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

Prepared by
SLBC Inc.
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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 $2,115.4 million (2022$) as outlined in Table ES-1 below.

Table ES-1 Inventory of Core Assets

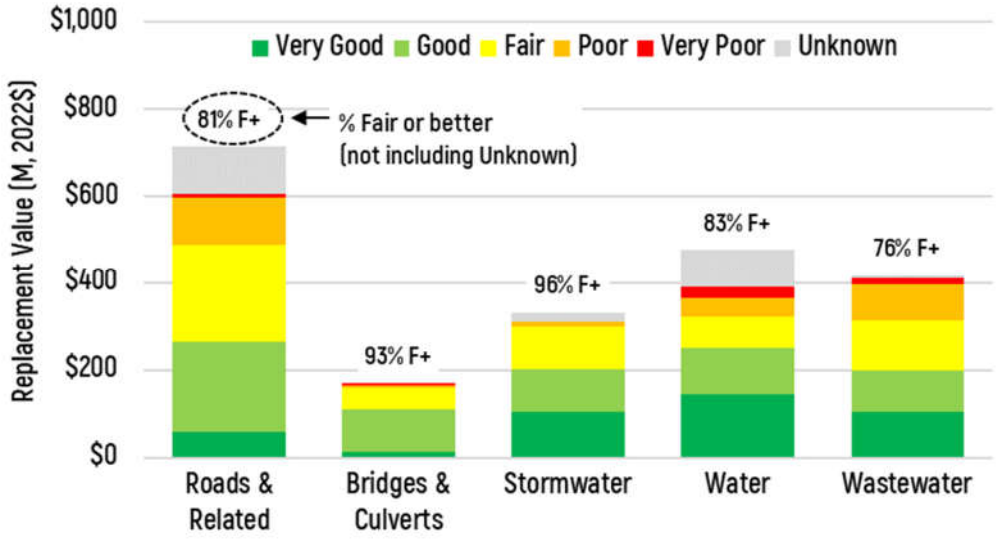
Service	Asset Categories	Replacement Value (2022$, millions)	Replacement Value (%)
Roads & Related	Roads, sidewalks, medians, barriers	$715.0	34%
Bridges & Culverts	Span bridges, span culverts, municipal structures	$171.5	8%
Stormwater Management	Storm sewers, ponds, appurtenances	$333.1	16%
Water	Water mains, facilities, appurtenances	$477.0	23%
Wastewater	Sewer Mains, facilities, appurtenances	$418.8	20%
TOTALS		**$2,115.4**	**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 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, 75% or $1,588 million of the City's core assets are in Fair condition or better, 14% or $305 million are in Poor or Very Poor condition, and 11% or $223 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 sidewalks, stormwater maintenance holes and catchbasins, and water services and curb stops.

Based on those assets with known condition, 2.9% or $54.5 million are in Very Poor condition. The assets in Very Poor condition are listed in a separate document and include roads ($6.7 million), bridges and culverts ($6.6 million), water mains ($24.5 million), and wastewater sewers, laterals, maintenance holes ($14.0 million). To minimize the cost of ownership and risk, these assets are generally included in the capital renewal program. Note that the confidence in "condition" data shown for sidewalks, storm sewers, ponds and appurtenances, and wastewater laterals and maintenance holes is moderate as it is based on calculated age rather than inspected condition. The City is working to improve the confidence in the supporting data for these asset types.

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 & Performance of 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 (low confidence – awaiting condition data)	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. The most appropriate strategy includes the right action, at the right time, for the least cost.

Criticality is evaluated as an asset's impact upon service delivery, health and safety, the environment, and the City's 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. Risk exposure can be shown in the form of a "risk map" which is a graphic representation of the risk exposure, as shown in Figure ES-2 below. After assessing the impact and likelihood of each risk, they are plotted on a matrix. Different colours on the map help to prioritize where and how to focus City resources, time, effort, and/or dollars.

Figure ES-2 Reliability Risk Exposure of Core Assets

PoF	Cdn					
5	VP	$0.56	$6.07	$37.97	$2.94	$0.00
4	P	$4.73	$43.55	$166.84	$43.12	$4.36
3	F	$2.05	$89.89	$369.53	$82.54	$17.49
2	G	$0.53	$74.70	$373.66	$102.59	$60.93
1	VG	$0.25	$118.07	$266.95	$24.83	$1.91
		VL	L	M	H	VH
		1	2	3	4	5

Criticality (CoF)

Risk	CRV ($)	CRV (%)
Very High	$7.30	0.4%
High	$98.58	5.2%
Moderate	$316.38	16.7%
Low	$981.68	51.8%
Very Low	$492.1	26.0%
Total	**$1,896.1**	**100.0%**

Based on those assets with known condition, the figure shows that 0.4% or $7.30 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) and six road segments namely Kalar Road, Kitchener Street, Allendale Avenue, Buchanan Avenue, Fallsview Boulevard, and Reixinger Road ($2.94 million).

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.

Lifecycle Management Strategy

Lifecycle management strategies are the planned asset-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.

Figure ES-3 shows the total operations, maintenance, renewal, growth and upgrade needs forecast for Tax based City core assets (transportation and stormwater management) 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 these core assets is estimated at $399 million for the period 2022-2031, for an average of $39.9 million per year. 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.

Figure ES-3 10-Year Forecast Lifecycle Needs, Tax Based Assets

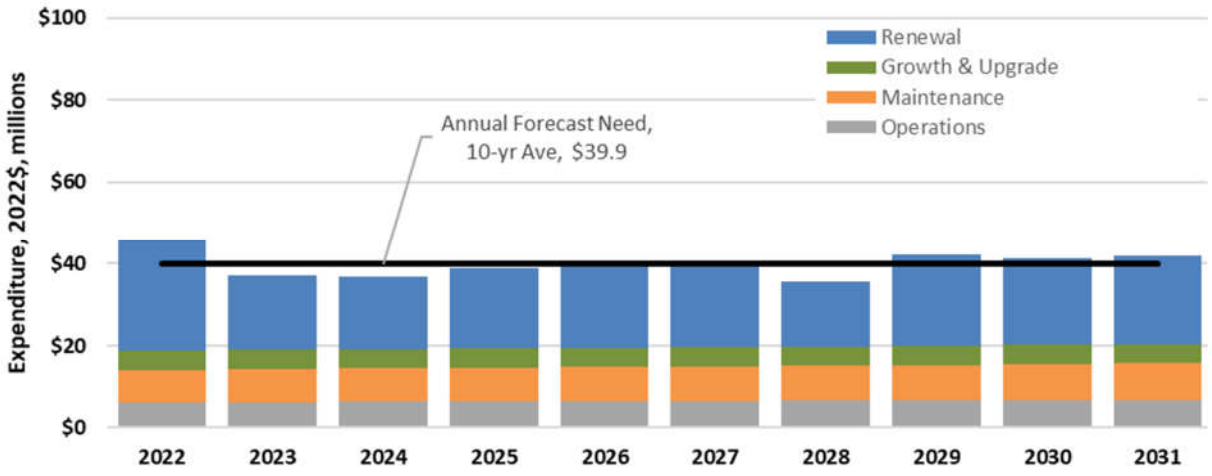
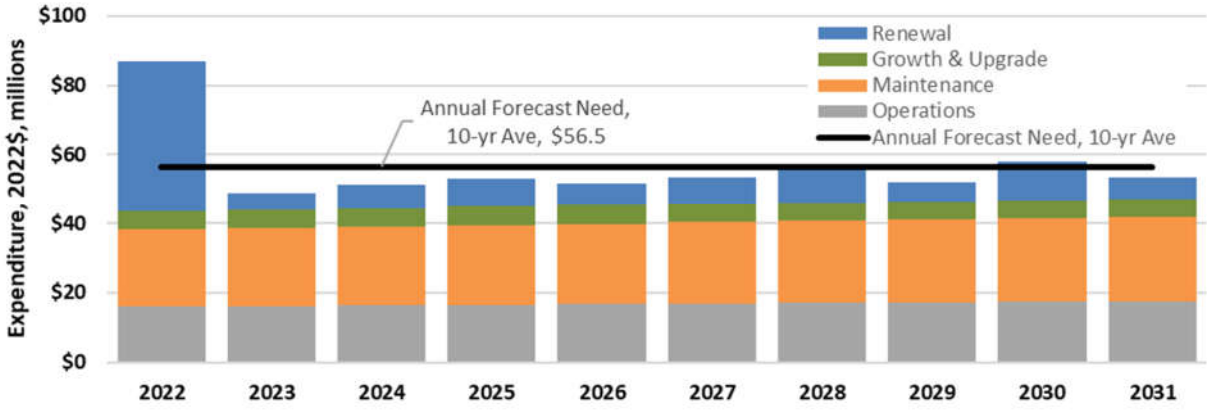


Figure ES-4 shows the total operations and maintenance, renewal, growth and upgrade needs forecast for Rate based City core assets (water and wastewater) over the next 10 years to sustain current levels of service. The sum of the City's needs forecasts for the planned strategies for managing these core assets is estimated at $565 million for the period 2022-2031, for an average of $56.5 million per year. The high cost of lifecycle

strategy needs shown in the first year is mainly due to the backlog of assets in poor and very poor condition, comprised mostly of water mains and wastewater sewers and maintenance holes. 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.

Figure ES-4 10-Year Forecast Lifecycle Needs, Rate Based Assets



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, federal gas tax, third party grants, casino revenue, development charges, and user fees and charges. New long term debt may be approved in a capital budget as an immediate cash source; however, long term debt approval must be accompanied by the inclusion of related debt charges funded by a sustainable revenue source in the approved operating budget. 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 assets, the City's services can be categorized into two groups:

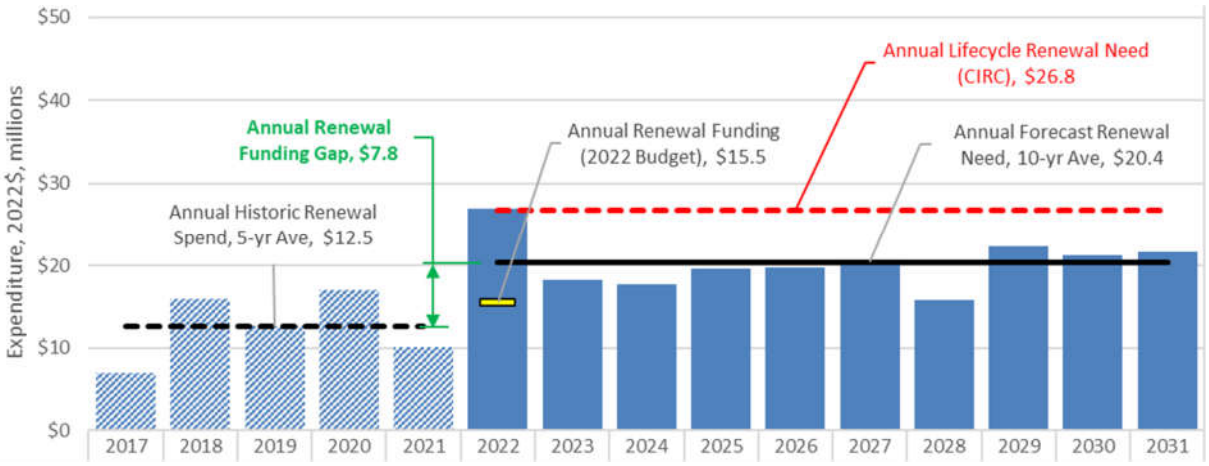
- **Tax based:** those that are funded through property taxes and other sources (i.e. roads, bridges and culverts, stormwater management), and

- **Rate based:** those that are funded through user fees or rates (i.e. water and wastewater).

The largest renewal funding gap was found for Tax based assets, namely roads, bridges and culverts, and stormwater management system assets. For these assets, Figure ES-5 shows historic spending (dashed black line at $12.5 million) and the 10-year average annual need forecast (solid black line at $20.4 million) for an annual funding gap for each of the next ten years of $7.8 million (shown in green text) for a total of $78 million over the 10-year period. The yellow line at $15.5 million is the 2022 budget.

The lifecycle annual renewal need estimate of $26.8 million based on the CIRC average annual renewal rate (dashed red line) forecasts significantly higher annual renewal amounts beyond the 10-year forecast period.

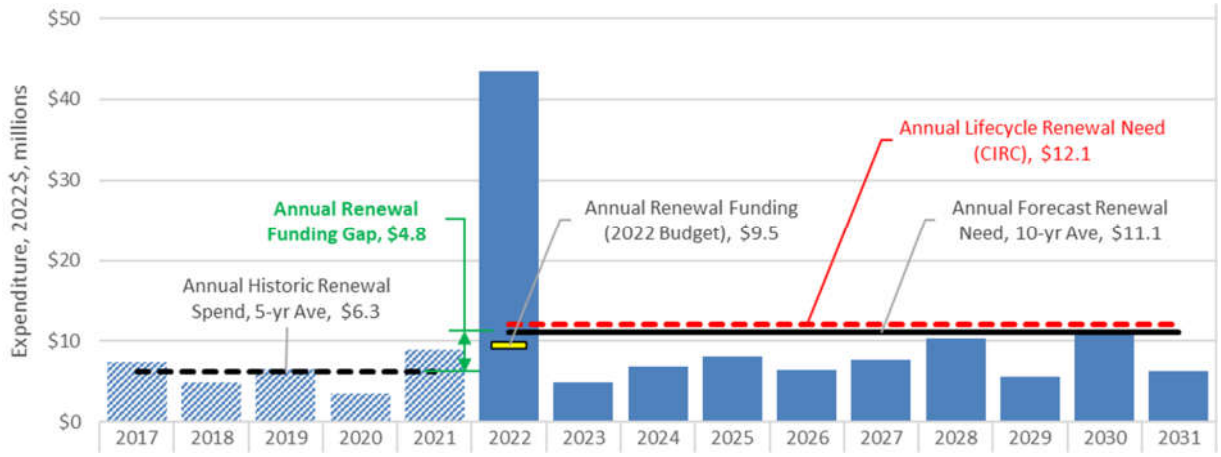
Figure ES-5 Annual Renewal Funding Gap, Tax Based Assets



The Rate based funding for water and wastewater assets is closer to the forecast needs. Figure ES-6 shows historic spending (dashed black line at $6.3 million) and the 10-year average annual need forecast (solid black line at $11.1 million) for an annual funding gap for each of the next ten years of $4.8 million (shown in green text) for a total of $48 million over the 10-year period. The yellow line at $9.5 million is the 2022 budget.

The lifecycle annual renewal need estimate of $12.1 million based on the CIRC average annual renewal rate (dashed red line) forecasts marginally higher annual renewal amounts beyond the 10-year forecast period.

Figure ES-6 Annual Renewal Funding Gap, Rate Based Assets



Strategies to Close Funding Gaps

The following strategies may be considered to close the funding gaps for Tax based assets (transportation and stormwater management system):

- 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; this will likely cause increased maintenance costs and/or reduced service levels
- Pursue technologies for rehabilitating assets that extend the service life of the assets to achieve an overall lower lifecycle cost. eg. storm sewer lining
- Increase available funds through property tax increases, leveraging third part grants, drawing on reserves or, issuance of debt
- Consider contributions to a stormwater capital reserve built into the operating budget under the service area “stormwater”
- Divest ownership of assets not providing core services.

The following strategies may be considered to close the funding gaps for Rate based assets (water and wastewater systems):

- Reduce near term renewal needs by deferring capital renewal projects on lower risk assets, as described above
- Pursue technologies for rehabilitating assets that extend the service life of the assets to achieve an overall lower lifecycle cost. eg. sanitary sewer lining
- Increase available funds through water and wastewater user fee increases and by leveraging third party grants
- Update rate studies for water and wastewater to achieve full cost recovery, as required.

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.

The following table lists the activities and timelines to meet Ontario Regulation 588/17 requirements.

Table E-3 Activities to Comply with O.Reg. 588/17

Activity	Due Date	Status
Obtain endorsement by the executive lead and approval by a resolution passed by City Council of the City's AM Plan for Core Assets prepared under O.Reg 588/17	July 01, 2022	On target
Conduct an annual review of the City's asset management progress on or before July 1 in each year, starting the year after the City's asset management plan is completed	July 01, 2023	Not Started
Prepare the City's AM Plan for Non-Core Assets under O.Reg 588/17 and obtain endorsement by the executive lead and approval by a resolution passed by City Council	July 01, 2024	Not Started
Provide the proposed levels of service for each asset category for each of the 10 years of the AM Plan	July 01, 2025	Framework developed
Develop a 10 Year Capital and Operating budget forecast that aligns with lifecycle planning and risk management principles	July 01, 2025	Under development (capital)
Post the City's current SAMP and AM Plan on the City's public-facing website and make a copy available to any person who requests it	Plan Approval Date	Complete

Opportunities for improvement include the following:

State of Infrastructure

- Compete bathymetric surveys for stormwater management ponds & develop 10-Year rehabilitation plan
- Undertaking sidewalk, median and barrier condition assessments based on a standardized rating scale (underway)
- Continue and enhance the CCTV inspection program for both sanitary and storm sewers (regular inspections provides fact-based decision-making and better confidence in results)

- Undertake inspections of water, wastewater and stormwater facilities and appurtenances based on a standardized rating scale with photographs
- Improve installation year data for critical assets
- Continue to fill asset data gaps to improve capital rehabilitation planning

Levels of Service

- Continue to review levels of service metrics that support lifecycle asset planning activities (Operations and Maintenance activity tracking at the asset level)
- Adjust of develop new measures related to the operations and maintenance of municipal infrastructure such as:
  - Percent of annual planned MMS inspections completed
  - Percent preventative maintenance works orders completed on time (e.g. sewer flushing)
  - Percent available funding vs. need at the asset category level.

Risk and Lifecycle Management

- Update master plans (Roads, Water, Sanitary, Stormwater) 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 plan studies
- Review sever weather risks and the City's climate change responses, particularly for stormwater management
- Separately budget and track operating and capital (growth, upgrade, renewal) costs by asset category including staff time

Financial Strategies

- 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 Proposed Levels of Service (2025)
- Update rates studies as required for water and wastewater to achieve full cost recovery
- 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 City's growing asset portfolio.

To enable O.Reg.588/17 compliance and completion of the above listed improvement opportunities, the City should:

- Dedicate staffing towards AM planning activities
- Increase project management staffing complements to address the backlog of infrastructure renewal identified in this AM Plan
- Recognize that this AM Plan is for Core assets only and the infrastructure funding gap will likely widen further once Non-Core these assets are analyzed and incorporated into the overall AM Plan.

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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 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 1-1 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)	• Inventory of assets, by category • Replacement cost of assets • Average age of assets • Condition of assets • Approach to assessing condition	• Inventory of assets, by category • Replacement cost of assets • Average age of assets • Condition of assets • Approach to assessing condition
Levels of Service (performance)	• Current LOS (performance) provided: - 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	• Proposed LOS (performance) for the next 10 years - For community (qualitative metrics) - By assets (quantitative metrics) • And why appropriate based on risk and affordability assessment
Lifecycle Management Strategy	• Population and employment forecasts per 2019 Growth Plan • Lifecycle activities needed for each of the next 10 years to: - Meet demand caused by growth or upgrade of existing assets - Maintain the current LOS at least cost and acceptable level of risk	• Population and employment forecasts per 2019 Growth Plan • Lifecycle activities needed for each of the next 10 years to: - Meet demand caused by growth or upgrade of existing assets - Provide proposed LOS at least cost and acceptable level of risk
Financing Strategy	• Cost of lifecycle activities needed for each of the next 10 years to: - Meet demand caused by growth or upgrade of existing assets - Maintain the current LOS	• Cost of lifecycle activities needed for each of the next 10 years to: - 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	• Statement on how all State of Infrastructure background information and reports will be made available to the public	• 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 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" municipality and the City of Niagara Falls is the "lower tier" or “local” municipality. For core assets, the responsibilities are divided as follows:

- The Region of Niagara provides roads related to travel through the Region, stormwater treatment, water supply and treatment, and wastewater treatment.
- The City of Niagara Falls provides roads to provide access to properties, sidewalks, street lights, stormwater collection, water distribution, and wastewater collection and conveyance.

1.2.3 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. 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.

- 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
- Niagara Falls Rate Study, 2021
- Operating and Capital Budgets
- Niagara Falls Climate Change Adaptation Plan, 2021
- Master Drainage Plan Update, 2017.

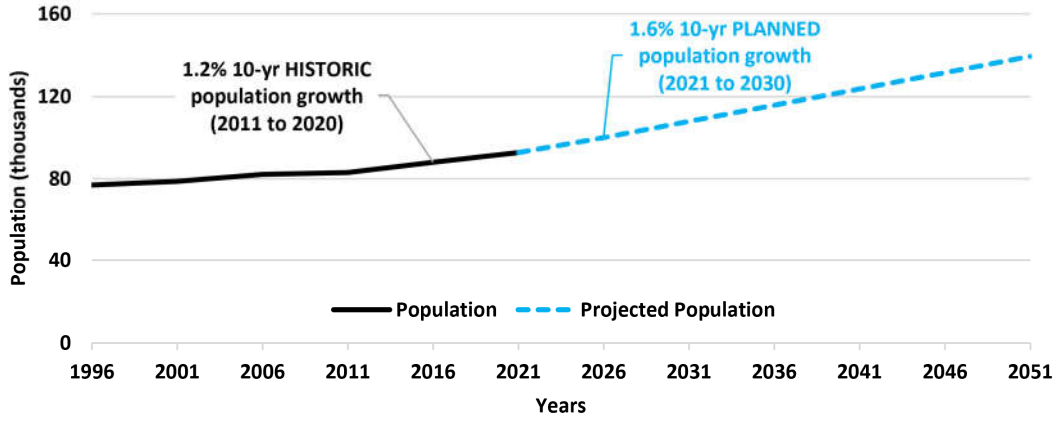
1.2.4 Growth at the City

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 1-2. 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 1-2 City Population History and Forecast to 2051



1.2.5 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 culvert and storm sewer system surcharges causing damage to property and other infrastructure systems via overland flow and potential underground flooding

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
- Increased treatment costs due to higher volumes at the treatment plant.

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 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 a significant proportion 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 two major wastewater storage facilities. Note that the City owns a significant number of minor inline wastewater storage facilities which are included in the inventory as sewers.

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. O.Reg. Compliance & Improvement: 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.

Appendix B – 2021 OSIM Reports: Contains the Ontario Structures Inspections for Span and Municipal Structures, 2020

Appendix C - List of Very High Risk Assets: Provides a list of the assets that fall within the Very High risk category

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.

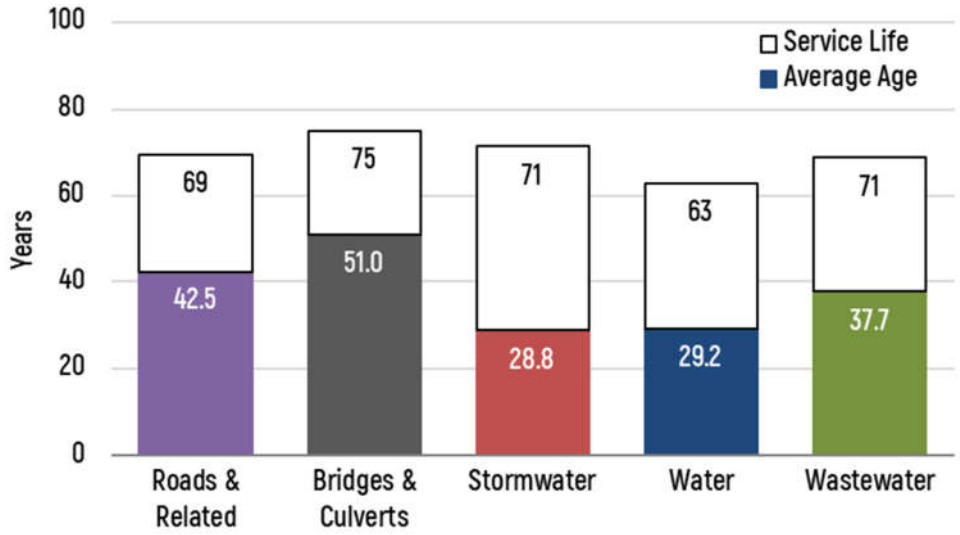
Understanding the assets owned by the City is the starting point to developing a plan to best manage them. The replacement value represents the expected cost to replace an asset to the same functional standard with a new version based on current market conditions and construction standards. Replacement 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 $2,115.4 million (2022$), and includes a breakdown of the inventory by service including current (2022$) replacement value.

Table 2-1 Inventory of Core Assets

Service	Asset Categories	Replacement Value (2022$, millions)	Replacement Value (%)
Roads & Related	Roads, sidewalks, medians, barriers	$715.0	34%
Bridges & Culverts	Span bridges, span culverts, municipal structures	$171.5	8%
Stormwater Management	Storm sewers, ponds, appurtenances	$333.1	16%
Water	Water mains, facilities, appurtenances	$477.0	22%
Wastewater	Sewer Mains, facilities, appurtenances	$418.8	20%
TOTALS		**$2,115.4**	**100%**

The average age and estimated service life of the City's core assets, by service, weighted by replacement value, is summarized in Figure 2-2. 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 2-1 Average Age & Estimated Life of 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 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 material type and age unless superseded by the observed condition during water 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 Core Assets

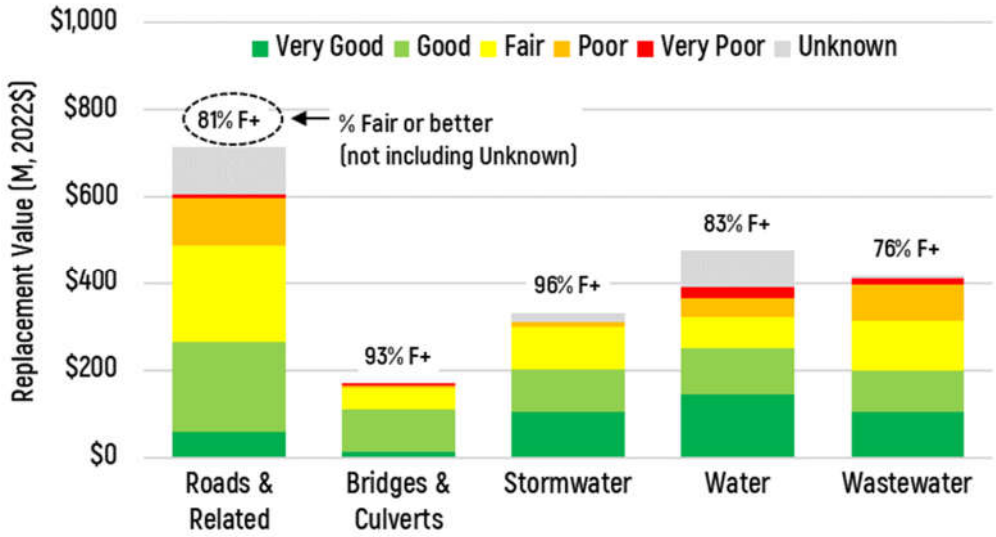
Condition Grade	% Remaining Useful Life (all asset types)	Pavement Condition Index (roads)	Bridge Condition Index (bridges & culverts)	Watermain Break Observed Condition	CCTV Structural Score (wastewater sewers)
Very Good	>75 – 100%	>85 – 100	>80 – 100	Excellent / Very Good	1
Good	>50 – 75%	>70 – 85	>70 – 80	Good	2
Fair	>25 – 50%	>55 – 70	>60 – 70	Fair / Okay	3
Poor	>0 – 25%	>40 – 55	>40 – 60	Poor	4
Very Poor	<= 0%	<= 40	<= 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 2-2 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 2-2 Condition Distribution of Core Assets



Overall, 75% or $1,588 million of the City's core assets are in Fair condition or better, 14% or $305 million are in Poor or Very Poor condition, and 11% or $223 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 sidewalks, stormwater maintenance holes and catchbasins, and property water services and curb stops.

Based on those assets with known condition, 2.9% or $54.5 million are in Very Poor condition. The assets in Very Poor condition are listed in a separate document and include roads ($6.7 million), bridges and culverts ($6.6 million), water mains ($24.5 million), and wastewater sewers, laterals, maintenance holes ($14.0 million). To minimize the cost of ownership and risk, these assets are generally included in the capital renewal program.

Note that the confidence in "condition" data shown for sidewalks, storm sewers, ponds and appurtenances, and wastewater laterals and maintenance holes is moderate as it is based on calculated age rather than inspected condition. 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 City is working to improve the confidence in the supporting data for these asset types.

Table 2-4 Data Sources & Confidence for State of Infrastructure

Service	Inventory Unknowns (%)	Replacement Value	Age → Condition	Condition Assessments
Roads & Related	Sidewalks (92.7%), 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	Maintenance Holes (46.2%), Catchbasins (66.6%)	Same as Roads & Related except SWM Ponds (unit construction costs based on storage volume)	storm sewers, ponds, appurtenances	pending for mains, ponds, maintenance holes
Water	Water Services (76.1%), Water Meters (25.0%), Curb Stops (51.3%)	Same as above except Water Facilities (purchase costs recorded in TCA register, inflated to 2022)	water facilities, appurtenances	age plus watermain break observed condition
Wastewater	Wastewater Storage & Pumping (100%)	Same as above except Wastewater Facilities (purchase costs recorded in TCA register, inflated to 2022)	wastewater laterals, facilities, appurtenances	sewer mains

Indicates lower confidence in source data (with pink highlighting)

* sidewalks in very poor condition assumed to be in unknown condition

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 & 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	$102.6	14.4%
Medians	19,695 m	$3.2	0.4%
Barriers	480,774 m	$4.2	0.6%
TOTALS		**$715.0**	**100.0%**

The average age and estimated life of the City's roads and related assets, weighted by replacement value, is summarized in Figure 2-3. 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 2-4. 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, 81% of paved urban roads (all functional classes) are in Fair condition or better and 75% of the semi-urban and rural paved roads are in Fair condition or better. On average, 42% 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.

Figure 2-3 Average Age & Estimated Life of Roads & Related Assets

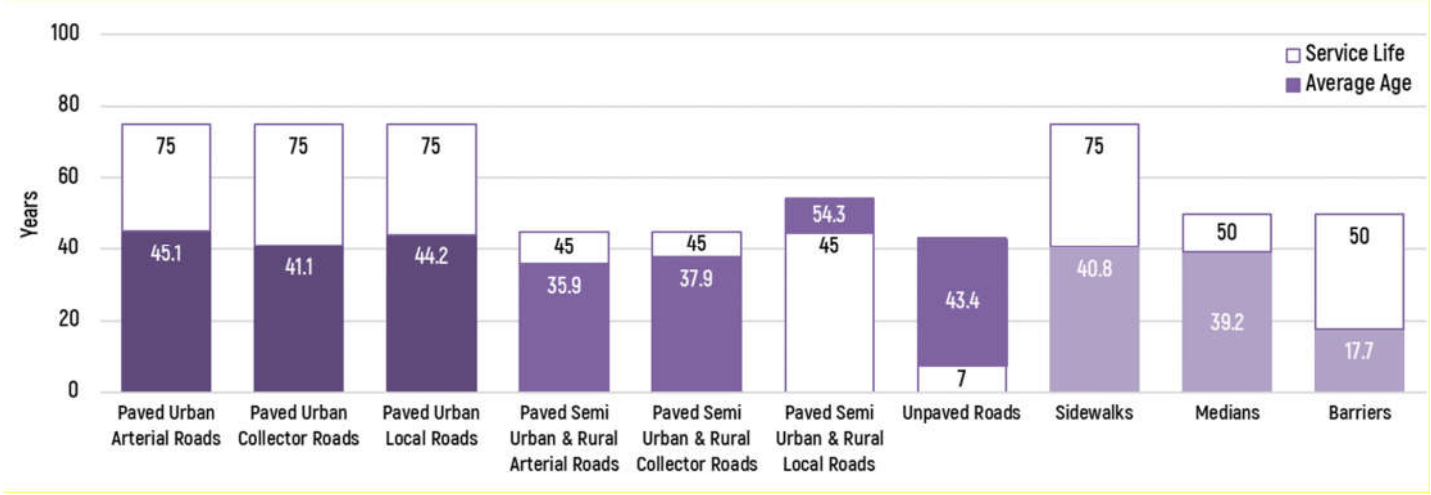


Figure 2-4 Condition Distribution of Roads & Related Assets

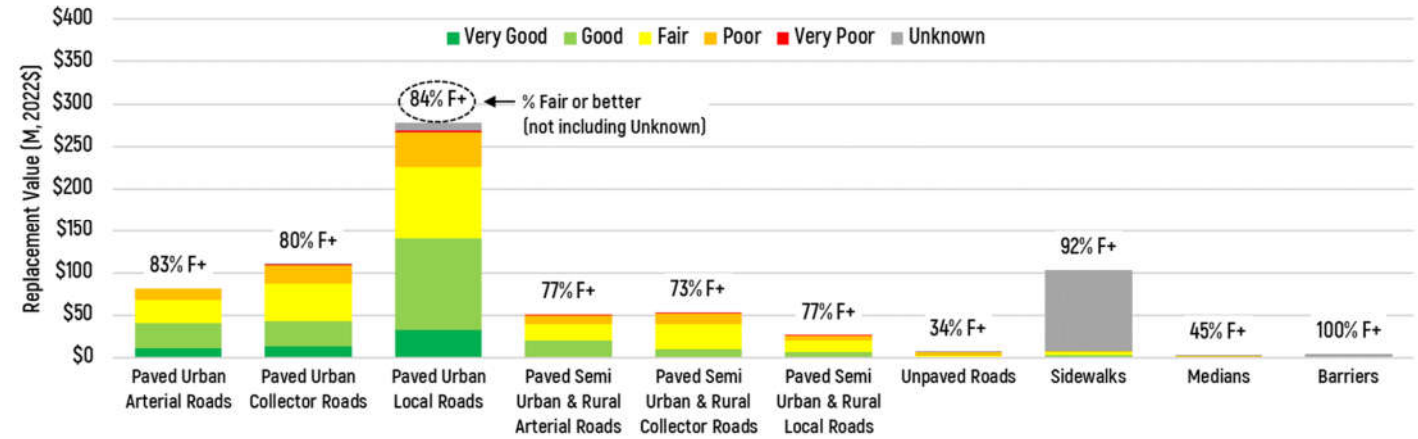


Table 2-6 provides a summary of data sources for inventory, replacement cost and condition and indicates lower confidence in source data with pink highlighting. The highest confidence in data is for bridges and the lowest is for stormwater assets.

Table 2-6 Data Sources & Confidence of Roads & 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: Unknown install dates: Sidewalks (92.7%)	Unit costs aligned with historical tender costs and peer municipalities	Age based on known installation date
Medians	GIS: Unknown install dates: Medians (24.7%)	Unit costs aligned with historical tender costs and peer municipalities	Age based on known installation date
Barriers	GIS 98.5% with unknown install date	Unit costs aligned with historical tender costs and peer municipalities	Age based on known installation date

(pink highlighting) indicates lower confidence in source data

2.2.2 Bridges and Culverts

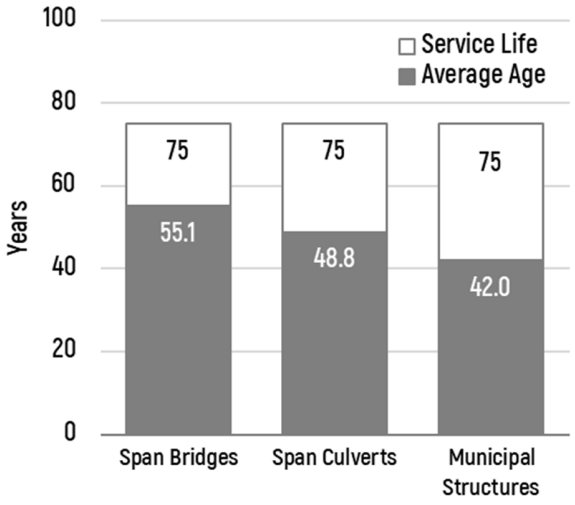
Bridges and culverts are comprised of span bridges and span culverts, which includes all bridges and culverts with spans of 3.0 metres or greater, and municipal culverts include all bridges and culverts with spans less than 3.0 metres. Table 2-7 shows the estimated replacement value of the City's bridges 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 & 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%
TOTALS	**150 structures**	**$171.5**	**100.0%**

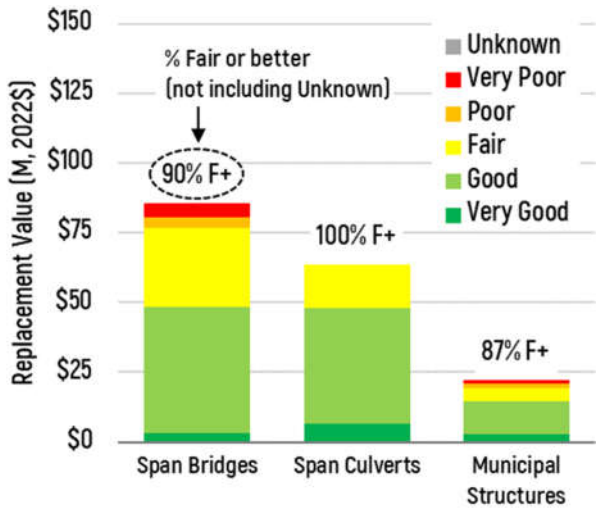
The average age and estimated life of the City's bridges and culverts, weighted by replacement value, is summarized in Figure 2-5. On average, all of the City's bridges and culverts are in the last half of their service lives.

Figure 2-5 Average Age & Estimated Life of Bridges & Culverts



The condition distribution of the City's bridges and culverts is shown in Figure 2-6. 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, 90% of span bridges, 100% of span culverts, and 87% of municipal structures are in Fair condition or better. No bridges or culverts are of unknown condition.

Figure 2-6 Condition Distribution of Bridges & 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.**

Table 2-8 Data Sources & Confidence of Bridges & Culverts SOI

Asset Category	Inventory Data Source	Source of Replacement Value	Condition
Bridges & Culverts	Annual OSIM Reporting	OSIM Reporting – Engineered estimate	BCI per OSIM

2.2.3 Stormwater Management System

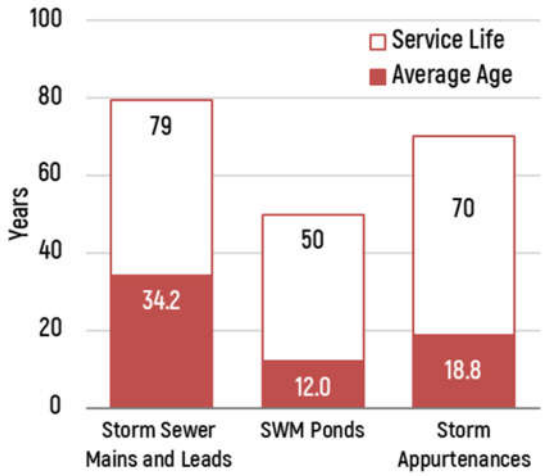
Assets that support stormwater management include storm sewers, catchbasin leads, ponds, maintenance holes, and catchbasins. Table 2-9 shows the estimated replacement value of the City's stormwater management system as $333.1 million (2022$), and includes a breakdown of the inventory by asset category. Storm sewers make up approximately three quarters (76.1%) of the portfolio by replacement value.

Table 2-9 Inventory of Stormwater Management System

Asset Category	Quantity	Replacement Value (2022$, millions)	Replacement Value (%)
Storm Sewers	314,758 m	$253.4	76.1%
Catchbasin Leads	54,575 m	$28.3	8.5%
SWM Ponds	27 ponds	$19.4	5.8%
Stormwater Appurtenances	4,778 Maintenance Holes	$12.5	3.8%
	7,400 Catchbasins	$19.4	5.8%
TOTALS		**$333.1**	**100%**

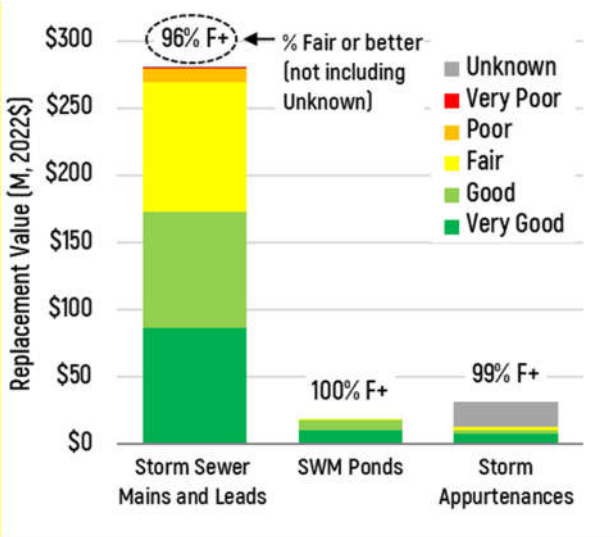
The average age and estimated life of the City's stormwater management system, weighted by replacement value, is summarized in Figure 2-7. On average, the City's stormwater management system assets are in the first third of their service lives.

Figure 2-7 Average Age & Estimated Life of Stormwater Mgmt System



The condition distribution of the City's stormwater management system is shown in Figure 2-8. 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 2-8 Condition Distribution of Stormwater Mgmt 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 2-10 Data Sources & Confidence of Stormwater Mgmt 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 Unknown install dates: Maintenance Holes (46.2%), Catchbasins (66.6%)	Unit costs aligned with historical tender costs and peer municipalities	Age and install date

(pink highlighting) indicates lower confidence in source data

2.2.4 Water and Wastewater Systems

Assets that support water service include water mains, services, bulk water stations and water appurtenances including hydrants, valves, meters and curb stops. The top part of Table 2-11 shows the estimated replacement value of the City's water system as $477.0 million (2022$), and includes a breakdown of the inventory by asset category. Water mains make up approximately two thirds (65.1%) of the portfolio by replacement value.

Assets that support wastewater service include sewer mains, laterals, a treatment facility, a storage and pumping facility, maintenance holes and cleanouts. The bottom part of Table 2-11 shows the estimated replacement value of the City's wastewater system as $418.8 million (2022$), 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 2-11 Inventory of Water & Wastewater Systems

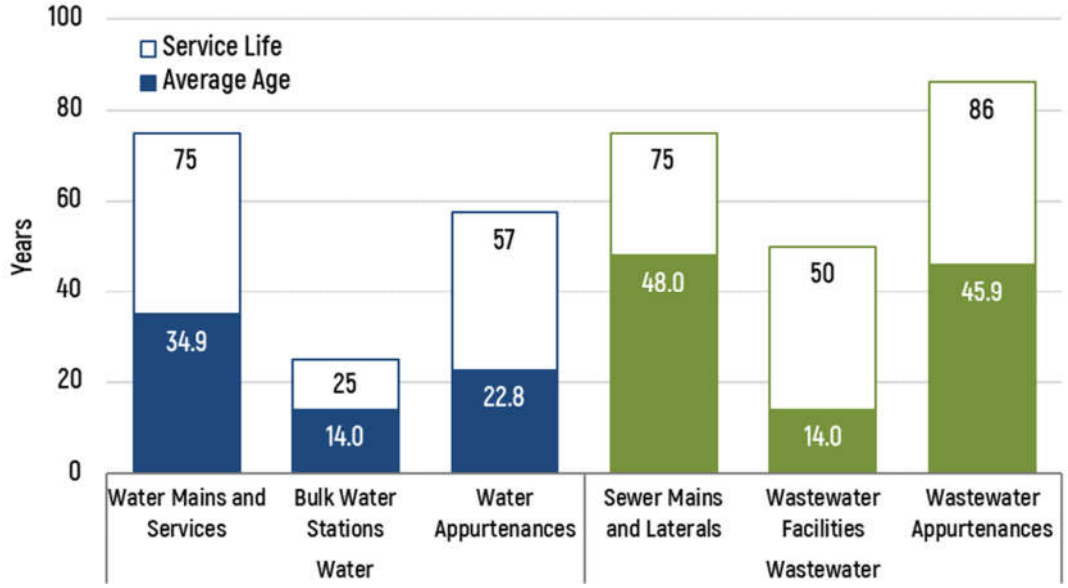
Asset Category	Quantity	Replacement Value (2022$, millions)	Replacement Value (%)
Water Mains	480,774 m	$310.5	65.1%
Services	289,658 m	$85.7	18.0%
Bulk Water Stations	2	$0.3	0.1%
Water Appurtenances	3,046 Hydrants	$28.8	6.0%
	4,955 Valves	$18.2	3.8%
	34,643 Meters	$17.7	3.7%
	31,412 Curb Stops	$15.7	3.3%
TOTALS		**$477.0**	**100%**
Sewer Mains	434,235 m	$237.8	56.8%
Laterals	301,560 m	$95.6	15.4%
Wastewater Facilities	1 High Rate Treatment Facility	$14.8	22.8%
	1 Storage & Pumping Facility *	$5.0	3.5%
Wastewater Appurtenances	5,984 Maintenance Holes	$64.3	1.2%
	1,188 Cleanouts	$1.2	0.3%
TOTALS		**$418.8**	**100%**

* The 2022 Wet Weather CSO Reduction Strategy includes verifying the City's inventory, completing condition assessments of all structures and forecasting capital needs. The results of the strategy will be included in the next iteration of the AM Plan.

The average age and estimated life of the City's water and wastewater systems, weighted by replacement value, are summarized in Figure 2-9. On average, the City's water system

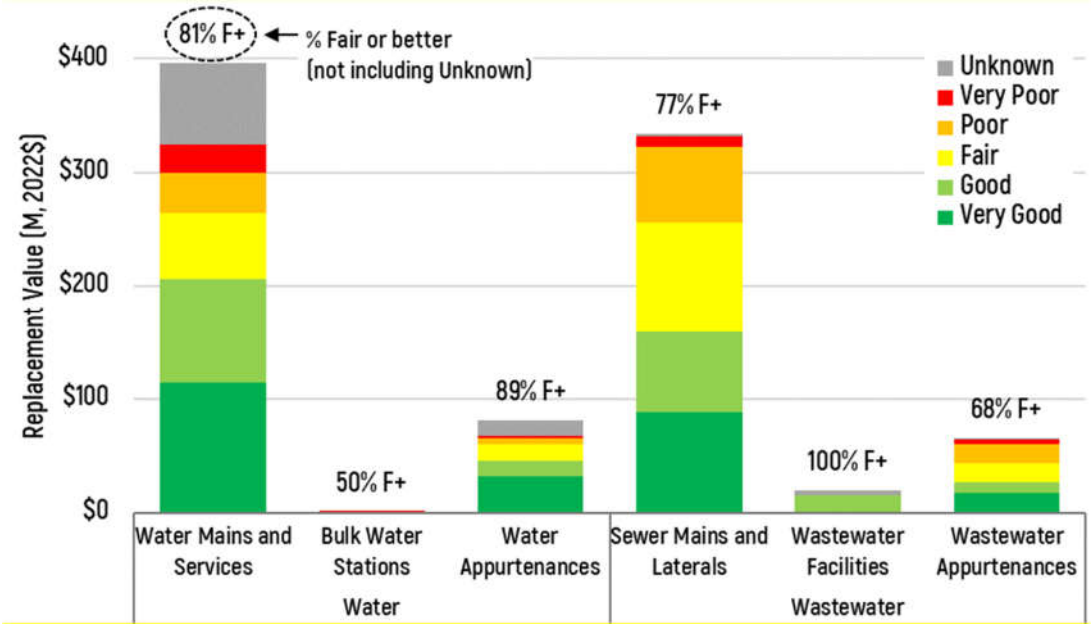
assets are in the first third of their service lives and the wastewater system assets are in the middle of their service lives.

Figure 2-9 Average Age & Estimated Life of Water & Wastewater Systems



The condition distribution of the City's water and wastewater systems are shown in Figure 2-10. The figure graphically shows the relative replacement value, by asset category, and the proportion of assets by condition grade. On average, 83% of water system assets and 76% of wastewater system assets are in Fair condition or better. For the water system, a significant portion (76.1%) of the property services are of unknown condition.

Figure 2-10 Condition Distribution of Water & 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 2-12 Data Sources & Confidence of Water & Wastewater Systems SOI

Asset Category	Inventory Data Source	Source of Replacement Value	Condition Source
Water Mains and Services	GIS: Unknown install dates: Services (76.1%)	Unit costs aligned with historical tender costs and peer municipalities	Age plus watermain break observed condition
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, 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
Wastewater Sewers	GIS	Unit costs aligned with historical tender costs and peer municipalities	CCTV structural scores
Laterals	GIS Unknown lateral sizes assume 100mm	As above	Age and install date
Wastewater Facilities	Tangible Capital Asset register 100% storage & pumping with unknown install date	Purchase costs recorded in Tangible Capital Asset register, inflated to 2022	Age and install date
Wastewater Appurtenances (Maintenance Holes, Cleanouts)	GIS: Assume maintenance holes are 1200mm	Unit costs aligned with historical tender costs and peer municipalities	Age and install date*

Indicates lower confidence in source data (with pink highlighting)

* Maintenance holes have been inspected, but data not collated

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
	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% (based on hydraulic model)
	Reliability	The number of connection-days per year where a boil water advisory notice is in place compared to the total number of properties connected to the municipal water system	0
		The number of connection-days per year due to water main breaks compared to the total number of properties connected to the municipal water system	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 blockages 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 ± 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 ± 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 ± 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 & Confidence for Performance on LOS Measures

Service	Capacity and Use	Function	Reliability
Roads & Related	Road network exceeding AADT counts – anecdotal ranking 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	Sewer main backups based on work order history	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)

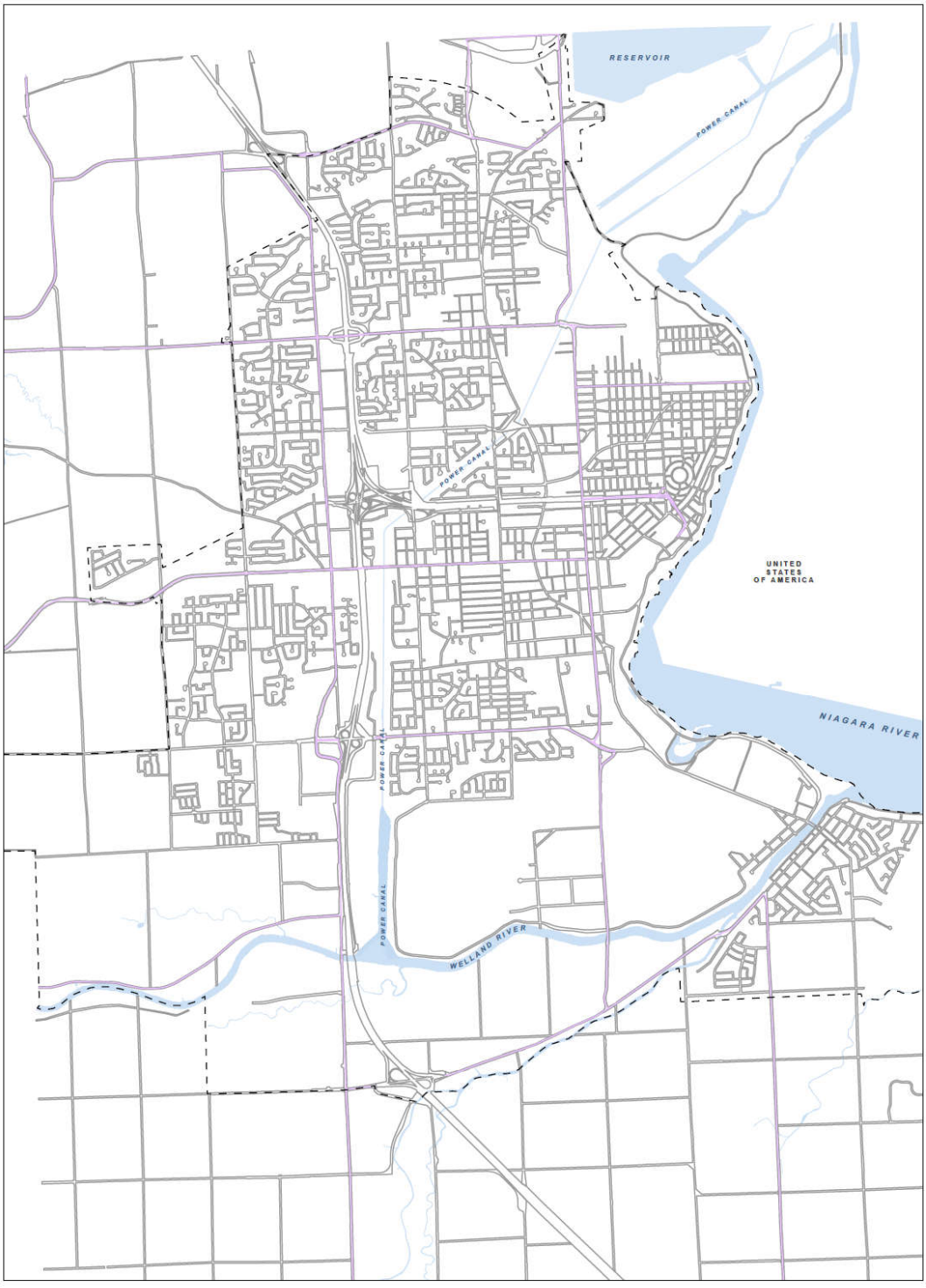
3.3.1 Roads and Related Assets

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 Niagara Parks Commission roadways. Provincial highways are regulated by the Ontario Ministry of Transportation. Development and access in close proximity to these roadways are subject to Provincial permitting and approval. The following maps illustrates the City's road network.

Figure 3-1 City of Niagara Falls Rural Road Network

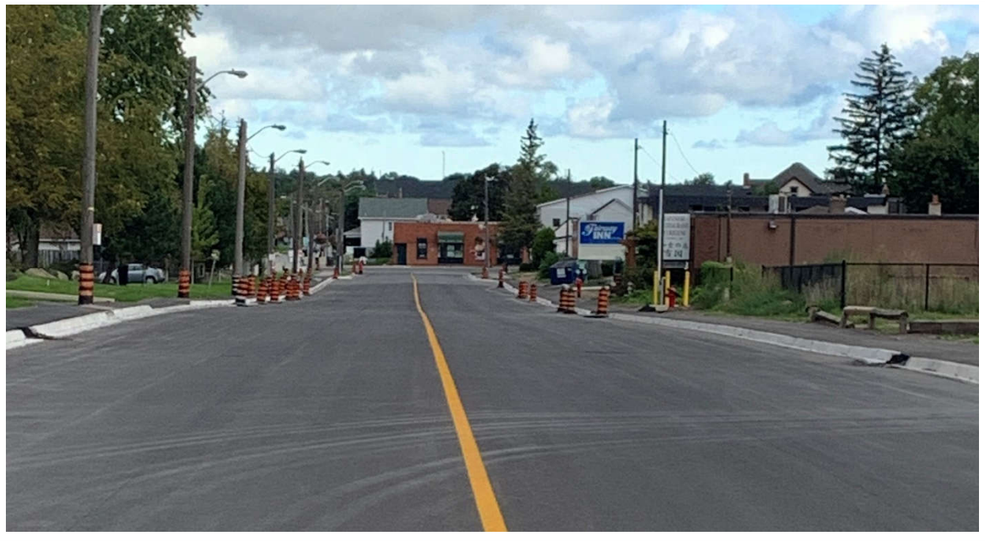
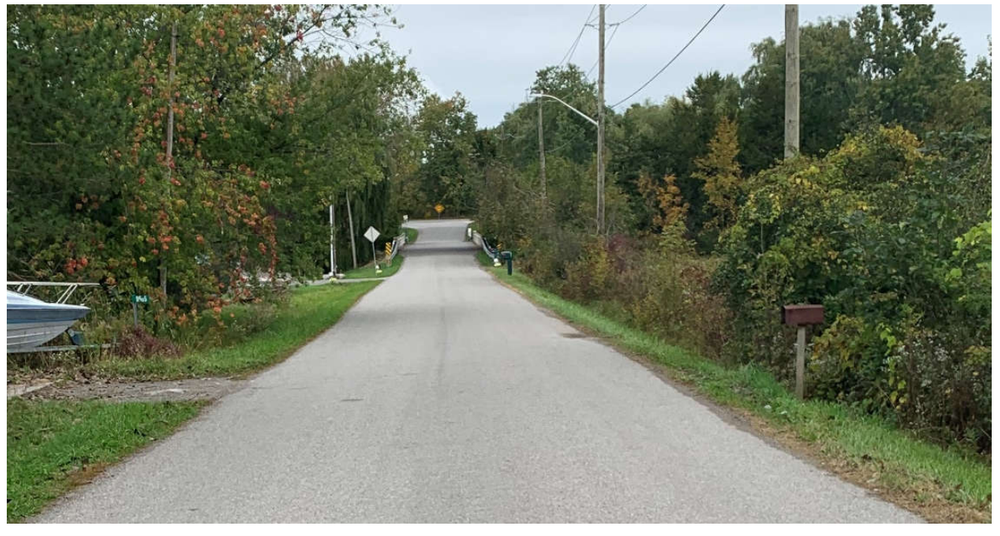
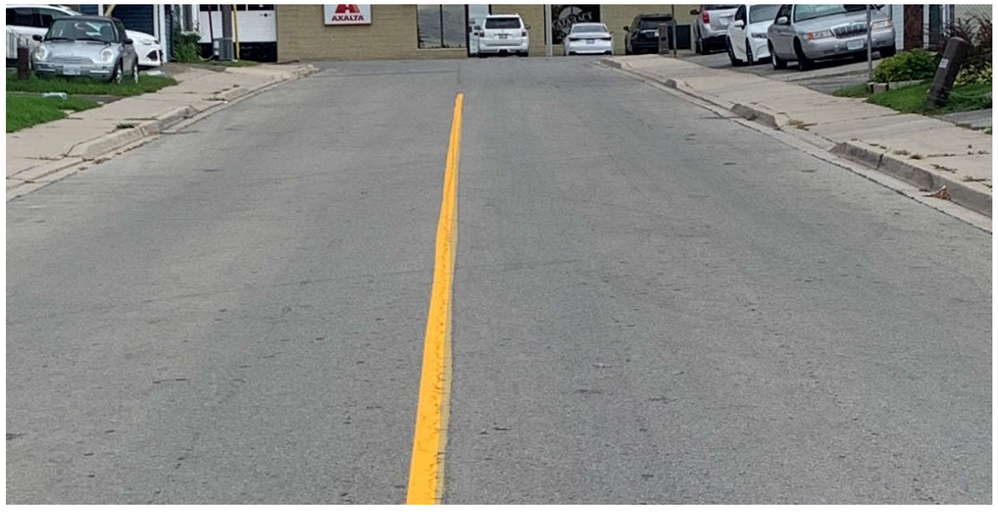
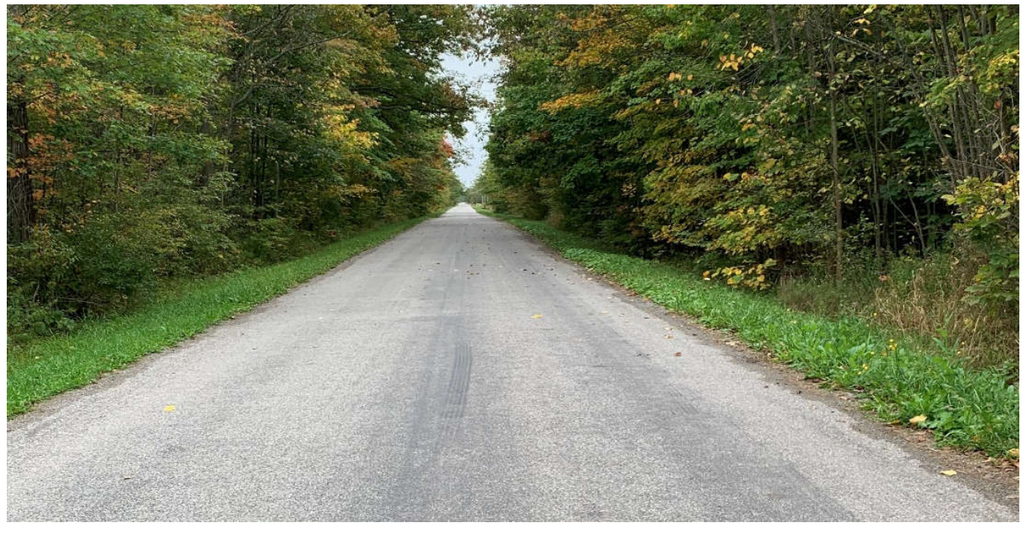
Figure 3-2 City of Niagara Falls Urban Road Network

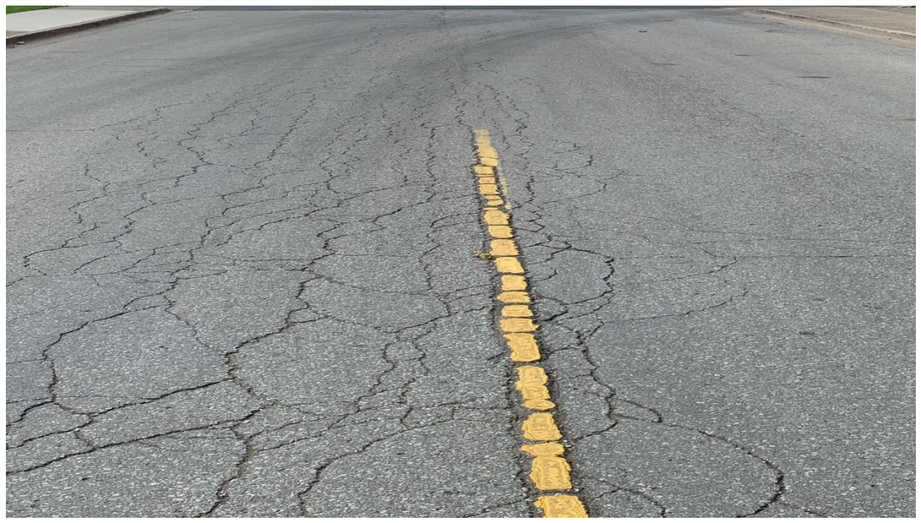


CUSTOMER LOS: Different levels of road class pavement condition and the impact on use

Pavement condition data is collected on the entire road network every three to five 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.

Figure 3-3 Condition Grade Examples – Urban and Rural Road Pavement

PCI Score	Urban Road Example	Rural Road Example
Very Good PCI 85 - 100	Fallsview Boulevard 	Stanley Avenue 
Good PCI 75-84	Chrysler Ave 	King Road 

PCI Score	Urban Road Example	Rural Road Example
Fair PCI 60-74	Forest Glen Drive 	Young Road 
Poor PCI 45-59	Lewis Avenue 	Marshall Road 

PCI Score	Urban Road Example	Rural Road Example
Very Poor PCI <45	Allendale Avenue 	Lyon's Creek Road / Schisler Road 

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	75
	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	70%

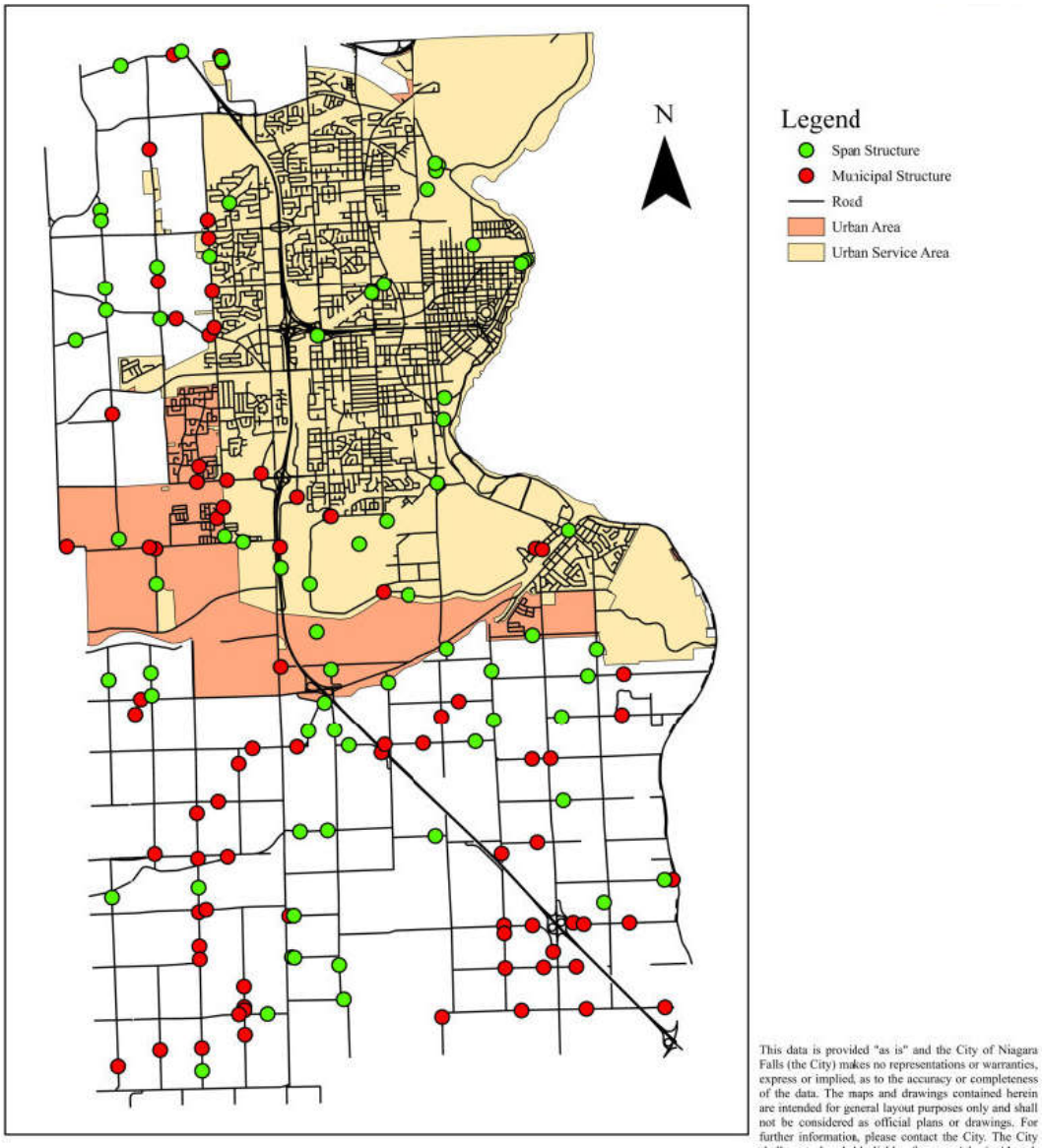
* Excludes un-opened road allowances (Class 6 roads)

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 3-4 Bridge & 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 3-5.

Figure 3-5 Condition Grade Examples – Bridges & Culverts

Condition Grade	Sample Span Structures Conditions	Sample Municipal Structures Conditions
Very Good BCI 80 - 100	 Mewburn Bridge (BCI=95)	 Kalar Culvert (BCI=90)
Good BCI 70 - 79	 Dorchester Culvert (BCI=75)	 Lyons Creek Culvert (BCI=77)

Condition Grade	Sample Span Structures Conditions	Sample Municipal Structures Conditions
Fair BCI 60 - 69	 Koabel Bridge (BCI=65)	 Garner Culvert (BCI=65)
Poor BCI 40 - 59	 Crowland Bridge (BCI=59)	 Weaver Culvert (BCI=52)
Very Poor BCI < 40	 McKenney Bridge (BCI=47)	 Marshal Culvert (BCI=39)

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 & 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%
	% of municipal structures in fair or better condition based on BCI	87.2%	Very Good	High	70%

* 9% is 4 bridges

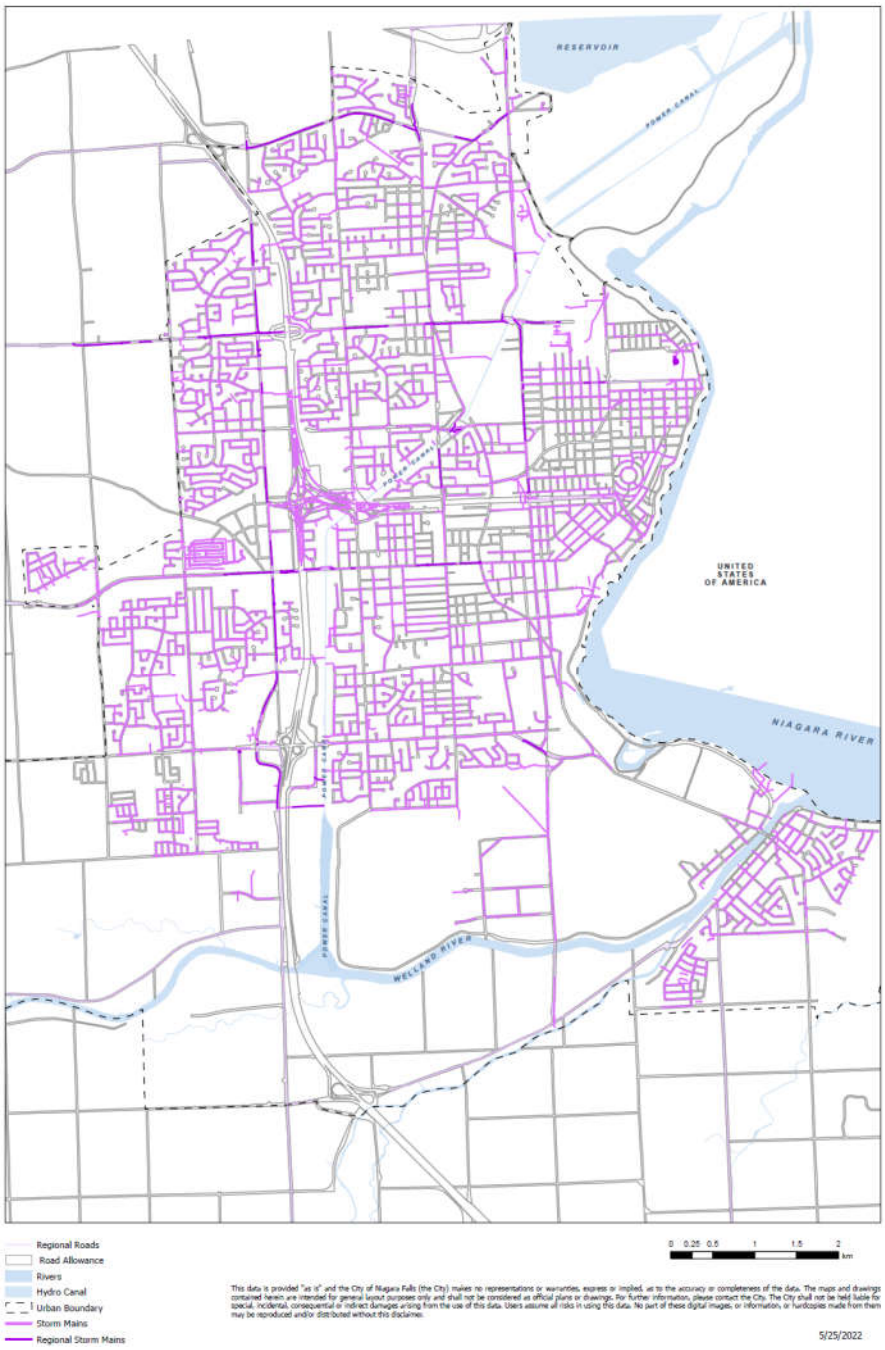
** 0% target is desirable but postings may be applied if achieving target is cost prohibitive

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 3-6 Stormwater Management System Map



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 the lack of detailed hydraulic modelling, sub-watershed studies, condition assessment activities and missing data gaps for the stormwater collection system. As such capacity performance is assessed as age-based rather than condition based (plans are in place to conduct condition assessment activities 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 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%

* 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

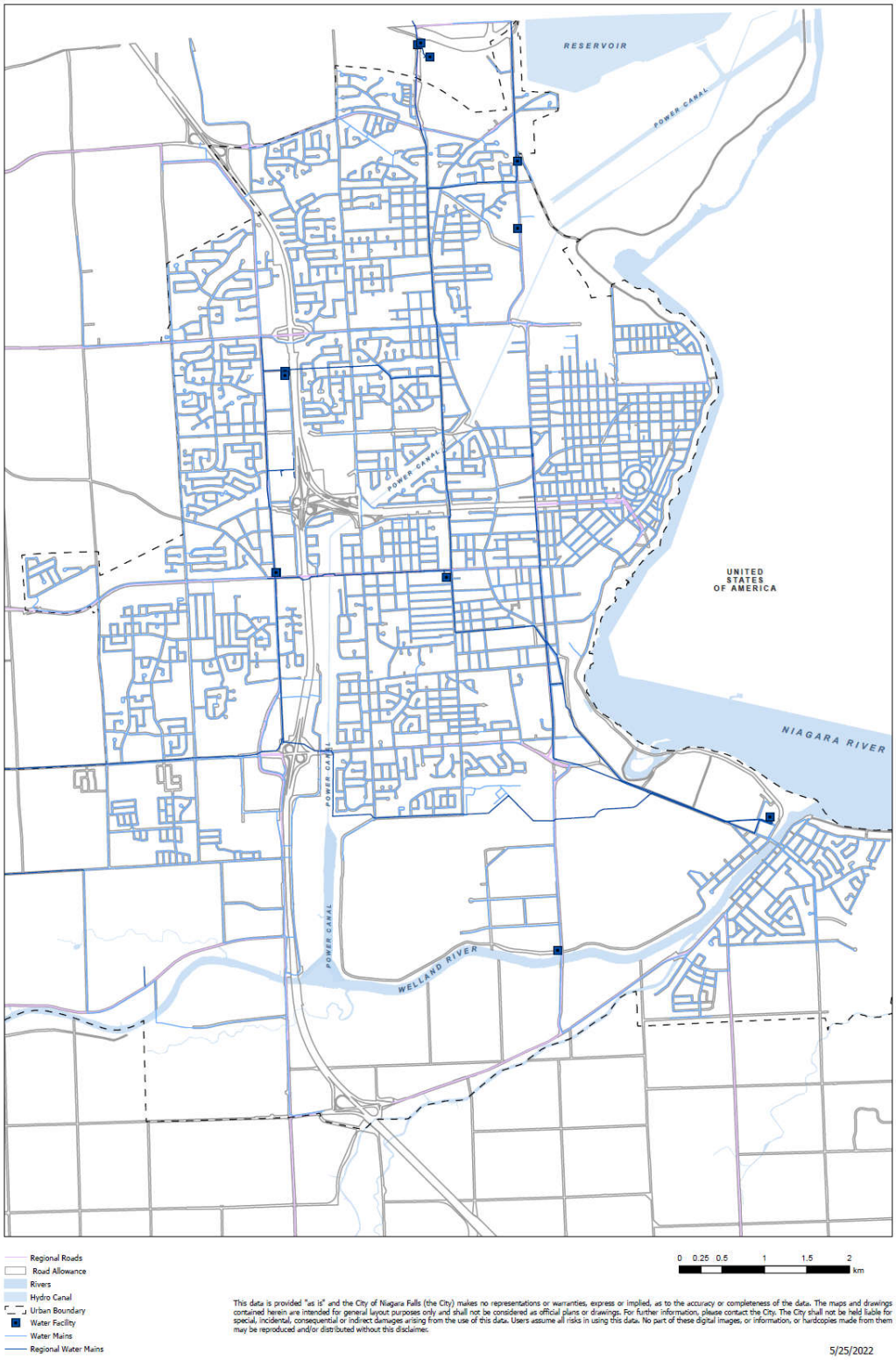
The City's engineering design standards require the provision for fire flow in the urban areas.

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 3-7 Water System Map



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 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% (based on hydraulic model)	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 to the City water system	0.05	Good	High	5
	% 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 incudes age, material and break history, as techniques for assessing physical condition are not readily available on this underground infrastructure

Potential future LOS measures related to water meters: increased confidence in meter reading and billing and increased accuracy in billing:

- % of re-reads due to water meter or reader malfunction
- % of water meter under-registration.

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 including all forcemains except low pressure main on Thoraldstone Road. The City owns and operates one sanitary pumping station (Gunning & Mears SPS), and a number of minor wastewater storage facilities. The City also owns one high rate treatment facility but is not responsible for its operations or maintenance.

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 currently tracks the instance of overflows events in combined sewers after significant rainfall events.

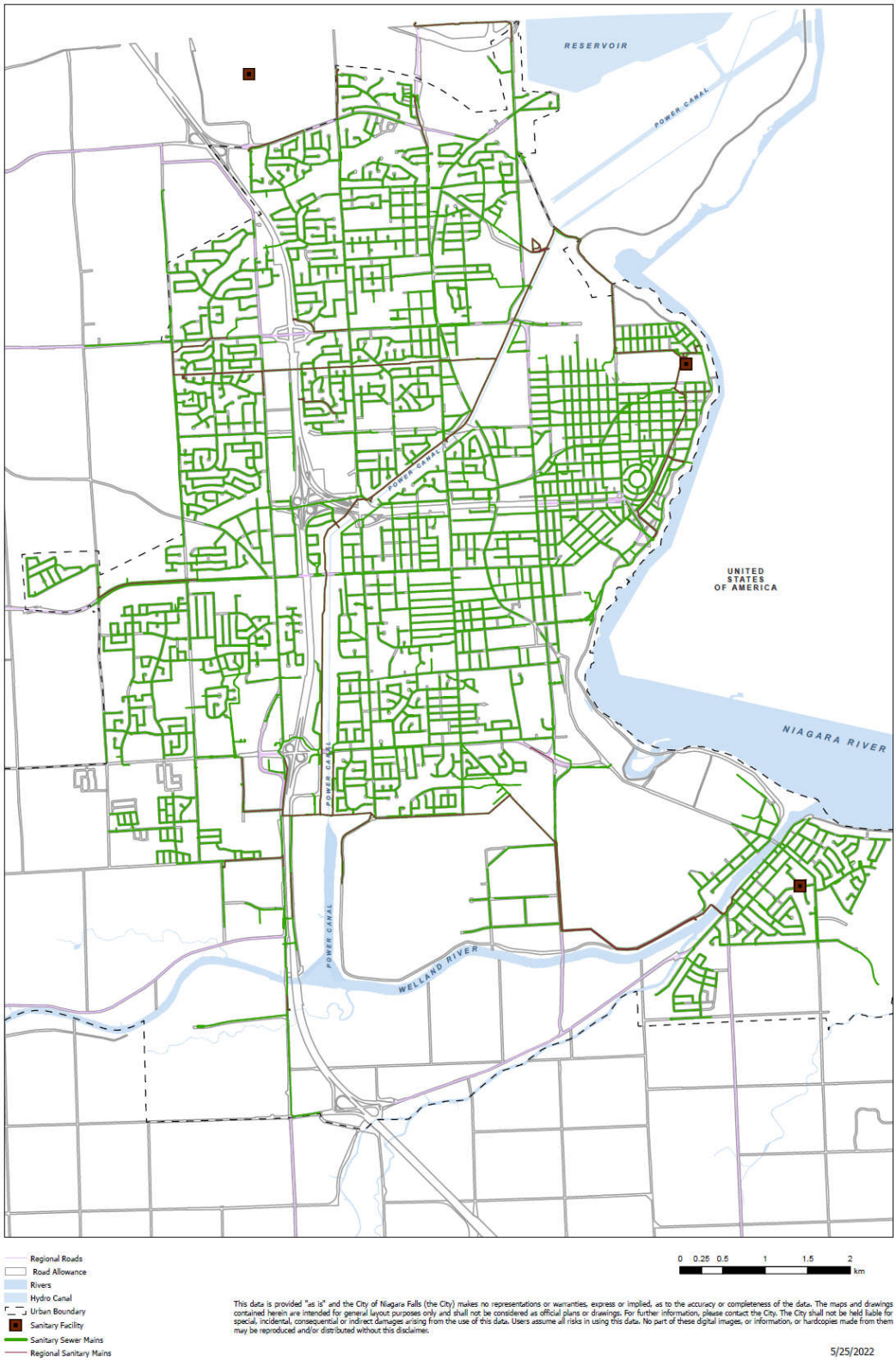
The City is working to separate its combined sanitary sewers. The minor wastewater storage facilities owned by the City are in place to accommodate overflow during storm events to prevent backups into homes due to the remaining combined sewers.

CUSTOMER LOS: Inflow and Infiltration (I/I)

Inflow occurs when stormwater enters the sanitary sewer systems at points of direct connection to the systems (catch basins, 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.

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

Figure 3-8 Wastewater System Map



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 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	*	Fair	High	15%
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

* under review, ** short term target (target will be examined as part of the Master Servicing Plan – looking to address as assets are replaced)

Potential future LOS measures related to wastewater:

- % of network meeting design infiltration allowance of 0.286 L/ha/s (hydraulic model)
- % of sewer network that meets minimum slope requirements per diameter (per design guidelines).

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:

Risk Exposure = Consequence of Failure x 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 Insignificant	2 Minor	3 Moderate	4 Major	5 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 4-1 shows that 0.4% or $7.30 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) and six road segments namely Kalar Road, Kitchener Street, Allendale Avenue, Buchanan Avenue, Fallsview Boulevard, and Reixinger Road ($2.94 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 4-1 Reliability Risk Exposure of Core Assets

Risk	CRV ($)	CRV (%)
Very High	$7.30	0.4%
High	$98.58	5.2%
Moderate	$316.38	16.7%
Low	$981.68	51.8%
Very Low	$492.1	26.0%
Total	**$1,896.1**	**100.0%**

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 Road & Related Assets

Service	Asset Category	Attributes	Capacity	Function	Reliability
Road Assets	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
Road Related Assets	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 4-2 combines the Criticality (CoF) ratings with the Condition (PoF) ratings for the City's Road assets, not including Sidewalks, Medians and Barriers which are shown in Figure 4-3Figure 4-3 Reliability Risk Exposure of Road Related Assets, which follows. Six road segments namely Kalar Road, Kitchener Street, Allendale Avenue, Buchanan Avenue, Fallsview Boulevard, and Reixinger Road make up the $2.94 million Very High risk exposure 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 4-2 Reliability Risk Exposure of Road Assets

PoF	Cdn					
5	VP	$0.26	$0.19	$3.31	$2.94	$0.00
4	P	$3.80	$2.51	$59.23	$43.12	$0.00
3	F	$1.70	$6.05	$135.66	$75.87	$0.00
2	G	$0.38	$2.87	$129.13	$70.11	$0.00
1	VG	$0.00	$0.00	$33.85	$24.82	$0.00
		VL	L	M	H	VH
		1	2	3	4	5

Criticality (CoF)

Risk	CRV ($)	CRV (%)
Very High	$2.94	0.5%
High	$46.43	7.8%
Moderate	$135.30	22.7%
Low	$343.72	57.7%
Very Low	$67.4	11.3%
Total	**$595.8**	**100.0%**

The risk map shown as Figure 4-3 combines the Criticality (CoF) ratings with the Condition (PoF) ratings for the City's Road Related assets (i.e. Sidewalks, Medians and Barriers). Road medians make up the $0.45 million High risk (orange) for Road Related assets.

Figure 4-3 Reliability Risk Exposure of Road Related Assets

PoF	Cdn					
5	VP	$0.30	$0.06	$0.45	$0.00	$0.00
4	P	$0.43	$11.44	$0.07	$0.00	$0.00
3	F	$0.10	$0.69	$0.25	$0.00	$0.00
2	G	$0.02	$9.77	$0.26	$0.05	$0.00
1	VG	$0.25	$9.18	$0.18	$0.01	$0.00
		VL	L	M	H	VH
		1	2	3	4	5

Criticality (CoF)

Risk	CRV ($)	CRV (%)
Very High	$0.00	0.0%
High	$0.45	1.3%
Moderate	$0.13	0.4%
Low	$13.00	38.8%
Very Low	$19.9	59.5%
Total	**$33.5**	**100.0%**

Note that the datasets for retaining walls, overhead sign supports and arches is not complete and will be improved prior to producing the next AM Plan.

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 Bridges & 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 4-4 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 4-4 Reliability Risk Exposure of Bridges & Culverts

PoF	Cdn					
5	VP	$0.00	$0.00	$0.00	$0.00	$0.00
4	P	$0.50	$0.71	$1.00	$0.00	$4.36
3	F	$0.24	$15.05	$17.21	$6.67	$17.49
2	G	$0.14	$5.82	$20.94	$17.61	$60.93
1	VG	$0.00	$0.00	$0.91	$0.00	$1.91
		VL	L	M	H	VH
		1	2	3	4	5

Criticality (CoF)

Risk	CRV ($)	CRV (%)
Very High	$4.36	2.5%
High	$17.49	10.2%
Moderate	$68.60	40.0%
Low	$73.44	42.8%
Very Low	$7.6	4.4%
Total	**$171.5**	**100.0%**

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

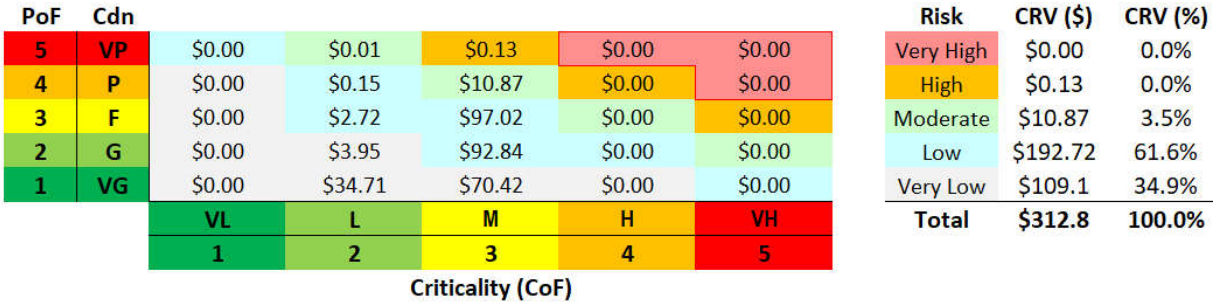
Table 4-5 provides a summary of the CoF assessment for the City's Stormwater Management System assets.

Table 4-5 Consequence of Failure Ratings for Stormwater Mgmt System

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

The risk map shown as Figure 4-5 combines the Criticality (CoF) ratings with the Condition (PoF) ratings for the City's Stormwater assets. The $0.13 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 low to moderate as it is age-based.

Figure 4-5 Reliability Risk Exposure of Stormwater Mgmt System



PoF	Cdn					
5	VP	$0.00	$0.01	$0.13	$0.00	$0.00
4	P	$0.00	$0.15	$10.87	$0.00	$0.00
3	F	$0.00	$2.72	$97.02	$0.00	$0.00
2	G	$0.00	$3.95	$92.84	$0.00	$0.00
1	VG	$0.00	$34.71	$70.42	$0.00	$0.00
		VL	L	M	H	VH
		1	2	3	4	5

Criticality (CoF)

Risk	CRV ($)	CRV (%)
Very High	$0.00	0.0%
High	$0.13	0.0%
Moderate	$10.87	3.5%
Low	$192.72	61.6%
Very Low	$109.1	34.9%
Total	**$312.8**	**100.0%**

4.3.4 Water System

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

Table 4-6 Consequence of Failure Ratings for Water System

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

The risk map shown as Figure 4-6 combines the Criticality (CoF) ratings with the Condition (PoF) ratings for the City's Water System. The $24.53 million shown as a High

risk exposure (orange) consists of over 300 water main segments with PoF of 5, Very Poor condition.

Figure 4-6 Reliability Risk Exposure of Water System

Risk	CRV ($)	CRV (%)
Very High	$0.00	0.0%
High	$24.53	6.3%
Moderate	$37.13	9.5%
Low	$167.55	42.8%
Very Low	$162.6	41.5%
Total	**$391.8**	**100.0%**

4.3.5 Wastewater System

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

Table 4-7 Consequence of Failure Ratings for Wastewater System

Service	Asset Type	Attributes	Capacity	Function	Reliability
Wastewater	Sanitary Sewers	Gravity Mains	2	3	3
		Low Pressure Mains	1	2	3
	Laterals			2	2
	Facilities	High Rate Treatment Facility	3	3	4
		Pumping Station		2	3
	Wastewater Appurtenances	MHs, Cleanouts		2	2

The risk map shown as Figure 4-7 combines the Criticality (CoF) ratings with the Condition (PoF) ratings for the City's Wastewater System. The $9.51 million shown as a High risk exposure consists of 480 sanitary sewer main segments with PoF of 5, Very Poor condition.

Figure 4-7 Reliability Risk Exposure of Wastewater System

Risk	CRV ($)	CRV (%)
Very High	$0.00	0.0%
High	$9.51	2.3%
Moderate	$64.68	15.7%
Low	$192.73	46.9%
Very Low	$143.8	35.0%
Total	**$410.8**	**100.0%**

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 shown in Figure 5-1 and listed in Table 5-1, and are driven by the levels of services defined in Section 3.

Figure 5-1 Asset Lifecycle Delivery

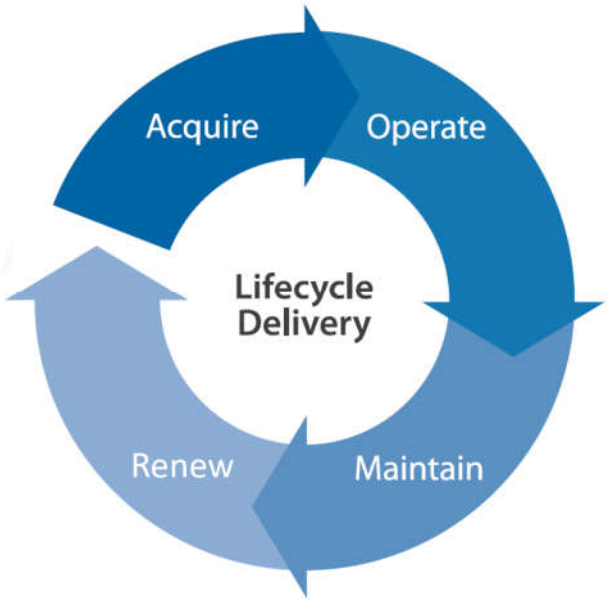


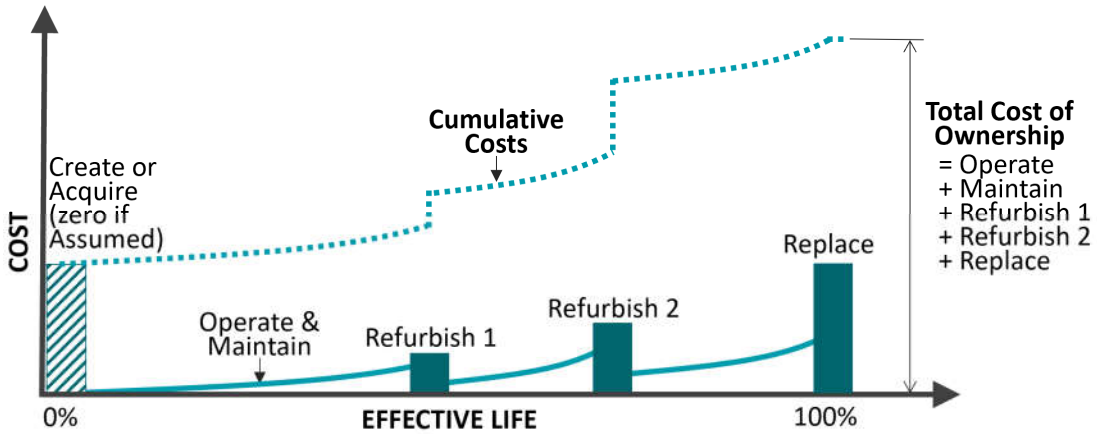
Table 5-1 Asset Lifecycle Management Categories

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
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
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

In addition to the above asset strategies, non-asset solutions are also considered which include 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 5-2. 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.

Figure 5-2 Conceptual Lifecycle Cost Model



The following two figures show how 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 5-3 Maintenance Deterioration Model

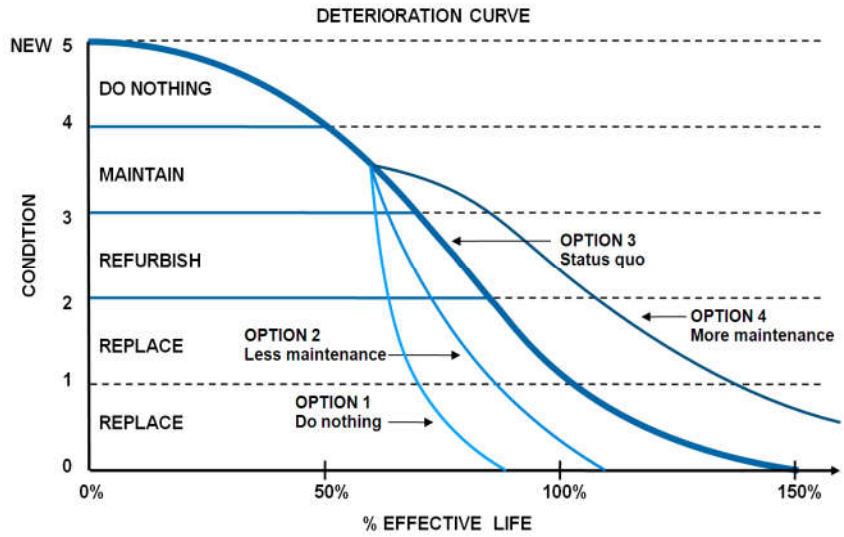
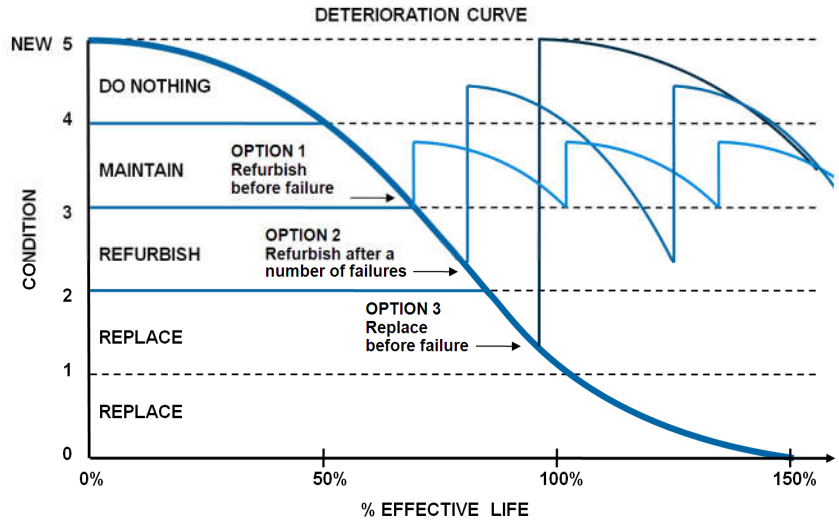


Figure 5-4 Renewal Deterioration Model



This section of the AM Plan first provides the growth and upgrade needs to support capacity and functional service levels, then the operations and maintenance needs, followed by the renewal needs to support reliability service levels. The final section summarizes the core asset needs.

5.2 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 needs are also reported separately depending on whether the funding source is Rate based (for water and wastewater services) or Tax based (for roads and related, bridges and culverts, and stormwater services). 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. However, the confidence in these forecasts is low. Therefore, the average of the historic growth and upgrade expenditures over the past 5 years have been used to forecast the growth and upgrade needs over the next 10 years. These needs are shown as the darker coloured, upper portion of the bars in Figure 5-5 for Tax Based and Figure 5-6 for Rate Based, by service.

Developer-Donated Growth

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 5-5 for Tax Based and Figure 5-6 for Rate Based, by service.

Figure 5-5 10-Year Forecast Growth & Upgrade Needs, Tax Based

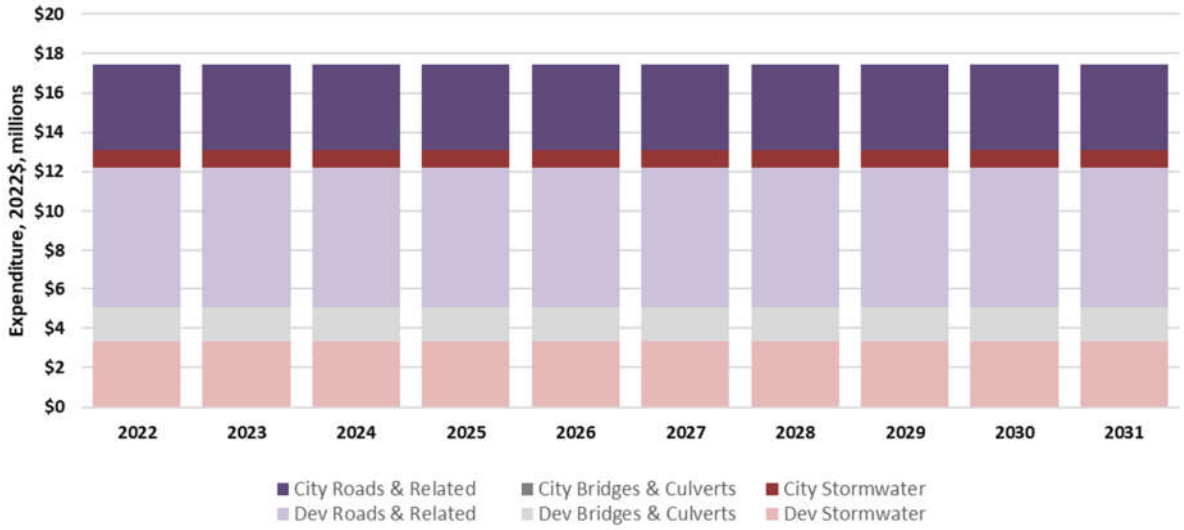
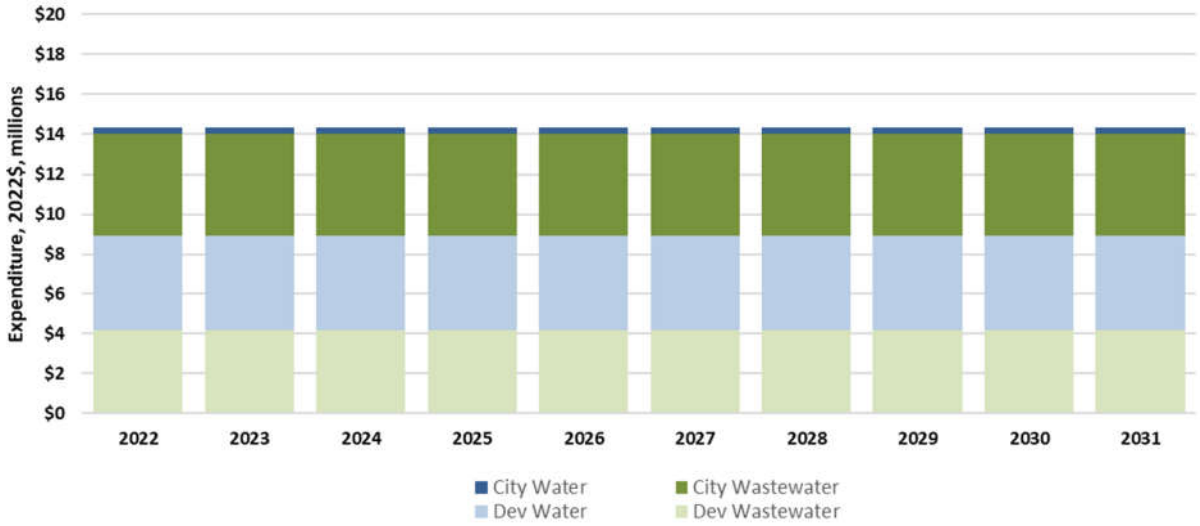


Figure 5-6 10-Year Forecast Growth & Upgrade Needs, Rate Based



To improve the confidence in these forecasts, the City plans to update current transportation, stormwater, water and wastewater master plans.

5.3 Operations and Maintenance Needs

Operations and Maintenance Needs for Current LOS

Along with timely renewal of assets, described in the next section, 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 operations and maintenance (operating expenses) and renewals (capital programs) 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 next section extend the useful life of the asset. Operations, maintenance and renewals 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 5-2 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 City 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 5-2.

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).

The City should undertake a formal gap assessment of O&M programs across all core asset portfolios including a roadmap with scope, cost estimates and timelines.

Table 5-2 O&M Needs Activities & 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			**$50**			**$0**
Water Mains	Track break history, Uni-directional flushing, C-Factor Testings	Y	$50	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	

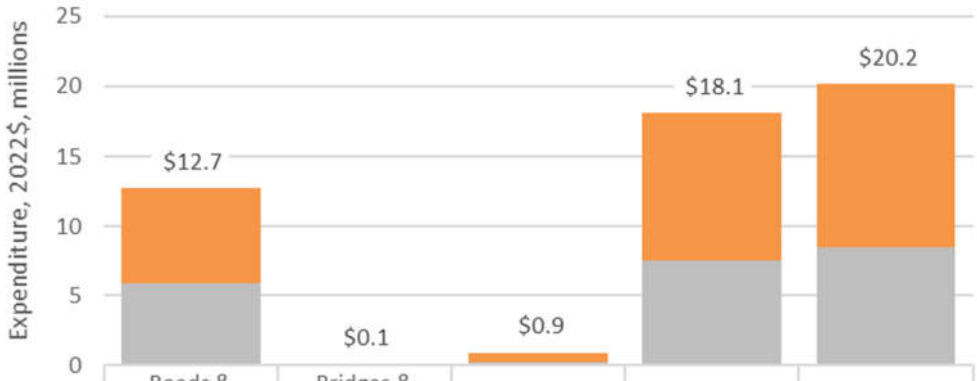
* Bridge repairs currently being done through capital works as recommended in the Bridge Needs Study

** shift survey from capital to operating

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. The total operations and maintenance needs for 2022 are forecast to be as follows:

- 2022 Tax Based O&M needs: $13.7 million
- 2022 Rate Based O&M needs: $38.3 million.

Figure 5-7 Operations & Maintenance Needs for Core Assets, by Service



	Roads & Related	Bridges & Culverts	Stormwater	Water	Wastewater
TOTAL O&M	$12.7	$0.1	$0.9	$18.1	$20.2
Maintenance	$6.8	$0.1	$0.7	$10.6	$11.6
Operations	$5.9	$-	$0.2	$7.5	$8.5

Additional operations and maintenance costs due to the growth or upgrade of assets over the next 10 years based on forecast new, expansion or upgraded assets are estimated to be as follows:

- 10-year average annual Tax Based O&M needs (2022 to 2031): $14.9 million
- 10-year average annual Rate Based O&M needs (2022 to 2031): $40.5 million.

5.4 Renewal (State of Good Repair) 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 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 without the activities. Examples of rehabilitation activities are milling and repaving of a paved road segment, concrete deck replacement on a bridge, and lining storm and sanitary sewers, all 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 (2020). 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 5-8 shows the renewal needs for Tax based assets (Roads and Related, Bridges and Culverts, and Stormwater Management System) over the next 10 years. The average renewal need (solid black line) is estimated at $20.4 million per year for the period 2022-2031. However, the renewal need in 2022 is $26.9 million. The difference between the 2022 renewal need and the 10-year average is $6.5 million and represents the backlog due to assets currently in need of renewal. The backlog is made up mostly of bridges and culverts at $5.0 million. The annual renewal need includes removal of the backlog over the 10 year period. Refer to Table 5-3 for a detailed breakdown of the current backlog. 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 5-8 10-Year Forecast Renewal (SOGR) Needs, Tax Based

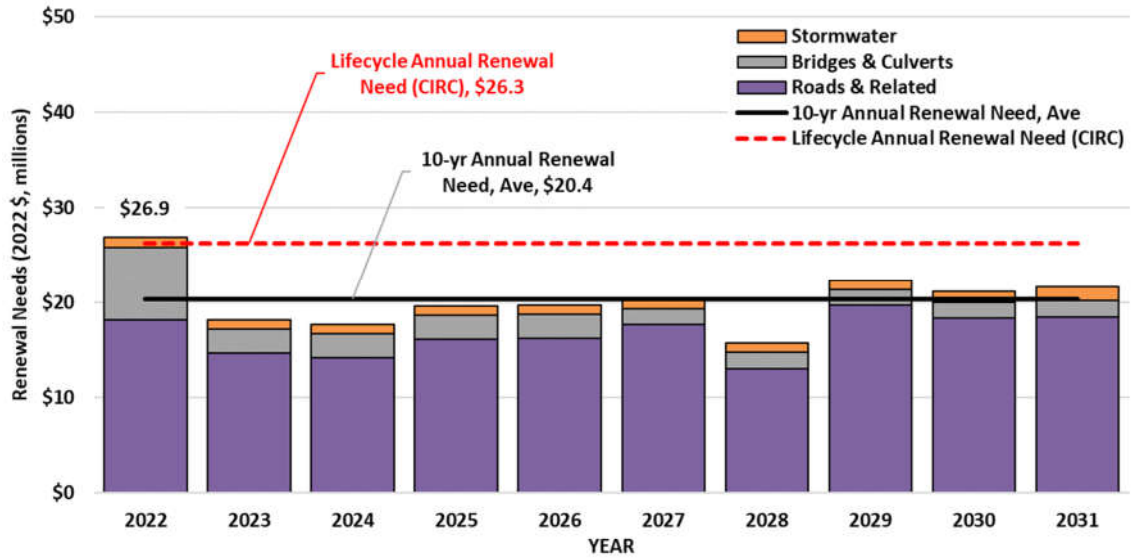
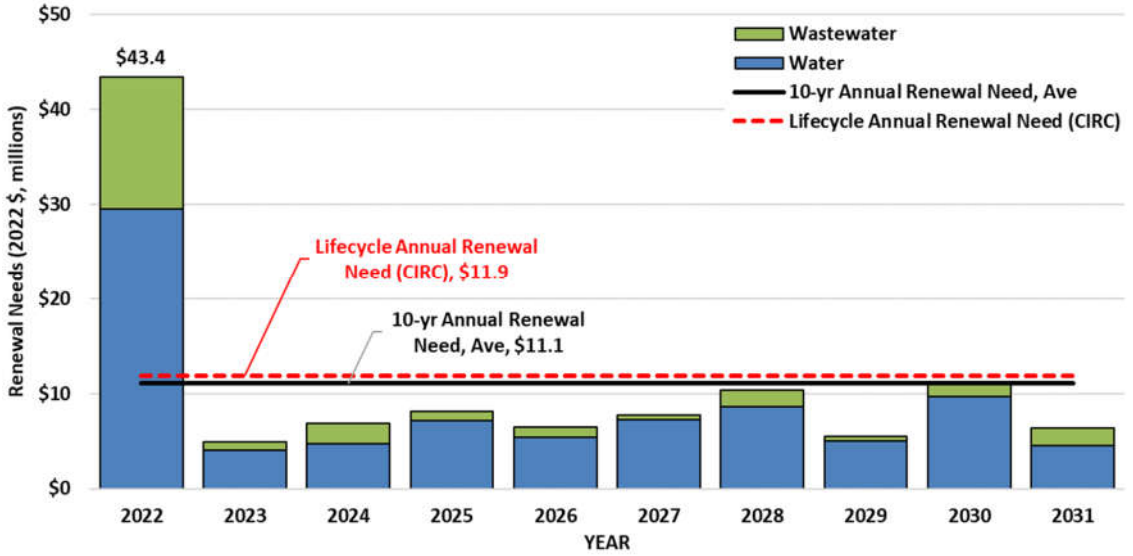


Figure 5-9 shows the renewal needs for Rate based assets (Water and Wastewater Systems) over the next 10 years. The average renewal need (solid black line) is estimated at $11.1 million per year for the period 2022-2031. However, the renewal need in 2022 is $43.4 million. The difference between the 2022 renewal need and the 10-year average is $32.3 million and represents the backlog due to assets currently in need of renewal. The backlog is made up mostly of water mains at $19.9 million and sanitary mains at $7.3 million. The annual renewal need includes removal of the backlog over the 10 year period. Refer to Table 5-3 for a detailed breakdown of the current backlog. 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 5-9 10-Year Forecast Renewal (SOGR) Needs, Rate Based



Backlog of Renewal Needs

Table 5-3 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 5-3 Makeup of Renewal Backlog, by Service & Asset Category

Service	Asset Category	Backlog ($)	Backlog (%)	Criticality *	Basis of Analysis	Confidence
Roads & Related	Roads	$0.9	6%	3 to 4	Inspected (PCI)	High
	Sidewalks	$0	0%	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	33%	3	Age-based	Moderate
	Maintenance Holes	$0.0	33%	2	Age-based	Moderate
	Catchbasins	$0.0	33%	2	Age-based	Moderate
	Catchbasins Leads	$0.0	0%	2	Age-based	Moderate
	SWM Ponds	$0.0	0%	3	Annual Amount	Low
TOTAL Tax Based		**$6.6**				
Water	Water Mains	$19.9	361%	3	Age, # breaks	Mod - High
	Services	$0.0	0%	2	Annual Amount	Low
	Bulk Water Stations	$0.0	0%	3	Annual Amount	Low
	Hydrants	$0.7	230%	2	Age-based	Moderate
	Valves	$0.2	195%	2	Age-based	Moderate
	Meters	$0.0	0%	3	Annual Amount	Low
	Curb Stops	$0.0	0%	2	Annual Amount	Low
Wastewater	Sewers	$7.3	731%	3	Inspected (CCTV)	High
	Laterals	$0.8	135%	2	Age-based	Moderate
	Facilities-Treatment	$0.0	0%	4	Annual Amount	Low
	Facilities-Storage & Pumping	$0.0	0%	3	Annual Amount	Low
	Maintenance Holes	$3.3	600%	2	Age-based	Moderate
	Cleanouts	$0.0	900%	2	Age-based	Moderate
TOTAL Rate Based		**$32.3**				

* 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 5-2, the annual reinvestment amount is the cost of (Refurbish 1 plus Refurbish 2 plus Replace) divided by (Effective Life).

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

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 5-4 provides the 2016 CIRC target reinvestment rates: upper target, lower target, and average target.

Table 5-4 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 Lifecycle Annual Renewal Need shown in Figure 5-8 and Figure 5-9 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. The City should plan for long term renewal needs close to the Lifecycle Annual Renewal Needs shown as $26.3 million for Tax Based assets and $11.9 million for Rate Based assets, including growth in the core asset portfolio over the next 10 years.

5.4.1 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 5-5 Renewal Forecast Assumptions for Roads & 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, with any sidewalks in very poor condition based on age being shown as in unknown condition *
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 City has an extensive in-house spot repair program. The City intends to develop a 5-point rating system for use during MMS reviews to evaluate and record the overall condition of each sidewalk segment (i.e., between two nodes or two intersecting streets). Partial segments will be scheduled for spot repairs or replacement, depending on condition.

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

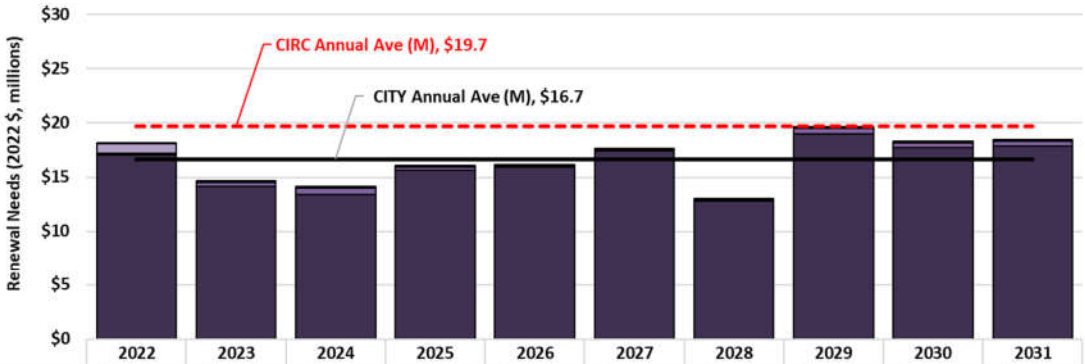
Table 5-6 Renewal Strategies for Roads and Related Assets

Asset Category	Cost Unit	Rehab 1			Rehab 2			Replace	
		Description	Time (yrs)	Unit Cost	Description	Time (yrs)	Unit Cost	Years	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	m2							40	$130
Medians	m							50	$161
Barriers	m							50	$8.66

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

The following figure shows the results of the renewal needs forecast. The graph highlights the small backlog of road pavement needs. Note that the longer term annual renewal amount of $19.7 million is above the 10-year average of $16.7 million.

Figure 5-10 10-Year Forecast Renewal Needs for Roads & Related Assets



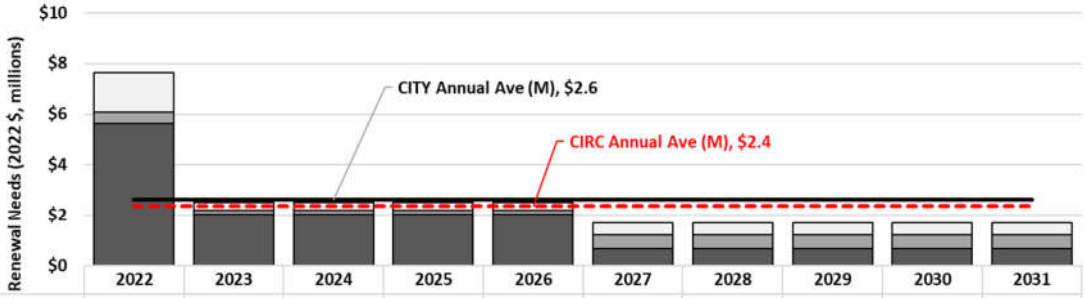
	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Barriers	$109,297	$109,297	$109,297	$109,297	$109,297	$109,297	$109,297	$109,297	$109,297	$109,297
Medians	$838,852	$65,546	$86,833	$74,442	$29,619	$93,344	$0	$41,455	$51,642	$15,335
Sidewalks	$209,728	$392,132	$541,563	$293,994	$101,126	$33,284	$146,808	$563,371	$428,277	$504,681
Roads	$17,026,031	$14,106,485	$13,426,138	$15,625,674	$15,946,042	$17,419,276	$12,802,445	$18,959,912	$17,747,324	$17,837,626
CITY Annual Ave (M)	$16.7	$16.7	$16.7	$16.7	$16.7	$16.7	$16.7	$16.7	$16.7	$16.7
CIRC Annual Ave (M)	$19.7	$19.7	$19.7	$19.7	$19.7	$19.7	$19.7	$19.7	$19.7	$19.7

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 $2.4 million is approximately equal to the 10-year average of $2.6 million. The City will review bridge related asset management needs biannually as OSIMs are updated.

Figure 5-11 10-Year Forecast Renewal Needs for Bridges & Culverts



	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Municipal Structures	$1,566,750	$328,250	$328,250	$328,250	$328,250	$488,750	$488,750	$488,750	$488,750	$488,750
Span Culverts	$452,500	$162,500	$162,500	$162,500	$162,500	$546,250	$546,250	$546,250	$546,250	$546,250
Span Bridges	$5,633,500	$2,030,000	$2,030,000	$2,030,000	$2,030,000	$667,875	$667,875	$667,875	$667,875	$667,875
CITY Annual Ave (M)	$2.6	$2.6	$2.6	$2.6	$2.6	$2.6	$2.6	$2.6	$2.6	$2.6
CIRC Annual Ave (M)	$2.4	$2.4	$2.4	$2.4	$2.4	$2.4	$2.4	$2.4	$2.4	$2.4

Stormwater Management System

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

Table 5-7 Renewal Forecast Assumptions for 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 5-8 Renewal Strategies for Stormwater Management System

Asset Category	Cost Unit	Time (years)	Unit Cost (2022$)
Storm Sewers	m	varies	varies
Catchbasin Leads	m	varies	varies
SWM Ponds	ea	50	$1,000,000
Maintenance Holes	ea	80	Varies
Catchbasins	ea	80	Single: $2401 Double: $3646

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 5-12 10-Year Forecast Renewal Needs for Stormwater Mgmt System

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Catchbasins Leads	$0	$0	$16,309	$0	$0	$0	$0	$3,634	$0	$0
Catchbasins	$7,060	$0	$0	$0	$1,163	$0	$0	$0	$9,772	$34,930
Maintenance Holes	$4,556	$0	$0	$0	$751	$0	$0	$0	$6,307	$22,542
SWM Ponds	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000
Storm Sewers	$92,208	$0	$0	$0	$15,191	$0	$0	$0	$127,630	$456,190
CITY Annual Ave (M)	$1.1	$1.1	$1.1	$1.1	$1.1	$1.1	$1.1	$1.1	$1.1	$1.1
CIRC Annual Ave (M)	$4.2	$4.2	$4.2	$4.2	$4.2	$4.2	$4.2	$4.2	$4.2	$4.2

Water System

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

Table 5-9 Renewal Forecast Assumptions for Water System

Asset Category	Forecast Assumptions
Watermains	Forecasted based on last observed condition (break history data) or age if condition not available
Services	Forecasted based on age
Hydrants & Valves	Forecasted based on age
Meters and Curb Stops	Forecast is an average annual reinvestment rate (same annualized investment each year) based on replacement value and useful life.
Bulk Water Station	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 5-10 Renewal Strategies for Water System

Asset Category	Cost Unit	Time (years)	Unit Cost (2022$)
Watermains	m	varies	varies
Services	m	25	$296

Asset Category	Cost Unit	Time (years)	Unit Cost (2022$)
Bulk Water Stations	ea	75	$150,000
Hydrants	ea	75	$9,467
Valves	ea	75	varies
Meters	ea	20	varies
Curb Stops	ea	75	<=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 approximately equal to the 10-year average of $6.0 million.

Figure 5-13 10-Year Forecast Renewal Needs for Water System

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Curb Stops	$224,650	$224,650	$224,650	$224,650	$224,650	$224,650	$224,650	$224,650	$224,650	$224,650
Services	$1,224,837	$1,224,837	$1,224,837	$1,224,837	$1,224,837	$1,224,837	$1,224,837	$1,224,837	$1,224,837	$1,224,837
Meters	$1,183,324	$1,183,324	$1,183,324	$1,183,324	$1,183,324	$1,183,324	$1,183,324	$1,183,324	$1,183,324	$1,183,324
Valves	$339,578	$63,191	$33,743	$120,758	$183,406	$78,436	$97,827	$75,842	$80,240	$77,139
Hydrants	$1,050,837	$151,472	$142,005	$293,477	$426,015	$179,873	$217,741	$255,609	$284,010	$179,873
Bulk Water Stations	$12,000	$12,000	$12,000	$12,000	$12,000	$12,000	$12,000	$12,000	$12,000	$12,000
Water Mains	$25,433,026	$1,220,886	$1,882,649	$4,126,502	$2,159,095	$4,367,560	$5,656,560	$2,001,638	$6,715,406	$1,651,125
CITY Annual Ave (M)	$7.4	$7.4	$7.4	$7.4	$7.4	$7.4	$7.4	$7.4	$7.4	$7.4
CIRC Annual Ave (M)	$6.6	$6.6	$6.6	$6.6	$6.6	$6.6	$6.6	$6.6	$6.6	$6.6

Wastewater System

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

Table 5-11 Renewal Forecast Assumptions for 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, Laterals, Cleanouts, Storage Tanks	Forecasted based on age

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

Table 5-12 Renewal Strategies for Wastewater System

Asset Category	Cost Unit	Time (years)	Unit Cost (2022$)
Sanitary Sewer Mains	m	varies	varies
Laterals	m	varies	varies
Facilities-Treatment	ea	50	$14.8M
Facilities-Storage & Pumping	ea	50	$2.13M
Maintenance Holes	ea	80	$10,764
Cleanouts	ea	80	$885

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 $5.3 million is significantly above the 10-year average of $1.9 million. Renewal works now include lining rehabilitation and is being planned with works to eliminate combined sewers.

Figure 5-14 10-Year Forecast Renewal Needs for Wastewater System

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Cleanouts	$1,770	$0	$0	$0	$0	$0	$0	$0	$0	$0
Maintenance Holes	$3,885,804	$0	$53,820	$215,280	$118,404	$32,292	$527,436	$0	$322,920	$398,268
Facilities-Storage & Pumping	$62,500	$62,500	$62,500	$62,500	$62,500	$62,500	$62,500	$62,500	$62,500	$62,500
Facilities-Treatment	$296,440	$296,440	$296,440	$296,440	$296,440	$296,440	$296,440	$296,440	$296,440	$296,440
Laterals	$1,355,008	$479,246	$1,755,143	$360,770	$256,730	$0	$131,779	$200,002	$476,745	$757,437
Sewers	$8,345,676	$0	$0	$0	$352,644	$46,071	$687,921	$5,535	$333,473	$269,409
CITY Annual Ave (M)	$1.9	$1.9	$1.9	$1.9	$1.9	$1.9	$1.9	$1.9	$1.9	$1.9
CIRC Annual Ave (M)	$5.3	$5.3	$5.3	$5.3	$5.3	$5.3	$5.3	$5.3	$5.3	$5.3

This AM Plan does not include the needs related to sewer separate needs. The 2017 Pollution Control Study / Plan (PPCP) showed a program of separate works (i.e., the CSO management strategy) which included design costs but not construction cost estimates for sewer separation. The next AM Plan will have better defined strategy with CSO and wet weather needs.

5.5 Summary of Core Asset Needs

Figure 5-15 shows the total operations, maintenance, renewal, growth and upgrade needs forecast for Tax based City core assets 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 $399 million for the period 2022-2031, for an average of $39.9 million per year. 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.

Figure 5-15 10-Year Forecast Lifecycle Needs, Tax Based

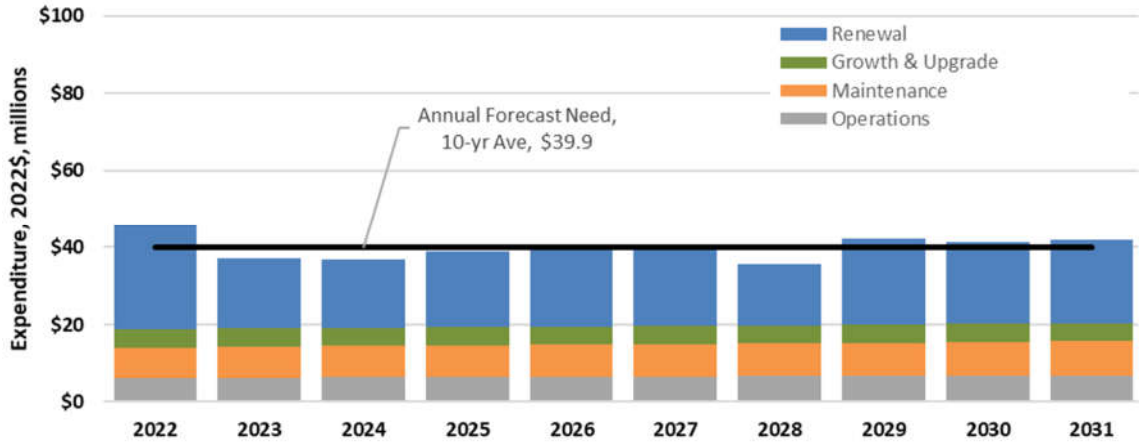
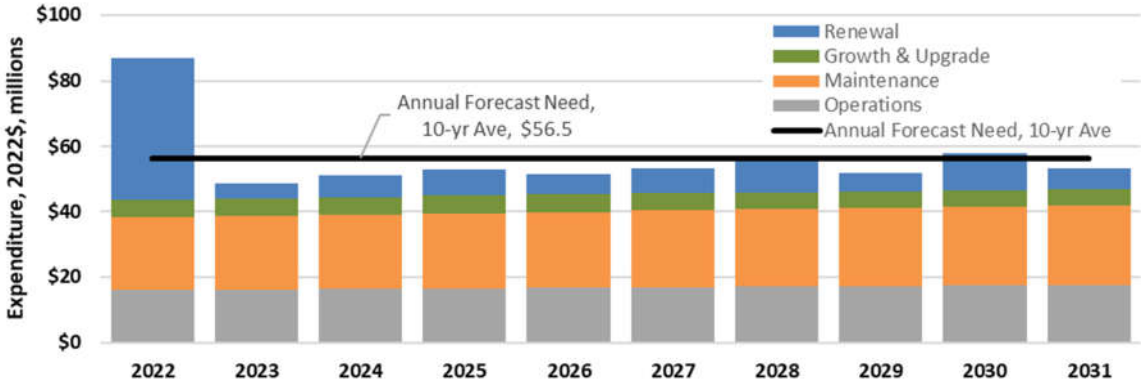


Figure 5-16 shows the total operations and maintenance, renewal, growth and upgrade needs forecast for Rate based City core assets over the next 10 years to sustain current levels of service. The sum of the City's needs forecasts for the planned strategies for managing core assets is estimated at $565 million for the period 2022-2031, for an average of $56.5 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 water mains and wastewater sewers and maintenance holes. 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.

Figure 5-16 10-Year Forecast Lifecycle Needs, Rate Based



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.

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, 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)

* An average, pre COVID, the City received approximately $23M in total of OLG funding ($4.2M allocated for the Casino Policing Unit, $5.9M for the tax supported budget as a levy subsidy, and the remaining $12.9M for Capital). Currently post COVID, Casino revenue is budgeted for about 60% of the normal amount ($13.8M) with Casino policing funding of 18% ($2.5M), tax levy of $5.5M, and $5.8M for capital. The funding for capital is contingent on total OLG funding, with policing and tax levy subsidy receiving funding first.

In addition to the above sources, capital reserves should be 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.

Annual property tax levies should be set to a level that replenishes capital reserves balances to meet future AM demands. Capital reserves should align with specific service areas. Similarly, annual property tax levies should be set at a level to fund new debt charges rated to debt approved for AM. The City minimizes impacts on residents through maximizing revenue sources such as third party grant revenue.

The funding of City services can be categorized into two groups:

- **Tax based:** those that are funded through property taxes and other sources (i.e. roads, bridges and culverts, stormwater management), and
- **Rate based:** those that are funded through user fees or rates (i.e. water and wastewater).

The following table summarizes the historical 5-year expenditures (escalated to 2022$ and averaged) and the 2022 available funding, by funding source, by lifecycle strategy.

Table 6-2 5-Year Historic and Current Available Funding

Funding Source →	Tax Based		Rate Based	
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	$4.7	$4.7	$4.9	$8.7
Renewal	$12.5	$15.5	$6.3	$9.5
Operations	$5.1	$5.8	$15.3	$15.2
Maintenance	$6.4	$7.5	$20.6	$22.1
TOTALS	**$28.6**	**$33.5**	**$47.1**	**$55.5**

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.

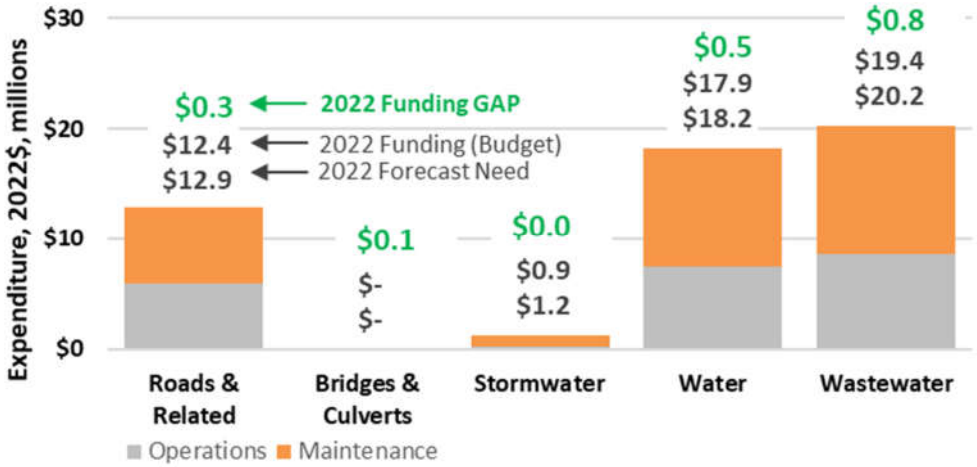
6.2 Growth & Upgrade Financial Sustainability

As discussed in the Lifecycle Management Strategy section above, the average historic growth and upgrade expenditures over the past 5 years have been used to forecast the growth and upgrade needs for the next 10 years due to low to moderate confidence in the forecast remaining in the City's 2019 Development Charges Background Study. As the City develops a comprehensive asset management plan for non-core assets, and 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 O&M Financial Sustainability

For each service, Figure 6-1 provides the 2022 forecast operations and maintenance need (bottom amount), available Funding (middle amount) and the Funding GAP (top amount, in green) 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 Tax based operations and maintenance (transportation and stormwater management assets) is $0.4 million and for Rate based (water and water systems) is $1.3 million. As the asset portfolio grows and is upgraded over time, the operations and maintenance needs will increase.

Figure 6-1 2022 O&M Funding Gap, by Service



6.4 Renewal (SOGR) Financial Sustainability

The largest funding gap was found for Tax based assets, namely roads, bridges and culverts, and stormwater management system assets. For these assets, Figure 6-2 shows historic spending (dashed black line at $12.5 million) and the 10-year average annual need forecast (solid black line at $20.4 million) for an annual funding gap for each of the next ten years of $7.8 million (shown in green text) for a total of $78 million over the 10-year period. The yellow line at $15.5 million is the 2022 budget.

The lifecycle annual renewal need estimate of $26.8 million based on the CIRC average annual renewal rate (dashed red line) indicates that the 10-year average annual forecast needs of $20.4 million is lower than renewal needs beyond the 10-year forecast period.

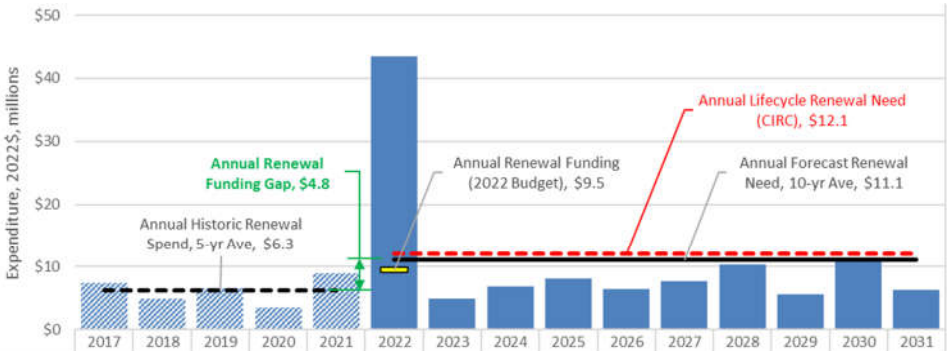
Figure 6-2 Annual Renewal Funding Gap, Tax Based Assets

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Renewal	$7.0	$15.9	$12.6	$17.0	$10.1	$26.9	$18.2	$17.7	$19.6	$19.7	$20.4	$15.8	$22.4	$21.2	$21.7
Annual Historic Renewal Spend, 5-yr Ave	$12.5	$12.5	$12.5	$12.5	$12.5										
Annual Renewal Funding (2022 Budget)						$15.5									
Annual Forecast Renewal Need, 10-yr Ave						$20.4	$20.4	$20.4	$20.4	$20.4	$20.4	$20.4	$20.4	$20.4	$20.4
Annual Lifecycle Renewal Need (CIRC)						$26.8	$26.8	$26.8	$26.8	$26.8	$26.8	$26.8	$26.8	$26.8	$26.8

The Rate based funding for water and wastewater assets is closer to the forecast needs. Figure 6-3 shows historic spending (dashed black line at $6.3 million) and the 10-year average annual need forecast (solid black line at $11.1 million) for an annual funding gap for each of the next ten years of $4.8 million (shown in green text) for a total of $43 million over the 10-year period. The yellow line at $9.5 million is the 2022 budget.

The lifecycle annual renewal need estimate of $12.1 million based on the CIRC average annual renewal rate (dashed red line) indicates that the 10-year average annual forecast needs of $11.1 million is only marginally lower than renewal needs beyond the 10-year forecast period.

Figure 6-3 Annual Renewal Funding Gap, Rate Based Assets



	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Renewal	$7.5	$4.9	$6.5	$3.5	$8.9	$43.4	$4.9	$6.9	$8.1	$6.5	$7.7	$10.3	$5.5	$11.2	$6.3
Annual Historic Renewal Spend, 5-yr Ave	$6.3	$6.3	$6.3	$6.3	$6.3										
Annual Renewal Funding (2022 Budget)						$9.5									
Annual Forecast Renewal Need, 10-yr Ave						$11.1	$11.1	$11.1	$11.1	$11.1	$11.1	$11.1	$11.1	$11.1	$11.1
Annual Lifecycle Renewal Need (CIRC)						$12.1	$12.1	$12.1	$12.1	$12.1	$12.1	$12.1	$12.1	$12.1	$12.1

6.5 Strategies to Close Funding Gaps

The following strategies may be considered to close the funding gaps for Tax based assets (transportation and stormwater management system):

- 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; this will likely cause increased maintenance costs and/or reduced service levels
- Pursue technologies for rehabilitating assets that extend the service life of the assets to achieve an overall lower lifecycle cost. e.g. storm sewer lining
- Increase available funds through property tax increases, leveraging third part grants, drawing on reserves or, issuance of debt
- Consider contributions to a stormwater capital reserve built into the operating budget under the service area “stormwater”
- Divest ownership of assets not providing core services

The following strategies may be considered to close the funding gaps for Rate based assets (water and wastewater systems):

- Reduce near term renewal needs by deferring capital renewal projects on lower risk assets, as described above
- Pursue technologies for rehabilitating assets that extend the service life of the assets to achieve an overall lower lifecycle cost. Eg. sanitary sewer lining
- Increase available funds through water and wastewater user fee increases and by leveraging third party grants

- Update rate studies for water and wastewater to achieve full cost recovery, as required.

7 O.Reg. Compliance & Improvements

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.

The following table lists the activities and timelines to meet Ontario Regulation 588/17 requirements.

Table 7-1 Activities to Comply with O.Reg. 588/17

Activity	Due Date	Status
Obtain endorsement by the executive lead and approval by a resolution passed by City Council of the City's AM Plan for Core Assets prepared under O.Reg 588/17	July 01, 2022	On target
Conduct an annual review of the City's asset management progress on or before July 1 in each year, starting the year after the City's asset management plan is completed	July 01, 2023	Not Started
Prepare the City's AM Plan for Non-Core Assets under O.Reg 588/17 and obtain endorsement by the executive lead and approval by a resolution passed by City Council	July 01, 2024	Not Started
Provide the proposed levels of service for each asset category for each of the 10 years of the AM Plan	July 01, 2025	Framework developed
Develop a 10 Year Capital and Operating budget forecast that aligns with lifecycle planning and risk management principles	July 01, 2025	Under development (capital)
Post the City's current SAMP and AM Plan on the City's public-facing website and make a copy available to any person who requests it	Plan Approval Date	Complete

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 (underway)
- 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 and photographs
- Perform C-factor testing on watermains as part of future hydraulic model calibration
- Perform statistical analysis using break history to better predict which factors (age, material, size, pressure, etc) impact break incidences
- Undertake inspections of water, wastewater and stormwater facilities and appurtenances based on a standardized rating scale use (building condition assessment (BCA) Uniformat 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:

- 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
- Allocate operations and maintenance funding to new growth assets at the time of assumption

To enable O.Reg.588/17 compliance and completion of the above listed improvement opportunities, the City should:

- Dedicate staffing towards AM planning activities

- Increase project management staffing complements to address the backlog of infrastructure renewal identified in this AM Plan
- Recognize that this AM Plan is for Core assets only and the infrastructure funding gap will likely widen further once Non-Core these assets are analyzed and incorporated into the overall AM Plan.

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.

App A – Service Life & 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-2 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-3 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

Asset Category	Replacement Costs
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
Paved Rural Local Roads	$110 / m2
Unpaved Roads	$36 / m2
Sidewalks	$121 / m2
Medians	$161 / m
Barriers	$8.66 / m

Table A-4 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-5 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-6 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
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-7 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
Polyvinyl Chloride	Plastic	80
Reinforced Concrete	Concrete	80
Unknown	Unknown/Other	80
Vitrified Clay	Unknown/Other	80

Table A-8 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-9 Estimated Useful Life for SWM Ponds

Asset Category	Useful Life
SWM Pond	50

Table A-10 Replacement Costs for SWM Ponds

Asset Category	Replacement Cost
SWM Pond	$169 / m3

Water System

Table A-11 Estimated Useful Life for Water Mains & Services

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-12 Replacement Costs for Water Mains & Services

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-13 Estimated Useful Life for Water Facilities

Asset Category	Useful life
Bulk Water Stations	75

Table A-14 Replacement Costs for Water Appurtenances

Asset Category	Replacement Costs
Bulk Water Stations	$150,000

Table A-15 Estimated Useful Life for Water Appurtenances

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

Table A-16 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-17 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		

Wastewater System

Table A-18 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-19 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

Size	Concrete	Plastic	Steel	Unknown/Other
750	$948	$1,285	$948	$948
825	$1,119	$1,285	$1,119	$1,119
900	$1,291	$1,285	$1,291	$1,291
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-20 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-21 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

Size	Concrete	Plastic	Steel	Unknown/Other
375	$650	$650	$650	$650
400	$650	$650	$400	$400
Unknown	$316	$316	$316	$316

Table A-22 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-23 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

* High Rate Treatment Facility located at 4300 Buttrey Street, Niagara Falls, On.

** Gunning & Mears In-line storage and pumping facility, partially located in the City's right of way in front 3625 Gunning Drive and within a City easement located on 290 Mears Crescent

App B – 2021 OSIM Reports

This appendix contains the Ontario Structures Inspections for Span and Municipal Structures, 2020.

CITY OF NIAGARA FALLS

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

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.
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 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 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 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.

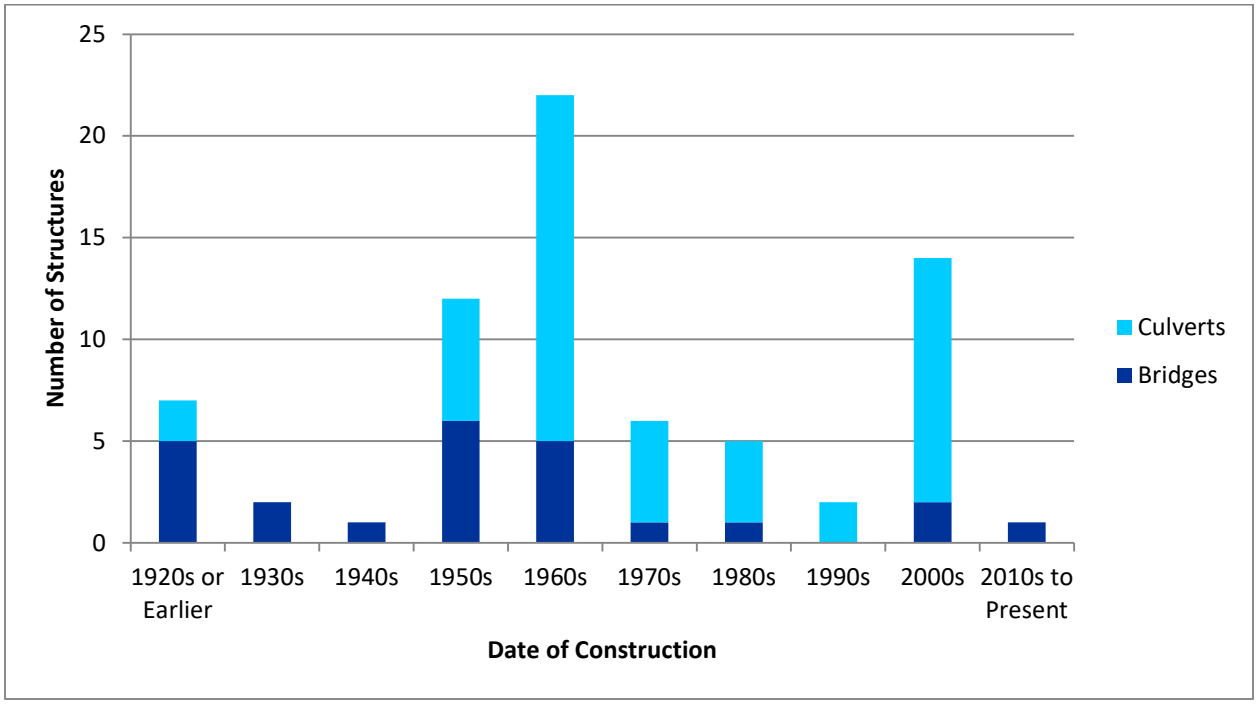


Figure 1: Estimated Dates of Construction

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 ERSL 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.

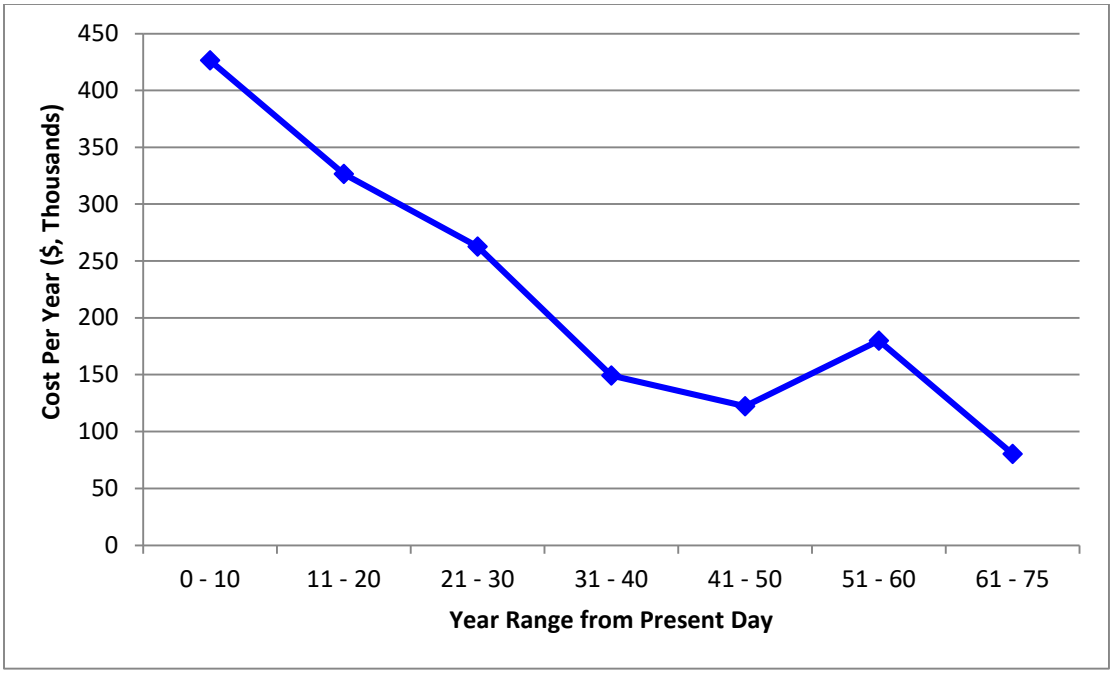


Figure 2: Net Present Value Cost per Year for the next 75 Years

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)*

City of Niagara Falls
2021 SAMCF - Municipal Structures (Spans less than 3m)

ELLIS Engineering Inc.
January 11, 2022
Job File: 981

STRUCTURE INFORMATION (More Inspection Data)-->

ID Number	Structure Name	Structure Type	Road Classification	No. of Spans	Span Lengths (m)	Deck Area (m²)	Consequence of Failure	General Overall Condition	Previous BCI	Current BCI	BCI in 10 Years, No Work	Recommended Work in Next 10 Years	BCI Post-Work	Priority Rating	Total Cost
BCV_000X	Old Mewburn Road	CPP	Arterial	2	0.45, 0.45	8	3	Very Good	N/A	95	85	None		Adequate	$0.00
BCV_000XX	Oldfield Road	CSP	Arterial	1	0.73	13	3	Fair	N/A	65	55	Replace	100	1-5 Years	$115,000.00
BCV_00167	McLeod Road	RB	Arterial	1	2.4	134	4	Good	N/A	76	73	Minor Maintenance	76	1-5 Years	$2,000.00
BCV_00168	Montrose Road	RB	Arterial	1	2.4	82	4	Good	N/A	79	76	None		Adequate	$0.00
BCV_00213	Oldfield Road	CSP	Arterial	2	0.6, 0.6	22	3	Good	N/A	70	65	None		Adequate	$0.00
BCV_00214	Mulberry Drive	RB	Local	1	2.4	78	2	Good	N/A	78	75	None		Adequate	$0.00
BCV_00217	Mewburn Road	CPP	Arterial	1	1.5	45	3	Very Good	N/A	90	85	None		Adequate	$0.00
BCV_00218	Mewburn Road	CPP	Arterial	1	0.9	27	3	Very Good	N/A	95	85	None		Adequate	$0.00
M002B	Warner Road	RCS	Local	1	0.8	7	1	Very Poor	40	38	33	Remove/Backfill	N/A	NOW	$46,000.00
M011C	Beechwood Road	RF	Arterial	1	1.8	39	4	Good	78	77	72	Install Rip Rap	78	NOW	$17,500.00
M013B	Garner Road	RF	Arterial	1	2.5	30	4	Fair	65	64	59	Replace	100	6-10 Years	$345,000.00
M015C	Garner Road	CP	Arterial	2	0.6, 0.6	15	3	Fair	64	63	58	None		Adequate	$0.00
M017C	Garner Road	RF	Arterial	1	1.8	27	4	Fair	66	65	60	SBGR & Rip Rap	68	NOW	$91,250.00
M019C	Beaverdams Road	CPP	Arterial	2	0.6, 0.6	9	3	Good	80	79	74	None		Adequate	$0.00
M020C	Beaverdams Road	CSP, RCS, CP	Arterial	1	1.35	25	3	Very Poor	50	49	44	Replace	100	NOW	$144,000.00
M022C	Kalar Road	CSP	Arterial	2	1.2, 1.2	44	3	Poor	62	59	49	Replace	100	1-5 Years	$575,000.00
M025C	Kalar Road	RF	Arterial	1	1.8	28	4	Good	79	78	73	None		Adequate	$0.00
M026C	Kalar Road	CP	Arterial	2	0.6, 2.0	84	4	Good	75	74	69	None		Adequate	$0.00
M027C	Kalar Road	CSP	Arterial	2	0.6, 0.6	18	3	Very Good	90	89	79	None		Adequate	$0.00
M028B	Kalar Road	RB	Arterial	1	2.4	72	4	Very Good	76	90	85	None		Adequate	$0.00
M030C	Kalar Road	CP	Arterial	1	2.6	81	4	Fair	67	63	58	Minor Maintenance		NOW	$2,000.00
M031B	McLeod Road	RB	Arterial	1	1.5	23	3	Good	77	76	73	None		Adequate	$0.00
M033C	Brown Road	CSP	Arterial	1	2.25	21	3	Good	77	76	73	None		Adequate	$0.00
M034C	Brown Road	RB	Arterial	1	2.2	19	4	Good	79	78	75	None		Adequate	$0.00
M046C	Oakwood Drive	RB	Collector	1	2.5	100	3	Good	78	78	75	None		Adequate	$0.00
M047C	Oakwood Drive	RF	Collector	1	1.2	31	2	Good	76	76	71	None		Adequate	$0.00
M052C	Chippawa Parkway	CP	Arterial	1	1.2	24	3	Poor	62	58	48	Replace	100	1-5 Years	$172,500.00
M054C	Chippawa Parkway	CP, RF, CSP	Collector	2	1.2, 1.2	52	3	Very Poor	50	48	43	Replace	100	NOW	$460,000.00
M055C	Front Street	CSP	Local	1	1.6	69	2	Fair	71	67	52	Replace	100	6-10 Years	$172,500.00
M058B	McKenney Road	RF	Unopened/Clay Road	1	2.6	15	1	Very Poor	50	49	44	None		Adequate	$0.00
M060C	McKenney Road	CSP	Collector	2	1.25, 1.25	37	3	Fair	69	65	50	Replace	100	6-10 Years	$172,500.00
M061C	Biggar Road	CSP	Arterial	2	1.5, 1.5	27	3	Fair	69	68	63	None		Adequate	$0.00
M065C	Morris Road	CSP	Arterial	1	1.4	17	3	Fair	72	68	60	None		Adequate	$0.00
M066C	Morris Road	SSMP	Arterial	2	1.3, 1.3	39	3	Fair	66	60	50	Replace	100	6-10 Years	$172,500.00
M069C	Crowland Avenue	SSMP	Collector	1	1.7	23	2	Poor	55	52	42	Replace	100	1-5 Years	$126,500.00
M070C	Crowland Avenue	CP	Collector	1	1.95	33	2	Very Good	45	90	85	None		Adequate	$0.00
M072B	Crowland Avenue	RB	Collector	1	2.4	24	3	Good	77	76	72	None		Adequate	$0.00
M073C	Crowland Avenue	CSP	Collector	2	0.9, 0.9	20	2	Fair	65	60	50	Replace	100	6-10 Years	$115,000.00
M074C	Crowland Avenue	CSP	Collector	1	1.45	17	2	Good	75	74	69	None		Adequate	$0.00
M075B	Crowland Avenue	RF	Collector	1	2.4	33	3	Fair	60	60	55	Replace	100	6-10 Years	$287,500.00
M077C	Carl Road	RF	Collector	1	2.4	57	3	Fair	69	68	63	None		Adequate	$0.00
M078C	Misener Road	CP	Collector	1	1.65	24	2	Very Good	30	90	85	None		Adequate	$0.00
M079C	Misener Road	Wood Arch	Collector	1	1.3	10	2	Good	71	70	65	SBGR & Rip Rap	72	NOW	$34,500.00
M080C	Misener Road	CSP	Collector	1	1.75	22	2	Fair	69	67	57	None		Adequate	$0.00
M081B	Misener Road	RF	Collector	1	2	12	3	Fair	69	68	63	None		Adequate	$0.00
M082C	Misener Road	RF	Collector	1	1.8	19	3	Good	77	76	73	None		Adequate	$0.00
M083B	Young Road	RF	Collector	1	2.1	12	3	Fair	63	62	57	Replace	100	6-10 Years	$230,000.00
M085C	Lyons Creek Road	RF	Local	1	2.4	48	3	Good	78	77	72	None		Adequate	$0.00
M086B	Yokum Road	RF	Collector	1	2.4	32	3	Good	76	75	70	SBGR	76	NOW	$57,500.00
M087C	Ridge Road	SSMP	Collector	1	2	22	2	Poor	56	53	43	Replace	100	1-5 Years	$230,000.00
M089C	Reixinger Road	CPP	Collector	3	3 x 0.75	32	2	Very Good	45	90	85	None		Adequate	$0.00
M092C	McCredie Road	CP	Collector	1	2.11	31	2	Very Good	30	90	85	None		Adequate	$0.00
M098C	Koabel Road	RF	Collector	1	2	31	3	Good	72	71	68	None		Adequate	$0.00
M106C	Stanley Avenue	RF	Arterial	1	1.8	15	4	Good	76	75	72	None		Adequate	$0.00
M107C	Logan Road	SSMP	Unopened/Clay Road	1	1.2	9	1	Very Poor	48	46	41	Replace	100	NOW	$69,000.00
M110C	Ort Road	CSP	Unopened/Clay Road	2	0.9, 0.9	11	1	Poor	59	56	46	Replace	100	NOW	$69,000.00
M112B	Ort Road	RF	Collector	1	1	54	2	Very Poor	46	45	40	Replace	100	NOW	$138,000.00
M113B	Ort Road	RF	Collector	1	1.4	10	2	Good	72	71	68	None		Adequate	$0.00
M118C	Weaver Road	SSMP	Arterial	1	1.6	21	3	Poor	59	52	37	Replace	100	NOW	$184,000.00
M120C	Miller Road	SSMP	Collector	1	2.95	42	3	Good	72	70	65	None		Adequate	$0.00
M122C	Marshall Road	CSP	Local	2	1.6, 1.6	23	2	Good	75	75	70	None		Adequate	$0.00
M123B	Marshall Road	RF	Local	1	2	16	2	Very Poor	40	39	34	Replace	100	NOW	$138,000.00
M124B	Marshall Road	RF	Collector	1	1.2	9	2	Good	72	71	68	None		Adequate	$0.00
M126C	Marshall Road	RF	Collector	1	1.7	20	2	Good	71	71	68	None		Adequate	$0.00
M127C	Marshall Road	RF	Collector	1	2.2	36	3	Fair	67	66	63	None		Adequate	$0.00
M130B	Bossert Road	RF	Unopened/Clay Road	1	2.1	18	1	Fair	66	63	55	Patch Repairs	69	6-10 Years	$57,500.00
M132C	Sherk Road	RF	Collector	1	2.1	24	3	Good	75	74	71	None		Adequate	$0.00
M133B	Sherk Road	RF	Collector	1	2.1	24	3	Fair	67	66	58	Replace	100	6-10 Years	$230,000.00
M134C	Sauer Road	SSMP	Arterial	1	1.5	22	3	Fair	62	61	56	Replace	100	6-10 Years	$172,500.00
M135B	Sauer Road	RF	Arterial	1	2.1	45	4	Good	74	73	70	None		Adequate	$0.00
M136C	Somerville Road	RF	Collector	1	2.4	37	3	Good	74	72	69	None		Adequate	$0.00
M137B	Somerville Road	RF	Collector	1	2.4	26	3	Good	72	71	68	Minor Maintenance	71	NOW	$1,000.00
M138B	Somerville Road	RF	Unopened/Clay Road	1	1.5	7	1	Good	74	73	68	None		Adequate	$0.00
M139B	Morningstar Road	RF	Unopened/Clay Road	1	1.6	9	1	Very Poor	43	42	37	Replace	100	1-5 Years	$92,000.00
M140B	Morningstar Road	RF	Unopened/Clay Road	1	1.2	8	1	Good	74	73	68	None		Adequate	$0.00
M141C	Morningstar Road	CSP	Unopened/Clay Road	2	0.9, 0.9	17	1	Very Poor	60	49	29	Replace	100	NOW	$115,000.00
M142C	Lapp Road	CP	Arterial	1	1.73	13	3	Very Good	46	90	85	None		Adequate	$0.00
M143C	Baker Road	CSP	Collector	1	1.25	15	2	Good	78	70	60	None		Adequate	$0.00
M144B	Baker Road	RF	Collector	1	2.4	27	3	Good	73	72	69	None		Adequate	$0.00
M145B	Baker Road	RF	Collector	1	2.4	23	3	Good	76	75	70	None		Adequate	$0.00
M146C	McGarry Drive Culvert	RB	Collector	1	2.35	89	3	Good	74	73	72	None		Adequate	$0.00

NET PRESENT VALUE ANALYSIS

Discount Rate (DR) = 2 %

ID Number	Year Constructed	Year of Replacement	Residual Life	Cost to Replace	Year Rehab No.1	Cost Rehab No.1	Year Rehab No.2	Cost Rehab No.2	Year Rehab No.3	Cost Rehab No.3	Year Rehab No.4	Cost Rehab No.4
BCV_000X	2018	70	70	$ 64,000	20	$ 12,800	45	$ 25,600		$ -		$ -
BCV_000XX	c.2000	5	5	$ 115,000	30	$ 23,000	55	$ 46,000		$ -		$ -
BCV_00167	c.2008	60	60	$ 1,072,000	15	$214,400	40	$428,800		$ -		$ -
BCV_00168	c.2000	55	55	$ 656,000	30	$262,400		$ -		$ -		$ -
BCV_00213	c.2000	25	25	$ 176,000	50	$ 35,200	75	$ 70,400		$ -		$ -
BCV_00214	c.2000	55	55	$ 624,000	30	$249,600		$ -		$ -		$ -
BCV_00217	2018	70	70	$ 360,000	20	$ 72,000	45	$144,000		$ -		$ -
BCV_00218	2018	70	70	$ 216,000	20	$ 43,200	45	$ 86,400		$ -		$ -
M002B	1955	0	0	$ 46,000		$ -		$ -		$ -		$ -
M011C	1984	40	40	$ 312,000	0	$ 17,500	15	$ 62,400	65	$124,800		$ -
M013B	1954	10	10	$ 345,000	35	$ 69,000	60	$138,000		$ -		$ -
M015C	1960	15	15	$ 120,000	40	$ 24,000	65	$ 48,000		$ -		$ -
M017C	1955	20	20	$ 216,000	45	$ 43,200	70	$ 86,400		$ -		$ -
M019C	2005	60	60	$ 72,000	15	$ 14,400	40	$ 28,800		$ -		$ -
M020C	c.1975	0	0	$ 144,000	25	$ 28,800	50	$ 57,600		$ -		$ -
M022C	1960	5	5	$ 575,000	30	$115,000	55	$230,000		$ -		$ -
M025C	1967	35	35	$ 224,000	60	$ 44,800		$ -		$ -		$ -
M026C	1958	25	25	$ 672,000	50	$134,400	75	$268,800		$ -		$ -
M027C	2018	45	45	$ 144,000	20	$ 57,600	70	$ 28,800		$ -		$ -
M028B	2018	70	70	$ 576,000	20	$115,200	45	$230,400		$ -		$ -
M030C	1966	15	15	$ 648,000	40	$129,600	65	$259,200		$ -		$ -
M031B	2004	50	50	$ 184,000	25	$ 73,600	75	$ 36,800		$ -		$ -
M033C	2000	25	25	$ 168,000	50	$ 33,600	75	$ 67,200		$ -		$ -
M034C	1996	45	45	$ 152,000	20	$ 60,800	70	$ 30,400		$ -		$ -
M046C	2009	60	60	$ 800,000	15	$160,000	40	$320,000		$ -		$ -
M047C	1960	30	30	$ 248,000	55	$ 49,600		$ -		$ -		$ -
M052C	1955	5	5	$ 172,500	30	$ 34,500	55	$ 69,000		$ -		$ -
M054C	1960	0	0	$ 460,000	25	$ 92,000	50	$184,000		$ -		$ -
M055C	1968	10	10	$ 172,500	35	$ 34,500	60	$ 69,000		$ -		$ -
M058B	1920	15	15	$ 120,000	40	$ 24,000	65	$ 48,000		$ -		$ -
M060C	1965	10	10	$ 172,500	35	$ 34,500	60	$ 69,000		$ -		$ -
M061C	2008	20	20	$ 216,000	45	$ 43,200	70	$ 86,400		$ -		$ -
M065C	1980	15	15	$ 136,000	40	$ 27,200	65	$ 54,400		$ -		$ -
M066C	1965	10	10	$ 172,500	35	$ 34,500	60	$ 69,000		$ -		$ -
M069C	1965	5	5	$ 126,500	30	$ 25,300	55	$ 50,600		$ -		$ -
M070C	2017	70	70	$ 264,000	20	$ 52,800	45	$105,600		$ -		$ -
M072B	1985	45	45	$ 192,000	20	$ 76,800	70	$ 38,400		$ -		$ -
M073C	1985	10	10	$ 115,000	35	$ 23,000	60	$ 46,000		$ -		$ -
M074C	2008	30	30	$ 136,000	55	$ 27,200		$ -		$ -		$ -
M075B	1966	10	10	$ 287,500	35	$ 57,500	60	$115,000		$ -		$ -
M077C	1920	20	20	$ 456,000	45	$ 91,200	70	$182,400		$ -		$ -
M078C	2017	70	70	$ 192,000	20	$ 38,400	45	$ 76,800		$ -		$ -
M079C	1890	20	20	$ 80,000	0	$ 34,500	45	$ 16,000	70	$ 32,000		$ -
M080C	1970	15	15	$ 176,000	40	$ 35,200	65	$ 70,400		$ -		$ -
M081B	1950	20	20	$ 96,000	45	$ 19,200	70	$ 38,400		$ -		$ -
M082C	1990	45	45	$ 152,000	20	$ 60,800	70	$ 30,400		$ -		$ -
M083B	1914	10	10	$ 230,000	35	$ 46,000	60	$ 92,000		$ -		$ -
M085C	1968	40	40	$ 384,000	15	$153,600	65	$ 76,800		$ -		$ -
M086B	1967	35	35	$ 256,000	0	$ 57,500	60	$ 51,200		$ -		$ -
M087C	1965	5	5	$ 230,000	30	$ 46,000	55	$ 92,000		$ -		$ -
M089C	2017	70	70	$ 256,000	20	$ 51,200	45	$102,400		$ -		$ -
M092C	2017	70	70	$ 248,000	20	$ 49,600	45	$ 99,200		$ -		$ -
M098C	1950	25	25	$ 248,000	50	$ 49,600	75	$ 99,200		$ -		$ -
M106C	1950	30	30	$ 120,000	55	$ 24,000		$ -		$ -		$ -
M107C	1970	0	0	$ 69,000	25	$ 13,800	50	$ 27,600		$ -		$ -
M110C	2007	0	0	$ 69,000	25	$ 13,800	50	$ 27,600		$ -		$ -
M112B	1950	0	0	$ 138,000	25	$ 27,600	50	$ 55,200		$ -		$ -
M113B	1912	20	20	$ 80,000	45	$ 16,000	70	$ 32,000		$ -		$ -
M118C	1965	0	0	$ 184,000	25	$ 36,800	50	$ 73,600		$ -		$ -
M120C	2009	25	25	$ 336,000	50	$ 67,200	75	$134,400		$ -		$ -
M122C	1970	20	20	$ 184,000	45	$ 36,800	70	$ 73,600		$ -		$ -
M123B	1930	0	0	$ 138,000	25	$ 27,600	50	$ 55,200		$ -		$ -
M124B	1940	20	20	$ 72,000	45	$ 14,400	70	$ 28,800		$ -		$ -
M126C	1950	25	25	$ 160,000	50	$ 32,000	75	$ 64,000		$ -		$ -
M127C	1960	20	20	$ 288,000	45	$ 57,600	70	$115,200		$ -		$ -
M130B	1960	25	25	$ 144,000	10	$ 57,500	50	$ 28,800	75	$ 57,600		$ -
M132C	1960	35	35	$ 192,000	60	$ 38,400		$ -		$ -		$ -
M133B	1960	10	10	$ 230,000	35	$ 46,000	60	$ 92,000		$ -		$ -
M134C	1968	10	10	$ 172,500	35	$ 34,500	60	$ 69,000		$ -		$ -
M135B	1970	35	35	$ 360,000	60	$ 72,000		$ -		$ -		$ -
M136C	1970	30	30	$ 296,000	55	$ 59,200		$ -		$ -		$ -
M137B	1950	20	20	$ 208,000	45	$ 41,600	70	$ 83,200		$ -		$ -
M138B	1930	20	20	$ 56,000	45	$ 11,200	70	$ 22,400		$ -		$ -
M139B	1910	5	5	$ 92,000	30	$ 18,400	55	$ 36,800		$ -		$ -
M140B	1910	20	20	$ 64,000	45	$ 12,800	70	$ 25,600		$ -		$ -
M141C	1980	0	0	$ 115,000	25	$ 23,000	50	$ 46,000		$ -		$ -
M142C	2017	70	70	$ 104,000	20	$ 20,800	45	$ 41,600		$ -		$ -
M143C	1969	15	15	$ 120,000	40	$ 24,000	65	$ 48,000		$ -		$ -
M144B	1960	25	25	$ 216,000	50	$ 43,200	75	$ 86,400		$ -		$ -
M145B	1958	30	30	$ 184,000	55	$ 36,800		$ -		$ -		$ -
M146C	2004	55	55	$ 712,000	30	$284,800		$ -		$ -		$ -
			Total:	$ 19,779,500								

Table 1: Unit Costs for Small Structures (Deck Area < 150m2)

Replacement Cost (sq.m):	$ 8,000	(75 Year life for replacement)
Major Rehab Cost (sq.m):	$ 3,200	(Year 50 from construction)
Minor Rehab Cost (sq.m):	$ 1,600	(Year 25 from construction)

NPV CALCS	(DR - 1.5)% -->	(DR - 1.0)% -->	(DR - 0.5)% -->	(DR)% -->	(DR+0.5)% -->	(DR+1.0)% -->	(DR+1.5)% -->
Applied Discount Rate (%):	0.5	1	1.5	2	2.5	3	3.5
BCV_000X	$ 77,178	$ 58,742	$ 45,175	$ 35,117	$ 27,602	$ 21,940	$ 17,636
BCV_000XX	$ 166,936	$ 153,095	$ 141,747	$ 132,336	$ 124,437	$ 117,727	$ 111,956
BCV_00167	$ 1,344,943	$ 1,062,760	$ 846,635	$ 680,228	$ 551,382	$ 451,021	$ 372,350
BCV_00168	$ 724,555	$ 574,195	$ 457,122	$ 365,610	$ 293,788	$ 237,185	$ 192,385
BCV_00213	$ 231,229	$ 192,021	$ 161,068	$ 136,298	$ 116,222	$ 99,758	$ 86,110
BCV_00214	$ 689,211	$ 546,185	$ 434,824	$ 347,776	$ 279,457	$ 225,615	$ 183,000
BCV_00217	$ 434,124	$ 330,424	$ 254,109	$ 197,532	$ 155,260	$ 123,411	$ 99,203
BCV_00218	$ 260,475	$ 198,255	$ 152,465	$ 118,519	$ 93,156	$ 74,047	$ 59,522
M002B	$ 46,000	$ 46,000	$ 46,000	$ 46,000	$ 46,000	$ 46,000	$ 46,000
M011C	$ 421,218	$ 346,166	$ 286,820	$ 239,617	$ 201,854	$ 171,470	$ 146,887
M013B	$ 488,472	$ 436,994	$ 394,735	$ 359,582	$ 329,953	$ 304,657	$ 282,792
M015C	$ 165,719	$ 144,621	$ 127,449	$ 113,282	$ 101,437	$ 91,409	$ 82,819
M017C	$ 290,947	$ 247,683	$ 212,951	$ 184,685	$ 161,379	$ 141,930	$ 125,516
M019C	$ 90,332	$ 71,379	$ 56,864	$ 45,687	$ 37,033	$ 30,292	$ 25,009
M020C	$ 214,311	$ 201,480	$ 191,209	$ 182,954	$ 176,293	$ 170,894	$ 166,500
M022C	$ 834,678	$ 765,475	$ 708,736	$ 661,679	$ 622,186	$ 588,635	$ 559,781
M025C	$ 221,334	$ 182,785	$ 151,362	$ 125,660	$ 104,569	$ 87,210	$ 72,881
M026C	$ 882,875	$ 733,171	$ 614,986	$ 520,410	$ 443,756	$ 380,893	$ 328,785
M027C	$ 187,495	$ 153,581	$ 126,610	$ 105,032	$ 87,666	$ 73,608	$ 62,162
M028B	$ 694,599	$ 528,679	$ 406,574	$ 316,052	$ 248,416	$ 197,457	$ 158,724
M030C	$ 894,881	$ 780,953	$ 688,226	$ 611,720	$ 547,758	$ 493,607	$ 447,221
M031B	$ 233,677	$ 186,718	$ 150,174	$ 121,556	$ 99,008	$ 81,133	$ 66,878
M033C	$ 220,719	$ 183,293	$ 153,746	$ 130,102	$ 110,939	$ 95,223	$ 82,196
M034C	$ 197,912	$ 162,113	$ 133,644	$ 110,867	$ 92,537	$ 77,698	$ 65,616
M046C	$ 1,003,689	$ 793,105	$ 631,817	$ 507,633	$ 411,479	$ 336,583	$ 277,873
M047C	$ 251,236	$ 212,692	$ 180,531	$ 153,604	$ 130,987	$ 111,932	$ 95,835
M052C	$ 250,403	$ 229,643	$ 212,621	$ 198,504	$ 186,656	$ 176,590	$ 167,934
M054C	$ 684,604	$ 643,618	$ 610,808	$ 584,438	$ 563,157	$ 545,911	$ 531,875
M055C	$ 244,236	$ 218,497	$ 197,367	$ 179,791	$ 164,977	$ 152,329	$ 141,396
M058B	$ 165,719	$ 144,621	$ 127,449	$ 113,282	$ 101,437	$ 91,409	$ 82,819
M060C	$ 244,236	$ 218,497	$ 197,367	$ 179,791	$ 164,977	$ 152,329	$ 141,396
M061C	$ 290,947	$ 247,683	$ 212,951	$ 184,685	$ 161,379	$ 141,930	$ 125,516
M065C	$ 187,815	$ 163,904	$ 144,443	$ 128,386	$ 114,962	$ 103,596	$ 93,861
M066C	$ 244,236	$ 218,497	$ 197,367	$ 179,791	$ 164,977	$ 152,329	$ 141,396
M069C	$ 183,629	$ 168,405	$ 155,922	$ 145,569	$ 136,881	$ 129,500	$ 123,152
M070C	$ 318,358	$ 242,311	$ 186,346	$ 144,857	$ 113,857	$ 90,501	$ 72,749
M072B	$ 249,994	$ 204,775	$ 168,814	$ 140,043	$ 116,888	$ 98,144	$ 82,883
M073C	$ 162,824	$ 145,665	$ 131,578	$ 119,861	$ 109,984	$ 101,552	$ 94,264
M074C	$ 137,775	$ 116,637	$ 99,001	$ 84,235	$ 71,831	$ 61,382	$ 52,554
M075B	$ 407,060	$ 364,162	$ 328,946	$ 299,652	$ 274,961	$ 253,881	$ 235,660
M077C	$ 614,221	$ 522,887	$ 449,563	$ 389,890	$ 340,690	$ 299,630	$ 264,978
M078C	$ 231,533	$ 176,226	$ 135,525	$ 105,351	$ 82,805	$ 65,819	$ 52,908
M079C	$ 142,258	$ 126,235	$ 113,371	$ 102,902	$ 94,270	$ 87,067	$ 80,987
M080C	$ 243,054	$ 212,111	$ 186,926	$ 166,146	$ 148,774	$ 134,066	$ 121,467
M081B	$ 129,310	$ 110,081	$ 94,645	$ 82,082	$ 71,724	$ 63,080	$ 55,785
M082C	$ 197,912	$ 162,113	$ 133,644	$ 110,867	$ 92,537	$ 77,698	$ 65,616
M083B	$ 325,648	$ 291,329	$ 263,157	$ 239,721	$ 219,969	$ 203,105	$ 188,528
M085C	$ 512,612	$ 430,441	$ 363,721	$ 309,238	$ 264,497	$ 227,552	$ 196,878
M086B	$ 310,453	$ 266,397	$ 230,486	$ 201,112	$ 177,008	$ 157,168	$ 140,793
M087C	$ 333,871	$ 306,190	$ 283,494	$ 264,672	$ 248,874	$ 235,454	$ 223,912
M089C	$ 308,711	$ 234,969	$ 180,699	$ 140,467	$ 110,407	$ 87,759	$ 70,544
M092C	$ 299,063	$ 227,626	$ 175,053	$ 136,078	$ 106,957	$ 85,016	$ 68,340
M098C	$ 325,823	$ 270,575	$ 226,959	$ 192,056	$ 163,767	$ 140,568	$ 121,337
M106C	$ 121,566	$ 102,915	$ 87,354	$ 74,325	$ 63,381	$ 54,161	$ 46,372
M107C	$ 102,691	$ 96,543	$ 91,621	$ 87,666	$ 84,474	$ 81,887	$ 79,781
M110C	$ 102,691	$ 96,543	$ 91,621	$ 87,666	$ 84,474	$ 81,887	$ 79,781
M112B	$ 205,381	$ 193,085	$ 183,242	$ 175,331	$ 168,947	$ 163,773	$ 159,563
M113B	$ 107,758	$ 91,735	$ 78,871	$ 68,402	$ 59,770	$ 52,567	$ 46,487
M118C	$ 273,841	$ 257,447	$ 244,323	$ 233,775	$ 225,263	$ 218,365	$ 212,750
M120C	$ 441,437	$ 366,585	$ 307,493	$ 260,205	$ 221,878	$ 190,447	$ 164,393
M122C	$ 247,844	$ 210,989	$ 181,403	$ 157,324	$ 137,471	$ 120,903	$ 106,921
M123B	$ 205,381	$ 193,085	$ 183,242	$ 175,331	$ 168,947	$ 163,773	$ 159,563
M124B	$ 96,982	$ 82,561	$ 70,984	$ 61,562	$ 53,793	$ 47,310	$ 41,839
M126C	$ 210,208	$ 174,564	$ 146,425	$ 123,907	$ 105,656	$ 90,689	$ 78,282
M127C	$ 387,929	$ 330,244	$ 283,935	$ 246,246	$ 215,173	$ 189,240	$ 167,355
M130B	$ 243,890	$ 209,162	$ 181,328	$ 158,686	$ 140,010	$ 124,405	$ 111,217
M132C	$ 189,715	$ 156,673	$ 129,739	$ 107,709	$ 89,631	$ 74,751	$ 62,470
M133B	$ 325,648	$ 291,329	$ 263,157	$ 239,721	$ 219,969	$ 203,105	$ 188,528
M134C	$ 244,236	$ 218,497	$ 197,367	$ 179,791	$ 164,977	$ 152,329	$ 141,396
M135B	$ 355,715	$ 293,761	$ 243,261	$ 201,954	$ 168,058	$ 140,159	$ 117,131
M136C	$ 299,862	$ 253,858	$ 215,473	$ 183,334	$ 156,339	$ 133,597	$ 114,383
M137B	$ 280,171	$ 238,510	$ 205,064	$ 177,845	$ 155,402	$ 136,673	$ 120,867
M138B	$ 75,431	$ 64,214	$ 55,210	$ 47,881	$ 41,839	$ 36,797	$ 32,541
M139B	$ 133,548	$ 122,476	$ 113,398	$ 105,869	$ 99,550	$ 94,182	$ 89,565
M140B	$ 86,207	$ 73,388	$ 63,097	$ 54,721	$ 47,816	$ 42,053	$ 37,190
M141C	$ 171,151	$ 160,904	$ 152,702	$ 146,109	$ 140,789	$ 136,478	$ 132,969
M142C	$ 125,414	$ 95,456	$ 73,409	$ 57,065	$ 44,853	$ 35,652	$ 28,659
M143C	$ 165,719	$ 144,621	$ 127,449	$ 113,282	$ 101,437	$ 91,409	$ 82,819
M144B	$ 283,781	$ 235,662	$ 197,674	$ 167,275	$ 142,636	$ 122,430	$ 105,681
M145B	$ 186,401	$ 157,804	$ 133,942	$ 113,964	$ 97,184	$ 83,047	$ 71,103
M146C	$ 786,407	$ 623,212	$ 496,145	$ 396,821	$ 318,867	$ 257,432	$ 208,808
TOTAL:	$ 25,472,053	$ 21,492,485	$ 18,362,729	$ 15,876,773	$ 13,882,342	$ 12,266,194	$ 10,943,580
Total/75 years:	$ 339,627	$ 286,566	$ 244,836	$ 211,690	$ 185,098	$ 163,549	$ 145,914

Notes:
-BCV_000X, BCV_000XX, BCV_00167, BCV_00168, BCV_00213, BCV_00214, BCV_00217, and BCV_00218 added to Municipal Database in 2021
-50 year service life generally assumed for CSP/SSMP type structures
-M017C was rehabilitated in 2021 (guide rail)
-Previous BCI is typically from 2018 (or earlier when on a 4+ year inspection cycle)

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.
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 HBSc, 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.

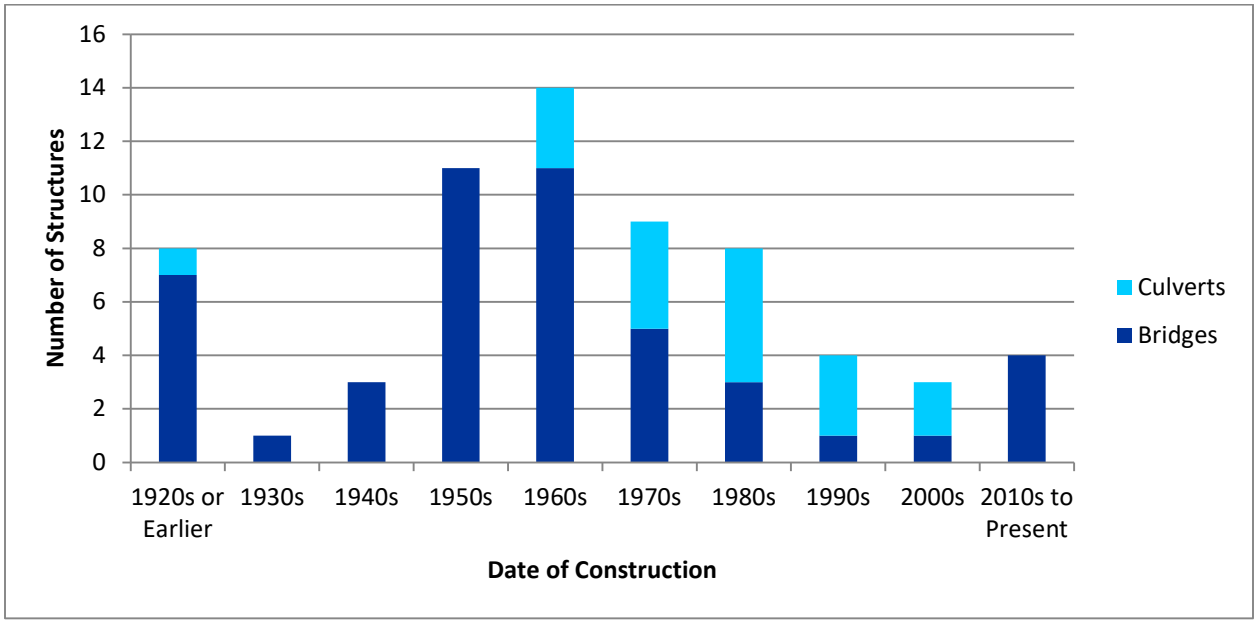


Figure 1: Estimated Dates of Construction

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 ERSL 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.

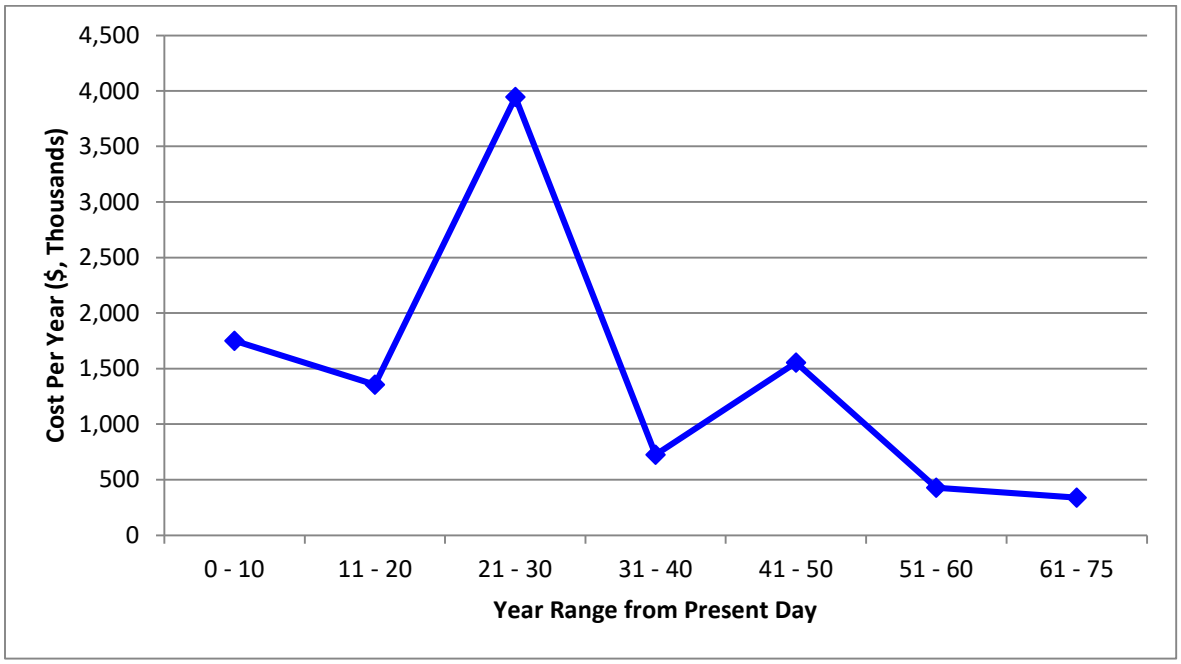


Figure 2: Net Present Value Cost per Year for the next 75 Years

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)*

STRUCTURE INFORMATION (More Inspection Data)-->

ID Number	Structure Name	Structure Type	Road Classification	Number of Spans	Span Lengths (m)	Deck Area (m²)	Consequence of Failure	General Overall Condition	Previous BCI	Current BCI	BCI in 10 Years, No Work	Recommended Work in Next 10 Years	BCI Post-Work	Priority Rating	Total Cost
S001B	Warner Road	RCS	Local	1	4	31	2	Poor	64	58	48	Replace	100	1-5 Years	$460,000.00
S003B	Warner Road	RF	Local	1	3	32	2	Good	71	70	65	None		Adequate	$0.00
S004B	Mewburn Road Bridge	SOCG	Arterial	1	21	237	5	Very Good	30	95	85	None		Adequate	$0.00
S005C	Uppers Lane	RB	Local	1	3	61	2	Good	79	79	75	None		Adequate	$0.00
S006C	Beechwood Road	RB	Arterial	1	3	93	4	Good	77	76	71	None		Adequate	$0.00
S007B	Beechwood Road	RCS	Arterial	1	3	28	4	Poor	62	59	49	Replace	100	1-5 Years	$460,000.00
S008B	Beechwood Road	RCS	Arterial	1	5	57	4	Poor	58	57	52	Replace	100	1-5 Years	$517,500.00
S010B	Beechwood Road	RF	Arterial	1	4	49	4	Poor	59	58	53	Replace	100	6-10 Years	$460,000.00
S012B	Beechwood Road	RF	Arterial	1	3.2	55	4	Fair	68	67	62	None		Adequate	$0.00
S014B	Garner Road	RF	Arterial	1	3.5	56	4	Good	74	73	68	None		Adequate	$0.00
S016B	Garner Road	RF	Arterial	1	3.2	57	4	Fair	68	67	62	None		Adequate	$0.00
S018C	Garner Road	RB	Arterial	1	4	94	4	Good	74	73	68	None		Adequate	$0.00
S021C	Shriner's Creek Culvert	RB	Collector	1	4	150	3	Good	74	73	68	Guide Rail	78	NOW	$34,500.00
S023C	Kalar Road	RB	Arterial	2	2.4, 2.4	157	4	Very Good	85	84	79	None		Adequate	$0.00
S024C	Kalar Road	RF	Arterial	1	4	62	4	Good	78	78	73	None		Adequate	$0.00
S035B	Brown Road	RB	Arterial	2	3.0, 3.0	163	4	Good	79	79	74	None		Adequate	$0.00
S036B	Whirlpool Road	SOSG	Collector	1	52	688	5	Good	78	78	73	None		Adequate	$0.00
S037C	CSR Bridge 1	ARCH	Unopened/OPG	1	25	1500	2	Fair	65	64	59	None		Adequate	$0.00
S038B	CSR Bridge 2	SOSG	Unopened/OPG	1	8	32	2	Fair	64	61	51	None		Adequate	$0.00
S039B	Victoria Avenue CNR Bridge	SOSG	Arterial	5	5 x 21	1814	5	Fair	67	66	61	Rehabilitate	76	1-5 Years	$2,365,000.00
S040C	Morrison Street	ARCH	Arterial	1	25	4350	5	Good	71	71	66	Maintenance & Rehabilitate	72	1-5 Years	$650,000.00
S041B	Drummond Road	SOCG	Arterial	3	27, 28, 27	1508	5	Good	74	73	68	Rip Rap & Maintenance	78	NOW	$23,000.00
S043B	Murray Street Pedestrian Bridge	TT	Collector	1	32	154	4	Good	74	73	68	Cleaning & Recoating	78	6-10 Years	$489,000.00
S044C	Portage Road	RF	Collector	1	8	388	3	Very Good	87	86	81	None		Adequate	$0.00
S045B	Marineland Parkway	SOCG	Arterial	2	16, 16	389	4	Good	74	74	71	Rehabilitate	75	NOW	$115,000.00
S048C	Oakwood Drive	RF	Collector	1	6	182	3	Good	75	74	69	None		Adequate	$0.00
S049C	Dorchester Road	SSMP	Arterial	1	6	302	3	Good	76	75	70	Debris	75	NOW	$1,000.00
S053C	Chippawa Parkway	SSMP	Arterial	1	5	52	3	Fair	65	64	59	Rehabilitate	74	NOW	$345,000.00
S056B	Portage Road - Weightman Bridge	SOSG	Arterial	3	33, 31, 33	1853	5	Good	78	77	72	Expansion Joint Seals	79	NOW	$34,500.00
S057B	McKenney Road	ARCH	Unopened/Clay Road	1	5	28	2	Poor	48	47	42	Replacement	100	6-10 Years	$345,000.00
S059C	McKenney Road	ARCH	Collector	1	9	119	3	Fair	66	65	60	Replacement	100	6-10 Years	$1,092,500.00
S062C	Morris Road	RF	Arterial	1	4	43	4	Good	78	77	72	None		Adequate	$0.00
S063C	Morris Road	RF	Arterial	1	3	38	4	Good	74	72	67	Remove Tree	72	NOW	$3,000.00
S071B	Crowland Avenue	RF	Collector	2	5.0, 5.0	146	3	Good	74	73	68	Guide Rail & Rip Rap	78	NOW	$103,500.00
S076B	Crowland Avenue	RF	Collector	1	4	34	3	Poor	60	59	54	Replace	100	1-5 Years	$460,000.00
S088C	Ridge Road	CSP	Collector	1	3	57	3	Very Good	90	89	79	None		Adequate	$0.00
S090B	Dell Road	RF	Collector	1	5	101	3	Good	78	77	72	Debris	77	NOW	$1,000.00
S091C	McCredie Road	SSMP	Collector	2	4.0, 4.0	145	3	Fair	65	60	40	Replace	100	6-10 Years	$1,092,500.00
S093C	Schisler Road	RF	Arterial	2	2.0, 2.0	145	4	Good	75	74	69	Guide Rail	79	NOW	$69,000.00
S094B	Schisler Road	RF	Arterial	1	13	120	4	Fair	62	61	56	Rehabilitate	76	NOW	$506,000.00
S096B	Lemon Road	RF	Collector	1	10	85	3	Very Good	89	88	83	None		Adequate	$0.00
S097B	Koabel Road	RB	Arterial	1	3	43	4	Good	76	75	70	Rip Rap	78	1-5 Years	$5,000.00
S099B	Koabel Road	RF	Arterial	1	9	96	4	Fair	66	65	60	Rehabilitate	75	1-5 Years	$402,500.00
S100B	Willowdell Road	SOCG	Collector	2	18, 18	448	5	Fair	70	69	64	Rehabilitate	79	1-5 Years	$862,500.00
S101B	Major Donald Dell Bridge	SOCG	Collector	1	16	170	5	Good	71	70	65	Rehabilitate	79	1-5 Years	$517,500.00
S102C	Willowdell Road	CSP	Collector	2	3.0, 3.0	97	3	Very Good	10	90	75	None		Adequate	$0.00
S103C	Schneider Road	CSP	Collector	2	3.0, 3.0	97	3	Very Good	58	90	75	None		Adequate	$0.00
S104B	Beck Road	RF	Collector	3	9, 14, 9	222	5	Poor	50	49	44	Scheduled for Replacement	100	NOW	$3,795,000.00
S105B	Stanley Avenue	RF	Arterial	3	9, 14, 9	271	5	Good	79	78	73	Guide Rail	78	NOW	$10,000.00
S108B	Ort Road	RF	Local	1	4	55	2	Good	75	74	69	None		Adequate	$0.00
S109B	Ort Road	RF	Local	1	4	35	2	Good	73	72	67	Guide Rail	77	NOW	$80,500.00
S114B	Willick Road	RF	Collector	1	4	28	3	Fair	71	69	64	Guide Rail	74	NOW	$80,500.00
S115B	Charles Ruch Bridge	SOCG	Collector	1	9	85	3	Good	77	77	74	None		Adequate	$0.00
S116B	Willoughby Drive	RF	Unopened/Clay Road	1	3	23	2	Fair	63	62	57	Rip Rap & Maintenance	67	NOW	$54,000.00
S117B	Weaver Road	RF	Arterial	1	6	58	4	Fair	65	64	59	Replacement	100	6-10 Years	$575,000.00
S119B	Miller Road	RF	Collector	1	8	64	3	Very Good	93	92	87	None		Adequate	$0.00
S121B	Marshall Road	RF	Local	1	4	41	2	Good	78	77	72	None		Adequate	$0.00
S125B	Marshall Road	RF	Collector	1	4	74	3	Good	76	75	70	None		Adequate	$0.00
S128B	Detenbeck Road	RF	Collector	1	3	22	3	Poor	43	42	37	Replace	100	NOW	$345,000.00
S129B	Bossert Road	RF	Arterial	1	5	67	4	Good	76	75	70	None		Adequate	$0.00
S131B	Sherk Road	RF	Collector	1	4	31	3	Good	74	73	68	Rip Rap & Maintenance	78	NOW	$28,000.00
S147B	Royal Manor Drive	SOSG	Local	3	19, 25,19	854	3	Fair	62	61	56	Rehabilitate	71	1-5 Years	$1,725,000.00
S148C	Conrail (Railway)	SSMP	Unopened/Falls View Golf C	1	5	281	2	Fair	72	69	62	None		Adequate	$0.00
S149C	Conrail (Golf Cart)	SSMP	Unopened/Falls View Golf C	1	5	151	2	Good	74	71	64	None		Adequate	$0.00
S150B	Baden Powel Park Pedestrian Bridge	PT	Unopened	1	16	31	3	Fair	67	66	51	Rehabilitate	76	NOW	$57,500.00
S151B	Cataract Street Bridge	SOSG	Local	3	7, 11, 6	343	3	Fair	N/A	62	57	Remove	N/A	6-10 Years	$402,500.00
S152B	Park Street Bridge	SOSG	Collector	4	6, 12, 12, 8	344	3	Poor	N/A	57	52	Remove	N/A	NOW	$400,000.00
S153B	Zimmerman Avenue Bridge	SOSG	Local	3	7, 14, 7	281	3	Poor	N/A	59	54	Remove	N/A	1-5 Years	$345,000.00
S154B	Legacy Pathway Bridge	ARCH	Unopened/OPG	1	30	300	3	Fair	N/A	64	59	Remove	N/A	6-10 Years	$400,000.00

NET PRESENT VALUE ANALYSIS

Discount Rate (DR) = 2 %

ID Number	Year Constructed	Year of Replacement	Residual Life	Cost to Replace	Year Rehab No.1	Cost Rehab No.1	Year Rehab No.2	Cost Rehab No.2	Year Rehab No.3	Cost Rehab No.3
S001B	1955	5	5	$ 460,000	30	$ 92,000	55	$ 184,000		$ -
S003B	1955	25	25	$ 256,000	50	$ 51,200	75	$ 102,400		$ -
S004B	2019	75	75	$ 1,659,000	50	$ 331,800	75	$ 663,600		$ -
S005C	1999	50	50	$ 488,000	25	$ 195,200	75	$ 97,600		$ -
S006C	2002	50	50	$ 744,000	25	$ 297,600	75	$ 148,800		$ -
S007B	1954	5	5	$ 460,000	30	$ 92,000	55	$ 184,000		$ -
S008B	1957	5	5	$ 517,500	30	$ 103,500	55	$ 207,000		$ -
S010B	1960	10	10	$ 460,000	35	$ 92,000	60	$ 184,000		$ -
S012B	1968	30	30	$ 440,000	55	$ 88,000	0	$ -		$ -
S014B	1962	35	35	$ 448,000	15	$ 179,200	60	$ 89,600		$ -
S016B	1958	20	20	$ 456,000	45	$ 91,200	70	$ 182,400		$ -
S018C	1999	45	45	$ 752,000	20	$ 300,800	70	$ 150,400		$ -
S021C	1990	40	40	$ 1,050,000	15	$ 420,000	65	$ 210,000		$ -
S023C	2011	65	65	$ 1,099,000	15	$ 219,800	40	$ 439,600		$ -
S024C	1985	40	40	$ 496,000	15	$ 198,400	60	$ 99,200		$ -
S035B	2011	60	60	$ 1,141,000	15	$ 228,200	35	$ 456,400		$ -
S036B	1984	45	45	$ 4,816,000	20	$ 1,926,400	60	$ 963,200		$ -
S037C	1920	25	25	$ 9,000,000	50	$ 1,800,000	75	$ 3,600,000		$ -
S038B	1905	15	15	$ 256,000	40	$ 51,200	65	$ 102,400		$ -
S039B	1960	30	30	$ 10,884,000	5	$ 2,365,000	55	$ 2,176,800		$ -
S040C	1978	50	50	$ 26,100,000	5	$ 650,000	25	$ 10,440,000	75	$ 5,220,000
S041B	1973	30	30	$ 9,048,000	0	$ 23,000	15	$ 3,619,200		$ -
S043B	2004	30	30	$ 1,078,000	10	$ 489,000	55	$ 215,600		$ -
S044C	2004	65	65	$ 2,716,000	15	$ 543,200	40	$ 1,086,400		$ -
S045B	1982	40	40	$ 2,723,000	0	$ 115,000	15	$ 1,089,200	65	$ 544,600
S048C	1960	35	35	$ 1,274,000	15	$ 582,400	60	$ 291,200		$ -
S049C	1980	20	20	$ 2,114,000	45	$ 422,800	70	$ 845,600		$ -
S053C	1970	20	20	$ 416,000	45	$ 83,200	70	$ 166,400		$ -
S056B	1967	30	30	$ 11,118,000	0	$ 34,500	55	$ 2,223,600		$ -
S057B	1930	10	5	$ 345,000	35	$ 69,000	60	$ 138,000		$ -
S059C	1963	10	10	$ 1,092,500	0	$ 23,000	35	$ 218,500	60	$ 437,000
S062C	1979	45	45	$ 344,000	20	$ 137,600	70	$ 68,800		$ -
S063C	1978	40	40	$ 304,000	15	$ 121,600	65	$ 60,800		$ -
S071B	1965	35	35	$ 1,168,000	0	$ 103,500	15	$ 467,200	60	$ 233,600
S076B	1950	5	5	$ 460,000	30	$ 92,000	55	$ 184,000		$ -
S088C	2015	40	40	$ 456,000	15	$ 182,400	65	$ 91,200		$ -
S090B	1974	40	40	$ 808,000	15	$ 323,200	65	$ 161,600		$ -
S091C	c.1980	10	10	$ 1,092,500	35	$ 218,500	60	$ 437,000		$ -
S093C	1965	35	35	$ 1,160,000	15	$ 464,000	60	$ 232,000		$ -
S094B	1950	25	25	$ 960,000	0	$ 506,000	50	$ 192,000	75	$ 384,000
S096B	2013	70	70	$ 680,000	20	$ 136,000	45	$ 272,000		$ -
S097B	1967	35	35	$ 344,000	15	$ 137,600	60	$ 137,600		$ -
S099B	1965	30	30	$ 768,000	5	$ 402,500	55	$ 153,600		$ -
S100B	1974	30	30	$ 3,136,000	5	$ 862,500	55	$ 627,200		$ -
S101B	1968	30	30	$ 1,190,000	5	$ 517,500	55	$ 238,000		$ -
S102C	2019	50	50	$ 776,000	25	$ 310,400	75	$ 155,200		$ -
S103C	2019	50	50	$ 776,000	25	$ 310,400	75	$ 155,200		$ -
S104B	1952	0	0	$ 3,795,000	25	$ 759,000	50	$ 1,518,000		$ -
S105B	1955	30	30	$ 1,897,000	55	$ 379,400	0	$ -		$ -
S108B	1970	35	35	$ 440,000	15	$ 176,000	60	$ 88,000		$ -
S109B	1948	25	25	$ 280,000	50	$ 56,000	75	$ 112,000		$ -
S114B	1946	20	20	$ 224,000	45	$ 44,800	70	$ 89,600		$ -
S115B	1963	40	40	$ 680,000	15	$ 272,000	60	$ 272,000		$ -
S116B	1955	15	15	$ 184,000	0	$ 54,000	40	$ 36,800	65	$ 73,600
S117B	1923	10	10	$ 575,000	35	$ 115,000	60	$ 230,000		$ -
S119B	2013	70	70	$ 512,000	20	$ 102,400	45	$ 204,800		$ -
S121B	1980	45	45	$ 328,000	20	$ 131,200	70	$ 65,600		$ -
S125B	1965	35	35	$ 592,000	15	$ 236,800	60	$ 118,400		$ -
S128B	1914	0	0	$ 345,000	25	$ 69,000	50	$ 138,000		$ -
S129B	1975	40	40	$ 536,000	15	$ 214,400	65	$ 107,200		$ -
S131B	1955	25	25	$ 248,000	0	$ 28,000	50	$ 49,600	75	$ 99,200
S147B	1941	30	30	$ 5,978,000	5	$ 1,725,000	55	$ 1,195,600		$ -
S148C	1980	20	20	$ 1,967,000	45	$ 393,400	70	$ 786,800		$ -
S149C	1980	20	20	$ 1,057,000	45	$ 211,400	70	$ 422,800		$ -
S150B	c.1990	10	10	$ 115,000	35	$ 23,000	60	$ 46,000		$ -
S151B	c.1920	10	10	$ 402,500	0	$ -	0	$ -		$ -
S152B	c.1920	0	0	$ 400,000	0	$ -	0	$ -		$ -
S153B	c.1920	5	5	$ 345,000	0	$ 50,000	0	$ -		$ -
S154B	1919	10	10	$ 400,000	0	$ -	0	$ -		$ -
			Total:	$ 129,630,000						

NPV CALCS — Applied Discount Rate (%):

ID Number	(DR - 1.5)% 0.5	(DR - 1.0)% 1	(DR - 0.5)% 1.5	(DR)% 2	(DR+0.5)% 2.5	(DR+1.0)% 3	(DR+1.5)% 3.5
S001B	$ 667,742	$ 612,380	$ 566,989	$ 529,343	$ 497,749	$ 470,908	$ 447,825
S003B	$ 336,333	$ 279,303	$ 234,280	$ 198,251	$ 169,050	$ 145,102	$ 125,252
S004B	$ 1,399,846	$ 988,328	$ 700,723	$ 498,966	$ 356,884	$ 256,426	$ 185,106
S005C	$ 619,751	$ 495,209	$ 398,287	$ 322,388	$ 262,585	$ 215,178	$ 177,371
S006C	$ 944,866	$ 754,990	$ 607,225	$ 491,510	$ 400,335	$ 328,058	$ 270,418
S007B	$ 667,742	$ 612,380	$ 566,989	$ 529,343	$ 497,749	$ 470,908	$ 447,825
S008B	$ 751,210	$ 688,928	$ 637,862	$ 595,511	$ 559,968	$ 529,771	$ 503,803
S010B	$ 651,296	$ 582,659	$ 526,313	$ 479,443	$ 439,938	$ 406,209	$ 377,056
S012B	$ 445,741	$ 377,357	$ 320,297	$ 272,524	$ 232,396	$ 198,590	$ 170,029
S014B	$ 608,950	$ 519,924	$ 446,058	$ 384,469	$ 332,870	$ 289,442	$ 252,726
S016B	$ 614,221	$ 522,887	$ 449,563	$ 389,890	$ 340,690	$ 299,630	$ 264,978
S018C	$ 979,141	$ 802,035	$ 661,187	$ 548,502	$ 457,813	$ 384,399	$ 324,625
S021C	$ 1,401,675	$ 1,176,987	$ 994,549	$ 845,572	$ 723,234	$ 622,213	$ 538,339
S023C	$ 1,358,750	$ 1,060,167	$ 835,689	$ 665,785	$ 536,258	$ 436,752	$ 359,683
S024C	$ 663,936	$ 558,636	$ 472,719	$ 402,282	$ 344,260	$ 296,235	$ 256,291
S035B	$ 1,440,952	$ 1,146,802	$ 920,573	$ 745,525	$ 609,209	$ 502,335	$ 417,952
S036B	$ 6,305,414	$ 5,186,652	$ 4,288,948	$ 3,565,486	$ 2,979,849	$ 2,503,624	$ 2,114,573
S037C	$ 11,824,216	$ 9,819,252	$ 8,236,414	$ 6,969,776	$ 5,943,165	$ 5,101,246	$ 4,403,376
S038B	$ 353,533	$ 308,524	$ 271,892	$ 241,667	$ 216,398	$ 195,005	$ 176,680
S039B	$ 13,332,769	$ 11,584,645	$ 10,118,322	$ 8,883,295	$ 7,838,948	$ 6,952,456	$ 6,197,171
S040C	$ 33,780,499	$ 27,104,004	$ 21,905,203	$ 17,831,214	$ 14,618,517	$ 12,069,187	$ 10,033,728
S041B	$ 11,171,914	$ 9,853,315	$ 8,706,393	$ 7,707,256	$ 6,835,501	$ 6,073,683	$ 5,406,874
S043B	$ 1,557,275	$ 1,367,209	$ 1,206,083	$ 1,068,833	$ 951,376	$ 850,407	$ 763,233
S044C	$ 3,357,931	$ 2,620,030	$ 2,065,269	$ 1,645,379	$ 1,325,275	$ 1,079,361	$ 888,899
S045B	$ 3,750,009	$ 3,167,319	$ 2,694,197	$ 2,307,849	$ 1,990,586	$ 1,728,607	$ 1,511,092
S048C	$ 1,826,241	$ 1,561,276	$ 1,341,606	$ 1,158,520	$ 1,005,139	$ 876,005	$ 766,763
S049C	$ 2,847,509	$ 2,424,084	$ 2,084,159	$ 1,807,516	$ 1,579,427	$ 1,389,072	$ 1,228,429
S053C	$ 560,342	$ 477,019	$ 410,128	$ 355,689	$ 310,805	$ 273,346	$ 241,734
S056B	$ 11,297,571	$ 9,569,614	$ 8,127,826	$ 6,920,675	$ 5,906,725	$ 5,052,500	$ 4,330,829
S057B	$ 488,472	$ 436,994	$ 394,735	$ 359,582	$ 329,953	$ 304,657	$ 282,792
S059C	$ 1,569,829	$ 1,406,815	$ 1,272,994	$ 1,161,676	$ 1,067,852	$ 987,747	$ 918,509
S062C	$ 447,905	$ 366,888	$ 302,458	$ 250,910	$ 209,425	$ 175,842	$ 148,499
S063C	$ 405,818	$ 340,766	$ 287,946	$ 244,813	$ 209,393	$ 180,146	$ 155,862
S071B	$ 1,691,121	$ 1,459,015	$ 1,266,438	$ 1,105,866	$ 971,340	$ 858,115	$ 762,392
S076B	$ 667,742	$ 612,380	$ 566,989	$ 529,343	$ 497,749	$ 470,908	$ 447,825
S088C	$ 608,727	$ 511,149	$ 431,918	$ 367,220	$ 314,090	$ 270,218	$ 233,793
S090B	$ 1,078,622	$ 905,719	$ 765,329	$ 650,688	$ 556,546	$ 478,808	$ 414,265
S091C	$ 1,546,829	$ 1,383,815	$ 1,249,994	$ 1,138,676	$ 1,044,852	$ 964,747	$ 895,509
S093C	$ 1,576,747	$ 1,346,231	$ 1,154,972	$ 995,500	$ 861,896	$ 749,447	$ 654,379
S094B	$ 1,767,250	$ 1,553,387	$ 1,384,551	$ 1,249,443	$ 1,139,938	$ 1,050,133	$ 975,693
S096B	$ 820,013	$ 624,135	$ 479,983	$ 373,116	$ 293,269	$ 233,109	$ 187,383
S097B	$ 518,593	$ 437,098	$ 370,669	$ 316,186	$ 271,234	$ 233,927	$ 202,790
S099B	$ 1,170,608	$ 1,041,624	$ 932,689	$ 840,234	$ 761,388	$ 693,829	$ 635,672
S100B	$ 4,018,177	$ 3,510,162	$ 3,083,470	$ 2,723,543	$ 2,418,674	$ 2,159,049	$ 1,938,046
S101B	$ 1,710,282	$ 1,512,961	$ 1,346,633	$ 1,205,768	$ 1,085,920	$ 983,495	$ 895,573
S102C	$ 985,505	$ 787,463	$ 633,342	$ 512,650	$ 417,554	$ 342,168	$ 282,049
S103C	$ 985,505	$ 787,463	$ 633,342	$ 512,650	$ 417,554	$ 342,168	$ 282,049
S104B	$ 5,647,980	$ 5,309,847	$ 5,039,164	$ 4,821,613	$ 4,646,048	$ 4,503,769	$ 4,387,972
S105B	$ 1,921,753	$ 1,626,921	$ 1,380,917	$ 1,174,948	$ 1,001,944	$ 856,192	$ 733,058
S108B	$ 598,076	$ 510,639	$ 438,093	$ 377,604	$ 326,926	$ 284,273	$ 248,213
S109B	$ 367,864	$ 305,488	$ 256,244	$ 216,837	$ 184,898	$ 158,705	$ 136,994
S114B	$ 301,723	$ 256,857	$ 220,838	$ 191,525	$ 167,357	$ 147,186	$ 130,165
S115B	$ 1,011,061	$ 840,733	$ 703,746	$ 592,966	$ 502,881	$ 429,213	$ 368,630
S116B	$ 308,102	$ 275,752	$ 249,422	$ 227,698	$ 209,536	$ 194,160	$ 180,989
S117B	$ 814,120	$ 728,324	$ 657,891	$ 599,303	$ 549,922	$ 507,762	$ 471,321
S119B	$ 617,421	$ 469,937	$ 361,399	$ 280,935	$ 220,814	$ 175,518	$ 141,088
S121B	$ 427,072	$ 349,824	$ 288,390	$ 239,240	$ 199,684	$ 167,663	$ 141,592
S125B	$ 804,684	$ 687,042	$ 589,434	$ 508,048	$ 439,864	$ 382,476	$ 333,959
S128B	$ 513,453	$ 482,713	$ 458,106	$ 438,328	$ 422,368	$ 409,434	$ 398,907
S129B	$ 715,521	$ 600,824	$ 507,694	$ 431,644	$ 369,194	$ 317,625	$ 274,809
S131B	$ 353,823	$ 298,575	$ 254,959	$ 220,056	$ 191,767	$ 168,568	$ 149,337
S147B	$ 7,738,517	$ 6,768,182	$ 5,952,922	$ 5,264,990	$ 4,682,066	$ 4,186,112	$ 3,762,482
S148C	$ 2,649,504	$ 2,255,522	$ 1,939,234	$ 1,681,828	$ 1,469,599	$ 1,292,481	$ 1,143,008
S149C	$ 1,423,755	$ 1,212,042	$ 1,042,080	$ 903,758	$ 789,714	$ 694,536	$ 614,214
S150B	$ 162,824	$ 145,665	$ 131,578	$ 119,861	$ 109,984	$ 101,552	$ 94,264
S151B	$ 382,918	$ 364,378	$ 346,821	$ 330,190	$ 314,432	$ 299,498	$ 285,340
S152B	$ 400,000	$ 400,000	$ 400,000	$ 400,000	$ 400,000	$ 400,000	$ 400,000
S153B	$ 386,503	$ 378,256	$ 370,250	$ 362,477	$ 354,930	$ 347,600	$ 340,481
S154B	$ 380,539	$ 362,115	$ 344,667	$ 328,139	$ 312,479	$ 297,638	$ 283,568
TOTAL:	$ 165,502,335	$ 139,875,617	$ 119,288,045	$ 102,612,319	$ 88,997,732	$ 77,797,485	$ 68,516,131
Total/75 years:	$ 2,206,698	$ 1,865,008	$ 1,590,507	$ 1,368,164	$ 1,186,636	$ 1,037,300	$ 913,548

Notes:
- -S053C Rehabilitated in 2020
- -S021C Rehabilitated in 2021 (Guide Rail)
- -S093C Rehabilitated in 2021 (Guide Rail)
- -S105B Rehabilitated in 2021 (Guide Rail)
- -S151B to S154B are structures scheduled for removal, therefore only removal costs are included under 'Cost to Replace'
- -50 year service life generally assumed for steel pedestrian or CSP/SSMP type structures
- -Previous BCI is typically from 2018 (or from 2016 when on a 4 year inspection cycle)

Deck Area < 150m2

Replacement Cost (sq.m):	$ 8,000	(75 Year life for replacement)
Major Rehab Cost (sq.m):	$ 3,200	(Year 50 from construction)
Minor Rehab Cost (sq.m):	$ 1,600	(Year 25 from construction)

150m2 > Deck Area < 1500m2

Replacement Cost (sq.m):	$ 7,000	(75 Year life for replacement)
Major Rehab Cost (sq.m):	$ 2,800	(Year 50 from construction)
Minor Rehab Cost (sq.m):	$ 1,400	(Year 25 from construction)

Deck Area > 1500m2

Replacement Cost (sq.m):	$ 6,000	(75 Year life for replacement)
Major Rehab Cost (sq.m):	$ 2,400	(Year 50 from construction)
Minor Rehab Cost (sq.m):	$ 1,200	(Year 25 from construction)

App C – List of Very High Risk Assets

This appendix provides a list of the assets that fall within the Very High risk category.

Road Assets

Risk Exposure	PoF (Cdn)	CoF	RDS_ID	STREETNAME	StreetAhead	StreetBack
20	5	4	1177	KALAR RD	PADDOCK TRAIL DR	WOODBINE ST
20	5	4	1222	KITCHENER ST	MACDONALD AV	SLATER AV
20	5	4	50	ALLENDALE AV	PEER LN	PEER ST
20	5	4	53	ALLENDALE AV	PEER ST	FERRY ST
20	5	4	268	BUCHANAN AV	KITCHENER ST	LIMITS
20	5	4	802	FALLSVIEW BV	ROBINSON ST	FERRY ST
20	5	4	1176	KALAR RD	BEAVERDAMS RD	PADDOCK TRAIL DR
20	5	4	2026	REIXINGER RD	LYONS CREEK RD	DELL RD

Bridge Assets

ID Number	Structure Name	Road Classification	Number of Spans	Span Lengths (m)	Deck Area (m^2)	Current BCI
S104B	Beck Road	Collector	3	9, 14, 9	222	49