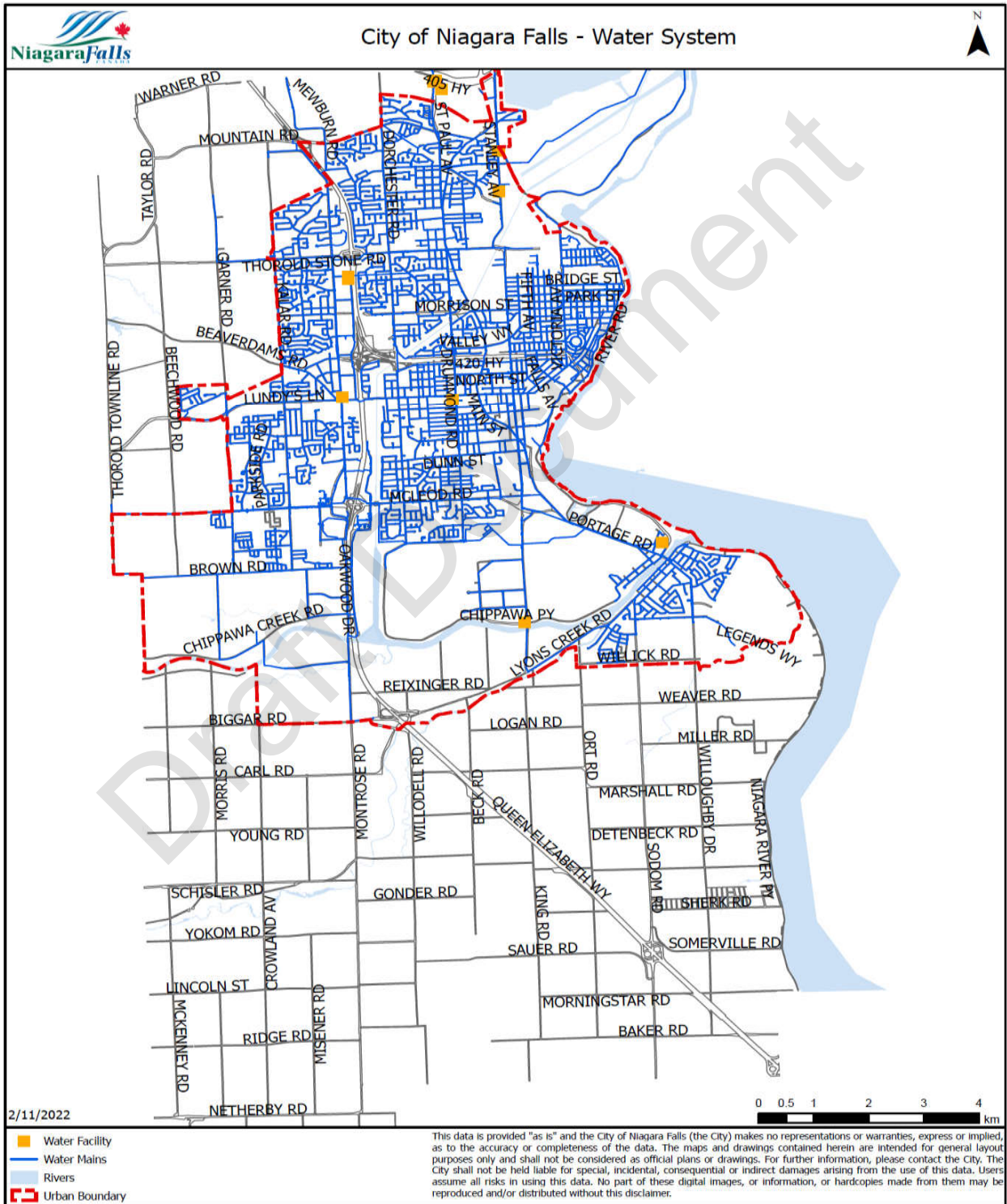
CUSTOMER LOS: Boil water advisories and service interruptions

Most boil water advisories are issued because the equipment and processes used to treat, store or distribute drinking water break down, require maintenance, or have been affected

by environmental conditions. In some cases, extreme weather or heavy rains may cause the quality of surface or ground water sources to temporarily worsen, challenging the drinking water treatment system. The City of Niagara Falls has not experienced any boil water advisories - service disruptions are generally caused by water main break failures.

A map of the City's water system is shown in the following figure.

Figure 23 Water System



The following table provides the technical LOS for water and related assets. 2021 performance ranges from fair to very good, with a high degree of confidence in all performance ratings except water mains as the condition is based on age, material type and history of breaks rather than inspected condition.

Table 3-9 Technical LOS for the Water System

Service Attribute	Technical Levels of Service	2021 Performance	2021 Grade	Confidence in Performance	Proposed Target
Capacity	% of properties where fire flow is available	89%	Fair	High	90%
	% of properties connected to the City water system within the Urban Boundary	100%	Very Good	High	90%
	% water network that meets Peak Hour Demand Minimum Operating Pressure of 40 PSI	99%	Very Good	High	90%
	% water network that meets Normal (Average Day / Maximum Day / Minimum Hour) Operating Pressure of 40-100 PSI	84%	Good	High	80%
	% of local watermain greater than 4" (100mm)	98%	Very Good	High	90%
Functionality	% of sampling results that meet Drinking Water License and legislated limits	100%	Very Good	High	98%
	# of water quality complaints due to discoloured water (City to set acceptable levels - if applicable)	14	Good	High	15
Reliability	# of connection-days per year where a boil water advisory notice is in place compared to the total # of properties connected to the City water system	0%	Very Good	High	0
	# of connection-days per year due to water main breaks compared to the total # of properties connected	0.0475	Good	High	5

Service Attribute	Technical Levels of Service	2021 Performance	2021 Grade	Confidence in Performance	Proposed Target
	to the City water system				
	% of linear water assets in fair or better condition	84.3%	Good	Moderate *	80%
	# of watermain segments that exceed break threshold	0.009% (3 segments per 32,499)	Very Good	High	5%

** based on a combined factor the includes age, material and break history, as techniques for assessing physical condition are not readily available on this underground infrastructure*

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3.3.5 Wastewater System

CUSTOMER LOS: Areas connected to the municipal wastewater system

The City collects wastewater from households, industry, commercial establishments, and institutions through a network of sewers, pumping and transmission facilities and infrastructure. The Region of Niagara owns and operates the wastewater treatment, pumping and transmission facilities and infrastructure. The City owns and operates two sanitary pumping stations and a number of minor wastewater storage facilities.

CUSTOMER LOS: Combined sewers

The majority of the City's wastewater system consists of separated sanitary sewers, but approximately 26% of the network is serviced by combined sewers. The City does not currently track the frequency and volume of overflows events in combined sewers.

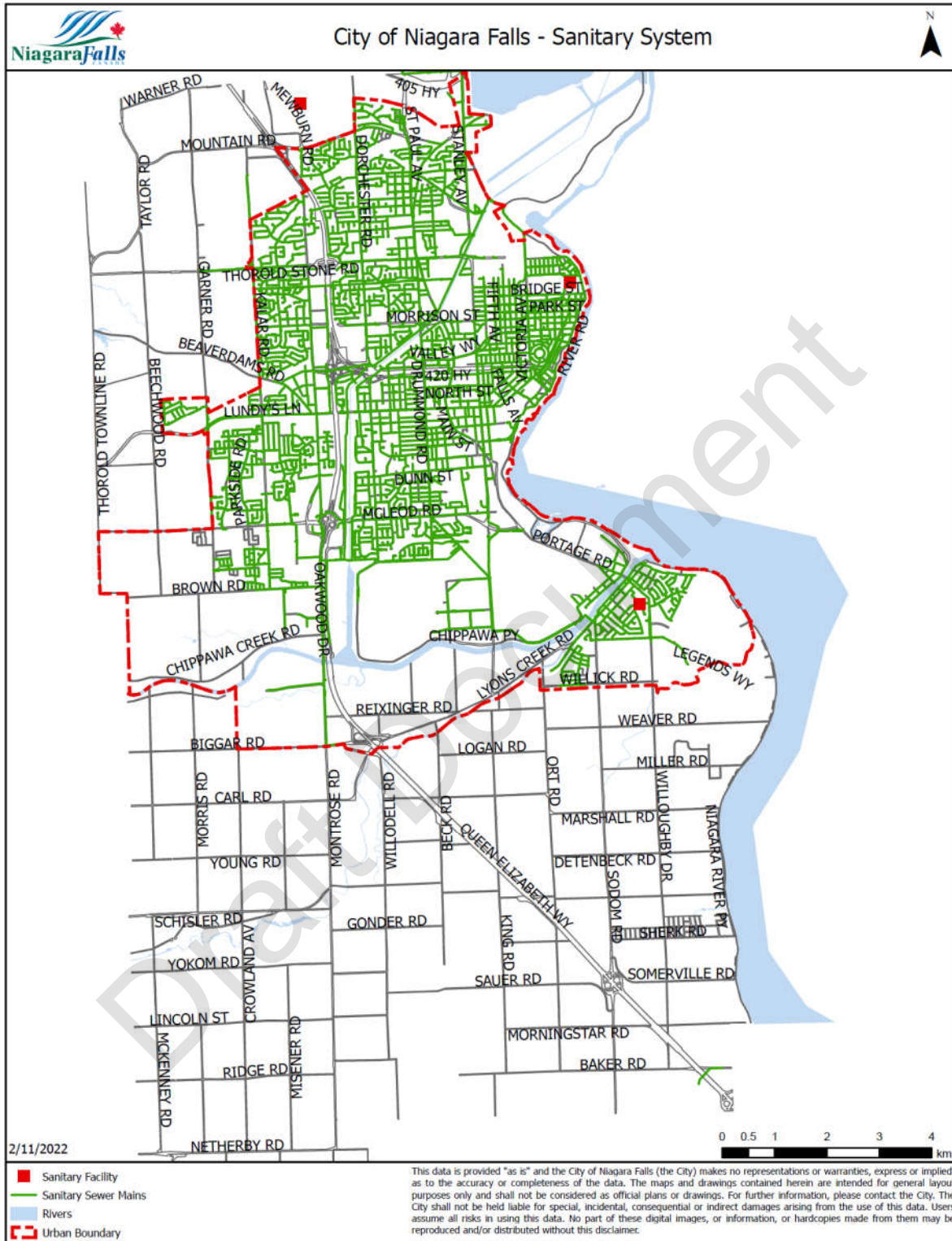
The City is working to separate its combined sanitary sewers. The minor wastewater storage facilities owned by the City are in place to accommodate overflow during storm events to prevent backups into homes due to the remaining combined sewers.

CUSTOMER LOS: Inflow and Infiltration (I/I)

Inflow occurs when stormwater enters the sanitary sewer systems at points of direct connection to the systems (rain leaders, basement sump pumps, foundation drains). Infiltration occurs when groundwater enters the sanitary sewer systems through cracks and/or leaky joints in the pipes, service connections or maintenance holes. These cracks or leaky joints may be caused by physical deterioration, poor design, installation or maintenance errors, or root infiltration. I/I increases flow to the sanitary collection system which is ultimately received by the wastewater treatment plants. I/I extraneous flow increases the risk of sanitary sewage backups in homes and businesses as well as the risk of upset to wastewater treatment plant processes including higher chance of bypasses. The City's engineering design standards ensure that City sewers will be resilient to I/I events.

A map of the City's wastewater system is shown in the following figure.

Figure 24 Wastewater System



The following table provides the technical LOS for the City's wastewater system. 2021 performance ranges from poor to very good, with a high degree of confidence in all performance ratings. The poor 2021 performance for linear sanitary assets was noted in the State of Infrastructure section above.

Table 3-10 Technical LOS for the City's Wastewater System

Service Attribute	Technical Levels of Service	2021 Performance	2021 Grade	Confidence in Performance	Proposed Target
Capacity	% of properties connected to the City wastewater system within the Urban Boundary	100%	Very Good	High	90%
	# of connection-days per year due to wastewater backups compared to the total # of properties connected to the City's wastewater system	5%	Good	High	5%
	% network with combined sewer	26%	Fair	High	20%
Functionality	% of sewer network that meets minimum slope requirements (0.6%)	47%	Fair	High	50%
	% of pipe network that meets design velocity targets of 0.6 - 3.0 m/s	67%	Good	High	60%
Reliability	% of linear sanitary assets in fair or better condition	68%	Poor	High	80%
	Average PACP score of sanitary network	1.49	Good	High	2

4 Risk Management Strategy

4.1 Introduction

The City's key asset management principle is to meet service levels and manage risk, while minimizing lifecycle costs. The relative importance of the assets to support service delivery, referred to as asset criticality, is a key driver in selection of the most appropriate asset management strategy for each asset. Critical assets include assets that are key contributors to performance, expensive in terms of lifecycle costs, and most prone to deterioration or in need of ongoing maintenance investment.

Risk events, such as an asset's failure to have sufficient capacity, function, or reliability, are events that may compromise the delivery of the City's strategic objectives. Lifecycle activities are used to manage the risk of failure by reducing the chance of asset failure to acceptable levels. The impact of asset failure on the City's ability to meet its strategic objectives dictates the type and timing of lifecycle activities.

The City's uses a risk framework for quantifying the risk exposure of its assets to enable prioritization of projects across asset classes and services. Risk exposure is the multiplication of the criticality or consequence of failure (CoF), which is the direct and indirect impact on the City if an asset failure were to occur, by the probability of failure (PoF), which is the likelihood or chance that an asset failure may occur:

$$\text{Risk Exposure} = \text{Consequence of Failure} \times \text{Probability of Failure}$$

Asset criticality or consequence of failure reflects the importance of an asset to the City's delivery of services. The following impacts of a potential asset failure are considered:

- **Financial impact** considerations such as asset replacement cost, damages to City or private property and infrastructure, loss of revenue, and fines.
- **Health and Safety** considerations including the ability to meet health and safety related regulatory requirements, and degree and extent of injury, ranging from negligible injuries to loss of life
- **Service Delivery** considerations ranging from a disruption of non-essential service to widespread and long-term disruption of essential service
- **Reputational** considerations such as residents' reduced trust and confidence in City government
- **Environmental** considerations such as length and extent of damages to the natural environment.

The City's Climate Change Adaptation Plan requires consideration of the consequences of extreme weather, emergency events and safety risks to the community. The risk assessment included climate change considerations but should be reviewed over time as the impacts of climate change become more apparent.

Table 4-1 summarizes the above listed impacts against an asset criticality rating scale from 1 to 5, with a higher score indicating a higher consequence of failure.

Table 4-1 Asset Criticality (Consequence of Failure) Ratings

Consequence Categories	1	2	3	4	5
	Insignificant	Minor	Moderate	Major	Catastrophic
Financial	Damages, losses (including 3rd party) or fines from \$1k to \$5k	Damages, losses (including 3rd party) or fines \$5k to \$50k	Damages, losses (including 3rd party) or fines \$50k to \$500K	Damages, losses (including 3rd party) or fines \$500K to \$5M	Damages, losses (including 3rd party) or fines > \$5M
Health & Safety	No obvious potential for injury or affects to health	Potential for minor injury or health effects of an individual Full recovery is expected	Potential for serious injury or health affects May affect many individuals	Potential for serious injury, health affects or long-term disability to 1+ individuals Emergency hospitalization for 1+ individuals	Potential for death of 1+ individuals Long-term hospitalization for 1+ individuals
Service Delivery	Small # of customers disrupted / impacted < 100 people or up to a few hours	Localized service disruption / impact 100 to 1,000 people or up to 1 day	Significant localized disruption / impact 1,000 to 10,000 or up to 1 week	Major service disruption / impact 10,000 to 50,000 or up to 1 month	City wide service disruption / impact > 50,000 people or permanent loss of services
Reputational	Minor or no media exposure	Minor or no media exposure	Moderate local media exposure lasting for several days	Intense local media exposure lasting several days and/or Municipality wide exposure	Significant Provincial exposure lasting several days or weeks
Environmental	Very negligible impact or can be restored within 1 week	Minor (within 1 month) very isolated damage / impact to the environment Local importance	Significant short-term impact (up to 2 months) Local importance	Significant long-term impact (up to 1 year) Regional importance	Major long-term impact (greater than 1 year) Provincial / Federal importance

The above criticality profiles enable risk to be incorporated into the development of asset lifecycle management strategies. More critical assets are prioritized for expansion, inspection, cleaning, maintenance, and renewal, depending on their current and forecasted performance.

Asset criticality is determined based on the degree to which the failure of the asset would impact the following three community levels of service attributes:

- **Capacity and Use:** Assets of sufficient capacity are available, convenient, and accessible
- **Function:** Assets comply with regulations, perform their intended function and are safe, secure, and sustainable
- **Reliability and Quality:** Assets are in adequate condition and are maintained as required.

Risk to Capacity and Use Levels of Service

As indicated in Section 1.2.4, the City has experienced growth in the past few decades and should continue to grow at a modest rate through to 2031 and beyond. The City anticipates that additional infrastructure will be required over the next 10 years to maintain capacity service levels. Additional infrastructure will be acquired at cost to the City, or donated by developments. The City’s 2019 Development Charge study lists new and expanded assets, sometimes coincident with upgrade and/or renewal plans, needed over the next 10 years to accommodate the additional infrastructure acquired at cost to the City. The assets donated by developments are assumed to be 1% of the current inventory per year for each of the next 10 years. Tables with Consequence of Failure (CoF) ratings for the City’s assets to support service delivery are provided in the City-Wide Core Assets Overview section below. CoF risks for **capacity and use** were rated at a maximum of 3 (Moderate).

Risk to Function Levels of Service

The City’s master plans provide requirements for functional upgrades. Consequence of failure risks for **function** were rated at a maximum of 3 (Moderate).

Risk to Service Reliability Levels of Service

The reliability LOS refers to the City’s aim to ensure that its assets are kept in a state of good repair to reduce the incidence of unplanned service disruptions due to poor asset condition. Depending on the asset, unplanned failures can have wide-ranging consequences including service disruption, damage to surrounding infrastructure and property, risks to public safety, and environmental impacts. Consequence of failure risks for **reliability** were rated at a maximum of 5 (Catastrophic) for Arterial and Collector Road span bridges and culverts and 4 (Major) for some other bridges and culverts, road and related assets, and wastewater facilities, as detailed in the next section.

Probability of Failure is estimated based on the condition of the asset, as shown in Table 4-2.

Table 4-2 Probability of Failure Ratings for Reliability

PoF Rating	Corresponding Asset Condition	
1	VG	Very Good
2	G	Good
3	F	Fair
4	P	Poor
5	VP	Very Poor

After assessing the criticality and probability of each asset’s risk, the results were plotted on a risk map, a graphic representation of probability and consequence of failure. Colours on the map denote different levels of risk and help to prioritize the City’s resources, time, and effort in the next section of the AM Plan – Lifecycle Management Strategy.

- Risks that appear in the light red (Very High) zone are significant to the City and therefore need to be actively managed and monitored in a more comprehensive manner than other risks (i.e., prioritized)
- Risks that appear in the orange (High) or green (Moderate) zones will also be actively managed depending on their nature
- Risks that appear in the light blue (Low) or grey (Very Low) zones are generally acceptable without significant mitigation strategies being implemented, although monitoring may still occur in some form.

4.2 City-Wide Core Assets Overview

Based on those assets with known condition, Figure 25 shows that 0.4% or \$7.76 million of the City’s core assets are in the Very High risk exposure category related to provision of reliable services. These assets are comprised of the Beck Road Bridge (\$4.36 million), six road segments namely Kalar Road, Kitchener Street, Allendale Avenue, Buchanan Avenue, Fallsview Boulevard, and Reixinger Road (\$2.94 million), and road medians (\$0.45 million). Details by service are provided in the following sub-sections. The City mitigates its exposure to these risks through the planned lifecycle strategies discussed in the next section of the AM Plan – Lifecycle Management Strategy.

Figure 25 Reliability Risk Exposure of the City’s Core Assets

PoF	Cdn						Risk	CRV (\$)	CRV (%)	CRV (\$)	
5	VP	\$0.26	\$27.13	\$38.15	\$3.39	\$0.00	Very High	\$7.76	0.4%	\$7.76	
4	P	\$4.30	\$68.00	\$164.61	\$43.18	\$4.36	High	\$98.82	5.0%	\$98.82	
3	F	\$1.95	\$100.51	\$362.71	\$82.79	\$17.49	Moderate	\$335.46	16.8%	\$335.46	
2	G	\$0.52	\$81.99	\$353.70	\$102.85	\$60.93	Low	\$989.94	49.6%	\$989.94	
1	VG	\$0.00	\$143.72	\$306.82	\$24.93	\$1.91	Very Low	\$564.2	28.3%	\$564.2	
		Insignificant	Minor	Moderate	Major	Catastrophic					
		1	2	3	4	5					
		Criticality (CoF)									
							Total	\$1,996.2	100.0%	\$1,996.2	

4.3 Details by Service

4.3.1 Roads and Related Assets

Consequence of failure risks for were estimated based on the expected impact of an asset failure. Each asset’s criticality is assessed based on the rating scale provided in Table 4-1. Table 4-3 provides a summary of the assessment for the City’s Roads and Related assets.

Table 4-3 Consequence of Failure Ratings for the City’s Road and Related Assets

Service	Asset Category	Attributes	Capacity	Function	Reliability
Roads & Related	Roads	Paved Urban Arterial	3	3	4
		Paved Semi-Urban Arterial	3	2	4
		Paved Rural Arterial	2	2	3
		Paved Urban Collector	2	2	4
		Paved Semi-Urban Collector	2	2	4
		Paved Rural Collector	2	2	3
		Paved Urban Local	1	2	3
		Paved Semi-Urban Local	1	1	3
		Paved Rural Local	1	1	2
		Unpaved All	1	1	1
	Sidewalks	Decorative	4	3	2
		Asphalt or Non-Decorative Concrete	2	3	2
	Medians	Centre Median		2	4
		Island – Traffic		1	3
		Island – Cul de Sac		1	2
	Barriers	Retaining Wall		3	4
		Fence/wall		2	4
		All Others		1	3

The risk map shown as Figure 26 combines the Criticality (CoF) ratings with the Condition (PoF) ratings for the City’s Road assets.

Figure 27 shows the same information for Roads and Related assets. Six road segments namely Kalar Road, Kitchener Street, Allendale Avenue, Buchanan Avenue, Fallsview Boulevard, and Reixinger Road make up the \$2.94 million for Road assets while road medians make up the \$0.45 million for Road Related assets. For Road assets, also of note is the \$43.12 million High risk exposure (orange) at the intersection of Major CoF and Poor PoF (condition). As the condition of these assets deteriorate over time, they will migrate into the Very High (red) risk exposure category.

Figure 26 Reliability Risk Exposure of the City’s Road Assets

PoF	Cdn	Criticality (CoF)					Risk	CRV (\$)	CRV (%)
5	VP	\$0.26	\$0.19	\$3.31	\$2.94	\$0.00	Very High	\$2.94	0.5%
4	P	\$3.80	\$2.51	\$59.23	\$43.12	\$0.00	High	\$46.43	7.8%
3	F	\$1.70	\$6.05	\$135.66	\$75.87	\$0.00	Moderate	\$135.30	22.7%
2	G	\$0.38	\$2.87	\$129.13	\$70.11	\$0.00	Low	\$343.72	57.7%
1	VG	\$0.00	\$0.00	\$33.85	\$24.82	\$0.00	Very Low	\$67.4	11.3%
		Insignificant	Minor	Moderate	Major	Catastrophic	Total	\$595.8	100.0%
		1	2	3	4	5			

Figure 27 Reliability Risk Exposure of the City's Road and Related Assets

PoF	Cdn						Risk	CRV (\$)	CRV (%)
5	VP	\$0.00	\$13.39	\$0.11	\$0.45	\$0.00	Very High	\$0.45	0.4%
4	P	\$0.00	\$13.91	\$0.10	\$0.06	\$0.00	High	\$0.18	0.2%
3	F	\$0.00	\$19.84	\$0.17	\$0.25	\$0.00	Moderate	\$13.75	13.1%
2	G	\$0.00	\$24.95	\$2.76	\$0.31	\$0.00	Low	\$36.99	35.4%
1	VG	\$0.00	\$27.19	\$0.93	\$0.11	\$0.00	Very Low	\$53.2	50.9%
		Insignificant	Minor	Moderate	Major	Catastrophic			
		1	2	3	4	5			
							Total	\$104.5	100.0%

Criticality (CoF)

Also of note is the \$43.12 million of High risk exposure with CoF of 4, Major criticality and PoF of 4, Poor condition. As these roads deteriorate with time, they will move into the Very High risk exposure category, at PoF of 5.

4.3.2 Bridges and Culverts

Table 4-3 provides a summary of the Consequence of Failure assessment of *Reliability* for the City's Bridges and Culverts. Capacity and function criticality were not assessed.

Table 4-4 Consequence of Failure Ratings for the City's Bridges and Culverts

Service	Asset Category	Attributes	Reliability
Bridges & Culverts	Span Bridges and Culverts (>=3.0m)	Arterial or Collector Road	5
		Local Road	4
		Unopened Road Allowance	2
	Municipal Structures (<3.0m)	Bridge on Arterial or Collector Road	4
		Bridge on Local Road	3
		Culvert on Arterial or Collector Road	3
		Culvert on Local Road	2
		Unopened Road Allowance	1

The risk map shown as Figure 28 combines the Criticality (CoF) ratings with the Condition (PoF) ratings for the City's Bridges and Culverts. The \$4.36 million shown as a Very High risk exposure is the Beck Road Bridge which carries a Collector Road (CoF of 5, Catastrophic criticality) and has a current Bridge Condition Index (BCI) of 49 (PoF of 4, Poor condition). Recall that the confidence in the bridge and culvert condition information is high.

Figure 28 Reliability Risk Exposure of the City's Bridges and Culverts

PoF	Cdn						Risk	CRV (\$)	CRV (%)
5	VP	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	Very High	\$4.36	2.5%
4	P	\$0.50	\$0.71	\$1.00	\$0.00	\$4.36	High	\$17.49	10.2%
3	F	\$0.24	\$15.05	\$17.21	\$6.67	\$17.49	Moderate	\$68.60	40.0%
2	G	\$0.14	\$5.82	\$20.94	\$17.61	\$60.93	Low	\$73.44	42.8%
1	VG	\$0.00	\$0.00	\$0.91	\$0.00	\$1.91	Very Low	\$7.6	4.4%
		Insignificant	Minor	Moderate	Major	Catastrophic	Total	\$171.5	100.0%
		1	2	3	4	5			

Criticality (CoF)

Also of note is the \$17.49 million of High risk exposure with CoF of 5 and PoF of 3, Fair condition. As these bridges and culverts deteriorate with time, they will move into the Very High risk exposure category, at PoF of 4.

4.3.3 Stormwater Management System

Table 4-5 provides a summary of the CoF assessment for the City's Stormwater Management System.

Table 4-5 Consequence of Failure Ratings for the City's Stormwater Management System

Service	Asset Type	Attributes	Capacity	Function	Reliability
Stormwater Management	Storm Sewers	Including inlet / outlet structures	2	3	3
	SWM Ponds		3	3	3
	Stormwater Appurtenances	MHs, CBs, Catchbasin Leads		2	2

The risk map shown as Figure 29 combines the Criticality (CoF) ratings with the Condition (PoF) ratings for the City's Bridges and Culverts. The \$0.19 million shown as a High risk exposure (orange) comprise ten (10) storm main segments with PoF of 5, Very Poor condition. Recall that the confidence in this data is moderate as it is age-based.

Figure 29 Reliability Risk Exposure of the City's Stormwater Management System

PoF	Cdn						Risk	CRV (\$)	CRV (%)
5	VP	\$0.00	\$0.03	\$0.19	\$0.00	\$0.00	Very High	\$0.00	0.0%
4	P	\$0.00	\$0.23	\$12.44	\$0.00	\$0.00	High	\$0.19	0.1%
3	F	\$0.00	\$3.02	\$98.76	\$0.00	\$0.00	Moderate	\$12.47	4.0%
2	G	\$0.00	\$4.44	\$91.87	\$0.00	\$0.00	Low	\$193.88	61.5%
1	VG	\$0.00	\$33.81	\$70.34	\$0.00	\$0.00	Very Low	\$108.6	34.5%
		Insignificant	Minor	Moderate	Major	Catastrophic	Total	\$315.1	100.0%
		1	2	3	4	5			

Criticality (CoF)

4.3.4 Water System

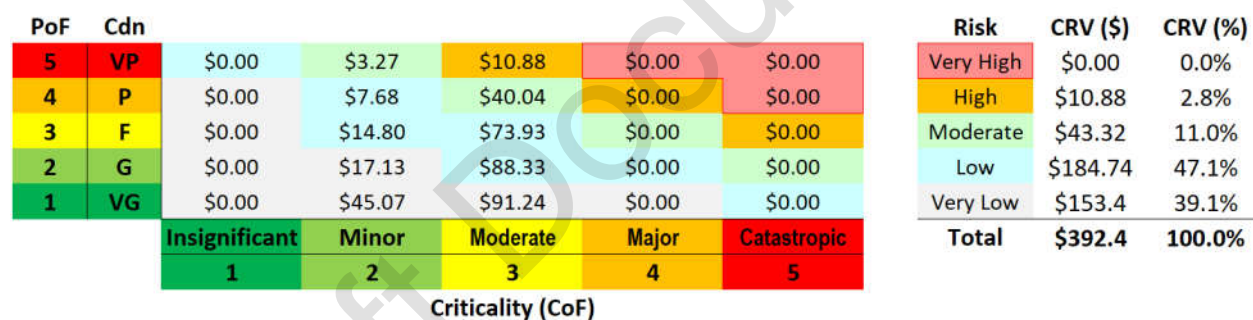
Table 4-6 provides a summary of the CoF assessment for the City's Stormwater Management System.

Table 4-6 Consequence of Failure Ratings for the City's Water System

Service	Asset Type	Attributes	Capacity	Function	Reliability
Water	Water Mains		2	2	3
	Facilities	Bulk Water Stations	2	1	3
	Water Appurtenances	Meters		2	3
		Hydrants, Valves, Services, Curb Stops		2	2
Services			1	2	

The risk map shown as Figure 30 combines the Criticality (CoF) ratings with the Condition (PoF) ratings for the City's Water System. The \$10.88 million shown as a High risk exposure (orange) consists of over 300 water main segments with PoF of 5, Very Poor condition.

Figure 30 Reliability Risk Exposure of the City's Water System



4.3.5 Wastewater System

Table 4-7 provides a summary of the Consequence of Failure assessment for the City's Stormwater Management System.

Table 4-7 Consequence of Failure Ratings for the City's Wastewater System

Service	Asset Type	Attributes	Capacity	Function	Reliability
Wastewater	Facilities	High Rate Treatment Facility	3	3	4
		Storage Tanks	3	3	3
		Pumping Station		2	3
	Sanitary Sewers	Gravity Mains	2	3	3

Service	Asset Type	Attributes	Capacity	Function	Reliability
		Low Pressure Mains	1	2	3
	Wastewater Appurtenances	Laterals, MHs, Cleanouts		2	2

The risk map shown as Figure 31 combines the Criticality (CoF) ratings with the Condition (PoF) ratings for the City’s Wastewater System. The \$23.66 million shown as a High risk exposure consists of 480 sanitary sewer main segments with PoF of 5, Very Poor condition.

Figure 31 Reliability Risk Exposure of the City’s Wastewater System

PoF	Cdn						Risk	CRV (\$)	CRV (%)
5	VP	\$0.00	\$10.24	\$23.66	\$0.00	\$0.00	Very High	\$0.00	0.0%
4	P	\$0.00	\$42.95	\$51.79	\$0.00	\$0.00	High	\$23.66	5.7%
3	F	\$0.00	\$41.76	\$36.98	\$0.00	\$0.00	Moderate	\$62.03	14.9%
2	G	\$0.00	\$26.79	\$20.66	\$14.82	\$0.00	Low	\$157.17	37.7%
1	VG	\$0.00	\$37.65	\$109.54	\$0.00	\$0.00	Very Low	\$174.0	41.7%
		Insignificant	Minor	Moderate	Major	Catastrophic			
		1	2	3	4	5			
		Criticality (CoF)							
							Total	\$416.8	100.0%

Draft Document

5 Lifecycle Management Strategy

5.1 Introduction

The City’s ability to deliver the levels of service outlined in the Asset Management Plan is impacted in large part by:

- aging infrastructure and the associated need for operations, maintenance, and renewal investments to sustain it
- forecast future population growth and the associated need for additional infrastructure to serve it
- changing functional, legislative and sustainability requirements and the associated need for existing assets to be upgraded to continue to be fit for purpose
- available funds and the associated need for assets to be provided at lowest cost for both current and future customers.

To achieve its objectives, the City builds new infrastructure assets to meet capacity needs, upgrades assets to meet new functional needs and manages existing assets to meet reliability needs – all with limited funds. Asset lifecycle management strategies are planned activities that enable assets to provide the defined levels of service in a sustainable way, while managing risk, at the lowest lifecycle cost. Asset lifecycle management strategies are typically organized into the categories listed in Table 5-1, and are driven by the levels of services defined in Section 3.

Table 5-1 Asset Lifecycle Management Categories

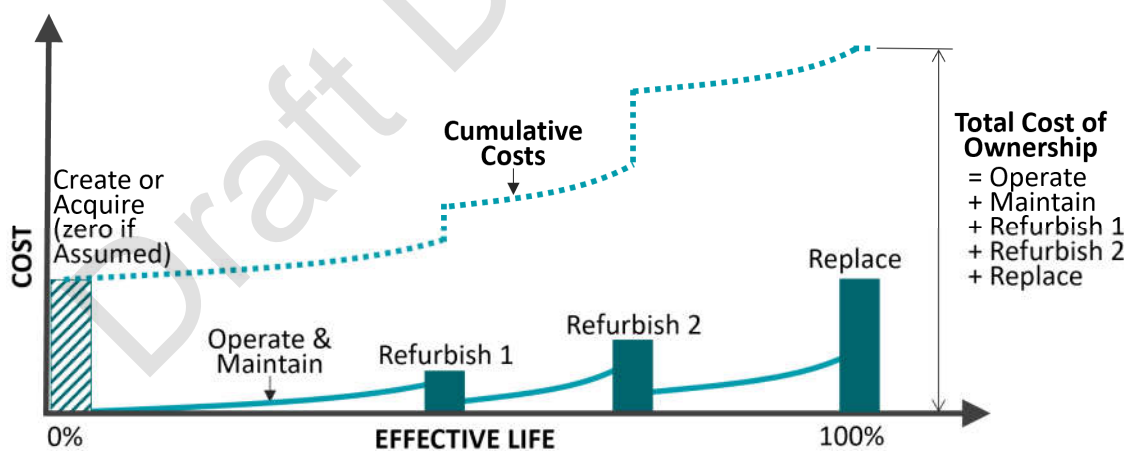
Lifecycle Management Category	Description	Examples of Associated Activities
Operate	Regular activities to provide services	inspect, clean, energy usage
Maintain	Activities to retain asset condition to enable it to provide service for its planned life	repair, replace component
Renew	Activities that return the original service capability of an asset	rehabilitate (minor), rehabilitate (major), replace
Upgrade	Activities to provide a higher level of service capability from an existing asset to achieve better fit for purpose or meet regulatory requirements	update system to be more energy efficient, improve environmental sustainability

Lifecycle Management Category	Description	Examples of Associated Activities
Grow	Activities to provide a new asset that did not exist previously or an expansion to an existing asset	acquire new asset, expand existing asset

In addition to the above asset strategies, non-asset solutions are also considered which actions or policies that can lower costs, lower demands, or also extend asset life. Examples of non-asset solutions include better integrated infrastructure planning and land use planning, demand management, insurance, process optimization, and education of the public.

The City assesses the costs of potential lifecycle activities to determine the lowest lifecycle cost strategy to manage each asset type while still meeting levels of service. The total cost of ownership is the sum of lifecycle activity costs to sustain each asset type over the asset lifecycle. A conceptual lifecycle cost model is shown in Figure 32. Sufficient investment of the right type and at the right time minimizes the total cost of ownership for each asset and also mitigates other potential risks such as interruption to service delivery or damage to other nearby infrastructure. Operations, maintenance, and renewal activities are timed to reduce the risk of service failure from deterioration in asset condition and are part of the total cost of ownership.

Figure 32 Conceptual Lifecycle Cost Model



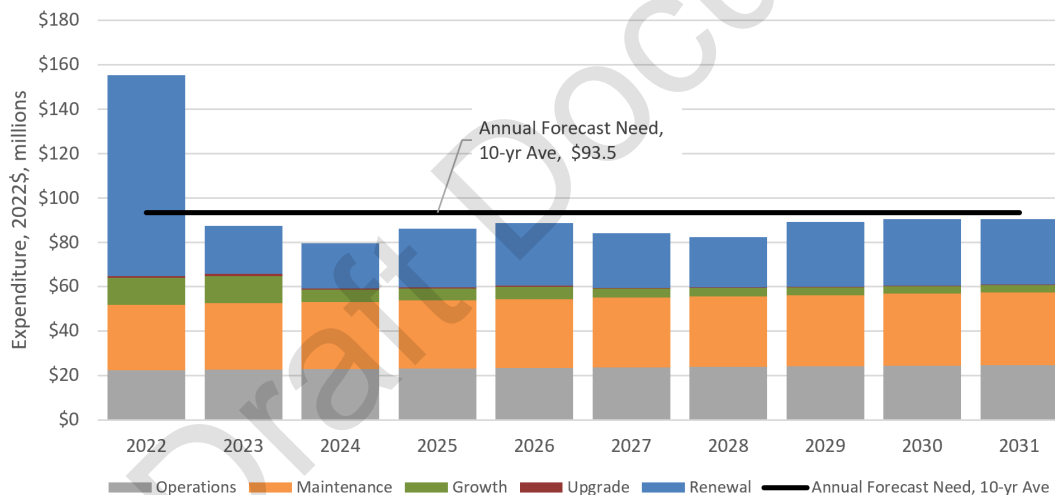
The City uses its understanding of risks of not meeting service levels to inform the timing and level of investments needed in infrastructure assets. The City aims to provide sufficient service capacity to meet demand and manages the upgrade, operations, maintenance, and renewal of assets to meet defined service levels, including legislated and other corporate requirements. This section of the AM Plan outlines the City's expansion and upgrade strategies to support capacity and functional service levels, and

the City’s operations, maintenance, and renewal activities to support reliability service levels.

5.2 City-Wide Core Assets Overview

Figure 33 shows the total operations and maintenance, renewal, growth and upgrade needs forecast for the City over the next 10 years to sustain current levels of service. The sum of the City’s needs forecasts for the planned strategies for managing core assets is estimated at \$935 million for the period 2022-2031, for an average of \$95.0 million per year. The high cost of lifecycle strategy needs shown in the first year is mainly due to the backlog of assets in Very Poor condition, comprised mostly of wastewater sewers, maintenance holes and laterals, water mains, roads, sidewalks, and bridges and culverts. The annual forecast need includes addressing the existing backlog over the next 10 years and sustaining other assets as they deteriorate over the same time period. As noted above, the confidence in the “condition” data for wastewater maintenance holes and laterals (\$10.2 million Very Poor), and sidewalks (\$13.1 million Very Poor) is moderate as it is based on a theoretical calculation of life consumed rather than inspected condition as is the case for wastewater sewers, road pavement, and bridges and culverts.

Figure 33 Total 10-Year Lifecycle Strategies Needs Forecast, 2022 to 2031



5.3 Details by Lifecycle Management Strategy

5.3.1 Overview of Core Assets Growth and Upgrade Needs

As indicated in Section 1.2.4, the City has experienced growth in the past and should continue to grow at a modest rate through to 2031 and beyond. The City anticipates that additional infrastructure will be required over the next 10 years to maintain capacity service levels. Additional infrastructure will be acquired at cost to the City (City-Constructed) and will also be “donated” by developments (Development-Donated). These growth and upgrade needs are kept separate because the City-Constructed growth and upgrade needs will be funded through the Capital Budget while the Development-Donated

growth needs will be funded through Development Charges. The funding is addressed in the next section of the AM Plan, Financial Strategy.

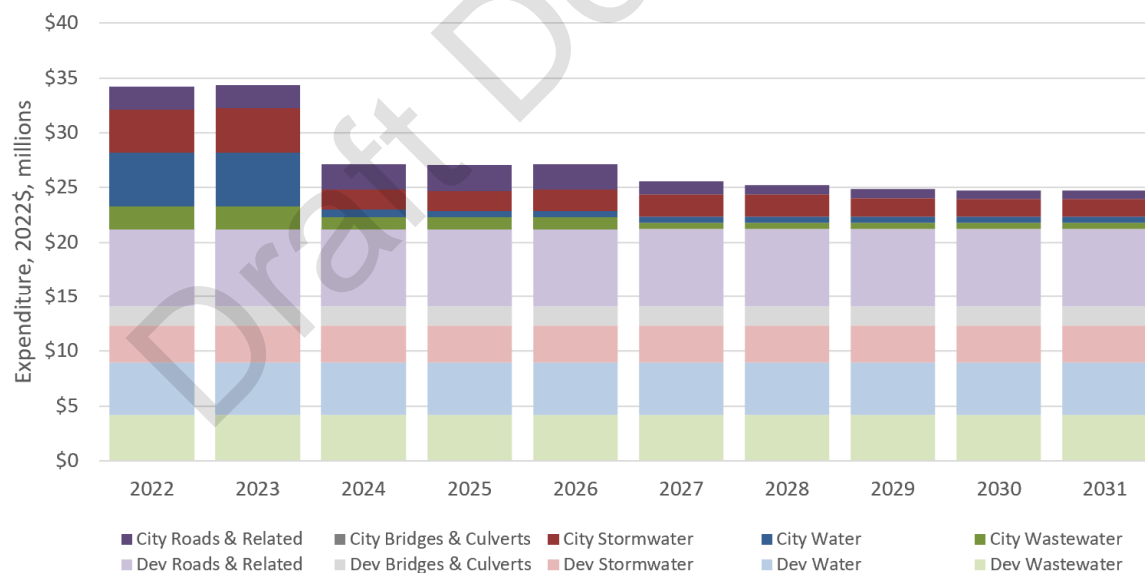
City-Constructed Growth and Upgrade Needs

The City’s 2019 Development Charges Background Study lists new and expanded assets needed through to 2028. Based on the 2019 Development Charges Background Study and more recent planning studies, City staff developed a program of asset Growth and Upgrade needs over the next 10 years, by service. These needs are shown as the darker coloured, upper portion of the bars in Figure 34, by service. No Bridges & Culverts are identified as City-Constructed growth and upgrade over the next 10 years.

Developer-Donated Growth Needs

Based on the anticipated population growth, the assets donated by developments (Development-Donated Growth) is assumed to be 1% per year over the next ten (10) years, or \$21.2 million per year for each of the next 10 years (calculated as 1% of the current core assets portfolio replacement value of \$2.12 billion). To determine the amount of Development-Donated Growth, by service, the \$21.2 million per year was assumed to be in the same proportion as the proportions of the current asset portfolio that support each service. These needs are shown as the lighter coloured, lower portion of the bars in Figure 34, by service.

Figure 34 10-Year Forecast Growth and Upgrade Needs, by Service



The City-Constructed growth and upgrade needs are highest in the first two years and drop off over the 10-year period. To ensure that this forecast accurately reflects the growth and upgrade needs, the City should update current transportation, stormwater, water and wastewater master plans.

5.3.2 Overview of Core Assets Renewal Needs

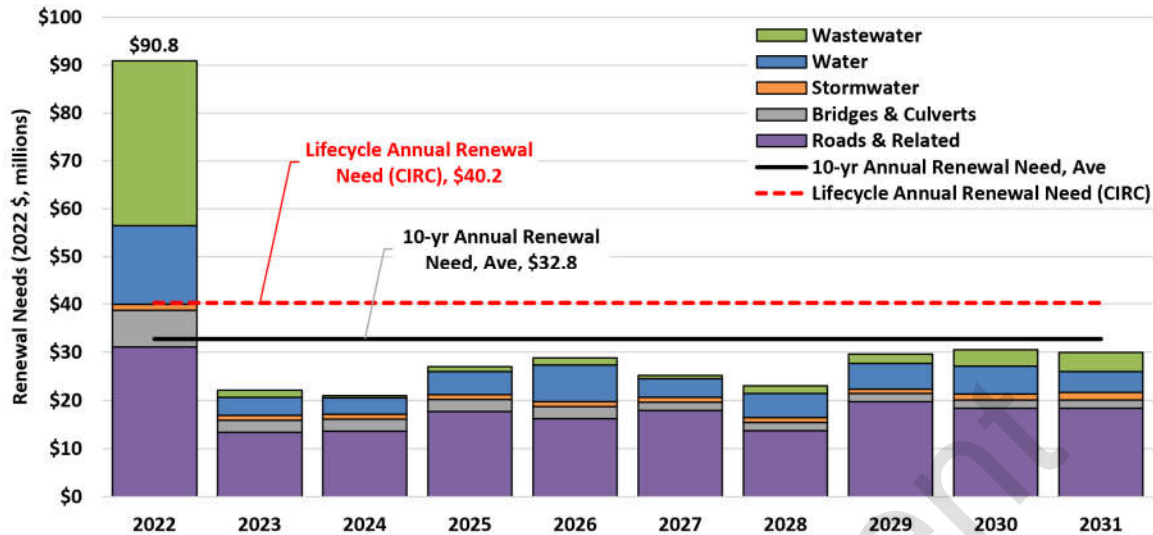
Renewal efforts focus on rehabilitation and replacement activities to enable the City to meet its reliability objectives. The renewal activities included in this AM Plan are forecast to be needed to address the existing backlog of assets in Very Poor condition and sustaining other assets as they deteriorate over the next 10 years. Over time, as the City refines the asset management strategies through tracking of actual condition and actual costs and benefits of the strategies, by service and asset category, the City will improve its understanding of the deterioration rates and the lowest lifecycle cost for each asset type.

Rehabilitation activities extend the life of an asset and reduce risk of failure. These activities and associated benefits are deemed more cost effective than allowing the asset to reach its end of life. Examples of rehabilitation activities are milling and repaving of a paved road segment and concrete deck replacement on a bridge, both of which will improve the condition of the asset and extend its life such that the overall lifecycle cost is minimized. At a certain point in an asset's lifecycle, it is no longer cost-effective to rehabilitate the asset, and replacement is required. The City has identified estimated service lives for each of its assets. These replacement intervals are developed to minimize lifecycle costs while considering service levels and associated risk.

The renewal forecasts consider the asset's current condition or age, the City's planned rehabilitation and replacement activities, as well as the recommended strategies from specific studies such as the Bridge Needs Study (2021). Asset renewal needs are triggered by condition, age, or other performance measure. If installation date is missing, renewal needs are included as an average annual reinvestment rate (same investment each year) based on asset value and useful life. Asset renewal forecast assumptions, lifecycle management strategies and identified needs specific to each service and asset category are provided in the following section. Detailed asset unit costs and lifecycles, by asset size and material, to support the renewal forecasts are provided in Appendix A – Asset Service Life and Replacement Cost.

Figure 35 shows the renewal needs over the next 10 years by service. The average renewal need (solid black line) is estimated at \$32.8 million per year for the period 2022-2031. However, the renewal need in 2022 is \$90.8 million. The difference between the 2022 renewal need and the 10-year average is \$58.0 million and represents the backlog due to assets currently in need of renewal. The backlog is made up mostly of sanitary mains at \$20.9 million, followed by sidewalks at \$11.9 million, and water mains at \$8.3 million. The annual renewal need includes removal of the backlog over the 10 year period. The sub-sections over the next pages discuss the Backlog of Renewal Needs and Lifecycle Annual Renewal Need (CIRC), shown as the dashed red line.

Figure 35 10-Year Forecast Renewal Needs, by Service



Backlog of Renewal Needs

Table 5-2 shows the makeup of the City’s renewal backlog expressed in million dollars and percent of the annual renewal need. The table also indicates the criticality, basis of the renewal needs analysis, and the confidence in the determination of the backlog of the asset category. This table informs the following:

- Due to availability of inspection data, the City is confident that span bridges, municipal culverts and sanitary sewer mains have significant backlogs and that roads and span culverts do not.
- The City should prioritize renewal works on span bridges, municipal structures on major roads, and sanitary sewer mains.
- The City should prioritize inspection of assets with higher criticality to understand the condition, including medians, barriers, storm sewers, stormwater management ponds, water facilities, and wastewater facilities

Table 5-2 Makeup of the City's Renewal Backlog, by Service and Asset Category

Service	Asset Category	Backlog (\$)	Backlog (%)	Criticality *	Basis of Analysis	Confidence
Roads & Related	Roads	\$0.5	3%	3 to 4	Inspected (PCI)	High
	Sidewalks	\$11.9	591%	2	Age-based	Moderate
	Medians	\$0.7	547%	2 to 4	Age-based	Moderate
	Barriers	\$0.0	0%	3 to 4	Annual Amount	Low
Bridges & Culverts	Span Bridges	\$3.9	230%	4 to 5	Inspected (BCI)	High
	Span Culverts	\$0.1	18%	4 to 5	Inspected (BCI)	High
	Municipal Structures	\$1.0	194%	2 to 4	Inspected (BCI)	High
Stormwater Management	Storm Sewers	\$0.1	110%	3	Age-based	Moderate
	Maintenance Holes	\$0.0	110%	2	Age-based	Moderate
	Catchbasins	\$0.0	110%	2	Age-based	Moderate
	Catchbasins Leads	\$0.0	188%	2	Age-based	Moderate
	SWM Ponds	\$0.0	0%	3	Annual Amount	Low
Water	Water Mains	\$8.3	301%	3	Age, # breaks	Mod - High
	Hydrants	\$0.7	230%	2	Age-based	Moderate
	Valves	\$1.6	521%	2	Age-based	Moderate
	Meters	\$0.0	0%	3	Annual Amount	Low
	Services	\$0.0	0%	2	Annual Amount	Low
	Curb Stops	\$0.0	0%	2	Annual Amount	Low
	Water Facilities	\$0.0	0%	3	Annual Amount	Low
Wastewater	Sewers	\$20.9	773%	3	Inspected (CCTV)	High
	Maintenance Holes	\$3.3	600%	2	Age-based	Moderate
	Laterals	\$5.0	354%	2	Age-based	Moderate
	Cleanouts	\$0.0	900%	2	Age-based	Moderate
	Storage Tanks	\$0.0	268%	3	Age-based	Moderate
	Facilities-Treatment	\$0.0	0%	4	Annual Amount	Low
	Facilities-Storage & Pumping	\$0.0	0%	3	Annual Amount	Low
TOTAL		\$58.0				

* Criticality ranges from 1 insignificant to 5 catastrophic

Lifecycle Annual Renewal Needs (CIRC)

As previously stated, the 2016 Canadian Infrastructure Report Card (CIRC) provides an assessment of the health of municipal infrastructure as reported by cities and communities across Canada. The CIRC refers to the Average Annual Renewal Rate (AARR) as the annual reinvestment amount expressed as a percentage of an asset's replacement value. In the conceptual lifecycle cost model provided in Figure 32, the annual reinvestment amount is the cost of (Refurbish 1 plus Refurbish 2 plus Replace) divided by (Effective Life).

$$\text{Therefore, the Average Annual Renewal Rate} = \text{AARR} = \frac{(\text{Refurbish 1} + \text{Refurbish 2} + \text{Replace})}{\text{Replace} \times \text{Effective Life}}$$

The 2016 CIRC provides **target reinvestment rates**, by **asset type**, as provided by experienced asset management practitioners. The rate can vary based on factors such as the age of the infrastructure, the level of service and risk tolerance. Table 5-3 provides the 2016 CIRC target reinvestment rates: upper target, lower target, and average target.

Table 5-3 2016 CIRC Target Reinvestment Rates

Infrastructure	Lower Target Reinvestment Rate	Upper Target Reinvestment Rate	Average Target Reinvestment Rate
Roads and Sidewalks	2.0%	3.0%	2.50%
Bridges	1.0%	1.5%	1.25%
Stormwater (linear)	1.0%	1.3%	1.15%
Stormwater (non-linear)	1.7%	2.0%	1.85%
Potable Water (linear)	1.0%	1.5%	1.25%
Potable Water (non-linear)	1.7%	2.5%	2.10%
Wastewater (linear)	1.0%	1.3%	1.15%
Wastewater (non-linear)	1.7%	2.5%	2.10%

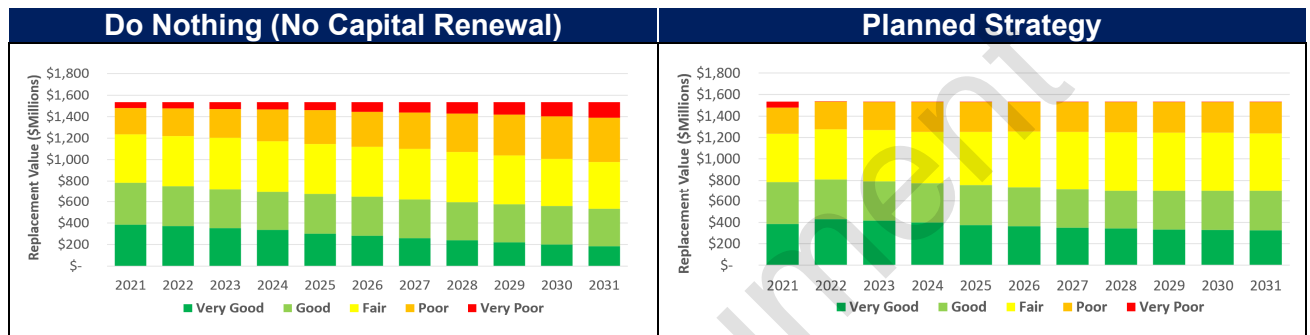
The AARA shown in Figure 35 above as the dashed red line was determined by applying the average target reinvestment rate from the last column in the above table to the City's core asset portfolio. This amount enables comparison of the management strategy needs over the entire lifecycle of the assets to the 10-year annual renewal need. As the City's assets are generally in fair or better condition, the lifecycle annual renewal need is greater than the 10-year annual renewal need. The Lifecycle Annual Renewal Needs inform the following;

- The City should plan for increased renewal needs (from the annual renewal need of \$32.8 over the next 10 years to the annual renewal need of \$40.2 beyond the 10-year forecast) as its assets age and continue to deteriorate.

Impact of Planned Renewal Strategy on LOS and Risk

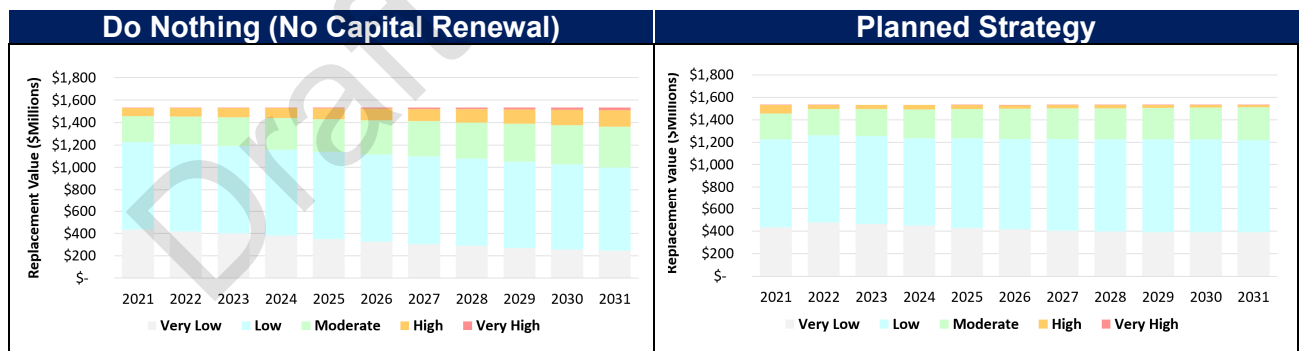
The 10-year planned renewal strategy of an average of \$32.8 million per year in expenditures supports the City’s ability to achieve its service levels while balancing risk and minimizing lifecycle costs. If the City does not invest in renewing its infrastructure, there is a significant deterioration in asset condition over time. The Planned Strategy ensures that assets are maintained and renewed in a state of good repair, as shown in Figure 36. The graph of the left shows the impact of a “do nothing” strategy, while the graph of the right shows the impact of the “planned strategy”.

Figure 36 Asset Condition Forecast Comparison – Do Nothing versus Planned Strategy



The planned strategy also has a significant impact on managing risk. If the City does not invest in renewal of its assets, there is a significant risk exposure to asset failure on factors such as health and safety and service delivery. The Planned Strategy mitigates very high risks and results in lower risk exposure compared to an increasing risk profile if the City did not perform any capital renewal activities, as shown in Figure 37.

Figure 37 Asset Risk Forecast Comparison – Do Nothing versus Planned Strategy



5.3.3 Details of Core Assets Renewal Needs by Service

Roads and Related Assets

The following table lists the renewal forecast assumptions for roads and related assets.

Table 5-4 Renewal Forecast Assumptions for the City's Roads and Related Assets

Asset Category	Forecast Assumptions
Roads	Roads forecast includes curb and gutter, forecasted based on PCI or age if PCI is not available
Sidewalks	Forecasted based on install year of associated road
Medians	Forecasted based on install year of associated road
Barriers	Due to missing installation year data, forecast is an average annual reinvestment rate (same annualized investment each year) based on replacement value and useful life

The following table provides the rehabilitation and replacement timing and costs for the renewal needs analysis.

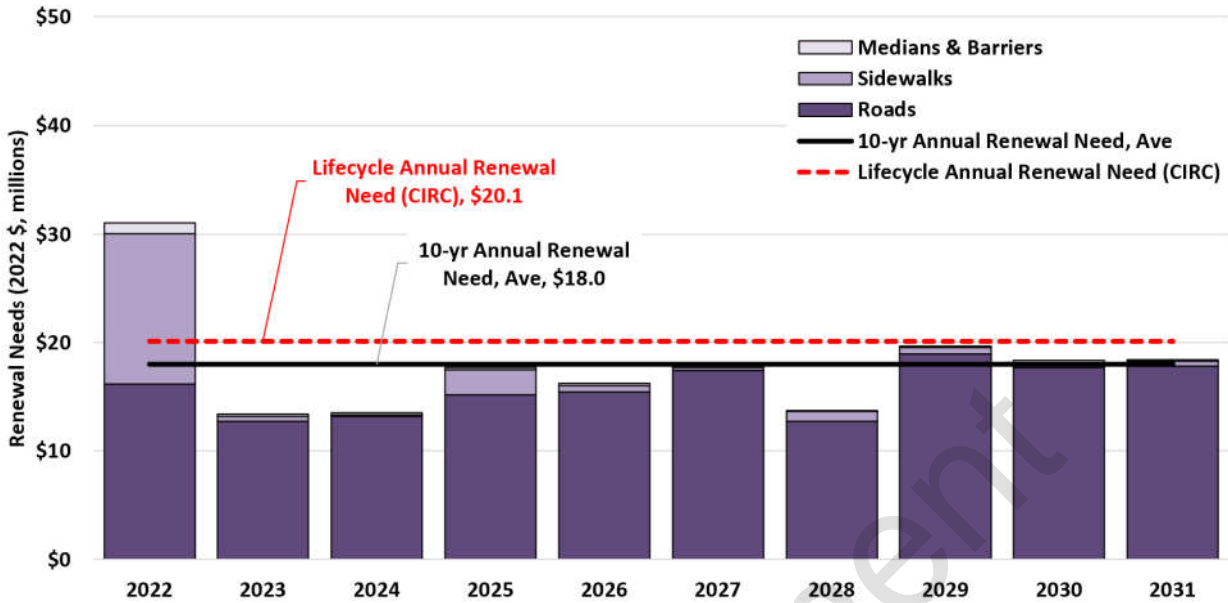
Table 5-5 Renewal Strategies for the City's Roads and Related Assets

Asset Category	Cost Unit	Rehab 1 Description	Time (yrs)	Unit Cost	Rehab 2 Description	Time (yrs)	Unit Cost	Replace (yrs)	Unit Cost
Roads Unpaved	m2	Re-gravel	7	\$10					
Roads Paved Rural & SU**	m2	Overlay	25	\$18	Pulverize & Pave	50	\$26	75	\$110
Roads Paved Urban* Arterial	m2	Mill & overlay	25	\$36	Resurface	50	\$62	75	\$205
Roads Paved Urban* Collector	m2	Mill & overlay	25	\$36	Resurface	50	\$62	75	\$138
Roads Paved Urban* Local	m2	Mill & overlay	25	\$36	Resurface	50	\$62	75	\$141
Sidewalks	m							75	\$130
Medians	m							50	\$161
Barriers	m								

* Urban includes curb and gutter, ** Semi-Urban

The following figure shows the results of the renewal needs forecast. The graph highlights the backlog of sidewalk needs at \$11.9 million as previously discussed (with moderate confidence because it is based on age). Note that the longer term annual renewal amount of \$20.1 million is only marginally above the 10-year average of \$18.0 million.

Figure 38 10-Year Forecast Renewal Needs for the City’s Roads and Related Assets

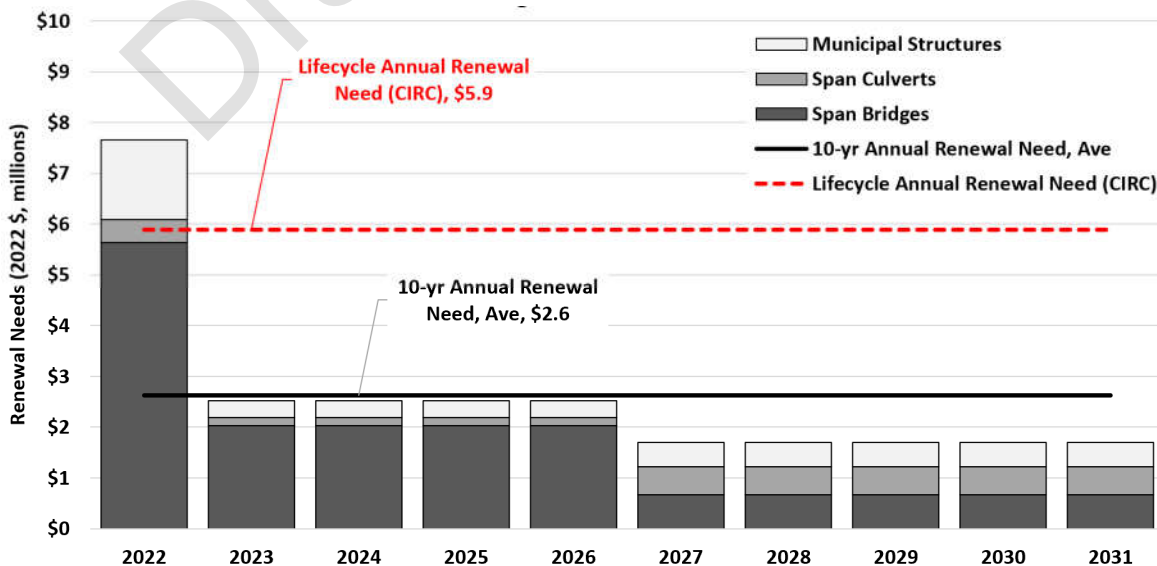


Bridges and Culverts

The renewal strategies for the City’s bridges and culverts were derived from the 2020 OSIM Bridge Condition Inspection and Analysis by Ellis Engineering Inc.

The following figure shows the results of the renewal needs forecast for bridges and culverts. The graph highlights the backlog of span bridge and municipal structure needs (\$3.9 and \$1.0 million respectively) as previously discussed (with high confidence because it is based on inspected condition). Note that the longer term annual renewal amount of \$5.9 million is significantly above the 10-year average of \$2.6 million, indicating that the City can expect bridge and culvert needs to increase in the future as the bridges and culverts age and deteriorate.

Figure 39 10-Year Forecast Renewal Needs for the City’s Bridges and Culverts



Stormwater Management System

The following table lists the renewal forecast assumptions for the stormwater management system.

Table 5-6 Renewal Forecast Assumptions for the City’s Stormwater Management Assets

Asset Category	Forecast Assumptions
Stormwater Sewers and Catchbasin Leads	Forecasted based on age
Stormwater Management Ponds	Construction year is missing for a portion of ponds, and bathymetric surveys will be completed in the future to improve planning for sediment removal. Forecast is an average annual reinvestment rate (same annualized investment each year) based on an average dredging cost and frequency (\$1.0 million per pond every 25 years)
Maintenance Hole and Catchbasins	Due to missing installation year data, aligned forecast of maintenance holes and catchbasins with stormwater sewers

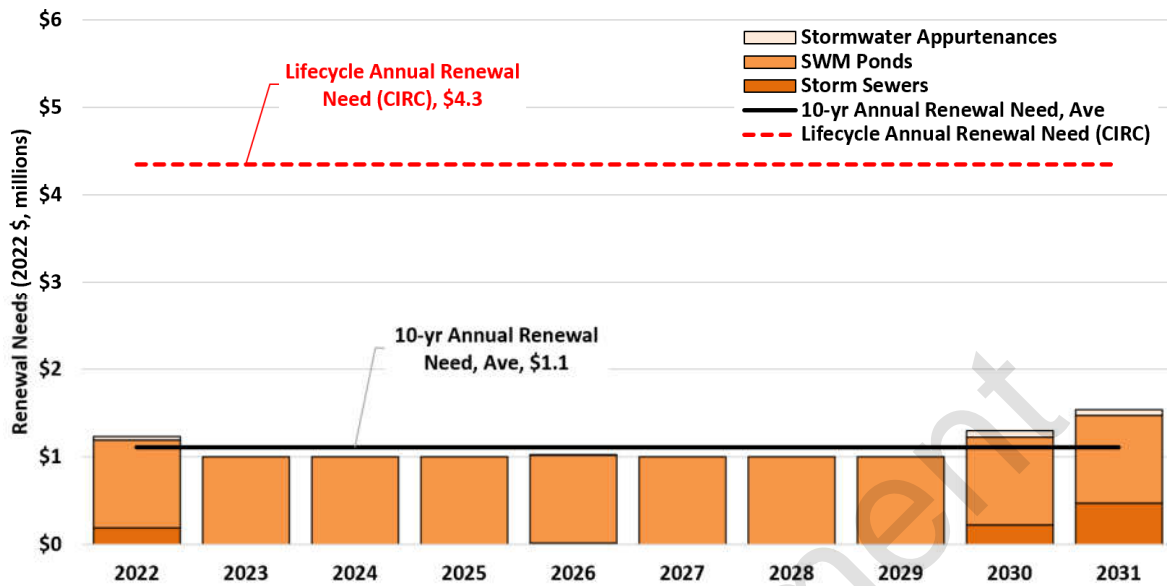
The following table provides the renewal strategies used as input to the renewal needs analysis for the stormwater management system. The renewal strategy is a simple replace at end of life. See Appendix a for unit cost details.

Table 5-7 Renewal Strategies for the City’s Stormwater Management System

Asset Category	Cost Unit	Time (years)	Unit Cost (2022\$)
Storm Sewers	m	75 / 80	varies
SWM Ponds	ea	25	\$1,000,000
Maintenance Holes	ea	80	Varies
Catchbasins	ea	80	Single: \$2401 Double: \$3646
Catchbasins Leads	m	80	varies

The following figure shows very little stormwater system renewal need over the 10-year forecast period because the forecast is age-based, the assets have a long lives, and are in the early stages of their lives. The longer term annual renewal amount of \$4.3 million is significantly above the 10-year average of \$1.1 million, indicating increased future needs. As condition information on the storm sewers and ponds becomes available, the 10-year forecast will be updated and the City will be more confident in the forecast. **A significantly higher 10-year annual renewal need is expected.**

Figure 40 10-Year Forecast Renewal Needs for the City’s Stormwater Management System



Water System

The following table lists the renewal forecast assumptions for the water system.

Table 5-8 Renewal Forecast Assumptions for the City’s Water System

Asset Category	Forecast Assumptions
Watermains	Forecasted based on last observed condition (break history data) or age if condition not available
Hydrants & Valves	Forecasted based on age
Meters, Services, and Curb Stops	Due to missing installation year data, forecast is an average annual reinvestment rate (same annualized investment each year) based on replacement value and useful life.
Water Facilities	As the facilities are only tracked at the overall facility level, forecast is an average annual reinvestment rate (same annualized investment each year) based on replacement value and useful life

The following table provides the renewal strategies used as input to the renewal needs analysis for the water system.

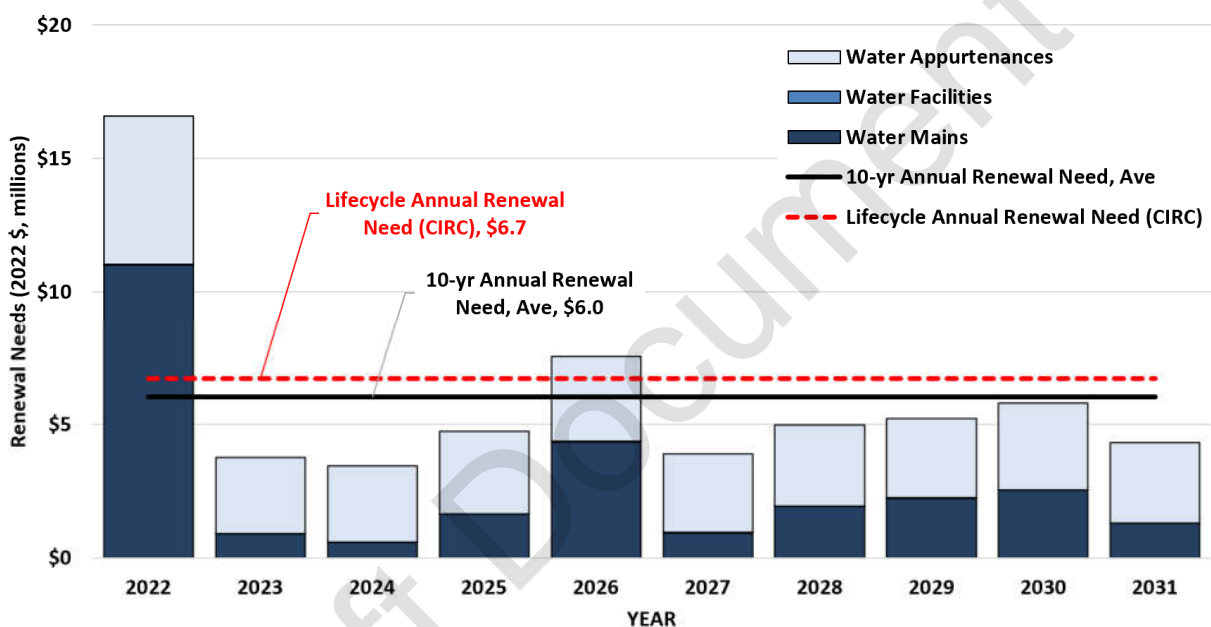
Table 5-9 Renewal Strategies for the City’s Water System

Asset Category	Cost Unit	Time (years)	Unit Cost (2022\$)
Watermains – 150 mm	m	75	varies
Facilities	ea	25	\$150,000
Hydrants	ea	75	\$9,467
Valves	ea	60	varies
Meters	ea	15	varies
Services	ea	70	Varies

Asset Category	Cost Unit	Time (years)	Unit Cost (2022\$)
Curb Stops	ea	70	<=25mm \$500, >25mm \$700

The following figure shows the results of the renewal needs forecast for the water system. The graph highlights the backlog of water main, hydrant and valve needs previously discussed (with high to moderate confidence because the water main is based on age and break history and has the highest replacement value). Note that the longer term annual renewal amount of \$6.7 million is only marginally above the 10-year average of \$6.0 million.

Figure 41 10-Year Forecast Renewal Needs for the City’s Water System



Wastewater System

The following table lists the renewal forecast assumptions for the wastewater system.

Table 5-10 Renewal Forecast Assumptions for the City’s Wastewater System

Asset Category	Forecast Assumptions
Wastewater Sewers	Forecasted based on CCTV score or age (if CCTV not available)
Wastewater Facilities	As the facilities are only tracked at the overall facility level, forecast is an average annual reinvestment rate (same annualized investment each year) based on Replacement value and useful life.
Wastewater Maintenance Holes,	Forecasted based on age

Asset Category	Forecast Assumptions
Laterals, Cleanouts, Storage Tanks	

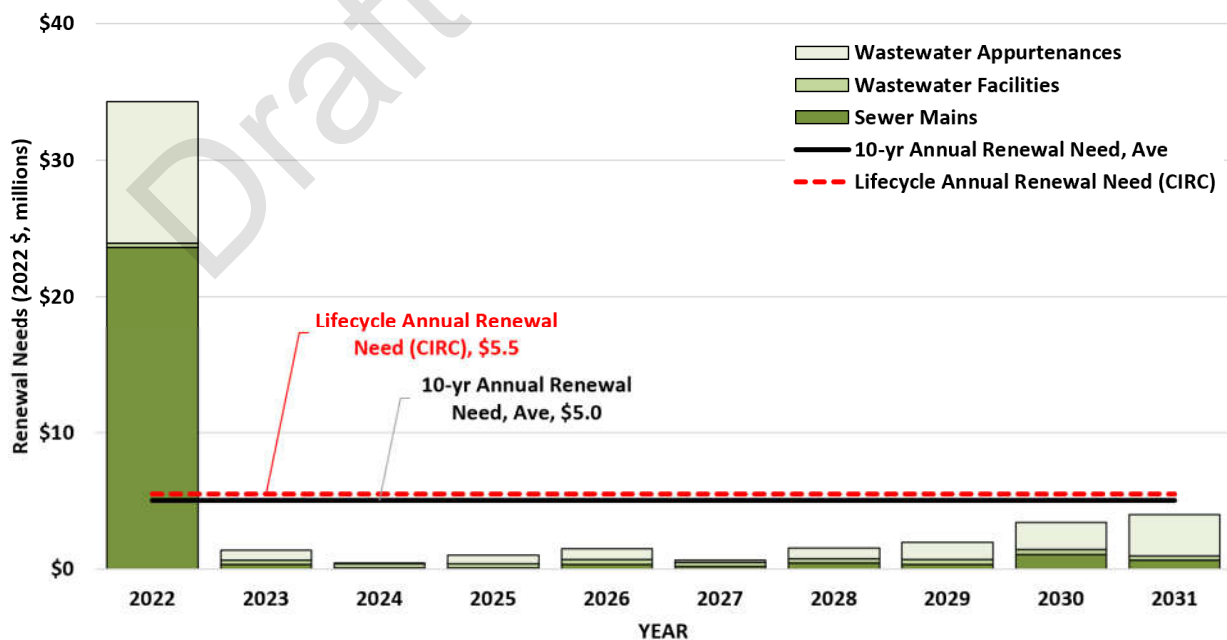
The following table provides the renewal strategies used as input to the renewal needs analysis.

Table 5-11 Renewal Strategies for the City’s Wastewater System

Asset Category	Cost Unit	Time (years)	Unit Cost (2022\$)
Sanitary Sewer Mains	m	75 / 80	varies
Facilities-Treatment	ea	50	\$14.8M
Facilities-Storage & Pumping	1	80	\$2.1M
Maintenance Holes	ea	80	\$10,764
Laterals	m	75 / 80	varies
Cleanouts	ea	80	\$885
Storage Tanks	m	80	\$1,291/m

The following figure shows the results of the renewal needs forecast for the wastewater system. The graph highlights the significant backlog of sewer main needs (with high confidence as based on CCTV inspection) and laterals and cleanouts (with moderate confidence). Note that the longer term annual renewal amount of \$5.5 million is only marginally above the 10-year average of \$5.0 million. Renewal works should be planned with works to eliminate combined sewers.

Figure 42 10-Year Forecast Renewal Needs for the City’s Wastewater System



5.3.4 City-Wide Core Assets Operations and Maintenance Needs

Operations and Maintenance Needs for Current LOS

Along with timely renewal of assets, operations and maintenance (O&M) work directly enables the City to meet state of good repair service levels (percentage of assets in fair or better condition) to support the reliable service delivery objective. The distinction between renewals (capital programs) and operations and maintenance (operating expenses) is defined by the City's accounting policies and standard operating procedures.

Generally, operations and maintenance activities ensure the asset continues to deliver defined levels of service, while renewal activities discussed in the preceding section extend the useful life of the asset. Renewals, operations, and maintenance are strongly linked; operations and maintenance strategies can accelerate or delay the need for renewals, and if renewals are deferred, operations and maintenance needs will often increase to ensure that assets are kept in a state of good repair.

The forecast of needed operations and maintenance activities is derived from a review of current activities and identification of additional activities to reliably deliver current services. Table 5-12 summarizes the needed operations and maintenance activities and frequencies, by service, and indicates whether the City is currently undertaking the activity and, if not, provides the estimated cost of the additional need. The cost estimates of additional O&M were developed based on input from staff. These cost estimates do not include costs due to growth or upgrade of assets. These costs are developed and discussed in the sub-section that follows Table 5-12.

The Minimum Maintenance Standards (MMS) for Municipal Highways, Ontario Regulation 239/02 (<https://www.ontario.ca/laws/regulation/020239>), were developed to provide municipalities with a defence against liability from actions arising from levels of care on roads and bridges. The Act sets out minimum standards for road and highway maintenance, including bridges, for all municipalities. MMS regulations pertain to various elements of road repair and maintenance, such as the frequency of road inspections, weather monitoring, ice formation on roadways, snow accumulation, and sidewalk trip ledges. Also, under the MMS, roads and highways throughout the province are classified based on their average annual daily traffic and posted speed limits, and based on the classification of a particular road/highway, there are required minimum levels of inspection and repair. The Act came into force on November 1, 2002 and contains the minimum maintenance standards to which municipalities must abide.

For several asset categories (e.g. storm sewers, stormwater management ponds and sanitary sewers), the City has conducted or is conducting inspection and assessment work which has been funded through the capital budget because of the significant cost. These inspections will continue to be undertaken over time to provide confidence in the needs forecasts, but with less intensity. These less intense inspections are now shown to be operations and maintenance activities with associated costs.

The City currently undertakes bridge repairs recommended through bridge and culvert inspections as part of capital renewal activities. These maintenance costs should be built into future annual maintenance needs (but are not included in the following table).

Draft Document

Table 5-12 Operations and Maintenance Needs Activities and Additional Costs (2022\$, thousands)

Asset Class	Operations Activities	Current Activity?	Add'l Annual Need (\$000)	Maintenance Activities	Current Activity?	Add'l Annual Need (\$000)
Roads & Related			\$0			\$350
Paved Roads - Urban	Patrol & inspect per MMS, control winter conditions, sweep (once in spring; weekly for tourist core & cycle lanes)	Y		Repair potholes (\$440k), trench repair, seal cracks (\$75K), repair winter damage	Y, but insufficient	\$100
Paved Roads - Rural & Semi Urban	Patrol & inspect per MMS, control winter conditions, sweep	Y		Repair potholes, seal cracks, re-ditch, re-shoulder (\$50k-\$\$), clear mowing/vegetation (4x), culvert repair (growth)	Y, but insufficient	\$50
Unpaved Roads	Patrol & inspect per MMS, control winter conditions, control dust	Y		Regrade road, repair winter damage, re-ditch (react to flooding), re-shoulder (\$\$), clear vegetation (4x/yr)	Y, but insufficient	\$50
Sidewalks	Inspect, control winter conditions (mainlines) 1/3 per year	Y		Repair concrete panels; seal asphalt paths, decorative (tourist core) – brick repointing in spring, concrete tree grates, bus stops, slab jack, grind (\$\$)	Y, but insufficient	\$50
Medians	Patrol & inspect per MMS	Y		Repair, cut grass, repair irrigation	Y	
Barriers	Patrol & inspect per MMS	Y		Repair from hits (\$\$), control veg, upgrades (\$\$), Acct 312 or 315	Y, but insufficient	\$100
Bridges			\$0			\$0
Span Bridges	Inspect every 2 years per OSIM. Patrol & inspect per MMS, control winter conditions, flush and clean (once in spring)	Y		Repair based on OSIM and patrol inspections	N *	
Span Culverts	As above	Y		Repair based on OSIM and patrol inspections	N *	
Municipal Structures	Inspect every 2 years	Y		Repair based on OSIM and patrol inspections	N *	
Stormwater			\$220			\$0
Storm Sewers	Flush, clean, CCTV inspect (freq based on risk) capital for first time	Y **	\$200 **	Spot repair based on CCTV condition	Y	
SWM Ponds	Bathometric survey & inspect (every 5 yrs); Test, exercise, inspect, clean I/O, weir, grate (annually)	Y **	\$20 **	Spot repair based on condition (sediment removal is capital)	Y	
Storm Appurtenances	MHs: Clean, CCTV inspect (freq based on risk); CBs: Wash, clean, CCTV inspect (1500 annually, every 6 yrs); Roads: sweep	Y		Spot repair based on CCTV condition	Y	
Water			\$0			\$0
Water Mains	Track break history	Y		Spot repair	Y	
Water Facilities	Inspect (weekly per MECP mandate), backflow testing (annual)	Y		Spot repair	Y	
Water Appurtenances	Test, exercise, inspect: valves every 5 yrs, hydrants annually, curb stops every 7 yrs	Y		Spot repair based on condition (5-pt cdn for curb stops)	Y	
Wastewater			\$250			\$0
Sewer Mains	Flush (every 6 yrs), clean, CCTV inspect (frequency based on risk)	Y **	\$250 **	Spot repair based on CCTV condition	Y	
Wastewater Facilities	Region operates	Y		Region maintains	Y	
Wastewater Appurtenances	Clean, CCTV inspect (every 10 yrs)	Y		Repair based on CCTV condition	Y	

* Bridge repairs currently being done through capital works as recommended in the Bridge Needs Study

** shift survey from capital to operating

Operations and Maintenance Needs to Accommodate Future Growth and Upgrade

Additional operations and maintenance costs due to the growth or upgrade of assets are considered in this sub-section based on forecast new, expansion or upgraded assets. The following graph shows the forecast operations and maintenance needs for 2022 based on additional activities and assumed 2022 growth and upgrade. Upon completion of the stormwater CCTV inspections, additional routine stormwater activities may be identified. Upon transfer of the bridge and culvert repair work to operating, additional bridge and culvert activities may be added.

Figure 43 Operations and Maintenance Needs for the City’s Core Assets, by Service

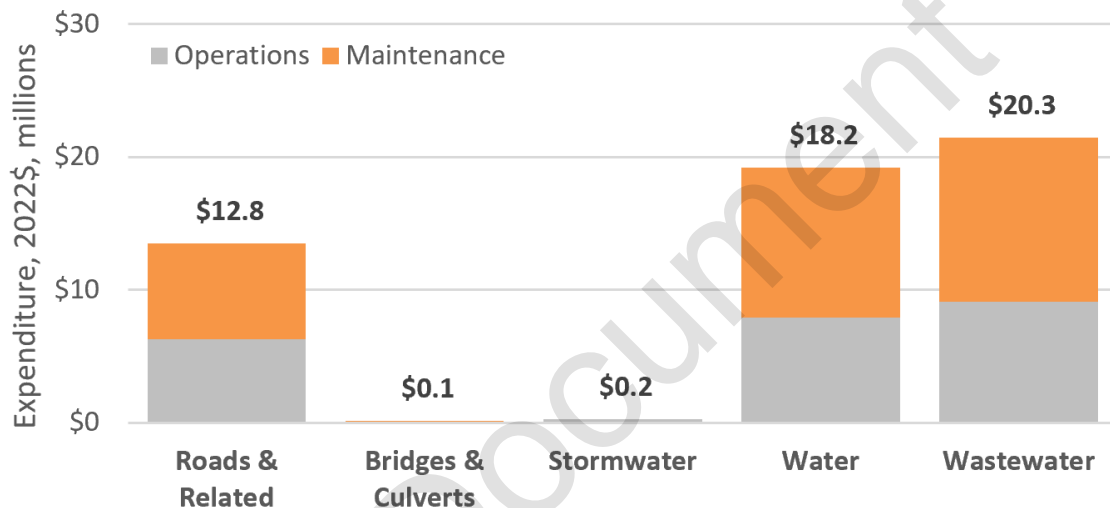
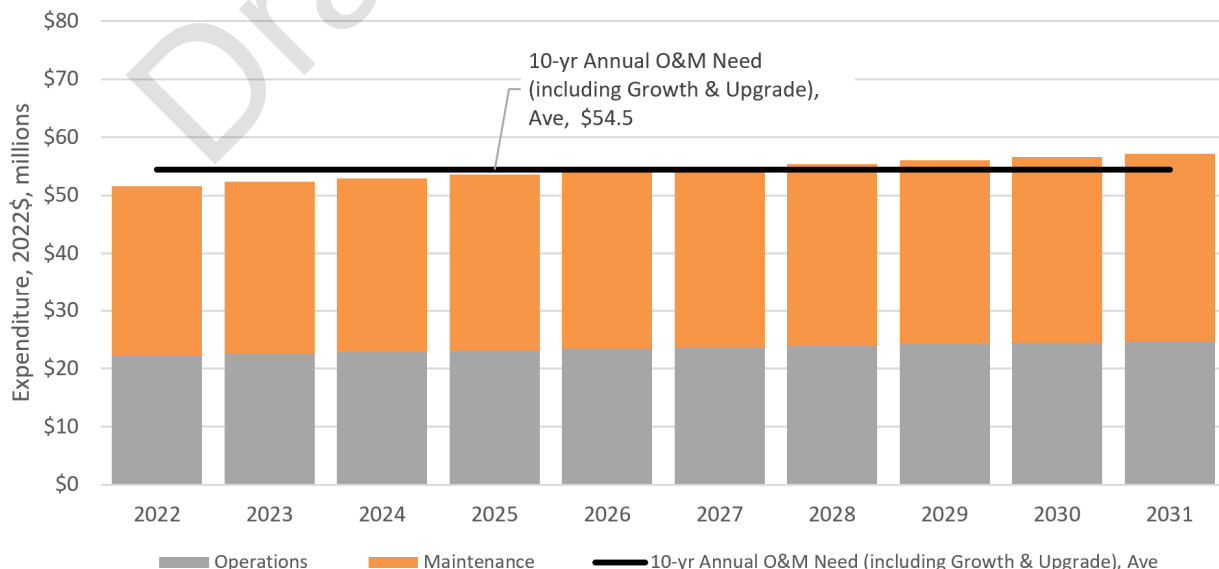


Figure 44 shows the total forecast operations and maintenance needs for the City’s core assets, including additional activities and growth and upgrade of the asset portfolio.

Figure 44 10-Year Forecast O&M Needs for the City’s Core Assets, including Growth & Upgrade



6 Financial Strategy

6.1 Introduction

The financial strategy is informed by the preceding sections of the AM Plan: the state or condition of the assets, the proposed levels of service, the risks to service delivery, and the lifecycle activities needed to reduce the risks to service delivery to acceptable levels. The financial strategy considers how the City will fund the planned asset management actions to meet the current service levels.

A global leader in asset management, the Local Government Association of Australia defines financial sustainability within the municipal government context as "... a government's ability to manage its finances so it can meet its spending commitments, both now and in the future. It ensures future generations of taxpayers do not face an unmanageable bill for government services provided to the current generation".

A municipality is in a financially sustainable position if it:

- Provides a level of service commensurate with willingness and ability to pay
- Can adjust service levels in response to changes in economic conditions or transfer payments from other levels of government
- Can adjust its implementation plans in response to changes in the rate of growth
- Has sufficient reserves and/or debt capacity to replace infrastructure when it needs to be replaced to keep its infrastructure in a state of good repair.

The key challenges to financial sustainability are:

- A discrepancy between level of service decisions and fiscal capacity
- The future cost of infrastructure investments
- Unforeseen impacts to revenue.

Per O.Reg. 588/17, this section of the AM Plan identifies the annual funding projected to be available to undertake the planned lifecycle activities and discusses strategies to address potential funding shortfalls.

6.2 City-Wide Core Assets Overview

6.2.1 Available Funding Amounts and Sources

Through the City's annual budget process, capital project and operating activity expenditure information is gathered from services areas / asset managers, including investment needs, trends and priorities to enable preparation of the capital and annual operating plans. The City currently approves one-year capital and operating plans and budgets. Note that O.Reg. 588/17 requires that AM Plans for proposed LOS (due by July

1, 2025) provide lifecycle management and financial strategies and annual funding projected to be available for each of the next 10 years.

The City’s main sources of revenue include property tax, debt, federal gas tax, third party grants, casino revenue, development charges, and user fees and charges. These funding sources are further outlined in the following table. There are restrictions on the use of funds from various sources (e.g. development charges, user fees).

Table 6-1 Key Sources of Funding and Financing

Funding Source	Description
Property Tax	Residential and commercial property owners pay an annual tax to the City
Debt	Long term borrowing, to be paid for by future taxpayers
Federal Gas Tax	Long-term grant agreement with the Association of Municipalities of Ontario that provides Federal gas tax revenues to municipalities for revitalization of infrastructure
Grants	Project specific grants / subsidies
OLG	Ontario Lottery and Gaming Corporation shares revenue with the municipalities that host our casinos (typically \$10 million/year, but \$0 million in 2021)
OCIF	Ontario Community Infrastructure Fund for small, rural and northern communities to develop and renew their infrastructure (typically \$3 million / year, but \$6.5 million in 2022)
User Fees	Funds collected for the use of City services or infrastructure (e.g., water/wastewater fees)

In addition to the above sources, capital reserves are established as a source of pay-as-you-go funding for the City’s capital program. Funding for these reserves is obtained through annual transfers from the operating budget. These annual reserve contributions sustain reserve balances at appropriate levels to address infrastructure replacement costs in the future and inherent uncertainties in capital funding needs. Reserve contributions are evaluated annually to ensure adequate funds are raised to meet future capital requirements and to smooth out the impact on the annual operating budget. The City minimizes impacts on residents through maximizing revenue sources such as grants.

Transportation assets (roads and related assets, bridges and culverts) and the stormwater management system are generally funded through property and other taxes, while the water and wastewater systems are funded through user fees (i.e. rates). The following table summarizes the historical 5-year expenditures (escalated to 2022\$ and averaged) and the 2022 available funding, by funding source, by service, by lifecycle strategy.

Table 6-2 5-Year Historic and Current Available Funding for the City's Core Assets, 2022\$, millions

Funding Source →	Property & Other Taxes		User Fees (Rates)	
Service →	Transportation + Stormwater		Water + Wastewater	
Lifecycle Strategy	5-yr Annual Expenditure History (average)*	2022 Approved Annual Funding	5-yr Annual Expenditure History (average)*	2022 Approved Annual Funding
Growth & Upgrade	\$5.3	\$4.7	\$5.4	\$8.7
Renewal	\$13.6	\$15.5	\$6.8	\$9.5
Operations	\$5.5	\$5.8	\$16.6	\$15.2
Maintenance	\$6.3	\$6.1	\$22.4	\$21.8
TOTALS	\$30.6	\$32.1	\$51.3	\$55.2

* escalated to 2022\$

The next section compares the expenditure history and budget forecasts against the forecast needs for the planned lifecycle activities to determine if there is a funding gap or surplus.

6.3 Details by Lifecycle Management Strategy

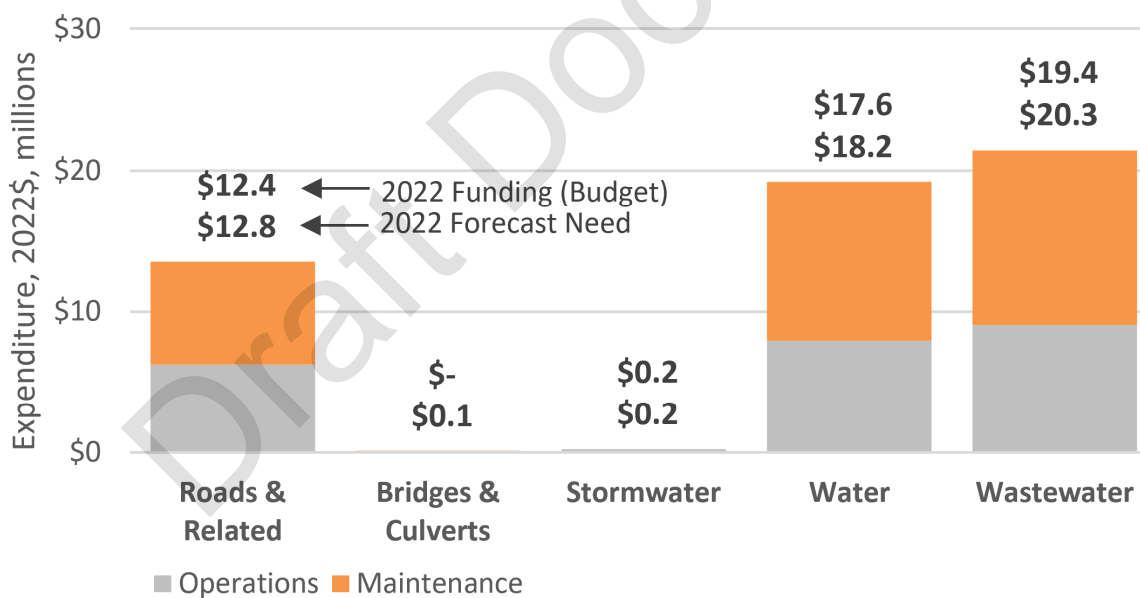
6.3.1 Financial Sustainability for Growth and Upgrade

For all services, the 2022 approved annual growth and upgrade budget is greater than the 10-year average annual forecast growth and upgrade needs, showing an annual surplus. As discussed in the previous section of the AM Plan, the confidence in the City-Constructed 10-year forecast growth and upgrade needs over the latter part of the forecast period is moderate. As the City updates its master plans over the next several years, the confidence in the growth and upgrade forecasts will improve and so will the financial sustainability assessment.

6.3.2 Financial Sustainability for Operations and Maintenance

For each service, Figure 45 provides the 2022 available funding or budget (top amount) and the 2022 forecast need (bottom amount) for operations and maintenance. The 2022 forecast need includes additional activities required to meet current LOS plus an increase to operate and maintain the forecast growth and upgrade of the asset portfolio. The forecast 2022 funding gap for transportation and stormwater management assets is \$0.5 million and, for water and water systems, \$1.5 million.

Figure 45 2022 O&M Funding Gap, by Service



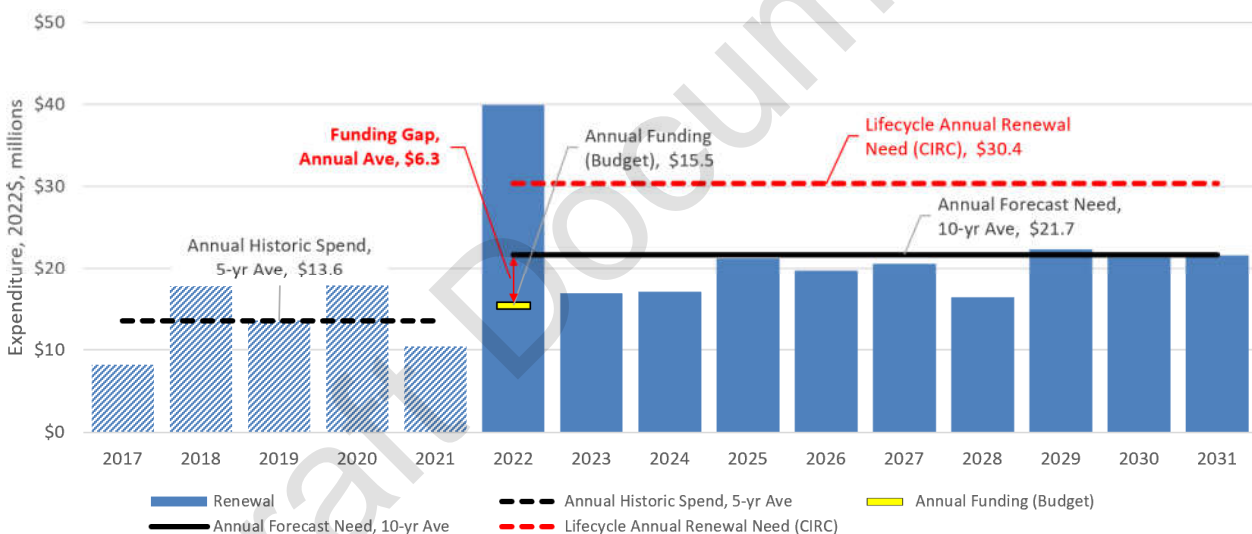
6.3.3 Financial Sustainability for Renewal

The largest funding gap was found for roads, bridges and culverts, and stormwater assets. For these assets, Figure ES-4 shows historic spending (dashed black line at \$13.6 million), and compares the 2022 budget (yellow line at \$15.5 million) to the 10-year average annual need forecast (solid black line at \$21.7 million) to show, in red text, an annual funding gap for each of the next ten years of \$6.3 million (a total of \$63 million over the 10-year period). If annual available funding were to remain at \$15.5 million over the

10-year period, at the end of the 10 years, the current \$40 million backlog would grow by \$63 million to over \$100 million.

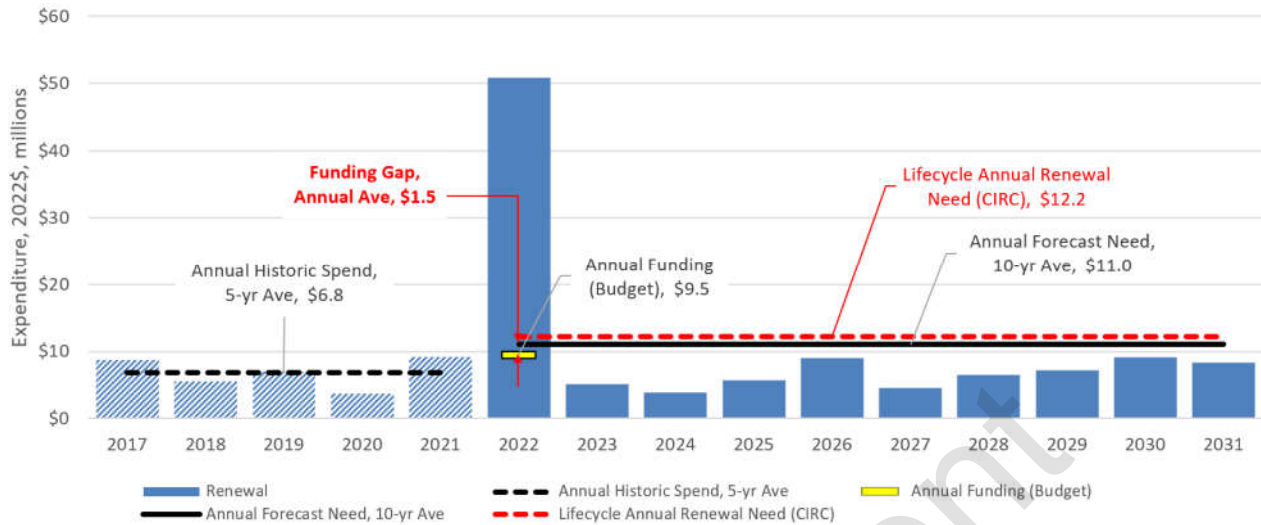
However, recall that the backlog of renewal needs shown in 2022 includes \$11.9 million in sidewalks for which the confidence is moderate because the forecast is age-based. The backlog also includes \$4.9 million in span bridges and municipal structures for which the confidence is high because the forecast is based on an industry standard inspection. Conducting sidewalk condition inspections will provide the confidence that the \$11.9 million sidewalk backlog truly exists or not. Without the sidewalk backlog, the 10-year average annual forecast renewal needs drop to \$20.4 million for an annual funding gap of \$4.9 million. Condition inspections and assessments of stormwater management system assets will also inform the backlog and amount of the funding gap. The lifecycle annual renewal need estimate of \$30.4 million based on the CIRC average annual renewal rate indicates that the 10-year average annual forecast needs of \$21.9 million is lower than renewal needs beyond the 10-year forecast period.

Figure 46 Transportation and Stormwater Annual Renewal Funding Gap



Water and wastewater assets are much closer to being fully funded. Figure 47 shows the 2022 approved annual budget (yellow line) as \$9.5 million, the 10-year average annual forecast needs (solid black line) as \$11.0 million, and the annual funding gap as \$1.5 million. The significant backlog is comprised primarily of \$8.3 million in water mains and \$20.9 million in sanitary storm sewers for which confidence in the forecast is high as the renewal forecast is based on inspected condition. However, all other water and wastewater system asset forecasts are based on age or an annual renewal amount.

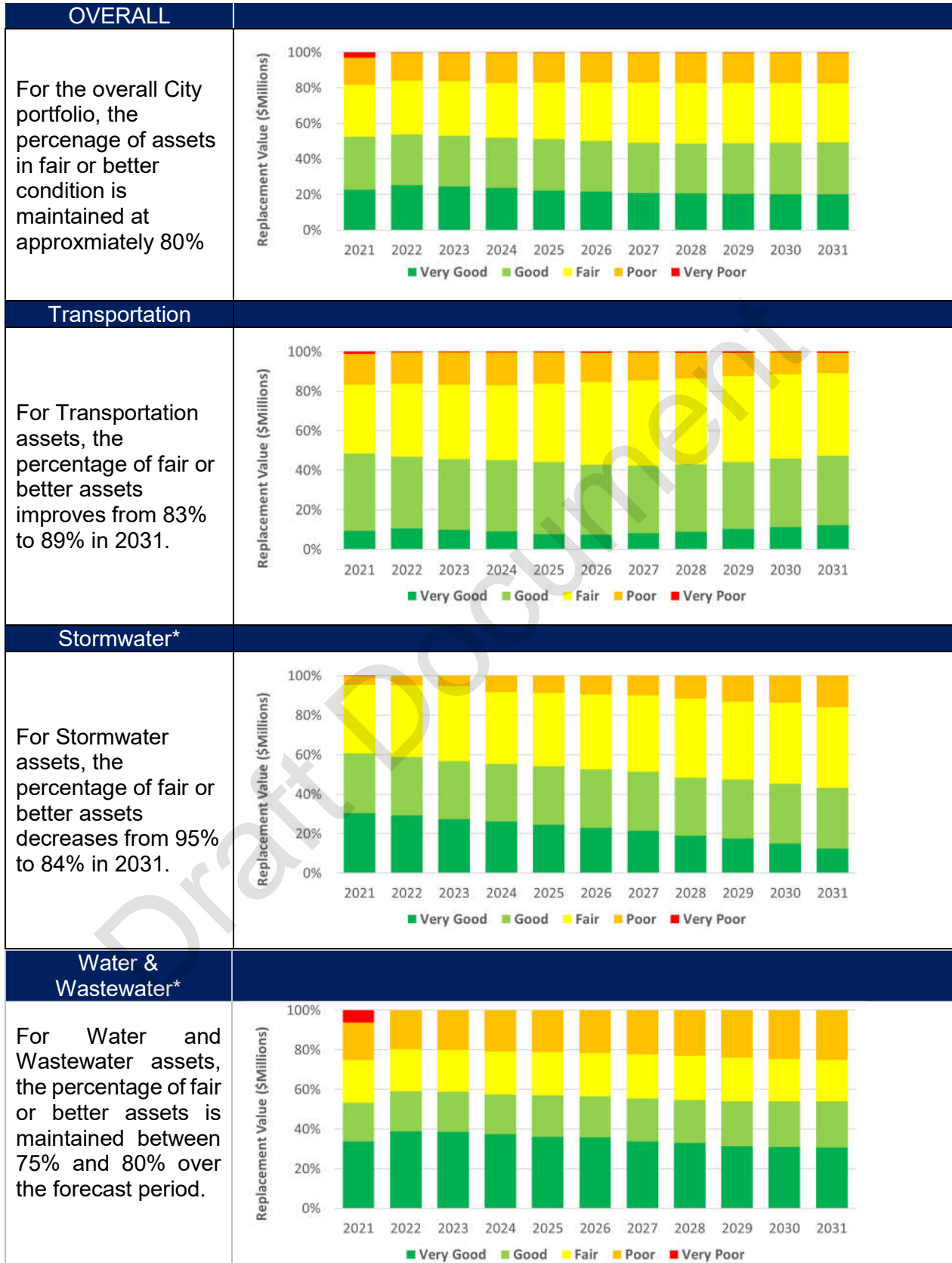
Figure 47 Water and Wastewater Annual Renewal Funding Gap



Impact of Planned Renewal Strategy on LOS (by Service)

Figure 48 Asset Condition Forecast Overall and by Service, shows the benefit of the planned strategy over the do nothing strategy by service. Based on currently available data, the stormwater portfolio does not require much renewal in the next 10 years, and the assets naturally deteriorate. However, the renewal requirements may be higher once storm sewer CCTV inspections are performed to better understand the current condition of those assets. Pond condition will also be forecasted after completion of bathymetric surveys.

Figure 48 Asset Condition Forecast Overall and by Service



*Does not include assets with unknown condition or forecasted with an average annual reinvestment rate such as stormwater ponds, water and wastewater facilities

6.3.4 Strategies to Close Funding Gaps

The transportation and stormwater management funding gaps may be closed by one or more of the following strategies:

- Reduce near term renewal needs by deferring capital renewal projects on lower risk assets, thereby lengthening the period in which the backlog is addressed beyond the 10 years, but likely increasing maintenance costs.
- Increase available funds through property tax increases, leveraging third party grants, or drawing on reserves
- Change the funding source for stormwater management from property taxes to a dedicated and stable stormwater user fee to recover the full cost of stormwater management.

The water and wastewater services funding gaps may be closed by one or more of the following strategies:

- Reduce near term renewal needs as described above
- Increase available funds through increased water and wastewater fees (rates) and leveraging third party grants.

7 AM Plan O.Reg. Compliance & Improvement Opportunities

7.1 Introduction

Development of AM Plans is an iterative process that includes improving processes, data, processes, and staff skills over time. This section provides an overview of the compliance of this AM Plan with Ontario Regulation 588/17 for current levels of service (year 2022 requirements) and identifies opportunities for improvements to the City's asset management practices, including those required to meet Ontario Regulation 588/17 for proposed levels of service prior to July 1, 2025.

7.2 Details by AM Plan Section

7.2.1 State of Local Infrastructure

O.Reg. 588/17 Compliance (Current LOS)

For each asset category, the AM Plan provides a summary of the assets, the replacement cost of the assets, the average age of the assets, the condition of the assets, and the approach to assessing condition of assets.

Improvement Opportunities

Continue to improve knowledge of asset replacement costs and current condition of the assets. Target efforts on highest criticality and high replacement value assets. This is an important first step as understanding of physical condition will improve confidence in future reporting of asset performance, risk assessments, and lifecycle management needs forecasts.

Specific improvements include the following:

- Complete bathymetric surveys for stormwater management ponds
- Undertake sidewalk, median and barrier condition assessments based on a standardized rating scale
- Continue the sanitary sewer CCTV inspection program and implement for storm sewers
- Continue inspections during watermain breaks and document condition with a standardized rating scale
- Undertake inspections of water, wastewater and stormwater facilities and appurtenances based on a standardized rating scale use (building condition assessment (BCA) Unifomat elements for facilities, NASSCO P/L/MACP for pipelines, laterals and maintenance holes)
- Improve installation year data for critical assets and infrastructure that cannot be tied to the forecast of other assets

- Continue to improve minor data gap improvements such as missing asset sizes to reduce need for assumptions.

7.2.2 Levels of Service

O.Reg. 588/17 Compliance (Current LOS)

For each asset category, the AM Plan provides the current LOS being provided. For core assets, the AM Plan provides the qualitative community descriptions and technical metrics as required by O.Reg. 588/17, the current performance and a draft proposed (i.e. target) performance.

Improvement Opportunities

Continue to review levels of service metrics that support lifecycle asset planning activities for specific asset types. Adjust or develop new measures as required.

Specific improvements include the following:

- % annual planned MMS inspections completed
- % preventive maintenance work orders completed on time
- % 10-year available funding to needs for each service or asset category and each service attribute (growth, function, and reliability).

7.2.3 Asset Management Strategy

O.Reg. 588/17 Compliance (Current LOS)

The AM Plan provides the population and employment forecasts as set out in Schedule 3 to the 2017 Growth Plan. For each asset category, the AM Plan provides the lifecycle activities that would need to be undertaken to maintain the current LOS for each of the next 10 years, based on risk and lowest lifecycle cost analyses.

Improvement Opportunities

Continue to optimize the lifecycle activities by searching out and testing various operations, maintenance and renewal activity and timing options, and then evaluating the benefits against the costs of each option over time to determine the lowest cost option for the required benefits.

Specific improvements include the following:

- Update master plans to improve growth forecasts and potentially lower levels of service to reduce costs
- Monitor build-out of developments and continue to adjust expansion activities in master plans to suit

- Review severe weather risks and the City's climate change responses, particularly for stormwater management
- Separately budget and track operating (maintenance and operations) and capital (growth, upgrade and renewal) costs by asset category (e.g. portion of project cost to road, sidewalks, stormwater management, water, wastewater), including staff time.

7.2.4 Financial Strategy

O.Reg. 588/17 Compliance (Current LOS)

The AM Plan provides the estimated 10-year capital expenditures and significant operating costs required to maintain the current levels of service to accommodate projected increases in demand caused by growth as set out in Schedule 3 to the 2017 Growth Plan.

For each asset category, the AM Plan provides the costs of providing the lifecycle activities that would need to be undertaken to maintain the current LOS for each of the next 10 years.

Improvement Opportunities

Continue to maximize funding sources such as grants to mitigate funding shortfalls and to use risk-based prioritization to address the most critical needs in years with limited funds.

Specific improvements include the following:

- Prepare 10-year operating and capital plans and budgets as required by O.Reg. 588/17 for AM Plans for proposed LOS (due by July 1, 2025)
- Update rate studies for water and wastewater to achieve full cost recovery, as required
- Investigate changing the funding source for stormwater management from property taxes to a dedicated and stable stormwater user fee to recover the full cost of stormwater management
- Increase operations and maintenance activity budgets as required to accommodate the growing asset portfolio.

7.3 AM Plan Monitoring and Review

The AM Plan will be updated every five years to ensure it reports an updated snapshot of the City's asset portfolio and its associated value, age, and condition. It will ensure that the City has an updated 10-year outlook including service levels, costs of the associated lifecycle strategies and as assessment of any funding shortfalls.

Per O.Reg. 588/17, the City will conduct an annual review of its asset management progress in implementing this AM Plan and will discuss strategies to address any factors impeding its implementation.

Appendix A – Asset Service Life and Replacement Cost

This appendix provides life and cost information used to develop the state of infrastructure section of the AM Plan.

Roads and Related, Bridges and Culverts

Table A-1 Estimated Useful Life for Roads and Related

Asset Category	Modelled As	Useful life
Paved Urban Arterial Roads w/C&G	Paved Urban Road	75
Paved Urban Collector Roads w/C&G	Paved Urban Road	75
Paved Urban Local Roads w/C&G	Paved Urban Road	75
Paved Semi Urban Arterial Roads	Paved Semi Urban Road & Rural Road	45
Paved Semi Urban Collector Roads	Paved Semi Urban Road & Rural Road	45
Paved Semi Urban Local Roads	Paved Semi Urban Road & Rural Road	45
Paved Rural Arterial Roads	Paved Semi Urban Road & Rural Road	45
Paved Rural Collector Roads	Paved Semi Urban Road & Rural Road	45
Paved Rural Local Roads	Paved Semi Urban Road & Rural Road	45
Unpaved Roads	Unpaved	7
Sidewalks	Sidewalks	75
Medians	Medians	50
Barriers	Barriers	50

Table A-2 Replacement Costs for Roads and Related

Asset Category	Replacement Costs
Paved Urban Arterial Roads w/C&G	\$205 / m2
Paved Urban Collector Roads w/C&G	\$138 / m2
Paved Urban Local Roads w/C&G	\$141 / m2
Paved Semi Urban Arterial Roads	\$110 / m2
Paved Semi Urban Collector Roads	\$110 / m2
Paved Semi Urban Local Roads	\$110 / m2
Paved Rural Arterial Roads	\$110 / m2
Paved Rural Collector Roads	\$110 / m2

Asset Category	Replacement Costs
Paved Rural Local Roads	\$110 / m ²
Unpaved Roads	\$36 / m ²
Sidewalks	\$121 / m ²
Medians	\$161 / m
Barriers	\$8.66 / m

Table A-3 Estimated Useful Life for Bridges and Culverts

Asset Category	Useful life
Span Bridges	75
Span Culverts	75
Municipal Structures	75

Stormwater Management System

Table A-4 Estimated Useful Life for Storm Sewers

Storm Sewer Material	Modelled As	Useful life
Asbestos Cement	Concrete	80
Brick	Unknown/Other	75
Clay	Unknown/Other	75
Concrete	Concrete	80
Corrugated Steel Pipe	Steel	75
High Density Polyethylene	Plastic	75
Polyethylene	Plastic	75
Polyvinyl Chloride	Plastic	75
Reinforced Concrete	Concrete	80
Unknown	Unknown/Other	75
Vitrified Clay	Unknown/Other	75
Corrugated Polyvinyl Chloride	Plastic	75
Steel	Steel	75
Corrugated Metal Pipe	Steel	75
Stainless Steel	Steel	75
Polypropylene	Steel	75

Table A-5 Replacement Costs for Storm Sewers

Size	Concrete	Plastic	Steel	Unknown/Other
100		\$439	\$439	\$439
150		\$439	\$439	\$439
200	\$439	\$439	\$439	\$439
225	\$439	\$439	\$439	\$439
250	\$439	\$439	\$439	\$439
275	\$439	\$439	\$439	\$439
280	\$439	\$439	\$439	\$439

Size	Concrete	Plastic	Steel	Unknown/Other
300	\$439	\$439	\$439	\$439
350	\$439	\$439	\$439	\$439
375	\$439	\$439	\$439	\$439
400	\$414	\$414	\$414	\$414
450	\$414	\$414	\$414	\$414
500	\$604	\$604	\$604	\$604
525	\$604	\$604	\$604	\$604
530	\$604	\$604	\$604	\$604
550	\$604	\$604	\$604	\$604
600	\$690	\$690	\$690	\$690
650	\$776	\$776	\$776	\$776
675	\$776	\$776	\$776	\$776
700	\$776	\$776	\$776	\$776
750	\$948	\$984	\$948	\$948
800	\$1,119	\$1,119	\$1,119	\$1,119
825	\$1,119	\$1,119	\$1,119	\$1,119
900	\$1,291	\$1,291	\$1,291	\$1,291
975	\$1,605	\$1,605	\$1,605	\$1,605
1050	\$1,605	\$1,119	\$1,605	\$1,605
1200	\$1,605		\$1,605	\$1,605
1300	\$1,605		\$1,605	\$1,605
1350	\$1,605		\$1,605	\$1,605
1375	\$1,605		\$1,605	\$1,605
1400	\$1,605		\$1,605	\$1,605
1500	\$1,605		\$1,605	\$1,605
1525	\$1,605		\$1,605	\$1,605
1650	\$1,605		\$1,605	\$1,605
1800	\$1,605		\$1,605	\$1,605
1825	\$1,605		\$1,605	\$1,605
1950	\$1,605		\$1,605	\$1,605
2100	\$1,605		\$1,605	\$1,605
2400	\$1,605		\$1,605	\$1,605

Table A-6 Estimated Useful Life for Catchbasin Leads

Catchbasin Lead Material	Modelled As	Useful life
Asbestos Cement	Concrete	80
Brick	Unknown/Other	80
Clay	Unknown/Other	80
Concrete	Concrete	80
Corrugated Steel Pipe	Steel	80
High Density Polyethylene	Plastic	80
Polyethylene	Plastic	80

Catchbasin Lead Material	Modelled As	Useful life
Polyvinyl Chloride	Plastic	80
Reinforced Concrete	Concrete	80
Unknown	Unknown/Other	80
Vitrified Clay	Unknown/Other	80

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Table A-7 Replacement Costs for Catchbasin Leads

Size	Concrete	Plastic	Steel	Unknown/Other
25	\$316	\$316	\$316	\$316
38	\$316	\$316	\$316	\$316
50	\$316	\$316	\$316	\$316
100	\$316	\$316	\$316	\$316
150	\$420	\$420	\$420	\$420
200	\$650	\$650	\$650	\$650
225	\$650	\$650	\$650	\$650
250	\$650	\$650	\$650	\$650
280	\$650	\$650	\$650	\$650
300	\$650	\$650	\$650	\$650
350	\$650	\$650	\$650	\$650
375	\$650	\$650	\$650	\$650
400	\$650	\$650	\$400	\$400
Unknown	\$316	\$316	\$316	\$316

Table A-8 Estimated Useful Life for SWM Ponds

Asset Category	Useful Life
SWM Pond	50

Table A-9 Replacement Costs for SWM Ponds

Asset Category	Replacement Cost
SWM Pond	\$169 / m3

Water System

Table A-10 Estimated Useful Life for Water Mains

Water Main Material	Modelled As	Useful life
Asbestos Cement	Concrete	75
Cast Iron	Metal	75
Concrete Pressure Pipe	Concrete	75
Copper	Metal	75
Ductile Iron	Metal	75
Ductile Iron Cement Lined	Concrete	75
High Density Polyethylene	Plastic	75
Polyethylene	Plastic	75
Polyvinyl Chloride	Plastic	75
Steel	Metal	75
Unknown	Unknown	75

Table A-11 Replacement Costs for Water Mains

Size	Concrete	Plastic	Metal	Unknown
25	\$257	\$214	\$214	\$214
38	\$257	\$214	\$214	\$214
50	\$257	\$214	\$214	\$214
100	\$408	\$340	\$340	\$340
150	\$456	\$380	\$380	\$380
200	\$780	\$650	\$650	\$650
250	\$1,105	\$921	\$921	\$921
300	\$1,429	\$1,191	\$1,191	\$1,191
350	\$1,754	\$1,462	\$1,462	\$1,462
400	\$2,078	\$1,732	\$1,732	\$1,732
450	\$2,405	\$2,004	\$2,004	\$2,004
500	\$2,729	\$2,274	\$2,274	\$2,274

Table A-12 Estimated Useful Life for Water Appurtenances

Asset Category	Useful life
Hydrants	75
Valves	60
Meters	20
Services	75
Curb Stops	75

Table A-13 Replacement Costs for Water Appurtenances

Asset Category	Replacement Costs
Valves	See table below
Hydrants	\$9,467
Meters	\$525
Services	\$296
Curb Stops	\$501

Table A-14 Replacement Costs for Water Valves

Size	Box	Chamber	Unknown
25	\$813	\$813	\$813
38	\$813	\$813	\$813
50	\$813	\$813	\$813
100	\$1,909	\$1,909	\$1,909
150	\$2,190	\$2,212	\$2,190
200	\$5,273	\$5,273	\$5,273
250	\$6,170	\$5,722	\$6,170
300	\$6,920	\$6,350	\$6,920
350	\$6,920	\$6,350	\$6,920
400	\$6,920		
500	\$6,920		

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Wastewater System

Table A-15 Estimated Useful Life for Sewer Mains

Sewer Main Material	Modelled As	Useful life
Asbestos Cement	Concrete	80
Brick	Unknown/Other	75
Clay	Unknown/Other	75
Concrete	Concrete	80
Corrugated Steel Pipe	Steel	75
High Density Polyethylene	Plastic	75
Polyethylene	Plastic	75
Polyvinyl Chloride	Plastic	75
Reinforced Concrete	Concrete	80
Unknown	Unknown/Other	75
Vitrified Clay	Unknown/Other	75
Corrugated Polyvinyl Chloride	Plastic	75
Steel	Steel	75
Corrugated Metal Pipe	Steel	75
Stainless Steel	Steel	75
Polypropylene	Steel	75

Table A-16 Replacement Costs for Sewer Mains

Size	Concrete	Plastic	Steel	Unknown/Other
25	\$439	\$401	\$401	\$401
38	\$439	\$401	\$401	\$401
50	\$439	\$401	\$401	\$401
100	\$439	\$401	\$401	\$401
150	\$439	\$401	\$401	\$401
200	\$439	\$401	\$401	\$401
225	\$439	\$468	\$468	\$468
250	\$439	\$468	\$468	\$468
280	\$439	\$634	\$634	\$634
300	\$439	\$634	\$634	\$634
350	\$439	\$634	\$634	\$634
375	\$439	\$650	\$650	\$650
400	\$414	\$1,285	\$650	\$650
450	\$414	\$1,285	\$650	\$650
500	\$604	\$1,285	\$650	\$650
525	\$604	\$1,285	\$650	\$650
600	\$690	\$1,285	\$690	\$690
675	\$776	\$1,285	\$776	\$776
750	\$948	\$1,285	\$948	\$948
825	\$1,119	\$1,285	\$1,119	\$1,119
900	\$1,291	\$1,285	\$1,291	\$1,291

Size	Concrete	Plastic	Steel	Unknown/Other
1050	\$1,605	\$1,285	\$1,605	\$1,605
1200	\$1,605	\$1,285	\$1,605	\$1,605
1300	\$1,605		\$1,605	\$1,605
1350	\$1,605		\$1,605	\$1,605
1400	\$1,605		\$1,605	\$1,605
1500	\$1,605		\$1,605	\$1,605
1575	\$1,605		\$1,605	\$1,605
1650	\$1,605		\$1,605	\$1,605
1800	\$1,605		\$1,605	\$1,605
2100	\$1,605		\$1,605	\$1,605

Table A-17 Estimated Useful Life for Sanitary Laterals

Sanitary Laterals Material	Modelled As	Useful life
Asbestos Cement	Concrete	80
Brick	Unknown/Other	80
Clay	Unknown/Other	80
Concrete	Concrete	80
Corrugated Steel Pipe	Steel	80
High Density Polyethylene	Plastic	80
Polyethylene	Plastic	80
Polyvinyl Chloride	Plastic	80
Reinforced Concrete	Concrete	80
Unknown	Unknown/Other	80
Vitrified Clay	Unknown/Other	80

Table A-18 Replacement Costs for Sanitary Laterals

Size	Concrete	Plastic	Steel	Unknown/Other
25	\$316	\$316	\$316	\$316
38	\$316	\$316	\$316	\$316
50	\$316	\$316	\$316	\$316
100	\$316	\$316	\$316	\$316
150	\$420	\$420	\$420	\$420
200	\$650	\$650	\$650	\$650
225	\$650	\$650	\$650	\$650
250	\$650	\$650	\$650	\$650
280	\$650	\$650	\$650	\$650
300	\$650	\$650	\$650	\$650
350	\$650	\$650	\$650	\$650
375	\$650	\$650	\$650	\$650
400	\$650	\$650	\$400	\$400
Unknown	\$316	\$316	\$316	\$316

Table A-19 Estimated Useful Life for Wastewater Appurtenances

Wastewater Asset	Useful life
Facilities-Treatment	50
Facilities-Storage & Pumping	50
Maintenance Holes	80
Cleanouts	80
Storage Tanks	80

Table A-20 Replacement Costs for Wastewater Appurtenances

Wastewater Asset	Replacement Costs
Facilities-Treatment	\$14,822,000 / each
Facilities-Storage & Pumping	\$2,129,400 / each
Maintenance Holes	\$10,764 / m
Cleanouts	\$1,039 / each
Storage Tanks	\$1,291 / m

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CITY OF NIAGARA FALLS

**2021 STRUCTURE ASSET MANAGEMENT COST FORECAST
SPAN STRUCTURES (SPANS 3.0m AND GREATER)**

January 2022



ELLIS Engineering Inc.
214 Martindale Road, Suite 201
St. Catharines, ON L2S 0B2
Phone: (905) 934-9049
Web: www.ellis.on.ca



ELLIS
Engineering Inc.



ELLIS
Engineering Inc.

ELLIS Engineering Inc.
Consulting Engineers
214 Martindale Rd, Suite 201
St. Catharines, ON, Canada
L2S 0B2

Tel: (905) 934-9049
Web: www.ellis.on.ca

January 11, 2022

The City of Niagara Falls
Municipal Works Department
4310 Queen Street
Niagara Falls, ON
L2E 6X5

Attention: Tara Gudgeon HBS, Infrastructure Asset Manager

Reference: 2021 Structure Asset Management Cost Forecast – Span Structures (Spans of 3.0m or Greater). ELLIS Job No.: 981

We are pleased to submit the 2021 Structure Asset Management Cost Forecast (SAMCF) for the City of Niagara Falls Span Structures, which includes all bridges and culverts with spans of 3.0 metres or greater. The SAMCF expands on information gathered from the 2020 Municipal Bridge Appraisal. The following report contains information relating to the City's 69 bridge and culvert structures with spans greater than 3 metres.

Background:

We reviewed the 2020 bridge appraisal, also referenced in this document as "inspection reports" (REF: 2020 Municipal Bridge Appraisal - Rehabilitation/Replacement Needs, Span Structure Inspections, completed by ELLIS Engineering Inc. in October 2020).

The above noted structure inspection reports formed the basis for the estimation of the expected remaining service life for each structure, as well as the estimated costs for any future replacement and/or rehabilitation needs for each structure.

Expected Remaining Service Life of Existing Structures:

The expected remaining service life (ERSL) was estimated for each existing structure on a case-by-case basis. In general, we have estimated the ERSL based on four criteria (further defined on the following page):

1. The assessed age of the structure.
2. The intended design life.
3. The type of structure.
4. The current condition of the structure as determined by the 2020 structure inspections.

.../2

1. Age of Structure

The age of some structures could be identified from the inspection reports. However, the age of many structures was estimated from the type of construction, condition of exposed concrete or other elements, and the age of similar proximal structures.

2. Intended Design Life

Previous to the 2000 Canadian Highway Bridge Design Code (CHBDC, CSA-S6-00), the design service life for span bridges was typically 50 years. The 2000 code (and subsequent codes) increased the design service life to 75 years. For structures with estimated dates of construction prior to 2000, an intended design service life of 50 years may be applied. For structures with estimated dates of construction after 2000, an intended design service life of 75 years was applied.

3. Type of Structure

For structure types with high potential for corrosion (such as Corrugated Steel Pipe) an ERSL of less than 50 years was applied. Our experience indicates that the rate of corrosion depends largely on the waterway.

In our experience, we have found certain structure types (such as concrete rigid frames and concrete rigid box culverts) consistently exceed their intended 50 year design life. Depending on the current condition of structure, roadway type, and quality of construction, a concrete rigid frame structure may remain in service for 75-100 years.

4. Current Condition of Structure

The ERSL of any structure is closely related to the current condition of the structure as determined by the most recent structure inspection. For example, a structure in poor condition that has been recommended for replacement with a priority rating of 'NOW' would have 0 years of service life remaining. Table 1, below, summarizes the relationship between priority rating and ERSL.

Table 1: ERSL for Structures Recommended for Replacement

Priority Rating	ERSL
NOW	0
1-5 Years	5
6-10 Years	10

Any structure that has not been recommended for replacement in the next 10 years would have an ERSL of 15 years or greater. With all else equal, a structure with a better 'General Overall Condition' or a higher 'Bridge Condition Index' (BCI) would have a greater ERSL.

The structure types and estimated construction dates are illustrated in Figure 1 on the following page.

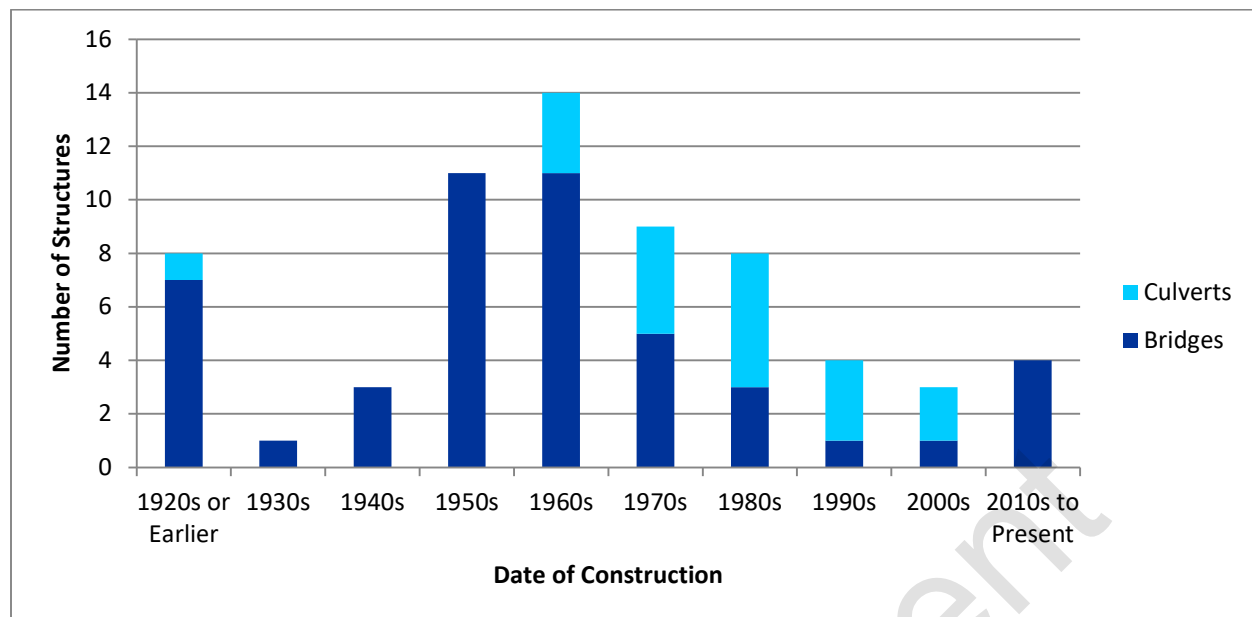


Figure 1: Estimated Dates of Construction

Estimated Replacement and Rehabilitation Costs:

Where relevant, the estimated replacement and rehabilitation costs from the 2020 appraisal (inspection reports) were utilized. Those estimates were calculated based on preliminary engineering assumptions. The accuracy of those cost estimates are in an approximated range of plus or minus 20%. The scope of the 2020 inspection report estimates was for work to be completed in the next 10 years.

For rehabilitation and replacement work beyond the next 10 years, the three following assumptions were utilized as necessary to derive the costs estimates:

1. Design Service Life of 75 years was considered for all replacement structures, excluding corrugated steel pipe structures (CSP), and prefabricated pedestrian bridges. A Design Service Life of 50 years was typically considered for CSP structures steel pedestrian structures.
2. No changes made to the roadway geometry or deck cross-section (i.e. single lane structures replaced with single lane structures).
3. Similar hydraulic cross-section and type of foundation.

In general, most structure replacements could be estimated from a unit replacement cost based on the deck area. The unit replacement costs used are based on our most recent construction experience with structures similar in size and complexity.

In general, rehabilitation costs were estimated assuming a minor rehabilitation for each structure after 25 years of service (20% of replacement cost) and a major rehabilitation for each structure after 50 years of service (40% of replacement cost). Table 2, on the following page, summarizes the unit replacement and rehabilitation costs that were utilized. Unit costs vary with the size of the structure.

Table 2: Unit Replacement and Rehabilitation Costs for each Structure Size by Deck Area

Structure Size	Replacement Cost (\$/m ² deck area)	Major Rehabilitation Cost (\$/m ² deck area)	Minor Rehabilitation Cost (\$/m ² deck area)
Deck Area < 150m ²	\$ 8,000	\$ 3,200	\$ 1,600
150m ² < Deck Area < 1,500m ²	\$ 7,000	\$ 2,800	\$ 1,400
Deck Area > 1,500m ²	\$ 6,000	\$ 2,400	\$ 1,200

Estimated replacement and rehabilitation costs include engineering fees, but do not include any contingencies. Design and contract administration fees are estimated as 15% of the total construction cost.

The estimated replacement costs for each structure are included in the appendix. The total replacement value for all 69 span structures is \$129,630,000.

Financial Analysis:

A net present value financial analysis was completed in general accordance with the Ontario Ministry of Transportation's Structural Financial Analysis Manual. An evaluation period of 75 years was employed. A base discount rate of 2.0% was applied to determine the net present value (NPV) for each structure, enabling a total dollar value to be derived in today's dollars (the applied discount rate is further discussed in the next section) for all anticipated rehabilitation and replacement work on each structure over the next 75 years.

Rehabilitation and replacement life cycle costs (treatments) were applied to each structure on a case-by-case basis in order to produce a realistic net present value model. The first step was to review any recommendations and/or cost estimates contained in the 2020 inspection reports. If no recommendations existed, then anticipated treatments were derived from the relevant inspection data and ERS� of each structure. In general, rehabilitation costs were simplified by assuming a minor rehabilitation for each structure after 25 years of service and a major rehabilitation for each structure after 50 years of service.

A net present value was then produced for each structure. A 75-year Design Service Life was used for all replacement structures (required durability for new structures as per the CHBDC).

Summary of Results:

The results of the net present value financial analysis for a base discount rate of 2.0% are summarized in Table 3, below.

Table 3: Results of Financial Analysis at a Discount Rate of 2.0%

Category of Structure	No. of Structures	Total Deck Area (m ²)	Total NPV Cost for 75 Years	Average NPV Cost per Year over 75 Years	Total NPV Costs for First 30 Years	Average NPV Cost per Year for First 30 Years
All Structures with Spans of 3m or Greater	69	20,267	\$ 102,612,000	\$ 1,368,000	\$ 70,490,000	\$ 2,350,000
Large Structures (over 1,500m ² deck area)	5	11,025	\$ 48,312,000	\$ 644,000	\$ 34,468,000	\$ 1,149,000

Note: Costs rounded to nearest \$1,000.

The summary of results in Table 3 indicates that in order to maintain the current inventory of 69 span structures, a total of \$102,612,000 (in today's dollars) must be allocated over the next 75 years. The average total cost (in today's dollars) to be allocated is \$1,368,000 each year. The future average total cost per year should be adjusted for inflation. Approximately 47% of the total costs are related to the City's five largest (by deck area) bridge and culvert assets.

Figure 2, below, summarizes the total NPV cost per year projected for the next 75 years. The costs are concentrated in the first 30 years with approximately 69% of the total costs occurring during this period. The average total cost (in today's dollars) to be allocated per year is \$2,350,000 for the first 30 years. The concentration of costs in the first 30 years is related to the concentration of structures constructed from approximately 1950 to 1980 as summarized in Figure 1 (see page 3). Many of these structures will require major rehabilitation and/or replacement within the next 30 years.

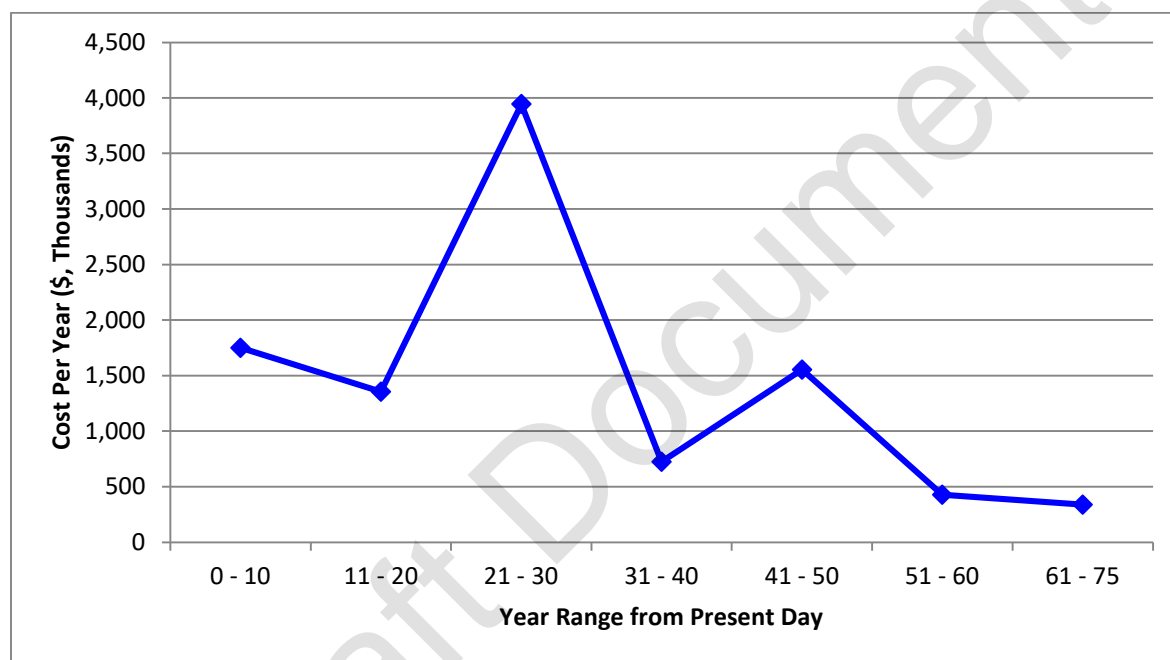


Figure 2: Net Present Value Cost per Year for the next 75 Years

Financial Sensitivity Analysis:

A base discount rate of 2.0% was used. Variable discount rates were used for the analysis to determine the sensitivity of the cost to the applied discount rate. The total cost and total cost per year were found to be sensitive to the discount rate utilized.

The sensitivity analysis was performed by varying the discount rate +/- 1.5% in 0.5% increments in order to produce a variety of present value financial analysis scenarios. The results of the sensitivity analysis are included in the attached spreadsheet.

Closing:

We thank you for giving us the opportunity to provide our services for this very interesting project. Should you have any questions concerning the report, please contact the undersigned.

Yours truly,

ELLIS Engineering Inc.



Arih Struger-Kalkman, P. Eng., M. Eng.
Project Manager



Emma Stephenson
Project Assistant

Attachments:

1. 2021 SAMCF – NF Span Structures Spreadsheet (PDF, 1 Page)
2. 2021 SAMCF – NF Span Structures Spreadsheet (Microsoft EXCEL Spreadsheet, Separate File)

Draft Document



CITY OF NIAGARA FALLS

**2021 STRUCTURE ASSET MANAGEMENT COST FORECAST
MUNICIPAL STRUCTURES (SPANS LESS THAN 3.0m)**

January 2022



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Engineering Inc.



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Web: www.ellis.on.ca

January 11, 2022

The City of Niagara Falls
Municipal Works Department
4310 Queen Street
Niagara Falls, ON
L2E 6X5

Attention: Tara Gudgeon HBSc, Infrastructure Asset Manager

Reference: 2021 Structure Asset Management Cost Forecast – Municipal Structures (Spans less than 3.0m). ELLIS Job No.: 981

We are pleased to submit the 2021 Structure Asset Management Cost Forecast (SAMCF) for the City of Niagara Falls Span Structures, which includes all bridges and culverts with spans less than 3.0 metres. The SAMCF expands on information gathered from the 2020 Municipal Bridge Appraisal. The following report contains information relating to the City's 81 bridge and culvert structures with spans less than 3 metres.

Background:

We reviewed the 2020 bridge appraisal, also referenced in this document as "inspection reports" (REF: 2020 Municipal Bridge Appraisal - Rehabilitation/Replacement Needs, Municipal Structure Inspections, completed by ELLIS Engineering Inc. in October 2020). We inspected eight additional municipal structures in 2021, which were added to the Municipal Bridge Database after the 2020 inspections.

The above noted structure inspection reports formed the basis for the estimation of the expected remaining service life for each structure, as well as the estimated costs for any future replacement and/or rehabilitation needs for each structure.

Expected Remaining Service Life of Existing Structures:

The expected remaining service life (ERSL) was estimated for each existing structure on a case-by-case basis. In general, we have estimated the ERS� based on four criteria (further defined on the following page):

1. The assessed age of the structure.
2. The intended design life.
3. The type of structure.
4. The current condition of the structure as determined by the most recent structure inspection.

.../2

1. Age of Structure

The age of some structures could be identified from the inspection reports. However, the age of many structures was estimated from the type of construction, condition of exposed concrete or other elements, and the age of similar proximal structures.

2. Intended Design Life

Previous to the 2000 Canadian Highway Bridge Design Code (CHBDC, CSA-S6-00), the design service life for span bridges was typically 50 years. The 2000 code (and subsequent codes) increased the design service life to 75 years. For structures with estimated dates of construction prior to 2000, an intended design service life of 50 years may be applied. For structures with estimated dates of construction after 2000, an intended design service life of 75 years was applied.

3. Type of Structure

For structure types with high potential for corrosion (such as Corrugated Steel Pipe) an ERSL of less than 50 years was typically applied. Our experience indicates that the rate of corrosion depends largely on the waterway.

In our experience, we have found certain structure types (such as concrete rigid frames and concrete rigid box culverts) consistently exceed their intended 50 year design life. Depending on the current condition of structure, roadway type, and quality of construction, a concrete rigid frame structure may remain in service for 75-100 years.

4. Current Condition of Structure

The ERSL of any structure is closely related to the current condition of the structure as determined by the most recent structure inspection. For example, a structure in poor condition that has been recommended for replacement with a priority rating of 'NOW' would have 0 years of service life remaining. Table 1, below, summarizes the relationship between priority rating and ERSL.

Table 1: ERSL for Structures Recommended for Replacement

Priority Rating	ERSL
NOW	0
1-5 Years	5
6-10 Years	10

Any structure that has not been recommended for replacement in the next 10 years would have an ERSL of 15 years or greater. With all else equal, a structure with a better 'General Overall Condition' or a higher 'Bridge Condition Index' (BCI) would have a greater ERSL.

The structure types and estimated construction dates are illustrated in Figure 1 on the following page.

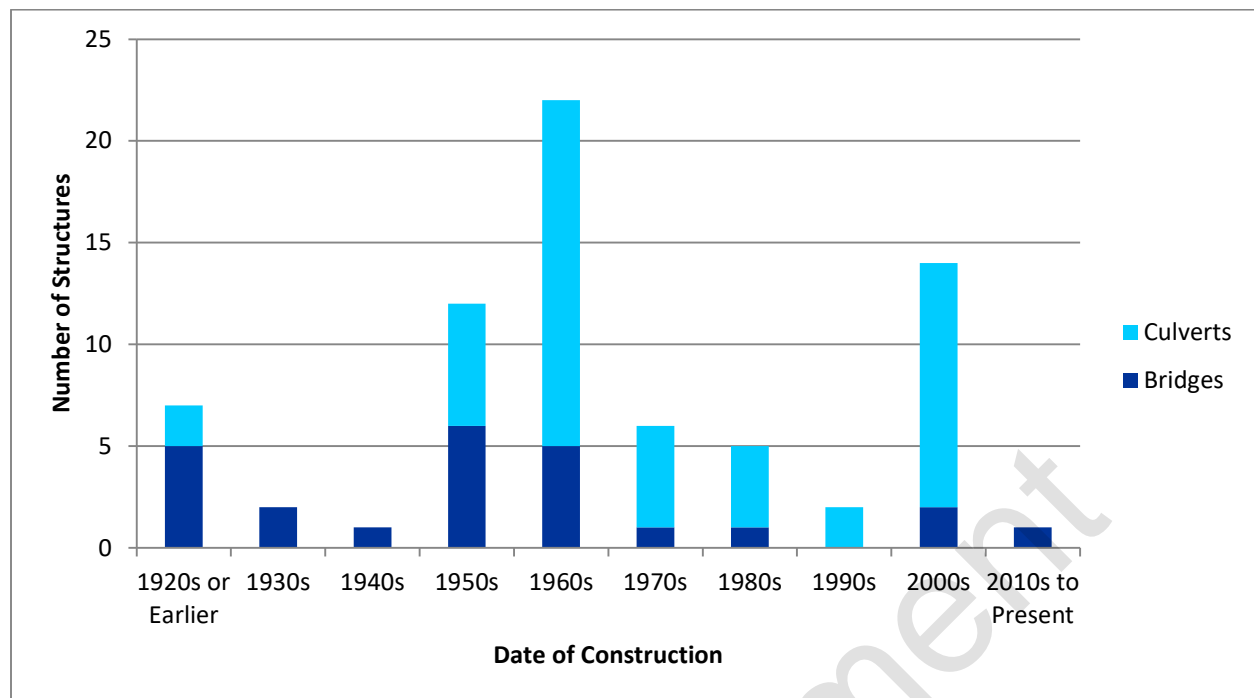


Figure 1: Estimated Dates of Construction

Estimated Replacement and Rehabilitation Costs:

Where relevant, the estimated replacement and rehabilitation costs from the appraisal (inspection reports) were utilized. Those estimates were calculated based on preliminary engineering assumptions. The accuracy of those cost estimates are in an approximated range of plus or minus 20%. The scope of the inspection report estimates was for work to be completed in the next 10 years.

For rehabilitation and replacement work beyond the next 10 years, the three following assumptions were utilized as necessary to derive the costs estimates:

1. Design Service Life of 75 years was considered for all replacement structures, excluding corrugated steel pipe structures (CSP), and prefabricated pedestrian bridges. A Design Service Life of 50 years was typically considered for CSP structures.
2. No changes made to the roadway geometry or deck cross-section (i.e. single lane structures replaced with single lane structures).
3. Similar hydraulic cross-section and type of foundation.

In general, most structure replacements could be estimated from a unit replacement cost based on the deck area. The unit replacement costs used are based on our most recent construction experience with structures similar in size and complexity.

In general, rehabilitation costs were estimated assuming a minor rehabilitation for each structure after 25 years of service (20% of replacement cost) and a major rehabilitation for each structure after 50 years of service (40% of replacement cost). Table 2, on the following page, summarizes the unit replacement and rehabilitation costs that were utilized.

Table 2: Unit Replacement and Rehabilitation Costs for each Structure Size by Deck Area

Structure Size	Replacement Cost (\$/m ² deck area)	Major Rehabilitation Cost (\$/m ² deck area)	Minor Rehabilitation Cost (\$/m ² deck area)
Deck Area < 150m ²	\$ 8,000	\$ 3,200	\$ 1,600

Estimated replacement and rehabilitation costs include engineering fees, but do not include any contingencies. Design and contract administration fees are estimated as 15% of the total construction cost.

The estimated replacement costs for each structure are included in the appendix. The total replacement value for all 81 municipal structures is \$19,779,500.

Financial Analysis:

A net present value financial analysis was completed in general accordance with the Ontario Ministry of Transportation's Structural Financial Analysis Manual. An evaluation period of 75 years was employed. A base discount rate of 2.0% was applied to determine the net present value (NPV) for each structure, enabling a total dollar value to be derived in today's dollars (the applied discount rate is further discussed in the next section) for all anticipated rehabilitation and replacement work on each structure over the next 75 years.

Rehabilitation and replacement life cycle costs (treatments) were applied to each structure on a case-by-case basis in order to produce a realistic net present value model. The first step was to review any recommendations and/or cost estimates contained in the 2020 and 2021 inspection reports. If no recommendations existed, then anticipated treatments were derived from the relevant inspection data and ERS� of each structure. In general, rehabilitation costs were simplified by assuming a minor rehabilitation for each structure after 25 years of service and a major rehabilitation for each structure after 50 years of service.

A net present value was then produced for each structure. A 75-year Design Service Life was used for all replacement structures (required durability for new structures as per the CHBDC).

Summary of Results:

The results of the net present value financial analysis for a base discount rate of 2.0% are summarized in Table 3, below.

Table 3: Results of Financial Analysis at a Discount Rate of 2.0%

Category of Structure	No. of Structures	Total Deck Area (m ²)	Total NPV Cost for 75 Years	Average NPV Cost per Year over 75 Years	Total NPV Costs for First 10 Years	Average NPV Cost per Year for First 10 Years
All Municipal Structures (Spans < 3m)	81	2,534	\$ 15,877,000	\$ 212,000	\$ 4,264,000	\$ 426,000

Note: Costs rounded to nearest \$1,000.

The summary of results in Table 3 indicates that in order to maintain the current inventory of 81 municipal structures, a total of \$15,877,000 (in today's dollars) must be allocated over the next 75 years. The average total cost (in today's dollars) to be allocated is \$212,000 each year. The future average total cost per year should be adjusted for inflation.

Figure 2, below, summarizes the total NPV cost per year projected for the next 75 years. The costs are concentrated in the first 10 years with approximately 27% of the total costs occurring during this period. The average total cost (in today's dollars) to be allocated per year is \$426,000 for the first 10 years. The concentration of costs in the first 10 years is related to the concentration of structures constructed from approximately 1950 to 1960 as summarized in Figure 1 (see page 3). There are also ten municipal structures constructed prior to 1950. Many of the structures constructed in the 1960's and prior will require replacement within the next 10 years.

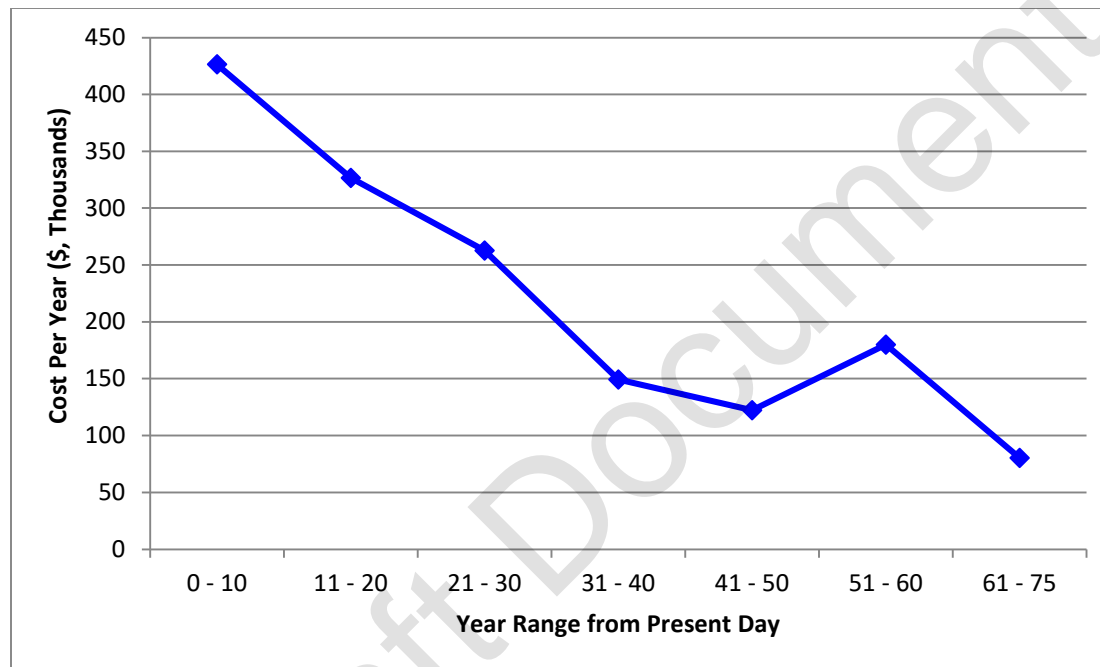


Figure 2: Net Present Value Cost per Year for the next 75 Years

Financial Sensitivity Analysis:

A base discount rate of 2.0% was used. Variable discount rates were used for the analysis to determine the sensitivity of the cost to the applied discount rate. The total cost and total cost per year were found to be sensitive to the discount rate utilized.

The sensitivity analysis was performed by varying the discount rate +/- 1.5% in 0.5% increments in order to produce a variety of present value financial analysis scenarios. The results of the sensitivity analysis are included in the attached spreadsheet.

Closing:

We thank you for giving us the opportunity to provide our services for this very interesting project. Should you have any questions concerning the report, please contact the undersigned.

Yours truly,

ELLIS Engineering Inc.



Arih Struger-Kalkman, P. Eng., M. Eng.
Project Manager



Emma Stephenson
Project Assistant

Attachments:

1. 2021 SAMCF – NF Municipal Structures Spreadsheet (PDF, 1 Page)
2. 2021 SAMCF – NF Municipal Structures Spreadsheet (Microsoft EXCEL Spreadsheet, Separate File)

Draft Document

