Enterprise Asset Management Plan (2021)

July 2021

Executive Summary

In December 2016, City Council endorsed the City of Greater Sudbury Municipal Asset Management Plan produced by KPMG in-conjunction with City staff. The plan reflects an approximate level of the financial requirements associated with maintaining City assets in a state of good repair. Since 2017, the City has been collaboratively working to advance asset management planning. Asset information including data collection and analysis initiatives have been underway to increase knowledge of infrastructure condition, risk level, and level of service for a more comprehensive implementation of lifecycle asset management.

Maintaining existing assets in a state of good repair and building new infrastructure to meet current and future needs is necessary to provide required service levels to the community and achieve Council priorities.

The Enterprise Asset Management Plan (2021) is a strategic document that uses a risk-based approach to asset management planning. The plan meets and exceeds the first phase requirements of *O. Reg. 588/17: Asset Management Planning for Municipal Infrastructure* with a mandated completion date of July 1, 2022 (formerly 2021).

Asset classes included within this asset management plan are core infrastructure as defined by the Province: water, wastewater, stormwater management, roads, bridges and large culverts. Additionally the plan includes: fleet and equipment and municipal parking.

The asset class specific asset management plans describe the characteristics and condition of infrastructure assets along with action and investment plans, required to achieve the current level of service set out by Council.

The Enterprise Asset Management Plan is a consolidated and integrated document of core infrastructure asset management plans that provide a clear integrated and holistic picture of core infrastructure and their asset maturity level. Furthermore, this version of the plan includes non-core infrastructure: municipal parking, and fleet and equipment. The plan will serve as a roadmap for future action plans by defining the next steps which include the legislated milestones to further the maturity of asset management planning. A state of the infrastructure provides comprehensive information regarding the asset classes included within the plan. Buildings and facilities, parks, solid waste, housing and long-term care will be incorporated to the Enterprise Asset Management Plan once the respective plans by asset class are complete.

The Enterprise Asset Management Plan was developed in line with the updated Enterprise Asset Management Policy which provides the guiding principles for the plan and the Asset Management Strategy that provides the direction to put the policy into practice.

Unless otherwise stated, all financial values in this asset management plan are described in 2020 Canadian dollars. When an estimate was prepared within an asset class specific asset management plan in previous year dollars, the CanaData construction cost estimate published by Construct Connect was used to inflate to 2020 Canadian dollars.

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- Road Structure Asset Management Report (**Bridge** and **Large Culvert** Asset Management Plan)
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- Asset Management Plan **Water** and **Wastewater**
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1. Introduction

Asset management is the systematic and coordinated activities and practices of an organization to realize value from an asset by optimally and sustainably delivering on its service objectives through cost-effective lifecycle management of assets.

Service delivery to the community is based on managing existing assets in an environmental, social, and economically sustainable manner to reduce cost and risks, while complying with regulation.

The majority of the City's assets have long service lives extending beyond a decade. These assets require significant ongoing investment in operation, maintenance and renewal activities to maintain a safe and reliable condition to support service delivery.

The City, like most Canadian municipalities, must overcome multiple challenges in managing assets including aging infrastructure; expectations of higher levels of service with minimal financial impact; increasingly demanding and complicated legislation with environmental requirements; and mitigation of the increased risk involved with the execution of service delivery. As a result, the City is moving to implement a focused and calculated approach to address these challenges of managing infrastructure assets with the development and implementation of the Enterprise Asset Management Plan.

In 2019, City Council approved the City of Greater Sudbury Strategic Plan 2019-2027 to define the City's strategic direction. There are six pillars that are defined within the strategic plan, the first of which is Asset Management and Service Excellence. The strategic pillar is intended to "maximize value of investment in physical infrastructure and initiatives that enable reliable service delivery and promote economic competitiveness."

The strategic plan is supported by a number of key documents including but not limited to: the City's annual budget and annual business plans, the City of Greater Sudbury Official Plan, enterprise risk management, master plans, by-laws, the core service review, state of the infrastructure reports, long-term financial plans and various policies and procedures.

1.1. Background and Legislation

In June of 2011, the province of Ontario released a long-term infrastructure plan for Ontario entitled *Building Together*. *Building Together* laid out a standardized and calculated approach to asset management planning. *Building Together* in conjunction with the *Infrastructure for Jobs and Prosperity Act, 2015* established a criteria and timeline for all municipalities to have an asset management plan in place by December 31, 2016. An asset management plan was required by this date in order to continue to be eligible for Federal and Provincial Government funding. In response, KPMG was retained to produce the City of Greater Sudbury Asset Management Plan (2016). The plan reflects an approximate level of the financial requirements associated with maintaining City assets in a state of good repair.

On December 13, 2017 the province approved *O. Reg. 588/17: Asset Management Planning for Municipal Infrastructure* under the *Infrastructure for Jobs and Prosperities Act, 2015*. The City has been working to develop asset management plans for all infrastructure assets that comply with legislation. This includes describing the asset's expected performance level (that is, its "service level") based on technical data.

In 2018, City Council achieved the first requirement of *O. Reg. 588/17* with the approval of the Enterprise Asset Management Policy aimed at ensuring municipal infrastructure systems are supported by plans and financing decisions that demonstrate effective service support and appropriate regard for managing lifecycle costs.

On April 16 2021, the Province formally announced an amendment to *O. Reg. 588/17*. The amendment extends the legislative phase-in schedule by one year. Specifically, municipalities must have approved phase one asset management plans for core assets (roads, bridges and culverts, water, wastewater, and stormwater management systems) completed by July 1, 2022. The plans must identify current levels of service and the cost to maintain the current level of service. With the approval of the Enterprise Asset Management Plan (2021), Greater Sudbury meets and exceeds the first phase requirement of *O. Reg. 588/17*. The aforementioned extension to the phase-in schedule is further reflected in the asset management roadmap.

Asset management represents the management of infrastructure, using proven lifecycle strategies that have been evolving over a number of years. Throughout this time, the City has developed asset management planning knowledge that is formally defined as part of the strategies within the Enterprise Asset Management Plan. The plan will culminate with the establishment of an improved and evolving long-term strategy to address the City's investment in infrastructure.

1.2. Maturity

The Federation of Canadian Municipalities (FCM) has prepared an Asset Management Readiness Scale to help municipalities understand where they started, where they currently are, and where they would like to be in asset management maturity. The levels that Greater Sudbury has currently achieved and will strive to achieve in the FCM Asset Management Readiness Scale are provided in Figure 1, which follows the description of the tool itself and how the tool is applied.

The readiness scale measures and analyzes five competency areas, with each competency acting as a building block. The five building block competencies include the following descriptions as provided by the FCM.

Policy and Governance: By developing this competency, the City is putting in place policies and objectives related to asset management, bringing those policies to life through a strategy and roadmap, and then measuring progress and monitoring implementation over time.

This competency helps create the policy structure that lays out asset management goals and how they will be achieved, leading to organizational alignment and commitment.

People and Leadership: By developing this competency, the City is setting up cross-functional teams with clear accountability and ensuring adequate resourcing and commitment from senior management and elected officials to advance asset management.

Asset Management requires collaboration and integration from multiple perspectives. At a minimum, the asset management team should be a representation of people who understand finance, decision-making, and the planning and operations of each relevant service area. This competency helps create and sustain connections across teams and build leadership in asset management.

Data and Information: By developing this competency, the City is collecting and using asset data, performance data and financial information to support effective asset management planning and decision-making.

This competency helps improve data management practices to ensure appropriate asset information is available as required.

Planning and Decision-Making: By developing this competency, the City is documenting and standardizing how the organization sets asset management priorities, conducts capital, operations and maintenance (O&M) planning, and develops budgets.

This competency helps implement asset management, by ensuring that asset management policies, objectives and information are consistently informing organizational plans.

Contribution to Asset Management Practice: By developing this competency, the City is supporting staff in asset management training, sharing knowledge internally to communicate the benefits of asset management, and participating in external knowledge sharing.

This competency helps build the organization's overall asset management practice by ensuring that internal stakeholders are well-informed and that the organization stays current with, and contributes to, leading practices, training and education.

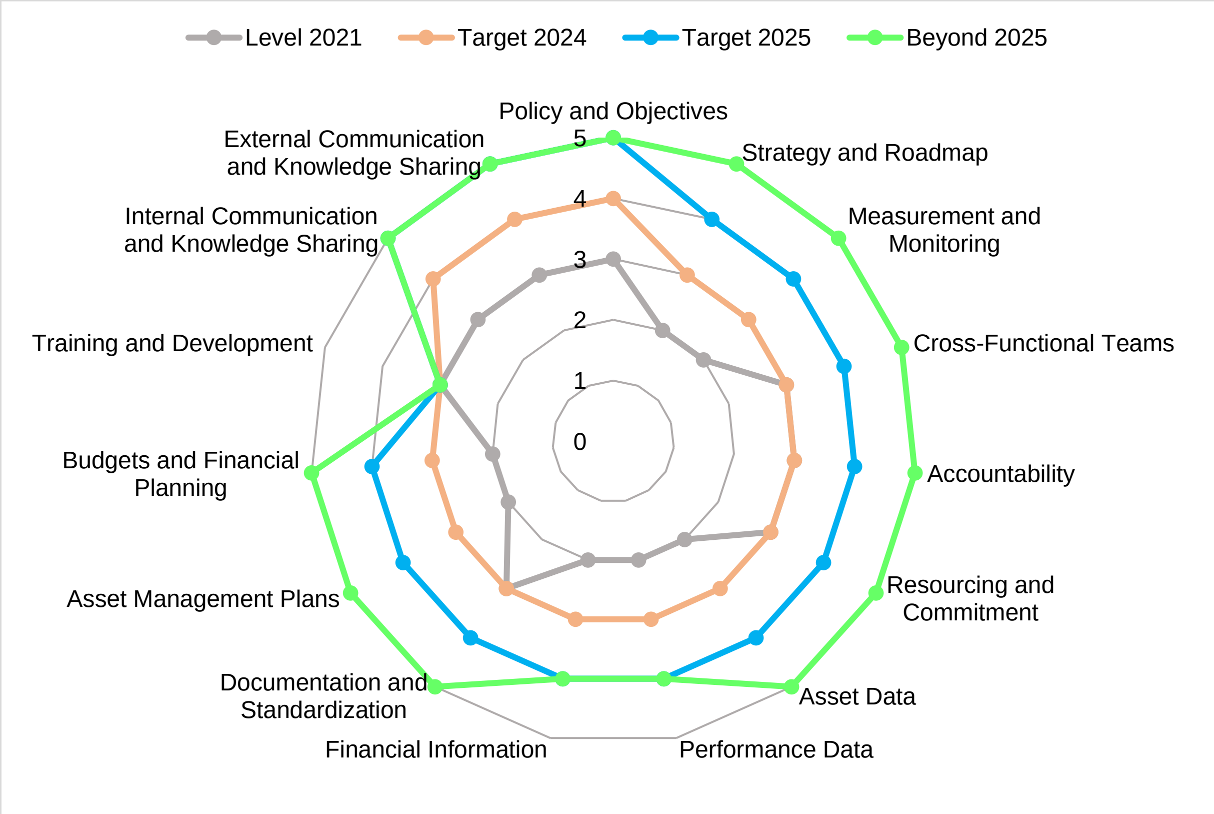
Each of the five competency areas is organized on a progressive scale of five levels. Each level is further broken down into three outcome areas. The outcomes describe milestones in asset management from initial investigation of practices, to adoption, and eventually to full integration of asset management practices into daily routines. Each of these outcome areas need to be achieved by the entire organization before a level can be achieved. Examples of outcomes within the readiness scale are Policy and Objectives, Asset Data, Financial Information, Asset Management Plans, Training and Development, among others.

Various asset classes may progress in the competencies at different rates and be further along in some competencies than in others. Furthermore, some asset classes may be further along with asset management practices than others. **The entire organization must achieve each outcome prior to advancing a level, meaning the overall rating should reflect the less advanced asset classes**. The levels are useful in planning for improvement.

Once the City achieves a Level 4 in the Asset Management Readiness Scale, the City will be roughly aligned with the requirements of the ISO 55000 standard; which is a significant accomplishment. The ISO 55000 provides an overview of asset management, its principles and terminology, and the expected benefits from adopting asset management.

The City's asset management maturity has been measured in the readiness tool on several occasions during grant applications with the FCM. The maturity measures are discussed with various City personnel while preparing grant application. The latest maturity measurement and targets are provided in Figure 1. Please note, the readiness scale is intended for Greater Sudbury to measure progress and set goals, it is not intended to benchmark or compare progress of various municipalities. For further details on the readiness tool and the various competency outcomes and levels please visit: https://fcm.ca/en/resources/mamp/tool-asset-management-readiness-scale.

Figure 1: Asset Management Maturity



Currently, the City's asset management maturity score is a Level 2 (average is 2.5 out of 5). By 2024, the City will improve to a Level 3 (average of 3.2 out of 5) and will achieve a Level 4 (average of 4.1 out of 5) in 2025.

Per the FCMs scoring criteria, the Training and Development Level remains at a Level 3. To achieve a Level 4, an asset management training plan must be in place for **all** City staff, even staff whose job descriptions do not include the operation or management of infrastructure assets. At this time, the approach to training and development is to implement proactive development training and role appropriate training for staff. If the City were to develop a training plan and provide asset management training to all staff, the Training and Development score would move directly to a Level 5.

In the pursuit to develop asset management maturity across the organization, the City has previously implemented initiatives that include:

- Development of a Capital Prioritization Tool to link the annual capital budget to asset management initiatives. The tool prioritizes departmental priorities against each other determined by criteria such as: appropriate lifecycle interventions, risk management, health and safety, strategic priorities, financial return on investment, environmental impacts and service level directives;

- Development of the Enterprise Asset Management Policy aimed at ensuring its municipal infrastructure systems are supported by plans and financing decisions that demonstrate effective service support and appropriate regard for managing lifecycle costs;
- Defined the roles of the individuals responsible for asset management planning;
- Development of data standards and completion of data collection and condition assessments; and
- Completion of a Core Service Review lead by the CAO's office.

1.3. Roadmap

The asset management roadmap outlines the actions, and time frames needed to implement and deliver asset management objectives. The key steps that must be performed to develop and implement effective asset management plans are detailed in Figure 2.

Within the asset management roadmap, the legislated phase 1 and 2 asset management plans are developed in steps 1 through 6 (Assess and Plan). The implement column represents requirements of the phase 3 asset management plan. Recently, activity has been focused on data collection and analysis to identify existing level of service, quantifiable risk and infrastructure need. Over the next several years, activities will be focused on the development of a sustainable financing strategy to achieve target level of service at an acceptable level of risk.

Figure 2: The Asset Management Roadmap

A) Assess	B) Plan	C) Implement
1. Framework • Asset Management Policy • Review Asset Management Practices • Develop Council Reporting	**4. Modeling** • Criticality • Failure Prediction • Climate Change Resiliency • Risk Management Framework	**7. Benchmark** • Target Level of Service Framework • Review Existing and Generate Additional Key Performance Indicators
2. Need and Gap Analysis • Data Availability • Data Collection Practices • Path to Improvement	**5. Prioritization** • Asset Lifecycle Planning and Optimization • Cost Benefit Analysis • Project Scheduling	**8. Sustainability Strategy** • Financing Strategy for Target Levels of Service • Plan to manage infrastructure within the City's capacity to renew and maintain assets, and accept the associated risk • Cost & Asset Tracking
3. Assessment • Data Analysis • Asset Performance • Legislative and Industry Standards • Levels of Service	**6. Financial Strategy** • Long-Term Needs • Capital expenditure and significant operating costs to maintain life cycle activities • Funding Gap • Future Demand	**9. Execution** • Monitor Performance of Asset Management Program

The asset management roadmap will be guided by the principle of continuous improvement, industry best practices, and regulatory requirements. Asset management planning is dynamic and must be continuously evolving to leverage opportunities and address upcoming challenges.

Upcoming milestones that will be achieved within the asset management roadmap are provided in Table 1.

Table 1: Asset Management Roadmap Upcoming Milestones

Year	Milestone	Actions
2021	1st Enterprise Asset Management Plan (Phase 1)	Include all core infrastructure, fleet and equipment and municipal parking
	Data Improvements	Technical Studies and Condition Assessments - annual requirements
	Asset Management Planning Process Improvements	Development of a building and facility asset management database
2024	2nd Enterprise Asset Management Plan (Phase 2)	Addition of buildings and facilities, housing, long-term care, parks and solid waste
	Define Target Levels of Service	Prepare Level of Service options for Council review and selection
	Prepare Sustainability Strategy	Prepare investment and financing plan to achieve the targets directed by Council
2025	3rd Enterprise Asset Management Plan (Phase 3)	Complete compliance with O. Reg. 588/17
2025	Continuous Improvement	Monitor the progress, achievements and needs of asset management planning Revise Enterprise Asset Management Plans, Strategies and Policy to reflect improvement objectives

1.4. Purpose of the Enterprise Asset Management Plan

The plan provides details to facilitate the best possible decisions regarding construction, operation, maintenance, renewal, replacement, expansion and disposal of infrastructure assets while minimizing risk and cost, and maximizing service delivery. The plan integrates a number of individual plans by asset class including: Water and Wastewater, Storm Water Management, Roads and Transportation, Bridges and Large Culverts, Fleet and Equipment and Municipal Parking. Future versions of the plan will include Buildings and Facilities, Housing, Long-Term Care, Parks and Recreation, and Solid Waste. Please note that the list above does not include asset classes that are managed by various Boards and Agencies that are funded by Greater Sudbury. There may be risks associated with asset failure in these areas and the City will do subsequent work to understand the potential risks.

The Enterprise Asset Management Plan is developed in accordance with Building Together – Guide for Municipal Asset Management Plans and *Ontario Regulation 588/17: Asset Management Planning for Municipal Infrastructure, 2017* and the principles included in Section 3 of the *Infrastructure for Jobs and Prosperity Act, 2015*.

Asset management plans provide a framework that functions along with annual budgets and long term financial plans to help understand the implications of budget and investment planning decisions on infrastructure. The 2021 Enterprise Asset Management Plan establishes a baseline of current asset management practices and establishes the infrastructure deficit and funding gap with greater accuracy for all asset classes included.

Asset class specific asset management plans are attached to the document in the appendices. The majority of asset class specific details such as current level of service, condition, risk exposure and financial need are provided in the appendices.

Also included within the appendices is the Enterprise Asset Management Policy and the Asset Management Strategy. The strategy builds upon the principles set out in the Enterprise Asset Management Policy. The strategy provides practices that can be applied consistently across Greater Sudbury aimed to improve asset management and support the objectives of the roadmap.

The Enterprise Asset Management Plan is dynamic and will be revised and updated regularly as a minimum per legislative schedule or as significant revisions become available. Revisions are expected as the City's maturity in asset management planning progresses.

2. State of the Infrastructure

The City of Greater Sudbury asset inventory serves various functions, but in all cases the assets are physical infrastructure assets that depreciate over time.

The State of the Infrastructure communicates the performance of infrastructure assets that are included in the Enterprise Asset Management Plan. A common tool to report on infrastructure is an Infrastructure Report Card to form the basis for further discussion and decision surrounding asset management and investment.

This is the City's first-ever Infrastructure Report Card and includes all "core" assets as defined in *O. Reg. 588/17* and the City's municipal parking, fleet and equipment asset classes. Additional asset classes will be added to the Infrastructure Report Card as their asset management plans progress.

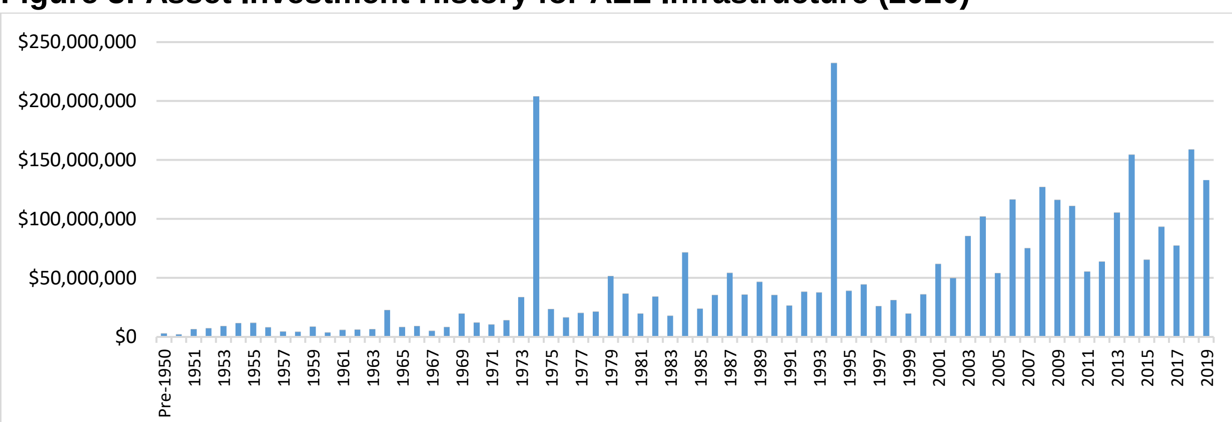
The State of the Infrastructure provides a baseline for discussion of infrastructure and is intended as a prologue to the asset management plans prepared for specific asset classes.

While the available asset data and information did not indicate that there are any major physical issues with the assets at the network level, normal degradation of assets will continue at the individual asset level and will require funding to address future needs. Leading up to 2021, the City has greatly increased the maturity and availability of datasets for the major asset classes included in the State of the Infrastructure.

2.1. Asset Valuation

The corporation has a historical capital investment of $3.3B (2020) invested into infrastructure assets that is detailed in Figure 3. The expenditure data to develop Figure 3 is managed within the City's Tangible Capital Asset Database.

Figure 3: Asset Investment History for ALL Infrastructure (2020)

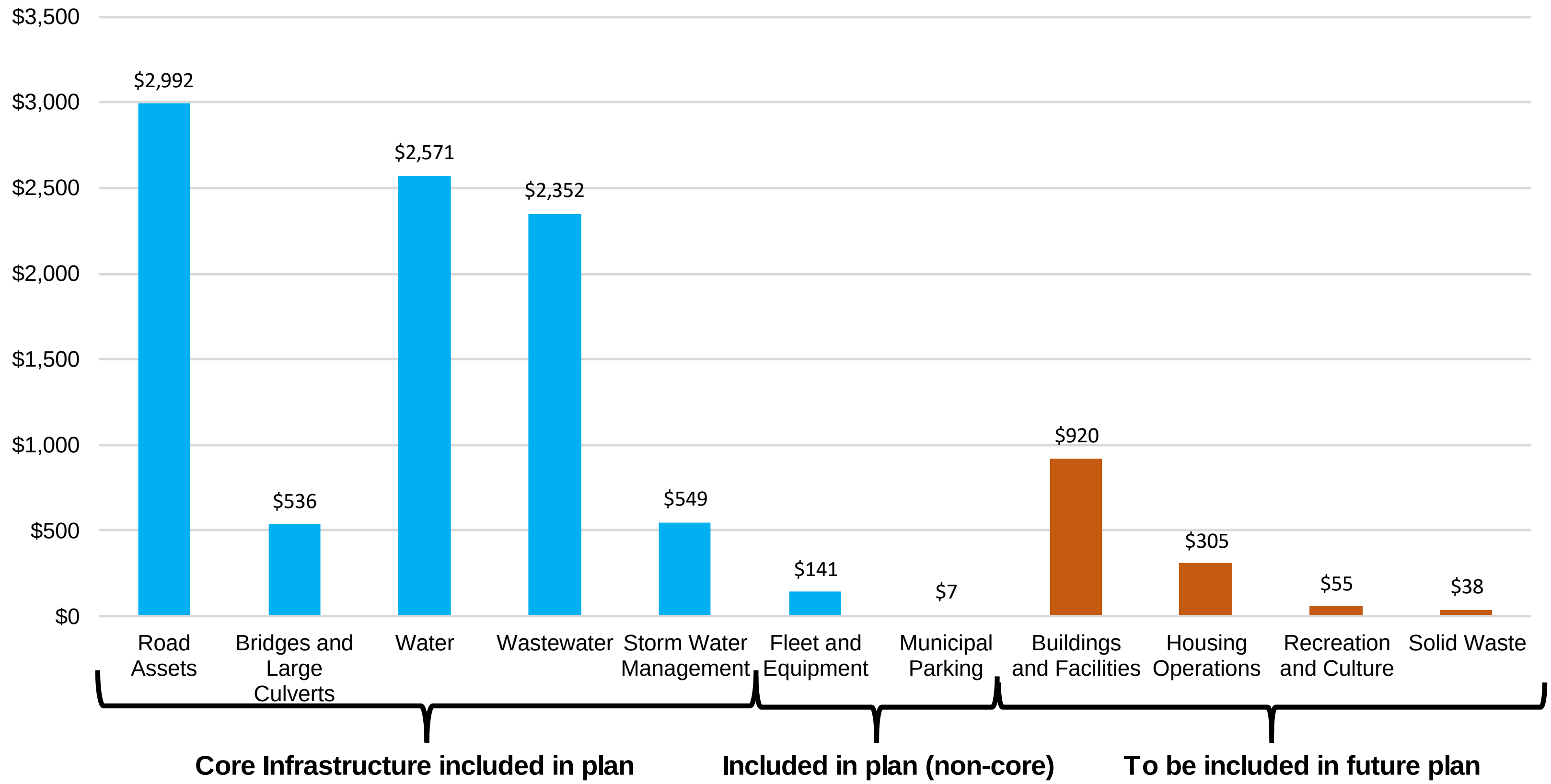


The historical investment of $3.3B (2020) invested into all infrastructure assets spans across a large portfolio that translates into a $10.5B (2020) replacement value for all infrastructure assets. All infrastructure assets refers to the entire Greater Sudbury infrastructure asset portfolio that includes asset classes not yet included in the Enterprise Asset Management Plan. For example, buildings and facilities, housing, parks, and solid waste. Replacement values (2020) for all infrastructure assets are presented in Figure 4.

Figure 4: Replacement Value (2020) in Millions for ALL City Infrastructure

The Replacement value for all City infrastructure is **$10.5B**. This replacement valuation includes **ALL** City infrastructure, not only the infrastructure included in this asset management plan.

Going forward, there may be revisions beyond inflation to the replacement value of the infrastructure portfolio due to an influx of data within various asset classes. For example, building condition assessments have been completed for approximately half the building and facilities portfolio. The building and facility replacement cost provided below has been determined by past purchasing records indexed forward, as opposed to on site data. Water and wastewater plants and facilities are currently undergoing similar review.



2.2. Methodology and how to read the Infrastructure Report Card

Specifically, the Infrastructure Report Card will provide: quantity of infrastructure assets that the City owns, details of the infrastructure condition, and a summary of historical capital investment and infrastructure need. Asset class specific Infrastructure Report Cards are provided in Section 2.6 Infrastructure Report Cards.

Condition and Life Expectancy

All infrastructure has a finite life, however different assets and their components have varying useful life expectancies. Useful lives have been estimated for each asset type within an asset class. Estimated useful lives are based upon industry acceptable standards and local experience. The estimated useful life is helpful to monitor service life consumption.

Infrastructure condition reporting involves both technical data and professional judgment. For example an asset, according to its technical data, may be deemed to be reliable for only a limited period. However, professional judgment may suggest the asset could remain in service longer. Ideally, the condition is determined by evidence based data from inspection, testing and performance assessment. When this data is unavailable, service life consumption is used to generate condition rating.

A common condition rating system includes five categories: Very Good (A), Good (B), Fair (C), Poor (D), and Very Poor (E). The condition rating systems helps to identify where infrastructure is within its lifecycle.

Various data sources were integrated during the development of the asset management plans. Data sources include: modeling, asset management and capital planning tools, pavement management system, maintenance and work order management system, the GIS database, spreadsheets and the tangible capital asset inventory.

The asset condition information in this document reflects best available data and professional judgment. Work continues to refine data collection activities and manage the evolution of the asset management program.

Infrastructure Need and Expenditure

The Infrastructure Report Card is a snapshot in time. To add context to the condition ratings, infrastructure need and the historical investment averaged over a 5-year period are provided within the report card.

Further detailed information and forecasts regarding replacement of assets and lifecycle interventions are discussed in the individual asset management plans. However these details are reflected in the average annual capital reinvestment and maintenance need. It is also important to note, some infrastructure capital need is addressed through external funding sources and reserves, not all funding requirements are from the annual municipal or water/wastewater levies.

Key terms that describe infrastructure need and expenditure within the Infrastructure Report Card are defined as follows.

- The **Funding Gap** is the unfunded value of infrastructure renewal needs that require attention as of the current year.
- The **Infrastructure Deficit** is the projection of the funding gap at the current service requirement over a defined period.
- The **Average Annual Reinvestment Requirement (AAR)** is the mean capital investment required over a defined period. It is recognized that annual infrastructure capital investment requirement is not linear and varies annually; however the AAR is a linear average. The AAR is useful for defining the required rate of funding based on an investment profile. It is also recognized that actual investment spending will vary year to year and the AAR value provides a benchmark upon which to measure whether infrastructure is being renewed at a rate that is financially sustainable. To address the actual investment spending that varies year to year, the City has implemented an annual capital prioritization process and Council has the ultimate authority to determine capital spending priorities on existing or new assets.

Data Confidence Rating

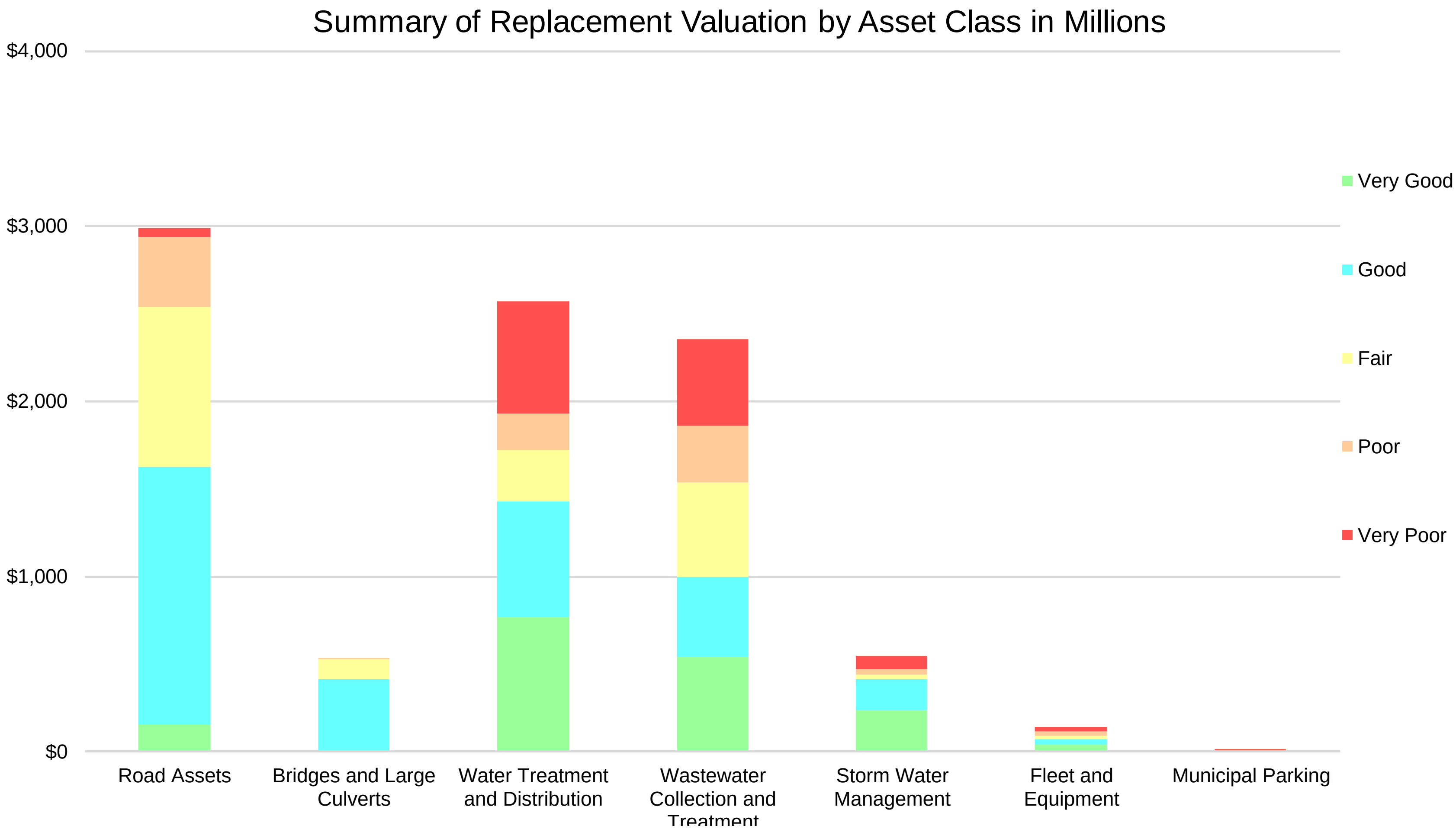
Asset management is a continuous improvement process. The City has several data collection and analysis projects underway to improve the data confidence within all asset classes. The data confidence rating is based in Table 2.

Table 2: Quality of Asset Datasets

Data Confidence Rating	Description
A	• No Assumptions with condition and age data • Reliable data inventory and source • Examples: Closed Circuit Television Inspection, Building Condition Assessment, Pavement Condition Assessment, Bridge Condition Assessment, Structural Report
B	• Dataset contains less than 10% assumptions • Moderately reliable data inventory and source • Example: aging condition data or studies
C	• Data contains greater than 10% assumptions • Moderately reliable data inventory and source • Example: aging condition data or studies
D	• Data from unreliable or out of date documents • Many assumptions of condition, age and replacement values • Example: purchasing records, condition data or studies older than 5 years
E	• Moderately reliable data for age or value, but not both • Only 1 moderately reliable data source
F	• No data available

2.3. Summary of Replacement Valuation for Asset Classes within the Enterprise Asset Management Plan

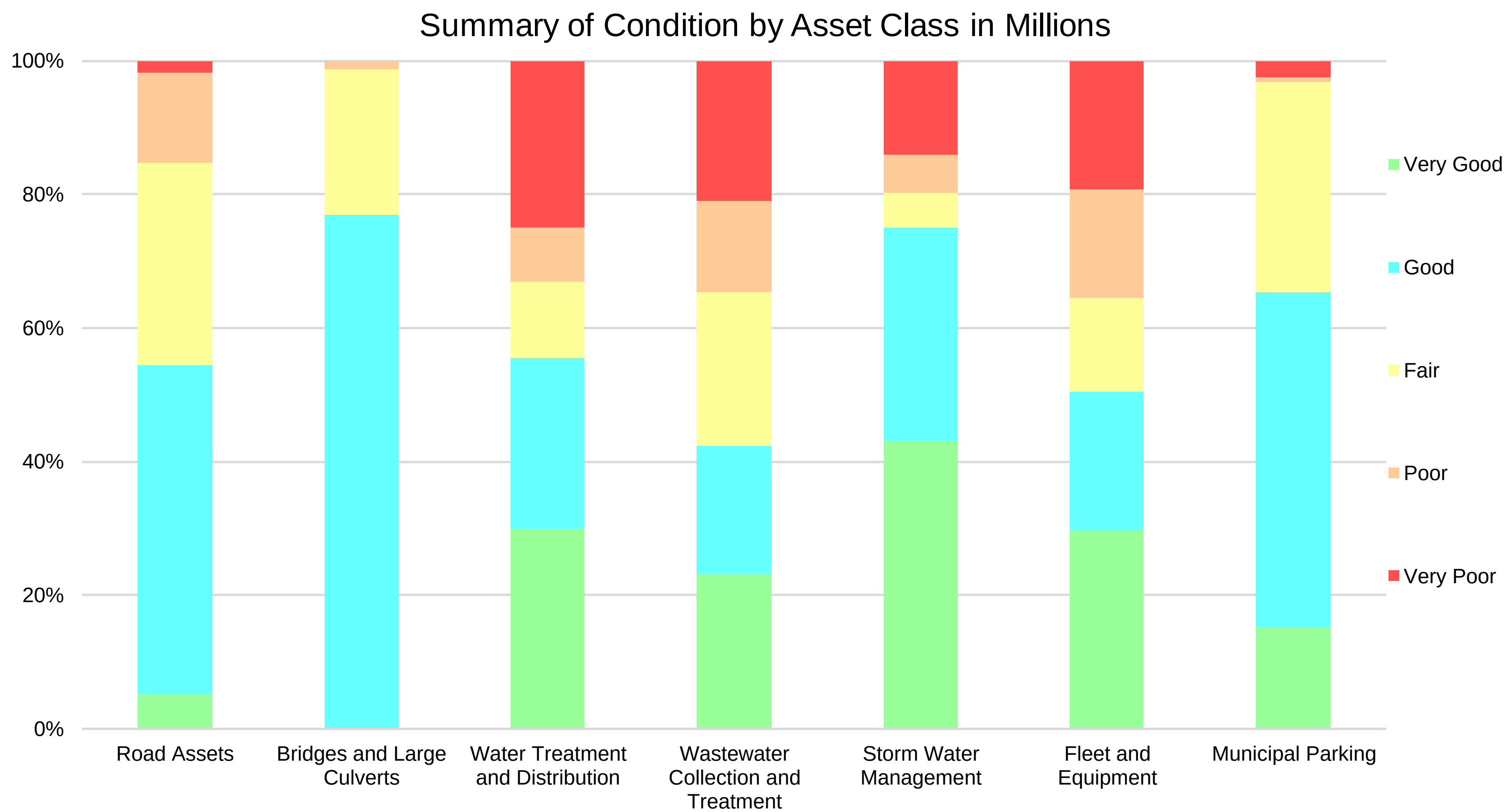
The replacement valuation of the City's infrastructure is $10.5B. Elements related to roads comprises 28.6% of the City's total replacement valuation. The percentage is indicative of the fact that the road network consists of approximately 3,500 lane kms. Water and wastewater infrastructure represent the second and third highest value at approximately 47% combined. Together, these three asset classes represent 75.6% of the total replacement value of infrastructure within the Enterprise Asset Management Plan.



2.4. Summary of Average Condition

The information on condition ratings presented in the figure below have been adapted from condition frameworks that vary by asset class. Areas with a high percentage of infrastructure with a Poor or Very Poor condition that are also deemed to be high risk or essential may require an increase or redistribution of funding to improve their condition. Often, however not in every situation, infrastructure condition is a major contributing factor to the probability of failure associated with service level delivery.

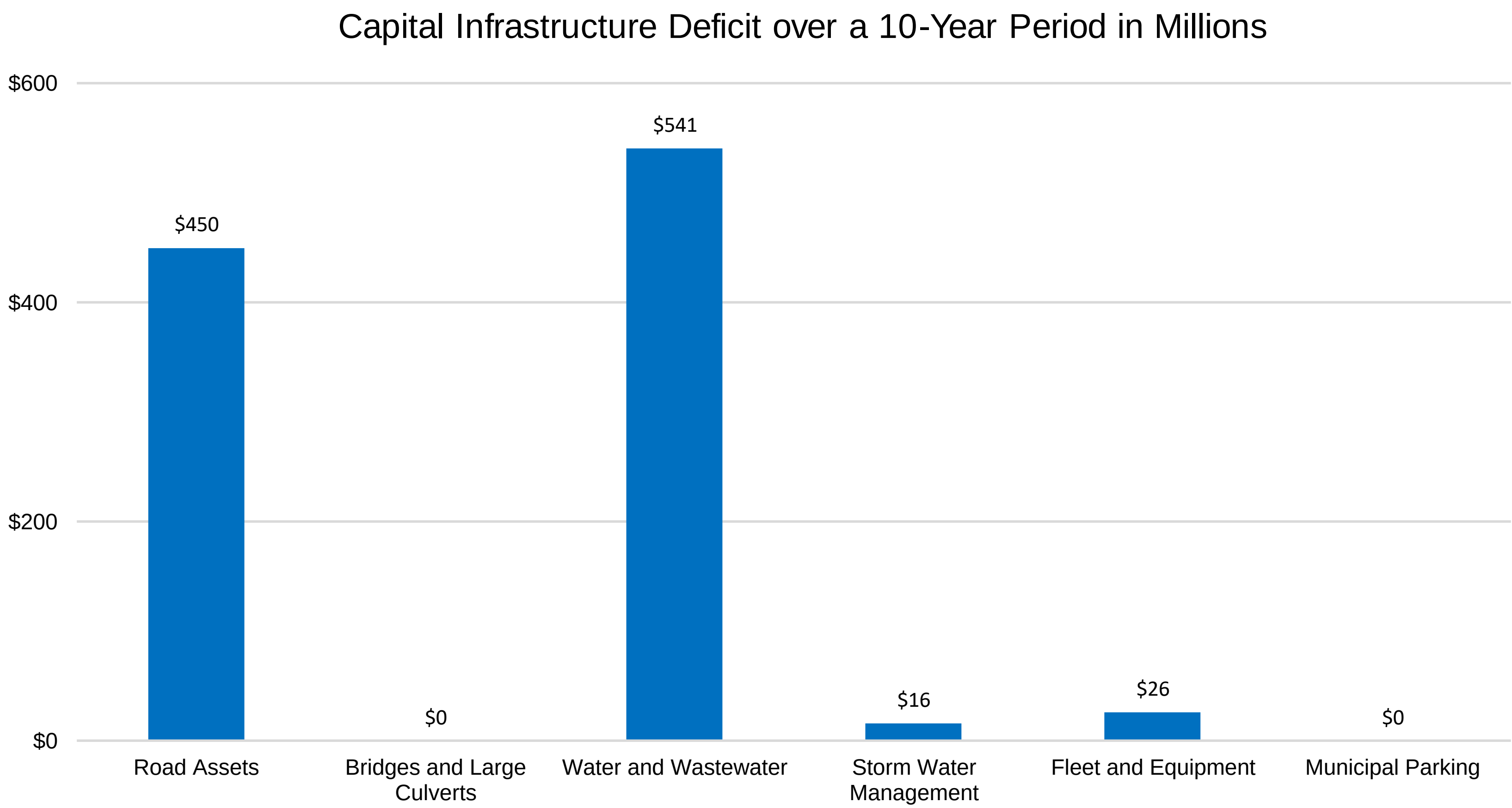
Average Condition	C	B+	B-	B-	B	B-	B



Valuation	$2,992	$536	$2,571	$2,352	$549	$141	$7 (In Millions)

2.5. Summary of Infrastructure Deficit over a 10-Year Period

Following the identification of investment expected during the lifecycle of infrastructure, the average annual reinvestment requirement is compared to recent annual capital budgets to determine the adequacy of investment. The comparison yields the financial risk of asset ownership known as a funding gap. The funding gap is the unfunded value of infrastructure renewal needs that require attention as of the current year. The funding gap and service requirement can be projected over a defined period to provide a capital infrastructure deficit. The deficit is recommended investment in addition to current capital expenditure. Currently, there is a 10-year capital infrastructure deficit of approximately **$1,033M** to maintain current levels of service. **Council will have the opportunity to address the infrastructure deficit with the approval of Target Levels of Service**.



2.6. Infrastructure Report Cards

Please see the following Infrastructure Report Cards by asset class.

Intentionally Blank

C

Fair Condition
(49.8 out of 100)

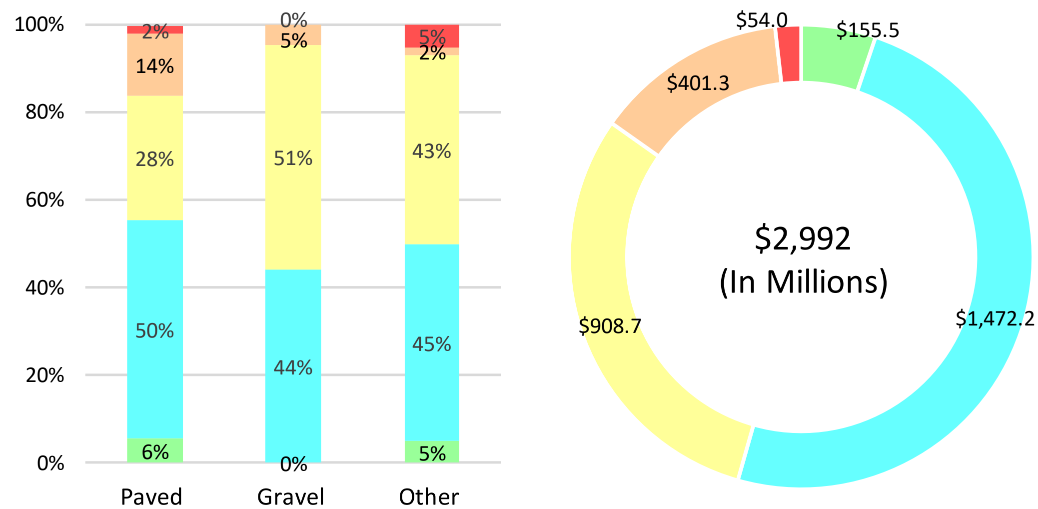
Roads

A well-maintained transportation system promotes economic vitality and a positive image. Investing in a measurable approach in the maintenance of road infrastructure will ensure the continued economic and social vitality of the city.
The City of Greater Sudbury road network strives for complete streets that accommodate multimodal transportations.

The City's road network transports people and goods safely and quickly. Roads are maintained to ensure safe and smooth transportation. One of the challenges facing the City is the need to balance competing needs between expanding the transportation network within the City's large geographic area and meeting the needs of existing and aging assets.
Overall, the assets in the road network are in **FAIR** condition.

Inventory: The City owns and operates a road network of 3,592 km of varying road classifications; namely arterial, collector and local. Other road inventory includes 441 km of sidewalk, 3,601 street light poles and 14,916 street light fixtures.

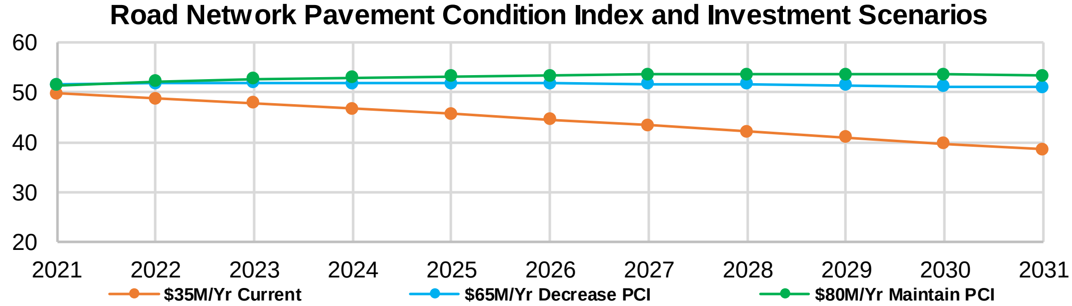
Condition of Inventory and Total Replacement Value



Legend:
Very Good
Good
Fair
Poor
Very Poor

Road Network Pavement Condition Index and Investment Scenarios

Note: PCI averages include asphalt and surface treated roads.



Expenditure	
Historical Investment (5 Year Average)	$35,000,000
Capital Funding Gap to Maintain PCI	$45,000,000

The funding gap is the unfunded value of infrastructure renewal needs that require attention as of the current year.

Infrastructure Need	
Average Annual Reinvestment Need	$80,000,000
Summer Maintenance Infrastructure Need	$22,800,000

Data Confidence Rating	
C	Please refer to confidence rating provided in Methodology.

Roads and Transportation Network

Current Asset Level of Service

How is our infrastructure performing?

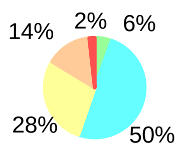
Current Performance

Plow Class 1 to 3 roads within **8** Hours	Plow Class 4 to 6 roads within **24** Hours	Clear snow from 80% of sidewalks within **24** Hours	Regulatory sign replacement **5%** Annually
Remove winter sand within **9** Weeks	Pothole repair meets min. maint. standards **100%**	Curb and sidewalk replacement **2.5%** Annually	Road crossing culvert replacement **3%** Annually

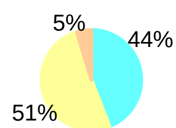
Condition by Asset Class Replacement Value

Legend:
- Very Good
- Good
- Fair
- Poor
- Very Poor

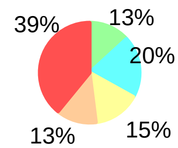
Paved Road



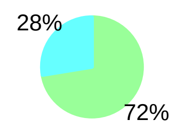
Gravel Road



Street Light Pole



Street Light Fixture



Street Lights Owned

Poles	Street Light Fixtures
3601	**14916**

The remainder of poles are owned by utilities.

Expected Service Life (Examples)

Paved Road 60 Years	Gravel Road 75 Years	LED Light Fixture 100,000 Hours	Concrete Light Pole 60 Years
Aluminum Light Pole 20 Years	Annodized Al Light Pole 25 Years	Steel Light Pole 10 Years	Treated Wood Pole 40 Years

Community Energy and Emission Plan (CEEP) Applicable Goals

Goal 8: Achieve 35% active mobility transporation mode share by 2050.

Current Performance

Sidewalk (km)	Bike Lane (lane km)	Bike Lane Multi-Use Path (lane km)
441	**32**	**4**

Cycle Tracks (lane km)	Street Light Fixtures Retrofitted to LED
10	**14916** (100% of Inventory)

All street lights operate on photocell technology to ensure optimal usage during dark hours only.

Bridges and Large Culverts

B+

Good Condition
(77 out of 100)

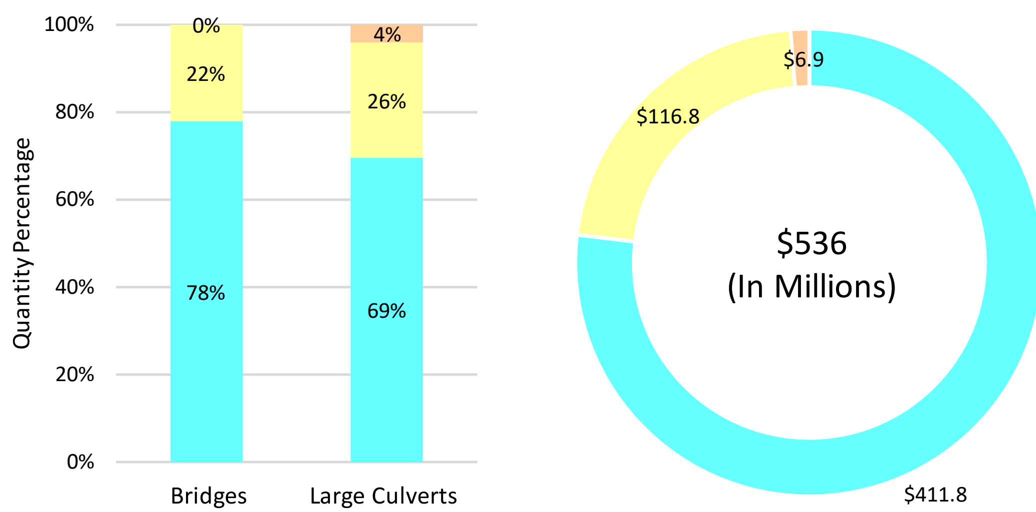
The bridge and large culvert inventory supports the transportation and road network as well as storm water management. The inventory provides safe passage to vehicles, cyclists, and pedestrians.
Each structure is inspected every two years as mandated by the Province of Ontario.

Any bridge or large culvert in the poor category is a high priority for reconstruction and/or renewal.
Overall, bridge and large culvert are in **GOOD** condition.

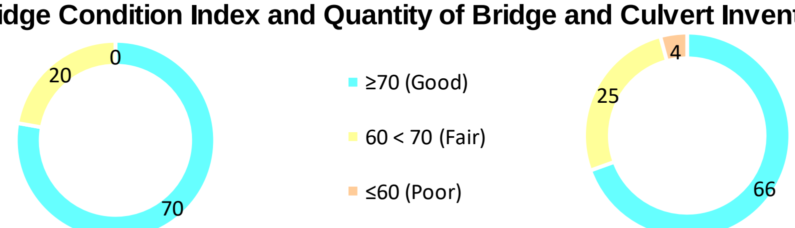
Inventory: The City owns 185 structures; 90 bridges and 95 large culverts. With some exceptions, a large culvert is generally characterized as a culvert with a span greater than 3 meters.

Condition and Total Replacement Value

Legend:
Good
Fair
Poor



Bridge Condition Index and Quantity of Bridge and Culvert Inventory



Expenditure	
Historical Investment (5 Year Average)	$7,500,000
Capital Funding Gap	$0

The funding gap is the unfunded value of infrastructure renewal needs that require attention as of the current year.

Infrastructure Need	
Average Annual Reinvestment Need	$6,900,000
Annual Maintenance Infrastructure Need	$536,000

Data Confidence Rating	
A	Please refer to confidence rating provided in Methodology.

Bridges and Large Culverts

Current Asset Level of Service

How is our infrastructure performing?

Current Performance

Percentage of bridges with a BCI greater than or equal to 70 **78%**

Percentage of large culverts with a BCI greater than or equal to 70 **69%**

MTO Goal is to maintain **at least 80%** of structures with a BCI greater than or equal to 70

Structure Data

Structures with load restrictions	Structures with 1-lane dimensional restrictions	Structures with height restrictions*	Single Span structures
2 Each to be replaced in 2022	**13** Dimensions are not inadequate	**2** CPR Subway and Brady Underpass	**130**

Multi-span structures	Average age of structures	Average age of bridges	Average age of large culverts
55	**31.4** Years	**42.8** Years	**25.4** Years

* The height of the CPR Subway on College Street is 3.8 m and the MTO height restriction on trucks is 4.15 m. The height of the Brady Street Underpass is 4.4 m; greater than the height restriction placed on trucks.

Structure Area in m^2

Largest Structure	Average Area	Total Area	Area rate of renewal
2381	**234**	**43219**	**0.83%**

The recommended area rate of renewal is 1.0%.

Community Energy and Emission Plan (CEEP) Applicable Goals

Goal 8: Achieve 35% active mobility transporation mode share by 2050.

Current Performance

Pedestrian Bridges	Pedestrian Culverts (Underpass)
22	**5**

B- Water Treatment and Distribution

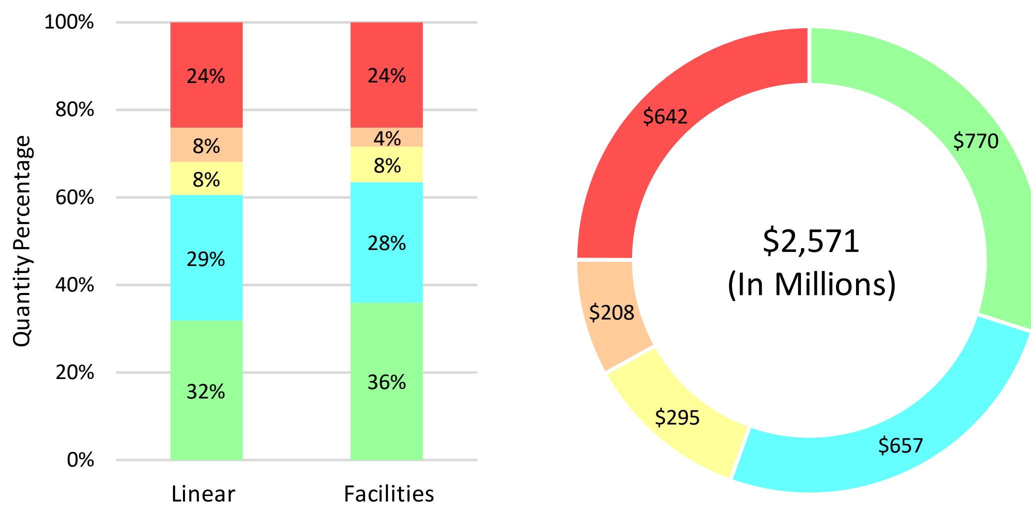
Fair to Good Condition
(2.6 out of 5)

Water treatment and distribution encompasses all aspects of supply, treatment, and distribution of water from the source to a community tap.
The City owns and operates the infrastructure to support six water supply systems.

The water treatment and distribution infrastructure condition is based on a desktop study of infrastructure age and service life consumption. Overall, water treatment and distribution infrastructure is in **Fair to GOOD** condition. A new program of condition assessment is underway to determine the exact condition of the assets.

Inventory: The linear water infrastructure inventory consists of approximately 997km of water mains and appurtenances, including: 533 km of service connections, 8,950 system valves, 90 control valves, 5,699 hydrants, 6 meter stations, 2,792 valve chambers and 47,940 water meters.
The vertical water infrastructure inventory consists of 57 water facilities including: 26 distribution facilities, 9 storage facilities, 2 treatment facilities and 20 water well facilities.

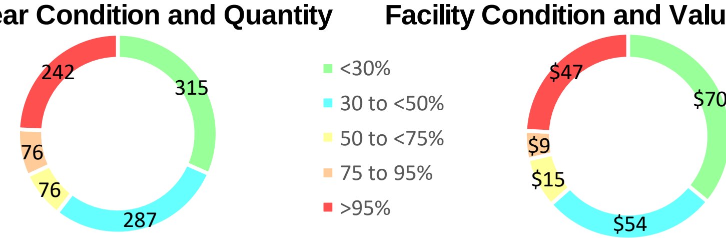
Condition and Total Replacement Value



Legend:

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

Linear Condition and Quantity **Facility Condition and Value**



Expenditure includes Wastewater	
Historical Investment (5 Year Average)	$41,900,000
Capital Funding Gap	$54,100,000

Infrastructure Need	
Average Annual Reinvestment Need	$96,000,000
Annual Maintenance Infrastructure Need	$3,000,000

Average annual reinvestment includes existing asset renewal and asset renewal driven by the W/WW Masterplan. Development projects with separate funding sources are not included.
The Water and Wastewater Long-Range Financial Plan dated April 2019, defines the Council supported path to sustainability that is summarized in Section 2.7 of this plan.

Data Confidence Rating	
B & D (Linear & Facilities)	Confidence rating provided in Methodology.

Water Treatment and Distribution

Current Asset Level of Service

How is our infrastructure performing?

Current Performance

Taste, odour, or colour complaints	Cleaning and swabbing small dia. watermains	Water main breaks	Valves inspected and operated
370 / Year	**10%** of network /Year	**72** / Year	**5410** / Year

Length of watermain tested for leakage	Ministry of Environment, Conservation and Parks	Quantity of water service repairs	Volume of water treated and supplied
99.25 km	**99.1%** Inpection Score	**94** / Year	**19,744,331** m^3

Condition by Asset Class

Legend:
Very Good
Good
Fair
Poor
Very Poor

Watermain Material	Condition Rating	Condition Grade
PVC	1.5	A
Concrete	2.3	B+
HDPE	1.1	A+
Cured in Place	2	B+
Steel	1.4	A
Galvanized Pipe	4.7	D-
Copper	4.4	D
Cast Iron	4.2	D+
PE	4.4	D
AC Cement	3.7	C

Facility Type	Condition Rating	Condition Grade
Water Well	2.6	B
Small Water System	1.4	A
Booster Station	2.6	B
Storage Facility	2.5	B
Treatment Plant	3	C+
Small Treat Plant	2	B+
Pump Station	1.4	A
Pressure Control	1.1	A+

Expected Service Life (Examples)

PVC Watermain 105 Years	Cast Iron Watermain 60 Years	Concrete Watermain 95 Years	HDPE Watermain 80 Years
Hydrants 60 Years	Maint. Hole & Chamber 70 Years	System Valve 40 Years	Service Connection 60 Years

Community Energy and Emission Plan (CEEP) Applicable Goals

Goal 5: Decrease energy usage in the potable water treatment and distribution system by up to 60% by 2050.

Current Performance

- Detailled energy studies have been completed for water treatment facilities and implementation of the recommendations are in progress. Recommendations include upgrades to energy consuming equipment. Efficiency has always been a top selection criteria for equipment. However, in many cases, equipment must also be sized up to accommodate required capacity.
- Implementation of 6 mobile district metered area sites to support water loss management.
- A water leak detection project is underway in the subdivision of Moonglo.
- A water efficiency strategy is under development for Greater Sudbury.
- A water transients project is underway to monitor for expected pressure within water systems.

Energy Consumption:	Electricity (kWh)	Natural Gas (m^3)
(Plants, Tanks, Wells, and Booster Stations)	**10,280,000**	**71,800**

B-

Fair to Good Condition

(2.9 out of 5)

Wastewater Collection and Treatment

Wastewater collection refers to the infrastructure that conveys sewage from collection points to the sewage treatment plants.

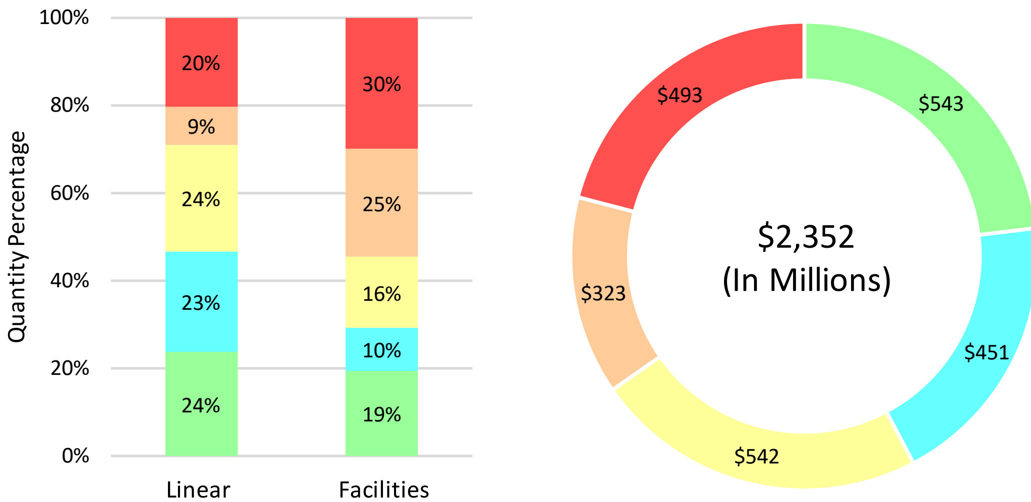
The City owns and operates the infrastructure to support thirteen wastewater collection systems.

The wastewater collection and treatment infrastructure condition is based on a desktop study of infrastructure age and service life consumption. Overall, wastewater collection and treatment infrastructure is in **Fair to GOOD** condition. A new program of condition assessment is underway to determine the exact condition of the assets.

Inventory: The linear wastewater infrastructure inventory consists of approximately 791 km of wastewater mains, 381 km of lateral connections, 70 control valves, 21 drop shafts and 11,726 maintenance holes.

The vertical wastewater infrastructure inventory consists of 83 wastewater facilities including: 69 collection facilities and 14 treatment facilities.

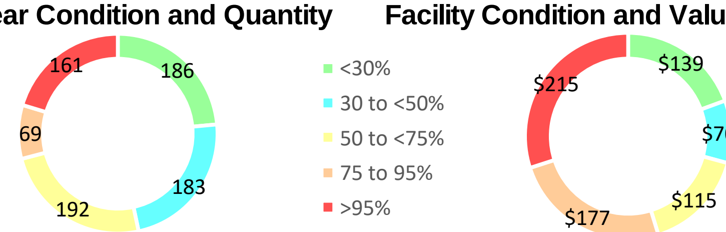
Condition and Total Replacement Value



Legend:

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

Linear Condition and Quantity | **Facility Condition and Value**



Expenditure	
Historical Investment (5 Year Average)	Included with Water
Capital Funding Gap	Included with Water

The funding gap is the unfunded value of infrastructure renewal needs that require attention as of the current year.

Infrastructure Need	
Average Annual Reinvestment Need	Included with Water
Annual Maintenance Infrastructure Need	$1,700,000

Data Confidence Rating	
B & D (Linear & Facilities)	Confidence rating provided in Methodology.

Wastewater Collection and Treatment

Current Asset Level of Service

How is our infrastructure performing?

Current Performance

Number of City-side sewer backups	Gravity Sewer blockage resulting in a back up	Volume of wastewater treated	Number of sewage bypass events
138 / Year	**7.1** /100 km / Year	**30,570,484** m^3	**12** / Year

Total number of reported overflows	Quantity of maintenance hole (MH) inspections	Flushing and cleaning program	Quantity of MH structure rehab
7 / Year	**1188** / Year	**27%** of network	**69** / Year

Condition by Asset Class

Legend:
Very Good
Good
Fair
Poor
Very Poor

Sanitary Sewer Material	Condition Rating	Condition Grade
PVC	1.7	A-
Concrete	2.3	B+
HDPE	1	A+
Steel	3.3	C+
Cast Iron	3.7	C-
Polyethylene	1.2	A+
AC Cement	3.5	C
Vitrified Clay	3.8	C-
Ductile Iron	1.5	A

Facility Type	Condition Rating	Condition Grade
Lift Stations	3.3	C+
Wastewater Treatment Lagoons	4.8	D-
Wastewater Treatment Plants	3.9	C-

Expected Service Life (Examples)

PVC Sewer 105 Years	AC Cement Sewer 55 Years	Concrete Sewer 90 Years	Cast Iron Sewer 60 Years
HDPE Sewer 80 Years	Steel Sewer 60 Years	Maintenance Hole 70 Years	Service Connection 60 Years

Community Energy and Emission Plan (CEEP) Applicable Goals

Goal 6: Achieve 90% solid waste diversion by 2050. An organics and biosolids anaerobic digestion facility is operational by 2030.

Current Performance

- Detailled energy studies have been completed for wastewater treatment facilities and implementation of the recommendations are in progress. Recommendations include upgrades to energy consuming equipment. Efficiency has always been a top selection criteria for equipment. However, in many cases, equipment must also be sized up to accommodate required capacity.
- I&I (Inflow and Infiltration projects underway for Lively, Chelmsford, Azilda, and Flour Mill
- New subsidy created to disconnect storm water connections from sanitary sewers

Energy Consumption: (Plants and Lift Stations)	Electricity (kWh)	Natural Gas (m^3)
	14,170,000	**295,600**

B Storm Water Management

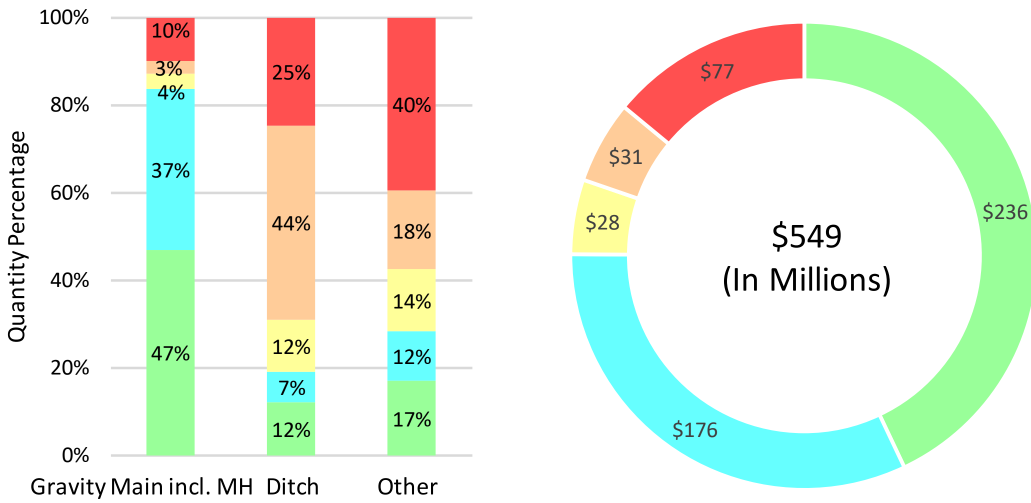
Good Condition
(2.5 out of 5)

Storm Water Management is comprised of two main asset types: land drainage and storm water management.
Land drainage infrastructure includes storm water collection and conveyance assets such as ditches, municipal drains, catch basins, manholes and gravity mains.
Storm water management infrastructure includes ponds and oil and grit seperators to protect people, property and the environment.

The City's geographic area ensures that the City must maintain a large storm water management system.
Overall, storm water management infrastructure is in **GOOD** condition.
The storm water system is relatively new and this is reflected in the condition. However, investment including additional maintenance is required to ensure the system continues to serve the community.

Inventory: The Storm water Management System includes 537 km of storm water mains, 277 km of ditches (urban), 8,600 maintenance holes, 8,744 catch basins, 2,751 discharges/outlets, 3,372 inlets, 15 ponds and 24 oil and grit separators.

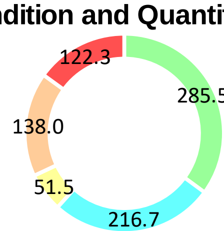
Condition and Total Replacement Value



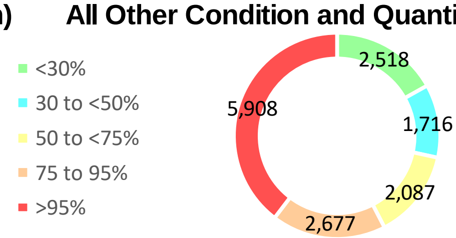
Legend:

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

Linear Condition and Quantity (km)



All Other Condition and Quantity (ea.)



Expenditure	
Historical Investment (5 Year Average)	$2,500,000
Capital Funding Gap	$1,600,000

The historical investment for Storm Water Management is contained within the Roads budget. The Drainage items in the Capital Budget are studies and new infrastructure.

Infrastructure Need	
Average Annual Reinvestment Need	$4,100,000
Annual Maintenance Infrastructure Need	$6,400,000

Data Confidence Rating	
C	Please refer to confidence rating provided in Methodology.

Storm Water Management

Current Asset Level of Service

How is our infrastructure performing?

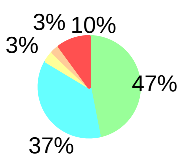
Current Performance

Annual culvert cleaning **4%** of inventory	Annual catch basin & manhole cleaning **20%** of combined inventory	Annual inspection & cleaning of OGS **100%** of OGS inventory	Spring cleanup street sweeping **100%** Annually
Spring cleanup sidewalk sweeping **100%** Annually	Storm sewer flushing and CCTV inspection **1%** Annually	Roadside ditching urban **4%** Annually	Roadside ditching rural **4%** Annually

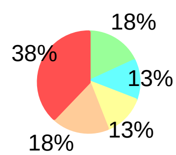
Condition by Asset Class

Legend:
- Very Good
- Good
- Fair
- Poor
- Very Poor

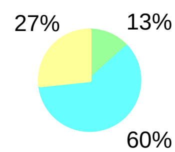
Storm Sewer & MH



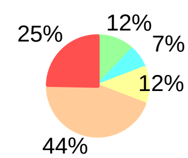
Catch Basins



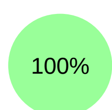
Ponds



Ditches



Oil and Grit Separators (OGS)



Expected Conservative Service Life (Examples)

HDPE Storm Sewer 80 Years	CSP Storm Sewer 30 Years	Concrete Sewer 90 Years	AC Sewer 55 Years
Catch Basin 70 Years	Oil and Grit Separators 50 Years	Maintenance Hole 70 Years	Ponds 25 Years

Community Energy and Emission Plan (CEEP) Applicable Goals

Goal 8: Achieve 35% active mobility transporation mode share by 2050.

Current Performance

Spring Cleanup

Street Bike Lane Sweeping	Sidewalk Sweeping
100%	**100%**

B- Fleet and Equipment

Good Condition
(60 out of 100)

Fleet and equipment includes assets that support services such as: employee transportation; the GOVA transit system; parks and recreation facility management; emergency services; and municipal road, sewer and water maintenance.

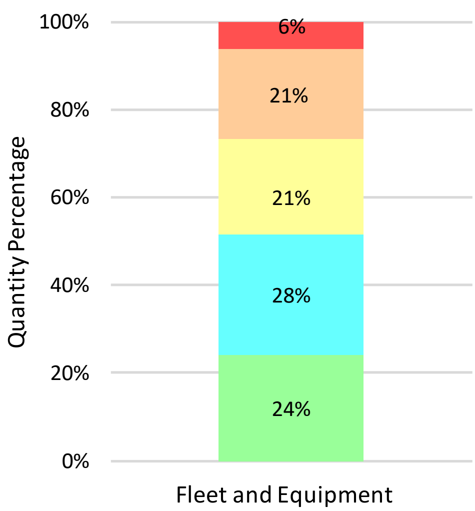
Furthermore, fleet and equipment includes: fuel and oil supply and fill station infrastructure. Overall, Fleet and Equipment infrastructure is in **GOOD** condition.

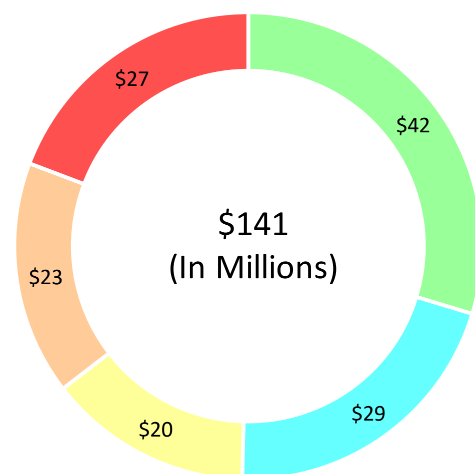
Inventory: The City owns a fleet of 570 vehicles, 4,738 pieces of equipment and 115 bus shelters.
The inventory includes: heavy, medium and light duty vehicles, ambulances, fire trucks, GOVA bus, heavy equipment, municipal tractors and light diesel equipment, paramedic equipment, fire equipment, bus stop shelters, park maintenance equipment and various operating equipment

Condition and Total Replacement Value

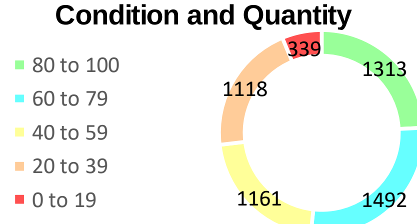
Legend:

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





Condition and Quantity



Expenditure	
Historical Investment (5 Year Average)	$8,000,000
Capital Funding Gap	$2,600,000

The funding gap is the unfunded value of infrastructure renewal needs that require attention as of the current year.

Infrastructure Need	
Average Annual Reinvestment Need	$10,600,000
Annual Maintenance Infrastructure Need	$12,700,000

Data Confidence Rating	
B	Please refer to confidence rating provided in Methodology.

Fleet and Equipment

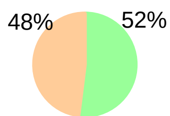
Current Asset Level of Service

How is our infrastructure performing?

Vehicle Maintenance Work Order (Service) Hours

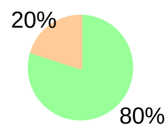
Preventative
Reactive

All Fleet



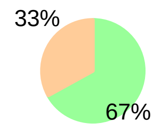
Total= 52,179 Hrs

Paramedic



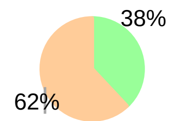
Total= 2,997 Hrs

Fire



Total= 3,527 Hrs

Transit



Total= 16,128 Hrs

Total Annual Mileage

All Fleet	Paramedic	Fire	Transit
≈11,700,000 kms	≈1,400,000 kms	≈1,300,000 kms	≈3,700,000 kms

Average Annual Engine Hours

Municipal Tractors and Light Diesel	Heavy Equipment
381 Hours	621 Hours

Expected Service Life (Examples)

Light Duty Vehicle 10 Years	Medium Duty Vehicle 10 years	Snowplow 10 Years	Solid Waste Packer 10 Years
Ambulance 7 Years	Fire Truck 20 years	Transit Bus 15 Years	Transit Shelter 15 Years
Municipal Tractor 12 Years	Heavy Equipment 15 years	Difibrillators 7 Years	Power Stretcher 6 Years
Structural Hose 20 Years	Fire Bunker Gear 10 Years	Zero-Turn Mower 15 Years	Ice Edger 20 Years

Community Energy and Emission Plan (CEEP) Applicable Goals

Goal 7: Enhance Transit Service to increase transit mode share to 25% by 2050

Goal 9: Electrify 100% of transit and City fleet (vehicles) by 2035

Current Performance

# of Hybrid Vehicles	# of Electric Vehicles	Rate of Fleet Electrification
31	**0**	**0**

GOVA Ridership	GOVA Service Hours	Fuel Consumption (litres/year)
4,605,502 (Pre-COVID)	**>180k/yr**	**4,570,000**

As mandated within the CEEP, Greater Sudbury will begin to electrify its fleet in the coming years. Electric vehicle charging stations will be installed as required as part of the fleet electrification.

B Municipal Parking

Good Condition
(67 out of 100)

The City of Greater Sudbury recognizes the need to ensure that downtown land uses remain supported by an effective transporation infrastructure network. The Downtown Master Plan anticipates that the planned intensification of the downtown will be supported through incremental investments in active transportation infrastructure and parking.

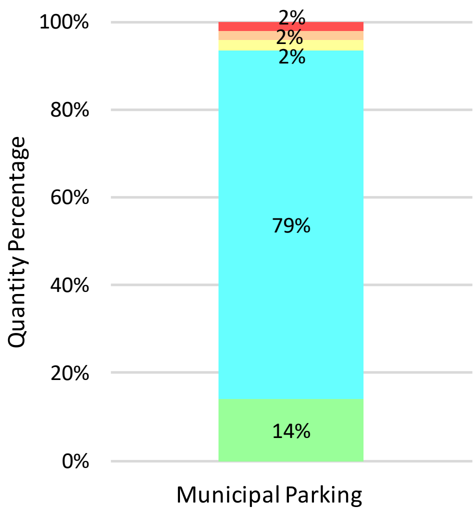
The downtown parking system provides two types of parking opportunities, permit and pay parking. Permit parking allows users to purchase monthly passes, while pay parking allows users to purchase parking time on demand on an hourly or shorter period. Overall, the municipal parking infrastructure is in **GOOD** condition.

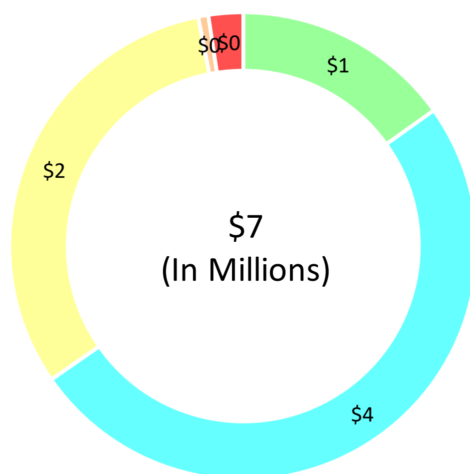
Inventory: The City owns 12 municipal parking lots, however maintains 13 municipal parking lots as one lot is leased. Of the 12 municipal parking lots, 10 are paved and 2 are gravel.
Other parking inventory includes: 230 meters, pay machines, kiosks and ticketing equipment, light standards and signs.

Condition and Total Replacement Value

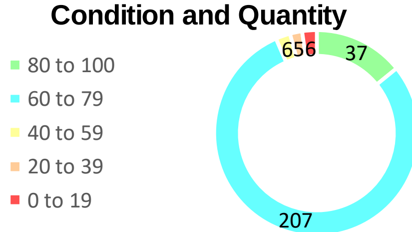
Legend:

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





Condition and Quantity



Expenditure	
Historical Investment (5 Year Average)	$107,000
Capital Funding Gap	$0

The average annual reinvestment need is elevated when compared to the 5-year historical investment. However, existing parking revenue will permit additonal expenditure as required.

Infrastructure Need	
Average Annual Reinvestment Need	$195,000
Annual Maintenance Infrastructure Need	$110,000

Data Confidence Rating	
B	Please refer to confidence rating provided in Methodology.

Municipal Parking

Current Asset Level of Service

How is our infrastructure performing?

Current Performance

Quantity of on-street spaces **438** Spaces	Quantity of spaces in municipal lots **1721** Spaces	Quantity of Lots with illumination **6** Lots	Average hourly rate for on-street parking **$1.30** /hour (2019)
Parking tickets per 100k population **10949** /100k (2019)	Parking revenue per space managed (2019) **$1,238.27**	Operating Cost per space managed **$657** /space (2019)	Revenue to cost ratio for spaces managed **1.88** (2019)

Expected Service Life (Examples)

Paved Lot 60 Years	Gravel Lot 60 Years	LED Light Fixture 100,000 Hours	Light Pole 40 Years
Parking Meters 20 Years	Parking Ticket System 5 Years	Pay Machines 10 Years	Light pole ESL will be monitored. Lot poles are not exposed to the same quantity of salts as as on-street light poles.

Community Energy and Emission Plan (CEEP) Applicable Goals

Goal 8: Achieve 35% active mobility transporation mode share by 2050.

Current Performance

- All municipal parking lots and spaces are located in or around the downtown core.
- Parking in the municipal lots on the downtown perimeter are lower cost than parking within the downtown core. All parking lots are connected to the downtown by sidewalk promoting walking into the downtown area.
- Solar Panels are installed with all new pay-by-plate technology.
- All new or retrofitted lighting fixtures receive LED lights and photocell technology to ensure optimal usage during dark hours only.

2.7. Infrastructure Deficit and Annual Funding Gap

Greater Sudbury must balance a multitude of competing spending priorities with limited resources. As the City's infrastructure ages, the need to make sustainable, well-timed infrastructure investments is essential to continue to deliver high-quality services to the community.

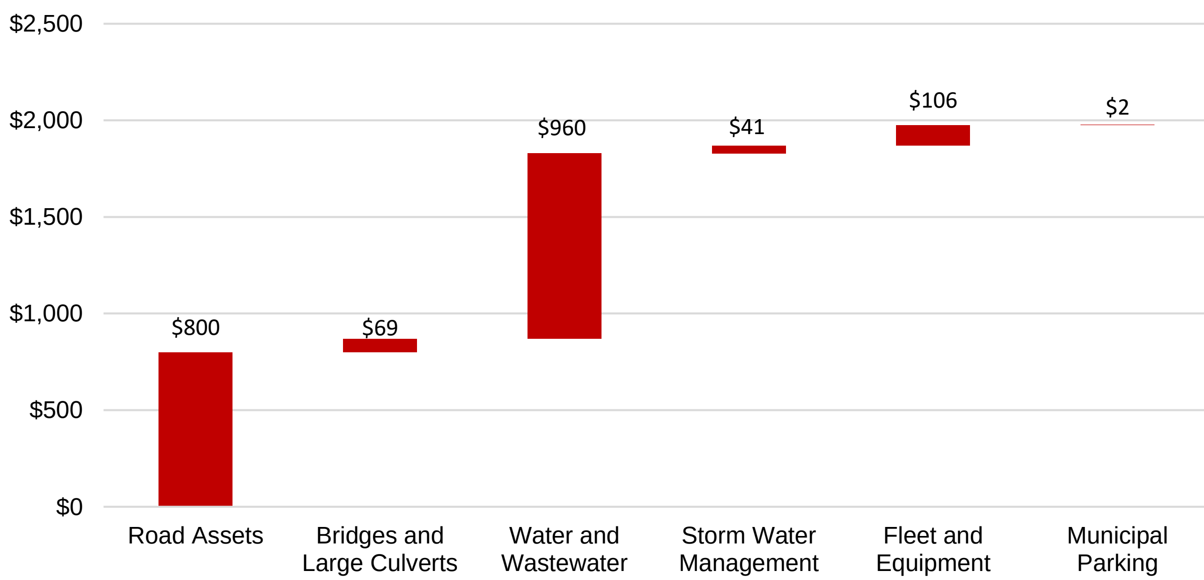
A combination of department-specific and city-wide financial strategies are required to effectively address the infrastructure deficit.

The infrastructure need detailed in the asset management plans are prepared for appropriate periods of time that were determined by the service life duration of the asset class. For example, a road or a sanitary sewer will have different service lives while also having significantly longer service lives than fleet or equipment. The capital need is based upon lifecycle management strategies required for the selected period of time.

As defined in Section 2.2: Methodology and How to Read the Infrastructure Report Card, the average annual reinvestment requirement (AAR) is the mean investment required for a selected period of time. The AAR is useful for defining the required rate of funding based on the investment profiles prepared for various asset classes. With the average annual reinvestment requirement, the City may either benchmark infrastructure investment against the AAR metric while monitoring the variability year to year, or contribute to reserves in years where the annual investment is short of the average annual reinvestment value.

The average annual reinvestment requirement over a 10-year period (AAR_{10}) of various asset classes are provided in Figure 4. This demonstrates the capital infrastructure investment requirement during the next ten year period which is equal to $1,978M.

Figure 5: Capital Infrastructure Investment Requirement over the next 10-Years in Millions



Following the identification of the average annual capital requirement by asset class, the capital reinvestment needs are compared to the recent annual capital budget to determine the adequacy of the funding for the sustainability of the infrastructure. The comparison yields the financial risk associated with asset ownership known as a funding gap as defined in Section 2.2: Methodology and How to Read the Infrastructure Report Card. The annual funding gap is provided in Table 3.

Table 3: Total Annual Funding Gap (Capital)

Asset Class	Average Annual Reinvestment Requirement	Mean (5-Year) Capital Investment	Annual Funding Gap
Road Assets	$80,000,000	$35,000,000	$45,000,000
Bridges and Large Culverts	$6,900,000	$7,500,000	$0
Water and Wastewater	$96,000,000	$41,900,000	$54,100,000
Storm Water Management	$4,100,000	$2,500,000	$1,600,000
Fleet and Equipment	$10,600,000	$8,000,000	$2,600,000
Municipal Parking	$195,000	$107,000	$0
		Total =	**$103,300,000**

With an annual funding gap of $103.3M, the City has not yet reached the sustainable funding levels required to stop the backlog from growing. It should be noted that assets included in the backlog are not necessarily performing poorly, they will soon be in need of replacement or rehabilitation in order to ensure continued service delivery.

Addressing the Capital Funding Gap

In recent years, Greater Sudbury has taken many steps to increase capital funding and maintain infrastructure asset level of service. Most notably, Council has approved a 4.8% annual increase to the water and wastewater rates for 2020 and 2021 and the annual increase is proposed-over a 20-year period as recommended in the City of Greater Sudbury Water and Wastewater Long-Range Financial Plan revision dated April 2019. Prior to this revision, Council had approved annual rate increases of 7.4% from 2016 through 2019, in an effort to address the capital funding gap. The annual increase to the water rate steers the City on the path to sustainability for water and wastewater service delivery.

This Council direction will allow the City to increase water and wastewater annual reinvestment expenditure up to $117M by the year 2039; effectively narrowing the funding gap. The latest Water and Wastewater Long-Range Financial Plan is subject to a revision every 5 years, with the next revision scheduled for the year 2024.

Within the City of Greater Sudbury Municipal Asset Management Plan (2016) prepared by KPMG, it was recommended that the City pursue a municipal levy increase of 2% per year in order to fund capital expenditures. Within the 2020 Capital Budget, Council approved a 1.5% special capital levy for investment into existing infrastructure renewal.

With the relatively newer capital prioritization model implemented by City staff, Greater Sudbury has addressed the recommendation from the previous asset management plan to fund projects that:

- Provide the greatest impact to residents and focus on core services;
- Address the greatest risks;

- Align with the City's strategic direction and priorities.

An additional recommendation from the previous asset management plan is to make use of borrowing for infrastructure investments. Historically, borrowing as a means of funding infrastructure investment has not been commonplace for Greater Sudbury. However, recent decisions by the current Council have been more accepting of borrowing. Additionally, the City does look for opportunity to periodically debt finance infrastructure investment as per the recommended criteria provided below; conditional upon one or more of the following:

- The principles of debt financing are in accordance with the City of Greater Sudbury Debt Management Policy; **and**
- The infrastructure investment will provide a stream of non-taxation revenues that can be used to fund some or all of the associated debt servicing costs; and/or
- The City requires debt financing to fund its portion of infrastructure projects that are cost shared with senior government; and/or
- The infrastructure investment is unavoidable as a result of regulatory changes or concerns over public health and safety and cannot be funded through other means; and/or
- The associated debt servicing costs would not jeopardize the City's financial sustainability or result in the City exceeding its annual debt repayment limit.

Furthermore, as asset management planning progresses, Council will have the ability to set target levels of service to mitigate the financial risks of infrastructure ownership. Provincial Regulation requires that Greater Sudbury not only identify target levels of service, but provide an explanation of why the targets are appropriate and why they are achievable. The City must demonstrate the ability to fund the targets by providing financial plans that will lead the path to sustainability.

To effectively achieve this requirement, the upcoming target level of service discussion will focus not only on the finances available to fund service delivery, but also the risk associated with service delivery. In some cases, the risk of a declining asset condition may be acceptable to a certain degree. At the appropriate time, detailed service level scenarios will be prepared for Council's review and discussion.

2.8. Future Demand

The entirety of the City's infrastructure assets are monitored and benchmarked against future demand. The most significant future demand drivers are growth, the aging population and population health. Greater Sudbury has implemented preventative measures in anticipation of the demand drivers. In some cases, the preventative measures are linked through accompanying documents; for example, the Transportation Master Plan, the Water/Wastewater Master Plan, and policy initiatives that have been initiated by various departments. Preventative measures may include:

- An increase in capacity to accommodate additional traffic volume or diverting traffic from high traffic zones;
- An increase in capacity of water treatment and distribution along with sanitary sewer collection and treatment;
- Realignment of the City's public transit route system and scheduling;
- Review of fleet and equipment usage and service requirements prior to replacement;

- A Health Promotion service with Paramedic Services in collaboration with health care stakeholders in the northeast.

2.9. Climate Change

In September 2020, Council approved the Community Energy Emissions Plan (CEEP) that is the long-term plan to reduce carbon emissions and pollution in Greater Sudbury. The CEEP is a response to the City of Greater Sudbury Council's Climate Emergency declaration in May 2019. The CEEP outlines 18 goals that need to be met to attain the City's target of becoming a net-zero greenhouse gas (GHG) emission community by 2050. For further information with respect to the Community Energy Emissions Plan, please visit: https://www.greatersudbury.ca/live/environment-and-sustainability1/net-zero-2050/.

Global climate models for the City of Greater Sudbury geographic area are available through various online resources, namely:

- Climatedata.ca, undertaken with the support of Environment and Climate Change Canada;

- Climateatlas.ca, undertaken with the support of Environment and Climate Change Canada, Public Health Agency of Canada, and Health Canada.

The City is beginning to monitor the effects of climate change on its infrastructure assets. The data provided in the aforementioned websites suggest that it is a possibility that there will be an increase in precipitation and an overall increase in mean temperature for the municipality. The climate projection scenarios from climateatlas.ca suggest that the increase in mean temperature within the Greater Sudbury area may result in the possibility of a decrease of freeze-thaw days, additional summer days, more very hot days and additional tropical nights. In a tropical night scenario, temperatures do not drop below 20°C.

A. Appendix A: Enterprise Asset Management Policy
A.1. Introduction

Asset management planning is the process of making the best possible decisions regarding the acquisition, operating, maintaining, renewing, replacing and disposing of infrastructure assets and is regarded as best practice for long-term financial planning. The objective of the City of Greater Sudbury Enterprise Asset Management Policy is long-term sustainability through principles which target a coordinated and consistent asset management approach for all asset classes in accordance with *O. Reg. 588/17: Asset Management Planning for Municipal Infrastructure*.

The City of Greater Sudbury (the City) strives to ensure a high quality of life is provided to the public through municipally funded services including water and wastewater services, stormwater management, intricate transportation networks, public transit, emergency services, sport and recreation, cultural services and solid waste management.

Many of the assets belonging to the City have long-term lifecycles spanning over decades such as roads networks and buildings, while other asset lifecycles are short in comparison such as advancing technology and security or capacity requirements. Long-term lifecycles require operational maintenance and rehabilitation or renewal activities to ensure the established levels of service are delivered.

Over time the City has addressed the development and implementation of asset management strategies to manage asset lifecycles. The City has proactively examined and implemented long-term rehabilitation and replacement strategies through condition assessments and reporting on the state of the infrastructure.

As of the year end 2020, the City has a total historical infrastructure investment of $3.3 billion; for which an estimated total replacement cost of over $10.5 billion has been determined. These tangible capital assets contribute to the high quality of life enjoyed by city residents and are essential to deliver the necessary levels of service. The total historical infrastructure investment detailed by year of expenditure is detailed below.

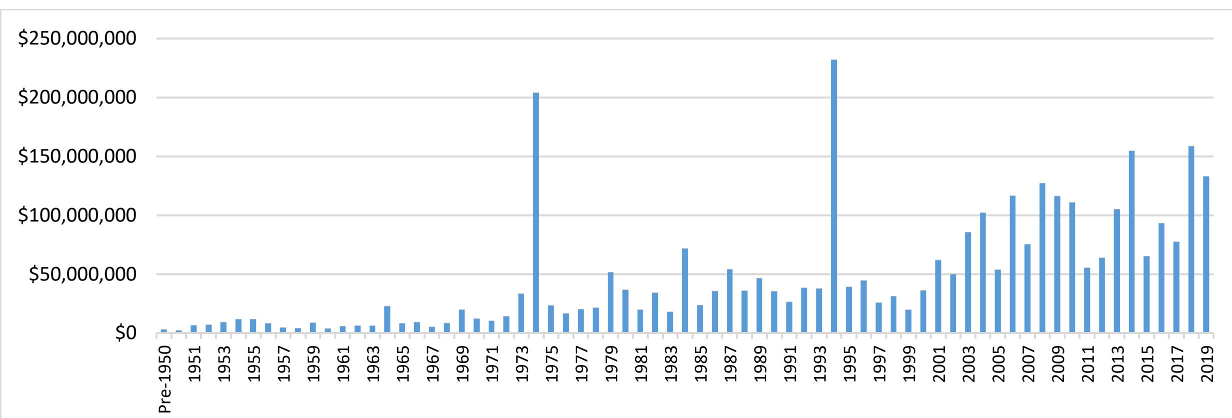


Figure 1: Asset Investment History for ALL Infrastructure (2020)

The Enterprise Asset Management program strives to achieve sustainability through established levels of service, asset level of service, cost effective life cycle management and risk assessment. This policy will play a critical role in guiding the development of consistent asset management practices across the City.

A.2. Policy Statement

The City of Greater Sudbury ensures its municipal infrastructure systems are supported by plans and financing decisions that demonstrate effective service support and appropriate regard for managing lifecycle costs.

A.3. Application

This policy applies to the lifecycle management activities of physical assets that are owned and operated by the City of Greater Sudbury. This policy sets out the organization's commitments and expectations for decisions and activities concerning asset management.

A.4. Purpose

This policy provides guidance applicable to the whole organization and all of its services to minimize the risk of service interruption or increased cost due to asset failure while supporting the consistent delivery of expected service levels.

A.5. Terms and Definitions

Asset: a) are held for use in the production or supply of goods and services, for rental to others, for administrative purposes or for the development, construction, maintenance or repair of other tangible capital assets;
b) have useful economic lives extending beyond an accounting period;
c) are used on a continuing basis; and
d) are not for resale in the ordinary course of operations.

Asset Level of Service (ALoS): The condition and performance expectation for a given asset in order to produce desired levels of service.

Asset Management: The systematic and coordinated activities and practices of an organization to optimally and sustainably deliver on its objectives through cost-effective life cycle management of assets.

Asset Management Plan: Long-term plans that outline the asset activities and programs for each service area and resources applied to provide a defined level of service in the most cost-effective way.

Enterprise Asset Management Program: The application of asset management principles and practices on an enterprise level to ensure a consistent, coordinated, cost effective and sustainable approach across all City departments to achieve the enterprise asset management goals.

Fiscal Stewardship: The representation of planning, attention, conservancy, care and management of the City's financial resources.

Life-Cycle: The time interval stages involved in the management of an asset beginning with the identification of the need for the asset, through design, construction and commissioning, maintenance and rehabilitation of the asset and concluding with the decommissioning and disposal of the asset.

Life-Cycle Costs: The total cost of an asset through its life including planning, design, construction, acquisition, operation, maintenance and rehabilitation and disposal costs.

Levels of Service (LoS): describes the outputs or objectives an organization or activity intends to deliver to customers via the respective asset class.

Risk Management: Coordinated activities to direct and control an organization with regard to risk.

Strategic Plan: A plan containing the long-term goals and strategies of an organization. Strategic plans have a strong external focus, cover major portions of the organization and identify major targets, actions and resource allocations relating to the long-term survival, value and growth of the organization.

A.6. Enterprise Asset Management Goals

To provide a framework and principles for asset management strategies that:

- Ensure legislative requirements are achieved;
- Create understanding about and optimize asset life-cycle costs while maintaining acceptable levels of service;
- Ensure existing and future asset needs are prioritized;
- Link investment decisions to service outcomes;
- Demonstrate financial sustainability through full life-cycle cost planning;
- Focus on long-term considerations and decision making.

A.7. Principles

The City owns, operates and maintains a wide variety of assets. The objective of the Enterprise Asset Management Policy is to ensure acceptable levels of service over the long term are satisfied by appropriate asset management practices throughout an asset's service life.

Asset Management guiding principles and practices will help to achieve the City's goals to provide the required services to support community needs by:

- Establishing full life-cycle costing principles aligned with asset management strategies that minimize ownership costs over the asset's service life;
- Maintaining assets in order to deliver defined levels of service that meet legislative requirements and customer expectations;

- Reducing reactive maintenance by emphasizing a planned asset maintenance approach;
- Risk management strategies to support service delivery at expected levels of service;
- Clear and continuous connections to the corporation's long-term financial plan and related financial policies;
- A system of performance monitoring and reporting on asset level of service and the impacts of potential changes in policy, levels of service or risk;
- Desired asset level of service will inform choices about appropriate maintenance strategies;
- Coordinate asset management planning to provide connection with multiple interrelated assets;
- Development and evolution of asset management knowledge, messaging and competencies across the corporation and with the public to ensure participation, feedback and appropriate use of the Enterprise Asset Management Program;
- Capital assets that the City does not require to meet its current or future program or operational needs are disposed;
- Align Infrastructure planning and priorities with the principles outlined in section 3 of the Infrastructure for Jobs and Prosperity Act, 2015 including:
    - alignment with Ontario's land-use planning framework;
    - promote economic competitiveness and innovation;
    - continued provision of core public services such as health care and education;
    - protect the health and safety of workers involved in the construction and maintenance of infrastructure assets.
- Minimize the impact of infrastructure on the environment and design infrastructure to be resilient to the effects of climate change. Monitor vulnerabilities caused by climate change and anticipate costs to manage vulnerabilities.
- Maintain assets to protect the safety of the public and health & safety of our employees.

A.8. Key Documents in the Asset Management Framework

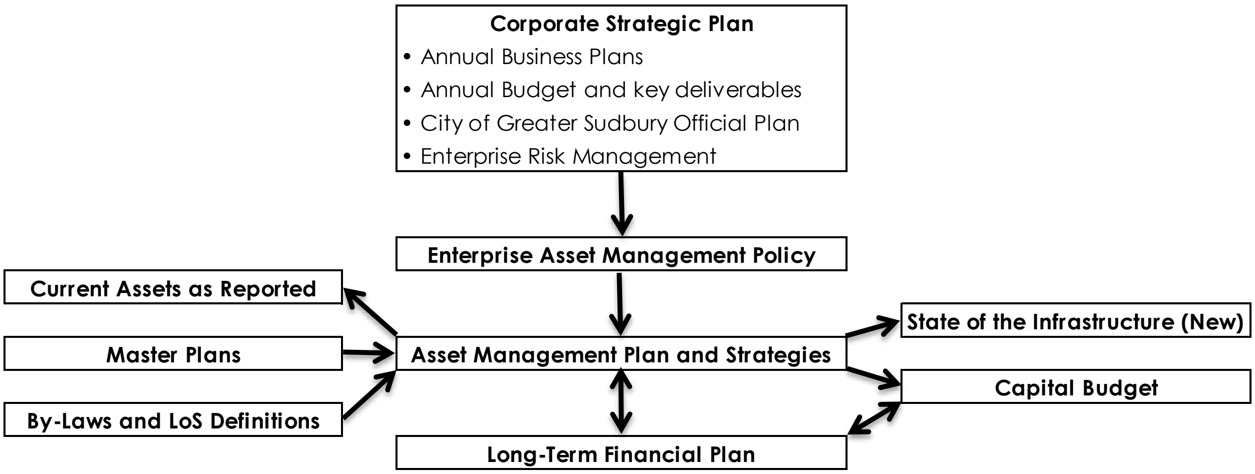


Figure 2: Key Documents in the City's Asset Management Framework

A.8.1 Corporate Strategic Planning Documents

The mission of the City of Greater Sudbury as detailed in strategic planning documents provides the overall direction and requirement for Asset Management Policy and Planning. The annual work planning process drives the production of the budget which is the authoritative source of levels of service. These levels of service place a demand on assets.

A.8.2 Enterprise Asset Management Policy

The Asset Management Policy will establish the goals and outline the key principles for the enterprise asset management program. This policy is intended to provide clear asset management direction.

A.8.3 Enterprise Asset Management Plan

The Asset Management Plan will be developed in accordance with Building Together – Guide for Municipal Asset Management Plans, the International Infrastructure Management Manual, 2015, O.Reg. 588/17: Asset Management Planning for Municipal Infrastructure, 2017 and the principles included in Section 3 of the Infrastructure for Jobs and Prosperity Act, 2015. Information collected and analyzed shall include:

- Sustainable financial planning with an understanding of impacts on the level of service delivered;
- Changing demographics and economic trends;
- AODA accessibility standards, Water Opportunities Act, Safe Drinking Water Act, Occupational Health and Safety Act, Ontario's land-use planning framework, Planning Act, and other applicable legislation and standards;
- An understanding of current asset inventories and condition, as well as projected performance, remaining service life, future needs and costs;
- A clear understanding of risks related to assets and the City's ability to mitigate the risks including consequences of failure and contingency planning;
- The feasibility of acquiring or constructing new assets.

The service rendered will be the determining factor of whether or not to include an asset in asset management plans. An asset with a role in service delivery that requires deliberate management will be included. The capital threshold outlined in the Tangible Capital Asset Policy and professional judgment will be used to determine which assets are to be included in the asset management plans.

A.8.4 Asset Management Strategy

The Asset Management Strategy requires collaboration between all personnel listed within section 9 Roles and Responsibilities.

The strategy will reflect levels of service expectations and the department's planned outcomes. Asset maintenance practices will continue to be developed and implemented with the objective of maximizing asset life-cycle and reliability by carrying out interventions at the right place and the right time considering budgetary and resource constraints.

The strategy will also include prioritization of required maintenance, rehabilitation and construction projects combined with budget requirements to be incorporated in the City's budget planning.

A.9. Roles and Responsibilities

Council

- Establish levels of service expectations.
- Approve the enterprise asset management plans.
- Approve asset investment and service delivery requirements for capital and operations through the annual budget process.

Executive Leadership Team

- The General Manager of Corporate Services is the executive lead for the Asset Management Program.
- Endorse asset management plans and strategies.
- Create an asset management governance structure.
- Develop administrative plans to address Council's level of service expectations.
- Demonstrate support for and encourage application of the Asset Management Principles.
- Produce a "State of the infrastructure" report to Council at least once per term.
- Ensure alignment of Asset Management Plans and Strategies with organizational objectives and strategies.
- Recommend asset investment and service delivery required for capital and operating through the annual budget process.

Asset Management Coordinator

- Establish policies and practices to ensure consistency across the corporation.
- Encourage information sharing throughout the departments.
- Provide input and guidance or assistance for development of asset class specific asset management plans following a standardized and consistent methodology.
- Provide support during the development of levels of service.

- Review, develop, recommend and implement asset management policies, guiding principles, plans and strategies.
- Review and monitor the performance of Asset Management Plan and Strategies for continuous improvement.
- Coordinate financial planning, strategic planning and information technology requirements.
- Produce reporting of asset class data.
- Ensure compliance with provincial asset management legislation and standards.
- Ensure accountability for implementation of goals and objectives.
- Lead the implementation of asset management initiatives.

Divisional and Sectional Leaders

- Ensure project, operations and maintenance work is consistent with enterprise asset management objectives.
- Liaise with all stakeholders with respect to asset management objectives and levels of service.
- Provide input and direction for development of divisional asset management plans.
- Responsible for the development and implementation of asset management plans and strategies.
- Coordinate sectional asset management reporting.
- Development of asset inventories, condition assessments and risk assessments.
- Develop and implement data collection requirements to meet asset management objectives.
- Lead the implementation of asset management initiatives.

Financial Services

- Provide financial business partnerships to departments.
- Ensure the financial stewardship of financial assets and records.
- Ensure consistent and pertinent financial reporting.

Asset Users and Operators

- Provide input on current levels of service.
- Provide input on current status of asset function and life-cycle.
- Provide input on asset needs to meet approved levels of service.
- Participate in the development and implementation of divisional asset management plans.
- Regularly review asset documentation, data collection requirements, data inputs/outputs and asset measurement tools for relevance with existing policies and practices.
- Respect assets under their care and responsibility including implementing any preventative maintenance programs, and operating in accordance with defined operating limits, guidelines, and regulatory limitations.

A.10. Legislation and Reference Materials

KPMG (2016) City of Greater Sudbury Municipal Asset Management Plan. KPMG, Sudbury, Ontario. (Online: https://agendasonline.greatersudbury.ca/?pg=agenda&action=navigator&lang=en&id=1034&itemid=11966). November 28th, 2016.

Ministry of Infrastructure Ontario (2011) Building Together – Guide for municipal asset management plans. (Online: https://www.ontario.ca/page/building-together-guide-municipal-asset-management-plans). Queen's Printer for Ontario, 2012.

Infrastructure for Jobs and Prosperity Act, 2015. (Online: https://www.ontario.ca/laws/statute/15i15). Queen's Printer for Ontario, 2015.

Ontario Regulation 588/17: Asset Management Planning for Municipal Infrastructure. (Online: https://www.ontario.ca/laws/regulation/r17588). Queen's Printer for Ontario, 2017.

City of Greater Sudbury Strategic Plan, 2019 - 2027. (Online: https://www.greatersudbury.ca/city-hall/reports-studies-policies-and-plans/)

The City of Greater Sudbury Official Plan, 2019. (Online: https://www.greatersudbury.ca/city-hall/reports-studies-policies-and-plans/official-plan/)

The City of Greater Sudbury 2021 Budget. (Online: https://www.greatersudbury.ca/city-hall/budget-and-finance/2021-budget/)

KPMG (2017) City of Greater Sudbury Municipal Long-Term Financial Plan. KPMG, Sudbury, Ontario. April 13, 2017. (Online: https://www.greatersudbury.ca/city-hall/budget-and-finance/financial-reports-and-plans/)

BMA (2019) City of Greater Sudbury Water and Wastewater Long-Range Financial Plan. BMA, Sudbury, Ontario. April 2019. (Online: https://www.greatersudbury.ca/live/water-and-wastewater-services/projects-plans-reports-and-presentations/water-wastewater-financial-plan/wwwgreater-sudbury-final-report-april-2019-v2-pdf/)

Various City of Greater Sudbury Plans for example the Transportation and Water and Wastewater Master Plans. (Online: https://www.greatersudbury.ca/city-hall/reports-studies-policies-and-plans/)

City of Greater Sudbury By-Laws. (Online: https://www.greatersudbury.ca/city-hall/by-laws/)

Fiscal Transparency and Accountability Act, 2004. (Online: https://www.ontario.ca/laws/statute/04f27). Queens Printer for Ontario, 2012 – 18.

Municipal Act, 2001. (Online: https://www.ontario.ca/laws/statute/01m25). Queen's Printer for Ontario, 2012 – 18.

Water Opportunities Act, 2010. (Online: https://www.ontario.ca/laws/statute/10w19). Queen's Printer for Ontario, 2012 – 18.

Accessibility for Ontarians with Disabilities Act, 2005. (Online: https://www.ontario.ca/laws/statute/05a11). Queen's Printer for Ontario, 2012 – 18.

Safe Drinking Water Act, 2002. (Online: https://www.ontario.ca/laws/statute/02s32). Queen's Printer for Ontario, 2012 – 18.

Occupational Health and Safety Act, 1990. (Online: https://www.ontario.ca/laws/statute/90o01). Queen's Printer for Ontario, 2012 – 18.

Purchasing By-Law 2014-01 and amendment 2017-158. (Online: https://www.greatersudbury.ca/city-hall/open-government/statutes-and-policies/)

Greater Sudbury Community Energy and Emissions Plan (Online: https://www.greatersudbury.ca/live/environment-and-sustainability1/net-zero-2050/)

B. Appendix B: Asset Management Strategy

The intention of the City's asset management program is to effectively manage the lifecycle of infrastructure assets that deliver services to the community. Implementation of this program involves guidance provided by the Executive Leadership Team delivered to well-trained employees.

The asset management strategy outlines management's commitment to implementation of the Enterprise Asset Management Policy.

B.1 Purpose of the Asset Management Strategy

The purpose of the strategy is to support the Enterprise Asset Management Policy and Plan, which in turn supports delivery of the City's strategic goals and provides oversight for the lifecycle activities required to maintain the City's infrastructure assets.

Objectives for this strategy include:

- Develop practices aimed at improving sustainability and asset management across the City;
- Ensure that these asset management practices are applied consistently across the City;
- Provide guidance for the City to maintain its assets in appropriate condition to achieve the delivery of Council approved service levels through proper lifecycle interventions.

The asset management strategy is an integral component of the asset management plan; this strategy will be reviewed and updated with asset management plans as per legislative requirements. It is expected that this strategy will evolve in response to City and Community needs and challenges faced over time.

B.2 Asset Management Planning Activities

For the City to successfully adopt and implement principles that support sustainability through lifecycle and asset management, the City must consider:

- **Fit with strategic goals and asset needs:** Asset management must form a connection between strategic planning and daily operational activities.
- **Clear goals and objectives:** Clear and consistent communication of levels of service, asset management objectives and strategies to achieve service delivery across the organization and community.
- **Organization wide commitment:** A commitment from City staff is required to implement and develop asset management competencies.
- **Allocation of appropriate resources:** Required resources must be identified so they may be devoted to the implementation of asset management guiding principles.

The City will prepare four key documents to detail asset management planning activities. Table B1 provides an explanation of the four key documents.

Table B1: Asset Management Planning Activities				
	AM Policy	**AM Strategy**	**AM Plans**	**State of the Infrastructure**
What is it?	Outlines why and how asset management will be undertaken by the City.	Outlines the actions the City will implement to enhance and improve AM capability and achieve strategic goals and objective.	Long-term plans that outline the asset activities across the City that will enable delivery of the approved levels of service.	Reporting to Council on the existing state of the City's infrastructure.
Objective	Sets the broad framework for planning and implementing asset management in a coordinated way.	Provide structure of the actions that will enable the City to implement the asset management program.	Outlines the actions that must be implemented to deliver the defined levels of service in a cost effective way.	Outline to Council the condition of our existing infrastructure and the progress of the asset management program.

B.3 Asset Management Program and Framework

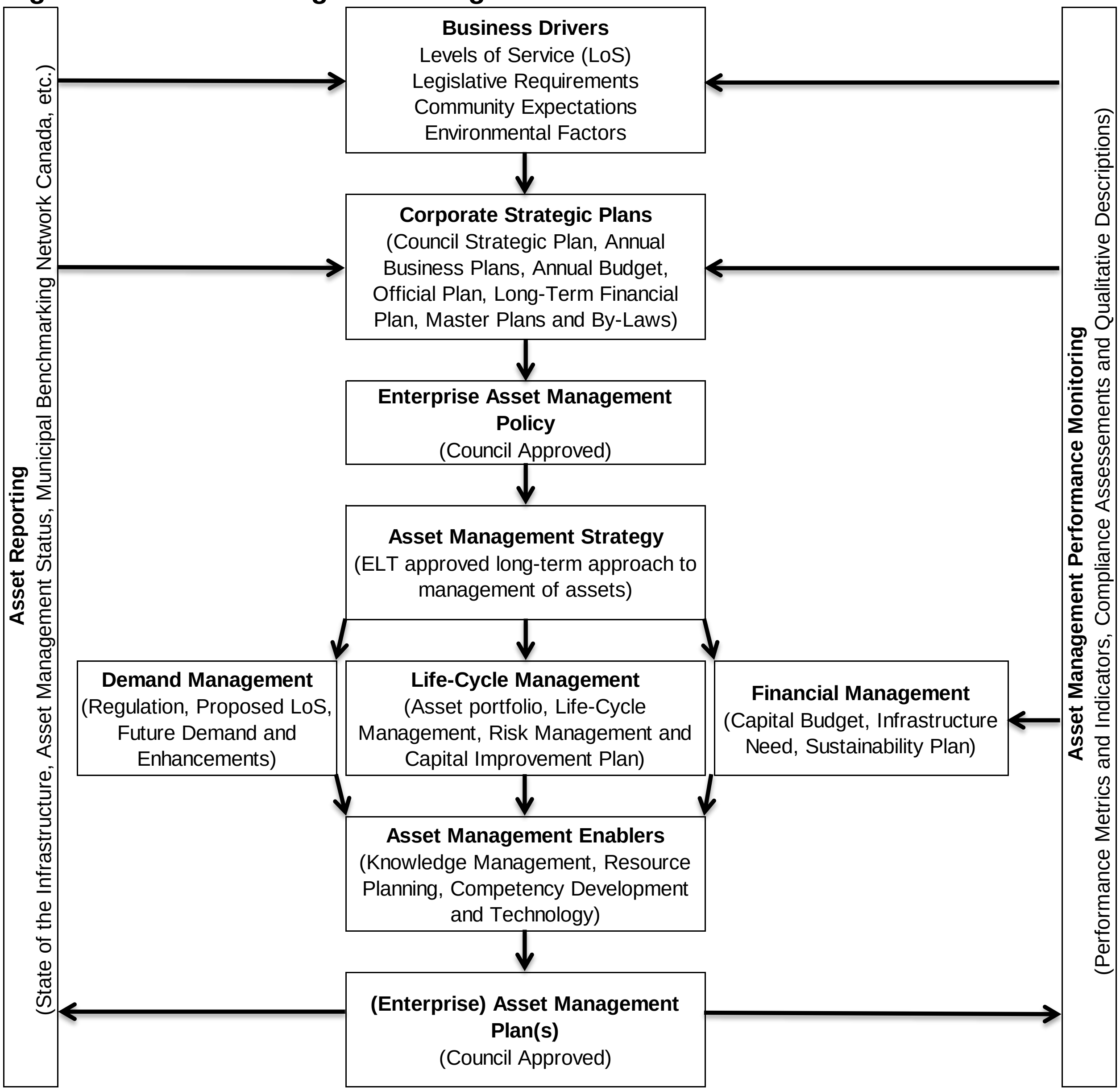
There are two requirements that form the foundation for the development of an asset management business framework that will support and improve the delivery of service levels. These requirements include:

- **Asset Management Process:** Asset management is a process that will influence City business practices including planning, service delivery and performance monitoring for improvement. Asset management will provide clarity for decision making through analysis of levels of service and the associated risk of service delivery. This analysis will outline alternatives that are aligned with performance and policy to determine appropriate allocation of resources.

- **Asset Management Principles:** Asset management is defined by a set of principles that address lifecycle management and costing; defined levels of service; demand management; risk management; asset level of service knowledge and management; inventory condition data and performance assessment and monitoring; and financial planning to sustainably delivery services.

The Asset Management Program framework is represented within Figure B1.

Figure B1: Asset Management Program Framework



The asset management program framework is the basis for all asset management activities within Greater Sudbury. Clearly defined and documented procedures within this framework will greatly enhance the City's asset management ability to achieve service delivery objectives. These procedures should encompass the entire lifecycle of an asset and the expected asset level of service.

B.4 Level of Service (LoS) and Community Demand

A service level is a direction or requirement for a particular service area which performance may be measured. Asset (technical) levels of service will provide data that can be quantitatively and objectively measured to identify if service levels have been met.

There are 3 tiers of service level that are discussed in asset management planning, namely:

- **Community**: Qualitative descriptions that define the community, stakeholder and individual expectations.

- **Strategic**: Qualitative and quantitative measures that describe what is being provided to the community. Examples of how this can be defined can include reliability, legislative compliance, quantity, quality and safety.

- **Asset (Technical)**: Quantitative measure that defines the performance expectations for a given asset in order to produce the desired levels of service. These services are measurable and can include asset condition, responsiveness, expenditure, and asset value.

The identification of existing and the development of target levels of service establish the foundation for the development of the City's asset management planning. Council will have the opportunity to define target levels of service as asset management planning evolves.

Current level of service performance will be monitored against target level of service to enable the City to identify 'if' and 'where' it is failing to meet service objectives. Consideration will include the consequence and cost of not achieving the target levels of service.

B.4.1 Performance Measurement

Performance measurement defines 'what', 'how much', 'how well' and the impact of what is being done in the community. Performance management utilizes key performance indicators to define, implement and maintain target levels of service.

B.4.2 Cost of Service Delivery for an Asset Class

The cost of service delivery provides valuable information to engage the community and stakeholders in meaningful discussion with respect to target level of service. Cost will influence the community appetite for what level of service should be provided, what changes to level of service are acceptable, and provides a basis for comparison with historic service levels and other service providers. Understanding the cost of service delivery can alter the community's perception of the value of services provided by Greater Sudbury acting as a very effective communication tool.

B.5 Failure Prediction and Risk Management

Failure prediction is performed to assess the potential for an asset to deliver an expected level of service over time. Current and historical condition performance data is analyzed to determine the current position of an asset within its lifecycle. This information informs a judgement about how much remaining service life is available.

Appropriate failure prediction will allow for maintenance and renewal strategies to be created with a greater degree of accuracy. These predictions provide the City time to consider all viable options for delivering levels of service and to manage pending failure in a timely and cost effective manner with an acceptable level of risk.

B.5.1 Risk Exposure

Risk management is a significant activity to support the lifecycle of an asset. The City's risk management goals involve identifying, understanding and managing the potential for infrastructure assets to meet planned service objectives. Adopting best practices for managing and maintaining assets increase the potential for achieving planned service objectives.

Risk assessment helps to prioritize and optimize capital spending and decision making. Greater Sudbury evaluates both the Probability of Failure (PoF) and the Consequence of Failure (CoF) when prioritizing capital budget choices. This helps clarify and build a shared understanding about the risk associated with a decision to not invest in a project.

The PoF is an estimate of how likely an asset is to not meet its service expectations. The CoF is an estimate of the effects on outcomes if an asset actually fails. The consequences of failure could range from a service interruption to a catastrophic result depending on asset class. Where these assessments indicate an unacceptably high risk, a capital project is deemed to be a relatively higher priority as the cost of the project is often less than the element of risk or consequence.

Overall, the probability and consequence of failure allow decision makers to focus on assets that have the greatest impact on service delivery. The two attributes form the calculation of the total risk exposure to either proceed or not proceed with a specific project. Risk exposure is calculated as the product of the probability and consequence of failure, which aligns with the requirements set out in the City's Enterprise Risk Management Policy.

B.6 Asset Lifecycle Planning and Optimization

The majority of Greater Sudbury's assets have lifecycles that span several decades. For this reason, capital investments needs to examine the entire lifecycle cost associated with the decision to make the investment. Lifecycle management supports decision making that will optimize capital planning by considering the investment value of planning, design, construction, acquisition, commissioning, operation, maintenance and rehabilitation, decommissioning and disposal. Furthermore, reducing or disposing of assets the City does not require to meet its current or future operational needs is one of the asset management guiding principles.

Managing infrastructure assets presents the opportunity for a large range of intervention options that are detailed below. These intervention options may also be considered in combination with each other.

- **Do Nothing**: The option may reduce service delivery. There is minimal investment on planned maintenance or renewal. The option may increase the City's risk exposure, reactive maintenance and premature asset replacement.
- **Status Quo**: This option maintains the current and operational trend of an asset.
- **Non-Infrastructure**: Actions or policies that can lower costs or extend asset life. For example integrated infrastructure and land use planning, as well as demand and failure management.
- **Revised Operations**: Variations in operation could offer financial benefits through economies of scale or be necessary to achieve evolving service mandates.
- **Revised Maintenance**: Variations in maintenance could offer financial benefits through economies of scale or be necessary to achieve evolving service mandates. Variations in

maintenance strategies include preventative versus reactive maintenance which may allow an asset to run to failure.

- **Rehabilitation and Renewal**: Replace or reconstruct substantial elements or equipment extending the lifecycle of the asset. These timely interventions require extensive analysis on lifecycle longevity, existing condition and costs.
- **Decommission**: Remove the asset from service.
- **Replacement**: Replacement includes a complete reconstruction of an existing asset in the same or an altered geographic location. Rehabilitation and renewal is no longer a viable option.
- **Disposal**: Dispose of an existing asset due to a reduction in service delivery or an elimination of demand. Disposal may also include replacement with a new asset.
- **Expansion**: Expansion activities required to extend service delivery to previously un-serviced areas or to expand services to meet increased demand from growth.

Prior to proceeding with lifecycle intervention options, Greater Sudbury will analyze the existing and predicted risks involved with various scenarios. These risks will be compared with existing and predicted benefits involved with the same scenarios. Following analysis, the City will develop lifecycle management strategies for inclusion in asset management plans.

B.7 Capital Prioritization

Upon completing a lifecycle intervention analysis, Greater Sudbury must determine the availability of financing to achieve the recommended lifecycle investment program. In many cases, the optimal lifecycle interventions will exceed the capital and operational budget availability. This common scenario results in budget constraints that emphasize the requirement to implement citywide capital prioritization of projects.

To begin the process of capital prioritization, technical experts within City departments will prioritize projects using an enterprise-wide tool with consideration of cost, benefit, and risk management for the community. Once a project has been selected for potential funding as evaluated by a committee of peers within the City's organizational structure, the project will seek Council approval and may proceed on a one-time or multi-year funding program.

The balance of projects that do not proceed in a given year will be placed in a capital backlog program that will be revised annually.

Once annual prioritization peer review is complete, the Executive Leadership Team may endorse the capital budget on the basis of this prioritization.

B.8 Finance and Sustainability Strategies

In accordance with legislation, at a minimum the City will be planning for lifecycle activities that maintain existing or target levels of service for a 10-year period. Planning will include the asset level of service, risk, lifecycle interventions, as well as forecast to accommodate potential increases in service demand.

As part of each budget cycle, these asset level of service and lifecycle interventions will be taken into account when recommending the priority capital investments that will make their way into the capital budget. Council retains the ultimate authority to decide which investments are made.

Furthermore, in following the asset management roadmap, Council will be provided with the opportunity to determine level of service targets to manage infrastructure within the City's capacity to renew and maintain assets, and accept the associated risk. A sustainability strategy that identifies funding sources for each asset class will be prepared to achieve all Council approved target levels of service.

B.9 Maintenance and Operations Management

Greater Sudbury will strive to maintain its assets with the objective of minimizing the risk and the total cost of ownership. Improvement of efficiency and effectiveness through a structured proactive maintenance approach is the key component of this objective.

The goal of proactive maintenance is to improve reliability while reducing the probability of failure. This goal directly translates into lower levels of risk and lower lifecycle costs.

Reactive maintenance is completed in response to a high probability or an actual failure event. Often reactive maintenance is a response to assets that have run to failure. Despite the negative connotation with respect to allowing an asset to run to failure, at times this scenario is the optimal option in an asset's lifecycle. This is acceptable when the failure prevention costs become higher than the costs and consequences arising from failure.

B.9.1 Maintenance Intervals

Maintenance intervals for many assets are determined on a fixed interval basis. Fixed intervals can be a period of time within service life consumption, operating hours, distance traveled, among other measurement parameters. Often these parameters are determined within technical or manufacturer's specifications. In situations where maintenance intervals are not predetermined the City will consider:

- Consequences of failure;
- Level of service delivery required;
- Appropriate performance measurement parameters;
- Frequency or usage measurement parameters.

Condition may also be a determinant for maintenance intervals for many assets. A predetermined condition may trigger an increased monitoring program, inspection, or servicing.

C. Appendix C: Asset Management Plans by Asset Class

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ROAD STRUCTURE ASSET MANAGEMENT REPORT

City of Greater Sudbury

Keystone Bridge Management Corp.

Your Bridge Asset Management Specialist

Contents

Executive Summary

Keystone Bridge Management Corp. was retained by the City of Greater Sudbury to provide information that will help the City satisfy the requirements of Ontario Regulation 588/17 **Asset Management Planning for Municipal Infrastructure**. Keystone's involvement was specific to the core municipal infrastructure assets of bridges and large culverts. The City has 185 structures of which 90 are considered bridges and the remaining 95 are culverts.

This report responds primarily to Part 5 of the Regulation, **Asset Management Plans**, and particularly Section 3 as it relates to bridges and culverts. To wit:

i. All bridges and culverts are identified and listed,
ii. Replacement costs of all bridges and culverts is provided,
iii. The average age of bridges and large culverts,
iv. Extensive information on the condition of the bridges and culverts,
v. A description of how the bridges and culverts are assessed.

The City of Greater Sudbury has captured vital asset management intelligence for its bridges and culverts that is not necessarily requested in the Regulation. This information is shared in the present report.

Introduction

This report is offered as partial fulfillment of Ontario Regulation 588/17, Asset Management Planning for Municipal Infrastructure. Bridges and large culverts that require biennial inspection following the Ontario Structure Inspection Manual (OSIM) are considered core municipal infrastructure assets. An asset management plan for core assets is obligated by July 1, 2021.

Understanding Asset Management

There are varying accepted definitions of the term “asset management”. Some follow:

“AM is a comprehensive process that allocates funds effectively and efficiently among competing pavement, structure, and other infrastructure needs.” Transportation Association of Canada

“AM is the process of guiding the acquisition, use and disposal of assets to make the most of their service delivery potential and manage the related risks and costs over their entire life.” Government of Victoria – Australia

“A systematic process of maintaining, upgrading, and operating physical assets cost effectively. It combines engineering principles with sound business practices and economic theory, and it provides tools to facilitate a more organized, logical approach to decision-making.” FHWA - USA

The writer defines AM as:

“Asset management is the application of engineering, economics, and risk science principles to achieve enduring benefit from the asset at minimal cost.”

The need for public agencies to systematically undertake asset management was recognized more overtly at the beginning of the present century. Central to any discussion of managing public assets is the notion of core municipal infrastructure assets or tangible capital assets. The Public Sector Accounting Board of Canada defines these as:

> **(a) Tangible capital assets are non-financial assets having physical substance that:**
>
> > **(i) are held for use in the production or supply of goods and services, for rental to others, for administrative purposes or for the development, construction, maintenance or repair of other tangible capital assets;**
> > **(ii) have useful economic lives extending beyond an accounting period;**
> > **(iii) are to be used on a continuing basis; and**
> > **(iv) are not for sale in the ordinary course of operations.**

Dr. Dana Vanier of the National Research Council of Canada speaking at an international congress in 2000 described the ability to answer the following six questions as fundamental to Asset Management:

- What do you own?
- What is it worth?
- What is the deferred maintenance?
- What is its condition?

- What is the remaining service life?
- What do you fix first?

Six additional questions when answered help frame an understanding of Asset Management:

- Where is the asset located?
- What is the consequence of investment in the asset?
- What is the cost of perpetual ownership, or in other words, the commuted cost?
- What risks and liabilities are associated with ownership of the asset?
- What is the present and future demand for the asset?
- What value is the asset generating?

This report demonstrates that the City of Greater Sudbury has an advanced standing in managing its road and park structure assets. The answers to the majority of the preceding 12 questions are provided within this document and accompanying appendices.

Keystone Bridge Management Involvement

Keystone Bridge Management Corp. (KBMC) has completed seven consecutive cycles of biennial bridge and large culvert inspections on behalf of the City of Greater Sudbury. Keystone initially inspected Sudbury structures in 2008, and then every second year thereafter.

As part of its services Keystone provides detailed capital needs, maintenance needs, individual bridge depreciations to date, forecast inventory depreciation, and the bridge condition index, for all 185 of the inspected structures. The estimated remaining service life and replacement cost is detailed for each structure. Individual inspection reports are prepared for each structure.

Network level reports are generated that speak meaningfully to asset management objectives. The following reports are provided by KBMC and are further described and explained herein:

1. Summary Statistics Report
2. Bridge List
3. Culvert List
4. Capital Needs
5. Maintenance List
6. Structure Replacement Cost & Estimated Remaining Service Life Report
7. Culvert Replacement Cost Report
8. Bridge Parabolic & Straight-Line Depreciation
9. Bridge Depreciation Forecast
10. Bridge Depreciation Forecast with Recommended Capital Investment
11. Bridge Average Depreciation with Investment Scenarios
12. Depreciation Forecast – Culverts
13. Average Culvert Depreciation with Investment Scenarios
14. Recommended Investigations
15. Performance Deficiencies
16. BCI Report

O. Reg. Table 5

This portion of the report attempts to directly satisfy Part 5 of Ontario Regulation 588/17, and more specifically responds to Part 5(2)-1, i & ii for Table 5, "Bridges and Culverts."

Description of Traffic

Community Levels of Service

The traffic supported by municipal bridges and culverts includes:

- Pedestrian traffic
- Cycling traffic
- Normal passenger vehicle traffic
- Emergency vehicles
- Public transit including Municipal bus service and school bus service
- Heavy commercial trucks
- Specialized ore hauling trucks
- Permitted over-load traffic
- Dangerous goods traffic

A subset of structures are park bridges and pedestrian culverts. These are designed for pedestrian and cyclist traffic only and do not support light service vehicles.

Technical Level of Service

The information required for bridges regarding their technical level of service are load and dimensional restrictions.

The table below identifies which bridges in Sudbury had load postings as of 2020. There were four in total in 2020, but two have since been replaced. Accordingly, 1.08% of Sudbury structures presently have load restrictions.

Table 1 List of Load Posted Structures

Bridge	ID	Posting (t)	Remark
Spanish River Bridge	1000	15	Replaced 2020
Kalmo Road Bridge / Whitson River	3006	10	Programmed for Replacement 2022
Vermilion River	4001	19-30-42	Replaced 2020
Romford Creek Bridge	5013	9-17-23	Programmed for Replacement 2022

The following table indicates the population of bridges with only one lane of traffic. This is construed to be a horizontal dimensional restriction for the purposes of this report.

Table 2 List of One-lane Bridges

Name	ID
Spanish River Bridge	1000
Manninen Road Bridge	1003
Chicago Mine Road Bridge	1005
Spanish River near Worthington Road	1006
Nelson Lk Rd @ Rapid River	3000
Kalmo Road Bridge / Whitson River	3006
Roberts River	4000
Vermilion River	4001
Industrial Rd (Ski Hill Rd)	4003
Roberts River	4005
Deer Creek Bridge	5020
Deer Creek Bridge	5021
Forest Lake Road Culvert	5503

A total of 13 bridges operates as one lane bridges. They are tabled above. The traffic demand on these bridges is relatively light and it is permissible by the Canadian Highway Bridge Design Code to have one lane bridges. Statistically 7.03% of Sudbury bridges are one lane, but that it is not to suggest they are dimensionally inadequate. All the one lane bridges have at least 3.0 m of horizontal clearance which is sufficient to pass all traffic except permitted traffic where that permitted traffic is carrying an extra wide load.

The CPR Subway on College Street, Site 6001 has a vertical dimensional limitation of 3.8 m clearance. The Brady Street Underpass Site 5003 has a signed vertical clearance of 4.4 m. The Ministry of Transportation Ontario requires all trucks not exceed a height of 4.15 m. Thus, the Brady Street Underpass is not deficient in height, even though permitted over-height loads would have to navigate Sudbury on a different route. For the purposes of Ontario Regulation 588/17, only one bridge or 0.54% of bridges has a dimensional vertical restriction.

All pedestrian bridges and culverts have adequate horizontal and vertical clearance.

Condition of Bridges and Culverts

Community level of Service

The condition of all bridges and culverts is captured in individual inspection reports that are updated every two years in conformance with the Ontario Bridges Act and Regulations thereunder. All inspection reports are available separately from the present report but are discussed later in the present report. An example inspection report is appended to this report at the beginning of the Appendices.

Extensive photographic imagery is utilized to present the condition of the bridges and culverts in the inspection reports. In 2020, 1136 images of the 70 road bridges were captured, or an average of 16.23 images per bridge. Similarly, for culverts, 1129 images of the 93 roads culverts were taken, for an average of 12.14 images per culvert. The 22 pedestrian bridges and culverts had 311 pictures in 2020. That is an average of 14.14 images per pedestrian structure.

Technical Level of Service

The average bridge condition index (BCI) for bridges in the City of Greater Sudbury is 75.25. Similarly, for culverts, the average BCI is 79.10. The average BCI for pedestrian bridges and culverts respectively is 77.17 and 68.50.

The BCI is not necessarily the best or only measure for describing the state of the municipal structure inventory. This is discussed more fully later in this report.

Since 2008 Sudbury has tracked the physical depreciation of its bridge and large culvert inventory. In a manner like accounting practise, the level of depreciation of each structure component is evaluated based on its age, normal life expectancy, relative value, rehabilitation history, and deterioration. The component depreciation is aggregated to obtain depreciation levels for each structure, and the entire structure inventory. This technical metric is not explicitly a requirement of Table 5, and thus a fuller description follows later in this report.

Summary of Bridge and Culvert Assets

Bridge and Culvert Lists

A printout of Sudbury's bridges and culverts is provided in the Appendices as **Bridge List** and **Culvert List**. These two printouts clarify what are considered as bridges and which structures are deemed culverts. Culverts are defined as an opening through the embankment and have soil cover.

Bridges typically have no cover, although certain bridges may have had their riding surface elevated by infilling between the curbs. The **Bridge List** identifies 90 structures that are considered bridges. The remaining 95 structures on the inventory are culverts. Nine culverts have a span less than 3.0 m and are therefore not subject to Statutory biennial inspection.

Structure Age & Other Summary Statistics

A one-page **Structure Summary Statistics** report included in the Appendices provides three graphical representations of the structure inventory by way of three histograms. The Structure Age Histogram shows that the Sudbury structures have a reasonably even age distribution. Seventy-three structures are new or have been replaced in the past 20 years. The average age of Sudbury structures as of 2020 is 31.4 years. There are 27 structures that are more than 60 years old. The oldest structure is 90 years old. The average of the road bridges is 42.8 years as of 2021. Similarly, the average age of the road culverts is 25.4 years as of the present. Where the age of a structure is uncertain, defining characteristics such as formwork marks and bridge railing type are utilized to provide an informed estimate.

The Structure Deck Area Histogram demonstrates that over half of the structures have less than 200 square metres of plan area. The largest structure has a plan area of 2,381 square metres. The average plan area is 234 square metres. The total plan area of structural assets is 43,219 square metres. Bridges with more than 600 square metres of deck surface are considered large bridges. Sudbury has 12 large bridges.

The Structure Deck Area per Age Histogram is a hybrid of the previous two histograms. It is a key piece of asset management information because this chart presents the age and size-weighted picture of the structure inventory. The plot shows a slightly unbalanced distribution. About 28% of the deck area is greater than 50 years old. About 16.6% of the deck area has been renewed in the past 20 years. A rate of at least 1% per year renewal is critical for a sustainable inventory. Sudbury is nearly achieving this with a rate of 0.83% per year.

The table below compares some key statistics tracked between 2014 and 2020.

Table 3 Comparison of Selected Structure Statistics 2014-2020

Year	Plan Area (m^2)	Average Age	Age of Oldest Structure
2020	43,219	31.4	90
2018	41,218	32.4	88
2016	41,055	35.1	86
2014	40,391	35.5	84

The increase in plan area of almost 3000 square metres from 2014 to 2020 is principally due to the addition of two large previously undocumented culverts, correction of the length of one other culvert, and inventory improvements.

Replacement Costs & Estimated Remaining Service Life

The estimated remaining service life (ERSL) and the replacement cost are vital asset management intelligence. These values are provided in an appended report titled **Structure Replacement Costs**.

Estimated Remaining Service Life

The structures are ordered based on the ERSL. The newest structures top the list. The structures at the bottom of the list, have effectively no or little remaining service life. Those structures that have a formally identified capital need have the recommended program year identified. All structures with less than ten years of estimated remaining service life are identified on the capital program.

The ERSL is calculated based on the deemed life of the structure, and present age. This is modified by an algorithm that recognizes the actual condition of the structure. Old bridges in good condition automatically have their lives extended. Newer structures in exceptionally poor condition have their life expectancy reduced. Recently rehabilitated bridges had their lives extended by not less than ten years. Thereafter, engineering judgement is applied to arrive at the listed ERSL.

Replacement Cost

The replacement costs are premised on replacement in kind. Typically, when a bridge is replaced, it is replaced with an improved structure type, and often to improved design criteria. Hence the replacement costs are not a reliable indicator of actual replacement costs. However, it is a useful parameter for asset management purposes, particularly when assessing the level of asset depreciation.

The replacement cost for bridges considers numerous factors and is computed by an algorithm. The factors are listed below:

- Structure type
- Plan area of bridge (Overall length by overall width)
- Location (city more expensive than rural)
- Skew (cost increased by 10% if skew angle > 0)
- Symmetry (cost increased by 10% if irregular or unsymmetrical)
- Size (a discount factor is applied as the size increases)
- Aspect ratio (A wide bridge has a lower unit cost)
- Allowance for existing structure removal
- The base replacement cost is factored by an allowance for design costs and contingencies.

Unit and fixed costs are updated yearly to adjust for inflation and market conditions.

The culvert replacement costs are calculated separately, and this is explained later in this report.

Summary Results

The estimated total replacement cost for the City of Greater Sudbury bridges and culverts was updated in 2021 and is $535,870,000. The average replacement cost per structure is nominally $2.9M.

A graph forecasts the future costs for structure replacement by decade. In the period from 40 to 50 years hence, there is a forecast requirement to replace about $96M in structure assets. The City needs to strategize on how best to prepare for this significant road structure renewal cost. Timely rehabilitation of some of these structures will prolong their service life.

Caveat

The estimated remaining service life is a guideline only. Rehabilitation can extend the life of a structure by 20 to 50 years. In some instances, the ERSL may be optimistic, especially for steel culverts.

The estimated replacement costs are a reasonable indication of actual replacement in-kind costs. However, there are numerous other considerations that influence replacement costs. Chief among these are market conditions, challenging foundation conditions, and traffic management requirements.

Culvert Replacement Cost Report

The **Culvert Replacement Cost** Report is in the Appendices to this report. It is generated based on a complex algorithm within KBMS that considers parameters such as depth of cover, skew, water depth, road width, and presence of guide rail. The estimated replacement cost is generated for both a corrugated steel and concrete box type culvert.

Concrete culverts outnumber steel culverts by 81 to 14. This is a favourable statistic. Keystone's experience indicates that only shallow cover smaller diameter steel culverts in shallow water can be justified over concrete culverts on a life-cycle cost basis.

The estimated cost to replace all the City of Greater Sudbury culverts, in kind, is $234,175,000.

Bridge Replacement Costs

From the previous two network level reports it is easily deduced that the replacement value of only the bridges is $301,695,000.

Information on Condition of Bridges & Culverts

The following information is captured as part of Sudbury's asset management program for bridges and large culverts.

- Defects and Damage to Bridge and Culvert Components
- Aggregate Level of Defects and Damage on a per structure basis
- Aggregate level of Defects and Damage for the entire Bridge Inventory
- Level of Depreciation of Bridge and Culvert Components
- Aggregate level of depreciation for individual bridges and culverts
- Aggregate level of depreciation for the entire bridge inventory and culvert inventory.
- Rate of depreciation separately for bridges and culverts
- Impact of Capital investment (recapitalization)
- Special Maintenance needs on a component and structure basis
- Capital improvement needs for all structures
- Performance Deficiencies
- Bridge Condition Index

Defects and Damage

All bridges and culvert components are assessed in terms of physical defects and damage. The amount of defects and damage is estimated as a percentage of the component. Defects are generally cosmetic in nature, detract from the structure aesthetics, may affect serviceability, and are typically caused by surface breakdown of poorly performing materials. Examples are scaling of concrete, and loss of paint or galvanizing.

Damage is more serious and is typically deeper and more consequential than defects. A delaminated deck surface or perforated culvert are examples of damage.

Both defects and damage reduce the value of the affected component, and in turn, the value of the structure. One percent damage to a component is deemed to devalue that component by 5%. Consequently, a component that is 20% damaged has lost all its value. Ten percent defect is treated as one percent damage.

Aggregate Defects and Damage

The cumulative effects of defects and damage to components is aggregated for each structure and graphically displayed on each individual structure inspection report. The entire bridge inventory is similarly aggregated to measure the deemed loss in value. In 2020, the bridges were assessed to have lost 8.2% of their value due to defects and damage. Almost $25 million in bridge value has been lost to the affects of defects and damage.

Bridge Depreciation

The New Value of each bridge is premised on the geometry and deemed unit price of the main components and summing the individual values. The costs of foundations are not included. Foundations are relatively expensive bridge components that may cost from $100K to $1,000K per bridge foundation unit. The deemed unit prices are approximate, and not necessarily reflective of current actual costs. Dollar values are current as opposed to historical values used in accounting practise. A report included in the Appendices titled **Parabolic and Straight-Line Depreciation** provides individual retained values for all the bridges. Culverts are not included in this report. The retained value is the reduced value of a bridge after accounting for aging depreciation and deterioration depreciation. It is expressed as a dollar amount and percentage.

Depreciation is premised on the actual age of each bridge component. So, for example if a bridge has replacement components such as expansion joints or new barrier walls, the depreciation of these components is based on their year of installation rather than the age of the original bridge. In some instances, judgement was required to establish the installation date of replacement bridge components.

The Present Value (book value) of a bridge is expressed in terms of how much of the original value is retained after considering Depreciation, Defects and Damage. Depreciation is calculated as Parabolic or Straight-Line (S/L). With a parabolic depreciation function, only 25% of the depreciation takes place in the first half of the component's life. Parabolic depreciation sustains a bridge's value in the early part of its life. Straight-line depreciation is probably a more realistic and conservative approach to describing the current book value of a bridge. Examples of four depreciation functions are illustrated in Figure 1. below.

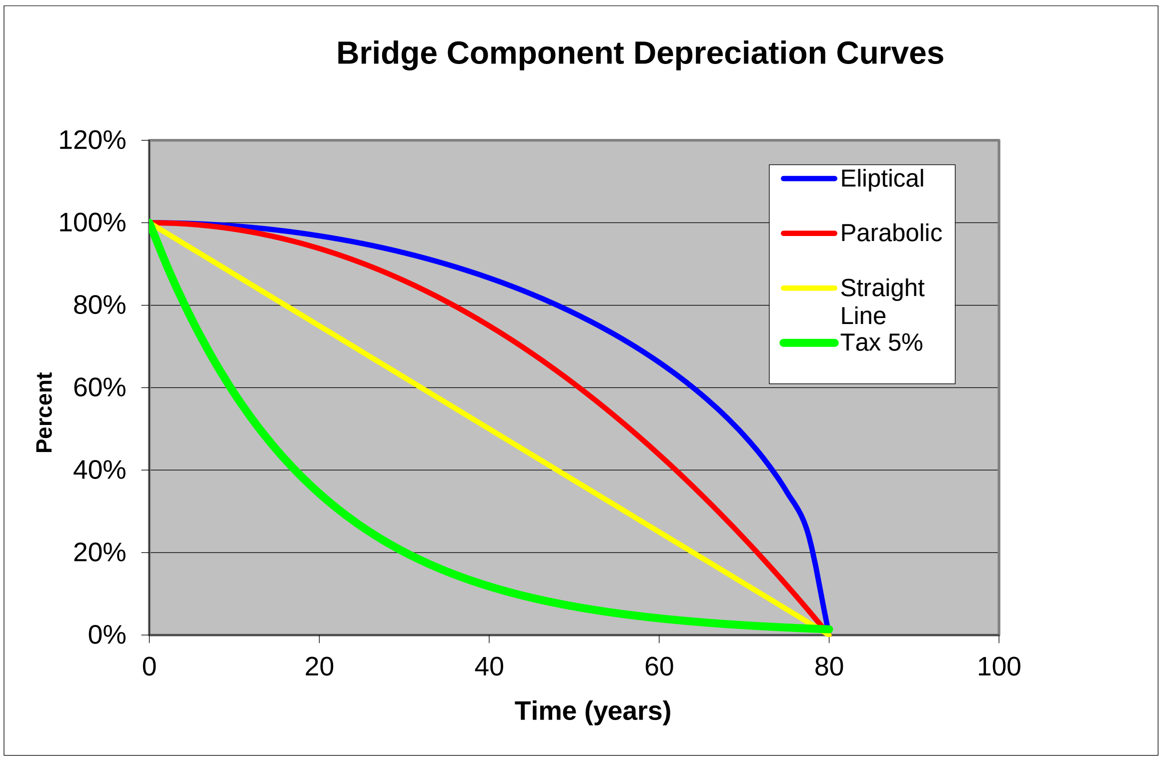


Figure 1 Examples of four depreciation functions for a bridge component with an 80-year deemed service life

The total depreciated value of the bridge inventory is 51.9% of the deemed New Value if parabolic depreciation is assumed. Similarly, for straight-line depreciation the value has declined to 34.6% of the original deemed New Value.

Alternate Technical Level of Service

Earlier in this report, BCI values are provided as a technical level of service for bridges and culverts. Here it is proposed that a more reliable level of service can be measured in terms of depreciation. Moreover, it is suggested that technical level of service targets for bridges should align with desirable and sustainable levels of depreciation.

Assuming a 100 year write down period for bridges, it is a desirable goal to maintain the entire bridge inventory at nominally 50% depreciation or better if Straight Line Depreciation is adopted. Similarly, for Parabolic Depreciation, it is desirable to maintain the level of depreciation at or above 67%. Depending on the choice of Depreciation function, The City of Greater Sudbury is behind the depreciation level of service target by 13.9% or 13.3% respectively.

There are six bridges where defects and damage account for more than 25% of the depreciation. All these structures are identified by Keystone as being recommended for the capital program.

A comparison of the results of this analysis to the previous three cycles of inspection completed by Keystone is provided in the table below. The retained value of the bridge assets has improved notably since 2016 because of significant recent investment. The value of investment is clearly exceeding the loss of value due to depreciation. The loss of value due to defects and damage has improved considerably since 2014. This is a strong indicator of the effectiveness of investment in repair and renewal of the bridge inventory.

Continued and greater strategic investment in rehabilitation and renewal will improve the depreciation numbers and bring Sudbury closer to the technical level of service targets.

Table 4 Comparison of Damage, Defects and Depreciation for Bridges 2014-2020

Year	Damage & Defects Loss in Value %	Retained Value Parabolic Depreciation %	Retained Value Straight-Line Depreciation %
2020	8.2	53.7	36.1
2018	10.2	51.1	33.5
2016	11.5	50.6	33.2
2014	12.5	52.3	34.4

Bridge Depreciation Forecast

As part of the bridge inspection deliverables, the bridges and culverts were assessed for their depreciated value and rate of depreciation. This section discusses bridge depreciation only.

The Depreciated percentage is calculated based on the deemed value, deemed life, and age of each bridge component. Once Defects or Damage is identified on a component, the Defects and/or Damage is assumed to grow at 0.5% per year non-compounded. Thus, a sidewalk that presently has 5% scaling (a Defect), is assumed to have 7.5% scaling in another five years time.

Depending on assumptions, the retained value of bridge assets is between 36% to 60% of the new value.

The projected average depreciation is approximately 1.48 percent per year. Accepting an actual replacement cost of $301.7M for only the bridge assets, the forecast depreciation loss in terms of replacement value is nominally $4.5M per year. Hence an annual capital expenditure of not less than this amount is required just to maintain the bridge inventory at present levels of depreciation. It is important to note this discussion does not include large culverts. A report in the Appendices called **Bridge Depreciation Forecast 1** shows the forecast depreciation for 20 from the present

Bridge Depreciation Forecast with Recommended Capital Investment

A companion to the preceding **Depreciation Forecast**, is a similar looking chart, **Bridge Depreciation Forecast 2,** also provided in the Appendices. However, this second chart demonstrates the effects of investing the recommended Capital Needs into the bridge inventory. Investing the recommended Capital expenditures helps increase the value of the bridges, and greatly improves the depreciation outlook.

It is important to understand this chart speaks only to bridges. The culverts are discussed separately in the sections following.

The premise for this chart is as follows. The recommended capital investments from the Capital Needs Report are grouped in five-year groupings. Hence all the recommended capital needs for bridges from the present to five years out is grouped, and so on and so on for 6 to 10-year needs, 11 to 15-year needs, and 16 to 20-year needs. The Capital is deemed to be spent exactly as recommended. The recapitalization of the bridge inventory offsets the depreciation.

The graph shows that the recommended capital spending for the first ten is insufficient to keep up with depreciation.

The graph is premised on one dollar of capital investment off sets one dollar of depreciation. This is reasonable when the replacement values of bridges include all the associated sundry costs of a bridge replacement in kind. Realistically, one dollar of capital may only offset eighty cents of depreciation.

In summary, the second **Bridge Depreciation Forecast** demonstrates that the recommended expenditures in the Keystone Capital Needs Report will, if followed exactly, still be insufficient to overcome the ongoing effects of Depreciation, Damage and Defects.

Over the past five years the City of Greater Sudbury has budgeted an average $7.5M annually on capital investment for bridges and culverts.

Average Bridge Depreciation with Investment Report

A chart named the **Average Bridge Depreciation with Investment** is appended to this report. It tests various investment strategies and their impact on long term depreciation.

As the title suggests, this chart considers the Average Depreciation. In the previous two charts, four different types of depreciation assumptions are provided. In this chart, the four assumptions are averaged. The resulting average is shown as a red line captioned as “**Invest 0**”. For the City of Greater Sudbury, the average level of depreciation is about 47% of New Value and is projected to decline to 17% of New Value in 20 years in the absence of capital investment.

Superimposed on the Zero Investment scenario are four other colour coded investment scenarios labelled **Invest 1** to **Invest 4**. The **Invest 1** scenario models the effect of following the Capital Needs Report exactly as recommended. The average investment is $1.3M per year for 20 years.

Examining the chart, and in particular, the green line that represents this investment scenario, it is shown that the recommended capital expenditure is insufficient in the long-term to overcome the projected depreciation.

The three other investment scenarios correspond to investing 0.75%, 1.0%, and 1.5% of the replacement cost of the bridge inventory annually. It is evident that only a long-term investment of 1.5% of the replacement value annually will begin to restore the bridge assets to desirable depreciation levels. <u>The City of Greater Sudbury should commit to spending not less than $4.5M per year on their bridges for the foreseeable future.</u>

Culvert Depreciation Forecast

A chart showing the **Culvert Depreciation Forecast** is provided as part of Keystone's bridge asset management services and is included herein as part of the Appendices. Culverts are treated differently than bridges and this is explained next.

The new or Original Value of culverts is based on their replacement value. The replacement value of a culvert calculation was explained earlier in this report. Basically, the replacement value considers the costs of excavating the road surface, providing water control, removal of the existing culvert, and replacement in kind of the existing culvert. The costs include backfill and restoring the pavement structure of paved roads. The estimated cost to replace in kind the entire Sudbury culvert inventory is $234,175,000. This is equivalent to $2.47M per culvert.

Straight-line depreciation is utilized to depreciate the culverts. Since the culvert conduit is only part of the cost of the entire replacement cost, it was deemed that only simple depreciation without considering the effects of defects and damage was the more appropriate depreciation model. Depreciation assumes a 100-year life for concrete culverts and a 35-year life for corrugated steel and timber culverts. The assumed life is adjusted in the calculations to the estimated remaining service life.

The culverts are individually depreciated based on their age, and construction. The chart shows that the retained value of the culverts is about 58% of their Original or new value. In the absence of capital investment, the culverts will depreciate a further 20% in 20 years, or 1.0% per year.

Since the entire cost of culvert replacement is considered, then like the bridges, a dollar invested in culvert replacement yields a dollar improvement in the depreciated values. The depreciated value changes from $136M to $89M in 20 years. This is nominally $2.35M per year. Thus, a minimum annual capital expenditure of $2.35M per year is required just to maintain the present depreciated value of the culverts.

Previously it was noted the average cost of a culvert in Sudbury is $2.47M. At a $2.35M annual rate of depreciation, not less than one culvert on average should be programmed for replacement every year, to maintain the current retained value.

Although it is recognized that Sudbury has invested heavily in culvert replacements over the past ten years, continued investment is still required.

Average Culvert Depreciation with Investment

A second chart that examines five different investment scenarios for culverts is also provided. Located in the Appendices is a copy of the report **Average Culvert Depreciation with Investment**. Based on the Capital Needs Report, it was identified that about $11.6M is required for culvert needs between the present and 2030.

The first, or null investment scenario shows that the depreciated value of the culverts will decline from 58% retained value to 38% retained value over 20 years.

The **Invest 1** scenario models the impact of capital investment following exactly the Capital Needs Report recommendations for culverts. This average level of expenditure of $579K per year for 20 years results in the retained value of the culverts stabilizing for five years, and thereafter declining to 44% after 20 years.

The **Invest 2**, **Invest 3,** and **Invest 4** scenarios correspond to spending 0.75%, 1.0%, and 1.5% of the replacement value of the culverts annually. The chart confirms that an annual average expenditure of $2.0M per year (under 1% of replacement value) is the most ideal capital investment strategy for culvert renewal for Sudbury.

Recommended Investigations Report

Biennial inspection of bridges as mandated by OSIM (Ontario Structure Inspection Manual) provides a cost-effective means of inspecting and reporting on the general condition of a bridge. Where, in the opinion of the Engineer, additional investigation is required, it is prescribed as part of the Inspection Report.

A one-page **Recommended Investigations** report is included in the Appendices of this report.

Bridge deck condition investigations (BDI's) are recommended for all structures identified as requiring comprehensive rehabilitation. Six bridges are recommended for a BDI. The ideal time for a BDI is two years before the planned rehabilitation.

Eleven structures are recommended for an enhanced inspection. An under-bridge type inspection vehicle is typically required to access parts of the bridge that cannot be accessed through a ground based ordinary OSIM type inspection. It is a good idea to map deterioration during an enhanced inspection.

Three structures are recommended for an under-water inspection. A dive team is required to perform such an inspection.

One structure would benefit from a boat inspection.

Nine structures are recommended for a planning study. Planning studies are a cost-effective approach to assessing the most prudent rehabilitation strategies for bridges earmarked for comprehensive rehabilitation.

Capital Needs Report

The capital needs were estimated with an estimating tool contained in the Keystone Bridge Management System. This utility covers common items that include deck replacement, expansion joint replacement, barrier wall replacement, waterproofing and paving. The utility provides guidance for traffic management costs. All costs are marked up 20% to account for contingencies and engineering. Contract administration costs are not included.

The **Capital Needs** for the City of Greater Sudbury are summarized in a separate Keystone report provided in the Appendices of this report.

The **Capital Needs Report** is organized from the most immediate needs to the less immediate needs by the Recommended Year sub-headings. Two capital needs pictures are graphically presented at the end of the Report. A Grand Total of **$39,756,000** is the projected capital need from the present to 2030.

There are 65 Capital Projects identified over the 10-year planning period to 2030. Six bridges and seven culverts are recommended for replacement. Twelve road bridges are scheduled for a comprehensive rehabilitation.

The distribution of capital needs is depicted in two different graphs at the end of the Capital Needs Report. The first graph shows the inventory needs and a line of “best fit” that describes the average needs over the planning period. The City of Greater Sudbury has $9.7M in immediate capital needs, and a further $26.9M in needs distributed from 2023 to 2030. The average ten-year outlook is about $3.7M in capital per year.

The second graph breaks down the capital expenditures between bridges, culverts and pedestrian structures. Bridge and culvert needs are reasonably well distributed through the planning period.

The capital needs groupings in the Capital Needs Report suggests relative priority, but other considerations such as traffic demand, risk of failure, and combining projects should also be considered to establish actual priorities.

It should be noted that capital estimates provided are approximate by nature. Environmental considerations, difficult foundations, dewatering requirements, and traffic management costs can be significant variables that can only be estimated accurately at the preliminary design stage. Culvert replacement cost estimates are premised on replacement with a similar sized culvert, but typically concrete culverts are chosen over steel.

Improved Prioritization of Capital Needs

An improved procedure for prioritizing capital needs was developed in 2021. Capital needs were assessed against six weighted factors as follows:

Table 5 Prioritization Factors and Weightings for Capital Needs

Prioritization Factor	Weight (out of 100)
Traffic Volume (AADT)	20
Capital Cost to Replacement Cost Ratio	5
Structure Depreciation	20

Failure Risk	25
Crash Worthiness	15
Inspector's Urgency Rating	15

The traffic volume is indicative of the structure importance. The ratio of Capital Cost to rehabilitate a structure to Estimated Replacement Cost of the same structure gives slight precedence to larger projects. Those structures that have the greatest overall level of depreciation are prioritized. Vulnerable structures as determined from a comprehensive risk analysis receive the greatest weight. Structures that have inadequate crash protection to safeguard the motoring public are considered. And lastly, there is room for human intervention to push the urgency of certain projects.

Bridge Maintenance

Detailed maintenance needs are provided in the **Bridge Maintenance Report**, a copy of which is included in the Appendices to this report**.**

Maintenance needs shown in red font are considered the most urgent.

Some of the more common maintenance needs identified are:

- Removing brush from around bridges and culverts
- Removal of obstructions in stream channels
- Repair of minor damage
- Cleaning surfaces

The maintenance list is not a substitute for ordinary regular maintenance but is intended to highlight where regular maintenance activity is insufficient.

The maintenance list offers guidance that will help maintain the life and serviceability of the structures, and in some instances, improve safety. These maintenance items are duplicated in the individual structure reports.

A course estimate of the cost of maintenance is provided as part of the report. The costs are offered as guidance only and should not be the basis of estimating the actual cost.

A common rule of thumb is to spend 1% of the replacement value per annum on structure maintenance. In practise, few municipalities spend even 0.1% of replacement value on bridge and large culvert maintenance. The most responsible division of capital and maintenance expenditures is elusive. Suffice to say that a productive and skilled maintenance crew can achieve significant reductions in capital needs while maximising the serviceability and service life of those structures they maintain.

Performance Deficiencies

The various components in and around a structure all have a purpose or functionality. Where the purpose or functionality is compromised, it is recorded as a performance deficiency. The performance deficiencies observed for the City of Greater Sudbury's bridges and large culverts is detailed in a six-page **Performance Deficiencies Report**. A copy is in the Appendices.

These deficiencies are often difficult or expensive to remedy. Ideally, a replacement structure should address the present performance deficiencies. These deficiencies should be reviewed when prioritizing the capital program. Bridges and culverts with numerous performance deficiencies, such as the Simmons Road Bridge (2000) and Martin Road Bridge (3002) should be prioritized for rehabilitation or replacement.

Performance Deficiencies require risk management strategizing by the owner.

Bridge Condition Index (BCI)

A **Bridge Condition Index Report** is contained in the Appendices. The calculation of BCI requires inspection following the OSIM Excellent-Good-Fair-Poor (EGFP) rating system. Up to 55 structural elements are considered in the calculation.

Keystone follows its proprietary Triple-D approach instead of the EGFP method of rating a bridge. To translate the Triple-D method to EGFP the following approach is observed. Anything considered Damaged in Triple-D format is mapped 1:1 as Poor in EGFP format. All bridge components transition from Excellent to Good in a straight-line decay function over a 20-year period. Thus, a new component becomes 10% Excellent and 90% Good after ten years of service. The determination of Fair is based on the percent Defects and considers the percent Damage loosely following OSIM philosophy and is performed following an algorithm implicit to KBMS. The percent Good is determined as 100% less the percent Excellent, Fair, and Poor. Excellent, Good, Fair, and Poor are weighted 1.00, 0.75, 0.40, and 0.0 respectively in the BCI calculations following the published MTO methods of July 2009.

The calculated BCI information is provided in the included report of the same name. Where the BCI is between 60 and 70 the index is printed in green font. Where the BCI is between 50 and 60 it is shown in orange font. Below 50 the BCI is shown in red font.

One hundred and thirty-seven of the 185 inspected structures, or 74.1% have a BCI greater than 70. Conversely, 26% of the structures have a BCI less than 70. The MTO's goal is to maintain at least 80% of its structures with a BCI greater than or equal to 70. On this account, the City of Greater Sudbury is 5.9% behind this metric.

The lowest BCI of 50.9 is for the Nolins Creek bridge-culvert, (2519). This structure is recommended for replacement in 2021. The top slab is weakened from deterioration caused by poorly detailed catch basins.

In summary, the BCI is a useful measure of the overall condition of common bridges and culverts but is still highly variable and dependent on the judgement of the individual bridge inspector. The BCI calculations could easily be ten points less if determined by others essentially because of the ambiguity and lack of consistency in differentiating between Fair and Poor in strict OSIM methodology inspections.

Comparing BCI to Other Measures

Unfortunately, the Bridge Condition Index is a capricious measure that is not the most suitable for asset management purposes. When the BCI was created, it was to replace an even more inappropriate measure of bridge condition. Formerly in Ontario, the overall condition of bridges was reported based on the condition of the asphalt on the bridge decks. Certainly, the BCI is a significant improvement over historical practise. However, the BCI was not created or calibrated to support asset management considerations.

To understand the problem with BCI one must examine how a bridge component in good condition is treated, and human psychology. A bridge that is entirely in good condition will have a BCI of 75 by definition. This is incontrovertible.

In fact, most bridge components remain in mostly **Good** condition for extended periods. Girders, piers, soffits, and waterproofed deck surfaces will remain in good condition for 50 years or more. Human psychology has been demonstrated in a remarkable American study to influence how inspectors rate a bridge. There is a tendency to rate something **Good** even if it might otherwise be **Excellent**.

There are conflicting and vague descriptions to hep define what is intended to be considered a **Fair** rating. MTO taught inspectors to think of an imaginary “halo” around **Poor** areas that should be considered as in **Fair** condition. Fortunately, the **Poor** rating is relatively unambiguous and can be applied more faithfully.

One other aspect of inspection that makes the exercise fraught is the weak-link syndrome. If you have a brand-new chain with 100 links and only one middle link is critically defective, how do you rate the chain? Some will argue 99% **Excellent** and 1% **Poor**, whereas others will say the entire chain is **Poor**. Who is right?

To demonstrate this phenomenon City of Greater Sudbury data was utilized in the following graph. All of Sudbury’s structures were grouped into five-year cohorts, 0-5 years old, 6-10 years old, 11-15 and so on. The average BCI and the average straight-line depreciation are compared for each cohort. The straight-line depreciation includes depreciation due to defects and damage.

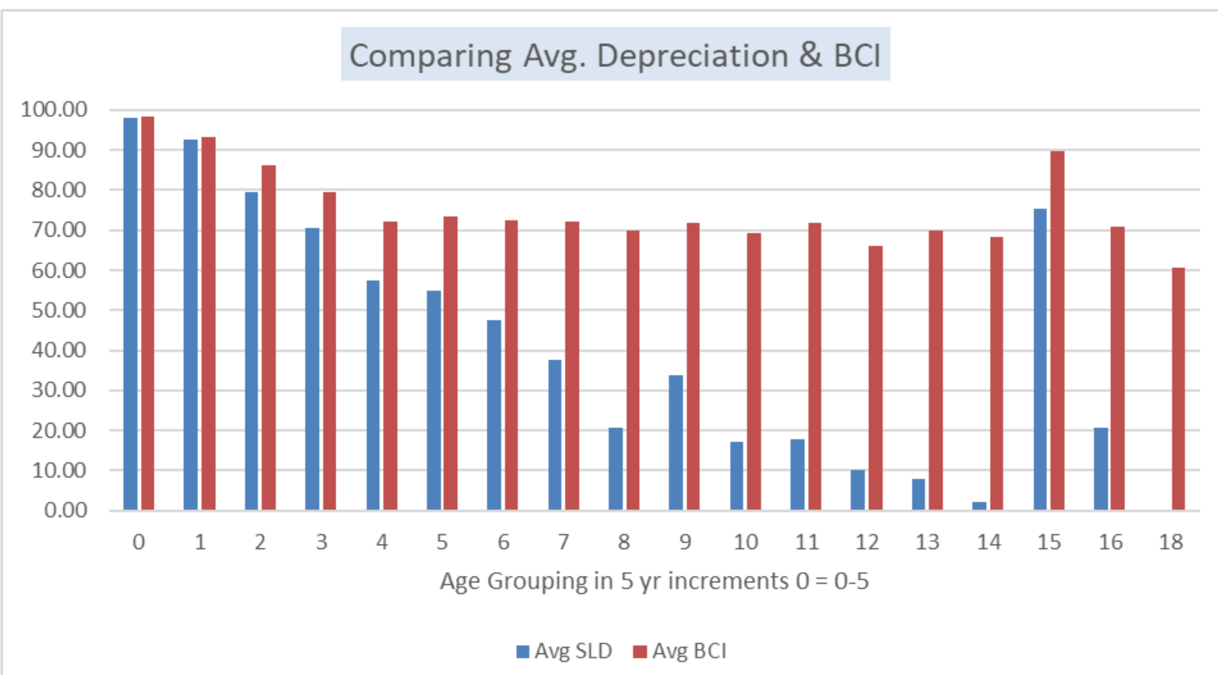


Figure 2 Comparing BCI and Depreciation levels for Sudbury structures

Examining this graph, the average BCI declines to just over 70 after 20 years, and plateaus. The level of depreciation continues to decline as might be expected.

There is an aberration at the 15th cohort. This represents a substantial reconstruction of a bridge or bridges where the original year of construction is retained, but much of the structure is updated.

The spike in depreciation of the 9th cohort and accompanying slight improvement of BCI rating is a clear indication of capital investment in the structures represented in this age group.

The reason that the BCI declines so uniformly in the first 20 years is that Keystone utilizes an algorithm that eases a new bridge component rating from Excellent to Good over 20 years.

For asset management, the depreciation of bridge components is a better measure of the inventory than BCI. The BCI is only capable of an imprecise and somewhat ambiguous measure of the condition of bridges and large culverts. Tracking depreciation offers a more in-depth and dynamic view of structure condition. Notwithstanding this, the City could consider using the BCI metric with MTO level of service goals as a metric for comparison purposes with other municipalities, provided the variabilities and limitations stated in this report are kept in mind.

Assessing Condition of Bridges and Large Culverts

The City of Greater Sudbury has retained Keystone Bridge Management Corp. on a biennial basis starting in 2008 to provide provincially mandated inspections of the City's bridges and large culverts. Keystone has completed seven biennial inspections of Sudbury's road structures to date. The inspections are mostly visual, ground based, and follow routine methodology. All ordinarily visible components of the structure are inspected, and existing condition descriptions updated in a database. Inspections capture:

1. Material changes in structure components
2. Maintenance Needs
3. Capital Needs
4. Performance deficiencies
5. Hazards associated with structure.

Biennial bridge inspection is mandated in Ontario under the Public Transportation and Highway Improvement Act and more specifically Ontario Regulation104/97 "Standards for Bridges."

Most engineering consultants follow the default provisions of the Act, which is to follow exactly the Ontario Structure Inspection Manual (OSIM), and supplement this as required by the Municipality or by following their own proprietary value-added services.

Keystone at the inception of its incorporation in 2006 recognized that OSIM on its own does not effectively respond to asset management considerations.

The Regulation states **"…. the inspection of a bridge may vary from the Ontario Structure Inspection Manual if,**

(a) The variation is not a marked departure from the Ontario Structure Inspection Manual; and
(b) The variation does not adversely affect the safety and mobility of people and goods."

Keystone's approach is an element-by-element quantitative inspection like OSIM that conforms to the spirit and intent of the Act. Keystone's approach provides an inspection of a Municipality's bridge and large culvert assets that both satisfies the Act, and as a natural biproduct, provides a wealth of asset management information. This information has already been shared in this report.

Risk Assessment Study

In 2020 Keystone supplemented the regular biennial inspection of Sudbury's structures with a risk assessment. Every structure was checked for the presence of 40 possible vulnerabilities. The implications of these vulnerabilities were translated into risk scores. The scoring considered catastrophic loss of the structure and the social and economic implications of the loss of any one structure. Separate scoring assessed the risk associated with deficient or missing traffic protection such as bridge railings, protruding culvert ends and inadequate guiderail.

The reader should review the risk assessment study independently. Results of the risk assessment study are being utilized to better inform the prioritization of capital needs.

Closing

Keystone Bridge Management Corp. is pleased to report on asset management considerations specific to the City of Greater Sudbury vehicle bridges and large culverts and pedestrian structures. Should there be any lingering concerns or additional information required with respect to this assignment, then Keystone will be happy to respond.

We trust the services rendered are complete, and in full keeping with the Terms of Reference. It is Keystone's sincerest desire that the information stemming from this work will be helpful to the City of Greater Sudbury in partly satisfying Ontario Regulation 588/17. Keystone strives to help you get the most out of your road and park structure assets.

Harold Kleywegt, P.Eng.
Managing Director
Keystone Bridge Management Corp.

Appendices

The following reports have been referenced in this report and are included in the Appendices following.

1. Sample Bridge Inspection Report
2. Bridge List
3. Culvert List
4. Structure Summary Statistics
5. Structure Replacement Costs
6. Culvert Replacement Cost
7. Parabolic & Straight-Line Depreciation
8. Bridge Depreciation Forecast 1
9. Bridge Depreciation Forecast 2 (with Recommended Capital Investment)
10. Average Bridge Depreciation with Investment
11. Culvert Depreciation Forecast
12. Average Culvert Depreciation with Investment
13. Recommended Investigations
14. Capital Needs
15. Maintenance List
16. Performance Deficiencies Report
17. Bridge Condition Index Report

Additional Reference Documents

(Bound Separately)

- 2020 Bridge & Large Culvert Structural Inspection Report
- Structure Risk Assessment & Analysis Report

Bridge Inspection Report

Deer Creek Bridge

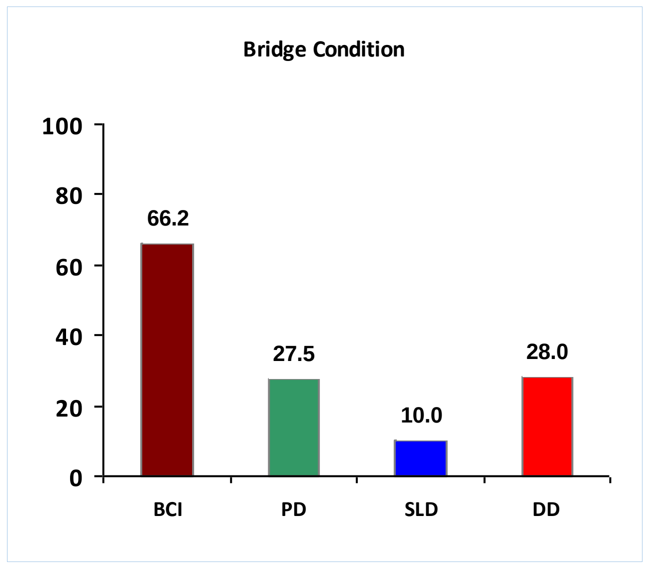
Road Name:	*Red Deer Rd.*
Site ID:	*5020*
Structure Type:	*Slab on Steel Girder*
Owner:	*Greater Sudbury*
Built:	*1970*
Length:	*18.5 m*
Width:	*5.7 m*
Spans:	*3*
Spans Arrange:	*5.4, 7.7, 5.4*
Feature Under:	*Navigable Channel*
Crossing:	*Deer Creek*
Location:	*1.9 km south of Woodland Road*

AADT:	*N/A*	**Latitude:**	*46.43857570*
Lanes:	*1*	**Longitude:**	*-80.70454535*
Skew:	*0 °*	**Orientation:**	*N-S*
Speed:	*30 km/h*	**Road Width:**	*4.5 m*
Trucks	*0%*	**Load Posting:**	*None*

Inspection Date:	*August-12-20*
Inspector:	*Steve Reid, C.E.T.*
Assistant:	*Seamus Fisher, Eng Student*

Comments:

This bridge requires major rehabilitation, however, economically it may be better option to replace. Wing walls require new timber piles. Lagging needs to be replaced and extended below the waterline at abutments. Girders should be cleaned and painted. Curbs require renewal. Recommend a planning study to review options for rehab or replacement. Investigate deck for remaining service life. Perforation detected in H pile at south pier in 2020.



BCI = Bridge Condition Index MTO Calculation

PD = Parabolic Depreciation
% retained value

SLD = Straight Line Depreciation
% retained value

DD = Defects and Damage
% loss of retained value

Recommended Investigations:

Enhanced Inspection, Planning Study

Recommended Capital Works:

Replace Bridge

Estimated Replacement Value: *$1,015,000*

Estimated replacement value is based on replacement in kind

Estimated Remaining Service Life: *19 Years*

Rehabilitation Year and Estimated Cost: *2030 $1,350,000*

Component Inspection Information

Timber-Laminated (1)
Deck
Length: *18.4 m*
Width: *5.8 m*
Height:

Defects 0.0%
Damage 10.0% Moderate Wear, Moderate Breakage
Maintenance Spot deck plank replacement
Capital Rec. None

2x10 boards on side comprise deck. Laminated timber deck is slightly worn. Timber running boards are damaged at south end. NE corner is settled, deck boards slightly displaced.

Timber Curb (2)
Curb
Length: *18.4 m*
Width: *0.6 m*
Height: *0.2 m*

Defects 15.0% Moderate Checking, Minor UV Weathering
Damage 25.0% Minor Breakage, Moderate Impact
Maintenance None
Capital Rec. Replace in 2 years

Curbs are damaged on both sides. Curb in NE corner is badly damaged. Curbs will need renewal within the next 2 years.

Timber Post & Guide Rail (2
Guide Rail
Length: *18.4 m*
Width:
Height:

Defects 0.0%
Damage 5.0% Minor Decay, Minor Impact
Maintenance None
Capital Rec. Replace in 2 years

No blocking for guide rail. Flex beam ends have minor impact damage, posts have minor decay in the top surface. NW corner post split at bolt connection.

Steel-Rolled (3)
Girder
Length: *18.4 m*
Width: *0.47 m*
Height: *0.61 m*

Defects 15.0% Moderate Corrosion, Major Corrosion, Minor Graffiti
Damage 2.0% Major Section Loss
Maintenance None
Capital Rec. None

Properly supported. Girders starting to corrode and blister. East girder has major corrosion with section loss occurring to the web at the bottom flange.

Paint Coating (1)
Steel Coating
Length:
Width:
Height:

Defects 25.0% Moderate Peeling/Blistering
Damage 0.0%
Maintenance None
Capital Rec. Replace in 2 years

Coating is blistering and flaking off. All structural steel should be cleaned and recoated at next rehabilitation.

Component Inspection Information

Timber Pile & Lagging (2)
Abutment Stem
Length:
Width: *9.9 m*
Height: *1.4 m*

Defects 0.0%
Damage 20.0% Moderate Decay, Moderate Crushing
Maintenance None
Capital Rec. Replace in 2 years

Generally in satisfactory condition however some granular material is potentially escaping from bottom of lagging. Wing wall piles and blocking exhibit substantial decay in the top metre and will require replacement. Walls are deformed between H piles due to backfill pressure, several boards exhibit moderate crushing. H piles have major corrosion at waterline, and minor section loss.

Steel Bent (6)
Piers
Length: *0.47 m*
Width: *0.47 m*
Height: *1.4 m*

Defects 20.0% Minor Corrosion, Moderate Corrosion, Minor Pitting
Damage 2.0% Minor Section Loss, Minor Perforation
Maintenance Repair Minor Damage
Capital Rec. Repair in 1 year

Major corrosion at and below the water line, perforation noted (2020) at middle H pile (web) south end. Major pitting. Bracing is in satisfactory condition. Perforated H pile needs repair to bolster web.

Steel Sliding Plate (6)
Pier Bearings
Length:
Width:
Height:

Defects 0.0%
Damage 0.0%
Maintenance None
Not Inspected
Capital Rec. None

Unable to view due to the water depth.

Steel Sliding Plate (6)
Abutment Bearings
Length:
Width:
Height:

Defects 30.0% Moderate Corrosion, Major Corrosion
Damage 3.0% Moderate Section Loss, Major Section Loss
Maintenance None
Capital Rec. None

Major corrosion and section loss to bearings, notably the exterior corner bearings.

Water Channel (1)
Channel

Defects 0.0%
Damage 0.0%
Maintenance None
Capital Rec. None

Sluggish stream is navigable for small boats. Channel clear in 2020.

Component Inspection Information

Embankment (2)	**Defects** 12.0% **Moderate Erosion**
Embankment	**Damage** 0.0%
	Maintenance None
	Capital Rec. None
	Erosion in the SE corner due to boat launching activity. Material escaping through bottom of abutment bent lagging. No approach guide rail at this structure.

Delineator (4)	**Defects** 0.0%
Sign	**Damage** 5.0% **Minor Impact**
Length:	**Maintenance** None
Width:	**Capital Rec.** None
Height:	*All signs have some minor impact damage. Signs located at the end of bridge barrier system.*

Recommended Investigations

X denotes not required

Deck Condion Survey	Enhanced Inspection	Underwater Investigation	Ice Inspection	Boat Inspection	Structure Evaluation	Load Posting	Planning Study
✘	✓	✘	✘	✘	✘	✘	✓

Capital Needs Cost Estimate Break-Down

Item	Req'd	Units	Quantity	Unit Price $	Estimated Cost
Misc Concrete Repairs	✗	m²		$1,120	$0
Deck Concrete Overlay	✗	m²	105.5	$560	$0
Deck Replacement	✗	m²	105.5	$3,500	$0
Barrier Wall Replacement	✗	m	42.5	$4,200	$0
Expansion Joint	✗	m	11.4	$7,000	$0
Waterproof & Pave	✗	m²	105.5	$308	$0
Bearing Replacement	✗	Count	18.0	$7,000	$0
Approach Guide Rail	✗	m	80.0	$350	$0

Other Work

Replace Bridge	$1,000,000

Structural Items Subtotal	$1,000,000
Mobilization General Sitework	$100,000
Estimated Traffic Management & Civil Items	$25,000
Contract Admin & Contingencies 20%	$225,000
Total Rehabilitation Cost Estimate	***$1,350,000***

Recommended Capital Year 2030

Recommended Capital Work Summary

Replace Bridge

Inspection Comments

This bridge requires major rehabilitation, however, economically it may be better option to replace. Wing walls require new timber piles. Lagging needs to be replaced and extended below the waterline at abutments. Girders should be cleaned and painted. Curbs require renewal. Recommend a planning study to review options for rehab or replacement. Investigate deck for remaining service life. Perforation detected in H pile at south pier in 2020.

Image 228

West elevation

Image 210

South approach

Image 211

South deck surface damaged boards

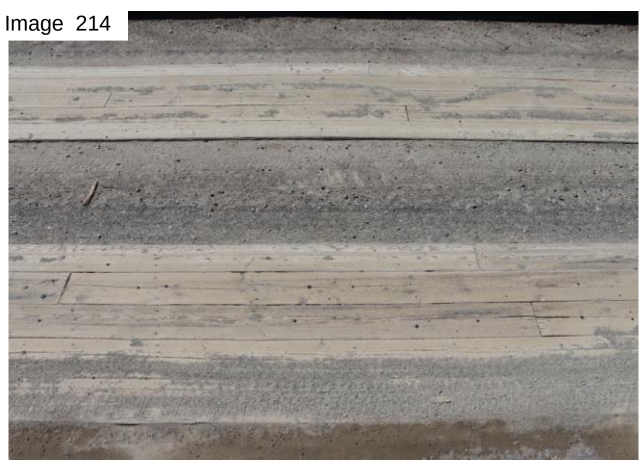
Image 212

West guide rail & curb

Image 213

East guide rail & curb

Image 214



Deck surface

Image 215

West channel

Image 217

North approach

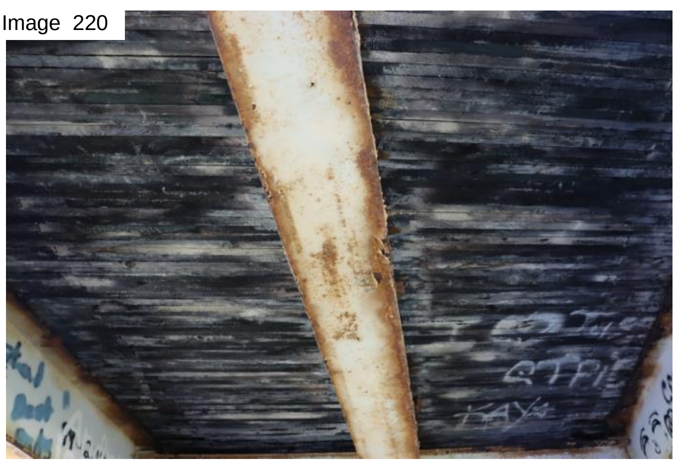
Image 218

East elevation

Image 219

North abutment

Image 220



North soffit

Image 221

North bearing

Image 222

North pier

Image 223

Mid span soffit

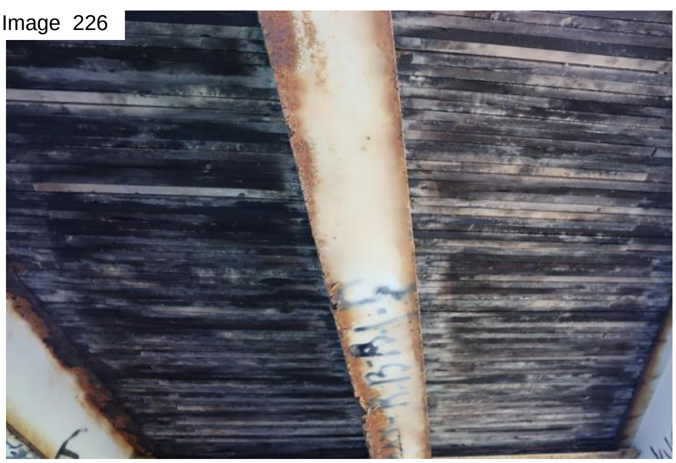
Image 224

South abutment

Image 225

South pier pile perforation

Image 226



South soffit

Image 227

South pier

Bridge List

Bridge ID	Name	Route	Length	Width	Spans	Const Yr
1000	Spanish River Bridge	Spanish River Rd.	30.5	3.3	1	2020
1001	Vermillion River Bridge	Panache Lake Rd.	80.6	9.5	2	1983
1002	Little Panache Lake Narrows	Panache Lake Rd.	27.5	11.0	3	1981
1003	Maninen Road Bridge	Manninen Rd.	13.3	4.9	1	1980
1004	High Falls Road Bridge	High Falls Rd.	33.5	9.0	3	2020
1005	Chicago Mine Road Bridge	Chicago Mine Rd.	18.6	4.7	1	2015
1006	Spanish River near Worthington Road	Spanish River Rd.	18.3	5.0	1	2007
1007	Vermillion River Bridge	Regional Rd. 55	91.5	10.6	4	1948
1008	Moxam Creek Bridge	Regional Rd. 55	38.7	12.5	3	1988
1009	Old Soo Road Bridge	Old Soo Rd.	4.1	8.5	1	2020
1010	Black Lake Road Bridge	Black Lake Rd.	25.6	10.1	1	1976
1011	Mikkola Road Bridge	Mikkola Rd.	43.4	9.4	3	1976
1012	Fielding Road Bridge	Fielding Rd.	30.6	9.5	1	1987
1013	CPR Overhead (Westbound)	Old Highway 17 (Regiona	150.7	15.8	6	1955
1014	CPR Overhead (Eastbound)	Regional Rd. 55	92.0	12.1	3	1969
1015	Finland Creek Bridge	Godfrey Dr.	4.4	14.5	1	2007
1019	Finland Creek Bridge	Balsam St.	15.0	7.0	1	2016
1020	Finland Street Bridge	Finland St.	46.0	5.6	1	1940
1022	Poland Street Bridge	Poland St.	7.0	9.8	1	1960
1023	Orford Street Bridge	Orford St.	6.3	10.2	1	1960
1024	Big Nickel Mine Rd	Big Nickel Mine Rd	46.5	10.1	1	2003
1025	Lily Creek Bridge	Bouchard St.	7.7	17.1	1	1959
1026	Junction Creek Bridge	Regent St.	9.2	18.5	1	1990
1028	Struthers Pedestrian Bridge	Struthers St.	22.0	2.0	3	1982
1029	Copper Cliff Trail Bridge	MR 55 (Old Hwy 17)	15.3	2.0	1	2010
1030	Meatbird Creek Pedestrian Bridge	Ped Path	18.3	1.8	1	2016
1561	Trans Canada Trail	Hillfield Trail #1	22.2	2.5	1	2006
2000	Simmons Road Bridge	Simmons Rd.	61.5	8.6	3	1970
2001	Vermillion Lk Rd	Vermillion Lk Rd	18.0	10.5	1	2006
2002	Main Street Bridge	Main St.	33.4	11.5	3	1967
2003	Whitson Creek Bridge	MR 15	21.1	9.6	1	1967
2004	Whitson Creek Bridge	MR 15	21.9	9.6	1	1967

Bridge ID	Name	Route	Length	Width	Spans	Const Yr
2005	Onaping River Bridge	M R 8	83.8	11.5	3	1959
2006	Onaping River Bridge	Morgan Rd.	41.2	9.5	3	1983
2007	Vermillion River Bridge	Morgan Rd.	39.8	10.4	3	1961
2008	Montee Principale Bridge	Montee Principale	25.9	9.8	3	1986
2009	Whitson River Bridge	M R 15	17.8	9.8	1	1967
2010	Landry Street Bridge	Landry St.	11.0	8.6	1	1981
2012	INCO Railway	Elm St. West	32.2	18.6	3	1975
2013	Lasalle Interchange	Elm St. West	19.6	18.2	1	1975
2014	CPR Overhead	Lasalle Blvd.	51.9	19.0	2	1975
2015	CPR Overpass / Nolin Creek	Elm St. West	73.2	18.6	3	1975
2016	Dufferin Street Bridge	Dufferin St.	6.5	11.0	1	1940
2021	Pedestrian Crossing	Dufferin St.	18.3	2.0	3	1980
2533	Trans Canada Trail	Onaping Falls	52.5	2.3	2	1989
2534	Bridge St /Emile St	Trans Canada Trail	50.0	2.2	3	2006
3000	Nelson Lk Rd @ Rapid River	Nelson Lk Rd.	15.0	5.4	1	1965
3001	Vermillion River Bridge	Desmarais	36.0	10.6	3	2010
3002	Martin Road Bridge	Martin Rd.	30.1	9.8	3	1965
3003	Whitson River Bridge	M R 15	17.0	11.0	1	1967
3004	Frappier Road Bridge	Frappier Rd.	19.0	9.8	1	1970
3005	Whitson River	M R 80 (Hwy 69)	14.9	22.1	1	1990
3006	Kalmo Road Bridge / Whitson River	Kalmo Rd.	27.6	3.6	1	1998
4000	Roberts River	M R 84 (Moose Mt)	21.9	5.7	1	1997
4001	Vermillion River	M R 84 (Moose Mt)	27.4	5.3	1	2020
4002	Bowland Bay Bridge	Bowland Bay Rd.	18.1	10.1	3	1983
4003	Industrial Rd (Ski Hill Rd)	Industrial Rd (Ski Hill Rd)	27.0	7.0	1	2005
4004	CNR Overpass	Falconbridge Rd.	62.7	17.0	3	1973
4005	Roberts River	Ironside Lake Rd.	12.3	4.2	1	2020
4010	Junction Creek Ped Bridge	Fielding St.	11.0	2.0	1	1980
4513	Gary Avenue Dead End	Trans Canada Trail	9.5	2.0	1	2006
5000	Riverside Drive Bridge	Riverside Dr.	9.6	20.3	1	1942
5002	Broadway Street Bridge	Broadway St.	19.8	3.7	1	1960
5003	Brady Street Underpass	Brady St.	19.8	19.3	2	1962
5008	Paris St Overpass SBL	Paris St.	207.3	11.0	3	1973
5009	Coniston Creek Bridge	Garson Coniston Rd.	14.9	10.1	1	1960

Bridge ID	Name	Route	Length	Width	Spans	Const Yr
5010	Romford Creek Bridge	Caruso St.	5.8	10.5	1	1950
5013	Romford Creek Bridge	Walter St.	6.5	10.5	1	1950
5015	Romford Creek Bridge	Edward Ave.	8.7	10.0	1	1955
5016	Coniston Creek	Government Rd.	11.9	8.9	1	2016
5017	Mountain View Road Bridge	Mountain View Rd.	8.0	13.0	1	1998
5018	Roseland Drive Bridge	Roseland Dr.	8.0	13.0	1	1998
5020	Deer Creek Bridge	Red Deer Rd.	18.5	5.7	3	1970
5021	Deer Creek Bridge	Woodland Rd.	8.3	5.6	1	2000
5022	Pedestrian Bridge	Wellington	22.0	2.0	3	1980
5023	Pedestrian Bridge	Nelson St.	51.9	3.6	1	1980
5029	Coniston Creek Pedestrian Bridge	Poplar St.	22.3	1.8	1	2020
5030	Paris St Overpass NBL	Paris St.	207.3	11.0	3	1973
5051	Centennial Dr Park Bridge	Centennial Dr.	12.8	2.5	1	1990
5516	Mallards Landing Park	Trans Canada Trail @ M	20.3	2.1	1	2006
6001	CPR Subway	College St.	15.5	19.5	2	1930
6008	Leslie Street Bridge	Leslie St.	48.5	13.3	3	1970
6009	Bond Street Bridge	Bond St.	7.1	6.8	1	1950
6010	King Street Bridge	King St.	7.1	14.9	1	1940
6012	Pedestrian Bridge	Agnes St.	12.5	2.0	1	1989
6013	Pedestrian Bridge	Perrault St.	20.4	2.0	3	1983
6014	Pedestrian Bridge	Stafford St.	11.0	2.0	1	1982
6015	Pedestrian Bridge	Mountainview Cres.	11.0	2.0	1	1980
6017	Eva Avenue Pedestrian Bridge	Eva Avenue	56.3	2.9	1	2000
6510	Trans Canada Trail (Barrydowne Aren	Trans Canada Trail	15.7	2.8	1	2006

Total # of Bridges 90

Those bridges where the span is highlighted in amber are not subject to the Ontario Statute for biennial inspection.

Culvert List

Culvert ID	Name	Route	Length	Span	Cells	Const Yr
1016	Creighton Road at Club Road	Creighton Rd.	14.7	3.0	1	2013
1017	Creighton Road at Tennis Club	Creighton Rd.	26.9	3.0	1	2013
1018	Power Street Bridge	Power St.	19.5	3.0	1	2013
1529	MR 24 Culvert	Regional Rd. 24	28.3	3.7	1	1960
1530	Finland Creek	Power St.	20.0	3.5	1	1987
1531	Junction Creek	Kelly Lake Rd.	30.0	10.0	1	2017
1532	Junction Creek	Martindale Rd.	39.0	8.2	1	1964
1533	Lily Creek	Martindale Rd.	20.0	6.7	1	2007
1534	Junction Creek	McLeod St.	54.6	8.4	1	1956
1535	Lily Creek	Regent St.	40.0	7.0	1	1952
1536	Fairbank Creek	Bay St	25.7	4.5	1	2006
1537	Fairbank Creek	Bay St (MR # 3)	22.2	3.6	1	2006
1538	Fairbank Creek	Fairbanks Lk Rd	22.0	3.6	1	2006
1539	Inco Drainage Ditch	MR 55 (old Hwy 17)	51.5	3.0	2	2006
1540	Panache Lake Rd Culvert	Panache Lake Rd.	28.2	4.2	1	2003
1541	Panache Lake Rd. Culvert	Panache Lake Rd.	19.2	3.4	1	2005
1542	Wabagishik Road Culvert	Wabagishik Rd.	17.0	5.0	1	2006
1543	Hill Road Culvert	Hill Rd.	23.8	3.0	1	2014
1544	C. Johnson Road Culvert @ MR #4	C. Johnsons Rd.	19.8	3.6	3	1980
1545	Lorne Falls Rd. Culvert	Lorne Falls Rd.	19.5	3.0	1	2009
1546	Graham Rd. Culvert	Graham Rd.	26.0	4.7	1	2009
1547	Worthington Rd. Culvert	Worthington Rd.	18.5	4.4	1	1980
1548	CSPA Culvert	Grassy Lake Rd.	18.6	3.1	1	1980
1549	Balsam Street Bridge	Balsam St.	19.8	2.4	1	2000
1553	Fairbank Creek Culvert	RR 55	38.5	2.4	2	2017
1560	Southview Dr.	Southview Dr	18.6	4.5	1	2006
1562	Old Soo Rd Box Culvert	Old Soo Rd	9.2	3.0	1	2017
1563	Fairbank Creek	RR 55	25.0	3.7	1	1950
1564	Fairbank Lake Rd Culvert	Fairbank Lake Rd.	17.1	2.4	2	2013
1565	Fairbank Creek Culvert	Fairbank Lake Road	28.0	2.4	2	2014
2020	Pedestrian Underpass	Dufferin St.	55.5	3.5	1	1987
2500	Birch St Culvert	Birch St	25.4	3.7	2	1970

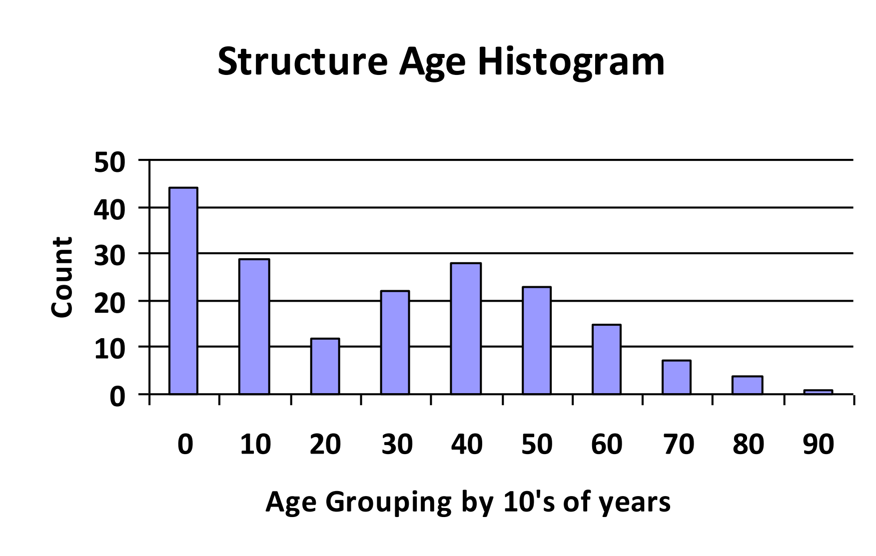
Culvert ID	Name	Route	Length	Span	Cells	Const Yr
2503	Montpellier Road South Culvert	Montpellier Rd.	15.3	3.0	1	2016
2504	Montpellier Road Middle Culvert	Montpellier Rd.	18.4	2.4	2	2013
2505	Nickel Basin Road Culvert	Nickel Basin Rd. (North)	16.8	2.4	2	2016
2506	Mckenzie Road Culvert	Mckenzie Road	15.0	4.8	1	2018
2507	Pilon Drain	Notre Dame Ave.	31.3	2.4	1	2018
2508	Landry Creek	Notre Dame Ave.	38.0	3.0	1	1960
2509	Inco Pipeline	Elm St. West	60.0	6.1	1	1975
2510	Whitewater Creek	MR 35	46.0	3.6	2	1993
2511	Huron Street Culvert	Huron St.	66.4	3.5	1	1980
2512	Nolins Creek	Frood Rd.	25.3	3.6	1	1960
2513	Inco Drainage Ditch	Lasalle Blvd.	73.0	3.6	1	1970
2514	Granite-McKim Culvert	Granite/McKim Streets	400.0	3.4	1	1993
2516	McNeil Pedestrian Crossing	Over Nolins Creek	15.1	2.0	2	1980
2517	Erie/Monck Pedestrian Crossing	Erie St.	27.0	2.1	1	1970
2518	Lasalle/Inco Culvert	Lasalle Blvd.	62.0	2.4	1	1990
2519	Nolins Creek	Beatty St.	24.0	5.3	1	1970
2536	McKenzie Creek Culvert	Montpellier Road	20.0	2.4	2	2014
3007	Whitson Flood Channel Culvert	MR 15	25.3	3.7	1	2017
3502	Lasalle Blvd Culvert	Lasalle Blvd	168.0	2.4	1	1940
3503	MR 80	MR 80	32.0	3.7	1	1995
3504	Fleming Street Culvert	MR 80 (Highway 69 North	36.8	3.1	1	2002
3505	Bodson East Culvert	Bodson East	12.3	3.0	1	2015
3510	Yorkshire Dr. Culverts	Yorkshire Drive	15.2	1.8	2	2017
4500	Christina St. Culvert	Christina St.	16.0	0.9	2	1985
4501	Junction Creek Culvert	Lasalle Blvd.	38.5	6.9	1	1971
4502	Robin St	Robins St W. of Crestmoo	19.2	3.0	1	2018
4503	Junction Creek	Madison Ave.	25.5	3.0	2	2015
4505	Junction Creek	Lansing Ave.	42.2	4.4	2	1970
4506	Madison Avenue	Madison Ave.	58.7	3.0	1	2007
4507	Junction Creek	Maley Dr.	29.4	3.7	1	1990
4508	MR 85 CULVERT	MR 85 Radar Rd.	22.0	2.4	2	2010
4514	Hanmer Lake Culvert	Hanmer Lake Rd West	17.0	1.8	2	2016
5001	Junction Creek Bridge	Douglas St.	137.3	7.6	1	1980
5011	Romford Creek Bridge	Allan St.	14.0	5.5	1	2020

Culvert ID	Name	Route	Length	Span	Cells	Const Yr
5014	Romford Creek Bridge	William Ave.	14.8	7.0	1	2019
5024	Elgin Pedestrian Subway	Elgin St.	86.0	2.9	1	1956
5025	Lily Creek	Paris St.	47.5	3.8	2	1972
5500	Chief Lake Road Culvert	Chief Lake Rd.	19.5	3.0	1	1994
5501	Elbow Creek Culvert	Dryden Rd.	26.5	3.4	1	2016
5502	Hill Street Culvert	Hill Street	24.6	1.5	2	2019
5503	Forest Lake Road Culvert	Forest Lake Rd	12.6	2.0	1	2016
5504	Garson Coniston Rd	Garson Coniston Rd.	30.0	5.0	1	2018
5506	Long Lake Road Culvert	Long Lake Rd.	43.0	5.0	1	2009
5507	Long Lake Road	Long Lake Rd.	26.8	3.1	1	1965
5508	Broadway	Broadway	46.0	7.6	1	1960
5511	Centennial Dr @ Lily Creek	Centennial Dr.	28.5	3.5	1	2003
5514	Jumbo Rd South	Jumbo Road	17.2	3.0	1	2015
5517	Kari Road Culvert	Kari Road	19.2	3.0	1	2018
5518	Walter Street Culvert	Walter Street	24.0	1.8	2	2018
5519	Jumbo Rd North	Jumbo Rd	19.2	3.0	1	2018
6011	Attlee Avenue Bridge	Attlee Ave.	31.0	7.2	1	1975
6020	Mountain Street	Mountain St.	69.2	6.7	1	1985
6500	Beatrice Crescent Culvert	Beatrice Cr.	24.3	2.4	1	2018
6501	Leon Drainage Ditch	Lasalle Blvd.	19.2	3.3	1	1950
6502	Junction Creek	Barrydowne Rd.	37.3	6.9	1	1967
6503	Hebert Street Culvert	Hebert St.	25.2	3.0	1	2015
6504	Belfry Avenue Culvert	Belfry Ave.	24.0	3.2	1	2006
6505	Attlee Avenue Culvert	Attlee Ave.	32.3	4.4	1	1980
6506	Third Avenue	Bancroft Dr.	24.5	3.7	1	1995
6507	Arthur Street	Arthur St.	22.5	6.0	1	2011
6508	Kenwood Avenue	Kenwood Ave.	33.0	3.8	2	1970
6509	Highgate	Highgate	35.0	3.5	2	1980
6511	Attlee Ave Pedestrian	Trail	12.5	3.5	1	1980

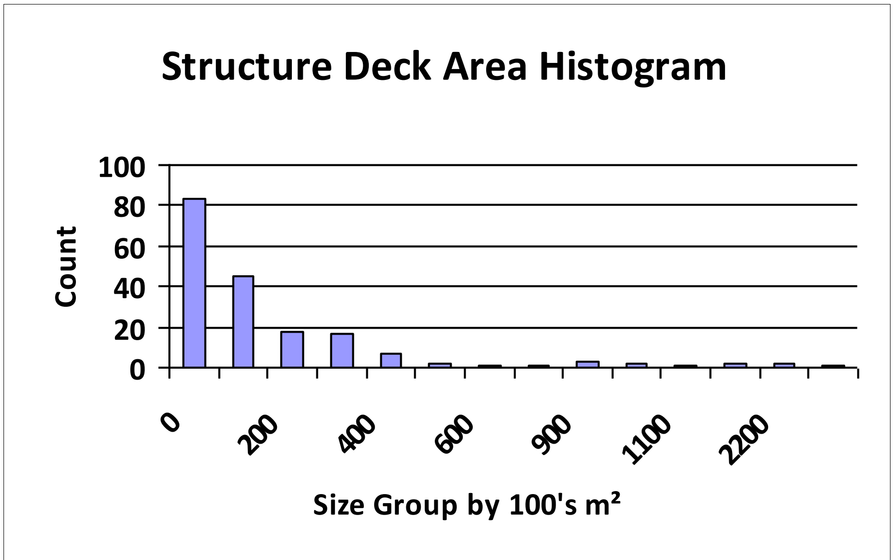
Total # of Culverts 95

Those culverts where the span is highlighted in amber are not subject to the Ontario Statute for biennial inspection.

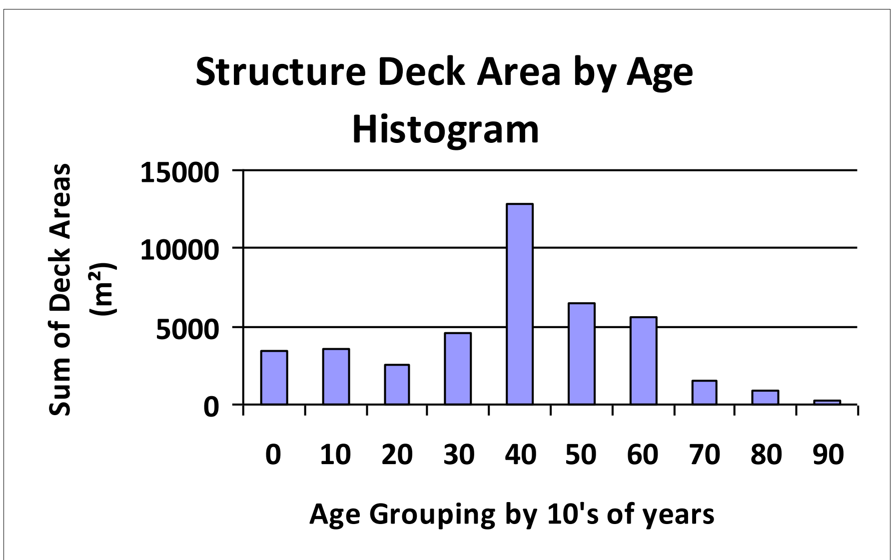
Structure Summary Statistics



Average Age	31.4
Youngest Age	0
Oldest Age	90
Structure Count	**185**



Average Deck Area	234 **m²**
Min Deck Area	19 **m²**
Max Deck Area	2381 **m²**
Total Deck Area	**43,219** m²



Deck area < 20 yrs old	7171 **m²**
Deck area < 50 yrs old	29096 **m²**
Deck area > 50 yrs old	12308 **m²**

Bridge ID	Name	Estimated Remaining Service Life	Program Year	Estimated Replacement Cost
1009	Old Soo Road Bridge	99		$980,000
5011	Romford Creek Bridge	99		$663,000
1019	Finland Creek Bridge	95		$2,196,000
5014	Romford Creek Bridge	88		$1,738,000
5502	Hill Street Culvert	88		$1,580,000
2507	Pilon Drain	87		$1,346,000
4502	Robin St	87		$1,116,000
5504	Garson Coniston Rd	87		$2,436,000
6500	Beatrice Crescent Culvert	87		$1,212,000
5519	Jumbo Rd North	87		$1,108,000
5517	Kari Road Culvert	87		$1,178,000
2506	Mckenzie Road Culvert	87		$1,230,000
5518	Walter Street Culvert	87		$1,551,000
1531	Junction Creek	86		$4,402,000
1562	Old Soo Rd Box Culvert	86		$754,000
1553	Fairbank Creek Culvert	86		$3,014,000
3007	Whitson Flood Channel Culvert	86		$1,685,000
3510	Yorkshire Dr. Culverts	86		$1,058,000
2503	Montpellier Road South Culvert	85		$1,088,000
2505	Nickel Basin Road Culvert	85		$1,660,000
5016	Coniston Creek	85		$1,420,000
5501	Elbow Creek Culvert	85		$1,386,000
4514	Hanmer Lake Culvert	85		$1,034,000
5503	Forest Lake Road Culvert	85		$563,000
3505	Bodson East Culvert	84		$848,000
4503	Junction Creek	84		$2,999,000
6503	Hebert Street Culvert	84		$1,299,000
5514	Jumbo Rd South	84		$1,136,000
1543	Hill Road Culvert	83		$1,617,000
1565	Fairbank Creek Culvert	83		$2,367,000
2536	McKenzie Creek Culvert	83		$1,853,000
1016	Creighton Road at Club Road	82		$754,000
1017	Creighton Road at Tennis Club	82		$1,168,000
1018	Power Street Bridge	82		$940,000
2504	Montpellier Road Middle Culvert	82		$1,808,000

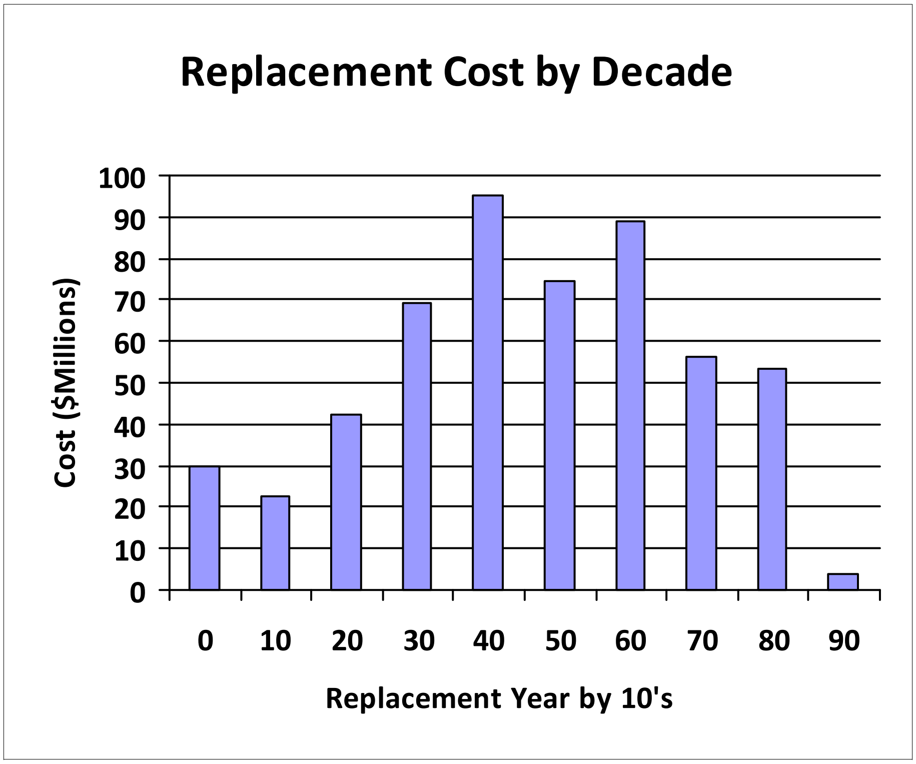
Bridge ID	Name	Estimated Remaining Service Life	Program Year	Estimated Replacement Cost
1564	Fairbank Lake Rd Culvert	82		$1,551,000
6507	Arthur Street	80		$2,510,000
3001	Vermillion River Bridge	79		$3,985,000
4001	Vermillion River	79		$3,158,000
4005	Roberts River	79		$1,167,000
4508	MR 85 CULVERT	79		$2,052,000
1000	Spanish River Bridge	79		$2,229,000
1545	Lorne Falls Rd. Culvert	78		$1,192,000
1546	Graham Rd. Culvert	78		$2,246,000
5506	Long Lake Road Culvert	78		$4,385,000
5017	Mountain View Road Bridge	77	2022	$1,991,000
5018	Roseland Drive Bridge	77		$1,991,000
1533	Lily Creek	76		$2,085,000
4506	Madison Avenue	76		$2,499,000
1536	Fairbank Creek	75		$2,160,000
1537	Fairbank Creek	75		$1,644,000
1538	Fairbank Creek	75		$1,595,000
1542	Wabagishik Road Culvert	75	2023	$1,424,000
1560	Southview Dr.	75		$1,253,000
2001	Vermillion Lk Rd	75		$1,881,000
1539	Inco Drainage Ditch	75		$5,398,000
1541	Panache Lake Rd. Culvert	74		$1,186,000
3004	Frappier Road Bridge	74		$3,180,000
1024	Big Nickel Mine Rd	72	2022	$4,608,000
4002	Bowland Bay Bridge	72		$1,822,000
5511	Centennial Dr @ Lily Creek	72		$1,313,000
1026	Junction Creek Bridge	69		$3,071,000
3005	Whitson River	69	2022	$5,124,000
5021	Deer Creek Bridge	69		$480,000
1006	Spanish River near Worthington Road	66	2021	$2,067,000
1015	Finland Creek Bridge	66		$904,000
2003	Whitson Creek Bridge	66		$3,784,000
2004	Whitson Creek Bridge	66		$3,921,000
2009	Whitson River Bridge	66		$3,277,000
3003	Whitson River Bridge	66		$3,504,000
1010	Black Lake Road Bridge	65		$2,209,000
2509	Inco Pipeline	64		$5,679,000

Bridge ID	Name	Estimated Remaining Service Life	Program Year	Estimated Replacement Cost
4003	Industrial Rd (Ski Hill Rd)	64		$4,134,000
6506	Third Avenue	64		$1,482,000
5500	Chief Lake Road Culvert	63		$1,149,000
1001	Vermillion River Bridge	62		$6,748,000
2510	Whitewater Creek	62	2024	$6,161,000
4004	CNR Overpass	62		$9,142,000
2514	Granite-McKim Culvert	62		$20,024,000
1011	Mikkola Road Bridge	60		$3,702,000
2010	Landry Street Bridge	60	2024	$2,167,000
2518	Lasalle/Inco Culvert	59		$2,874,000
4507	Junction Creek	59		$1,924,000
5001	Junction Creek Bridge	59		$14,286,000
1004	High Falls Road Bridge	58		$3,215,000
1008	Moxam Creek Bridge	57	2024	$4,534,000
1012	Fielding Road Bridge	56	2022	$2,702,000
1530	Finland Creek	56		$1,274,000
4000	Roberts River	56	2021	$2,751,000
5000	Riverside Drive Bridge	56		$2,359,000
2008	Montee Principale Bridge	55	2025	$2,494,000
2012	INCO Railway	54		$7,753,000
2013	Lasalle Interchange	54	2024	$7,085,000
3503	MR 80	54	2022	$2,062,000
6020	Mountain Street	54		$6,165,000
1532	Junction Creek	53		$5,025,000
1540	Panache Lake Rd Culvert	52	2022	$2,338,000
2006	Onaping River Bridge	52	2022	$3,564,000
3504	Fleming Street Culvert	51		$2,236,000
5009	Coniston Creek Bridge	49		$2,841,000
5029	Coniston Creek Pedestrian Bridge	49		$360,000
6010	King Street Bridge	49	2024	$1,990,000
1025	Lily Creek Bridge	48	2025	$2,333,000
1002	Little Panache Lake Narrows	45		$2,944,000
1030	Meatbird Creek Pedestrian Bridge	45		$299,000
1005	Chicago Mine Road Bridge	44		$1,275,000
2014	CPR Overhead	44	2024	$8,621,000
2015	CPR Overpass / Nolin Creek	44	2023	$12,454,000
5507	Long Lake Road	44		$1,377,000

Bridge ID	Name	Estimated Remaining Service Life	Program Year	Estimated Replacement Cost
6011	Attlee Avenue Bridge	44		$3,196,000
2005	Onaping River Bridge	43	2030	$8,115,000
5008	Paris St Overpass SBL	42	2022	$17,176,000
5030	Paris St Overpass NBL	42	2023	$17,176,000
5025	Lily Creek	41	2022	$6,971,000
2007	Vermilion River Bridge	40	2023	$3,936,000
4501	Junction Creek Culvert	40		$3,917,000
2000	Simmons Road Bridge	39	2025	$5,378,000
2513	Inco Drainage Ditch	39	2022	$4,798,000
5002	Broadway Street Bridge	39		$902,000
6008	Leslie Street Bridge	39	2023	$6,625,000
1029	Copper Cliff Trail Bridge	39		$270,000
1014	CPR Overhead (Eastbound)	38		$14,575,000
6502	Junction Creek	36	2025	$3,866,000
1561	Trans Canada Trail	35	2024	$498,000
2534	Bridge St /Emile St	35		$1,863,000
4513	Gary Avenue Dead End	35		$170,000
5024	Elgin Pedestrian Subway	35	2025	$1,496,000
5516	Mallards Landing Park	35	2025	$383,000
6510	Trans Canada Trail (Barrydowne Aren	35		$395,000
1013	CPR Overhead (Westbound)	34		$14,598,000
5015	Romford Creek Bridge	34		$1,795,000
2533	Trans Canada Trail	33	2022	$1,161,000
1535	Lily Creek	31	2025	$6,129,000
5003	Brady Street Underpass	31	2024	$4,358,000
1022	Poland Street Bridge	29	2025	$1,264,000
1023	Orford Street Bridge	29	2025	$1,257,000
5508	Broadway	29		$5,123,000
6017	Eva Avenue Pedestrian Bridge	29		$1,421,000
2002	Main Street Bridge	26	2023	$8,096,000
1534	Junction Creek	25	2023	$6,401,000
6504	Belfry Avenue Culvert	25		$692,000
6501	Leon Drainage Ditch	24	2023	$1,257,000
5051	Centennial Dr Park Bridge	24	2021	$287,000
3502	Lasalle Blvd Culvert	24		$6,998,000
1549	Balsam Street Bridge	24		$952,000
6012	Pedestrian Bridge	23		$165,000

Bridge ID	Name	Estimated Remaining Service Life	Program Year	Estimated Replacement Cost
1007	Vermillion River Bridge	22		$8,156,000
1003	Maninen Road Bridge	19	2021	$673,000
1529	MR 24 Culvert	19		$1,713,000
2016	Dufferin Street Bridge	19	2022	$1,263,000
5020	Deer Creek Bridge	19	2030	$1,067,000
1563	Fairbank Creek	19		$1,868,000
6013	Pedestrian Bridge	17		$270,000
1028	Struthers Pedestrian Bridge	16		$291,000
6014	Pedestrian Bridge	16	2022	$146,000
1020	Finland Street Bridge	14	2024	$5,621,000
2021	Pedestrian Crossing	14		$242,000
2500	Birch St Culvert	14	2023	$1,446,000
2516	McNeil Pedestrian Crossing	14		$1,240,000
4010	Junction Creek Ped Bridge	14	2023	$145,000
5022	Pedestrian Bridge	14		$291,000
5023	Pedestrian Bridge	14	2022	$1,619,000
6009	Bond Street Bridge	14		$1,022,000
6015	Pedestrian Bridge	14		$151,000
6508	Kenwood Avenue	14		$1,460,000
6511	Attlee Ave Pedestrian	14		$332,000
2020	Pedestrian Underpass	11		$1,273,000
4500	Christina St. Culvert	11		$406,000
2517	Erie/Monck Pedestrian Crossing	9	2022	$472,000
3006	Kalmo Road Bridge / Whitson River	9	2027	$2,512,000
6505	Attlee Avenue Culvert	9	2028	$951,000
3002	Martin Road Bridge	7	2028	$2,875,000
1548	CSPA Culvert	7	2027	$606,000
6001	CPR Subway	5	2026	$5,682,000
1544	C. Johnson Road Culvert @ MR #4	4	2026	$1,640,000
2508	Landry Creek	4	2022	$1,918,000
4505	Junction Creek	4	2023	$2,106,000
5010	Romford Creek Bridge	4	2024	$1,141,000
5013	Romford Creek Bridge	4	2023	$1,736,000
6509	Highgate	4	2024	$1,382,000
1547	Worthington Rd. Culvert	2	2023	$573,000
2512	Nolins Creek	1	2022	$1,841,000
3000	Nelson Lk Rd @ Rapid River	1	2021	$829,000

Bridge ID	Name	Estimated Remaining Service Life	Program Year	Estimated Replacement Cost
2519	Nolins Creek	0	2021	$2,408,000
2511	Huron Street Culvert	0	2021	$1,287,000



Total Replacement Cost	$535,870,000
Average Replacement Cost	$2,896,595
Total Deck Area	43275 m^2

Culvert Replacement Cost

Culvert ID	Name	Existing Culvert Type	Common Costs	Total Cost Concrete Replacement	Total Cost Steel Replacement	Existing Culvert Replacement Cost	Life-Cycle Cost Concrete Replacement	Life-Cycle Cost Steel Replacement
1009	Old Soo Road Bridge	Precast 3 Sided RF	$392,100	$1,145,000	$980,000	$980,000	$1,158,700	$1,195,600
1016	Creighton Road at Club Road	Concrete Culvert	$208,500	$754,000	$709,000	$754,000	$763,000	$865,000
1017	Creighton Road at Tennis Club	Concrete Culvert	$225,500	$1,168,000	$1,087,000	$1,168,000	$1,182,000	$1,326,100
1018	Power Street Bridge	Concrete Culvert	$229,400	$940,000	$876,000	$940,000	$951,300	$1,068,700
1529	MR 24 Culvert	Concrete Culvert	$373,900	$1,713,000	$1,632,000	$1,713,000	$1,733,600	$1,991,000
1530	Finland Creek	Concrete Culvert	$246,500	$1,274,000	$1,183,000	$1,274,000	$1,289,300	$1,443,300
1531	Junction Creek	Concrete Culvert	$612,900	$4,402,000	$4,161,000	$4,402,000	$4,454,800	$5,076,400
1532	Junction Creek	Concrete Culvert	$633,700	$5,025,000	$4,620,000	$5,025,000	$5,085,300	$5,636,400
1533	Lily Creek	Concrete Culvert	$363,700	$2,085,000	$1,927,000	$2,085,000	$2,110,000	$2,350,900
1534	Junction Creek	Concrete Culvert	$574,500	$6,401,000	$6,026,000	$6,401,000	$6,477,800	$7,351,700
1535	Lily Creek	Concrete Culvert	$2,107,200	$6,129,000	$5,893,000	$6,129,000	$6,202,500	$7,189,500
1536	Fairbank Creek	Concrete Culvert	$368,800	$2,160,000	$2,004,000	$2,160,000	$2,185,900	$2,444,900
1537	Fairbank Creek	Concrete Culvert	$350,300	$1,644,000	$1,534,000	$1,644,000	$1,663,700	$1,871,500
1538	Fairbank Creek	Concrete Culvert	$333,700	$1,595,000	$1,488,000	$1,595,000	$1,614,100	$1,815,400
1539	Inco Drainage Ditch	Concrete Culvert	$430,500	$5,398,000	$4,992,000	$5,398,000	$5,462,800	$6,090,200
1540	Panache Lake Rd Culvert	Concrete Culvert	$387,200	$2,338,000	$2,217,000	$2,338,000	$2,366,100	$2,704,700
1541	Panache Lake Rd. Culvert	Concrete Culvert	$226,500	$1,186,000	$1,101,000	$1,186,000	$1,200,200	$1,343,200
1542	Wabagishik Road Culvert	Concrete Culvert	$302,300	$1,424,000	$1,323,000	$1,424,000	$1,441,100	$1,614,100
1543	Hill Road Culvert	Concrete Culvert	$278,100	$1,617,000	$1,507,000	$1,617,000	$1,636,400	$1,838,500

Culvert ID	Name	Existing Culvert Type	Common Costs	Total Cost Concrete Replacement	Total Cost Steel Replacement	Existing Culvert Replacement Cost	Life-Cycle Cost Concrete Replacement	Life-Cycle Cost Steel Replacement
1544	C. Johnson Road Culvert @ MR	Soil-Steel Structure	$455,600	$1,968,000	$1,640,000	$1,640,000	$1,991,600	$2,000,800
1545	Lorne Falls Rd. Culvert	Concrete Culvert	$269,800	$1,192,000	$1,112,000	$1,192,000	$1,206,300	$1,356,600
1546	Graham Rd. Culvert	Concrete Culvert	$365,300	$2,246,000	$2,079,000	$2,246,000	$2,273,000	$2,536,400
1547	Worthington Rd. Culvert	Soil-Steel Structure	$230,900	$671,000	$573,000	$573,000	$679,100	$699,100
1548	CSPA Culvert	Soil-Steel Structure	$226,100	$693,000	$606,000	$606,000	$701,300	$739,300
1549	Balsam Street Bridge	Concrete Culvert	$215,200	$952,000	$889,000	$952,000	$963,400	$1,084,600
1553	Fairbank Creek Culvert	Concrete Culvert	$371,100	$3,014,000	$2,846,000	$3,014,000	$3,050,200	$3,472,100
1560	Southview Dr.	Concrete Culvert	$252,600	$1,253,000	$1,159,000	$1,253,000	$1,268,000	$1,414,000
1562	Old Soo Rd Box Culvert	Concrete Culvert	$315,300	$754,000	$730,000	$754,000	$763,000	$890,600
1563	Fairbank Creek	Concrete Culvert	$391,200	$1,868,000	$1,778,000	$1,868,000	$1,890,400	$2,169,200
1564	Fairbank Lake Rd Culvert	Concrete Culvert	$286,400	$1,551,000	$1,440,000	$1,551,000	$1,569,600	$1,756,800
1565	Fairbank Creek Culvert	Concrete Culvert	$286,200	$2,367,000	$2,236,000	$2,367,000	$2,395,400	$2,727,900
2020	Pedestrian Underpass	Soil-Steel Structure	$250,700	$1,484,000	$1,273,000	$1,273,000	$1,501,800	$1,553,100
2500	Birch St Culvert	Soil-Steel Structure	$406,000	$1,708,000	$1,446,000	$1,446,000	$1,728,500	$1,764,100
2503	Montpellier Road South Culvert	Concrete Culvert	$290,500	$1,088,000	$1,022,000	$1,088,000	$1,101,100	$1,246,800
2504	Montpellier Road Middle Culvert	Concrete Culvert	$349,400	$1,808,000	$1,683,000	$1,808,000	$1,829,700	$2,053,300
2505	Nickel Basin Road Culvert	Concrete Culvert	$347,900	$1,660,000	$1,545,000	$1,660,000	$1,679,900	$1,884,900
2506	Mckenzie Road Culvert	Concrete Culvert	$287,400	$1,230,000	$1,146,000	$1,230,000	$1,244,800	$1,398,100
2507	Pilon Drain	Concrete Culvert	$220,200	$1,346,000	$1,245,000	$1,346,000	$1,362,200	$1,518,900
2508	Landry Creek	Concrete Culvert	$293,400	$1,918,000	$1,774,000	$1,918,000	$1,941,000	$2,164,300
2509	Inco Pipeline	Concrete Culvert	$883,100	$5,679,000	$5,376,000	$5,679,000	$5,747,100	$6,558,700

Culvert ID	Name	Existing Culvert Type	Common Costs	Total Cost Concrete Replacement	Total Cost Steel Replacement	Existing Culvert Replacement Cost	Life-Cycle Cost Concrete Replacement	Life-Cycle Cost Steel Replacement
2510	Whitewater Creek	Concrete Culvert	$859,900	$6,161,000	$5,823,000	$6,161,000	$6,234,900	$7,104,100
2511	Huron Street Culvert	Soil-Steel Structure	$314,900	$1,582,000	$1,287,000	$1,287,000	$1,601,000	$1,570,100
2512	Nolins Creek	Concrete Culvert	$296,800	$1,841,000	$1,746,000	$1,841,000	$1,863,100	$2,130,100
2513	Inco Drainage Ditch	Concrete Culvert	$1,510,900	$4,798,000	$4,603,000	$4,798,000	$4,855,600	$5,615,700
2514	Granite-McKim Culvert	Concrete Culvert	$1,050,400	$20,024,000	$18,781,000	$20,024,000	$20,264,300	$22,912,800
2516	McNeil Pedestrian Crossing	Concrete Culvert	$146,900	$1,240,000	$1,146,000	$1,240,000	$1,254,900	$1,398,100
2517	Erie/Monck Pedestrian Crossing	Soil-Steel Structure	$130,900	$563,000	$472,000	$472,000	$569,800	$575,800
2518	Lasalle/Inco Culvert	Concrete Culvert	$663,100	$2,874,000	$2,740,000	$2,874,000	$2,908,500	$3,342,800
2519	Nolins Creek	Concrete Culvert	$438,500	$2,408,000	$2,250,000	$2,408,000	$2,436,900	$2,745,000
2536	McKenzie Creek Culvert	Concrete Culvert	$269,600	$1,853,000	$1,755,000	$1,853,000	$1,875,200	$2,141,100
3007	Whitson Flood Channel Culvert	Concrete Culvert	$247,600	$1,685,000	$1,558,000	$1,685,000	$1,705,200	$1,900,800
3502	Lasalle Blvd Culvert	Concrete Culvert	$637,700	$6,998,000	$6,586,000	$6,998,000	$7,082,000	$8,034,900
3503	MR 80	Concrete Culvert	$454,400	$2,062,000	$1,964,000	$2,062,000	$2,086,700	$2,396,100
3504	Fleming Street Culvert	Concrete Culvert	$441,600	$2,236,000	$2,080,000	$2,236,000	$2,262,800	$2,537,600
3505	Bodson East Culvert	Concrete Culvert	$283,500	$848,000	$801,000	$848,000	$858,200	$977,200
3510	Yorkshire Dr. Culverts	Concrete Culvert	$210,700	$1,058,000	$990,000	$1,058,000	$1,070,700	$1,207,800
4500	Christina St. Culvert	Soil-Steel Structure	$197,000	$450,000	$406,000	$406,000	$455,400	$495,300
4501	Junction Creek Culvert	Concrete Culvert	$696,800	$3,917,000	$3,716,000	$3,917,000	$3,964,000	$4,533,500
4502	Robin St	Concrete Culvert	$244,300	$1,116,000	$1,041,000	$1,116,000	$1,129,400	$1,270,000
4503	Junction Creek	Concrete Culvert	$426,500	$2,999,000	$2,836,000	$2,999,000	$3,035,000	$3,459,900
4505	Junction Creek	Soil-Steel Structure	$445,200	$2,608,000	$2,106,000	$2,106,000	$2,639,300	$2,569,300

Culvert ID	Name	Existing Culvert Type	Common Costs	Total Cost Concrete Replacement	Total Cost Steel Replacement	Existing Culvert Replacement Cost	Life-Cycle Cost Concrete Replacement	Life-Cycle Cost Steel Replacement
4506	Madison Avenue	Concrete Culvert	$255,000	$2,499,000	$2,288,000	$2,499,000	$2,529,000	$2,791,400
4507	Junction Creek	Concrete Culvert	$267,300	$1,924,000	$1,778,000	$1,924,000	$1,947,100	$2,169,200
4508	MR 85 CULVERT	Concrete Culvert	$306,200	$2,052,000	$1,903,000	$2,052,000	$2,076,600	$2,321,700
4514	Hanmer Lake Culvert	Concrete Culvert	$175,800	$1,034,000	$955,000	$1,034,000	$1,046,400	$1,165,100
5001	Junction Creek Bridge	Concrete Culvert	$821,800	$14,286,000	$13,113,000	$14,286,000	$14,457,400	$15,997,900
5014	Romford Creek Bridge	Concrete Culvert	$439,100	$1,738,000	$1,636,000	$1,738,000	$1,758,900	$1,995,900
5024	Elgin Pedestrian Subway	Pedestrian Tunnel	$245,200	$1,846,000	$1,496,000	$1,496,000	$1,868,200	$1,825,100
5025	Lily Creek	Concrete Culvert	$1,227,100	$6,971,000	$6,471,000	$6,971,000	$7,054,700	$7,894,600
5500	Chief Lake Road Culvert	Concrete Culvert	$234,000	$1,149,000	$1,070,000	$1,149,000	$1,162,800	$1,305,400
5501	Elbow Creek Culvert	Concrete Culvert	$217,400	$1,386,000	$1,281,000	$1,386,000	$1,402,600	$1,562,800
5502	Hill Street Culvert	Concrete Culvert	$246,200	$1,580,000	$1,476,000	$1,580,000	$1,599,000	$1,800,700
5503	Forest Lake Road Culvert	Concrete Culvert	$121,000	$563,000	$529,000	$563,000	$569,800	$645,400
5504	Garson Coniston Rd	Concrete Culvert	$352,700	$2,436,000	$2,306,000	$2,436,000	$2,465,200	$2,813,300
5506	Long Lake Road Culvert	Concrete Culvert	$612,100	$4,385,000	$4,146,000	$4,385,000	$4,437,600	$5,058,100
5507	Long Lake Road	Concrete Culvert	$227,200	$1,377,000	$1,274,000	$1,377,000	$1,393,500	$1,554,300
5508	Broadway	Concrete Culvert	$618,200	$5,123,000	$4,836,000	$5,123,000	$5,184,500	$5,899,900
5511	Centennial Dr @ Lily Creek	Concrete Culvert	$215,400	$1,313,000	$1,220,000	$1,313,000	$1,328,800	$1,488,400
5514	Jumbo Rd South	Concrete Culvert	$293,200	$1,136,000	$1,065,000	$1,136,000	$1,149,600	$1,299,300
5517	Kari Road Culvert	Concrete Culvert	$275,500	$1,178,000	$1,123,000	$1,178,000	$1,192,100	$1,370,100
5518	Walter Street Culvert	Concrete Culvert	$235,200	$1,551,000	$1,434,000	$1,551,000	$1,569,600	$1,749,500
5519	Jumbo Rd North	Concrete Culvert	$197,300	$1,108,000	$1,029,000	$1,108,000	$1,121,300	$1,255,400

Culvert ID	Name	Existing Culvert Type	Common Costs	Total Cost Concrete Replacement	Total Cost Steel Replacement	Existing Culvert Replacement Cost	Life-Cycle Cost Concrete Replacement	Life-Cycle Cost Steel Replacement
6011	Attlee Avenue Bridge	Concrete Culvert	$486,100	$3,196,000	$2,938,000	$3,196,000	$3,234,400	$3,584,400
6020	Mountain Street	Concrete Culvert	$585,000	$6,165,000	$5,805,000	$6,165,000	$6,239,000	$7,082,100
6500	Beatrice Crescent Culvert	Concrete Culvert	$254,300	$1,212,000	$1,130,000	$1,212,000	$1,226,500	$1,378,600
6501	Leon Drainage Ditch	Concrete Culvert	$385,600	$1,257,000	$1,180,000	$1,257,000	$1,272,100	$1,439,600
6502	Junction Creek	Concrete Culvert	$616,700	$3,866,000	$3,560,000	$3,866,000	$3,912,400	$4,343,200
6503	Hebert Street Culvert	Concrete Culvert	$268,100	$1,299,000	$1,236,000	$1,299,000	$1,314,600	$1,507,900
6504	Belfry Avenue Culvert	Soil-Steel Structure	$271,000	$764,000	$692,000	$692,000	$773,200	$844,200
6505	Attlee Avenue Culvert	Soil-Steel Structure	$293,900	$1,136,000	$951,000	$951,000	$1,149,600	$1,160,200
6506	Third Avenue	Concrete Culvert	$299,500	$1,482,000	$1,374,000	$1,482,000	$1,499,800	$1,676,300
6507	Arthur Street	Concrete Culvert	$427,900	$2,510,000	$2,326,000	$2,510,000	$2,540,100	$2,837,700
6508	Kenwood Avenue	Soil-Steel Structure	$368,400	$1,680,000	$1,460,000	$1,460,000	$1,700,200	$1,781,200
6509	Highgate	Soil-Steel Structure	$326,900	$1,700,000	$1,382,000	$1,382,000	$1,720,400	$1,686,000
6511	Attlee Ave Pedestrian	Soil-Steel Structure	$116,700	$384,000	$332,000	$332,000	$388,600	$405,000

Estimated cost is based on a new culvert of similar size.

Recorded values, Length, Width, Height, Fill Depth, # Lanes Over, Water Depth are used in the calculations.

Typical culvert works (dewatering, traffic, etc.) are estimated and totalled for each structure.

Total Number of Timber Structures: 0

Total Number of Steel Structures: 14

Total Number of Concrete Structures: 80

Total Cost of Culvert Replacement Based on Similar Size and Type: $234,175,000

Parabolic & Straight Line Depreciation

(Does not include culverts)

Name	Bridge ID	Built	Value (New)	Damage/Defects		Present Val (Parab)		Present Val (S/L)	
Spanish River Bridge	1000	2020	$470,230	0.0%	$0	100.0%	$470,230	100.0%	$470,230
Vermillion River Bridge	1001	1983	$4,122,194	1.6%	$66,532	72.6%	$2,992,372	48.5%	$1,998,015
Little Panache Lake Narrows	1002	1981	$2,474,535	5.1%	$127,226	62.4%	$1,544,756	39.3%	$972,361
Maninen Road Bridge	1003	1980	$157,430	19.3%	$30,306	16.7%	$26,266	8.1%	$12,715
High Falls Road Bridge	1004	2020	$1,062,160	0.0%	$0	100.0%	$1,062,160	100.0%	$1,062,160
Chicago Mine Road Bridge	1005	2015	$441,978	3.3%	$14,600	95.9%	$424,047	88.3%	$390,445
Spanish River near Worthington Road	1006	2007	$260,037	5.9%	$15,353	88.5%	$230,153	71.3%	$185,342
Vermillion River Bridge	1007	1948	$3,278,860	0.7%	$22,572	82.1%	$2,691,257	76.8%	$2,516,877
Moxam Creek Bridge	1008	1988	$2,101,332	4.1%	$85,328	73.1%	$1,535,635	49.3%	$1,035,661
Old Soo Road Bridge	1009	2020	$211,890	0.0%	$0	100.0%	$211,890	100.0%	$211,890
Black Lake Road Bridge	1010	1976	$1,231,892	1.2%	$14,188	62.0%	$763,472	41.0%	$505,624
Mikkola Road Bridge	1011	1976	$2,170,861	1.2%	$25,471	64.6%	$1,401,320	42.3%	$917,248
Fielding Road Bridge	1012	1987	$1,320,645	16.8%	$221,879	60.9%	$804,748	39.3%	$519,652
CPR Overhead (Westbound)	1013	1955	$8,711,555	4.5%	$390,104	23.6%	$2,054,182	14.7%	$1,281,600
CPR Overhead (Eastbound)	1014	1969	$6,050,574	8.8%	$535,178	40.8%	$2,471,369	21.0%	$1,268,861
Finland Creek Bridge	1015	2007	$119,900	1.4%	$1,620	91.5%	$109,767	75.4%	$90,373
Finland Creek Bridge	1019	2016	$294,930	0.0%	$0	99.5%	$293,345	93.6%	$275,918
Finland Street Bridge	1020	1940	$886,490	21.3%	$189,019	0.0%	$0	0.0%	$0

(Does not include culverts)

Name	Bridge ID	Built	Value (New)	Damage/Defects		Present Val (Parab)		Present Val (S/L)	
Poland Street Bridge	1022	1960	$217,822	54.0%	$117,523	6.2%	$13,485	1.8%	$3,883
Orford Street Bridge	1023	1960	$239,738	37.5%	$89,861	9.6%	$23,087	3.0%	$7,268
Big Nickel Mine Rd	1024	2003	$2,749,250	20.1%	$553,053	74.0%	$2,035,640	56.2%	$1,544,254
Lily Creek Bridge	1025	1959	$489,141	16.6%	$81,187	14.7%	$71,983	9.5%	$46,594
Junction Creek Bridge	1026	1990	$1,744,446	7.2%	$125,713	65.9%	$1,149,592	42.9%	$748,348
Struthers Pedestrian Bridge	1028	1982	$128,250	3.7%	$4,692	50.2%	$64,347	30.4%	$39,001
Copper Cliff Trail Bridge	1029	2010	$107,306	0.2%	$268	51.3%	$55,087	44.9%	$48,142
Meatbird Creek Pedestrian Bridge	1030	2016	$174,779	0.0%	$0	99.5%	$173,966	93.6%	$163,539
Trans Canada Trail	1561	2006	$166,408	11.5%	$19,110	84.0%	$139,745	68.2%	$113,500
Simmons Road Bridge	2000	1970	$1,858,690	6.7%	$124,796	39.6%	$735,834	22.0%	$408,272
Vermillion Lk Rd	2001	2006	$911,048	5.0%	$45,660	89.6%	$816,691	73.9%	$673,428
Main Street Bridge	2002	1967	$2,372,690	7.4%	$174,516	37.6%	$892,518	19.4%	$460,214
Whitson Creek Bridge	2003	1967	$1,342,768	4.4%	$59,395	51.2%	$687,004	31.7%	$425,718
Whitson Creek Bridge	2004	1967	$1,736,757	2.3%	$40,342	51.2%	$888,753	31.5%	$546,854
Onaping River Bridge	2005	1959	$3,092,950	6.0%	$184,273	34.4%	$1,063,615	22.0%	$681,825
Onaping River Bridge	2006	1983	$1,679,629	12.1%	$203,045	59.1%	$992,295	36.6%	$614,716
Vermillion River Bridge	2007	1961	$1,876,898	8.6%	$161,296	34.5%	$646,911	19.3%	$362,240
Montee Principale Bridge	2008	1986	$972,198	7.1%	$69,477	63.2%	$614,894	41.7%	$405,598
Whitson River Bridge	2009	1967	$1,522,492	1.9%	$29,575	52.4%	$798,277	32.9%	$500,443
Landry Street Bridge	2010	1981	$781,496	18.4%	$143,913	51.4%	$401,519	28.1%	$219,630

(Does not include culverts)

Name	Bridge ID	Built	Value (New)	Damage/Defects		Present Val (Parab)		Present Val (S/L)	
INCO Railway	2012	1975	$2,906,838	17.1%	$497,147	73.2%	$2,126,645	57.9%	$1,682,186
Lasalle Interchange	2013	1975	$5,960,880	9.1%	$539,558	54.9%	$3,272,432	31.2%	$1,861,570
CPR Overhead	2014	1975	$3,500,754	8.4%	$295,376	50.5%	$1,768,886	29.4%	$1,029,003
CPR Overpass / Nolin Creek	2015	1975	$4,206,247	23.8%	$1,002,527	39.6%	$1,665,962	19.1%	$803,896
Dufferin Street Bridge	2016	1940	$494,724	17.5%	$86,784	0.0%	$0	0.0%	$0
Pedestrian Crossing	2021	1980	$167,196	3.1%	$5,263	45.1%	$75,413	26.3%	$43,978
Trans Canada Trail	2533	1989	$442,736	1.6%	$7,275	78.8%	$348,942	55.8%	$246,875
Bridge St /Emile St	2534	2006	$1,301,925	0.0%	$150	96.0%	$1,250,385	80.3%	$1,045,827
Nelson Lk Rd @ Rapid River	3000	1965	$334,225	13.3%	$44,388	32.0%	$106,927	17.7%	$59,102
Vermillion River Bridge	3001	2010	$1,593,397	2.1%	$33,361	81.7%	$1,302,399	66.8%	$1,064,088
Martin Road Bridge	3002	1965	$769,999	24.1%	$185,464	9.3%	$71,711	0.9%	$7,018
Whitson River Bridge	3003	1967	$1,536,480	5.0%	$76,669	49.0%	$752,255	29.5%	$453,491
Frappier Road Bridge	3004	1970	$1,532,862	0.0%	$146	59.4%	$910,363	38.9%	$595,853
Whitson River	3005	1990	$2,217,443	22.3%	$494,903	59.4%	$1,316,838	36.0%	$798,873
Kalmo Road Bridge / Whitson River	3006	1998	$430,404	2.7%	$11,635	75.7%	$325,720	59.6%	$256,406
Roberts River	4000	1997	$433,624	4.7%	$20,259	77.3%	$335,110	55.8%	$241,937
Vermillion River	4001	2020	$454,790	0.0%	$0	100.0%	$454,790	100.0%	$454,790
Bowland Bay Bridge	4002	1983	$755,840	1.7%	$12,635	78.8%	$595,529	60.2%	$455,207
Industrial Rd (Ski Hill Rd)	4003	2005	$623,725	1.8%	$11,340	88.1%	$549,450	69.8%	$435,625

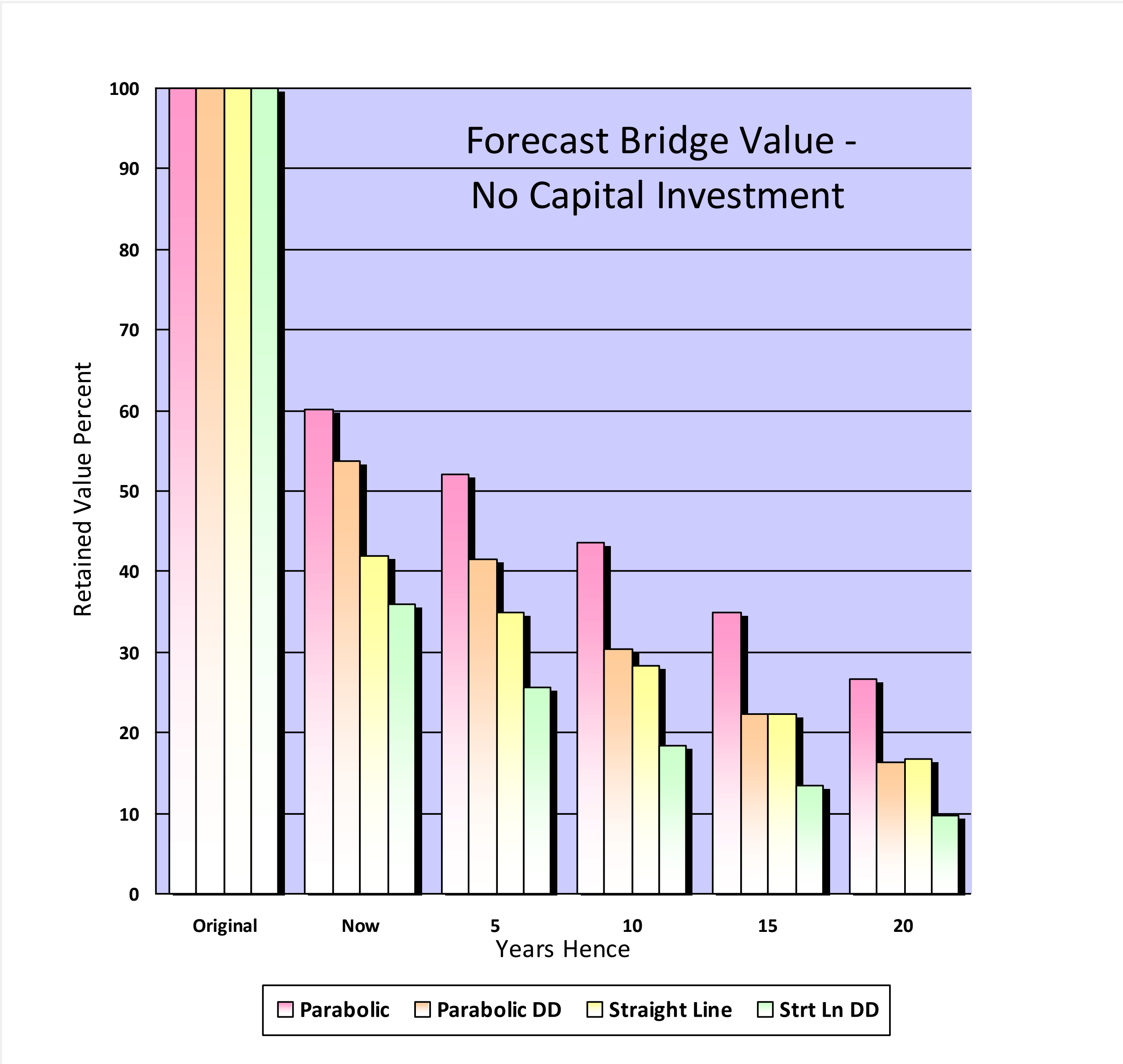
(Does not include culverts)

Name	Bridge ID	Built	Value (New)	Damage/Defects		Present Val (Parab)		Present Val (S/L)	
CNR Overpass	4004	1973	$3,723,032	2.9%	$108,414	56.9%	$2,119,200	34.9%	$1,298,354
Roberts River	4005	2020	$561,580	0.0%	$0	100.0%	$561,580	100.0%	$561,580
Junction Creek Ped Bridge	4010	1980	$106,046	22.9%	$24,269	34.4%	$36,527	20.7%	$21,939
Gary Avenue Dead End	4513	2006	$100,227	0.0%	$0	47.2%	$47,294	39.3%	$39,438
Riverside Drive Bridge	5000	1942	$1,503,635	0.0%	$530	66.3%	$997,528	62.5%	$939,483
Broadway Street Bridge	5002	1960	$599,692	9.4%	$56,562	27.9%	$167,033	12.0%	$72,034
Brady Street Underpass	5003	1962	$2,472,538	12.3%	$305,295	62.8%	$1,552,817	45.2%	$1,118,547
Paris St Overpass SBL	5008	1973	$12,970,847	4.9%	$637,121	55.0%	$7,138,785	33.0%	$4,277,090
Coniston Creek Bridge	5009	1960	$1,267,557	5.4%	$68,359	33.8%	$428,683	17.6%	$223,463
Romford Creek Bridge	5010	1950	$221,416	12.6%	$27,868	0.0%	$0	0.0%	$0
Romford Creek Bridge	5013	1950	$204,402	11.3%	$23,004	5.5%	$11,289	3.9%	$7,942
Romford Creek Bridge	5015	1955	$461,711	14.6%	$67,268	8.7%	$40,143	2.8%	$12,717
Coniston Creek	5016	2016	$1,234,874	9.2%	$114,000	90.3%	$1,114,901	84.6%	$1,044,774
Mountain View Road Bridge	5017	1998	$329,472	8.4%	$27,617	79.9%	$263,292	59.7%	$196,650
Roseland Drive Bridge	5018	1998	$315,500	5.2%	$16,514	79.3%	$250,211	59.3%	$186,963
Deer Creek Bridge	5020	1970	$596,151	28.0%	$167,189	28.9%	$172,345	11.1%	$66,170
Deer Creek Bridge	5021	2000	$262,610	0.6%	$1,562	34.4%	$90,229	25.0%	$65,575
Pedestrian Bridge	5022	1980	$182,574	5.5%	$10,001	39.7%	$72,527	22.0%	$40,226
Pedestrian Bridge	5023	1980	$1,145,543	15.4%	$176,182	46.4%	$531,989	24.2%	$276,728
Coniston Creek Pedestrian Bridge	5029	2020	$198,375	0.0%	$0	100.0%	$198,375	100.0%	$198,375

(Does not include culverts)

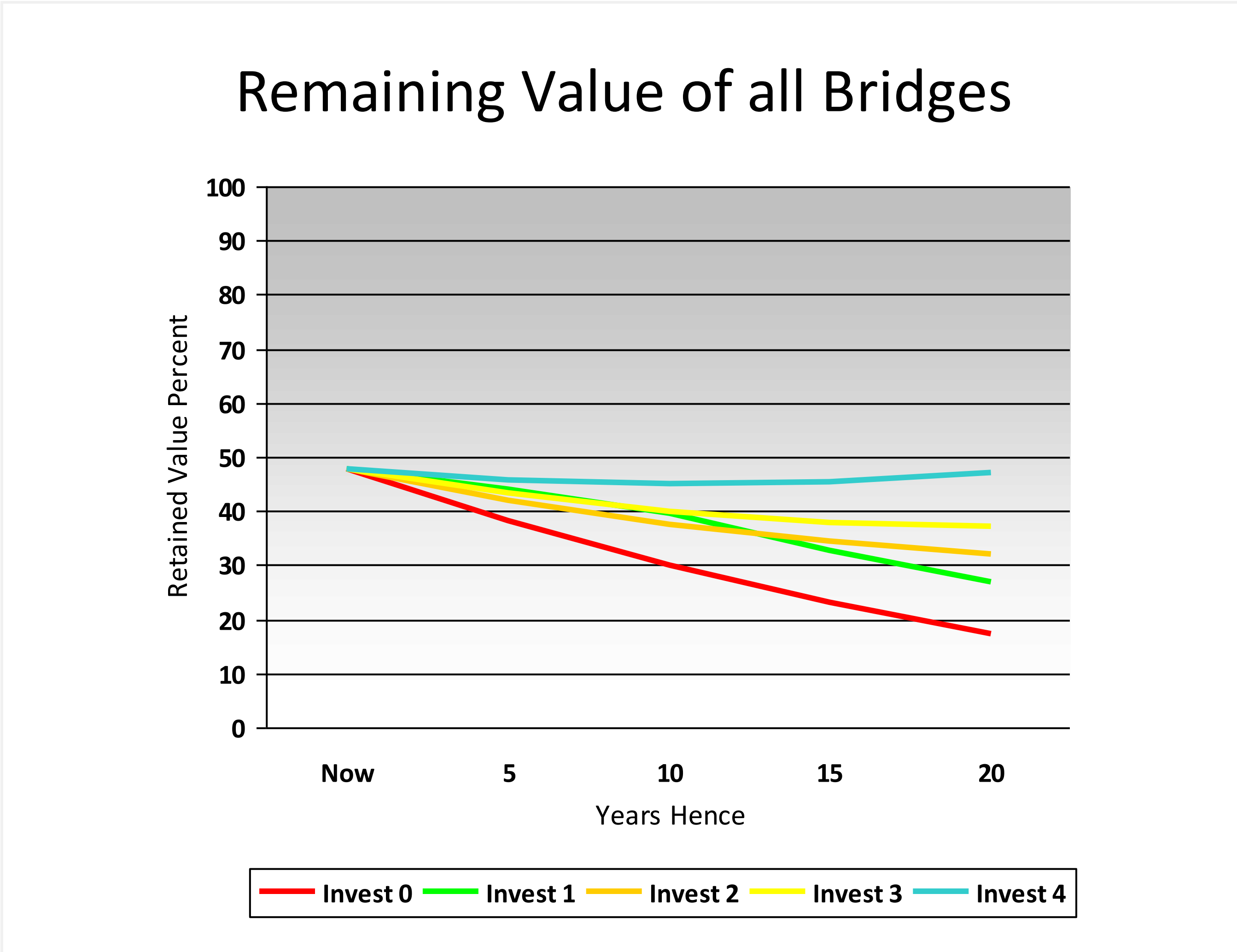
Name	Bridge ID	Built	Value (New)	Damage/Defects		Present Val (Parab)		Present Val (S/L)	
Paris St Overpass NBL	5030	1973	$13,055,347	8.2%	$1,076,891	51.2%	$6,687,571	29.2%	$3,808,830
Centennial Dr Park Bridge	5051	1990	$101,662	2.6%	$2,622	81.8%	$83,186	58.0%	$58,964
Mallards Landing Park	5516	2006	$99,125	11.8%	$11,697	83.3%	$82,569	67.3%	$66,725
CPR Subway	6001	1930	$787,852	34.6%	$272,420	0.0%	$0	0.0%	$0
Leslie Street Bridge	6008	1970	$2,087,283	13.5%	$281,071	30.0%	$626,975	14.3%	$298,324
Bond Street Bridge	6009	1950	$574,870	34.7%	$199,654	9.7%	$55,785	4.9%	$28,453
King Street Bridge	6010	1940	$645,336	15.9%	$102,867	36.7%	$237,028	27.7%	$178,817
Pedestrian Bridge	6012	1989	$116,803	20.6%	$24,005	48.0%	$56,023	28.6%	$33,351
Pedestrian Bridge	6013	1983	$189,655	1.7%	$3,312	51.9%	$98,447	31.6%	$59,986
Pedestrian Bridge	6014	1982	$114,999	38.3%	$44,032	24.2%	$27,854	9.5%	$10,897
Pedestrian Bridge	6015	1980	$123,556	8.4%	$10,394	36.1%	$44,598	20.3%	$25,068
Eva Avenue Pedestrian Bridge	6017	2000	$1,192,310	2.4%	$28,213	88.8%	$1,058,755	68.4%	$815,664
Trans Canada Trail (Barrydowne Arena)	6510	2006	$190,917	3.0%	$5,660	64.3%	$122,816	51.8%	$98,921
Grand Total			$136,933,829	8.2%	$11,186,541	53.7%	$73,558,324	36.1%	$49,396,211

Bridge Depreciation Forecast 1

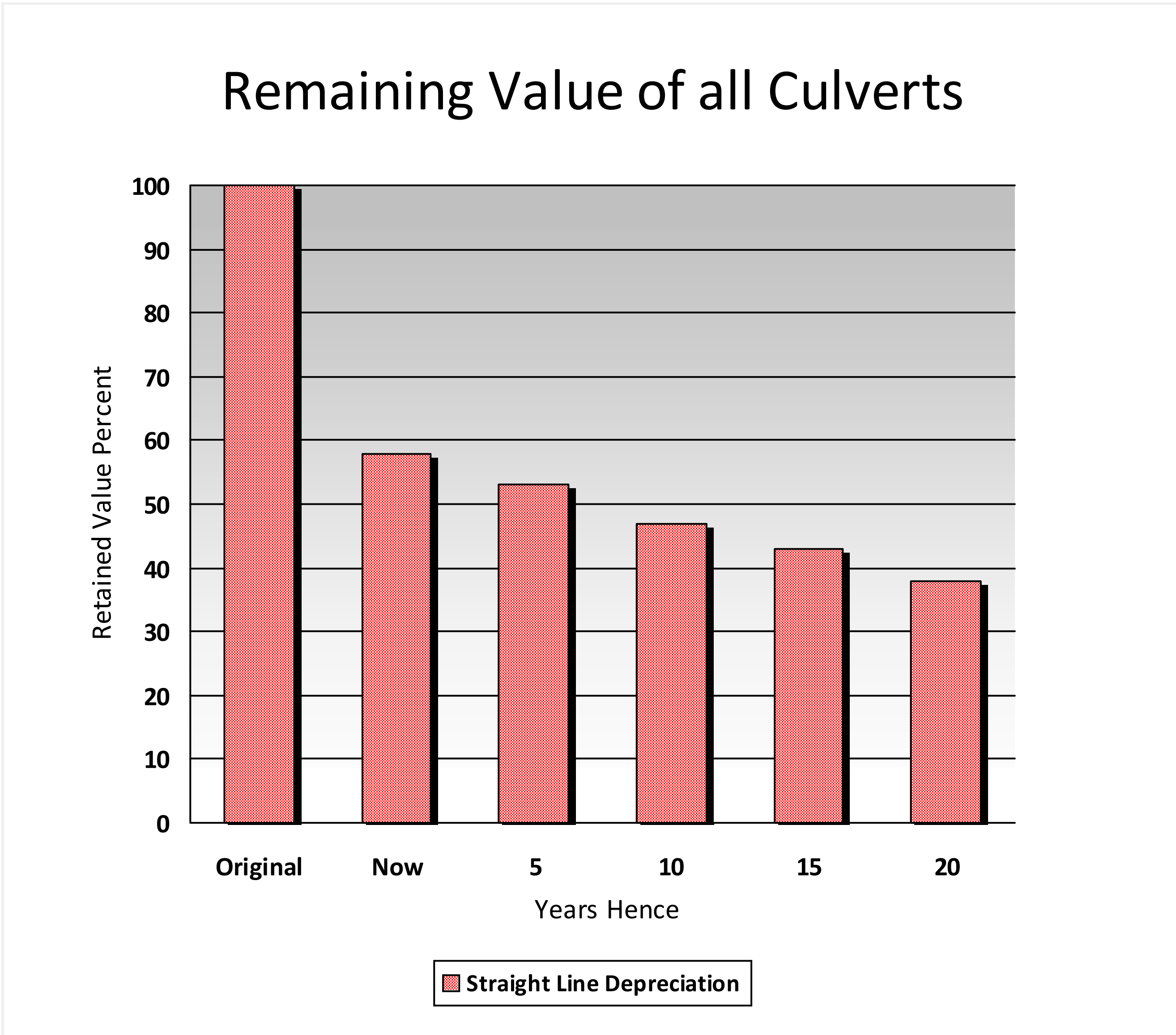


Legend

Parabolic: Parabolic Depreciation not including effects of Defects & Damage
Parabolic DD: Parabolic Depreciation including effects of Defects & Damage
Straight Line: Straight-Line Depreciation not including effects of Defects & Damage
Strt Ln DD: Straight-Line Depreciation including effects of Defects & Damage



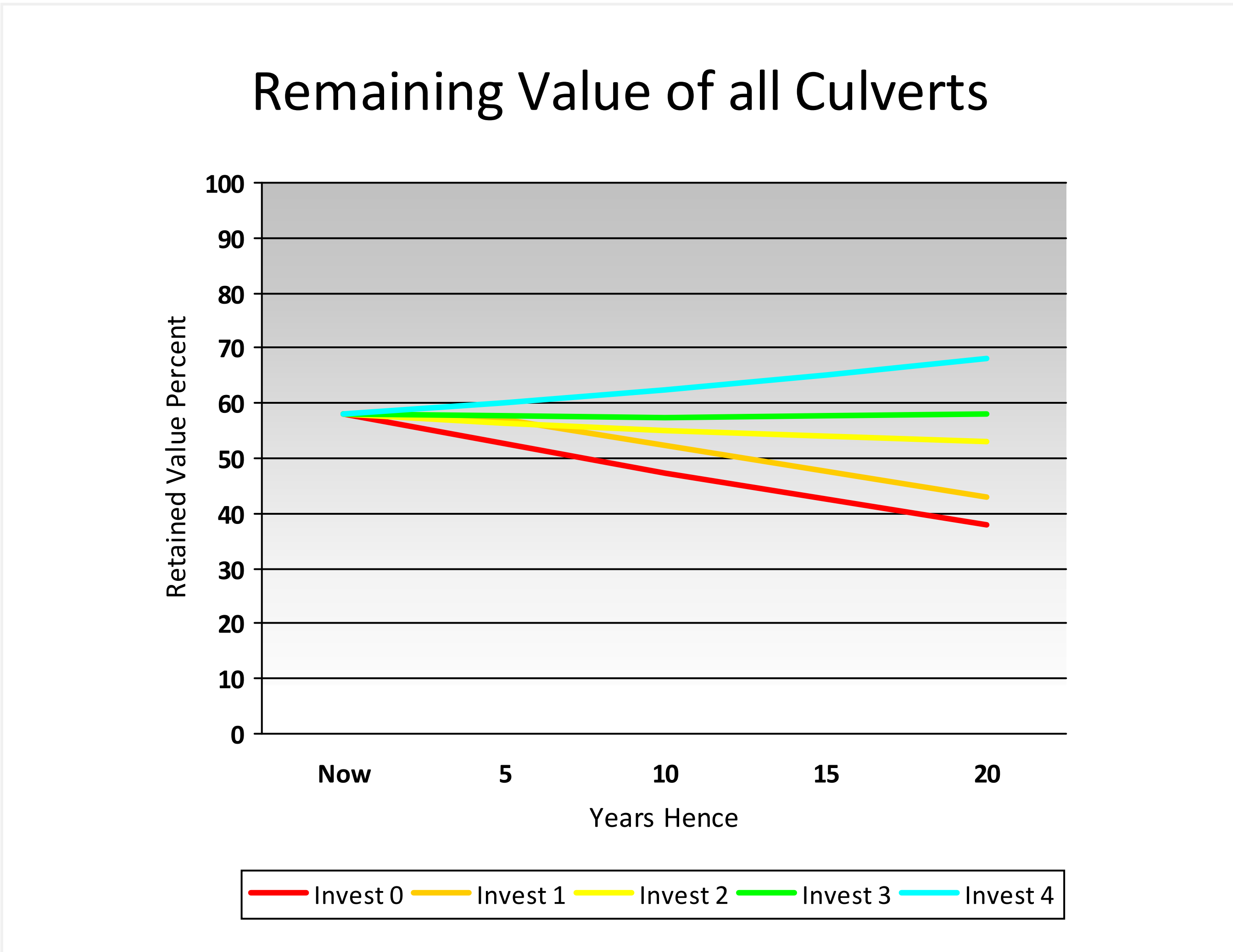
Key	Investment Description	Annual Amount
Invest 0	No Investment	$0
Invest 1	Recommended Capital (Average)	$1,296,000
Invest 2	0.75% Replacement Value	$2,002,500
Invest 3	1.0% Replacement Value	$2,670,000
Invest 4	1.5% Replacement Value	$4,005,000



Original & Depreciated Values

Original	Now	5	10	15	20
$234,175,000	$135,778,897	$123,074,816	$111,177,262	$99,773,756	$88,873,696

Average Culvert Depreciation with Investment



Key	Investment Description	Annual Amount
Invest 0	No Investment	$0
Invest 1	Recommended Capital (Average)	$579,000
Invest 2	0.75% Replacement Value	$1,762,500
Invest 3	1.0% Replacement Value	$2,350,000
Invest 4	1.5% Replacement Value	$3,525,000

Recommended Investigations

Bridge ID	Name	Deck Condition Survey	Enhanced Inspection	Underwater Investigation	Ice Inspection	Boat Inspection	Structure Evaluation	Load Posting	Planning Study
1008	Moxam Creek Bridge	✓							
1535	Lily Creek		✓	✓					
1544	C. Johnson Road Culvert @ MR #4			✓					
2000	Simmons Road Bridge		✓	✓					
2002	Main Street Bridge	✓							
2005	Onaping River Bridge	✓							
2013	Lasalle Interchange	✓							
2015	CPR Overpass / Nolin Creek	✓	✓						
2016	Dufferin Street Bridge		✓						✓
2512	Nolins Creek		✓						✓
2514	Granite-McKim Culvert		✓						
2516	McNeil Pedestrian Crossing								✓
2519	Nolins Creek								✓
3000	Nelson Lk Rd @ Rapid River								✓
3002	Martin Road Bridge		✓						
3005	Whitson River	✓							
4505	Junction Creek		✓						✓
5020	Deer Creek Bridge		✓						✓
5023	Pedestrian Bridge								✓
5506	Long Lake Road Culvert					✓			
5508	Broadway		✓						
6020	Mountain Street		✓						

Bridge ID	Name	Deck Condition Survey	Enhanced Inspection	Underwater Investigation	Ice Inspection	Boat Inspection	Structure Evaluation	Load Posting	Planning Study
6509	Highgate								✓

Capital Needs Report

Year ***2021***

Structure ID	Name	Route	Work	Cost
1003	Maninen Road Bridge	Manninen Rd.	Replace Deck, Guide Rail, Paint or galvanize girders	$455,000
1006	Spanish River near Worthington Road	Spanish River Rd.	Replace Timber Deck	$85,000
2511	Huron Street Culvert	Huron St.	Partial Replacement	$842,000
2519	Nolins Creek	Beatty St.	New Conc Culvert	$1,252,000
3000	Nelson Lk Rd @ Rapid River	Nelson Lk Rd.	Replace bridge	$977,000
4000	Roberts River	M R 84 (Moose Mt)	Wearing surface, Impact protection, Repair rakers	$169,000
5051	Centennial Dr Park Bridge	Centennial Dr.	New timber deck, Paint bridge	$160,000

Sum for Year ***$3,940,000***

Percentage of Grand Total ***9.9%***

Year ***2022***

Structure ID	Name	Route	Work	Cost
1012	Fielding Road Bridge	Fielding Rd.	Misc Concrete Repairs, WP&P, X-Jnt, Guide Rail, Repave approaches	$575,000
1024	Big Nickel Mine Rd	Big Nickel Mine Rd	Resurface, Seal Concrete, Seal B/W Joints	$218,000
1540	Panache Lake Rd Culvert	Panache Lake Rd.	Seal Culvert Walls	$160,000
2006	Onaping River Bridge	Morgan Rd.	Concrete sealing, Exp Jnt Repair	$134,000
2016	Dufferin Street Bridge	Dufferin St.	Misc Concrete Repairs, O'Lay, WP&P, B/Wall, Retaining Walls, Deck Drains	$492,000
2508	Landry Creek	Notre Dame Ave.	Partial Culvert Replacement	$450,000
2512	Nolins Creek	Frood Rd.	Culvert Replacement, Retaining walls	$1,097,000
2513	Inco Drainage Ditch	Lasalle Blvd.	Daylighting	$188,000
2517	Erie/Monck Pedestrian Crossing	Erie St.	Replace retaining walls, surfacing	$79,000

2533	Trans Canada Trail	Onaping Falls	Wood Span Replacement	$54,000
3005	Whitson River	M R 80 (Hwy 69)	Misc Concrete Repairs, WP&P, Guide Rail, New Pedestrian Railings, Pipe Rails	$410,000
3503	MR 80	MR 80	Retaining Wall, New Guide Rail	$108,000
5008	Paris St Overpass SBL	Paris St.	Misc Concrete Repairs, WP&P, X-Jnt, Coat girder ends, Abut repair	$1,616,000
5017	Mountain View Road Bridge	Mountain View Rd.	Guide Rail, Gabions	$108,000
5023	Pedestrian Bridge	Nelson St.	Misc Concrete Repairs, Replace Deck, X-Jnt, Truss Coating, Repl Meshing	$1,236,000
5025	Lily Creek	Paris St.	Pedestrian Railings	$116,000
6014	Pedestrian Bridge	Stafford St.	Ballast walls, Retaining walls, Rails etc.	$131,000

Sum for Year	***$7,172,000***
Percentage of Grand Total	***18.0%***

Year ***2023***

Structure ID	Name	Route	Work	Cost
1534	Junction Creek	McLeod St.	Misc Concrete Repairs, Waterproofing, Conc Rep.	$295,000
1542	Wabagishik Road Culvert	Wabagishik Rd.	Update Guide Rail	$86,000
1547	Worthington Rd. Culvert	Worthington Rd.	New Conc Culvert	$556,000
2002	Main Street Bridge	Main St.	Misc Concrete Repairs, WP&P, Replace brg, curbs, sidewalk	$323,000
2007	Vermilion River Bridge	Morgan Rd.	Guide Rail	$142,000
2015	CPR Overpass / Nolin Creek	Elm St. West	Misc Concrete Repairs, WP&P, FRP Pier Repair, Deck Drains	$935,000
2500	Birch St Culvert	Birch St	Replace Guiderail	$79,000
4010	Junction Creek Ped Bridge	Fielding St.	Repair concrete ballast walls, approach railings	$102,000
4505	Junction Creek	Lansing Ave.	Concrete Liner	$324,000

5013	Romford Creek Bridge	Walter St.	Replace Bridge	$1,260,000
5030	Paris St Overpass NBL	Paris St.	Misc Concrete Repairs, WP&P, X-Jnt, Coat girder ends, Abut repair	$1,757,000
6008	Leslie Street Bridge	Leslie St.	Girder end repairs	$116,000
6501	Leon Drainage Ditch	Lasalle Blvd.	Outlet Wall Repair	$83,000

Sum for Year	***$6,058,000***
Percentage of Grand Total	***15.2%***

Year ***2024***

Structure ID	Name	Route	Work	Cost
1008	Moxam Creek Bridge	Regional Rd. 55	Seal barrier walls	$176,000
1020	Finland Street Bridge	Finland St.	Misc Concrete Repairs, WP&P, Renew upstream retaining walls	$846,000
1561	Trans Canada Trail	Hillfield Trail #1	Painting	$102,000
2010	Landry Street Bridge	Landry St.	Misc Concrete Repairs, WP&P, Guide Rail, Replace Sidewalks	$292,000
2013	Lasalle Interchange	Elm St. West	Misc Concrete Repairs, WP&P, Approach Drainage, C&G	$360,000
2014	CPR Overhead	Lasalle Blvd.	Remediate Drainage, Abut Repair	$218,000
2510	Whitewater Creek	MR 35	Waterproof or Topping slab, Ret Walls	$498,000
5003	Brady Street Underpass	Brady St.	Misc Concrete Repairs, Sealing	$270,000
5010	Romford Creek Bridge	Caruso St.	Replace Bridge	$634,000

6010	King Street Bridge	King St.	Abutment wall repairs	$71,000
6509	Highgate	Highgate	New Conc Culvert	$1,313,000

Sum for Year	***$4,780,000***
Percentage of Grand Total	***12.0%***

Year *2025*

Structure ID	Name	Route	Work	Cost
1022	Poland Street Bridge	Poland St.	Misc Concrete Repairs, O'Lay, WP&P, B/Wall, Abutment wall refacing	$469,000
1023	Orford Street Bridge	Orford St.	Misc Concrete Repairs, O'Lay, WP&P, B/Wall, Abutment wall refacing	$456,000
1025	Lily Creek Bridge	Bouchard St.	Retaining walls	$184,000
1535	Lily Creek	Regent St.	Partial replacement, Ret Walls	$842,000
2000	Simmons Road Bridge	Simmons Rd.	Misc Concrete Repairs, Strengthen/Replace Barriers	$500,000
2008	Montee Principale Bridge	Montee Principale	Misc Concrete Repairs, WP&P, B/Wall, X-Jnt, Guide Rail	$888,000
5024	Elgin Pedestrian Subway	Elgin St.	Floor & Wall Repairs	$218,000
5516	Mallards Landing Park	Trans Canada Trail @ Mall	Coating truss, new decking	$95,000
6502	Junction Creek	Barrydowne Rd.	Waterproof, Drain Improvements	$324,000

Sum for Year	***$3,976,000***
Percentage of Grand Total	***10.0%***

Year *2026*

Structure ID	Name	Route	Work	Cost
1544	C. Johnson Road Culvert @ MR #4	C. Johnsons Rd.	New Conc Culvert	$1,528,000
6001	CPR Subway	College St.	Repl Bridge	$3,886,000

Sum for Year	***$5,414,000***
Percentage of Grand Total	***13.6%***

Year *2027*

Structure ID	Name	Route	Work	Cost
1548	CSPA Culvert	Grassy Lake Rd.	New Conc Culvert	$546,000
3006	Kalmo Road Bridge / Whitson River	Kalmo Rd.	Replace with 2 lane bridge	$2,647,000

Sum for Year	***$3,193,000***
Percentage of Grand Total	***8.0%***

Year ***2028***

Structure ID	Name	Route	Work	Cost
3002	Martin Road Bridge	Martin Rd.	Replace Bridge	$2,381,000
6505	Attlee Avenue Culvert	Attlee Ave.	New Conc Culvert	$887,000

Sum for Year ***$3,268,000***

Percentage of Grand Total ***8.2%***

Year ***2030***

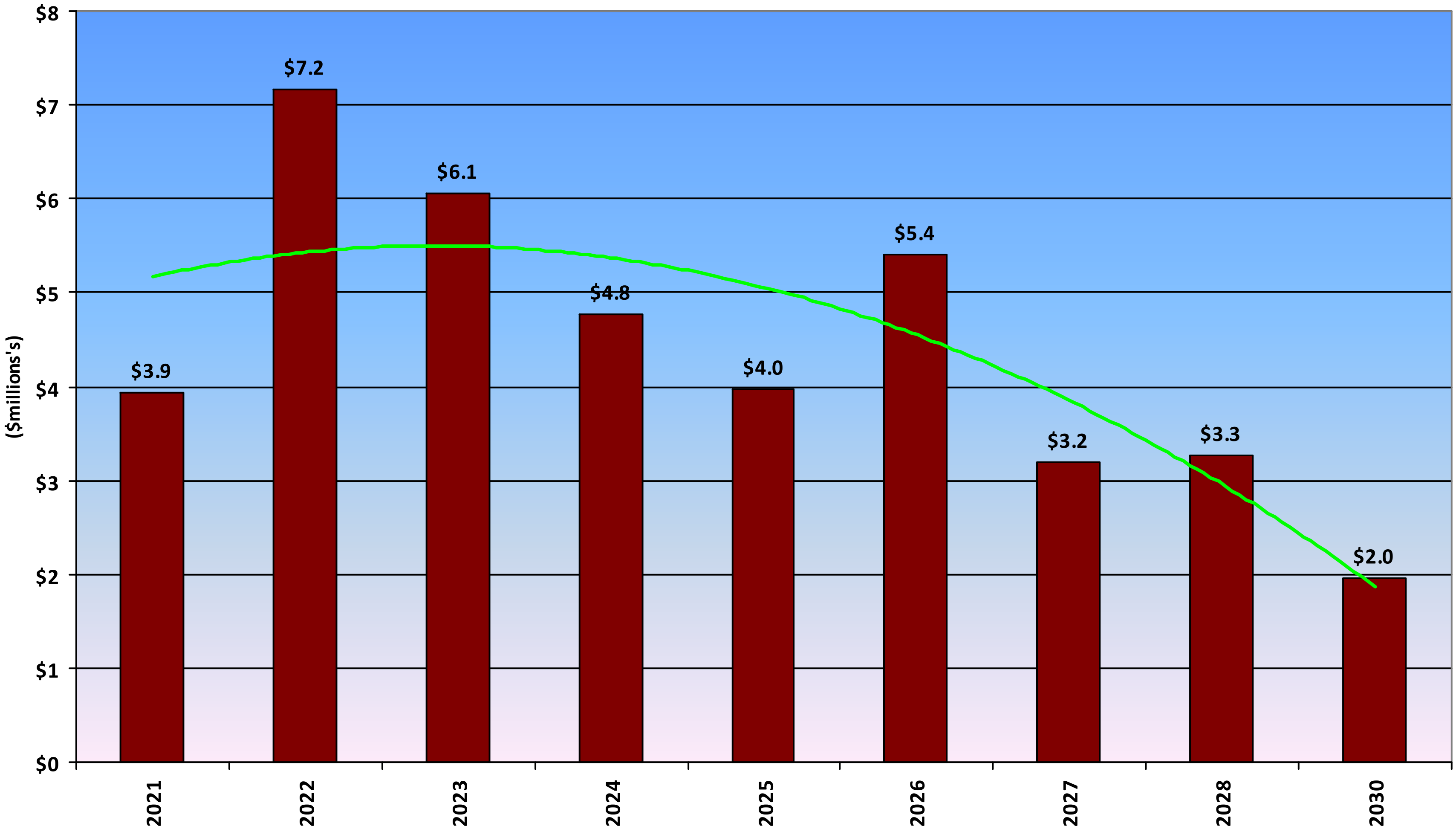
Structure ID	Name	Route	Work	Cost
2005	Onaping River Bridge	M R 8	WP&P, Guide Rail	$575,000
5020	Deer Creek Bridge	Red Deer Rd.	Replace Bridge	$1,380,000

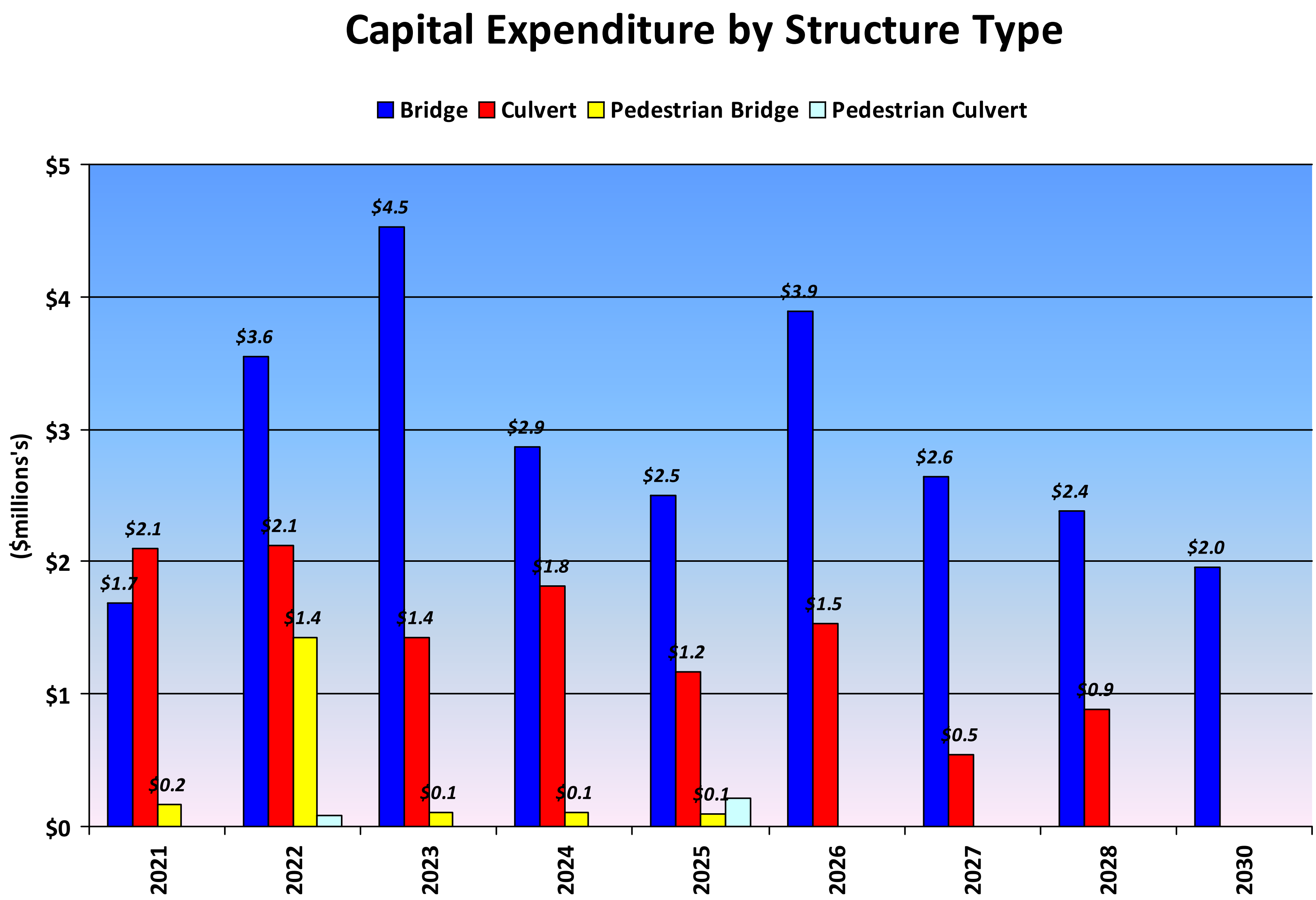
Sum for Year ***$1,955,000***

Percentage of Grand Total ***4.9%***

Total Capital Needs (m's) $39,756,000 Over 10 Years

Capital Expenditure by Year




Capital Expenditure by Structure Type
Bridge
Culvert
Pedestrian Bridge
Pedestrian Culvert
($millions's)
$5
$4
$3
$2
$1
$0
$1.7
$2.1
$0.2
$3.6
$2.1
$1.4
$4.5
$1.4
$0.1
$2.9
$1.8
$0.1
$2.5
$1.2
$0.1
$3.9
$1.5
$2.6
$0.5
$2.4
$0.9
$2.0
2021
2022
2023
2024
2025
2026
2027
2028
2030

Bridge Maintenance Report

Bridge ID	Name	Road	Component	Maintenance

Southwest

Bridge ID	Name	Road	Component	Maintenance
1001	Vermillion River Bridge	Panache Lake Rd.	Steel Post & Guide Rail	Repair Minor Damage

Attachment to barrier wall ends not improved in 2016. End treatment at the SE has been damaged from vehicle impact, this requires repair. Several vehicle scrapes on all quadrants.

Bridge ID	Name	Road	Component	Maintenance
			Delineator	Straighten Sign

4 hazard markers, 2 name boards, 2 bridge Ices signs. Sign at end of SE barrier wall requires straightening.

Bridge ID	Name	Road	Component	Maintenance
			Safety Shape B/Wall	Apply Sealant

Generally in fair to good condition. Consider sealing.

Bridge ID	Name	Road	Component	Maintenance
1003	Maninen Road Bridge	Manninen Rd.	Water Channel	Remove Obstructions

There is a significant scour pool downstream of the bridge. The fore-slopes of the bridge have constricted the channel thereby increasing the stream velocity downstream. Small beaver dam under bridge 2020.

Bridge ID	Name	Road	Component	Maintenance
			Steel Sliding Plate	Power Wash

Satisfactory condition. Accumulating debris.

Bridge ID	Name	Road	Component	Maintenance
			Timber-Laminated	Spot deck plank replacement

2x6 PT laminated deck showing decay at top surface in 2018. Deck is leaking onto girders causing corrosion. Major decay in several timber deck boards and damage in soffit noted in 2020.

Bridge ID	Name	Road	Component	Maintenance
			Delineator	Replace Sign

Delineator missing at the SE end of guide rail. Narrow bridge signs located on the approaches.

Bridge ID	Name	Road	Component	Maintenance
			Embankment	Remove Brush/Trees

Thick vegetation around bridge. Brushing out is recommended.

Bridge ID	Name	Road	Component	Maintenance
1005	Chicago Mine Road Bridge	Chicago Mine Rd.	Timber Curb	Local repair

Timber curb on east side has localized area of major decay. Sand gravel accumulating against curbs.

Bridge ID	Name	Road	Component	Maintenance
1005	Chicago Mine Road Bridge	Chicago Mine Rd.	Steel-Rolled	Power Wash

Corrosion is occurring on bottom flange of middle girders, due to the open deck along centreline. Open deck ends will cause damage to girder ends in future. Sandy granulars accumulating along the top side of the bottom flange of exterior girders.

1006	Spanish River near Worthington Road	Spanish River Rd.	Steel Sliding Plate	Power Wash Remove debris

Bearing seats on east side covered with sandy granular material. All bearings are covered or partially covered with debris.

			Timber Curb	Local repair

Scuffed, assumed from winter plow. SE end portion requires replacement. Sand accumulation along curbs.

			Water Channel	Remove Obstructions

Beaver dam under bridge is partly obstructing channel. Beaver dam holding about 1.0 m head at time of 2014 inspection. Old abutments could potentially fall into channel and result in a severe scour condition. No change in 2020, beaver dam still under bridge.

1008	Moxam Creek Bridge	Regional Rd. 55	Safety Shape B/Wall	Apply Sealant

Barrier walls have AAR cracking and scaling throughout. Reaction rims developing on some AAR cracking. Some random wide vertical cracks.

1009	Old Soo Road Bridge	Old Soo Rd.	Delineator	Repair Pavement Joint
1011	Mikkola Road Bridge	Mikkola Rd.	Delineator	Replace Sign

Delineators located at ends of the guide rails. NE and SE signs damaged from vehicle impact.

			Steel Post & Guide Rail	Repair Minor Damage

Extruder end treatments at all ends. Small vehicle scrapes. End treatment at NE is detached should be repaired.

			Asphalt Wear Surf	Repair Pavement Joint

Satisfactory, condition around joints at end of approach slabs is in need of repairs.

1012	Fielding Road Bridge	Fielding Rd.	Delineator	Replace Sign

Delineators at ends of barrier walls, SW corner sign is missing, laying on embankment.

Bridge ID	Name	Road	Component	Maintenance
1030	Meatbird Creek Pedestrian Bridge	Ped Path	Embankment	Place rip-rap

Protected with rip rap. SW corner rip rap stones have slid down exposing geotextile fabric.

1529	MR 24 Culvert	Regional Rd. 24	Steel Post & Guide Rail	Repair Minor Damage

New guide rail was installed in 2016. NW end treatment has been damaged from vehicle impact, repairs are required.

1536	Fairbank Creek	Bay St	Steel Beam on Steel Post	Repair Minor Damage

Several scrapes from vehicle impact. Eccentric loader end treatments at all ends. SW end treatment too low to be effective. Guide rail overgrown with vegetation.

1537	Fairbank Creek	Bay St (MR # 3)	Water Channel	Remove Obstructions

Very poor channel alignment to culvert, both at inlet and outlet. Beaver dam 20m upstream of culvert.

			Embankment	Remove Brush/Trees

Large stone rip rap on embankments, some slippage into channel at culvert corners. Tree growth at culvert ends should be cleared. Natural gas noted on south side.

			Steel Beam on Steel Post	Repair Minor Damage

Several scrapes from vehicle impact. SW end treatment is damaged and needs repairs. Guide rail is overgrown with vegetation.

1540	Panache Lake Rd Culvert	Panache Lake Rd.	Embankment	Erosion Control Place rip-rap

Areas of washout at and near culvert. Drop curb and gutter with spillway beyond the culvert location would prevent washout of embankments.

1541	Panache Lake Rd. Culvert	Panache Lake Rd.	Embankment	Place rip-rap Repair Gullies

Sparse vegetation. Washout of embankment at culvert corners. Recommend placing some rip rap on culvert embankments.

			Asphalt Wear Surf	Routine Maintenance

Random unsealed cracks throughout. Settlement over culvert may indicate problem with sub-grade.

			Steel Post & Guide Rail	Repair Minor Damage

NW and SE end treatments damaged from vehicle impact.. Eccentric loader end treatment at all four corners.

Bridge ID	Name	Road	Component	Maintenance
1542	Wabagishik Road Culvert	Wabagishik Rd.	Embankment	Place rip-rap

Partial failure of embankment at all 4 corners of culvert. Stone rubble type embankment is falling down into channel. Washout noted in the SW embankment, roadside.

			3 Cable Wood Post	Local repair

Some cables are slack. One post split and one severed on west side.

1543	Hill Road Culvert	Hill Rd.	Steel Post & Guide Rail	Repair Minor Damage

Eccentric loader end treatment at NW, SW, SE, extruder end treatment at NE. Minor impact damage at SW end treatment..

1545	Lorne Falls Rd. Culvert	Lorne Falls Rd.	Embankment	Remove Brush/Trees

Rip rap protection on embankments and over culvert ends. Heavy vegetation growth around guide rail should be cleared.

1547	Worthington Rd. Culvert	Worthington Rd.	Embankment	Remove Brush/Trees

Brush growth around culvert ends should be removed. Embankments are stable. No guide rail protection at this site.

1561	Trans Canada Trail	Hillfield Trail #1	Timber-Sawn	Spot deck plank

Several boards are loose/detached and require replacement. Deck ends are a pedestrian trip hazard.

			RC Abutment Wall	Clean/sweep surface

Good condition. Rust stains on face of abutment walls, debris on bearing seats. Debris is holding moisture and should be cleared before causing damage to abutments.

1562	Old Soo Rd Box Culvert	Old Soo Rd	Steel Beam on Steel Post	Repair Minor Damage

End treatments on north side are both damaged from vehicle impact. Minor scrape in the SW corner.

1563	Fairbank Creek	RR 55	3 Cable Wood Post	Local repair

Cables loose on north side. Cables partially detached on south side. Cables badly corroded.

			Water Channel	Remove Obstructions

Debris is accumulating at both inlet and outlet. Beaver dam at inlet has almost 1.5 m head. Fall at outlet. This has resulted in a very large scour pool downstream of culvert.

Bridge ID	Name	Road	Component	Maintenance
1564	Fairbank Lake Rd Culvert	Fairbank Lake Rd.	Steel Beam on Steel Post	Repair Minor Damage

Extruder end treatment located at all four corners. Damaged in SE, SW, and NW. Some end treatment is obscured by thick vegetation.

			Embankment	Remove Brush/Trees

Rip rap placed on embankment. Some stones have slipped down into channel at culvert corners. Vegetation at guide rail ends should be cleared.

1565	Fairbank Creek Culvert	Fairbank Lake Road	Delineator	Replace Sign

Delineators located in the NW, SW, and SE. Signs in the SE and SW are damaged from vehicle impact.

			Embankment	Erosion Control

Some slippage of rip rap stones into channel at culvert ends. South end outlet has partial blockage due the stones from embankment. Natural gas noted on the north side of road.

Bridge ID	Name	Road	Component	Maintenance

Southeast

4004	CNR Overpass	Falconbridge Rd.	Concrete-Prestressed	See Comment

Girder ends repaired as part of 2019 rehabilitation. Repairs standing up very well in 2019. Otherwise girders are in mostly good condition. Web of exterior girder in NE corner not repaired and this should be repaired ASAP. One small spall on girder flange in NE corner about 3 m from bearing.

4010	Junction Creek Ped Bridge	Fielding St.	Steel Pipe Ped Barrier	Repair Minor Damage

Welded wire mesh has holes cut in it, & has corroded. Condition continues to worsened.

			RC Abutment Wall	Clean/sweep surface

Generally in good condition. Rust stains at west abutment. Graffiti covering abutments. Granular material accumulating on bearing seats.

			Embankment	Remove Brush/Trees See Comment

Asphalt padding added to both approaches. Approaches still require railings. Trees around bridge should be cut back.

			RC Ballast Wall	Re & Re Concrete

Ballast walls require reconstruction. Asphalt has been placed to fill areas of damaged east ballast wall. Lack of room for expansion has damaged the ballast walls.

			Water Channel	Remove Obstructions

Beaver dam under bridge.

4500	Christina St. Culvert	Christina St.	Embankment	Remove Brush/Trees

Overgrown at barrel ends. Trees growing between barrels at the east end.

4505	Junction Creek	Lansing Ave.	Embankment	Remove Brush/Trees

Undermining of slope protection. Tree growth at culvert ends should be cut back.

			Water Channel	Remove Obstructions

Moderate aggradation of waterway at outlet Aggradation islands at west end outlet of both barrels, mainly the south barrel. North barrel has significant aggradation inside (up to 1.0m) & carries minimal flow under low flow conditions. Trees down across channel upstream of culvert (east).

Bridge ID	Name	Road	Component	Maintenance
4513	Gary Avenue Dead End	Trans Canada Trail	Embankment	Erosion Control Remove Brush/Trees

Some erosion of embankment along water channel.

			Water Channel	Place rip-rap

Suspected to have overtopped bridge due to debris caught in stringers.

5008	Paris St Overpass SBL	Paris St.	Scupper & Pipe	Unplug Scuppers

One scupper on each end of deck. Expansion joints have their own drain systems. North scupper is causing delamination of north pier.

			X- Joint Conventional	Repair End Dams

Dams have uniform light to moderate scaling, and some spalling. Spalls should be repaired at this time. Seal appears to be pulling out of retainer in one area. Small areas of missing armouring.

			Sidewalk	Minor Patching

Brick pavers on north approach have settled up to 50 mm and are a potential tripping hazard. Frequent shrinkage cracks.

			X-Joint Modular.	Repair End Dams

Dams have uniform light to moderate scaling, and some spalling. Spalls should be repaired at this time. Joint performing reasonably well.

5009	Coniston Creek Bridge	Garson Coniston Rd.	Delineator	Straighten Sign

Delineators should have been placed before guide rail on approaches. Minor impact strikes to all signs. NE sign needs to be reset.

5013	Romford Creek Bridge	Walter St.	Load Posting	Brush Sign

Posted 9-17-23 tonnes. SW sign should be cleared of vegetation.

			Gabion Basket	Stabilize walls

Needs to be completely reconstructed with a 1:6 back slope. Local resident voiced concerns with gabion walls in NE. No change in gabion walls noted in 2018 or 2020.

5015	Romford Creek Bridge	Edward Ave.	Delineator	Replace Sign

Three delineators in place, SE, NW and NE. Missing sign in SW.

Bridge ID	Name	Road	Component	Maintenance
5015	Romford Creek Bridge	Edward Ave.	Gabion Basket	Stabilize walls

Gabions line the channel at bridge corners. Baskets are bulged and displaced. Some loss of fill. Baskets require maintenance.

			Embankment	Remove Brush/Trees

Satisfactory condition. Gabion baskets along the SW embankment. Wild parsnip noted at NE embankment.

5017	Mountain View Road Bridge	Mountain View Rd.	Gabion Basket	Stabilize walls

Gabion baskets are tilting towards channel. Baskets are spilling their contents. Gabion baskets should all be reset and refilled.

5030	Paris St Overpass NBL	Paris St.	X-Joint Modular.	Repair End Dams

Dams have uniform moderate scaling, and some spalling. Spalls should be repaired at this time. Seals are leaking.

			Scupper & Pipe	Unplug Scuppers

One scupper on deck. Expansion joints have their own drain systems. Drains are poorly placed causing damage to slope protection and piers. Drains plugged in 2020.

			X- Joint Conventional	Repair End Dams

Dams have moderate scaling, and some spalling. Seal retainer is broken for 1.5 m length. Spalls should be repaired at this time.

5501	Elbow Creek Culvert	Dryden Rd.	Embankment	Remove Brush/Trees

Rip rap on embankments. Some minor wash-out of the granular shoulder over north end of culvert. Tree growth at SW corner should be cleared.

			Water Channel	Remove Obstructions

Moderate velocity current at time of 2018 inspection. Water moving well through culvert. Small beaver/debris blockage at north end 2020. Scour hole just downstream south of culvert.

6008	Leslie Street Bridge	Leslie St.	Concrete-Prestressed	Repair Damage

With the exception of the girder ends the girders are in good condition. One middle girder at east abutment has a large spall. Other girders show incipient spalling, presumably caused by earlier leaking expansion joints. Previous repairs to girder ends have delaminated. Girder ends need repairs soon.

			Embankment	Remove Brush/Trees

Stable, with exception of the minor wash-out from deck rains emptying onto foreslopes. Evidence of regular human activity under this bridge.

Bridge ID	Name	Road	Component	Maintenance
6008	Leslie Street Bridge	Leslie St.	Scupper & Pipe	Unplug Scuppers

Light corrosion at drainage pipe ends; drains eroding slope protection in front of embankments. Drains were all plugged at deck top.

			Conc Curb	Re & Re Concrete

Damage in NE & NW corners. Localized area of disintegration.

			Water Channel	Place rip-rap

Channel is undercutting gabion baskets that support the ped path, east side. Channel is centered between the piers. Shopping carts in the channel.

			Sidewalk	Minor Patching

Brick pavers on approaches have settled in all corners & should be reset. Asphalt padding has been added to approaches. Longitudinal cracks in top surface of sidewalk.

6009	Bond Street Bridge	Bond St.	Steel Post & Panel	Repair Minor Damage

North top steel rail has minor impact damage. Same damage noted in 2018, damage not effecting pedestrian safety. Condition similar in 2020.

			Water Channel	Remove Obstructions

Watermain pipe is partly obstructing channel during normal high water. Water is reasonably fast flowing and scour has developed under the bridge. Several shopping carts in channel.

			Embankment	Remove Brush/Trees

Satisfactory condition. Tree growth around bridge should be cut back.

6010	King Street Bridge	King St.	Water Channel	Remove Obstructions

Shopping carts in channel under the bridge.

			RC Abutment Wall	Re & Re Concrete

Base of wall in NE corner & for 2/3 of the length of this abutment going downstream is undercut by disintegration to a depth of 25cm and should be repaired. CSP storm outlet penetrates the east wall, damage around. West wall has numerous areas of honeycomb.

6012	Pedestrian Bridge	Agnes St.	Steel Pipe Ped Barrier	Repair Minor Damage

Railing in SE quadrant is bent and should be straightened. Sections of 1" x 1" fencing has bulged and should be replaced. Several small holes in fencing.

Bridge ID	Name	Road	Component	Maintenance
6012	Pedestrian Bridge	Agnes St.	Ped End Post	Spot post replacement

Old timber bollard replaced with concrete block with hazard marker located at the west end.

			RC Abutment Wall	Re & Re Concrete

Spalling at bearing seat under east end of girders, exposing bearing anchor bolts. Maintenance type concrete repairs are required.

			Water Channel	Remove Obstructions

Sides of channel lined with steel sheet piling. Shopping cart in channel, channel is flowing well.

6013	Pedestrian Bridge	Perrault St.	Steel Sliding Plate	Remove debris

Light corrosion. Debris is accumulating.

			Embankment	Remove Brush/Trees

Well vegetated. Mass concrete on west foreslope, east foreslope has large amount of granular material against the abutment wall. Tree growth around bridge should be cut back.

			RC Abutment Wall	Clean/sweep surface

East abutment wall buried by granular debris. Mass concrete at the west abutment wall, voids noted under the concrete. Abutment walls were not visible, bearing seats were only visible portion. Similar condition 2020.

6014	Pedestrian Bridge	Stafford St.	Steel Pipe Ped Barrier	Repair Minor Damage

Approach railings are critically perforated & have lost most of their support. Replace railings & add proper retaining walls in all four corners. Approach trail has eroded away at ends of deck.

			RC Ballast Wall	Re & Re Concrete

Both ballast walls require replacement. Bridge was too long for abutments, bridge expansion has destroyed ballast walls. South end suffering the worst damage.

			Water Channel	Place rip-rap

Revetment in front of the abutments is a high priority maintenance requirement. Tree down upstream of bridge across the channel. No change from previous visit.

			Steel Channel	Repair Minor Damage

Generally in good condition. Connections at north & south ends have severed and need to be reset.

Bridge ID	Name	Road	Component	Maintenance
6014	Pedestrian Bridge	Stafford St.	Embankment	Erosion Control

Significant bank erosion on both sides warrants channel armouring at this time. South footing is exposed from scouring. Erosion at level of path is compromising path surface. Condition of trail at both approaches is a pedestrian hazard.

Bridge ID	Name	Road	Component	Maintenance
6015	Pedestrian Bridge	Mountainview Cres.	RC Abutment Wall	Repair Damage Clean/sweep surface

Abutments slightly twisted causing the structure to rack. Spalls under the girders at bearing locations. Debris is accumulating on bearing seats.

			Timber Soldier Post	Spot post replacement

West bollard post has been removed. East bollard post has been replaced.

			RC Ballast Wall	Repair Damage

East ballast wall has spalled & broke off in sections. Girders are tight against ballast walls this is causing the damage, no room for expansion.

Bridge ID	Name	Road	Component	Maintenance
6017	Eva Avenue Pedestrian Bridge	Eva Avenue	Steel Floor Beam	Power Wash

Patina well developed. Cleaning at abutments strongly encouraged.

			Stringers	Power Wash

Patina well developed. No excessive corrosion at abutments.

			Steel Sliding Plate	Power Wash

Good condition.

			RC Abutment Wall	Clean/sweep surface

Satisfactory condition. Debris on bearing seats.

Bridge ID	Name	Road	Component	Maintenance
6020	Mountain Street	Mountain St.	Embankment	Repair Security Fence

Stable. Security fence on north side is leaning and would benefit from maintenance.

Bridge ID	Name	Road	Component	Maintenance
6500	Beatrice Crescent Culvert	Beatrice Cr.	Embankment	See Comment

Rip rap stone around culvert ends. No guide rail protection at road side. Fence post hazard at outlet end requires removal. See image.

Bridge ID	Name	Road	Component	Maintenance
6502	Junction Creek	Barrydowne Rd.	Water Channel	Remove Obstructions

Significant scour over 1 m deep at middle of culvert. Aggradation is occurring along the north wall. Many shopping carts (at least 6) in the channel causing obstruction these should be removed.

Bridge ID	Name	Road	Component	Maintenance
6504	Belfry Avenue Culvert	Belfry Ave.	Embankment	Remove Brush/Trees

North embankment is over steepened. Heavy vegetation around guide rail should be brushed out. Gabion basket retaining walls at south end of culvert.

Bridge ID	Name	Road	Component	Maintenance
6506	Third Avenue	Bancroft Dr.	Water Channel	Channel Dredging

Downstream channelization recommended. Aggradation building up inside barrel at south end outlet, culvert should be cleaned out. Large aggradation island at the south end, channel forced to flow out at SE corner of culvert barrel.

Bridge ID	Name	Road	Component	Maintenance
6507	Arthur Street	Arthur St.	Timber Post & Guide Rail	Spot post replacement

Rip rap has been placed and guide rail posts have been supported. Eccentric loader end treatments on west side. Wraps around into driveway in the SE. One post on the west side has been severed, see pic.

Bridge ID	Name	Road	Component	Maintenance
			Embankment	Remove Brush/Trees See Comment

Old sheet pile holding up old concrete wall in SE corner. SE corner should be updated with proper retaining wall. Large tree in SE corner interfering with retaining wall. Rip rap on NE side. West embankments are good.

Bridge ID	Name	Road	Component	Maintenance
6508	Kenwood Avenue	Kenwood Ave.	Embankment	Remove Brush/Trees

Mature trees growing at culvert ends should be removed.

Bridge ID	Name	Road	Component	Maintenance
			Water Channel	Place rip-rap

Raising invert with culvert liner has initiated some channel scour downstream (south). Low flow is mostly in east barrel. Channel drops about 0.7 m into scour hole at outlet. No change in 2020.

Bridge ID	Name	Road	Component	Maintenance
6509	Highgate	Highgate	Embankment	See Comment Remove Brush/Trees

Sink hole has developed around catch basin in SW quadrant, see image.

Bridge ID	Name	Road	Component	Maintenance
			Water Channel	Remove Obstructions Channel Dredging

Both inlet & outlet ends should have channel cleaned. Significant aggradation & sedimentation at outlet is backing up water in culverts. Marshy growth is obstructing channel. Small beaver dam at outlet (south end) of east barrel (2016-2020).

Bridge ID	Name	Road	Component	Maintenance
			CS Plate Pipe Arch	Remove debris

Small perforations present at inlet of both barrels, north end. Light to moderate corrosion. Many nuts missing. Aggradation inside both barrels up to 0.5m. East barrel carries flow of the channel. Large amount of debris in east barrel. Difficult to assess condition of bottom of culvert due to the aggradation inside barrels.

Bridge ID	Name	Road	Component	Maintenance
6510	Trans Canada Trail (Barrydowne Arena)	Trans Canada Trail	Bottom Chord	Spot Paint

Paint is blistering and debonding. Significant loss of coating on underside of the bridge. Exposed steel has moderate corrosion.

			Steel Floor Beam	Spot Paint

Paint is blistering & debonding. Touch up paint would be beneficial.

6511	Attlee Ave Pedestrian	Trail	Embankment	Remove Brush/Trees

Concrete & stone slope protection at culvert ends, good condition. Trees growing through chain link fence over culvert should be cleared.

			Chain Link Fence	Repair Minor Damage

Fencing is damaged in several locations. One post is severed.

Bridge ID	Name	Road	Component	Maintenance

South

Bridge ID	Name	Road	Component	Maintenance
1013	CPR Overhead (Westbound)	Old Highway 17 (Regional 55)	Asphalt Wear Surf	Repair Pavement Joint

Resurfaced in 2017. West end driving lane off bridge there is settlement, potholing and distortion.

			Protected ECRC Deck	Clean/sweep surface

Deck was rehabilitated in 2017. Appears full depth deck repairs were required. Presumed deck was waterproofed. Deck should be in reasonable serviceable condition following rehab.

			X- Joint Conventional	Local repair

All expansion joints replaced with Type A clamping plate type joints in 2017. Joints ends do not align with joint drains on sides of bridge, see images. Joint drains should be reworked. Joint cover plates on barrier walls are facing the wrong direction. Some minor spalling of concrete dams.

1014	CPR Overhead (Eastbound)	Regional Rd. 55	Protected ECRC Deck	Clean/sweep surface

Deck is covered with asphalt, no signs of any problems with deck top.

			Embankment	Erosion Control Place rip-rap

Areas of gullying type erosion along NW embankment and at SE embankment. SE erosion is caused by failing CSP in embankment. Both areas will eventually cause loss of road shoulder if not repaired. Extending curbs and adding catch basins may help. Additional severe gullying of SW embankment noted in 2020.

			Asphalt Wear Surf	Repair Pavement Joint

Asphalt on deck is in good condition. Asphalt expansion joints at approaches are settled and distorted and require repair. Normal wear and aging on deck. No evidence of underlaying delamination.

1015	Finland Creek Bridge	Godfrey Dr.	Sidewalk	Re & Re Concrete

Footprints in original concrete sidewalk. Abrasion along curbs.

1022	Poland Street Bridge	Poland St.	Paint Coating	Touch-up Paint

Coating on railing system, several areas require touch-up.

			Sidewalk	Repair Damage

Sidewalk has settled on approaches, possible tripping hazard for pedestrians. Asphalt padding should be added or grind down uneven surface.

Bridge ID	Name	Road	Component	Maintenance
1024	Big Nickel Mine Rd	Big Nickel Mine Rd	RC Wing Walls	Re & Re Concrete See Comment

Brine discharge occurring below semi-integral abutment joint detail at all wing walls. Brine has caused deep disintegration and development of AAR. This has given an unsightly appearance to recently rehabbed bridge. Gaps in barrier walls should be sealed to contain brine. Substantial delamination in NE wing wall. About 1.2 m^2 severe disintegration and 3-4 m^2 delam on SE wing wall.

			Asphalt Wear Surf	Repair Pavement Joint

Excessive random cracking given the age of pavement. Expansion joints in pavement off ends of approach slabs require maintenance repairs. No evidence of underlaying delamination however one suspect area noted in SE quadrant.

1025	Lily Creek Bridge	Bouchard St.	Stacked Concrete	Re & Re Concrete

Under-cut in SE corner and requires maintenance to stabilize.

1026	Junction Creek Bridge	Regent St.	Safety Shape B/Wall	Apply Sealant Repair Damage

Extensive cracking on interior face. Part of barrier wall removed in 2018 &replaced with steel beam guide rail. Guide rail posts have sharp burrs where cut off and should be ground smooth.

1028	Struthers Pedestrian Bridge	Struthers St.	Guide Posts	Spot post replacement

Timber Bollards at both ends of deck are decayed & should be replaced.

			Embankment	Remove Brush/Trees Pad approach settlement

Trees are overhanging structure.

			RC Shaft	See Comment

Small delamination on east pier, small spall on west pier at girder bearing. Embankment pushing on piers and should be graded to balance pressure on pier faces.

			RC Abutment Wall	See Comment

West abutment partly obscured by granular material. Small spall NE corner of east abutment. Bearing seats should be cleared of granular debris.

			Steel Pipe Ped Barrier	Repair Minor Damage

Two panels moderately corroded. Several locations were the steel mesh has separated from top rail.

1029	Copper Cliff Trail Bridge	MR 55 (Old Hwy 17)	Paint Coating	Touch-up Paint

Good condition. Very minor spot rust.

Bridge ID	Name	Road	Component	Maintenance
1533	Lily Creek	Martindale Rd.	Water Channel	Remove Obstructions

The inlet alignment is not ideal. Aggradation inside barrel of culvert. Beaver dam just upstream of culvert inlet, this appears to be an on-going problem at this site. Some debris in downstream channel as well.

			Embankment	Remove Brush/Trees

Paved shoulders over top of the structure. Old tree on SW side is partially obstructing the channel.

1534	Junction Creek	McLeod St.	Embankment	Remove Brush/Trees

Well vegetated.

1560	Southview Dr.	Southview Dr	Steel Beam on Steel Post	Repair Minor Damage

Some minor impact damage.

2012	INCO Railway	Elm St. West	Asphalt Wear Surf	Repair Pavement Joint

Random open cracking on approaches. Pattern cracking along asphalt joints. Asphalt joints have been repaired since 2014 inspection but require further attention. Normal wear and aging. One lane in WBL resurfaced since 2018.

2013	Lasalle Interchange	Elm St. West	Embankment	Repair Gullies
				Place rip-rap

Erosion at ends of barrier walls has been padded with asphalt. Curbs on south side have detached. Slopes on low side of superelevation are being washed out regularly. Improved curb and gutter with directed drainage and catch basins recommended.

			Soffit	Scale Loose Concrete

Minor delaminations and rust staining on construction joint of original structure. About 10 m^2 shallow delam on original bridge soffit. To prevent further damage to the soffit it is recommended that the deck be water proofed and paved. Small distressed area developing on fascia corner south side.

			Asphalt Wear Surf	Rout & Seal

Open random cracking. Pavement joints have been repaired.

2014	CPR Overhead	Lasalle Blvd.	Steel Post & Guide Rail	Repair Minor Damage

Minor guide rail damage is projecting into traffic.

			RC Abutment Wall	Re & Re Concrete

Disintegration observed on both abutments, east side where water is leaking through semi-integral abutment joints. Approximately 2.0m^2 of severe disintegration in southeast corner. And 1.0m^2 by 0.6 m deep in northeast corner. Disintegration up to 60 cm deep estimated in 2020. Rate of disintegration is alarming and repair and prevention measures urgently required.

Bridge ID	Name	Road	Component	Maintenance
2015	CPR Overpass / Nolin Creek	Elm St. West	Embankment	See Comment

Bridge is partly in rock cut. Despite stabilization efforts on east side, loose rock is falling on the east pier footing. Further rock face stabilization warranted.

			RC Column	Apply Sealant Re & Re Concrete

Exterior pier columns are suffering due to location of deck drains. Base of south column at east pier has significant deterioration and open AAR cracking that will require repair.

			Pier Base/Foundation	Re & Re Concrete

Wide longitudinal cracks observed. Disintegration under deck drain to a depth of 150 over most of the end of the east pier.

			Asphalt Wear Surf	Repair Pavement Joint

Expansion joints in asphalt at ends of bridge are very distorted and cracked and require maintenance.

			RC Cap	Apply Sealant

Pier caps are partly wrapped with FRP. Appears to be recently installed. Generally caps in good condition.

2016	Dufferin Street Bridge	Dufferin St.	Water Channel	Remove Obstructions

Small weir located at inlet is severely corroded and gathering debris. This weir is resulting in some minor scour. Large scour hole downstream of this bridge is associated with a storm water sewer. Log resting against entrance to bridge in 2020.

			Embankment	Remove Brush/Trees

Brush growing against bridge. Embankments stable.

			Steel Pipe Ped Barrier	Repair Minor Damage

Secure. 40% loss of coating. Moderate impact damage SW corner. Does not satisfy current standards. Not suitable for traffic barriers.

2020	Pedestrian Underpass	Dufferin St.	Single Pipe Hand Rail	Repair Minor Damage

Railing damaged at south end.

2021	Pedestrian Crossing	Dufferin St.	RC Shaft	Remove Grafitti See Comment

Minor spalls below bearings. Bearings at the piers are corroded. Embankment is pushing on face of north pier. Slope should be regraded to relieve pressure.

Bridge ID	Name	Road	Component	Maintenance
2021	**Pedestrian Crossing**	**Dufferin St.**	**RC Abutment Wall**	**Clean/sweep surface**

North abutment partly buried with fill. Small spalls west abutment at bearing location. Debris at north abutment should be removed.

			Embankment	**Pad approach settlement**

Recommend padding approaches to prevent trip hazard.

2509	**Inco Pipeline**	**Elm St. West**	**CIP RF Box Culvert**	**Apply Sealant**

Culvert has been extended to the south. Extension is in excellent condition. Open AAR cracking at north fascia to 10 mm wide. Plastic sheeting hanging from original soffit. Some leaking noted at CJ north extension.

2512	**Nolins Creek**	**Frood Rd.**	**Steel Pipe Ped Barrier**	**Repair Minor Damage**

Top rail separated, loose mesh. Partially insecure.

			Embankment	**Stabilize Wall**
				Repair Security Fence

Retaining wall in the southeast corner is undercut and should be strengthened. Neighbour complained about surface flow from adjacent street.

2513	**Inco Drainage Ditch**	**Lasalle Blvd.**	**CIP RF Box Culvert**	**See Comment**

Barrel is overall in good condition. Only concern is the complete obstruction of the south end. Silt has started to build up inside culvert at buried end. Only inspected from north end in 2020 due to confined space and water depth concerns.

			Water Channel	**Remove Obstructions**

Outlet is obstructed by infilling of channel with waste earth material. Also storm water outlet is discharging material into outlet end of culvert. Water is ponding & trickling through fill. This condition is not sustainable. Culvert will eventually silt full and be rendered unserviceable. No notable change in 2020.

2516	**McNeil Pedestrian Crossing**	**Over Nolins Creek**	**Wood Post Wood Rail**	**Spot post replacement**

This refers to the platform railing. Based on age, posts and rails should be assessed by a carpenter and replaced as required.

2517	**Erie/Monck Pedestrian Crossing**	**Erie St.**	**Sidewalk**	**Repair Damage**

Asphalt sidewalk at both the north and south entrance are a hazard for pedestrians. Culvert and approaches do not satisfy accessibility standards. Severe distortion and settlement of asphalt at north entrance.

2518	**Lasalle/Inco Culvert**	**Lasalle Blvd.**	**Water Channel**	**Remove Obstructions**

Gravelly material is being eroded from slopes and is being deposited as a large alluvial fan that is partly obstructing the culvert outlet. A retaining wall is suggested to maintain channel.

Bridge ID	Name	Road	Component	Maintenance
2519	Nolins Creek	Beatty St.	CIP RF Open Ftg Culv	Repair Damage

Soffit is saturated, has extensive leaching, spalling, and delaminated areas mainly associated with a catch-basin penetrating the soffit. Wide crack in barrel walls. Water main through culvert is severely corroded. Steel bracing for water main pipe has severe corrosion and section loss, bracing is attached to spalled areas on soffit. Culvert is vulnerable to localized failure around catch basins.

			Component	Maintenance
			Steel Pipe Ped Barrier	Repair Minor Damage

Bottom rail of steel railing west side is damaged and there is perforation evident.

Bridge ID	Name	Road	Component	Maintenance
5002	Broadway Street Bridge	Broadway St.	Chain Link Fencing	Repair Minor Damage

Light corrosion and pitting of posts and mesh. Two post caps missing causing instability. Trees growing into fence.

			Component	Maintenance
			Embankment	Remove Brush/Trees

Stable. Trees growing into fence should be cleared.

Bridge ID	Name	Road	Component	Maintenance
5003	Brady Street Underpass	Brady St.	RC Wing Walls	Apply Sealant

Disintegration & AAR most prominent in splash zone.

Bridge ID	Name	Road	Component	Maintenance
5020	Deer Creek Bridge	Red Deer Rd.	Steel Bent	Repair Minor Damage

Major corrosion at and below the water line, perforation noted (2020) at middle H pile (web) south end. Major pitting. Bracing is in satisfactory condition. Perforated H pile needs repair to bolster web.

			Component	Maintenance
			Timber-Laminated	Spot deck plank replacement

2x10 boards on side comprise deck. Laminated timber deck is slightly worn. Timber running boards are damaged at south end. NE corner is settled, deck boards slightly displaced.

Bridge ID	Name	Road	Component	Maintenance
5021	Deer Creek Bridge	Woodland Rd.	Timber Post & Guide Rail	Spot post replacement

Flex beam attached to 2 - HSS sections on bridge. Timber post and guide rail on approaches. Several posts have major decay in tops , similar timber blocking.

			Component	Maintenance
			Embankment	Erosion Control

Fill slopes on both south sides has spilled into the water channel and is constricting the flow. Erosion in the NW corner behind ballast wall, G/R post is partially exposed.

Bridge ID	Name	Road	Component	Maintenance
5022	Pedestrian Bridge	Wellington	RC Abutment Wall	Clean/sweep surface

Abutments buried.

Bridge ID	Name	Road	Component	Maintenance
5022	Pedestrian Bridge	Wellington	Water Channel	Place rip-rap

Downstream north bank is scouring and would benefit from rip rap slope revetment.

			Steel Grating	Repair Minor Damage

Grating is not square on girders which suggests the bridge may have an inadvertent skew. One section of grating near north end is raised about 20 mm and should be refastened tight to the girder.

			Steel Pipe Ped Barrier	Repair Minor Damage

One missing bolt on east side south end post base. One rail panel at north end is missing one bolt. Panel on east side is corroded and should be replaced. Welded wire mesh partly detached from top rail of centre span west side.

			Timber Soldier Post	Spot post replacement

Soldier posts have been removed since 2016. No change 2020.

5023	Pedestrian Bridge	Nelson St.	Conc Curb	Clean/sweep surface

Satisfactory condition.

			Unprotected BSRC Deck	Clean/sweep surface

One section of deck is significantly disintegrated. Another large section is delaminated.

			Embankment	Remove Brush/Trees Repair Gullies

Over-steepened below abutments.

			Bottom Chord	Remove debris Power Wash

Debris is contributing to corrosion of bottom chords. No obvious cleaning since previous inspection.

5024	Elgin Pedestrian Subway	Elgin St.	Unprotected BSRC Deck	Repair Damage

Stairs rehabilitated in 2017. Walking surface through tunnel has localized areas of delamination through out. Minor spalling occurring.

			CIP RF Box Culvert	Re & Re Concrete

Some light graffiti competing with the intended art. Two uneven sections of floor warrant repair. Interior surfaces have been painted thus obscuring some concrete defects. Structurally the tunnel is in good condition. The SE wall of the culvert adjacent the south portal has delaminated with some spalled areas. Moisture & active seepage penetrating top of structure at north entrance. Scaled areas on soffit near south end.

Bridge ID	Name	Road	Component	Maintenance
5025	Lily Creek	Paris St.	Ped Steel Post & Panel	Repair Minor Damage

Railing on the both sides have collision damage most likely from plow, west side is worst condition. Post in the SE corner lacks proper support. Railing is not secure for pedestrians.

Bridge ID	Name	Road	Component	Maintenance
5051	Centennial Dr Park Bridge	Centennial Dr.	Bottom Chord	Spot Paint

Areas of paint loss are starting to corrode. Utility conduit attached to the north bottom chord.

			Timber-Sawn	Spot deck plank

Deck has been repaired since 2016, plywood over top of 2x6 planks. Deck requires renewal, boards are decayed and failing. Bollard at west end restricts vehicle traffic.

			RC Abutment Wall	Clean/sweep surface

Good condition. Wingwalls are not connected to the abutments and have begun to separate causing some erosion. Debris accumulating on the bearing seats, this should be cleaned.

Bridge ID	Name	Road	Component	Maintenance
5500	Chief Lake Road Culvert	Chief Lake Rd.	Embankment	Remove Brush/Trees

Satisfactory condition tree growth should be brushed back at culvert ends. No traffic protection at this site. No guide rail or delineators at this location.

Bridge ID	Name	Road	Component	Maintenance
5506	Long Lake Road Culvert	Long Lake Rd.	Steel Post & Guide Rail	Repair Minor Damage

Guide rail has partially detached in the NE corner. Eccentric loader end treatment in the NW is damaged from vehicle impact. Several impact strikes to long guide rail at this structure.

Bridge ID	Name	Road	Component	Maintenance
5507	Long Lake Road	Long Lake Rd.	Water Channel	Remove Obstructions

Drop structure designed into culvert. Blocky stone material is partly obstructing inlet (north). High velocity current at 2018 inspection. Moderate velocity at 2020.

			Embankment	Repair Gullies Place rip-rap

Check warrant for protecting ends of culvert. Wash-out of granular material noted on both sides of road. Natural gas line noted at south end of structure.

Bridge ID	Name	Road	Component	Maintenance
5508	Broadway	Broadway	RC Slab on Wall Culvert	Re & Re Concrete

South exposed ends have severe scaling & disintegration . Ice inspection carried out in 2014 revealed interior of culvert is in generally good condition. Water main crosses through roof of culvert. Leaching and minor damage around CJ. Not possible to wade through culvert in 2018 due to current and water level.

			Embankment	Remove Brush/Trees

Slopes are stable. Trees need brushing back.

Bridge ID	Name	Road	Component	Maintenance
5511	Centennial Dr @ Lily Creek	Centennial Dr.	Embankment	Remove Brush/Trees

Tree growing over culvert at the south end.

Bridge ID	Name	Road	Component	Maintenance
5516	Mallards Landing Park	Trans Canada Trail @ Mall	Embankment	Remove Brush/Trees Pad approach

Brush growing tight to bridge.

Bridge ID	Name	Road	Component	Maintenance
6001	CPR Subway	College St.	Sidewalk	Repair Damage

The sidewalk on the west side has a steel clad splash barrier. The barrier is secure but heavily corroded with perforations in a few areas.

Bridge ID	Name	Road	Component	Maintenance
			RC Wing Walls	Re & Re Concrete

Retaining walls on approaches have severe open AAR cracking. Substantially delaminated in 2018 and at risk of sudden crumbling.

Bridge ID	Name	Road	Component	Maintenance

Northwest

2000	Simmons Road Bridge	Simmons Rd.	X- Joint Conventional	Reinstate Seal Repair End Dams

Expansion joints replaced around 2000. Seal is depressed and pulled out of retainer and leaking at west joint. Large spall in west expansion joint dam. AAR present. Numerous smaller spalls.

			RC Column	Re & Re Concrete

Columns of east bent are honeycombed and scaled at water line. North column of west pier has lost about 1/3 of its section due to spalling or severe honeycomb, or possibly ice damage, and should be repaired with a steel collar and grout. Remaining columns have similar but less severe condition. One column of east pier is out-of-plumb. Not possible to access in 2020.

			Embankment	Remove Brush/Trees

Some severe erosion in SW corner. Retaining wall recommended at water gauging station.

			Scupper & Pipe	Unplug Scuppers

Grating on one drain in NE corner has been broken off. Unusual side discharge leads to easy plugging of drains.

2001	Vermillion Lk Rd	Vermillion Lk Rd	Safety Shape B/Wall	Re & Re Concrete

Base of both barrier walls exhibiting delamination. About 10 m length of spalling and delamination at base of south wall and 6 m on north wall.

2002	Main Street Bridge	Main St.	Embankment	Remove Brush/Trees

No concerns. Syringes previously noted under bridge.

2003	Whitson Creek Bridge	MR 15	Asphalt Wear Surf	Routine Maintenance

Minor longitudinal crack. Debris on shoulders.

2004	Whitson Creek Bridge	MR 15	Single Pipe Hand Rail	Replace/Tighten Nuts

Good condition. Railing detached from one post in NW quadrant, 3rd bracket from west.

2005	Onaping River Bridge	M R 8	Timber Post & Guide Rail	Spot post replacement Local repair

Some moderate decay in posts but about 5 years of remaining service life. Guide rail set too low adjacent sidewalk at east end.

Bridge ID	Name	Road	Component	Maintenance
2005	Onaping River Bridge	M R 8	X- Joint Conventional	Local repair

Some scaling appearing on end dams. Minor abrasion. In the SE corner at the expansion joint dam thickening wood in the concrete has caused a spall. Joint is sealed. Some seepage from west paved over joint. Some ravelling of asphalt adjacent the dams.

			Sidewalk	Re & Re Concrete

Scuffed by snow ploughs. Sidewalk soffit has frequent leach stained cracks. Abraded several mm by snowmobiles.

			Embankment	See Comment

Spotty vegetation cover. Evidence of combustibles being stockpiled in SW corner. Severe gullying in NE quadrant.

2006	Onaping River Bridge	Morgan Rd.	Deck_Drain Tube	Re&Re Deck Drain Tubes

Missing, leading to brine from deck dripping on girder ends.

			RC Wing Walls	Apply Sealant

Generally in good condition.

			RC Abutment Wall	Apply Sealant

AAR related cracking and spalling noted in abutment corners. Worst AAR in NE corner with 4 mm wide cracks, about to disintegrate.

			Safety Shape B/Wall	Apply Sealant

Light AAR throughout is most noticeable at base. Small collision spall in NW corner. Snow plough scoring on base.

			Embankment	Erosion Control

Not fully vegetated. Some erosion at bridge corners most notably in the SE corner.

			Conc Filled Pipe	Spot Paint

Light pitting of columns. Pier collars have some light scaling throughout. About 10% loss of coal tar epoxy coating. Base of pier columns has been undercut in SE corner.

			X- Joint Conventional	Local repair

Joint dams have pronounced AAR and scaling, and are starting to disintegrate. No evidence of leakage at time of inspection (2020). Large divots in dams require repair. South expansion joint in poorest condition.

Bridge ID	Name	Road	Component	Maintenance
2006	Onaping River Bridge	Morgan Rd.	RC Cap	Apply Sealant

Open AAR cracks on exposed ends of piers. West end of south pier cap has delaminated and will likely spall off within the next 2-4 years.

2007	Vermillion River Bridge	Morgan Rd.	Embankment	Remove Brush/Trees

Mostly vegetated. Banks scour susceptible.

			Timber Post & Guide Rail	Spot post replacement Local repair

Tops of many posts exhibit major decay. G/R attachment to SE end wall requires repairs.

			Water Channel	Remove Obstructions

Navigable channel. River is cutting into upstream east bank. Some pre-emptive rip rap revetment may help keep river in desired channel. Debris has accumulated against east pier and about 40% of the channel is obstructed.

2008	Montee Principale Bridge	Montee Principale	X- Joint Conventional	Remove Debris

Moderate AAR and scaling developing on concrete dams. Drainage from north joint at NW corner is causing disintegration damage to the substructure. Seals slightly pulled at retainers.

			RC Abutment Wall	Apply Sealant

AAR developing on exposed ends.

			RC Wing Walls	Re & Re Concrete

Wingwalls at NE & NW corners are spalled and disintegrated due to AAR and expansion joint leakage.

			Embankment	Remove Brush/Trees

Minor erosion on fore-slopes. Trees around wing walls need to be cleared, especially SE quadrant.

			Asphalt Wear Surf	Rout & Seal

Normal wear. Numerous random, transverse and longitudinal sealed and unsealed cracks throughout. No evidence of underlaying delamination.

2009	Whitson River Bridge	M R 15	Asphalt Wear Surf	Routine Maintenance

Deck waterproofed and paved in 2017. Some debris on deck shoulders should be cleaned. Cracking from thermal bridge movement at ends of bridge.

Bridge ID	Name	Road	Component	Maintenance
2009	Whitson River Bridge	M R 15	Safety Shape B/Wall	Repair Minor Damage

New safety shape barrier wall installed in 2017.

Bridge ID	Name	Road	Component	Maintenance
2010	Landry Street Bridge	Landry St.	RC Wing Walls	Apply Sealant

Good condition. Early AAR visible. Etching below water line.

			Component	Maintenance
			Timber Post & Guide Rail	Local repair

Recommend spot replacement of the decayed posts. No terminals present.

			Component	Maintenance
			Embankment	Remove Brush/Trees

South embankments have stacked curb protection. Wall at the SE corner has partially failed. Tree growing between concrete blocking in the SE. SE wall is unstable.

			Component	Maintenance
			Twin Pipe & Stanchion	Repair Minor Damage

Two caps missing at NE end. Top railing on south side has minor impact damage.

			Component	Maintenance
			RC Arched Slab	Apply Sealant

Deck surface was remeasured in 2018. Extensive open AAR cracking on both fascia. Cracks approaching 3mm width.

Bridge ID	Name	Road	Component	Maintenance
2500	Birch St Culvert	Birch St	Embankment	Remove Brush/Trees

Well vegetated. Wild parsnip noted along embankments 2020. Recommend brushing out culvert ends. Trees growing between barrels at both ends.

Bridge ID	Name	Road	Component	Maintenance
2504	Montpellier Road Middle Culvert	Montpellier Rd.	Steel Post & Guide Rail	Repair Minor Damage

Extruders in all 4 corners. Damage to ends at south side in 2020, see images.

Bridge ID	Name	Road	Component	Maintenance
2508	Landry Creek	Notre Dame Ave.	Steel Pipe Ped Barrier	Repair Minor Damage

Railing at the south end at bus stop location. Railing is loose. Top rail is bent.

			Component	Maintenance
			Gabion Basket	Repair Minor Damage

Loss of stones from baskets.

Bridge ID	Name	Road	Component	Maintenance
2510	Whitewater Creek	MR 35	Gabion Basket	Repair Minor Damage

Basket in NW corner has lost its contents, also similar in the NE. A more permanent solution than gabion baskets is justified.

			Precast RF Box Culvert	See Comment

Good alignment. Scaling developing below the water line. Staining and damp areas on walls due leaking joints. Ice inspection in 2014 confirms good condition of interior. Could not walk through in 2020, joints at ends are leaking east end is the worst case. Leakage at the joints will be the cause of future damage to this culvert. Principal flow through east barrel. About 20 cm settlement at upstream end. Erosion has resulted in partial obstruction of outlet of north pipe. Channelizing recommended. Retaining wall in NW quadrant would help with erosion.

2533	Trans Canada Trail	Onaping Falls	Embankment	Remove Brush/Trees

Brush at west end should be trimmed to promote air circulation at abutment.

			RC Ballast Wall	Re & Re Concrete

Good condition. Minor spalls in tops of both ballast walls.

			Timber-Sawn	Spot deck plank

About 12 boards require replacement as of 2020. Deck is being well maintained.

2534	Bridge St /Emile St	Trans Canada Trail	RC Abutment Wall	Clean/sweep surface

Debris on top of abutments should be removed.

			Embankment	Remove Brush/Trees Erosion Control

Embankment is contacting bottom of bridge at NW corner. Local hand excavation required to remove this condition. There is a large gulley feeding into the stream and this is a potential liability. On the west approach erosion is reducing the width of the approach path and this may result in accessibility and liability challenges. Bollards on bridge ends should have a reflective strip.

			RC Cap	Clean/sweep surface

Good condition.

2536	McKenzie Creek Culvert	Montpellier Road	Steel Post & Guide Rail	Repair Minor Damage

Extruders in all four corners. Repair of extruders in SW & NE corners required.

Bridge ID	Name	Road	Component	Maintenance

Northeast

3000	Nelson Lk Rd @ Rapid River	Nelson Lk Rd.	Timber Post & Guide Rail	Spot post replacement

Buried end treatments. Several posts are starting to decay on top surface. Guide rail at NE corner has minor impact damage.

3001	Vermillion River Bridge	Desmarais	Steel Post & Guide Rail	Repair Minor Damage

Satisfactory condition. Eccentric loader at the NE and extruder end treatment at NE. NE end has been repaired since 2018. SE flex beam has a long tear from vehicle scrub this section of beam should be replaced, see pic.

			RC Parapet	Re & Re Concrete

SW end wall is damaged from presumably vehicle impact, top is spalled see pic. Walls have numerous areas of parging and leaching cracks.

			Embankment	Remove Brush/Trees

Large stone on fore slopes. Tree growth under bridge and around bridge requires removal.

			Single Pipe Hand Rail	Repair Minor Damage

2 damaged railing anchors on east side. Damage at SW end post.

3002	Martin Road Bridge	Martin Rd.	Gabion Basket	Repair wire mesh

Gabion baskets in SW quadrant have lost most of their contents. These should be reset and refilled. Gabions on all corners are failing to some degree.

			Timber-Laminated	Local repair

Creosoted timber in mostly good condition. Asphalt on deck indicates several suspect areas in the deck surface see pics. Expect some localized areas of major decay in top of deck boards.

			Steel-Rolled	Remove debris

Some minor section loss and significant slab rust where approach girders rest on main girders. Appears salt is penetrating the deck and corroding the girders.

			Water Channel	Remove Obstructions

Some upstream bank scour. Tree lodged against south pier. Evidence of scour on the fore slopes. Stream stable and centred under bridge. Adequate bridge opening.

			Asphalt Wear Surf	Routine Maintenance

Asphalt has a number of small cracks corresponding with laminated timber deck boards. In 2018 a "soft" spot was noted on the centre span, west side. Possible decay in underlaying deck. This is also noted in several locations during the 2020 inspection.

Bridge ID	Name	Road	Component	Maintenance
3002	Martin Road Bridge	Martin Rd.	Timber Post & Guide Rail	Local repair

Strut supporting G/R post is displaced on downstream side. Appears post is split in half. Damaged post at the NW end. Barrier system on bridge should be updated.

			Timber Curb	Local repair

Curb has moderate impact damage at the SE and NW from winter plow.

3005	Whitson River	M R 80 (Hwy 69)	Single Pipe Hand Rail	Repair Minor Damage

Snow plow damage on both sides. One post anchor on east side has been severed. About 10 posts anchors damaged in total. Missing end caps in all four corners. Railing is rusted through in numerous locations.

			Timber Post & Guide Rail	Local repair

Extruder end treatment located in NW and SE corners. Buried ends in NE and SW corners, buried ends are not fully buried and have some impact damage. A number of posts have been split or damaged from sidewalk traffic.

			Steel Pipe Ped Barrier	Repair Minor Damage

Chain-link fencing attached to the pedestrian railings. Railings on both sides are leaning outwards.

3006	Kalmo Road Bridge / Whitson River	Kalmo Rd.	Bailey Bearings	Power Wash Remove debris

Mostly covered with debris.

			Steel Angle	Repair Minor Damage

One steel angle approach curb has been removed in the northwest corner and should be replaced.

			Timber-Laminated	Spot deck plank replacement

Laminated deck portion in good condition. Some wear and decay in chessing and running boards.

			Timber Wear Surface	Local repair Reset Nail Heads

Mechanical wear. Some running boards partly replaced. Lag bolts should be counter-sunk so they are not plucked by traffic or plough. Curbs are tired.

3503	MR 80	MR 80	Timber Post & Guide Rail	Spot post replacement

Some minor collision damage. Minor decay noted in guide rail posts. These posts should be spot replaced. End treatments are damaged and should be updated due to high volume traffic at this location.

Bridge ID	Name	Road	Component	Maintenance
3504	Fleming Street Culvert	MR 80 (Highway 69 North)	Steel Beam on Steel Post	Repair Minor Damage

Installed in 2008. Several areas of impact damage to both guide rails. Extruder end treatment in the NW end.

4000	Roberts River	M R 84 (Moose Mt)	Timber Post & Guide Rail	Spot post replacement

Satisfactory condition. Guide rail does not properly align with HSS box beam rail system on the bridge. 1 timber post on north approach is split needs replacement. End treatments or connections to bridge do not meet current standards.

			Panel Bridge Brg	Remove debris

Good condition, debris is accumulating and should be cleaned. South end is fixed bearing.

			Water Channel	Remove Obstructions

Small beaver dam about 70m downstream of bridge. Beaver debris under bridge also.

			Timber-Sawn	Spot deck plank replacement

Timber deck is covered by 2 x 6 timber wearing surface. Consider replacing with steel grate type deck.

			Mabey Panel	Repair Minor Damage

Good condition. Two rakers, one at each approach corner (SE & NW) have been plastically deformed and bent, see images. The Maybe panels at these corners have received slight damage. Better impact prevention measures are needed. Condition unchanged in 2020.

			Timber Wear Surface	Local repair

Wearing surface should be replaced at this time. Several boards have major decay and require replacement. Nail heads are sticking up at numerous locations. Several loose boards.

			RC Abutment Wall	Clean/sweep surface

Good condition. Requires debris removal from bearing seat. Rock protection at face of abutment walls.

4003	Industrial Rd (Ski Hill Rd)	Industrial Rd (Ski Hill Rd)	Panel Bridge Brg	Remove debris
				Power Wash

2 roller bearings per corner. Tree growth at east end requires removal.

			Bin Wall	Remove debris

Trees growing in bin wall should be removed.

Bridge ID	Name	Road	Component	Maintenance
4003	Industrial Rd (Ski Hill Rd)	Industrial Rd (Ski Hill Rd)	Steel Post & Guide Rail	Repair Minor Damage

Several areas of damage from vehicle impact at the east ends.

			Embankment	Remove Brush/Trees

Rip rap revetment in place.

			Delineator	Replace Sign

All delineators are vulnerable to impact damage and require frequent straightening. Delineators should be properly installed in the ground not on guide rail.

4005	Roberts River	Ironside Lake Rd.	RC Abutment Wall	Local repair

New 2020.

			Gravel Surface	Local repair

Performance Deficiencies Report

Bridge ID	Name	Component	Deficiency
1001	Vermillion River Bridge	Scupper & Pipe	Ponding
1002	Little Panache Lake Narrows	Paved-Over	Leaking
1003	Maninen Road Bridge	Water Channel	Constricted
		Paint Coating	Adhesion Loss
1005	Chicago Mine Road Bridge	Water Channel	Constricted
1006	Spanish River near Worthington Road	Water Channel	Obstructed
		Embankment	Erosion
1007	Vermillion River Bridge	Embankment	Erosion
		Paint Coating	Adhesion Loss
1012	Fielding Road Bridge	X- Joint Conventional	Leaking
		Asphalt Wear Surf	Uneven,Potholed
1019	Finland Creek Bridge	Water Channel	Lacking Freeboard
		Chain Link Fencing	Weakened
1020	Finland Street Bridge	Water Channel	Lacking Freeboard
		Asphalt Wear Surf	Uneven,Potholed
1022	Poland Street Bridge	Water Channel	Aggradation
		Sidewalk	Uneven,Potholed
1024	Big Nickel Mine Rd	Asphalt Wear Surf	Settlement
		Embankment	Over-steepened
1025	Lily Creek Bridge	Stacked Concrete	Displaced
1026	Junction Creek Bridge	Sidewalk	Settlement
1028	Struthers Pedestrian Bridge	RC Shaft	Tilting
1030	Meatbird Creek Pedestrian Bridge	Restriction	Missing
1529	MR 24 Culvert	Asphalt Wear Surf	Uneven,Potholed
		Water Channel	Obstructed
1531	Junction Creek	CIP RF Open Ftg Culv	Aggradation
1532	Junction Creek	Concrete Wing Walls	Displaced
1533	Lily Creek	Water Channel	Obstructed
1535	Lily Creek	Gabion Basket	Spilling
		Embankment	Erosion

Bridge ID	Name	Component	Deficiency
1535	Lily Creek	Timber Post & Cable	Weakened
1537	Fairbank Creek	Water Channel	Poor Alignment
1538	Fairbank Creek	Precast RF Box Culvert	Insufficient Barrel Length
1541	Panache Lake Rd. Culvert	Water Channel	Poor Alignment
		Steel Post & Guide Rail	Weakened
		Embankment	Erosion
1542	Wabagishik Road Culvert	Precast RF Box Culvert	Lacking Freeboard
		3 Cable Wood Post	Weakened
		Embankment	Erosion
1544	C. Johnson Road Culvert @ MR #4	Water Channel	Constricted
		Circular CS Plate Pipe	Lacking Freeboard
1545	Lorne Falls Rd. Culvert	Steel Post & Guide Rail	Inadequate Height
1546	Graham Rd. Culvert	Water Channel	Scour Prone
1548	CSPA Culvert	Circular CS Plate Pipe	Insufficient Barrel Length
1549	Balsam Street Bridge	Masonry Retaining Wall	Tilting
1553	Fairbank Creek Culvert	Steel Beam on Steel Post	Weakened
1561	Trans Canada Trail	Paint Coating	Adhesion Loss
1563	Fairbank Creek	CIP RF Open Ftg Culv	Insufficient Barrel Length
		Water Channel	Obstructed
		3 Cable Wood Post	Weakened
1565	Fairbank Creek Culvert	Water Channel	Poor Alignment
2000	Simmons Road Bridge	RC Column	Tilting
		Steel Sliding Plate	Uneven Bearing
		Paint Coating	Adhesion Loss
		Conc Rail/End Posts	Weakened
		X- Joint Conventional	Leaking
		Scupper & Pipe	Plugged
		RC Abutment Wall	Tilting
		Water Channel	Lacking Freeboard
2002	Main Street Bridge	Conc Curb	Inadequate Height
2003	Whitson Creek Bridge	Embankment	Over-steepened
2004	Whitson Creek Bridge	Conc Curb	Weakened

Bridge ID	Name	Component	Deficiency
2004	Whitson Creek Bridge	Embankment	Over-steepened
2005	Onaping River Bridge	Pole Base	Under Strength
		Rocker or Roller Bearing	Excess Displacement
		Timber Post & Guide Rail	Inadequate Height
2007	Vermillion River Bridge	Timber Post & Guide Rail	Weakened
		RC Cantilever	Tilting
		Water Channel	Obstructed
2008	Montee Principale Bridge	Water Channel	Scour Prone
2009	Whitson River Bridge	Embankment	Over-steepened
2010	Landry Street Bridge	Embankment	Unstable
2012	INCO Railway	Embankment	Over-steepened
2015	CPR Overpass / Nolin Creek	Scupper & Pipe	Collateral Damage
		Embankment	Unstable
2016	Dufferin Street Bridge	Water Channel	Scour Prone
		Soffit	Under Strength
		Steel Pipe Ped Barrier	Does'nt Meet New Standard
		Sidewalk	Uneven,Potholed
2500	Birch St Culvert	Circular CS Plate Pipe	Settlement
2505	Nickel Basin Road Culvert	Water Channel	Constricted
2507	Pilon Drain	Water Channel	Poor Alignment
2508	Landry Creek	Steel Pipe Ped Barrier	Weakened
		RC Slab on Wall Culvert	Load Carrying Capacity
2509	Inco Pipeline	Embankment	Unstable
2510	Whitewater Creek	Precast RF Box Culvert	Settlement
2512	Nolins Creek	Water Channel	Settlement
2513	Inco Drainage Ditch	Timber Post & Cable	Weakened
		Water Channel	Obstructed
		CIP RF Box Culvert	Obstructed
		Embankment	Unstable
2516	McNeil Pedestrian Crossing	Water Channel	Scour Prone
2517	Erie/Monck Pedestrian Crossing	Sidewalk	Uneven,Potholed
		RC Inlet/Outlet Walls	Tilting

Bridge ID	Name	Component	Deficiency
2517	Erie/Monck Pedestrian Crossing	Eliptical CS Plate Pipe	Lacking Freeboard
2518	Lasalle/Inco Culvert	Embankment	Unstable
2519	Nolins Creek	Wood Post Wood Rail	Weakened
		CIP RF Open Ftg Culv	Insufficient Barrel Length
		Asphalt Wear Surf	Uneven,Potholed
2534	Bridge St /Emile St	Embankment	Erosion
3000	Nelson Lk Rd @ Rapid River	Asphalt Wear Surf	Uneven,Potholed
		Timber Post & Guide Rail	Does'nt Meet New Standard
		Timber Post & Guide Rail	Does'nt Meet New Standard
		Embankment	Unstable
3001	Vermillion River Bridge	Delineator	Obscured
3002	Martin Road Bridge	Timber Post & Guide Rail	Weakened
		Timber Post & Guide Rail	Does'nt Meet New Standard
		Water Channel	Scour Prone
		Paint Coating	Material Breakdown
		Gabion Basket	Displaced
3003	Whitson River Bridge	Safety Shape B/Wall	Weakened
3005	Whitson River	Water Channel	Constricted
3006	Kalmo Road Bridge / Whitson River	Water Channel	Lacking Freeboard
		Bailey Transom	Exess LL Deflection/Vibration
3503	MR 80	Asphalt Wear Surf	Rutting
		Gabion Basket	Spilling
4000	Roberts River	Timber Post & Guide Rail	Does'nt Meet New Standard
		Mabey Panel	Connection
4005	Roberts River	RC Abutment Wall	Settlement
4501	Junction Creek Culvert	Water Channel	Aggradation
4503	Junction Creek	Water Channel	Poor Alignment
4505	Junction Creek	CS Plate Pipe Arch	Obstructed
		Water Channel	Obstructed
4506	Madison Avenue	Precast RF Box Culvert	Lacking Freeboard
		Water Channel	Lacking Freeboard
4507	Junction Creek	Water Channel	Obstructed

Bridge ID	Name	Component	Deficiency
4508	MR 85 CULVERT	Water Channel	Poor Alignment
4513	Gary Avenue Dead End	Water Channel	Lacking Freeboard
		Embankment	Erosion
5001	Junction Creek Bridge	Steel Post & Panel	Weakened
		RC Parapet	Weakened
5009	Coniston Creek Bridge	Water Channel	Obstructed
		Asphalt Wear Surf	Rutting
5010	Romford Creek Bridge	RC Wing Walls	Tilting
		Embankment	Unstable
5011	Romford Creek Bridge	Steel Post & Guide Rail	Weakened
5013	Romford Creek Bridge	RC Abutment Wall	Tilting
		Gabion Basket	Tilting
		Steel Pipe Ped Barrier	Does'nt Meet New Standard
5015	Romford Creek Bridge	Water Channel	Aggradation
		Embankment	Toxic Weeds
		Gabion Basket	Spilling
5017	Mountain View Road Bridge	Gabion Basket	Tilting
5018	Roseland Drive Bridge	Gabion Basket	Tilting
5021	Deer Creek Bridge	Water Channel	Constricted
		Delineator	Obscured
		RC Ballast Wall	Tilting
5023	Pedestrian Bridge	Misc Steel	Weakened
		Embankment	Erosion
5025	Lily Creek	Ped Steel Post & Panel	Weakened
		Sidewalk	Undermined/Voids
5029	Coniston Creek Pedestrian Bridge	Water Channel	Constricted
		RC Abutment Wall	Tilting
5030	Paris St Overpass NBL	X- Joint Conventional	Leaking
		X-Joint Modular.	Leaking
5051	Centennial Dr Park Bridge	Water Channel	Lacking Freeboard
5502	Hill Street Culvert	Water Channel	Poor Alignment
5504	Garson Coniston Rd	Steel Post & Guide Rail	Weakened

Bridge ID	Name	Component	Deficiency
5504	Garson Coniston Rd	Water Channel	Constricted
5506	Long Lake Road Culvert	Steel Post & Guide Rail	Weakened
5511	Centennial Dr @ Lily Creek	Precast RF Box Culvert	Lacking Freeboard
5517	Kari Road Culvert	Water Channel	Poor Alignment
6008	Leslie Street Bridge	Steel Post & Guide Rail	Does'nt Meet New Standard
6010	King Street Bridge	Sidewalk	Uneven,Potholed
6014	Pedestrian Bridge	Steel Pipe Ped Barrier	Weakened
		Embankment	Erosion
6501	Leon Drainage Ditch	Headwall	Tilting
		Water Channel	Aggradation
6502	Junction Creek	Timber Post & Guide Rail	Weakened
6504	Belfry Avenue Culvert	Water Channel	Poor Alignment
		Embankment	Over-steepened
6505	Attlee Avenue Culvert	Water Channel	Aggradation
6506	Third Avenue	Water Channel	Obstructed
		Gabion Basket	Spilling
6507	Arthur Street	Embankment	Unstable
6508	Kenwood Avenue	Water Channel	Scour Prone
6509	Highgate	Water Channel	Obstructed

Bridge Condition Index Report

Bridge ID	Name	BCI	Program Year
1000	Spanish River Bridge	**100.0**	
1001	Vermillion River Bridge	**75.2**	
1002	Little Panache Lake Narrows	**73.5**	
1003	Maninen Road Bridge	**67.3**	2021
1004	High Falls Road Bridge	**100.0**	
1005	Chicago Mine Road Bridge	**93.2**	
1006	Spanish River near Worthington Road	**80.5**	2021
1007	Vermillion River Bridge	**90.4**	
1008	Moxam Creek Bridge	**73.4**	2024
1009	Old Soo Road Bridge	**100.0**	
1010	Black Lake Road Bridge	**76.2**	
1011	Mikkola Road Bridge	**75.9**	
1012	Fielding Road Bridge	**70.1**	2022
1013	CPR Overhead (Westbound)	**73.4**	
1014	CPR Overhead (Eastbound)	**72.2**	
1015	Finland Creek Bridge	**82.8**	
1016	Creighton Road at Club Road	**90.1**	
1017	Creighton Road at Tennis Club	**90.1**	
1018	Power Street Bridge	**91.1**	
1019	Finland Creek Bridge	**95.0**	
1020	Finland Street Bridge	**64.6**	2024
1022	Poland Street Bridge	**63.5**	2025
1023	Orford Street Bridge	**62.0**	2025
1024	Big Nickel Mine Rd	**72.6**	2022
1025	Lily Creek Bridge	**69.3**	2025
1026	Junction Creek Bridge	**72.9**	
1028	Struthers Pedestrian Bridge	**73.4**	
1029	Copper Cliff Trail Bridge	**87.1**	
1030	Meatbird Creek Pedestrian Bridge	**95.0**	
1529	MR 24 Culvert	**65.3**	
1530	Finland Creek	**77.9**	
1531	Junction Creek	**96.3**	
1532	Junction Creek	**74.2**	
1533	Lily Creek	**80.4**	
1534	Junction Creek	**69.7**	2023
1535	Lily Creek	**66.3**	2025
1536	Fairbank Creek	**81.1**	
1537	Fairbank Creek	**81.3**	
1538	Fairbank Creek	**80.8**	
1539	Inco Drainage Ditch	**80.4**	

Bridge ID	Name	BCI	Program Year
1540	Panache Lake Rd Culvert	**71.1**	2022
1541	Panache Lake Rd. Culvert	**77.0**	
1542	Wabagishik Road Culvert	**82.5**	2023
1543	Hill Road Culvert	**88.7**	
1544	C. Johnson Road Culvert @ MR #4	**75.3**	2026
1545	Lorne Falls Rd. Culvert	**85.0**	
1546	Graham Rd. Culvert	**82.4**	
1547	Worthington Rd. Culvert	**66.5**	2023
1548	CSPA Culvert	**55.6**	2027
1549	Balsam Street Bridge	**72.1**	
1553	Fairbank Creek Culvert	**96.3**	
1560	Southview Dr.	**81.1**	
1561	Trans Canada Trail	**77.7**	2024
1562	Old Soo Rd Box Culvert	**96.3**	
1563	Fairbank Creek	**64.0**	
1564	Fairbank Lake Rd Culvert	**89.8**	
1565	Fairbank Creek Culvert	**90.9**	
2000	Simmons Road Bridge	**72.5**	2025
2001	Vermillion Lk Rd	**81.8**	
2002	Main Street Bridge	**71.8**	2023
2003	Whitson Creek Bridge	**77.0**	
2004	Whitson Creek Bridge	**76.1**	
2005	Onaping River Bridge	**73.1**	2030
2006	Onaping River Bridge	**71.4**	2022
2007	Vermillion River Bridge	**72.7**	2023
2008	Montee Principale Bridge	**72.9**	2025
2009	Whitson River Bridge	**75.8**	
2010	Landry Street Bridge	**67.9**	2024
2012	INCO Railway	**67.3**	
2013	Lasalle Interchange	**69.4**	2024
2014	CPR Overhead	**72.5**	2024
2015	CPR Overpass / Nolin Creek	**71.3**	2023
2016	Dufferin Street Bridge	**67.6**	2022
2020	Pedestrian Underpass	**68.7**	
2021	Pedestrian Crossing	**73.8**	
2500	Birch St Culvert	**67.8**	2023
2503	Montpellier Road South Culvert	**95.0**	
2504	Montpellier Road Middle Culvert	**91.1**	
2505	Nickel Basin Road Culvert	**95.0**	
2506	Mckenzie Road Culvert	**97.5**	
2507	Pilon Drain	**97.5**	
2508	Landry Creek	**60.3**	2022

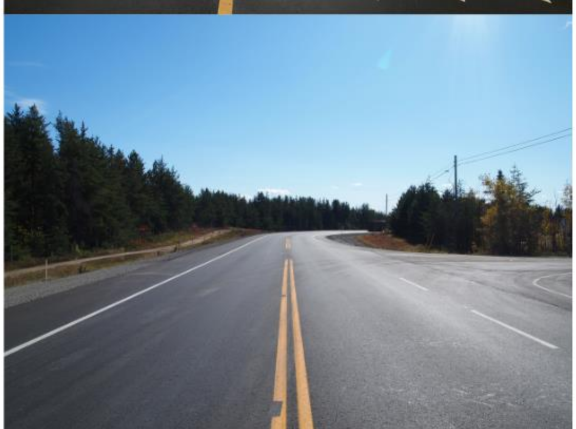
Bridge ID	Name	BCI	Program Year
2509	Inco Pipeline	69.7	
2510	Whitewater Creek	69.5	2024
2511	Huron Street Culvert	62.1	2021
2512	Nolins Creek	51.3	2022
2513	Inco Drainage Ditch	73.6	2022
2514	Granite-McKim Culvert	73.2	
2516	McNeil Pedestrian Crossing	65.2	
2517	Erie/Monck Pedestrian Crossing	68.5	2022
2518	Lasalle/Inco Culvert	72.1	
2519	Nolins Creek	50.9	2021
2533	Trans Canada Trail	74.5	2022
2534	Bridge St /Emile St	82.5	
2536	McKenzie Creek Culvert	90.9	
3000	Nelson Lk Rd @ Rapid River	72.6	2021
3001	Vermillion River Bridge	84.0	
3002	Martin Road Bridge	66.2	2028
3003	Whitson River Bridge	70.5	
3004	Frappier Road Bridge	78.7	
3005	Whitson River	70.2	2022
3006	Kalmo Road Bridge / Whitson River	84.5	2027
3007	Whitson Flood Channel Culvert	91.7	
3502	Lasalle Blvd Culvert	67.4	
3503	MR 80	70.3	2022
3504	Fleming Street Culvert	69.9	
3505	Bodson East Culvert	92.3	
3510	Yorkshire Dr. Culverts	96.3	
4000	Roberts River	72.8	2021
4001	Vermillion River	100.0	
4002	Bowland Bay Bridge	80.3	
4003	Industrial Rd (Ski Hill Rd)	79.1	
4004	CNR Overpass	73.8	
4005	Roberts River	100.0	
4010	Junction Creek Ped Bridge	69.4	2023
4500	Christina St. Culvert	67.4	
4501	Junction Creek Culvert	70.3	
4502	Robin St	96.0	
4503	Junction Creek	93.4	
4505	Junction Creek	59.9	2023
4506	Madison Avenue	83.7	
4507	Junction Creek	71.5	
4508	MR 85 CULVERT	87.5	
4513	Gary Avenue Dead End	82.5	

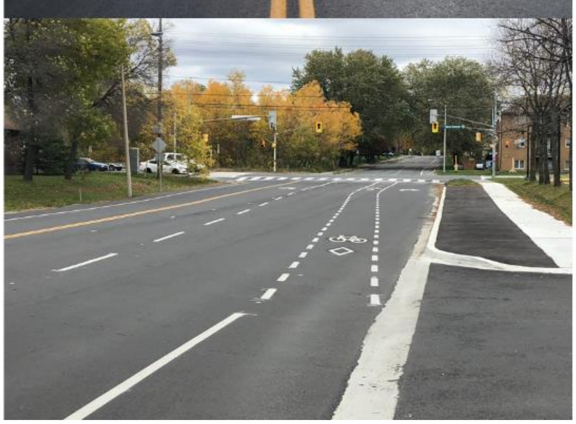
Bridge ID	Name	BCI	Program Year
4514	Hanmer Lake Culvert	**93.5**	
5000	Riverside Drive Bridge	**85.6**	
5001	Junction Creek Bridge	**77.8**	
5002	Broadway Street Bridge	**70.1**	
5003	Brady Street Underpass	**70.4**	2024
5008	Paris St Overpass SBL	**72.5**	2022
5009	Coniston Creek Bridge	**70.2**	
5010	Romford Creek Bridge	**69.5**	2024
5011	Romford Creek Bridge	**100.0**	
5013	Romford Creek Bridge	**71.6**	2023
5014	Romford Creek Bridge	**97.5**	
5015	Romford Creek Bridge	**68.3**	
5016	Coniston Creek	**90.1**	
5017	Mountain View Road Bridge	**73.7**	2022
5018	Roseland Drive Bridge	**73.2**	
5020	Deer Creek Bridge	**66.2**	2030
5021	Deer Creek Bridge	**74.6**	
5022	Pedestrian Bridge	**73.8**	
5023	Pedestrian Bridge	**69.0**	2022
5024	Elgin Pedestrian Subway	**68.7**	2025
5025	Lily Creek	**71.2**	2022
5029	Coniston Creek Pedestrian Bridge	**100.0**	
5030	Paris St Overpass NBL	**71.9**	2023
5051	Centennial Dr Park Bridge	**77.0**	2021
5500	Chief Lake Road Culvert	**67.4**	
5501	Elbow Creek Culvert	**95.0**	
5502	Hill Street Culvert	**98.8**	
5503	Forest Lake Road Culvert	**95.0**	
5504	Garson Coniston Rd	**96.0**	
5506	Long Lake Road Culvert	**83.0**	
5507	Long Lake Road	**64.4**	
5508	Broadway	**65.8**	
5511	Centennial Dr @ Lily Creek	**75.2**	
5514	Jumbo Rd South	**93.8**	
5516	Mallards Landing Park	**76.8**	2025
5517	Kari Road Culvert	**96.0**	
5518	Walter Street Culvert	**97.5**	
5519	Jumbo Rd North	**97.5**	
6001	CPR Subway	**60.7**	2026
6008	Leslie Street Bridge	**69.5**	2023
6009	Bond Street Bridge	**64.2**	
6010	King Street Bridge	**70.3**	2024

Bridge ID	Name	BCI	Program Year
6011	Attlee Avenue Bridge	**73.5**	
6012	Pedestrian Bridge	**72.7**	
6013	Pedestrian Bridge	**74.8**	
6014	Pedestrian Bridge	**65.3**	2022
6015	Pedestrian Bridge	**73.3**	
6017	Eva Avenue Pedestrian Bridge	**74.1**	
6020	Mountain Street	**74.3**	
6500	Beatrice Crescent Culvert	**97.5**	
6501	Leon Drainage Ditch	**73.4**	2023
6502	Junction Creek	**68.8**	2025
6503	Hebert Street Culvert	**92.9**	
6504	Belfry Avenue Culvert	**79.1**	
6505	Attlee Avenue Culvert	**66.8**	2028
6506	Third Avenue	**73.1**	
6507	Arthur Street	**86.8**	
6508	Kenwood Avenue	**69.0**	
6509	Highgate	**64.3**	2024
6510	Trans Canada Trail (Barrydowne Arena)	**81.2**	
6511	Attlee Ave Pedestrian	**67.7**	

Total Number of Structures: 185

BCI < 50:	**0**	**BCI Between 50 and 60:**	**4**	**BCI Between 60 and 70:**	**44**	**BCI Above 70:**	**137**
Percent:	**0**		**2.2%**		**23.8%**		**74.1%**





Greater | Grand Sudbury

ROADS AND TRANSPORTATION ASSET MANAGEMENT PLAN

2021

JULY

Contents

1 Executive Summary

1.1 Introduction

Asset Management is the systematic coordination of activities and practices of an organization to optimally and sustainably deliver on its service objectives through the cost-effective lifecycle management of assets.

The Roads and Transportation Asset Management Plan (RTAMP) describes asset planning work which will be completed in two parts. This document presents Part 1 of the work associated with Phase 1 of the Enterprise Asset Management Plan. This includes identification of the current state of the infrastructure, levels of service, review of expenditures and funding. Also included are discussions regarding risk, future demand, the Community Energy and Emissions Plan, Climate Change and identification of next steps and improvement opportunities.

Section 9.1 Next Steps will identify work to be completed during Part 2 of the work associated with Phase 3 of the Enterprise Asset Management Plan. This will include a review of proposed options for various levels of services with associated costs and risks, valuation and continued review of asset condition performance projections. Part 2 work will also include a review of long term financial strategy options in conjunction with sustainability, future network demands, impacts of climate change, recommendations for continued data collection for all road assets and continuous improvements to integration of Operational and Capital Programs.

The City of Greater Sudbury is unique due to its large area and relatively high number of road lane kilometres per capita. The City's northern location also differentiates this community from others due to factors such as higher construction costs, harsher climate and the reliance on the industrial base that affect service level alternatives.

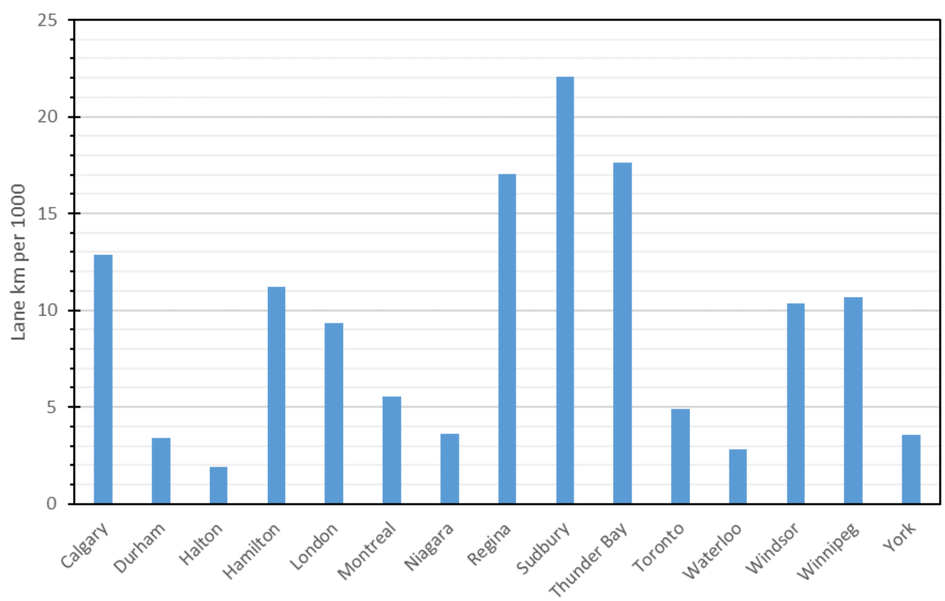


Figure 1.1 - Municipality Comparison of Road Length versus Population

Funding of road asset capital improvements for roads projects has significantly increased over the last five year period. Average road investment from 2016-2020 for all road capital projects increased by approximately 30% over the previous five year period. In 2019, the budget process was transformed from an envelope system where previously defined funding levels were distributed to the various operating departments to an enterprise prioritization system which ensures funds are distributed to projects on a city wide priority basis. In addition to the prioritization process, Council provided an additional investment in roads infrastructure of approximately $4 million in 2019.

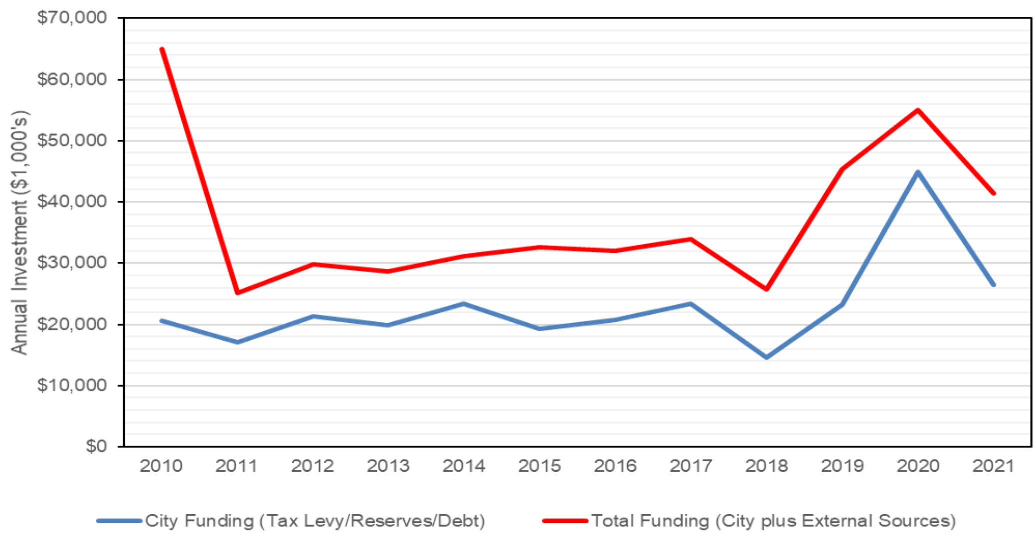


Figure 1.2 Historical Funding - Roads

Council has encouraged the use of new technologies and materials to explore methods for reduction of infrastructure maintenance costs and economic extension of expected asset life. These include:

- Review of capital construction and operational activities for opportunities to employ asphalt recycling treatments;
- Hot In-place Recycled Asphalt Pilot Study; and
- Pothole Patching Study Initiative

The Stormwater Asset Management Plan has been finalized and Council will be reviewing alternatives for implementation of recommendations resulting from the plan. Investment in City drainage assets associated with roads will improve road drainage and extend the life of the road network structure.

Enhancements to coordination of road improvement projects with the improvement of other assets such as water and wastewater infrastructure have been made in recent years to better align the preferred road structure treatments with underground infrastructure work.

The City remains committed to continuous improvement in review of existing internal and external processes, emerging technologies and alternative construction standards to enhance work activity efficiencies and provide efficient capital program recommendations.

1.2 Current State of the Infrastructure

This plan is prepared for the roads and transportation assets owned and operated by the City of Greater Sudbury. Assets reviewed in this plan include road asphalt and granular structure, curbs, sidewalks, cycling infrastructure, street light poles and street light fixtures. Other assets to be reviewed for future inclusion in this document include signs, guide rails, rock cuts, traffic signals, street trees, and retaining walls.

Paved and gravel road condition summaries are indicated in Figure 1.3 and Figure 1.4 below. Paved road conditions are based on evaluation using *ASTM D6433 – Standard Practice for Roads and Parking Lots Pavement Condition Index Surveys*. Gravel road conditions were established using methods based on the Ministry of Transportation document "SP-025 Manual for Condition Rating of Gravel Surface Roads."

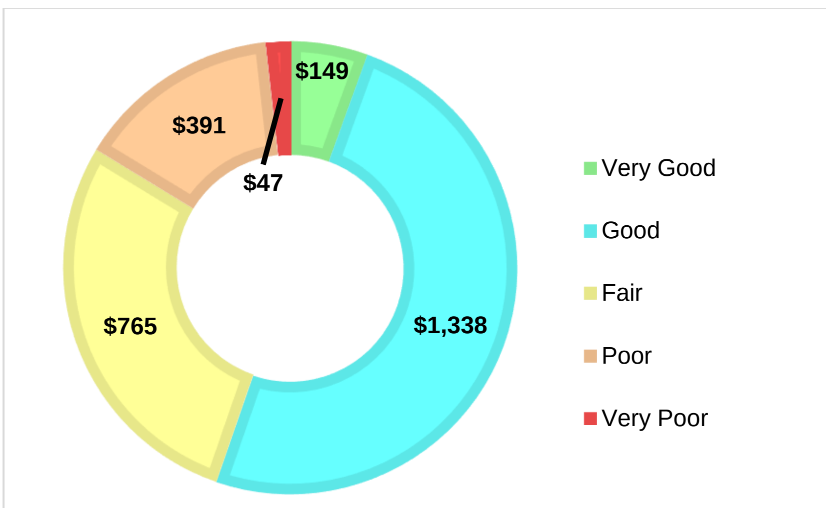


Figure 1.3 - Condition and Replacement Cost of Paved Roads (millions)

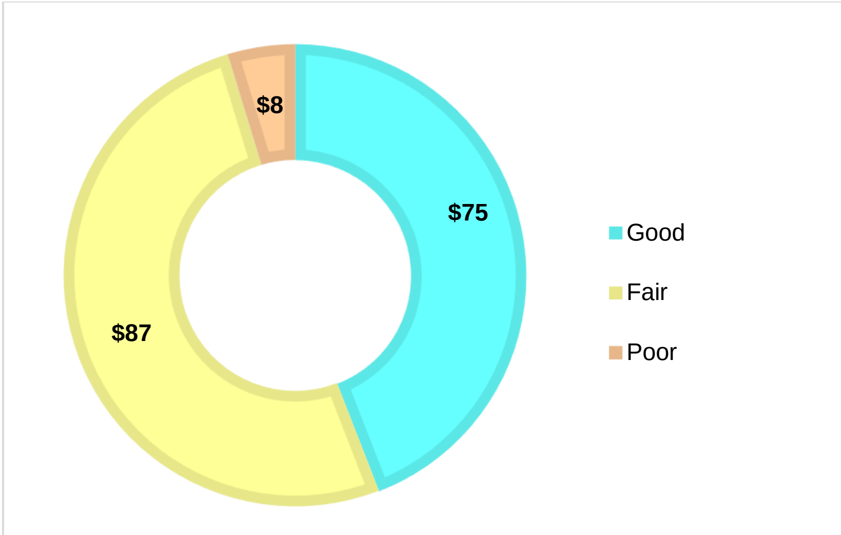


Figure 1.4 - Condition and Replacement Cost of Gravel Roads (millions)

Figure 1.5 indicates the replacement value of the assets included in Part 1 of this report. This cost estimate does not include traffic signals, signs, rock cuts, guide rails, street trees and retaining walls that may be deemed appropriate for inclusion into future versions of the RTAMP. The total replacement cost of these assets is approximately $3 billion.

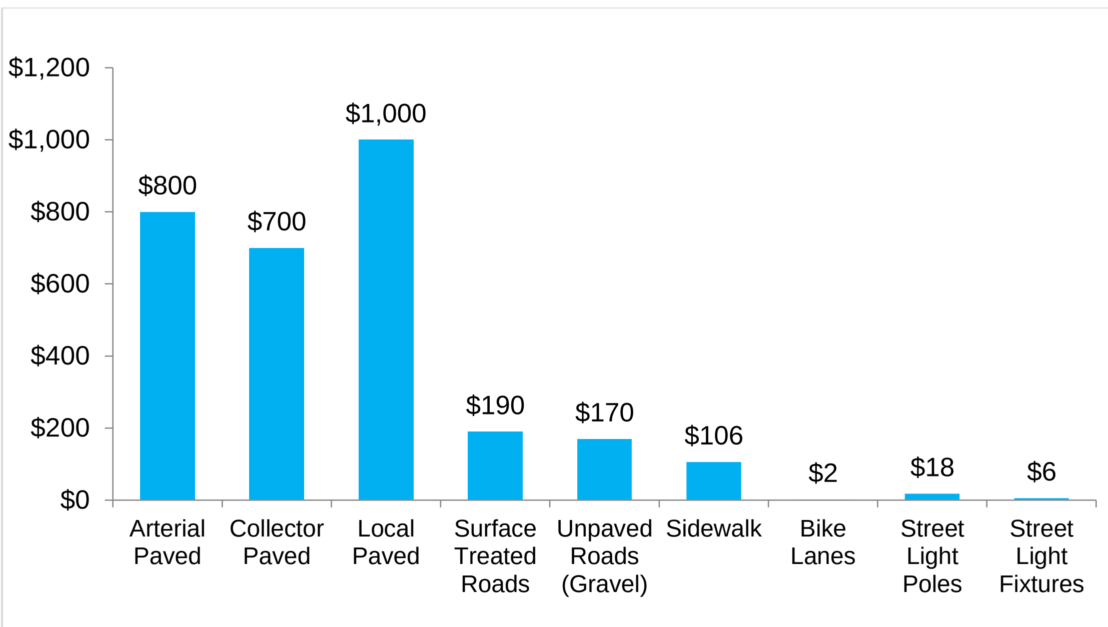


Figure 1.5: Road Network Replacement Value (Millions)

1.3 Level of Service

The levels of service discussion in this document outlines current service levels at current funding levels. Part 2 of the Asset Management Plan will review a variety of alternatives for Council to consider to achieve an acceptable level of service at an acceptable cost. These future alternatives will be evaluated considering various levels of acceptable condition, risk and financial alternatives.

The future review will provide insight of establishing the criticality of assets and on the long-term financial sustainability of the various options and impacts of accelerating or deferring projects.

The work required to prepare the level of service framework has included consultation with staff, review of current activities, review of financial data and upgrades to the pavement management system. The level of services indicated below are considered to be a starting point for preparation of target levels of service and will be subject to further review, revision and addition through the Part 2 work and evolution of this plan.

1.3.1 Community Level of Service

Community levels of service are high level statements which indicate what the City currently strives to achieve. The actual service levels achieved on individual road segments will vary depending on a variety of factors including road class, traffic levels and type, road maintenance levels, road structure, accessibility and employment activities. The level of services will be further reviewed in Part 2 to prepare alternatives for target levels of service and definition of service levels the community can expect on different types of roads.

- Roads are safe, accessible, and have sufficient capacity.
- Roads are in a fair state of repair and maintained at an acceptable cost.
- Roads are capable of supporting essential services and multimodal transportation.
- Roads are constructed and maintained in an environmentally responsible manner.

1.3.2 Strategic Level of Service

The strategic levels of service indicated below support the community levels of service.

Roads are maintained in accordance with *Ontario Regulation 239/02 Minimum Maintenance Standards for Municipal Highways* (minimum maintenance standards), as amended and with approved City policies. These strategic level of service activities include:

- Class 1 to 3 roads are to be plowed within 8 hours (after end of storm)
- Class 4 to 6 roads are to be plowed within 24 hours (after end of storm)
- 80% of all sidewalks to be cleared of snow within 24 hours (after end of storm)
- 100% potholes are repaired in accordance with minimum maintenance standards
- Nine weeks to remove winter sand
- Road line painting and markings are completed one time per year
- 5% of regulatory signs are replaced annually
- 3% of road crossing culverts are replaced annually
- 2.5% of curb and sidewalk are replaced annually
- 500 aged trees are removed annually
- Average network road pavement condition is currently subject to gradual deterioration of approximately one (1) pavement condition index point annually. At the current funding level, the road network will maintain an average condition of “fair” over the next 10 years.

- Road maintenance classes which range from Class 1 (arterial) to Class 6 (local) are subject to different levels of road maintenance and capital repair service levels. Class 1 to 5 roads are reviewed annually for resurfacing or rehabilitation.
- Roads with condition scores of Poor and Very Poor are reconstructed or rehabilitated when work aligns with strategic priorities such as the Transportation Master Plan and Industrial Lands Strategy or when work can be coordinated with other asset priorities such as watermain or sewer replacement.
- Surface treated roads and gravel roads are maintained and repaired through maintenance activities.

1.3.3 Asset Level of Service – Key Performance Indicators (KPI)

The key performance indicators currently included in the asset levels of service are indicated below. During Part 2 of this study, other asset levels of service will be reviewed for inclusion into this category and may include items relating to work backlog, congestion, access and safety.

- Pavement Condition Index
- Gravel Condition Index
- International Roughness Index (IRI)
- Road summer maintenance cost per lane km
- Percentage of roads in Fair or better condition based on asset replacement value
- Percentage of total annual road investment based on asset replacement value

1.3.3.1 Pavement Condition Index (PCI)

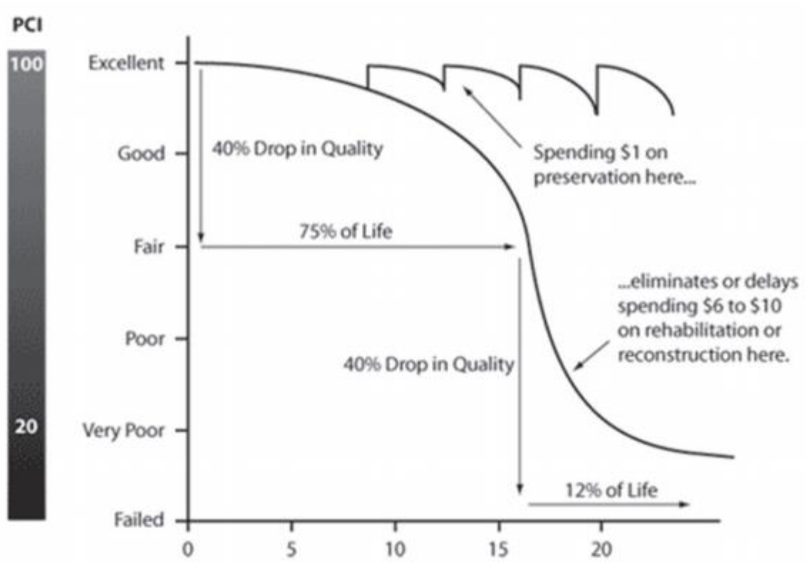
The development of a level of service for pavement condition will be an important component of Part 2 of the plan. Average Pavement Condition Indexes measured in 2016 and 2019 are indicated in Table 1.1. Proposals for PCI levels were identified in the July 2012 report entitled *Financial Planning for Municipal Roads, Structures and Related Infrastructure Final Report*, prepared by KPMG (2012 KPMG Report) for the purposes of the financial analysis. These recommendations included aiming to maintain an average PCI of 70 for arterial/collector roads and an average PCI of 60 for local roads. Alternative PCI service levels will be explored and presented to Council for their discussion and consideration in the next part of the plan.

Table 1.1 - City of Greater Sudbury PCI by Road Class (2019)

Road Classification	Average PCI (2016)	Average PCI (2019)	Average Condition
Arterial	58	57	Good
Collector	49	48	Fair
Local	50	47	Fair
Network Average	52	49	Fair

In order to establish the optimal future PCI service level, an analysis of conditions that will provide the maximum benefit for the road network with proposed funding will be reviewed during Part 2 of this study. This includes an analysis of the required treatments or optimum interventions proposed throughout the lifecycle of the road, costs of proposed treatments and risk evaluation.

When a road asset is permitted to deteriorate beyond a condition where rehabilitation cannot be selected as an effective treatment strategy, the asset becomes more expensive to maintain than the asset that has received recommended treatments at the recommended timing. The result of not completing recommended treatments at the right time is the asset network becomes more costly to maintain year after year. This is demonstrated in Figure 1.6, illustrating a typical pavement deterioration curve.



Road Projects: Paved road resurfacing or rehabilitation treatments are selected for roads fair and better.

Road and Pipes Projects: Paved road reconstruction are selected when pipework required for roads poor and very poor.

Figure 1.6 - Pavement Deterioration Curve

From Bouali, El Hachemi Y., "ANALYZING THE LIFE-CYCLE OF UNSTABLE SLOPES USING APPLIED REMOTE SENSING WITHIN AN ASSET MANAGEMENT FRAMEWORK", Open Access Dissertation, Michigan Technological University, 2018. https://digitalcommons.mtu.edu/etdr/649

Under the current municipal investment funding levels, reconstruction is not a recommended treatment unless there are other factors contributing to project rationale such as coordination with recommended water and wastewater improvements. The replacement cost of paved roads currently in Poor and Very Poor condition is estimated to be $438 million. This replacement cost can be considered to be an immediate need of recommended work on Poor and Very Poor roads. Other recommended annual maintenance and rehabilitation work costs on the remaining roads such as crack sealing, spreader laid patches, mill and pave, pulverize and replacement of asphalt structure would be in addition to the reconstruction treatments.

Figure 1.7 represents the life cycle costs of a typical two lane local urban road using recommended treatments at regular intervals for the purposes of estimating total costs of recommended maintenance and rehabilitation treatments over the assumed 60 year life cycle of the road. These life cycle activities and costs are presented solely to demonstrate an order of magnitude and will vary with existing conditions based on road class and type, road width, traffic, and existing conditions.

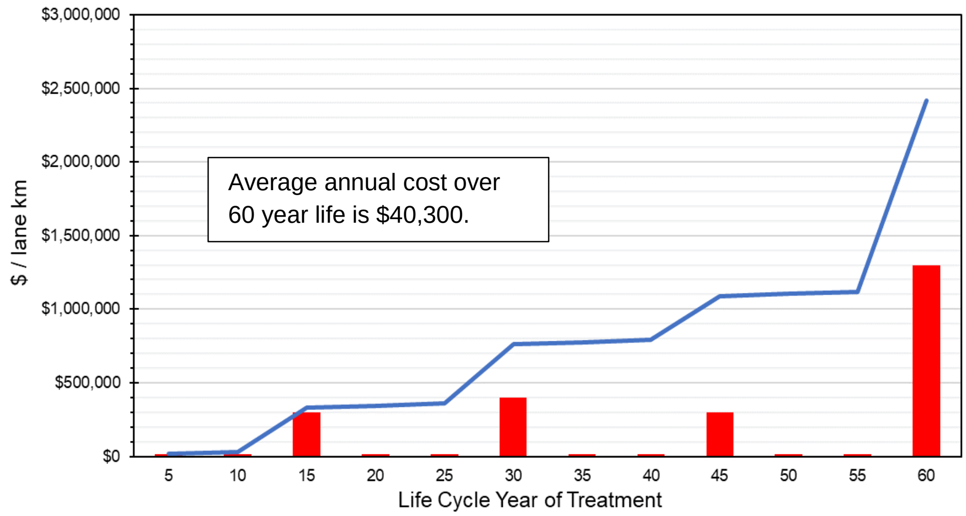


Figure 1.7 - Lifecycle Costs for Two Lane Hot Mix Paved Urban Road (60 Year Life Cycle)

Figures 1.8 and 1.9 demonstrate the anticipated PCI for the two road groups used to prepare road capital construction programs at various levels of funding, including the annual average investment over the previous five years of $26 million for arterial/collector roads and $9 million for local roads.

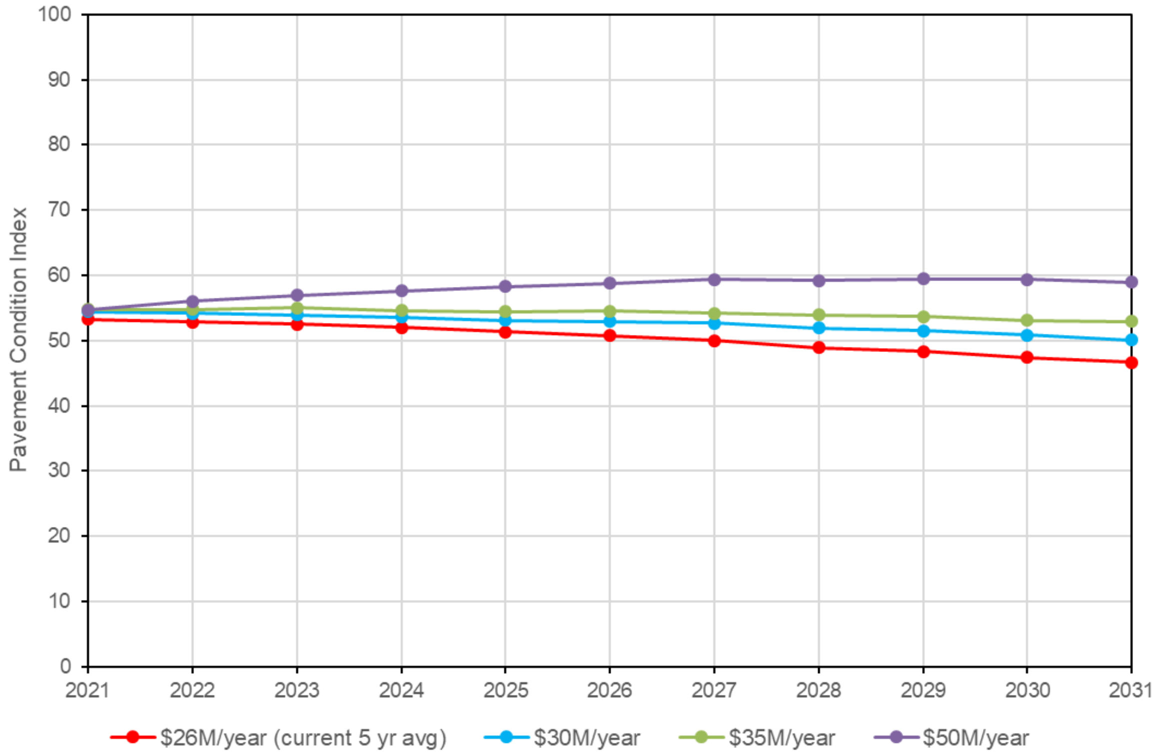


Figure 1.8 – Arterial/Collector Roads: Projected PCI at Various Annual Investment Levels

There are four levels of funding for Arterial/Collector roads illustrated in Figure 1.8. These include annual funding of $26 million, $30 million, $35 million and $50 million. The average annual investment in arterial/collector road capital projects over the last five years is approximately $26 million. At this funding level, the pavement management system anticipates the PCI will continue to decrease from an average of 53 or Good (as measured in 2019) over the next 10 years to a PCI of approximately 47 or Fair.

The road network was analyzed with annual funding of $30 and $35 million to demonstrate how the PCI could be improved with an additional $4 or $9 million increase in annual funding. The $50 million annual investment option was analyzed to demonstrate the funding necessary to maintain the PCI at an approximately steady level, with a slight increase over the next 10 years.

Further financial forecasting work is required to prepare detailed options and associated risks to inform decisions regarding future arterial/collector road conditions and associated service levels.

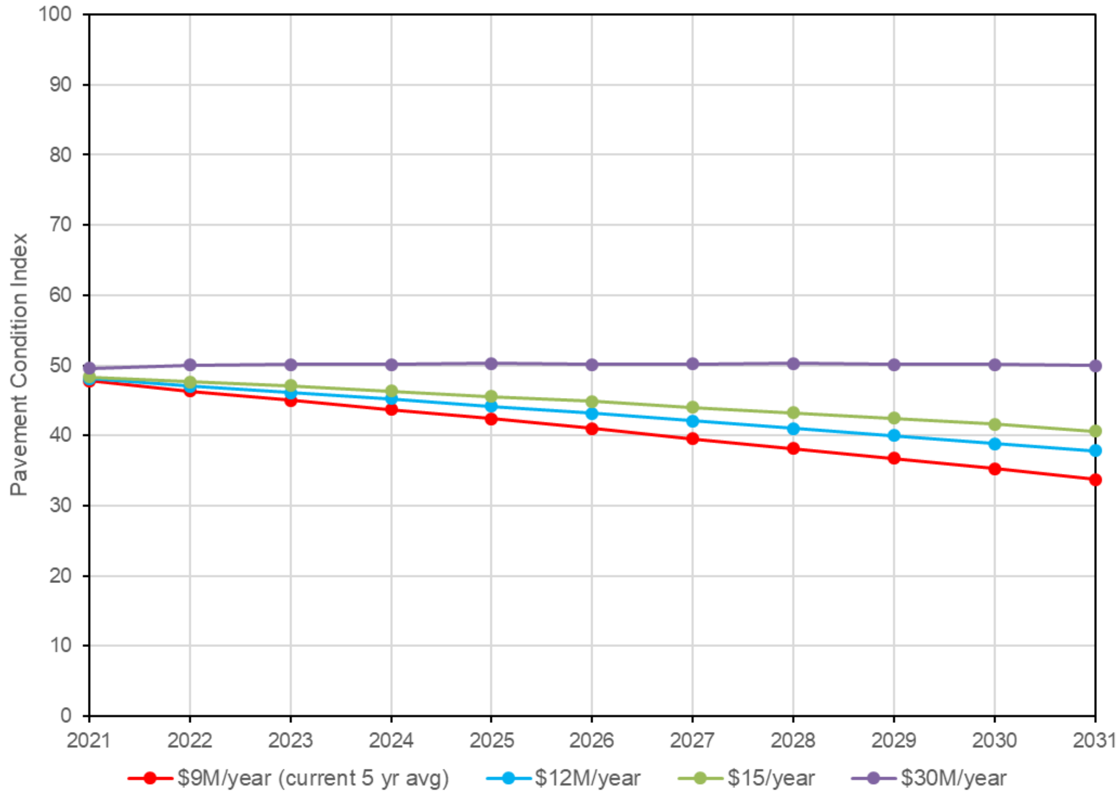


Figure 1.9 - Local Roads: Projected PCI at Various Annual Investment Levels

There are four levels of funding for Local roads illustrated in Figure 1.9. These include annual funding of $9 million, $12 million, $15 million and $30 million. The average annual investment in local road capital projects over the last five years is approximately $9 million. At this funding level, the pavement management system anticipates the PCI will continue to decrease from 47 or Fair (as measured in 2019) over the next 10 years to a PCI of approximately 34 or Poor.

The network was analyzed with annual funding of $12 and $15 million to demonstrate how the PCI could be improved with an additional $3 or $6 million increases in annual funding. The $30 million annual investment option was analyzed to demonstrate the funding necessary to hold the PCI at an approximately steady level over the next 10 years.

Further financial forecasting work is required to prepare detailed options and associated risks to inform decisions regarding future local road conditions and associated service levels.

1.3.3.2 Gravel Condition Index

Similar to paved roads, gravel road conditions will be dependent on the acceptable balance between capital investment and operational funding as determined in consultation with Council. A review of the City's inventory of gravel roads was undertaken in 2020 and results of the review indicate an average condition of Fair. Future work in Part 2 of this plan will include a more detailed review of gravel road maintenance practices, as well as capital activities and financial requirements.

1.3.3.3 International Roughness Index (IRI):

The International Roughness Index is a roughness measurement developed to standardize roughness data collection and analysis techniques for pavement. An IRI value of 0 m/km indicates absolute smoothness and a value of 10m/km would represent a very rough roadway. IRI is calculated for all paved road segments in the City using the asphalt condition data collected for the pavement management system. Table 1.2 indicates average IRI for each road planning class, as measured in 2019.

Target IRI levels of service for the City are not yet established. Acceptable limits will vary with road classification and operating speed. Two examples of different grading scales have been used in Table 1.2 to illustrate different approaches to assessing IRI scores. The Transportation Association of Canada (TAC) conditions were developed for highways and not necessarily applicable to many municipal roads. Other municipalities have developed their own grading system and are included for information and illustrative purposes. The development of a unique grading system for the City will be undertaken in Part 2 of the plan.

Table 1.2 – International Roughness Index (IRI)

Road Class	IRI m/km (2019)	Condition (TAC - Highway Roads)	Condition (Other Municipality Guidelines)
Arterial	3.4	Poor	Fair
Collector	4.9	Poor	Good
Local	6.0	Poor	Good

1.3.3.4 Roads Summer Maintenance Costs per Lane Km:

Summer road maintenance costs are relatively consistent and can be evaluated from year to year. As a result, this is a useful metric to report as a KPI, with the annual investment level to be determined in consultation with Council. The work included in this metric is a contributing component to the overall road condition of the network for both paved and gravel roads, while also providing year to year costs for these activities.

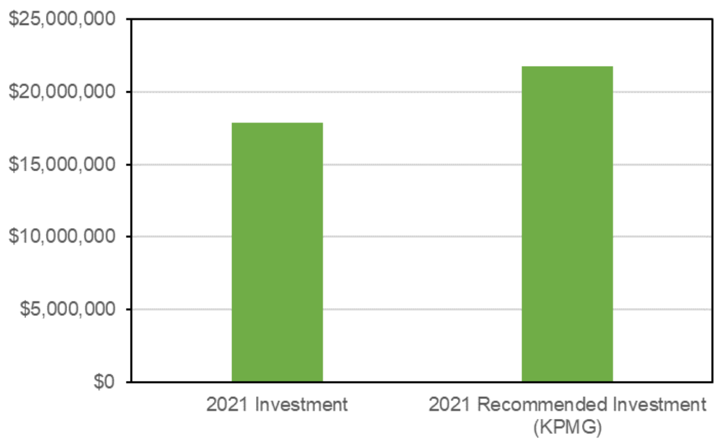


Figure 1.10 - Paved Road Summer Maintenance Investment (Actual)

A review of operational funding for paved and unpaved roads was initiated. Findings to date indicate anticipated funding shortfalls of approximately $3.9 million in paved road summer maintenance activities, based on the zero based budget prepared for the 2012 KPMG Report (Figure 1.10). In 2006, a summer maintenance best practice model was prepared for the City to assist in preparation of operational budgets. Using this model, a funding shortfall of approximately $2.3 million in gravel road maintenance was estimated (Figure 1.11).

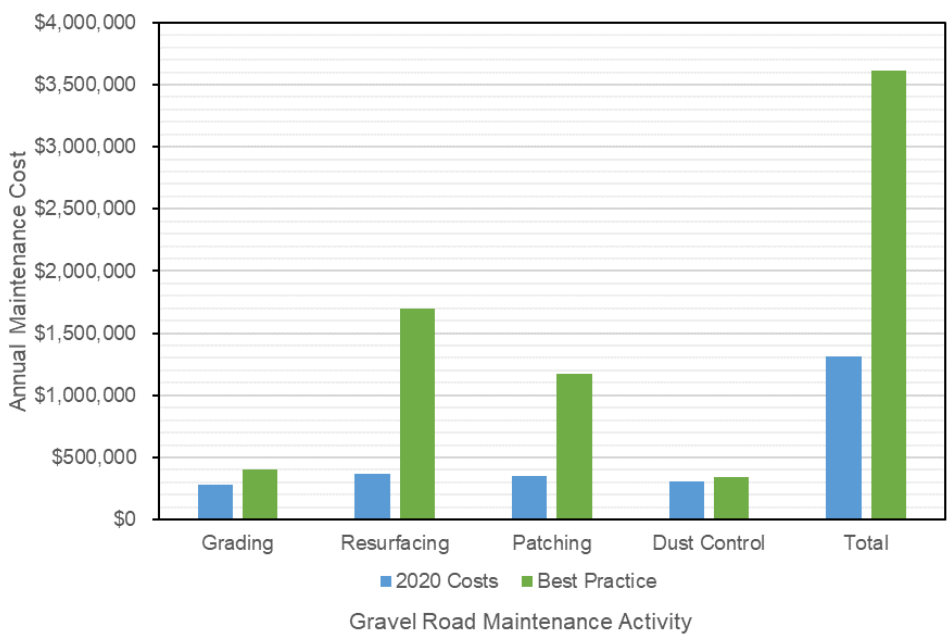


Figure 1.11 - Gravel Road Maintenance Activities 2020 vs Best Practice

1.3.3.5 Percentage of roads in Fair or better condition based on replacement value

The current percentage of roads in Fair or better condition based on 2019 data is 84%. Recommended target percentage levels vary between municipalities from 75% to 90% with unique municipal requirements based on condition, extent and age of road network. A target level of service for this metric in Greater Sudbury will be established in Part 2 of the plan.

1.3.3.6 Percentage of total annual road investment based on asset replacement value

The current percentage of annual road investment based on the recent five year average is 1.22% of the asset replacement value. Recommended target percentage levels of other municipalities vary from 1.7% to 2.5% with unique requirements based on condition, extent and age of road network. The percentage will also vary with the immediate requirements of the network or backlog of work that does not get prioritized. A target level of service for this metric will be established in Part 2 of the plan.

Funding shortfalls identified within this plan will be the subject of further review. Development of target levels of service as part of Part 2 of the RTAMP will include proposals for future funding levels to accommodate infrastructure need and associated risk.

1.4 Community Energy and Emissions Plan/Climate Change

A primary goal of an asset management plan is to maintain infrastructure in a way that is environmentally resilient and sustainable. This means the level of service will meet the needs of the present community without compromising the needs of the future community. In September 2020, Council authorized staff to proceed with the next steps in the implementation of the Community Energy and Emissions Plan (CEEP). The CEEP identifies 18 goals that need to be met to attain the City's target of becoming a net-zero GHG emission community by 2050.

As part of the work of asset management planning and prioritization, environmental scans of different technologies will be completed and the evaluation will result in recommendations for integration of new technologies into operational and capital programs. Levels of service will be reviewed with a CEEP, climate change and risk assessment lens during Part 2 of the RTAMP preparation.

1.5 Next Steps and Improvement Opportunities

Following completion of Part 1 of the Roads and Transportation Asset Management Plan, the next steps will be to initiate work toward the goals of Part 2, which are listed in detail in Section 9.1 of this plan. Goals for Part 2 include the development of target levels of service options for various KPIs with costs and risks, options for life cycle management and long-term financial strategies, opportunities for use of green technologies and management of risks associated with climate change.

Asset management is a process of continuous improvement to data collection, program planning, financial planning, and asset condition monitoring. When Part 2 of the plan is complete, future success will rely on continuation of work to provide improved methods of developing service level options and asset investment alternatives. Future opportunities are identified in Section 9.2.

2 Introduction

2.1 Roads and Transportation Asset Management Plan (RTAMP)

The Roads and Transportation Asset Management Plan (RTAMP) supports the Enterprise Asset Management Plan (EAMP) which is being developed and implemented in a phased approach to meet the requirements of *O. Reg. 588/17: Asset Management Planning for Municipal Infrastructure.* The Enterprise Asset Management Plan will be completed in three phases. Phase one generally describes current levels of service for core assets (roads, bridges, water, wastewater, stormwater) and the costs associated with maintaining existing levels of services. Phase two of the EAMP applies to municipal assets that do not fall into the core asset category and as such, does not apply to this document. Phase three of the EAMP builds upon phase one as outlined in this report.

The RTAMP supports the achievement of goals under five of the pillars of the City of Greater Sudbury Strategic Plan 2019-2027. These reinforce the need to maximize the value of investments in physical infrastructure and initiatives to enable service delivery, climate change resilience, community health and promote economic competitiveness. The supported strategic plan pillars include:

The RTAMP will provide guidance to future updates to the City's Transportation Master Plan (TMP). The TMP is prepared to support and inform the vision of the City's Official Plan as a modern and vibrant city that is healthy and sustainable. It presents background information, policy recommendations and network improvements to be considered through the development of a sustainable, multi-modal transportation system. The TMP recommends a sustainability-focused transportation network which places an emphasis on modes of transportation other than motorized vehicles, including walking, cycling and supporting greater public transit use.

First recommended in the TMP, in June 2018, Greater Sudbury adopted the Complete Streets Policy, becoming only the sixth municipality in Ontario to do so at the time of adoption. This policy commits the City to plan, design, construct, operate and maintain the transportation network to provide a comprehensive and integrated network of facilities that are safe and convenient for people of all ages and abilities travelling by foot, bicycle, public transit or vehicle. This policy applies only to capital projects where a reconstruction is required or where a roadway is planned to be substantially improved within the existing road allowance.

The objective of the RTAMP is to inform the decision making processes required for establishing a method of sustainable management of assets in consideration of acceptable condition, risk, costs and other influencing factors. The goals of this plan include:

1. Identify existing asset data information;
2. Document existing levels of service and the financial impact of potential alternatives;
3. Complete technical reviews of the assets using a life cycle approach;
4. Identify, assess and evaluate risks and establish risk tolerance;
5. Develop options or criteria for guiding long-term financial planning decisions;
6. Promote asset management strategies to attract growth and development, community health and build climate change resilience.

2.2 RTAMP Part 1

This document represents Part 1 of the Roads and Transportation Asset Management Plan which has been completed as part of Phase 1 of the Enterprise Asset Management Plan. In preparation of this document, the current state of existing roads infrastructure was reviewed, which includes identification of assets, condition, classes and types, and replacement cost. This plan also includes a review of existing service levels, current approach to lifecycle analysis, maintenance activities, renewal and rehabilitation activities, review of risk and review of asset funding requirements. Part 1 includes the following tasks:

- Assess existing paved and unpaved road conditions;
- Report on road asset inventory quantities, classes, replacement cost;
- Document existing levels of service;
- Outline existing maintenance, renewal and rehabilitation activities;
- Discuss incorporation of risk into the AMP;
- Review of current road asset investment and funding;
- Discussion of CEEP and climate change adaptation strategies;
- Establish preliminary list of demand drivers.

2.3 RTAMP Part 2

Preparation of the second part of the RTAMP will commence upon completion of Part 1. Part 2 of the RTAMP will be completed as part of Phase 3 of the Enterprise Asset Management Plan. The work included in this part requires a detailed review of proposed alternative service levels and long-term financial strategies. These tasks are outlined in Section 9.1.

3 Current State of Infrastructure

The City of Greater Sudbury is unique due to its large area and relatively high number of road lane kilometres per capita. The City's northern location also differentiates the community from others due to factors such as higher construction costs, harsher climate and the reliance on the industrial base which will affect service level alternatives. The City of Greater Sudbury's largest asset class in terms of replacement cost is the road network. Figure 3.1 provides an overview of the City's transportation network.

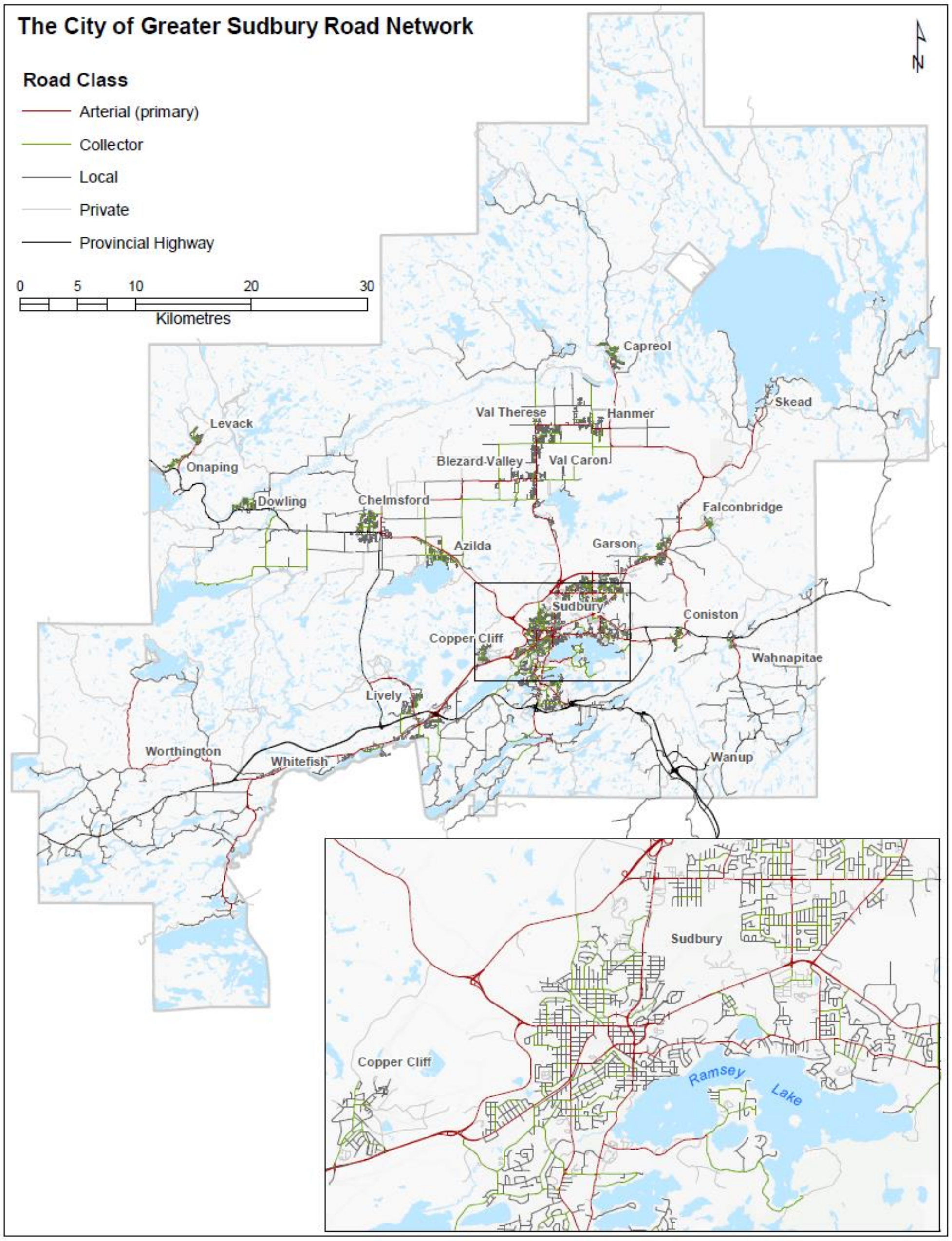


Figure 3.1 - The City of Greater Sudbury Road Network

The City's road network consists of approximately 2,974 paved lane km and 618 unpaved lane km for a total for 3,592 lane km of municipal roads. This equates to a total of approximately 22 lane km per 1,000 population; which is the largest value submitted by participating municipalities that reported to the 2019 MBNCan data call. Figure 3.2 provides a comparison of other municipality's road lane km inventory relative to their population.

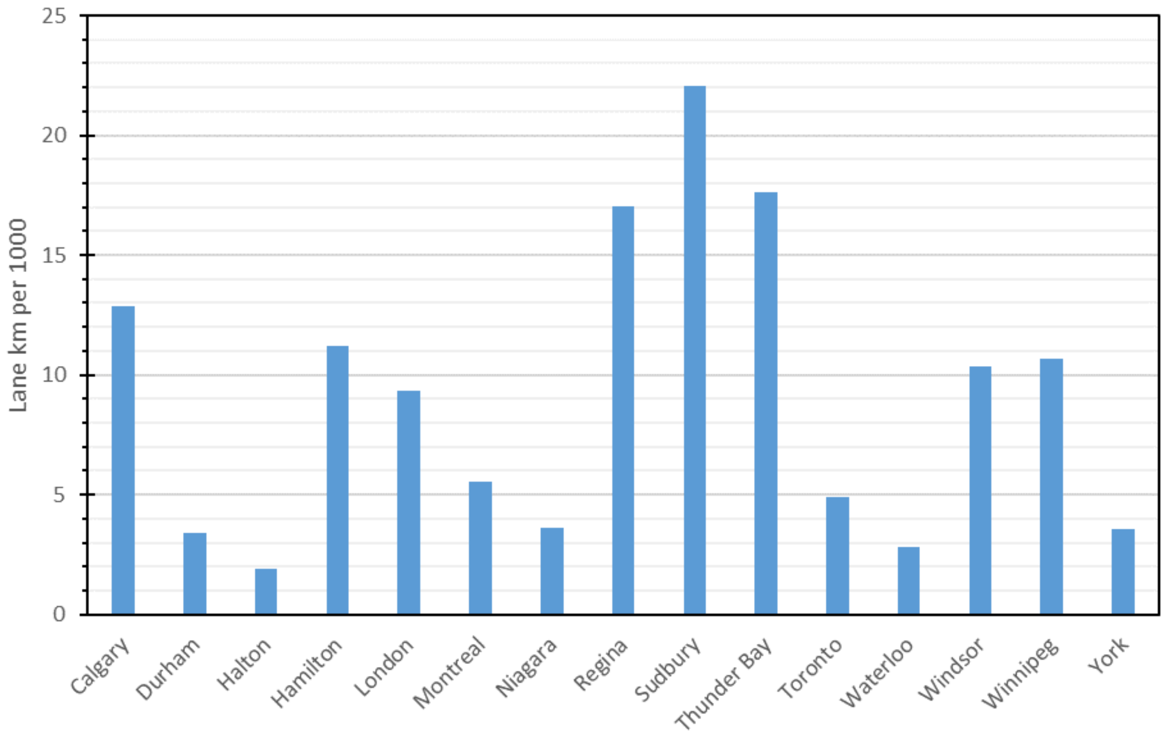


Figure 3.2 - Municipality Comparison of Road Length versus Population

All 3,592 km of roads in Greater Sudbury are classified according to function, in five classes. The Transportation Master Plan outlines five functional classifications which are described in Table 3.1.

Table 3.1: Road Network Classifications

Priority Class	Function
1. Primary Arterial	• Connect the City with other major centres outside the City and/or communities within the City; • Facilitate long distance person or goods movement travel through the City or between major activity areas within the City; • Traffic movement is primary consideration.
2. Secondary Arterial	• Connect two or more communities or major activity centres; • Connect two primary arterial roads; • Connect a community or activity centre with a primary arterial road; • Traffic movement is major consideration.
3. Tertiary Arterial	• Connect small / rural communities; • Connect communities to primary or secondary arterial roads; • Traffic movement is major consideration.
4. Collector	• Connect neighbourhoods; • Connect a neighbourhood with an arterial road; • Traffic movement and land access of equal importance.
5. Local	• Connect properties within a neighbourhood; • Land access is primary function.

3.1 Asset Data Inventory

The road network inventory is stored in the City's corporate GIS database. The GIS data is shared with other enterprise systems which use road network data including the pavement management system, the roads work order management system and traffic engineering system. Information within these data sets include location, traffic information, pavement structure, lengths and many more. The pavement management system stores up to approximately 120 fields of data information for each paved road segment. Paved road segments are generally defined as road segments between the two closest road intersections.

Collection and detailed identification for the purposes of inclusion in datasets for unpaved roads, sidewalks, cycling facilities etc. into City's GIS datasets is a work in progress. Recommendations for the priority and completion of this work are expected to be identified in Part 2 of this Plan. The City's road network and asset inventory are highlighted in Table 3.2. Existing assets not included in this part of the RTAMP are signs, guide rails, traffic signals, street trees, retaining walls, and rock cuts. These will be added to the inventory as deemed appropriate during Part 2 of this study process.

Table 3.2 - Road Network Inventory

Road Classification	Quantity (lane km)
Arterial	763
Collector	616
Local	2213
Total	3592
Road Surface	**Quantity (lane km)**
Paved Roads (Hot Mix Asphalt, Surface Treatment, and Concrete)	2974
Unpaved Roads (Gravel)	618
Total	3592
Other Assets	**Quantity (lane km)**
Sidewalk (km)	441
Bike Lanes - On-road bicycle lanes (lane km)	32
Bike Lanes - Multi-use paths (lane km)	4
Bike Lanes - Cycle tracks (lane km)	10
Street Light Poles	3601
Street Light Fixtures	14916

3.2 Asset Valuation

Asset valuation is determined by reviewing construction costs, current market demand, supply issues, construction standards and legislation. Evolving standards and legislation, technological improvements, or the announcement of a significant funding program from a senior level of government can lead to a sharp increase in material costs over a short duration and an increase in market demand.

Valuation of paved and unpaved roads must also consider road cross-section type and structure. This will include rural (roads with ditches) or urban (roads with curbs) cross sections, road pavement structure, gravel road structure and subsurface drainage systems (road subdrains). Drainage systems including storm sewers and ditches are incorporated into the Storm Water Asset Management Plan.

Enhancements to the pavement management system which include valuation of paved road assets is currently in progress. This will be developed with data that can be used to calculate asset value from historic record and capital construction programs from previous years.

3.3 Asset Lifecycle

The estimated life of road pavement and granular structure will vary with existing road structure, drainage, traffic, maintenance activities and weather. In previous financial analyses, the City has assumed 60 year life cycles for paved roads and estimated 75 year service life for unpaved roads.

Over the life of an asset, appropriate maintenance and rehabilitation treatments should be implemented at appropriate times to maximize the useful life of the asset prior to full reconstruction. Treatments for paved roads would include crack sealing, resurfacing (mill and overlay) and rehabilitation before reconstruction of the road. The proposed scheduling of these treatments and costs associated with a typical two-lane local urban road is outlined in Section 6 of this document. Currently, reconstruction of paved roads is not a scheduled activity unless work is coordinated with other assets such as water and wastewater. A detailed analysis will review current activities, best practice activities and provide any recommendations for modifications to current practices in Part 2 of the RTAMP.

3.4 Paved Road Assessment Approach

Since 2000, the City has used a pavement management system to assist in evaluation of the condition of the road network and preparation/planning of road maintenance and construction projects. The pavement management system provides an objective analysis of the road network and provides proposed multi-year construction programing that reflects the City's established criteria based on planned capital budgets. Every two years the city reviews the condition of the asphalt including cracking, rutting and roughness to calculate four defined indices. These indices are rutting, roughness, non-structural cracking and structural cracking. The methods and procedures of this data collection are completed in conformance with *ASTM D6433 – Standard Practice for Roads and Parking Lots Pavement Condition Index Surveys*.

All road segments are categorized with three characteristics including traffic load (low, medium and high), pavement structure (strong and weak), and drainage conditions (adequate and poor). Twelve categories of roads are established using these characteristics and based on the measured indices (cracking, roughness and rutting), various pavement management strategies for each road segment are determined. These strategies are compiled and analyzed to develop the program which will deliver the highest benefit to the road network given various budget scenarios.

Maintenance and construction treatments provided in the pavement management system output include crack sealing, surface treatment, overlay, single grind and single overlay, double grind and double overlay, rehabilitation, reconstruction, widening and drainage improvements.

The measured condition data is also used to calculate the Pavement Condition Index (PCI) using life cycle deterioration curves developed for the measured indices. These curves provide a means of preparing a roads program that considers the continued deterioration of individual road segments over time.

The pavement condition index in the pavement management system is evaluated as follows:

Table 3.3 - Paved Road Condition Index Summary

Condition	Pavement Condition Index (PCI)	Description
Very Good	>85 to 100	Sound pavement with few defects perceived by drivers
Good	>55 to 85	Slight rutting and/or cracking and/or roughness becomes noticeable to drivers
Fair	>40 to 55	Multiple cracks are apparent, and/or rutting may pull at wheel and/or roughness causes drivers to make minor corrections
Poor	>25 to 40	Significant cracks may cause potholes and/or rutting pulls at vehicles and/or roughness is uncomfortable to occupants. Drivers may need to correct to avoid road defects.
Very Poor	0 to 25	Significant cracks with potholes and/or rutting pulls at vehicles and/or roughness is uncomfortable to occupants. Drivers will need to correct to avoid road defects.

The pavement management system also currently utilizes an Overall Condition Index (OCI) to prioritize road segments and provide a recommended capital road program. The road construction treatments are triggered as described above and the road capital program is adjusted by the Overall Condition Index. The OCI is currently comprised of five (5) categories being pavement condition index, safety opportunity index, water and wastewater opportunity index, economic development opportunity/public needs assessment index and a mobility opportunity index (environment and congestion). These indices are currently under review and revisions are expected to be recommended. In particular, coordination with other assets and the economic opportunity index will be reviewed, and the assessment of risk will be incorporated.

The resulting recommended construction program provided by the pavement management system provides the alternative for maximum benefit to the network pavement condition. The recommended program is then reviewed and adjusted as required to suit coordination opportunities with development, other City assets such as water and wastewater, and other priorities that arise.

The current road segment age database is incomplete. In Part 2 of the work of this plan, alternatives for updating road segment age will be reviewed to assist in development of long term financial goals. These alternatives will include review of historical information and use of existing condition data to estimate asset age.

3.5 Gravel Road Assessment Approach

The gravel road network is evaluated through a visual dashboard review using methods outlined in Ministry of Transportation document *"SP-025 Manual for Condition Rating of Gravel Surface Roads"* and modified to suit local data requirements. The evaluation framework is based on *Table B-1 A Guide for the Estimation of Pavement Condition Rating, Gravel Surface Pavement Condition Evaluation Form from SP-025* and local experience of CGS Roads Operations staff to establish a condition rating for gravel roads and deficiencies within the right-of-way.

Gravel road parameters reviewed include road platform width, ditching/drainage, road shoulders, roadside vegetation, roadside embankments and alignment. Temporary conditions such as surface deficiencies were not included in the evaluation. Table 3.4 indicates conditions used to establish an estimate of the Gravel Road Index (CGI).

Table 3.4 - Gravel Road Condition Summary

Condition	Gravel Condition Index (GCI)	Description
Good	>60	Routine maintenance is required, existing conditions generally include adequate platform width, existing ditches may require cleaning, horizontal and vertical alignment are generally comfortable, no or few roadside hazards exist, roadside vegetation is minor.
Fair	40 to 60	Corrective maintenance is required, improvements may be required, existing conditions may include platform width that requires widening, existing ditches that require cleaning, significant ditching work, deficiencies may exist in horizontal and vertical alignment, roadside hazards may be present, roadside vegetation in ditch area may be significant and require normal clearing maintenance work.
Poor	<40	Increased maintenance or road rehabilitation or significant roadside work is required, existing conditions may include existing platform width which requires improvement, ditches that need to be established, issues exist with horizontal and vertical alignment, roadside hazards may be present, roadside vegetation in ditch area is significant and will require extensive removals.

3.6 Road Safety Network Screening

A road safety network screening program is used to evaluate road segments and intersections to determine if there is a higher than expected number of collisions. The screening program is based on the Highway Safety Manual (HSM), produced by the American Association of State Highway and Transportation Officials (AASHTO). This screening provides a quantitative approach to determine sites that are most likely to respond to safety improvements. Screening analysis considers the number of predicted collisions, traffic volumes, and observed collisions.

The safety evaluation results in a score called Potential for Safety Improvement (PSI). All roads and intersections in the City have been scored and prioritized by the screening program using the PSI score and the top 20 locations have been identified. Each of the prioritized locations are reviewed to determine what countermeasures may be implemented to improve safety. Where countermeasure improvements have been identified in the prioritized locations, they are scheduled into the City's capital works program.

Currently, five locations plus those locations that are within an identified capital project are reviewed on an annual basis to determine if suitable countermeasures can be implemented. The development of possible metrics for a safety level of service will be reviewed in Part 2 of the RTAMP work.

3.7 Lighting

Within the City of Greater Sudbury, street light fixtures may be mounted on City owned poles or mounted on shared poles owned by electrical and telephone utilities. Sharing of poles reduces the cost of installation, but may result in a less than optimal mounting height and angle.

The City has developed a service life consumption model for street light poles that can vary by the pole material type.

Table 3.5 - Street Light Pole Condition Summary

Condition	Service Life Consumption	Condition Score
Very Good	0% to 20%	80 to 100
Good	21% to 40%	60 to 79
Fair	41% to 60%	40 to 59
Poor	61% to 80%	20 to 39
Very Poor	>80%	0 to 19

Table 3.6 - Street Light Fixture Condition Summary

Condition	Service Life Consumption	Condition Score
Very Good	0 to 20,000 hours	80 to 100
Good	20,001 to 40,000 hours	60 to 79
Fair	40,001 to 60,000 hours	40 to 59
Poor	60,001 to 80,000 hours	20 to 39
Very Poor	>80,000 hours	0 to 19

The City has recently retrofitted the entire street light network to new LED technology. The new street lights are individually controlled by a photocell and have an estimated useful life of 100,000 hours of light projection. The photocell mounted on the light activates the light at a preset level of darkness. Maintenance of a street light consists almost entirely of replacing a spent fixture. The street lights are periodically inspected by Greater Sudbury Utilities (GSU) and fixture replacement may be triggered when reported by community members.

3.8 Current RTAMP Asset Condition

The following tables provide average Pavement Condition Index (PCI) and Gravel Road Condition Index (GCI) data on a network level.

Table 3.7 - Paved Road Average PCI by Road Classification

Road Classification	Average PCI (2019)	Average Condition
Arterial	57	Good
Collector	48	Fair
Local	47	Fair
Network Average	49	Fair

Table 3.8 - Paved Road PCI Condition Category Summary

Road Condition (PCI)	Lane Km	Repl. Cost Percentage	Replacement Cost (Millions)
Very Good	90	6%	$149
Good	1100	50%	$1,338
Fair	981	28%	$765
Poor	713	14%	$391
Very Poor	90	2%	$47
Total	2974	100%	$2,690

Table 3.9 - Gravel Road Average GCI

Surface Type	Average Network GCI (2020)	Average Network Condition
Gravel Road	59	Fair

Table 3.10 - Gravel Road GCI Category Summary

Road Condition (GCI)	Lane Km	Repl. Cost Percentage	Replacement Cost (Millions)
Good	272	44%	$75
Fair	315	51%	$87
Poor	31	5%	$8
Total	618	100%	$170

The following tables provide condition information on street light poles and fixtures on a network level.

Table 3.11 - Street Light Average Condition

Street Light Asset	Average Condition Score	Average Network Condition
Street Light Poles	36	Poor
Street Light Fixtures	88	Very Good

Table 3.12 - Street Light Condition Category Summary

Condition	Poles	Fixtures	Repl. Cost Percentage	Replacement Cost (Millions)
Very Good	475	10799	28%	$6.5
Good	715	4117	22%	$5.2
Fair	539	0	11%	$2.7
Poor	465	0	10%	$2.3
Very Poor	1407	0	30%	$7.0
Total	3601	14916	100%	$23.8

4 Levels of Service

4.1 Background

In order to assess services to the public and determine if services are deemed to meet established goals, it is important to define current and target service levels the City provides. The work required to prepare the current level of service framework has included consultation with staff, review of current activities, financial data and upgrade to the pavement management system.

The following levels of service discussion indicates current service levels at current funding levels. Part 2 of the Asset Management Plan will review a variety of alternatives for Council to consider to achieve an acceptable level of service at an acceptable cost. The alternatives will be evaluated considering various levels of acceptable condition, risk and financial alternatives. The review will provide insight on development of establishing criticality of assets and on the long term financial sustainability of the various options and impacts of accelerating or deferring projects.

All level of service statements indicated below will be reviewed and further developed in Part 2 of the plan to set community expectations and reflect the unique character of the City. A few examples of some of the services to be reviewed will include:

- Operating and capital investment.
- Safe and accessible definitions and application to various types of roads.
- Emergency access and types of emergency vehicles that may be required.
- Road condition and geometry based on road type details and use.

4.2 Level of Service Definitions

Level of Service refers to a series of statements that describe the services provided to maintain and operate the assets included in the Roads and Transportation asset category. Service levels have been defined within the following 3 categories which align with the Enterprise Asset Management Plan:

- Community - Qualitative descriptions that define the community, stakeholder and individual expectations.
- Strategic - These include qualitative and quantitative measures that describe what is being provided to customers. Examples of how this can be defined can include reliability, legislative compliance, quantity, quality and safety.
- Asset (Technical) - An asset level of service is a quantitative measure that defines the performance expectation for a given asset in order to produce the desired levels of service. These services are measurable and can include asset condition, responsiveness, cost and asset value.

4.3 Community Level of Service

Community levels of service are high level statements which indicate what the City currently strives to achieve. The actual service levels on individual road segments will vary depending on a variety of factors including road class, traffic levels and type, road maintenance levels, road structure, accessibility and employment activities. The level of service statements will be further reviewed in Part 2 to prepare alternatives for target levels of service and definition of service levels the community can expect on different types of roads.

- Roads are safe, accessible, and have sufficient capacity.
    - Roads and intersections are reviewed using a road safety network screening program.
    - Roads are maintained in summer and winter to provide access for the traveling public
    - Road capacity is reviewed in five year intervals as part of the Transportation Master Plan
- Roads are in a fair state of repair and maintained at an acceptable cost.
    - Roads are maintained and improved to be in a condition commensurate with use and traffic volumes.
    - Collector and Local roads are in fair condition based on average pavement condition index.
    - Arterial roads are in good condition based on average pavement condition index.
    - Total road costs per lane km are below average total MBNCan benchmarking costs.
- Roads are capable of supporting essential services and multimodal transportation.
    - All roads are maintained in a condition to allow passage of emergency vehicles and essential vehicles as seasonal conditions permit.
    - Roads will provide access to active transportation modes such as cycling, transit and walking where deemed appropriate.
- Roads are constructed and maintained in an environmentally responsible manner.
    - Capital construction and operational activities are reviewed for opportunities to employ asphalt recycling treatments. Advancements in recycled asphalt technology are monitored and implemented where appropriate.
    - A salt management plan was developed in 2017 and was followed with a salt optimization plan in 2018 to provide guidance to winter control activities and environmentally conscious road salt management.

4.4 Strategic Level of Service

The strategic levels of service indicated below support the community levels of service.

- Roads are maintained in accordance with provincial minimum maintenance standards and City policy. These activities include:
    - Class 1 to 3 roads – plowed within 8 hours (after end of storm)
    - Class 4 to 6 roads – plowed with 24 hours (after end of storm)
    - 80% sidewalk cleared of snow within 24 hours
    - 100% potholes repaired in accordance with minimum maintenance standards
    - 9 weeks to remove winter sand
    - Road line painting and markings 1 time per year

  - 5% regulatory signs are replaced annually
  - 3% road crossing culverts replaced annually
  - 2.5% curb and sidewalk are replaced annually
  - 500 aged trees are removed annually
- Average network road pavement condition is currently subject to gradual deterioration of approximately 1 pavement condition index point annually. At the current funding level, the road network will maintain an average condition of "fair" over the next 10 years.
- Road maintenance classes which range from 1 (arterial) to 6 (local) are subject to different levels of road maintenance and capital repair service levels. Class 1 to 5 roads are reviewed annually for resurfacing or rehabilitation.
- Roads with condition scores of Poor and Very Poor are reconstructed or rehabilitated when work aligns with strategic priorities such as the Transportation Master Plan and Industrial Lands Strategy or when work can be coordinated with other asset priorities such as watermain or sewer replacement.
- Surface treated roads and gravel roads are maintained and repaired through maintenance activities only.

4.5 Asset Level of Service – Key Performance Indicators (KPI):

The key performance indicators currently included in the asset level of service are indicated below. Other asset levels of service will be reviewed for inclusion into this category and may include items relating to work backlog, congestion, access and safety.

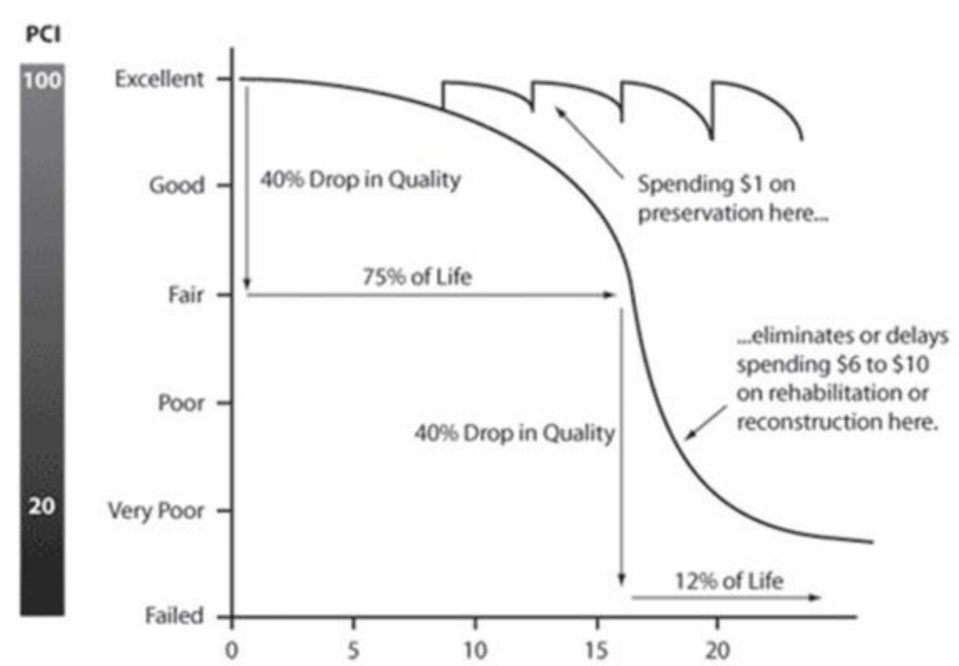
- Pavement condition index
- Gravel condition index
- Road summer maintenance cost per lane km
- International Roughness Index (IRI)
- Percentage of roads in fair or better condition based on asset replacement value
- Percentage of total annual road reinvestment based on asset replacement value

4.6 Current Asset Level of Service

4.6.1 Pavement Condition Index:

In order to establish the optimal future PCI service level, an analysis of conditions that will provide the maximum benefit for the road network with proposed funding will be reviewed. This includes an analysis of the required treatments or optimum interventions proposed throughout the lifecycle of the road, costs of proposed treatments and risk evaluation.

When a road asset is permitted to deteriorate beyond a condition where rehabilitation cannot be selected as an effective treatment strategy, the asset becomes more expensive to maintain than the asset that has received recommended treatments at the recommended timing. The result of not completing recommended treatments at the right time is the asset network becomes more costly to maintain year after year. This is demonstrated by the pavement deterioration curve indicated in the figure below. The City selects roads for resurfacing and rehabilitation that have a pavement condition in the upper part of this curve to maximize benefit of available budget. Investment in poor or very poor roads will occur if other priorities arise such as sewer or watermain pipework repair and road reconstruction will be required.



Road Projects: Paved road resurfacing or rehabilitation treatments selected for roads fair and better.

Road and Pipes Projects: Paved road reconstruction selected when pipework required for roads poor and very poor.

Figure 4.1 - Pavement Deterioration Curve

From Bouali, El Hachemi Y., "ANALYZING THE LIFE-CYCLE OF UNSTABLE SLOPES USING APPLIED REMOTE SENSING WITHIN AN ASSET MANAGEMENT FRAMEWORK", Open Access Dissertation, Michigan Technological University, 2018. https://digitalcommons.mtu.edu/etdr/649

Table 4.1 - City of Greater Sudbury PCI by Road Classification

Road Classification	Average PCI (2016)	Average PCI (2019)	Average Condition
Arterial	58	57	Good
Collector	49	48	Fair
Local	50	47	Fair
Network Average	52	49	Fair

The development of a level of service for pavement condition will be an important component of the plan. Proposals for PCI levels were identified in the 2012 KPMG report for the purposes of the financial analysis. These recommendations included an average PCI of 70 for arterial and collector roads and PCI of 60 for local roads. Some municipalities have set different PCI target levels for 90% of the roads in the individual road classes. Alternate PCI service levels will be considered and proposed to council for their consideration in the next part of the plan.

The 2 charts below demonstrate the anticipated Pavement Condition Index for the two road groups used for Capital Budget preparation at the annual average capital investment over the previous five years. The funding used in the analysis is $26 million for Arterial/Collector Roads and $9 million for Local Roads.

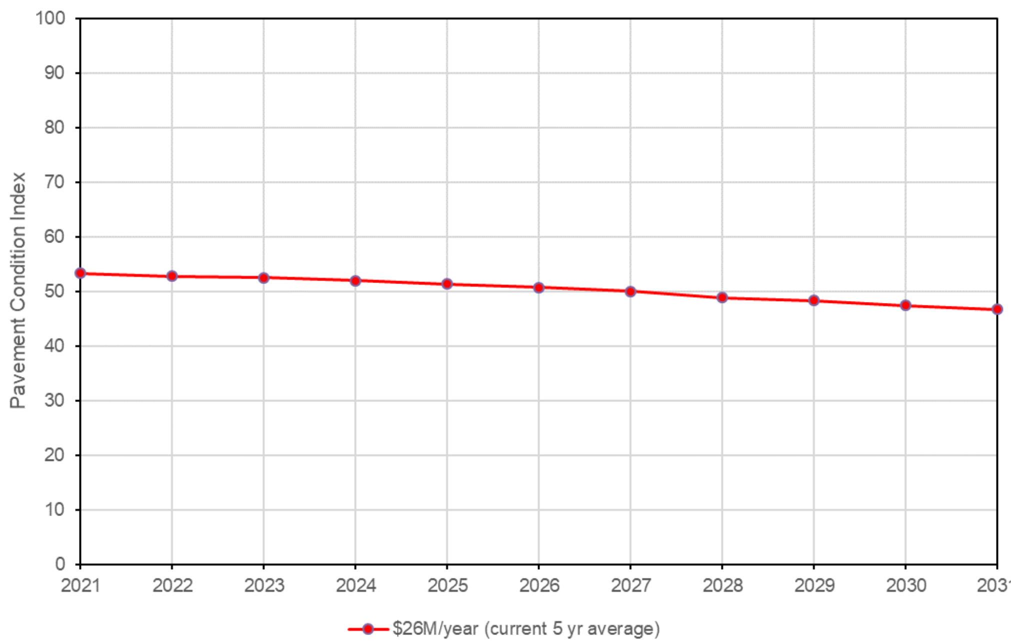


Figure 4.2 - 10 Year PCI Projection for Arterial/Collector Roads (Current 5 Yr $ Avg)

The PCI measured for the Arterial/Collector road group in 2019 was 57 and at the current rate of investment the pavement management system anticipates the PCI will continue to decrease over the next 10 years to a PCI of approximately 47 or “fair”.

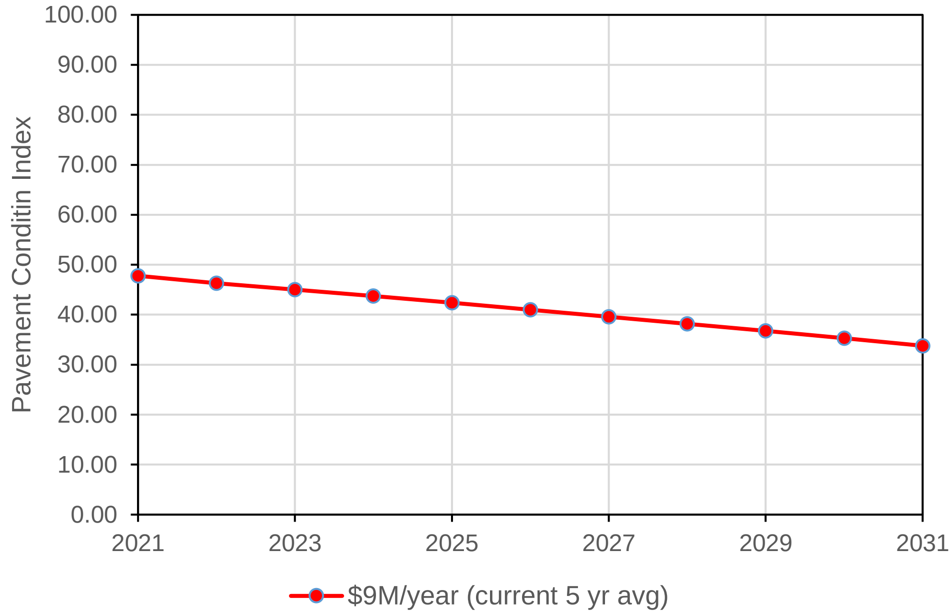


Figure 4.3 - 10 Year PCI Projection for Local Roads (Current 5 Yr $ Avg)

The PCI measured for the Local road group in 2019 was 47 and at the current rate of investment the pavement management system anticipates the PCI will continue to decrease over the next 10 years to a PCI of approximately 34 or “poor”.

The impact on the pavement condition at various funding levels is discussed further in Section 6.0 – Financial Review.

4.6.2 Gravel Condition Index

Similar to paved roads, gravel road conditions will be dependent on the acceptable balance between capital/operational investment as determined in consultation with council. The review completed in 2020 indicates an average condition of “Fair”. Future work will include a more detailed review of gravel road maintenance, capital and financial requirements.

4.6.3 Roads Summer Maintenance Costs per Lane Km

Summer road maintenance costs are relatively consistent and can be evaluated from year to year. As a result, this is a useful metric to report as a KPI, with the annual investment level to be determined in consultation with Council. The work included in this metric is a contributing component to the overall road condition of the network for both paved and gravel roads while also providing year to year costs for these activities.

4.6.4 International Roughness Index (IRI)

The international roughness index is a roughness measurement developed to standardize roughness data collection and analysis techniques for pavement. An IRI value of 0 m/km indicates absolute smoothness and a value of 10m/km would represent a very rough roadway. IRI is calculated for all paved road segments in the City using the asphalt condition data collected for the pavement management system.

Table 4.2 – Average IRI by Road Planning Class

Road Class	IRI m/km (2019)	Condition (TAC - Highway Roads)	Condition (Other Municipality Guidelines)
Arterial	3.4	Poor	Fair
Collector	4.9	Poor	Good
Local	6.0	Poor	Good

Target IRI levels of service for the City are not yet established. Acceptable limits will vary with road classification and operating speed. Two examples of different grading scales are indicated in Table 4.2. The Transportation Association of Canada conditions are developed for highways and not necessarily applicable to many municipal roads. Other municipalities have developed their own grading system and are included for information. The development of a grading system unique for the City will be reviewed in Part 2 of the plan.

4.6.5 Percentage of roads in fair or better condition based on replacement value:

The current percentage of roads in fair or better condition based on 2019 data is 84%. Recommended target percentage levels vary between municipalities from 75% to 90% with unique municipal requirements based on condition, extent and age of road network. A target level of service for this metric will be established in Part 2 of the Plan.

4.6.6 Percentage of total annual road investment based on asset replacement value:

Greater Sudbury's current percentage of total road investment based on average investment over last five years is 1.22% of the asset replacement value. Recommended target percentage levels generally vary between municipalities from 1.7% to 2.5% with unique requirements based on condition, extent and age of road network. The percentage will also vary with the immediate requirements of the network or backlog of work that does not get prioritized. A target level of service will be established in Part 2 of the Plan.

Service levels will drive the investment forecasts in the RTAMP. Council will be provided with the opportunity to determine level of service targets to manage infrastructure within the City's capacity to renew and maintain assets with associated risks. Final levels of service will be based on regulations, standards, risk acceptance and Council approval. Annual capital and maintenance budget proposals will be developed to achieve the desired service levels as directed by council.

A long term financial strategy will be developed after a detailed review of acceptable service levels, affordability and risks. Service levels and the associated costs will be presented to council to determine the acceptable balance between these three parameters. Further study will develop achievable alternatives to review and determine acceptable service levels, expenditures and risks.

5 Risk Management

The City's risk management goals involve identifying risks and managing infrastructure assets to meet planned service objectives within the accepted levels of risk. Risk assessment will assist in prioritization and optimization of capital spending and decision making. The assessment process involves evaluation of Probability of Failure (PoF) and the Consequence of Failure (CoF). This will assist in clarification and development of a shared understanding about the risk associated with decisions made in Operating and Capital programs.

Risk factors not currently included in the pavement management system analysis will be reviewed for possible inclusion into the decision making process. These include:

- Potential for safety improvement;
- Congestion;
- Preventative and planned maintenance;
- Vulnerability (i.e. flooding);
- Climate change;
- Data quality;
- Truck and transit routes;
- Traffic Volume;
- Replacement Cost;
- Environmental considerations;
- Social consequence;
- Critical public use facilities.

The City's pavement management system is used in the preparation of the annual capital road construction program to provide maximum benefit to the road network condition. The anticipated reduction of the pavement condition is currently an identified risk requiring further review. The details of this risk will be reviewed in conjunction with existing and future investment and presented to council for consideration. Conditions associated with various funding levels is discussed further in Section 6.0 – Financial Review.

6 Financial Review

6.1 Investment

Funding of road asset capital improvements for roads capital projects has significantly increased over the last five year period. Average road investment from 2016 to 2020 for all road capital projects increased by approximately 30% over the previous five year period (Figure 6.1).

In 2019, the budget process was transformed from an envelope system where previously defined funding levels were distributed to the various operating departments to an enterprise prioritization system which ensures funds are distributed to projects on a city wide priority basis. In addition to the prioritization process, Council provided an additional investment in roads infrastructure of approximately $4 million in 2019.

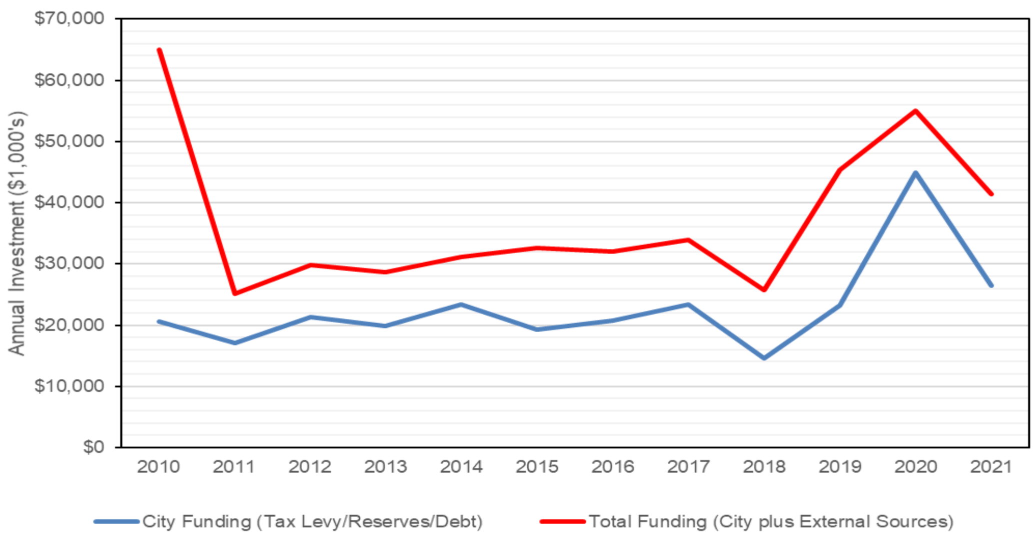


Figure 6.1 Historical Funding - Roads

Figures 6.2 and 6.3 demonstrate the anticipated Pavement Condition Index for the two road groups used to prepare road capital construction programs at various levels of funding including the annual average investment over the previous five years of $26 million for Arterial/Collector roads and $9 million for Local roads.

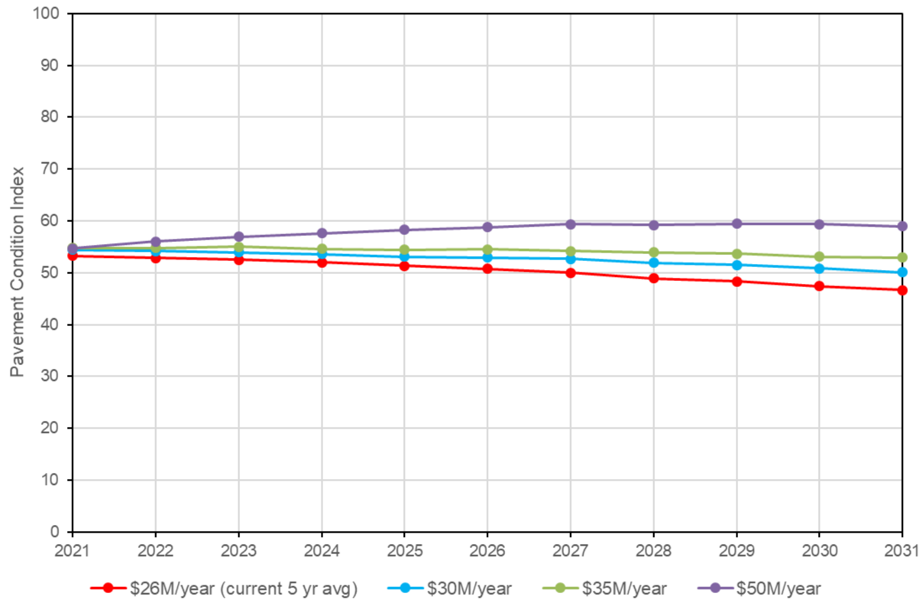


Figure 6.2 - Arterial Collector Roads: Projected PCI at Various Annual Investment Levels

There are four levels of funding indicated for Arterial/Collector in Figure 6.2. These include annual funding of $26 million, $30 million, $35 million and $50 million. The average annual investment in arterial and collector road capital projects over the last five years is approximately $26 million. At this funding level the pavement management system anticipates the PCI will continue to decrease over the next 10 years to a PCI of approximately 47 or Fair.

The network was analyzed with annual funding of $30 and $35 million to demonstrate how the PCI will be improved with $4 and $9 million increases in annual funding. The $50 million annual investment option will provide a slight increase to the PCI over the next 10 years.

Further financial forecasting work will be required to present detailed options and associated risks to inform decisions regarding future arterial and collector road condition and associated service levels.

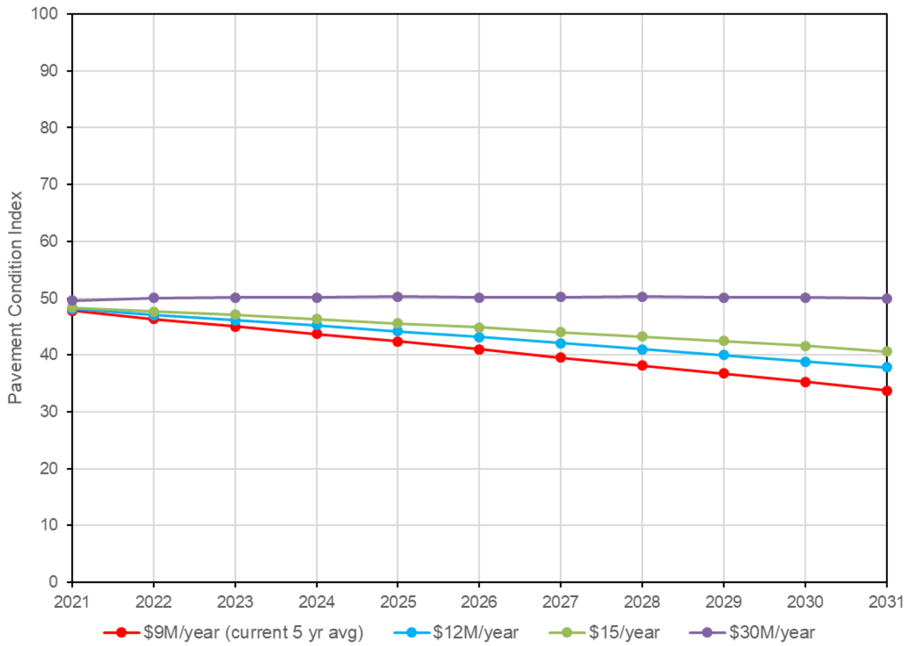


Figure 6.3 - Local Roads: Projected PCI at Various Annual Investment Levels

There are four levels of funding for Local roads in Figure 6.3. These include annual funding of $9 million, $12 million, $15 million and $30 million. The average annual investment in local road capital projects over the last five years is approximately $9 million. At this funding level the pavement management system anticipates the PCI will continue to decrease over the next 10 years to a PCI of approximately 34 or Poor.

The network was analyzed with annual funding of $12 and $15 million to demonstrate how the PCI will be improved with $3 and $6 million increases in annual funding. The $30 million annual investment option is analyzed to demonstrate the funding necessary to hold the PCI approximately steady over the next 10 years.

Further financial forecasting work will be required to present detailed options and associated risks to inform decisions regarding future local road condition and associated service levels.

6.2 Estimated Replacement Cost

A summary of the City's Road Asset Replacement Costs is provided in Figure 6.4.

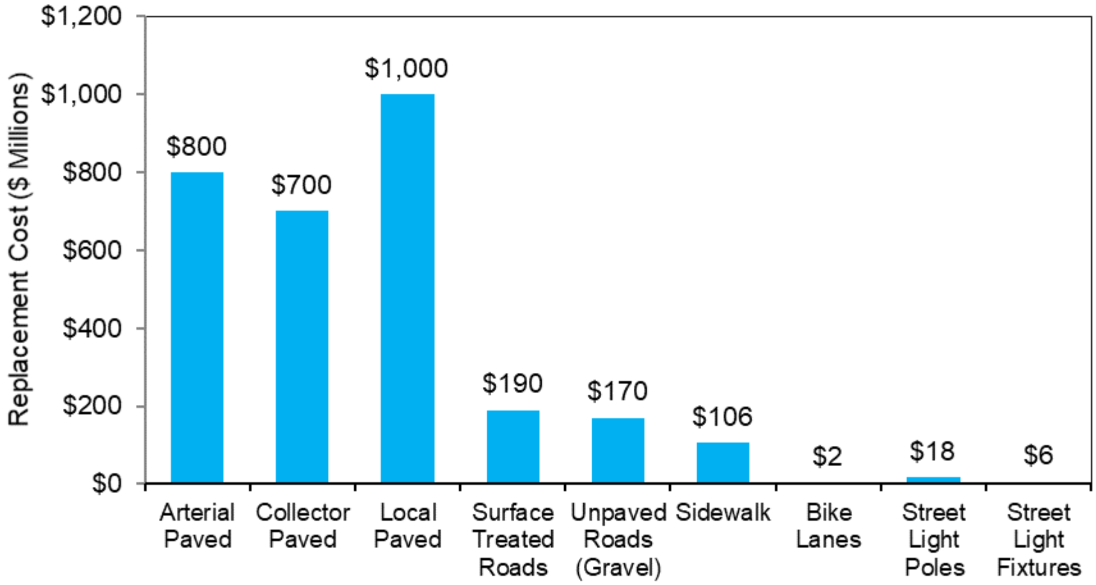


Figure 6.4 - Road Asset Replacement Costs

The estimated replacement value for all paved and gravel roads is $2.86 billion. In 2016, the KPMG Asset Management Plan indicated there was an estimated $896 million in immediate need for rehabilitation or reconstruction. They also projected 10 year need of $802 million for road replacement and rehabilitation for a total estimated investment requirement of $1.7 billion at that time.

Table 6.1 - Road Network Replacement Costs

Asset Type	Replacement Value
Arterial – Hot Mix Asphalt Paved Roads	$800,000,000
Collector – Hot Mix Asphalt Paved Roads	$700,000,000
Local – Hot Mix Asphalt Paved Roads	$1,000,000,000
Surface Treated Roads	$190,000,000
Unpaved Roads (Gravel)	$170,000,000
Sidewalk (km)	$106,000,000
Bike Lanes - On-road bicycle lanes (lane km)	Included with Road
Bike Lanes - Multi-use paths (lane km)	$600,000
Bike Lanes - Cycle tracks (lane km)	$1,500,000
Street Light Poles	$18,000,000
Street Light Fixtures	$5,800,000
Subtotal Hot Mix Asphalt Paved Roads	$2,500,000,000
Subtotal Paved and Unpaved (Gravel) Roads	$2,860,000,000
Grand Total	$2,991,900,000

The replacement value for all assets currently included in this plan is approximately $3 billion. This estimate does not include other road assets which include traffic signals, signs, rock cuts, guide rails, street trees and retaining walls that may be deemed appropriate for inclusion into the RTAMP.

6.3 Estimated Lifecycle Costing

Figure 6.5 represents the life cycle costs of a two lane local urban hot mix paved road using assumed treatments at regular intervals for the purposes of estimating total costs of recommended maintenance and rehabilitation treatments over the assumed 60 year life cycle of the road. These life cycle activities and costs are presented to demonstrate an order of magnitude and will vary with existing conditions based on road class and type, road width, traffic, and existing conditions.

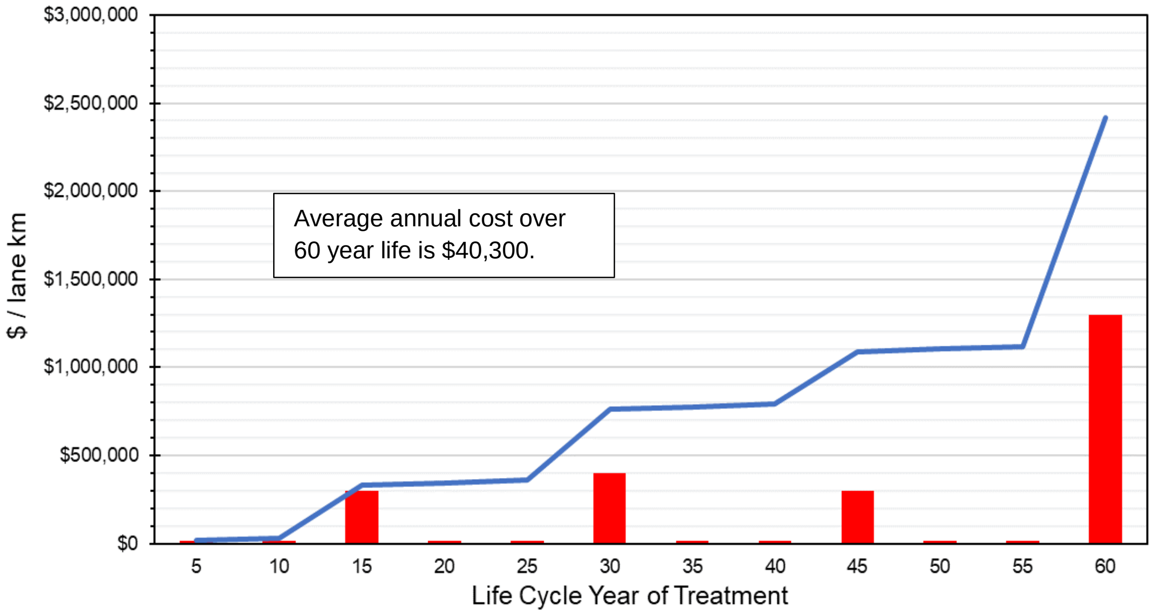


Figure 6.5 - Lifecycle Costs for Two Lane Hot Mix Paved Urban Road (60 Year Life Cycle)

Table 6.2 highlights the estimated costs and proposed treatment activities indicated in Figure 6.5. In this estimate the average annual cost is estimated to be approximately $40,000 per lane km and the total cost of maintaining a road with the recommended treatments is approximately $2.4 million.

Note that these costs will vary with road class, type and width of road. Asphalt thicknesses will vary with road class (arterial/collector and local). Reconstruction costs will vary with road type (urban and rural). All treatment costs will vary with asphalt surface width.

These costs represent a fully funded program to maintain one lane km of road on a recommended treatment cycle. This lifecycle cost review has been prepared to provide an order of magnitude as continuing work on the asset management plan will develop customized programs for different types of roads.

Table 6.2 - Paved Road Network Treatments for 2 Lane Local Urban Hot Mix Paved Road per Lane Km (2021CAD)

Year	Activity	Estimated Cost/Lane km
5	Crack Sealing	$15,000
10	Crack Sealing	$15,000
15	Resurfacing	$300,000
20	Crack Sealing	$15,000
25	Crack Sealing	$15,000
30	Rehabilitation	$400,000
35	Crack Sealing	$15,000
40	Crack Sealing	$15,000
45	Resurfacing	$300,000
50	Crack Sealing	$15,000
55	Crack Sealing	$15,000
60	End of Life Reconstruction	$1,300,000
Total Lifecycle Cost / Lane km (60 Years)		$2,420,000
Average Cost per Year / Lane km		**$40,300**

6.4 Paved Road Summer Maintenance Program

Summer maintenance costs in 2020 were approximately $16.8 million and the requested summer maintenance budget in 2021 was $17.85 million. Based on the Zero Based Budget analysis for summer road maintenance programs identified in the 2012 Report, the projected funding gap for paved road summer maintenance activities required to achieve a recommended standard of maintenance will be approximately $3.9 million for 2021 (Figure 6.6). Maintenance activities and service levels will be the subject of further review and analysis through the continuing asset management plan development in Part 2.

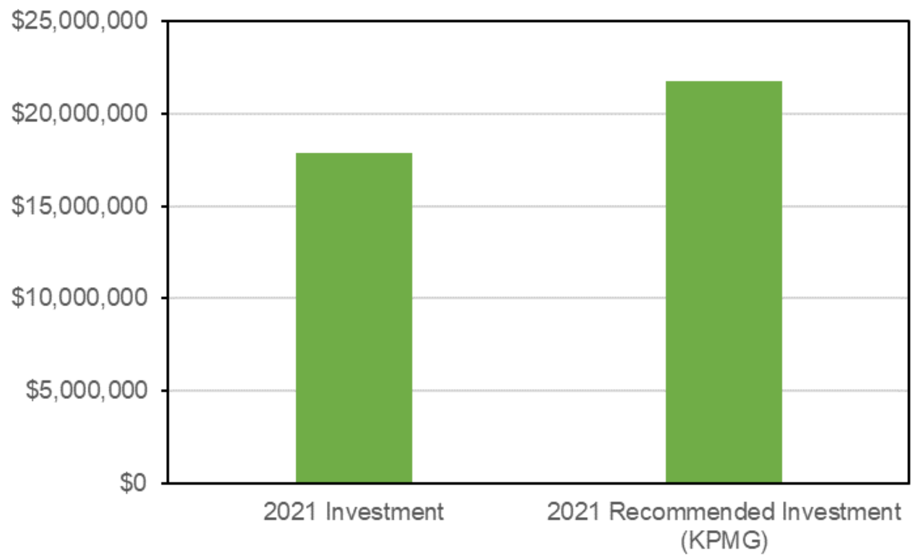


Figure 6.6 - Paved Road Summer Maintenance Investment

6.5 Gravel Road Maintenance Program

A sample of four budgeted gravel road maintenance activities were reviewed and compared to gravel road best practices that were identified in 2005 during the development of a maintenance model framework. Not all gravel road maintenance activities can currently be isolated to gravel road assets and as result, only maintenance activities that were dedicated to gravel roads were reviewed. These activities are indicated in Figure 6.7.

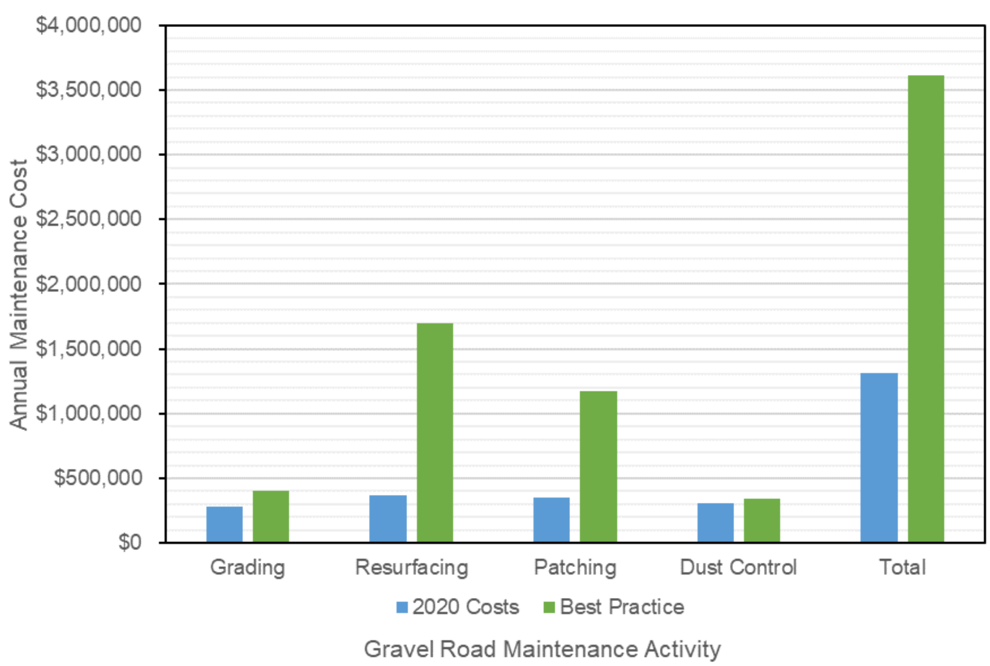


Figure 6.7 - Gravel Road Maintenance Activities 2020 vs Best Practice

The difference between the annual spending on the identified gravel road maintenance activities and best practices is estimated at $2.3 million. These activities do not include all maintenance activities completed on gravel roads. Maintenance activities such as mowing and brushing were not included in the analysis because to date, these activities are not attributed to specific assets and the actual maintenance expenditure on gravel roads could not be accurately estimated. Maintenance activities such as ditching have been evaluated as part of the Stormwater Asset Management Plan (SWAMP). Ditching activity estimates in the SWAMP have been completed with the assumption that ditches generally exist along all gravel roads however the assessment of gravel road conditions reveal that there are significant lengths of gravel road where no ditches exist. Treatment of these locations will be the subject of further review. The values estimated for these activities are indicated in the table below.

Table 6.3 - Gravel Road Activity Funding

Gravel Road Maintenance Activity	2020 Costs	Best Practice	Funding Gap
Grading	$280,000	$400,000	$120,000
Resurfacing	$370,000	$1,700,000	$1,330,000
Patching	$350,000	$1,170,000	$820,000
Dust Control	$310,000	$340,000	$30,000
Total	**$1,310,000**	**$3,610,000**	**$2,300,000**

7 Future Demand

The RTAMP must account for impacts and changes due to asset demand. Demand drivers include population, legislation, demographics, seasonal factors, technological advancement, economic, environmental awareness and Council directed service revisions. Table 7.1 indicates drivers, current and projected status, impact and actions.

The present position and projections for demand drivers, from the City of Greater Sudbury Outlook for Growth to 2046 developed in March 2018, will impact future service delivery. The City will monitor the demand on assets through a combination of managing assets, upgrading of assets and providing new assets to meet demand. Future opportunities will be developed in continuing improvements to the asset management plan.

Table 7.1 - Demand Drivers, Projections, Impact on Services and Management Plan

Demand Driver	Present Position	Projection	Impact on Services	Demand Management Plan
Population	City of Greater Sudbury Population: 166,130	Population (2046): • Low: 165,090 • Mid-Range: 172,990 (Reference Scenario) • High: 181,290	The City's population is anticipated to remain relatively constant. This will minimize the impact on the existing road network. However new development will require new road construction.	The City will continue to monitor population. Should the population deviate from the expected constant, the data will be analyzed to formulate an appropriate plan.
Legislation	Minimum Maintenance Standards Highway Traffic Act Accessibility for Ontarians with Disabilities Act (AODA)	Maintenance standards are anticipated to remain constant. AODA and Barrier-Free needs are expected to evolve.	Maintenance standards have been established. Review of potential for safety improvements i.e. pedestrian crossings, tactile strips and intersections.	Maintenance standards will be reviewed regularly. Additional investment may be required as items are identified within the capital program and with the potential for safety improvement.
Demographic	Households: 69,152	Households (2046): • Low: 72,890 • Mid-Range: 75,250 (Reference Scenario) • High: 77,590	The anticipated increase in housing will be monitored and services provided by the road network will be adjusted accordingly.	Through development approvals, the City plans for additional road network assets.
Aging Population	Median Age from 2016 Canada Census: 43.2	There is an anticipated increase in median age of population. By 2037 the population of seniors (75+) in Ontario is expected to increase to 2.1 times its current size.	The increase in median age of population is expected to have minimal impact on the road network.	Changes to use of public transit may affect traffic characteristics. The biennial pavement condition data collection will capture changes to pavement condition performance.

Table 7.1 (cont'd) - Demand Drivers, Projections, Impact on Services and Management Plan

Demand Driver	Present Position	Projection	Impact on Services	Demand Management Plan
Seasonal Factors	Shifts in temperature and precipitation from summer to winter months	Per climate change models, shifts in temperature and precipitation from summer to winter months are expected to continue for the foreseeable future.	Seasonal changes have an impact on the road network. The City's operations, maintenance and capital programs are driven by seasonal change. The City has and will continue to collect, analyze and monitor condition data as it relates to seasonal factors.	The road network will be monitored. The biennial pavement condition data collection will capture changes to pavement degradation due to seasonal factors. Maintenance and operational requirements may change with potential changes to snow removal, street sweeping and pothole repair.
Technological Advancement	The City reviews available technology to improve the level of service provided by the road network.	The need for additional investment in technology is anticipated.	Technological advancement will provide the opportunity to investigate process improvements.	Changes in technology will be reviewed for opportunities for implementation into the asset renewal program.
Economic	Jobs: 79,440	Jobs (2046): • Modest: 81,230 • Mid-Range: 85,750 (Reference Scenario) • High: 90,460	The City's employment is expected to grow with the minor projected increase in population. Impact on the road network is anticipated to be minimal.	The City will continue to monitor employment. Should the employment deviate from the expected constant, the data will be analyzed to formulate an appropriate plan.
Environmental Awareness	Through legislation and the City's own actions, the City has demonstrated that it recognizes the need for environmental and climate protection. The City has adopted the CEEP and a complete streets policy.	Environmental awareness is anticipated to result in additional legislative requirements and stricter best practices.	Addition of sidewalks and bike lanes may result. Investigation of Rapid Transit Bus Lanes on high importance GOVA routes.	Alternate green methods of road resurfacing and rehabilitation will be used, new methods will be reviewed and piloted where deemed appropriate. Active transportation planning included in capital projects where identified in Transportation Master Plan and deemed appropriate. CEEP and climate change considerations will become integral part of project planning.

8 Community Energy and Emissions Plan and Climate Change

8.1 Community Energy and Emissions Plan

In September 2020, Council authorized staff to proceed with the next steps in the implementation of the Community Energy and Emissions Plan (CEEP). The CEEP outlines 18 goals that are to be achieved to attain the City's target of becoming a net-zero GHG emission community by 2050.

The City has historically been involved in early adoption of asphalt recycling technologies such as Cold In-place Recycled Asphalt Expanded Asphalt Mix (CIREAM) or Cold In-place Recycling (CIR) asphalt. The City is currently in the process of completing a pilot project using Hot In-place Recycling (HIR) technology to determine if this technology will be a suitable substitute for mill and pave asphalt maintenance activities. The HIR process could result in savings in the scheduled resurfacing of roads that are indicated at the 15 and 45 year marks of the life cycle costing table indicated in Section 6.2.

Other City initiatives include annual funding for new sidewalks and bike lanes, and development of a Traffic Congestion Index for evaluation and development of solutions to traffic flow issues within the transportation system. Solutions will be expected to reduce travel times and reduce GHG emissions.

As part of the ongoing work of asset management planning and prioritization, environmental scans of different technologies will be completed and the evaluation will result in recommendations for consideration for technologies into operational and capital programs.

8.2 Climate Change

A primary goal of an asset management plan is to maintain the asset in a way that is resilient and sustainable. This means the level of service will meet the needs of the present community without compromising the needs of the future community. Levels of service will be reviewed with a climate change lens with risk assessment. Climate change may affect such parameters as freeze/thaw cycles, precipitation, storm intensity and changes to construction season length. In addition to the possibility of negative impacts, there could be some positive impacts which may result such as the potential for lower winter control costs. Service levels will be reviewed on an ongoing basis to determine if they need be adjusted or scaled back as a result of the potential for changes in priorities.

To analyze the effects of climate change, the City reviews online resources such as:

- Climatedata.ca, undertaken with the support of Environment and Climate Change Canada;
- Climateatlas.ca, undertaken with the support of Environment and Climate Change Canada, Public Health Agency of Canada, and Health Canada.

Climatedata.ca and Climateatlas.ca analyze parameters called pathways named RCP4.5 and RCP8.5. RCP means Representative Concentration Pathway which is a greenhouse gas concentration trajectory. The greenhouse gas concentration trajectory is not to be confused with current emissions, although emissions impact the atmospheric concentrations. These are defined as indicated below:

RCP 4.5: This pathway is intermediate because global emissions would peak by 2040. CO_2 emissions must reduce to half of the 2050 levels by 2100, CH_4 emissions must decline by 75% in the decade leading to the year 2050, and SO_2 emissions must decline by 80% of the SO_2 emission level from 1980. Similar to RCP 2.6, this scenario requires negative CO_2 emissions equivalent to a minimum of two Gigatons/year every year from natural sources to keep the global temperature rise between 2°C and 3°C by the year 2100. Many plant and animal species will not be able to adapt to the effects of RCP 4.5 or higher.

RCP 8.5: This pathway is business as usual. Emission will continue to rise on the current global pace throughout the 21st century.

Global Climate Models depict how the climate is likely to change in the future. As no single climate model is correct, the asset management plan will consider the effect of Low Carbon (RCP 4.5) and High Carbon (RCP 8.5) pathways on the road network. The two scenarios are appropriate as RCP 4.5 assumes a drastic and sustained reduction of emissions in the coming decades, while RCP 8.5 represents the current global pace; emission of very large amounts of carbon dioxide from the burning of fossil fuels.

Table 8.1 provides the results of several Global Climate Models for the City of Greater Sudbury geographic area with high and low carbon emission scenarios and the anticipated impact on the road network. It is important to note that the anticipated impact is of climate change on infrastructure, not the potential impact of infrastructure contribution to climate change.

Table 8.1 - Climate Change Scenarios and Impact on Services

Variable	Current Mean	RCP	2021 - 2050 Mean	2051 - 2080 Mean	Anticipated Impact
Precipitation (mm)	848	High 8.5	904	938	The increase in precipitation may increase the risk of ROW flooding or washout and may increase stress on pavement structures. An increase in precipitation is expected to result in increased gravel road costs.
		Low 4.5	890	924	
Mean Temperature	4.3°C	High 8.5	6.5°C	8.8°C	Review of asphalt mix design.
		Low 4.5	6.3°C	7.3°C	
Tropical Nights (+20°C)	1	High 8.5	5	17	Review of asphalt mix design.
		Low 4.5	4	7	
Very Cold Days (-30°C)	5	High 8.5	1	0	The decrease in very cold days may reduce the frost penetration depth.
		Low 4.5	2	1	
Very Hot Days (+30°C)	6	High 8.5	18	39	Review of asphalt mix design.
		Low 4.5	16	24	
Frost-Free Season (days)	137	High 8.5	163	184	Impact cannot be projected as there could be benefits or drawbacks (i.e extended early spring temperatures and moisture or additional days of sound dry road structure)
		Low 4.5	157	168	
Freeze Thaw Cycles	68	High 8.5	64.2	61.5	The decrease in freeze-thaw cycles is expected to lengthen expected road service life.
		Low 4.5	65.4	64.3	
Mild Winter Days (-5°C)	120.1	High 8.5	103.6	84.2	Impact cannot be projected as there could be benefits or drawbacks. (i.e. less snow removal or negative impact on road structure)
		Low 4.5	104.5	96.6	
Summer Days (+25°C)	42.9	High 8.5	68.9	93.8	Review of asphalt mix design.
		Low 4.5	65.2	77.4	
Winter Days (-15°C)	58.4	High 8.5	42	24.8	Impact cannot be projected as there could be benefits or drawbacks. (i.e. less snow removal or negative impact on road structure)
		Low 4.5	43.9	35.3	

9 Next Steps and Future Opportunities

9.1 Next Steps

Following completion of Part 1 of the Roads and Transportation Asset Management Plan, target level of service options required for Part 2 of the RTAMP work will be prepared for Council review and discussion. The target level of service framework will be an important driver of the sustainability strategy. Proposed service levels will have impact on asset condition, life cycles, financial commitments and associated risks.

The following tasks are the next steps in development of Part 2 of the Roads and Transportation Asset Management Plan:

- Develop proposed level of service options which will include a review of the following:
    a. Varying paved road surface condition levels based on road class and traffic;
    b. Strategies for investment in Poor and Very Poor roads;
    c. Review of maintenance activity levels of service;
    d. Establish target service level for percentage of roads in Fair condition or better;
    e. Establish target service level for investment as percentage of asset replacement value;
    f. Service levels for surface treated and gravel roads;
    g. Review other indices for possible addition to level of service metrics.
- Identify differences between existing service levels and proposed service levels;
- Assessment of risk for proposed level of service options;
- Estimate asset performance over 10 years for various level of service options;
- Review affordability of proposed service levels and determine if service levels are achievable;
- Select the target level of service that is appropriate for the community;
- Identify improvement opportunities to operating and capital programs, recommend action items to provide improved alignment between operating and capital activities;
- Update road network valuation and incorporate into pavement management system;
- Implement risk analysis into pavement management system;
- Provide options for lifecycle management and associated financial strategies;
    a. Lifecycle evaluation and assumptions;
    b. Lifecycle activities and activity options;
    c. Risks of lifecycle options;
    d. Identification of lowest cost lifecycle activity options;
    e. Estimates for activities identified (capital and operating costs);
    f. Projected available annual costs for activities;
    g. Review of alternate lifecycle options and evaluation;
    h. Management of risks associated with recommended activities not selected for implementation.
- Develop long term financial strategy options (60 years);
- Incorporate considerations for future growth and development demand;

- Identify opportunities for implementation of green technologies;
- Identify impacts and strategies to manage risks associated with climate change;
- Identify future improvement opportunities.

9.2 Future Opportunities

Asset management planning establishes a baseline of the current asset management practices that will guide asset management planning and will be subject to continuous review and improvement. Future opportunities and tasks will include:

- Continue to improve quality of data and incorporate assets into the management plan for all assets including those associated with paved and unpaved road data, sidewalks, signs, guide rails, traffic signals, street trees, retaining walls, rock cuts and other assets deemed to be appropriate for inclusion into the RTAMP;
- Develop and incorporate congestion index into level of service metrics;
- Improvement in asset management planning including improvements to valuation, lifecycle analysis through project reviews including cost analyses and review asset performance under various selected treatments;
- Continuous improvements to risk analysis including regular review and assessment for possible realignment and revisions as may be deemed by current requirements;
- Continuous review and monitoring of operational activities on paved and unpaved roads to evaluate expenditures, best practices and evaluation of activity impact on asset life cycle;
- Alignment of roads asset management drainage assets with those identified in the stormwater asset review;
- Development of a corridor approach to level of service and project prioritization with the objective to integrate level of service and prioritization review of multiple asset class projects including water and wastewater, drainage and storm water management, and bridges/large culverts;
- Continue to review methods for project alignment with CEEP and climate change resilience.

City of Greater Sudbury

Stormwater Asset Management Plan

Final Report

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Date: April, 2021

Project #: 60541343

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Drainage Engineer
City of Sudbury
200 Brady Street
Sudbury, ON P3A 5P3

April 1, 2021

Project #
60541343

Dear Mr. Javor:

**Subject: Stormwater Asset Management Plan
Final Report**

Please find enclosed AECOM's final submission of the **City of Greater Sudbury's Stormwater Asset Management Plan Final Report**.

We trust the enclosed meets your approval. Should you have any questions or require further information about our submission, please do not hesitate to contact Nancy Hill at (604) 790-1637.

Sincerely,
AECOM Canada Ltd.

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Encl.
cc:

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1. Introduction

1.1 Background

According to ISO 55000:2014, an asset is defined as an item, thing or entity that has potential or actual value to an organization. As such, the City of Greater Sudbury (hereinafter refer to as “the City”) owns, operates and maintains a wide array of assets that include, but are not limited to, information technology systems, equipment, stormwater management ponds, vehicles and even natural systems. These assets are expected to function efficiently and effectively for many years and support the mission-critical functions of the organization. Actions such as planning, delivery of assets, operations, maintenance, and performance management, which are performed by various divisions within “the City”, all contribute to effective asset management (AM) with support from finance and information systems. However, all these assets have a defined service life and, as they age and deteriorate, it is imperative for the City to understand how to manage them in such a way to ensure that their full-service life is reached, and to have in place a mechanism to enable their renewal or replacement whilst risks are managed.

The objective of this Asset Management Plan (AMP) is to deliver the context and the financial and technical road map for the management of the City’s **stormwater infrastructure assets** and to provide the basis for decision making and budgeting for sustainable management of these assets and delivery of these assets over a 10-year planning period.

The City’s goal in managing infrastructure assets is to meet their defined levels of service (as amended from time to time) in the most cost-effective manner for present and future consumers. Key elements of the City’s approach to infrastructure asset management are:

- Providing a defined level of service and monitoring performance;
- Managing the impact of growth through demand management and infrastructure investment;
- Taking a lifecycle approach to developing cost-effective management strategies for the long-term that meet the defined level of service;
- Identifying, assessing and appropriately controlling risks; and
- Linking to a long-term financial plan which identifies required, affordable expenditures and how funding will be allocated.

1.2 Connectivity to Other Corporate Documents

This AMP supports the City of Greater Sudbury’s Strategic Plan objective for Asset Management and Service Excellence which states “maximize value of investments in physical infrastructure and initiatives that enable reliable service delivery and promote economic competitiveness”[1]. It also serves to advance the City’s strategic priorities; one of which is to continue to develop and implement asset management plans. Since AM affects a large portion of the City’s activities, it is important that there is a line-of-sight between all AM documents. The City’s recently updated AM Strategic Plan sets the vision and guiding principles for the corporate-wide management of the City’s assets and articulates commitment to continuous improvement in AM.

[1] *City of Greater Sudbury, Strategic Plan, 2019 - 2027*

1.3 Key Steps Supporting this Asset Management Plan

The actual steps used to develop this AMP are listed below and were selected to ensure that reliable and robust useful information is provided with which the City can have confidence to make fact-based and defensible business decisions.

1. Reviewed and summarized existing inventory of the City's stormwater assets;
2. Improved the City's data through its GIS inventory where possible;
3. Established a Levels of Service framework with performance indicators;
4. Optimized and formalized stormwater operations and maintenance to match desired Levels of Service;
5. Determined criticality of system assets;
6. Assessed the City's stormwater asset life cycles and replacement costs, funding gaps, and capital investment requirements;
7. Provided a plan for capital improvement rationalized by asset life cycles, risk, and available funding;
8. Summarized findings of all tasks to provide the City with an overall stormwater asset management plan.

The following sections summarize the exploration and findings of the AM Planning process for the City's stormwater infrastructure assets.

1.4 Limitations of this Asset Management Plan

This plan is based on current assets and current conditions. It does not include analysis of future growth, regulatory changes, or changes in climate. The operations and maintenance plan is based on the current asset inventory and the capital investment plan is based on "like for like" replacement of the current asset inventory. The City is not expected to experience significant growth in the near future, but it is likely that when existing stormwater assets are replaced, they will need to be built larger to consider current design standards. It is possible that future environmental regulations will necessitate changes to the City's stormwater infrastructure (e.g. the provincial's proposed requirements for stormwater runoff volume control). The existing design storm is the "Timmins" storm which was an extreme "once in a century" rainfall event. Therefore, increases to the design storm are not expected in the near future. However, it is recommended that as the City periodically reviews and updates its stormwater asset management plan, considerations are integrated to include changes in demand stimulated by growth, regulatory requirements, and/or climate change projections as required by O. Reg 588/17.

2. State of the Infrastructure

2.1 Asset Summary

The City owns and operates approximately 540 kilometres of stormwater mains and approximately 277 kilometres of ditches alongside other stormwater management assets including manholes, catch basins, discharges/outlets, inlets, ponds (dry, wet & infiltration), and oil and grit separators (OGS). The complete engineered stormwater asset inventory is summarised in **Table 1**. Note that this inventory doesn't include the natural stormwater assets (e.g. creeks, lakes etc.) within the City, which also serve an important stormwater function.

Table 1: City of Greater Sudbury Asset Inventory Summary

Stormwater Assets	Quantity	Unit
Stormwater Mains (includes culverts)	537	km
Ditches*	277	km
Manholes	8,600	EA
Catch Basins	8,744	EA
Discharges / Outlets	2,751	EA
Inlets	3,372	EA
Ponds	15	EA
Oil Grit Separators	24	EA

*Note: * While ditches within urban areas were reviewed through this assignment, rural roadside ditches remain a key data gap. Rural roadside ditches are not digitized but could account for a significant portion of the drainage system (based on a cursory desktop review of rural roads not covered by the City's coverage of as-built drawings).*

2.2 Replacement Cost

To calculate replacement cost for the engineered stormwater asset inventory, a series of unit replacement costs were developed based on the combination of industry standard replacement values carried by AECOM during financial planning, and information gathered from AECOM's National Water and Wastewater Benchmarking Initiative. Several of the City's largest oil grit separators were valued individually using the City's records of design and construction costs.

Table 2 and **Figure 1** show the replacement costs for all engineered stormwater assets owned and operated by the City. The total replacement value for all the City's engineered stormwater assets is $520 M with 81% of the value associated with stormwater mains (and manholes).

Table 2: Summary of Asset Replacement Cost

Stormwater Assets	Quantity**	Unit	Replacement Value
Pond	15	count	**$1,500,000**
OGS	24	count	**$10,350,000**
Ditch	277	kilometres	**$13,836,000**
Discharge	2751	count	**$18,707,000**
Inlet	3372	count	**$22,930,000**
Catch Basin	8744	count	**$29,730,000**
Gravity Main (includes culverts) (Manholes)*	537 (8600)	Kilometres (count)	**$423,042,000 ($75,671,000)**
Total			**$520,095,000**

*Note: * The individual cost of manholes (~ $76 M) is included within the cost of gravity mains ($423 M). The cost of manholes has been itemized to demonstrate the relative contribution but is not included as an additional input into the valuation.*
*** based on GIS inventory – may need to update once GIS update assumptions are confirmed*

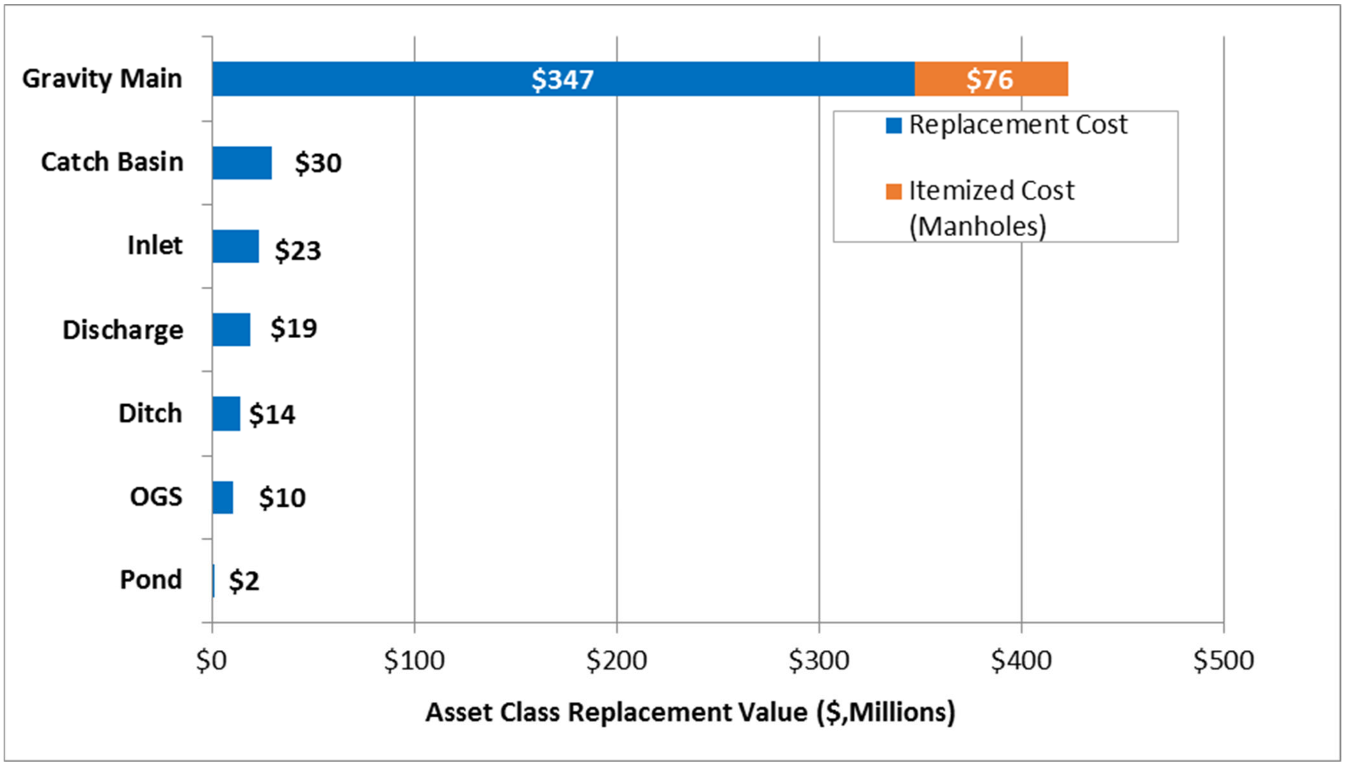

Figure 1: Replacement Value Breakdown by Asset Type

2.3 Supportive Drainage Assets

While the provided inventory serves as the basis for understanding investments and financial exposure for stormwater assets engineered by the City to convey stormwater, it is important to recognize the other natural features within the City that contribute to the management of stormwater. These assets provide value to the City by conveying or retaining stormwater, either as naturalized features or assets constructed by the City. The intrinsic value of these assets should be recognized by the City – if an asset was altered or removed, the support it provided could have to be supplemented elsewhere in the system to ensure drainage is adequate. Supportive drainage assets under consideration include waterbodies, wetlands, forests, municipal drains and road surfaces (act as overland flow routes). From an asset management perspective, preserving these features can play an important role in minimizing the cost of the City's drainage system (for example, allowing a resident to in-fill their ditch or municipal drain could lead to increased demands for infrastructure). See **Table 3**.

Table 3: Summary of Supportive Drainage Assets

Asset Class	Units	Amount	Data Source
Municipal Drains	km	179	City
Wetlands	km^2	336	City (Remote Sensing Analysis)
Waterbodies	km^2	442	City (Remote Sensing Analysis)
Water Courses	km	2,565.5	City (Remote Sensing Analysis of Rivers, Streams, and Creeks)
Forests	km^2	2,146	City
Roads	km	2,847	City

For this study, supportive drainage assets listed above were not considered except municipal drains which were included in the operation and maintenance plan.

2.4 Lifecycle Analysis

For developing a rate of sustainable funding for the City, medium to long term investment needs were determined by developing an investment profile for each of the primary stormwater asset groupings. 30-year and 100-year planning periods were chosen to represent the medium-and-long term cases respectively. Here, a 30-year planning period represents the investment profile most applicable to the needs of the City in the next planning cycle. The 100-year investment profile may appear abstract but gives the City additional foresight into long term asset renewal needs. For developing the investment profile, a combination of two approaches was taken. For linear assets a probability-based (Weibull-type) assessment was used, while for non-linear assets a straight-line approach using age and expected service life was used. Given the sensitivity of both approaches to expected service life, and in cases where in situ experiences differ from known expected service life behaviour, it is useful to calculate a range of options, thereby providing multiple scenarios that can support planning and high-level decision making.

Optimistic vs. Conservative Scenario:

To further aid the City's overall asset management plan, a scenario analysis was developed to quantify the effect of varying assumed ESLs for stormwater mains on capital expenditure over the next 30 years, comparing "optimistic" values (i.e. ESLs typically experienced by AECOM on past projects) and "conservative" values (i.e. ESLs typically experienced within the City's specific operating context) as provided within **Table 4**. These types of comparisons are valuable, given the sensitivity of a lifecycle analysis to the inputs for expected service life (limitations and recommendations previously provided). By comparing optimistic and conservative scenarios, the City gains a broader insight into the potential funding requirements over the next planning cycle.

Table 4: Expected Service Lives of Stormwater Mains by Material Type

Abbreviation	Material	ESL – Conservative	ESL – Optimistic
AC	Asbestos Cement	85	120
CI	Cast Iron	85	120
CL	Clay	85	120
CSP	Corrugated Steel Pipe	10-25*	15-30*
CON	Concrete	90	120
HDPE	High Density Polyethylene	85	120
LEAD	Lead	75	120
OTH	Other	75	120
PCCSP	Pre-stressed Corrugated Steel Pipe	90	120
PE	Polyethylene	85	120
PVC	Polyvinyl Chloride	75	120
RCON	Concrete, Reinforced	90	120
STL	Steel	85	120
UNK	Unknown	80	120
WD	Wood	75	120

Note: From discussions with the City, CSP pipes experienced premature degradation around **10-15 years when the pipe segment is open and exposed. For buried CSP pipes, the ESLs are closer to **25-30** years.*

Figure 2 shows the range or "band" of annual capital expenditures because of varying assumed ESLs (conservative vs. optimistic). The annual expenditure difference starts at $1.8 M/year in 2018 and reaches a high of $7.2M in 2041, with the end of analysis period being 2047. The reason for this increase in difference is the timing of the City's replacement "envelope". By taking the conservative approach, the replacement envelope when many assets will reach their ESL occurs earlier in the investment profile than what is forecasted under the optimistic approach. Recognizing the need to gather condition data to verify ESLs and that local site conditions will produce varying lifecycles for assets of similar design, it is likely that the City's recommended capital expenditure will fall between the "band" over the next 30 years.

Given the City's proposed asset management strategies (**Section 4.4**) , the 'optimistic' approach was carried through remaining lifecycle analysis calculations so that long term planning incorporated normalized expected service life behaviour.

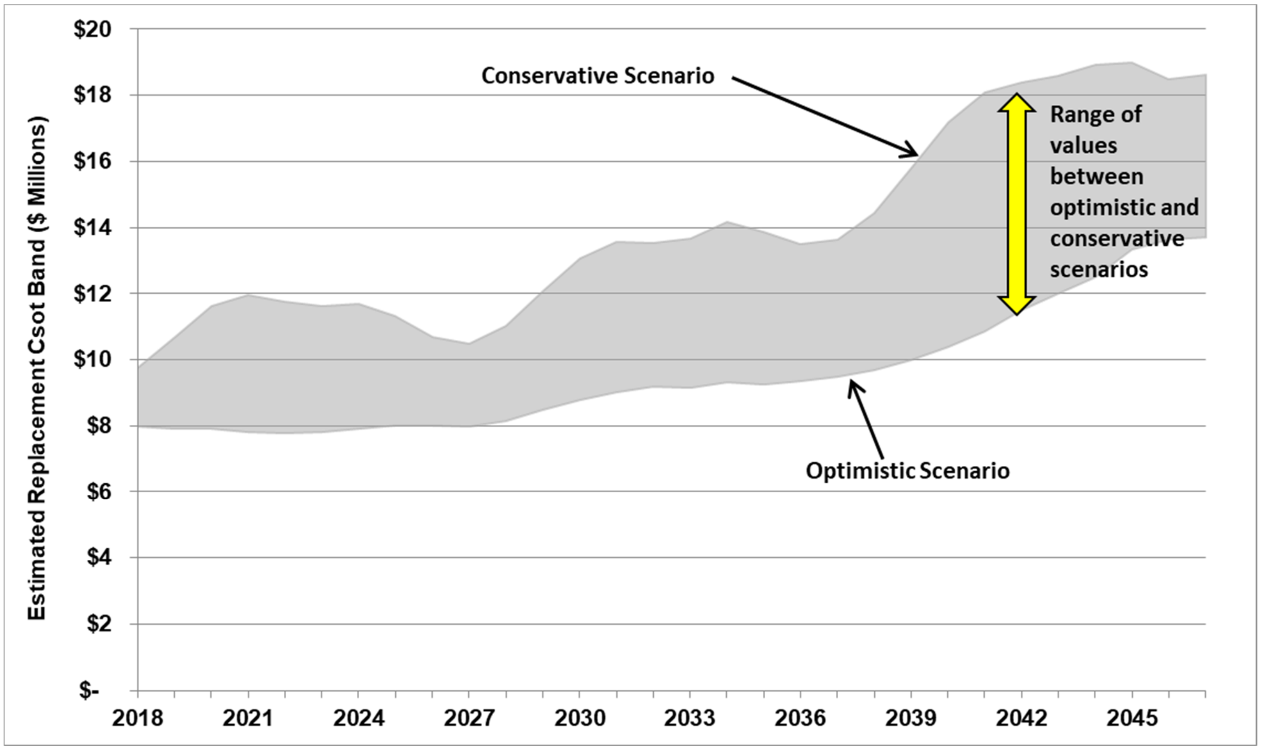

Figure 2: Optimistic vs. Conservative Budget Scenarios

Lifecycle Investment Profiles:

Figure 3 and **Figure 4** define the City's medium and long range investment profiles provided that an optimized approach to capital improvements is taken, namely by being proactive and addressing the existing investment backlog.

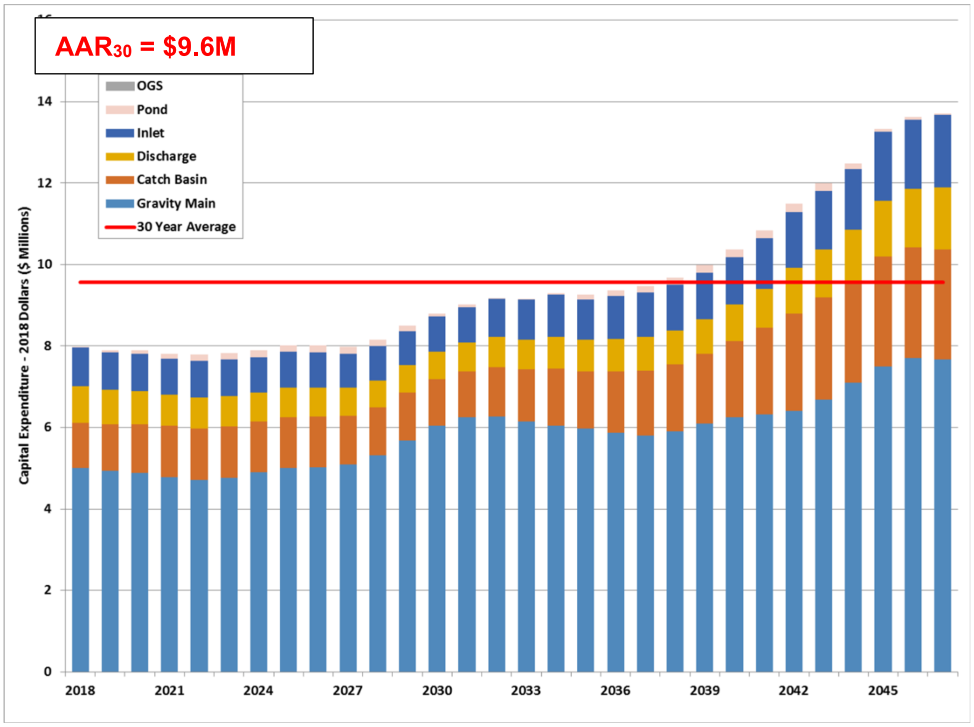

Figure 3: 30 Year Investment Profile for Stormwater Assets (Optimistic Scenario)

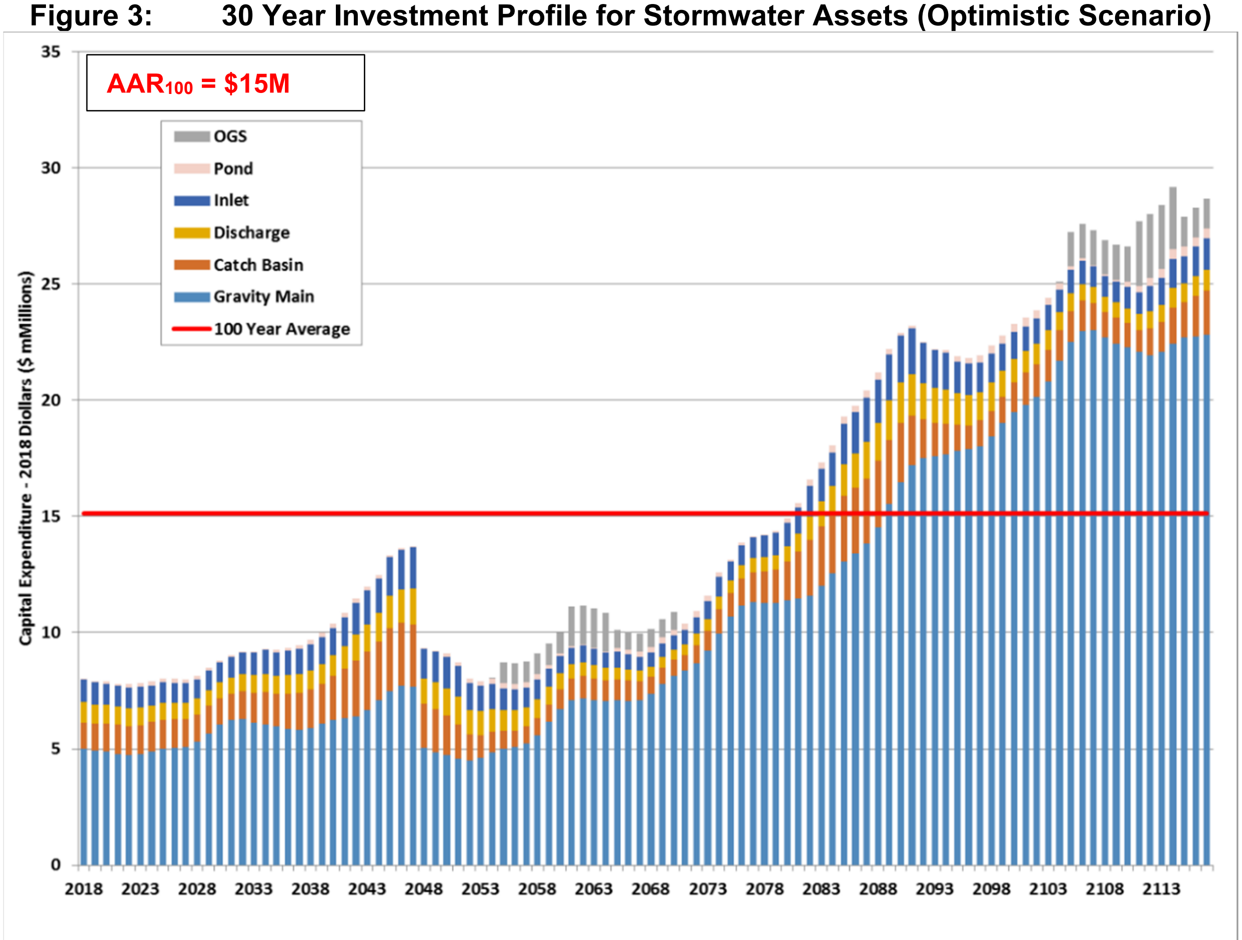

Figure 4: 100 Year Investment Profile for Stormwater Assets (Optimistic Scenario)

For each investment profile, an average annual reinvestment value, or "AAR", is depicted. The average annual reinvestment rate represents the average value across the time scale of the presented scenario.

Funding Gap Analysis:

Using the calculated investment profiles (i.e. required capital expenditures for sustainable infrastructure capital funding) as well as an estimate of the City's funds spent on capital improvement based on current levels, AECOM conducted a funding gap analysis to quantify the difference between the City's current capital expenditures and the forecasted capital expenditures required. **Figure 5** shows the projection from 2018 to 2047. Over the entire 30-year period, the City could develop a significant funding shortfall. On average, the funding shortfall is approximately $6.7 M. When extrapolated over 30 years, the funding shortfall (ranging from $5.1 M to $10.3 M per year) reaches approximately $200 M in 2047. Asset management and replacement strategies (e.g. risk management) discussed later in this report were undertaken to improve on the City's funding gap by incorporating risk-based and rehabilitation strategies.

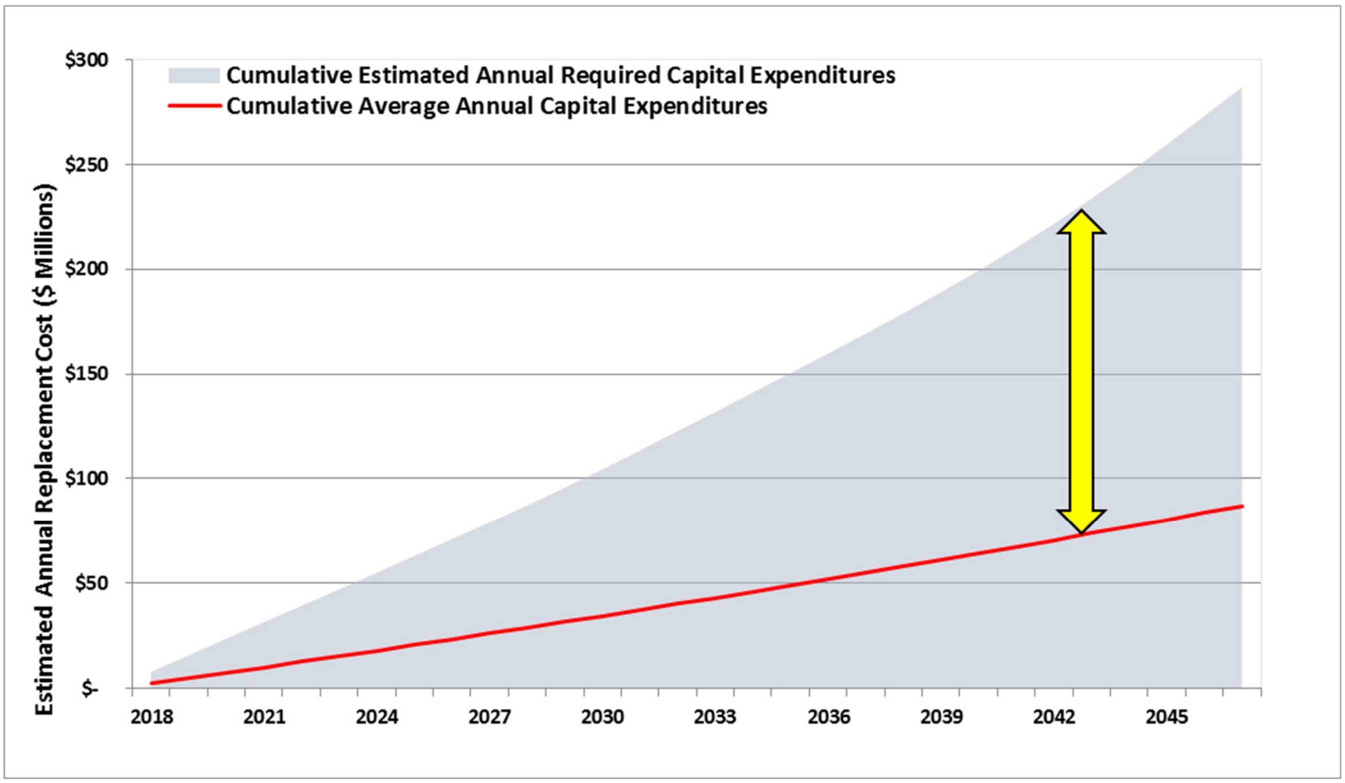

Figure 5: Cumulative Funding Gap

These results present the first step in developing an understanding of the total lifecycle cost of the assets, as well as the approach to a sustainable funding strategy.

Refer **Appendix C – Technical Memorandum #2: Asset Lifecycle Analysis & Financial Model** for additional information.

3. Levels of Service

Levels of Service (LoS) document the services provided by and performance of the City's stormwater system. By defining outcomes of the assets and the services they provide, links can then be made to the activities needed to own and maintain them. Based on the City's strategic goals, AECOM documented the City's desired LoS, and hence the required level of activities to achieve them. By rationalizing each goal to understand what actions should be taken by an organization to achieve the goal (for example using policy, planning, capital, or O&M), the linkage between the activities and the rationale for completing them (at a given cost) becomes clear.

LoS are generally separated into three levels, as presented in **Figure 6**. This aligns with *Ontario Regulation 588/17*, which establishes requirements for **Community LoS** and **Technical LoS**.

- **Corporate LoS** describe the organizational mission, vision and corporate goals and objectives, as reflected in the direction provided by elected officials and the municipal senior administration. The Corporate LoS should reflect the values of the stakeholders and their willingness to pay but may be directed by certain legislative / regulatory requirements.
- **Community LoS** describe the service that individual stakeholders and users can expect using plain language that is understandable by most stakeholders.
- **Technical LoS** describe parameters that must be achieved to deliver Customer LoS. Technical LoS may be described in more technical language.

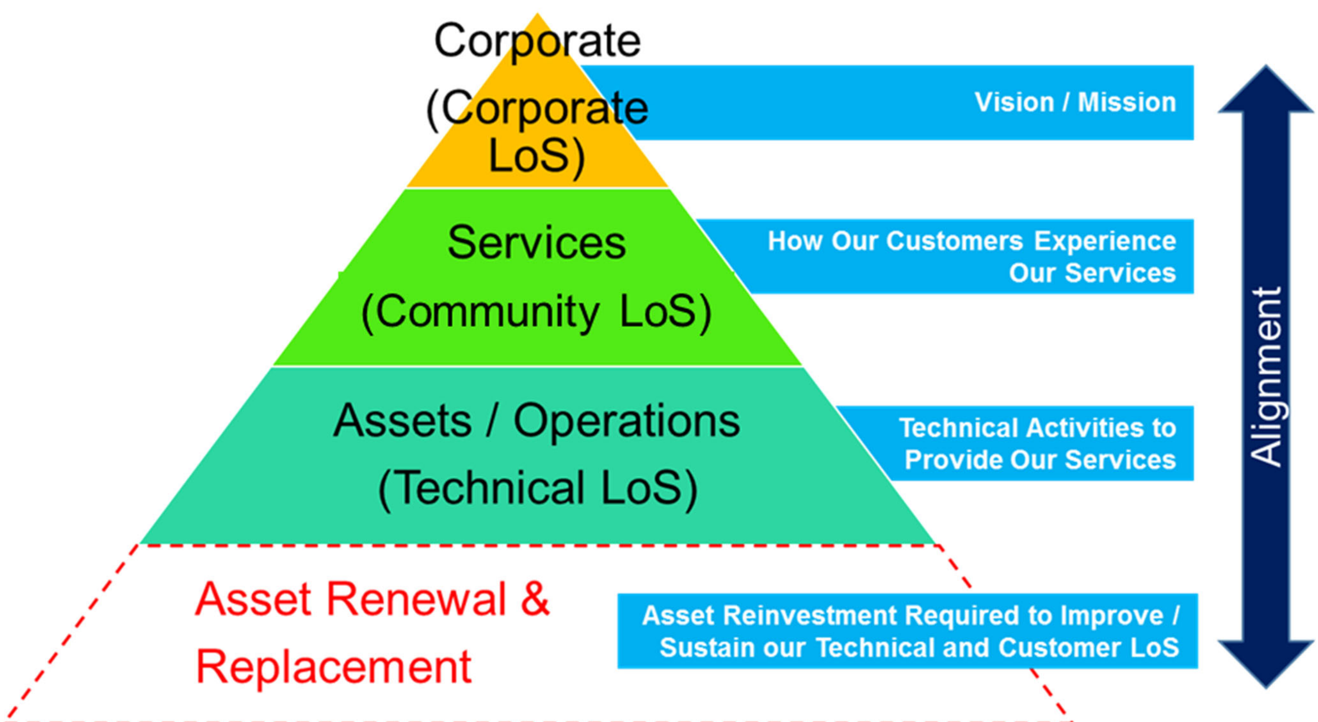

Figure 6: LoS Should Ensure Strategic Alignment of Activities throughout an Organization

To articulate the City's LoS, several overarching goals were defined. Each goal had several sub-goals that described in detail how the strategic outcome, or Corporate LoS, could be measured or achieved. When combined, they represent the overall strategic vision for the services provided by the stormwater system, and serve as the basis for determining what lifecycle activities and Technical LoS should be applied to the assets:

- Goal #1 – Protect the Environment
- Goal #2 – Obtain Adequate and Sustainable Funding
- Goal #3 – Ensure Adequate Capacity to Protect Life and Property
- Goal #4 – Provide a Safe and Productive Workplace
- Goal #5 – Have Satisfied and Informed Customers
- Goal #6 – Meet Service Requirements with Economic Efficiency

Evident from the goals listed above is that they are high level, and strategic in nature but can be further translated into tangible AM activities. With the overall goals established, the focus can then shift to where the City is currently as well as where it wants to be. Using the LoS goal model, the City's current and desired LoS were determined using the following definitions:

- Current Levels of Service: Describes the current performance of the assets and the actions taken by the City to maintain the assets or deliver services. It is based on current approaches, practices, and funding.
- Desired Levels of Service: Describes the desired performance of the assets, assuming the use of asset management practices and other enabling factors. It is based on the City's vision for what it wants to achieve with its stormwater program.

3.1 Current Technical Levels of Service

Aside from the overall level of drainage the system offers, there are several other services and activities associated with the stormwater system that are a technical LoS. Here, a detailed view of the activities establishes the performance of the stormwater system and the lifecycle activities needed to support current and desired LoS. Using the LoS Goal Model, the current Technical LoS can be summarized as well as supporting lifecycle activities.

Current Technical LoS are summarized in **Table 5**. For a full breakdown of the City's Technical LoS, see **Appendix D – Technical Memorandum #3: Levels of Service**.

Table 5: Summary of Current Technical LoS

Goal	Current Technical Levels of Service Highlights
Protect the Environment	• Source Protection Plans developed and maintained. • Source control program in place with a supporting By-Law • Riparian areas are maintained in a natural state or are being addressed by sub-watershed studies. • Flow rates are controlled within developments where design permits. • Discharge volumes are not limited. • Enhanced protection is provided by developments with stormwater management ponds. Additional quality measures will be identified by sub-watershed studies.
Adequate and Sustainable Funding	• Stormwater assets are funded through the general tax base. • The City will review funding requirements as per stormwater asset management plan, identify options and implement preferred funding option.

Table 5: Summary of Current Technical LoS

Goal	Current Technical Levels of Service Highlights
Capacity to Protect Life and Property	• A limited number of properties are impacted by minor storm events. • Existing developments are designed to various standards. • Design storms were last updated in 2003 but are based on an extreme event. • Very little damage to property is reported during minor storms. • Zero incidences resulting in injury or death. • Safe passage is maintained on arterial roads. • New developments are designed for a 100-year event (5 year in the minor system, 100 year in the major system). Existing developments are to be modified as funds are available. • Emergency response times range from 1 to 4 hours.
Safe and Productive Workplace	• Accidents are recorded and addressed in accordance with health and safety policies. • All regulatory requirements for workplace safety are achieved. • Current breakdown of field hours and productivity is unknown. • More maintenance work is preventative than corrective.
Satisfied and Informed Customers	• The City received a total of 969 stormwater related customer complaints in 2018. This includes all issues related to drainage and ponding – it does not necessarily reflect the number of unique incidents. • Stormwater educational information is provided on the City's website.
Meet Service Requirements with Economic Efficiency	• The final goal is to achieve the first five goals while doing it in the most cost-effective manner. Once the City can articulate all its targets with respect to the first five goals, it can then work towards accomplishing these goals in the most cost-effective manner possible.

3.1.1 Lifecycle Activities Supporting Current Level of Service

As demonstrated by **Figure 6**, maintaining current or desired LoS is incumbent upon operational and lifecycle activities that either deliver services or maintain the assets in the state necessary to provide the LoS. The links to activities allow the City to evaluate how any modifications will impact service outcomes. The activities carried out to provide the current LoS are summarized as follows (**Table 6**).

Table 6: Activities Supporting the Current Technical LoS

Capital Activities*	Operational Activities*
• Gravity sewers are replaced at the end of their life, typically during road corridor reconstructions. • Catch basin and manhole lids/chambers are reconstructed in advance of road overlay work. • The City maintains a culvert replacement program. • Support for driveway culvert replacements is provided by the City to homeowners.	• Storm sewers were flushed and inspected • Catch basin sumps are cleans and leads are flushed. • Ditches are regraded mechanically. • Culverts are inspected, cleaned, and repaired • Screens and inlets are inspected • Drainage maintenance is provided in the form of service requests, responses to flooding, etc.

*Note: * Activities are identified at a high-level only and do not indicate activity frequencies. Activity frequencies and the necessary adjustments are shown in **Appendix F**.*

3.2 Desired Technical Levels of Service

Building on current LoS, the City has identified desired LoS it can work towards through continual improvement, with the objective of providing a stormwater system that achieves all goals completely. A summary of the City's desired LoS is provided within **Table 7**. Desired LoS are included in the detailed breakdown in **Appendix D**.

Table 7: Summary of Desired Technical LoS

Goal	Desired Levels of Service Highlights
Protect the Environment	• Review and implement all quality, volume, and flow rate modifications and monitoring requirements based on sub-watershed studies. • Sewers, catch basins, OGS units, and stormwater management ponds are inspected and cleaned at an optimal frequency.
Adequate and Sustainable Funding	• Funding comes from a long-term, sustainable source that ensures resources, staff, and equipment necessary to deliver desired LoS.
Capacity to Protect Life and Property	• Design criteria for all developments are defined and achieved. • Modelling is used to review and update design criteria • Private damage caused by stormwater is limited to properties located within the flood plain. • Passage is maintained on arterial roads 100% of the time. • Existing developments are modified with available funds.
Safe and Productive Workplace	• Zero accidents. • Continue successful record of compliance with regulatory requirements. • Complete preventative maintenance program each year. • Define and track all stormwater O&M activities.
Satisfied and Informed Customers	• Review and track call center data. • Outreach during public facing projects, such as sub-watersheds studies.
Meet Service Requirements with Economic Efficiency	• Meet all service requirements. • Strive to improve the efficiency of how requirements are met.

3.2.1 Lifecycle Activities Supporting Desired Level of Service

Table 6 began the process of linking activities to the technical LoS the City provides for its stormwater assets. Many of the same activities apply to the desired level of service, but adjustments to the achievements of the activities are required. There are also new activities that need to be introduced to achieve desired Levels of Service. This is summarized in **Table 8**.

Table 8: Activities Supporting Desired Technical LoS

Lifecycle Activity	Activity Type	New Activity for Desired Level of Service	Adjustments from Current LoS Required
End of Life Replacements	Capital	-	✓
Storm Structure Reconstructions		-	✓
Culvert Replacement Program		-	✓
Homeowner Culvert Replacement Subsidy		-	-
Storm Sewer Lining and Trenchless Repairs		✓	-
Storm Pond Sediment Dredging		✓	-
Ditch Inspections	Operational	✓	-
Mechanical Ditching		-	✓
Screens and Inlet Inspections		-	✓
Culvert Inspections		-	✓
Culvert Maintenance		-	-
Culvert Resets		-	-
Culvert Cleaning		-	✓
Culvert Snow Removal		-	-
Storm Structure Cleaning		-	✓
OGS Maintenance (Inspect/Clean/Repair)		✓	-
Pond Maintenance		✓	-
Storm Sewer CCTV		-	✓
Storm Sewer Flushing		-	✓
Storm Sewer Repairs		-	✓

From **Table 8**, it is clear that moving towards the desired LoS means that changes to current capital and operational practices are required, with the overall goal of providing sustainable capital, operations and maintenance program that meet service requirements. To address these changes beyond the conceptual level, a detailed breakdown of the recommended O&M and capital improvement activities is discussed later.

Refer to **Appendix F – Technical Memorandum #3: Levels of Service** for additional information.

4. Asset Management Strategy

The primary purposes of the asset management strategy are to describe the organization's long-term requirements, provide a clear rationale for these objectives (explaining how they align with asset management policy and the strategic plan), and provide the framework for developing and prioritizing detailed asset management plans. For the Stormwater AMP, the methodology included the development of components that could be combined as a strategy to produce the AMP. The enabling components of the overall strategy were:

- Establishing asset data needs that will support planning, analysis, decision making, and performance measurement. Improving asset data is built into both capital and operational work streams.
- Using risk as the basis for tactical asset management and a driver for decision-making in the face of limited funds to create prioritized work program.
- Emphasizing the need for preventative operations and maintenance program that extend the life of the assets, maintain a state of good repair, improve Levels of Service, and create opportunities for field-based data collection.
- Carrying out a capital improvements program that uses condition data to renew the system at funding levels aligned with the rate at which the system is aging.

When combined, these components of the strategy allow for O&M and Capital Improvement Plans to be produced, which represent the total cost of maintaining the existing stormwater network while meeting service requirements. The Plans incorporate the AM strategy elements to ensure that they are technically sound, strategic, and aligned with core City values. See the O&M and Capital Plans in **Section 5** and **Section 6 r**espectively.

4.1 Asset Data

Data is the core of any asset management program. The City has made significant efforts to improve its data holdings, an effort that will continue going forward with the implementation of the stormwater AMP. Data will support all levels of asset management, including financial planning, defining and measuring Levels of Service, assessing and managing risk, programming and reviewing maintenance activities, and applying decision making in support of capital improvements. Technical Memorandum #1 (see **Appendix A**) summarizes the City's existing information databases and outlines recommendations for filling any notable gaps

The strategy for the stormwater AMP and the proposed O&M and capital improvement programs are underpinned by the assumption that the City will continue to improve its asset inventory, data capture, and use of data for asset management. A detailed asset information strategy was developed for the City that identified a series of measures that could be taken to improve on the current state. To summarize:

1. The City will work to expand the current asset inventory within GIS to include rural roadside ditches and driveway culverts. Within the overall inventory, it will define asset ownership (e.g. public versus private) and roles/responsibilities, with the goal of having an awareness of the entire AM system. The addendum to Technical Memorandum #1 (see **Appendix B**) provided the results of the GIS update that was completed as part of this asset management plan.
2. The City will continue other stormwater management efforts that produce data applicable to the AMP. This includes stormwater modeling and sub-watershed studies, which can be used to define Levels of Service, risk profiles, investment needs, etc.
3. The City will conduct asset inspections as part of its O&M and capital improvement plans to build condition information. Lifecycle activities related to condition (e.g. rehabilitation/replacement/failures)

and CCTV condition data will also be recorded. The information will be used to update long term investment profiles, which are currently based on installation date information only, and to update the current risk-based approach (which uses age only).

4. The City will improve the use of its existing CMMS to capture asset level activity data for all maintenance activities. It will categorize the maintenance activities as preventative or reactive and ensure that activities are quantified using asset-level units of attainment (e.g. metres or number of assets). The City will use maintenance data to update and improve the AMP and facilitate future maintenance planning.
5. The City will engage in larger efforts to share stormwater data with water, wastewater, and roads staff to facilitate integrated corridor decision making with the assistance of decision support software.

When combined, current data and future efforts will facilitate the use of asset data in all AM activities, while engaging in processes of continual improvement based on key performance indicators. Technical Memorandum #7 (see **Appendix H**) provides an overview of the role of asset management software, establishes the current state of how software is used to support asset management and data management at the City, and suggests ways to improve upon the current state of data management through a combination of technology and business processes.

4.2 Risk

Many municipalities, including the City, must work hard to balance priorities as demands increase and resources remain limited. This creates several strategic challenges when planning for asset replacement. Accounting for asset risk facilitates the development of management strategies and prioritized replacement schedules so that risks can be balanced against budget constraints while the most critical assets are still triggered for rehabilitation and/or replacement. In addition, understanding the risk exposure for a given set of assets allows the City to identify where the organization is most exposed, and to target strategies to most effectively reduce that exposure.

During the development of the AMP, risk or criticality was calculated for each asset in the City's inventory as a function of the asset's consequence of failure (CoF) and likelihood of failure (LoF); each of which were measured on a 1 - 100 rating scale. CoF scores were assigned in consultation with City staff using a blend of qualitative and quantitative frameworks. In both cases, the CoF score generated recognised the potential environmental, public safety, worker safety, equipment, and operational impacts, with severity of the criticality ranging from "Low" to "High". Conversely, LoF scores considered the asset's age, expected service life, and used Weibull Probability Distribution to act as a proxy to condition due to limited records of condition assessment data for linear stormwater assets.

The risk values defined for assets enable the City to identify management strategies for the different risk categories based on the City's risk tolerance. **Figure 7** shows a sample intervention plan in matrix form.

Likelihood of Failure		Consequence of Failure: Low	Consequence of Failure: Medium	Consequence of Failure: High
	High	Repair / Run-to-Failure	Programmed Rehabilitation	Urgent/ Corrective Rehabilitation
	Medium	Inspect, Monitor and Forceast	Proactive Assessment	Programmed Rehabilitation
	Low	Inspect, Monitor and Forceast	Inspect, Monitor and Forceast	Proactive Assessment

Figure 7: Risk Matrix Intervention Plan

4.3 Operations and Maintenance Strategy

4.3.1 Background

Operations and Maintenance (O&M) describe the principal activities taken by the City to control assets in a manner that allows them to deliver the necessary outputs to the City. How the City uses and maintains the assets can impact performance, reliability, and productive life. Effective asset management involves co-ordinating plans and activities across the life cycle of an asset to maximize value. The operations and maintenance of the asset will account for a significant amount of the cost during an asset's lifecycle. In the case of the City's stormwater assets which do not expend labour, energy or materials when in operations, most lifecycle activities will be attributed to inspections, cleaning, and maintenance. **Figure 8** demonstrates the different stages of an asset's life cycle.

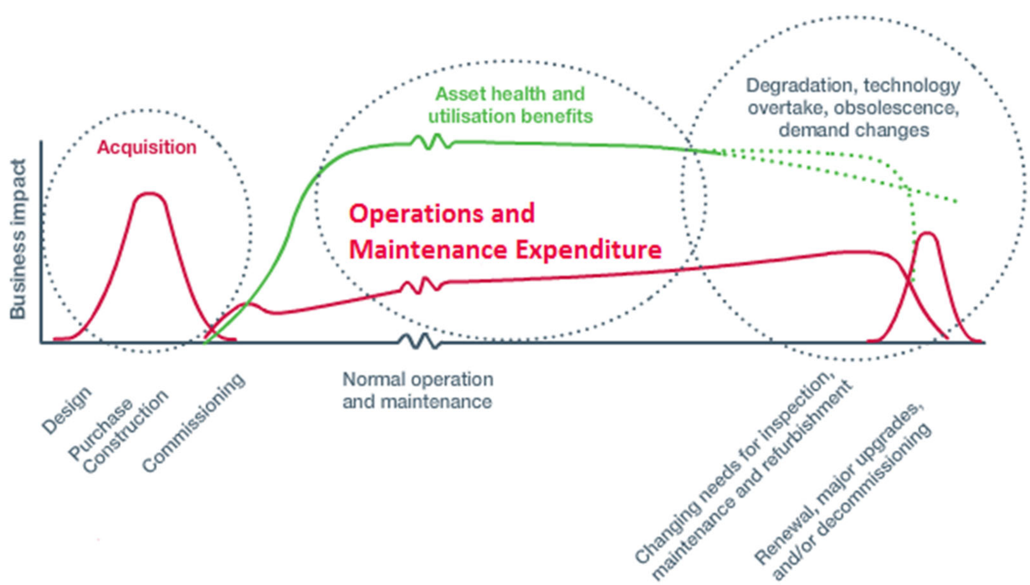

Figure 8: Capital and Maintenance Expenditure during an Asset Lifecycle

Every organisation has a variety of stakeholders, such as residents, businesses, staff, regulators, suppliers and the local environment. These groups have a variety of interests and priorities, so the organisation needs to find the best value compromise between conflicting interests. Realizing value, therefore, involves finding the optimal mix of factors such as costs, risks, and performance, while considering the longer-term consequences of a given approach. In the context of asset management, understanding and optimizing O&M serves as a critical component of managing the asset portfolio. Good maintenance planning and maintenance management is a vital component of asset management. Ultimately, a system of infrastructure such as the City's stormwater system requires O&M practices that achieve the following:

1. Maintains infrastructure in a state of good repair
2. Ensures the stormwater system performs as designed
3. Ensures public safety
4. Maintains high customer satisfaction
5. Protects the environment

Beyond these primary objectives, operations and maintenance should be executed in a cost-effective manner. Formalizing an optimal O&M program is the practice of analyzing, defining, and monetizing the O&M practices that will actualize these objectives. Completed successfully, annualized savings may accrue from some or all the following:

1. Reduced cost of individual work orders through better planning and execution
2. Reduced levels of overtime and premium pricing of equipment and materials
3. Extended useful life of assets, thereby reducing the need for replacements and capital reinvestments.
4. Better and more predictive O&M planning, as past year results feed directly into the forecasting of workloads and budgets for the future.

4.3.2 O&M Planning

One of the core objectives of this study is to develop an operations and maintenance (O&M) model for stormwater assets that will allow the City to identify best-practice maintenance activities and forecast the cost and resource impacts of various O&M strategies. For that purpose, AECOM has developed an O&M model that aligns the asset inventory with existing O&M activities categorized by the City's work management system and proposed new activities defines activity frequencies, and quantifies annual costs based on local context and best practices.

When planning for O&M, two types of work can be considered - preventative and reactive:

- *Preventative Maintenance (PM):*
  Preventative maintenance is regularly scheduled, periodic maintenance activities that are proven to prevent assets from failing or that result in timely defect identification. These activities are defined in advance through sources that include asset manufacturer recommendations, operator knowledge, and generally accepted best practices. PM work can be forecasted in advance, and the cost to complete PM work can also be forecasted and ideally budgeted in advance. The general assumption of PM work is that completing this volume of work reliably is the most cost-effective way to minimize the occurrence of unexpected asset failures that can result in loss of service, costly repair work, increased risk exposure and reduced service life. Failure to complete PM work exposes the utility to risk associated with asset failures and results in reduced efficiency as unanticipated corrective work volumes increase, further disrupting work schedules. One of the most important key performance indicators for utility maintenance is the attainment percentage of PM Work Orders over time. Low

levels of PM attainment could result in higher levels of service outage risk and is an indicator that the utility is operating in a more expensive, reactive manner.

- *Corrective Maintenance (CM):*
  Corrective maintenance is work that is required to respond to the failure of an asset or responding to a condition that has or will soon result in a loss of service. Corrective maintenance will always account for a portion of maintenance work. While the year to year volume of corrective work can be generally estimated (based on historical trends), it is not possible to predict when and where the work will be required. Corrective maintenance can be further broken down into emergency corrective maintenance and regular corrective maintenance. By making this distinction, the reactive impacts of corrective “break-down” work can be minimized, resulting in higher levels of maintenance efficiency.

The focus of this study was on the preventative maintenance, as it was assumed that corrective maintenance would be conducted on an ongoing basis, as required.

For each activity that was suggested (recall the activities linked to desired LoS), AECOM developed activity unit cost and resource requirements for each activity, which can then be used along with asset quantities and attainment levels to forecast costs of program adjustments. The activity costs were based upon existing information within CityWorks, and interpolation for the activities that are currently not tracked at a detailed level. It is recommended that the costs be refined based on actual costs in the future.

The activity and cost information was assembled while linking Levels of Service and consulting best practices (including the National Water Wastewater Benchmarking Initiative) to produce an O&M Plan (**Section 5**).

4.3.3 Implementation

The O&M planning process served as the basis for a new understanding of how stormwater O&M should be programmed and how it supports asset management and Levels of Service. The City already has a robust O&M program in place that will serve as a strong foundation for implementing the proposed improvements. A few key observations from the O&M planning process inform the suggested implementation:

1. In most cases, the City already conducts the prescribed stormwater O&M activities at some level of attainment: many proposed changes are changes in attainment levels or activity frequency only.
2. The City relies on a massive ditch network for drainage that is not fully inventoried or proactively maintained. The key gap in current practices is an awareness of the ditch network, which is serviced but only mostly in response to flooding issues.
3. Current practices and business processes associated with the City's use of CityWorks is not adequate for the envisioned O&M program, which assumes the use of computerized maintenance management to measure activities performed for each asset and track associated costs. Without this technological support, it is difficult to determine the status of individual assets or the achievements of the overall program.
4. Most O&M activities are driven by knowledgeable operators and City staff, but not all of this knowledge is documented. Documented known problem areas and risk-based approaches to maintenance are needed to optimize the assets that are proposed within attainment levels selected by AECOM.

Understanding these realities, implementation of the O&M strategy needs to provide a path from current to desired states of the program.

4.3.3.1 Adjusting Attainment Levels

The assumptions under the desired preventative maintenance program is that this level of preventative maintenance will help to minimize the City's risk exposure such that all catchment areas have a plan that meets required levels of service and ongoing regulatory requirements over the long term. It is recognized that enhancement to the current maintenance program will need to be incremental over time as it is not reasonable to modify the current preventative program so significantly in a short period of time. The preferred approach to enhancing the preventative maintenance program will be therefore to address the most critical assets / activities initially and expand to less critical assets / activities when possible. As such, **Figure 9** illustrates the proposed phased implementation which focuses on meeting the desired future targets on high priority preventative maintenance activities (for critical assets), along with the current preventative maintenance attainment levels for medium and low priority activities.

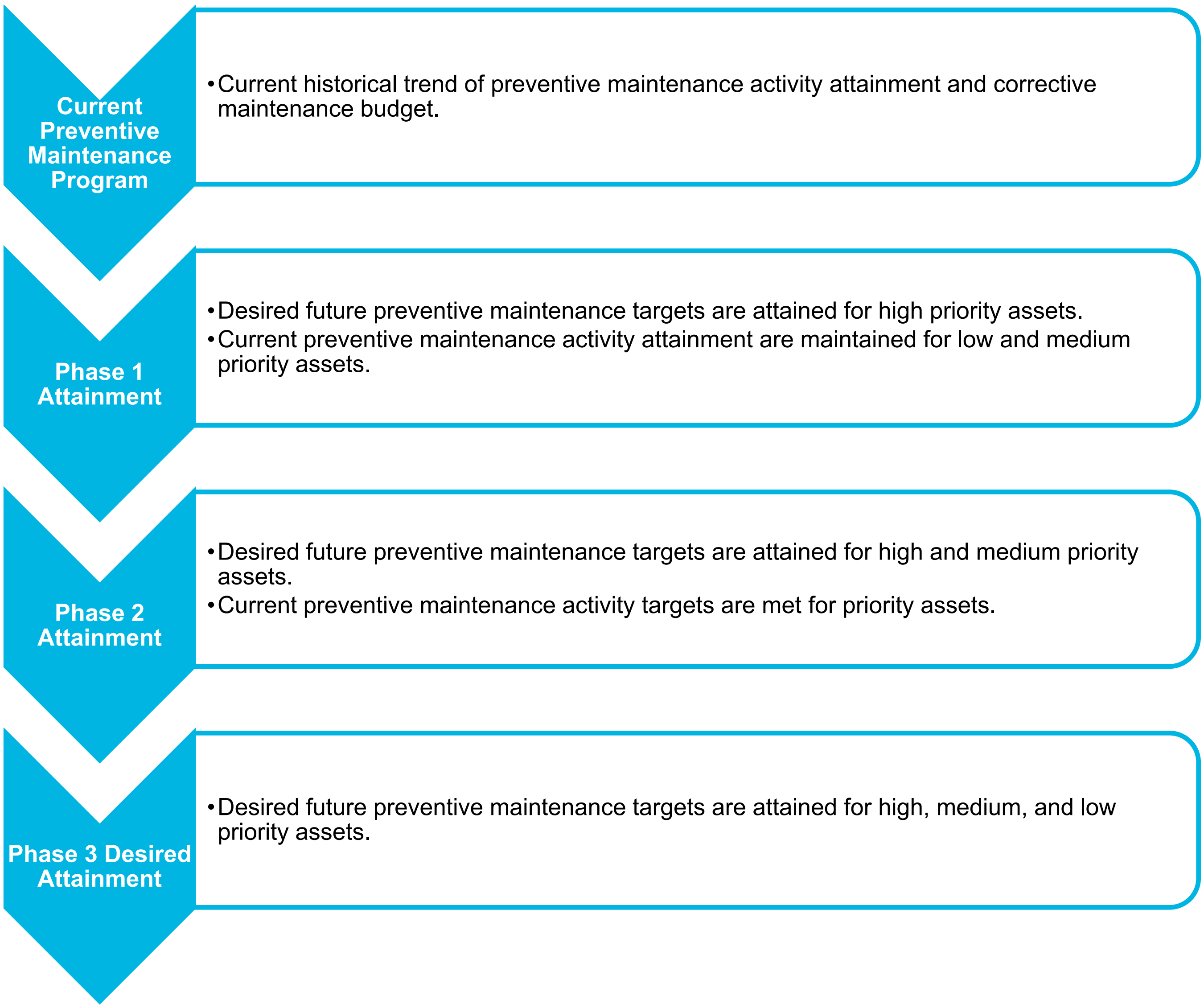

Figure 9: Recommended Phased Approach to Maintenance Funding

It is important to note that as additional activity-based data becomes available through implementation and tracking of various maintenance activities; the desired preventative maintenance targets should be reviewed. The O&M framework developed by AECOM did not optimize using criticality due to condition data being mostly unavailable. However, the City has tools to plan the O&M program as well as to employ risk-based decision making for both capital and O&M programs. It is envisioned that the City work to build a maintenance planning process that incorporates O&M data, failure histories, maintenance records, and risk profiles. At a high level, AECOM envisions a structured and risk-based maintenance management program as one of the outcomes of incorporating risk and failure data (**Figure 10**):

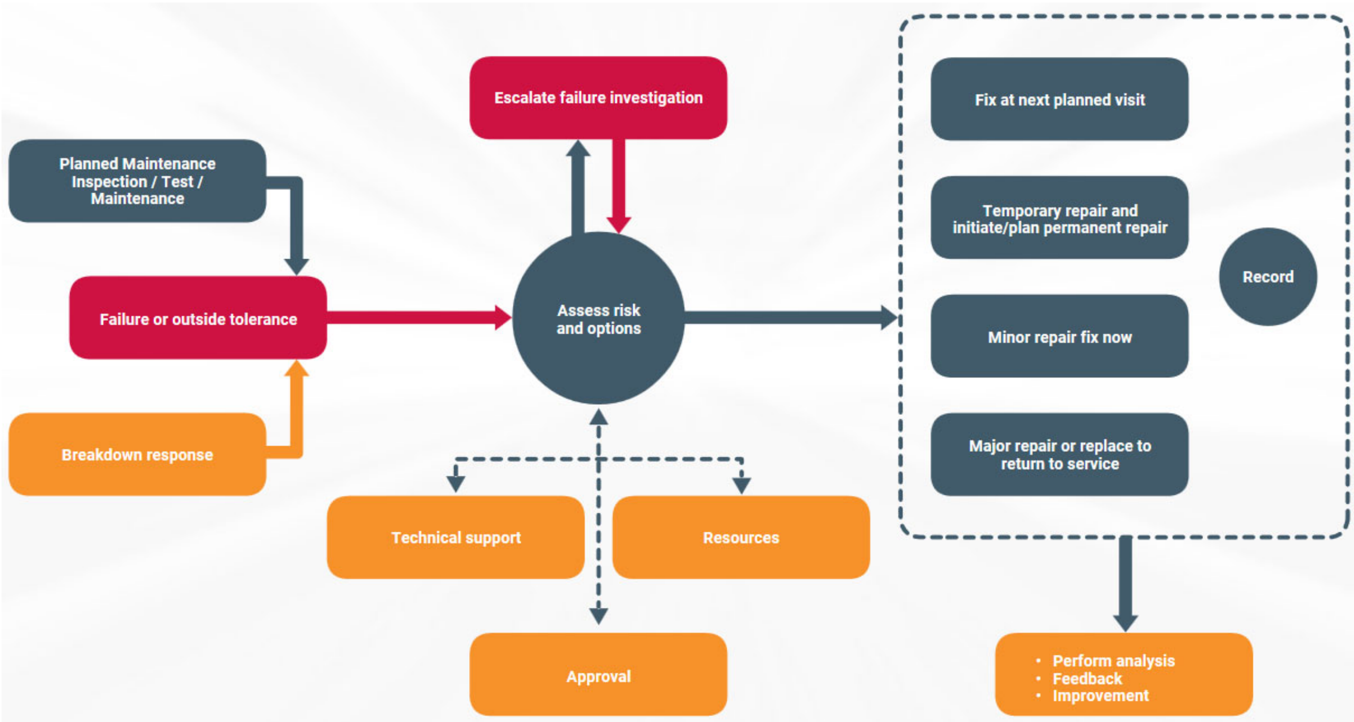

Figure 10: Incorporating Risk within the Maintenance Planning Cycle

4.3.3.2 Computerized Maintenance Management, Activity Tracking, and Performance Measurement

The current use of the City's CMMS (CityWorks) has the potential to limit the achievement of the O&M strategy. At present, work orders can be generated within GIS but activities for individual assets cannot be tracked. The City needs to deploy field-based data collection tools and procedures to record asset activities (preventative and reactive) for each asset. When the new O&M program is implemented, it is important that the City's CMMS and performance measuring are configured to track the attainment of O&M activities as measured by asset quantities and tracked back to the individual asset. To do this, the City also requires a complete asset inventory: the AMP identified that the ditch and culvert inventory is complete within the extent of the City's as-built drawings, but there are large rural areas serviced by ditches and culverts that are not in the inventory. These assets need to be accounted for so that O&M requirements can be accounted for and results measured.

4.4 Capital Improvements Strategy

4.4.1 Introduction

A capital improvement strategy sets out the approach to planning capital activities. Capital improvements describe major activities required to rehabilitate or replace existing assets in response to an asset failing to deliver on its service objectives. Improvements are typically required when there are deficiencies within the asset caused by age or operating conditions and should be managed through the risk assessment process. Other drivers of capital improvements could include inadequate performance by design, or regulatory related requirements. The City is currently undergoing a series of "sub-watershed studies" which examine the performance and capacity of the drainage system and will also address performance related issues and capital upgrade requirements.

The City's approach to capital improvements is guided by its Asset Management Policy. Here, it is stated that:

- Strategies should reflect levels of service expectations
- Rehabilitation and construction projects should be prioritized to support budget planning

This aligns with the approach taken for this Stormwater AMP.

4.4.2 Renewal Timing

When estimating the timing and scope of infrastructure renewal or replacement there are many factors to consider. The right time for asset replacement will depend on expected levels of service including reliability, the ability of an organization to adjust maintenance schedules for unplanned repairs, and capital budget. Each of the following criteria should be assessed when determining whether an asset should be replaced.

- **Criticality:**
  A highly critical asset should be replaced before failure, while some non-critical assets can be run to failure and replaced as required.
- **Condition:**
  What is the asset's current condition and what level of refurbishment can be achieved through maintenance.
- **Functionality:**
  Design and operating conditions. A bad design or poor material selection may reduce reliability or condition of an asset, triggering the need for premature asset replacement.
- **Budget:**
  Resources (funding and staffing) available to complete the project(s).

4.4.3 Strategies

For each stormwater asset class, a capital improvement strategy was devised that reflected the current state of asset data, the age and risk profile of the assets, and available options for renewal or replacement. This generally comprised of an Inspection Strategy and a Rehabilitation Strategy, that when combined would guide the City on how to complete capital improvements.

4.4.3.1 Inspection Strategies

All assets require inspection data that support the needs assessment and business case before carrying out any capital improvements. Within the assets that do have condition data, it is assumed that risk-based prioritizations will help to select the assets programmed for replacement. This identifies the need for data driven work streams supported by inspection program.

When considering storm sewers, structures, ditches, driveway culverts, road crossing culverts, and storm management ponds as a collection of assets, it is clear each will require a separate inspection strategy. This is summarized within **Table 9**.

Table 9: Summary of Inspection Strategies

Asset Class	Inspection Strategy	Link to Capital Improvements
Gravity Sewers	• Prioritize baseline inspections based on Consequence of Failure. This will typically begin with the City's main transportation corridors and the largest sewers. • Deploy CCTV to establish the types of defects and the overall condition. • Work to establish baseline conditions for the entire system. • Update risk profiles based on condition information. • Schedule subsequent inspections based on system risk (likelihood of failure can be determined by the previous inspection(s)).	• Age is not an indicator of replacement needs due to the deterioration mechanisms for sewers. • Defect codes can be translated to viable repair methods. • Condition data ensures the selected assets for replacement are appropriate. • Proactive inspections ensure sewers are repaired and failures are avoided.
Storm Structures	• Operators will visit the storm structures as part of annual cleaning program(proposed). Site visits should be leveraged as opportunities to record visual condition observations using field data collection tools. • O&M Plan includes some targeted inspections that assume the use of a risk-based methodology and greater inspection detail than regular O&M.	• Condition data allows for targeted repairs when need is identified by inspections. • Inspections are largely opportunistic but provide valuable information for capital improvements.
Culverts	• Meet legislative requirements for the City's largest culverts (>900 mm) based on OSIM protocols. • Apply same approach as storm structures for medium culverts (450-900 mm). • Use customer complaints about driveway and small culverts (<450 mm) to build on inspection data.	• Driveway or small culvert replacements are often managed operationally but are still a renewal of the asset lifecycle. The inspection information and the renewal information should be used to inform the state of the City's culverts and future renewal needs.
Ditches	• O&M program proposes proactive inspections of the ditch network, including completing the GIS inventory.	• Ditches do not need to be "replaced" but may need to be regraded and can typically be managed operationally. Inspection and condition information should still drive maintenance renewals.
Stormwater Management Ponds	• Stormwater Ponds will require renewal of the assets within the footprint (e.g. structures, vegetation, fencing etc.) as well as dredging of the storage basin. • Stormwater Pond condition assessments shall be used to document condition of facility assets. • Bathymetric surveys should be used to determine sediment accumulations.	• Bathymetric surveys and environmental monitoring can be used to trigger dredging projects that "reset" the capacity of the storage basin. • Multiple inspection data points can be used to calculate a time-based sedimentation rate, which will improve the accuracy of forecasting future dredging needs.

Over time, the City can use the outputs of the inspection strategy to improve and refine its approach to capital improvements. This is summarized within **Figure 11**, which shows the progression of approaches that can take place as the City builds on the Stormwater AMP.

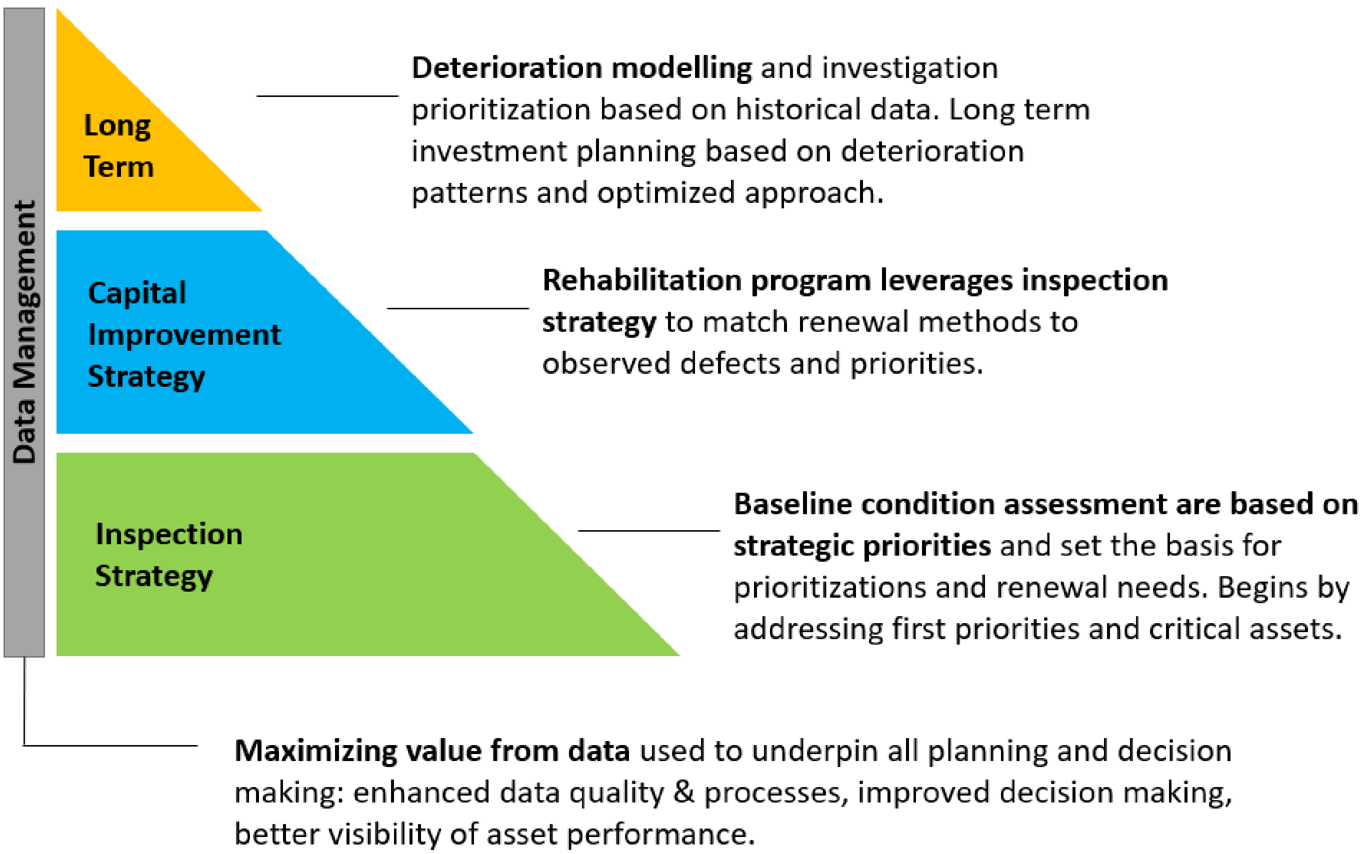

Figure 11: Advances in Capital Improvements are Dependent on Data Management and an Inspection Strategy

4.4.3.2 Rehabilitation Strategies

Rehabilitation strategies describe the decisions the City can make when selecting assets for renewal or replacement – while all assets will age and require renewal over time, the City can still make optimized decisions when presented with numerous defects and limited funds to address them.

- **All Assets**

  Focus should be made on proactively carrying out the rehabilitation of assets with a strong cost/benefit ratio or high strategic priority. Given a budget constraint, all actions should be ranked according to risk, and needs are funded in this order until the budget constraint is reached for given funding period. All unfunded needs would then roll into the set of needs for the next period, at which point the risk prioritization would be re-evaluated. This is illustrated in **Figure 12**.

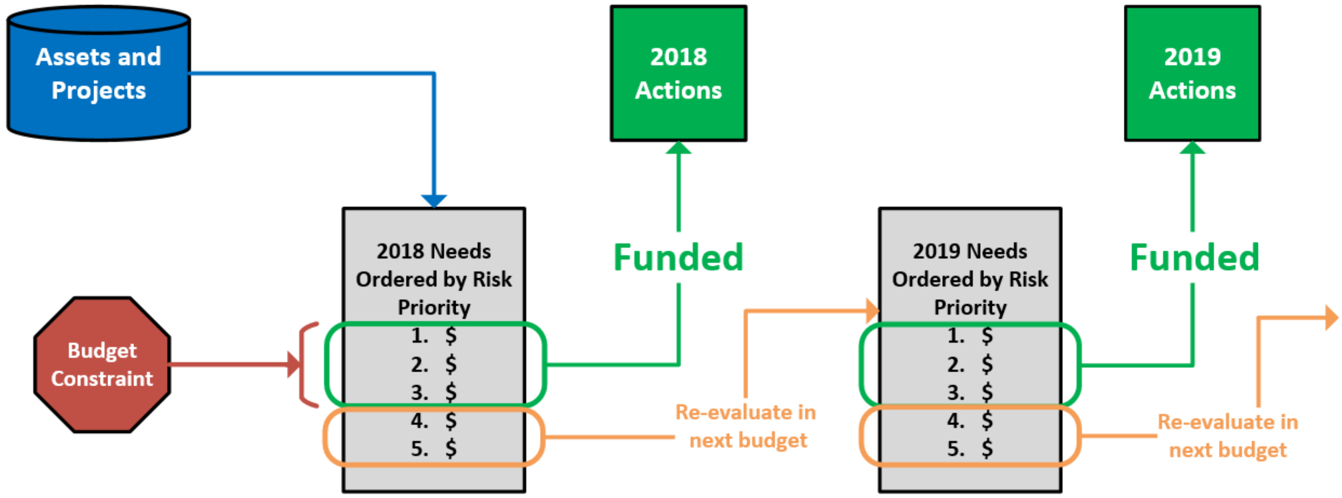

Figure 12: How Risk is Used to Prioritize Annual Asset Renewal and Replacement Spending

- **Gravity Sewers**

  To maximize the utility of the condition assessment process, the rehabilitation strategy recommends that the treatment of each sewer be matched to the type of defects that are observed. In this way, a wider range of repair techniques become available with a wider range of costs and levels of pavement disruption. Such a rehabilitation strategy will reduce the use of full segment replacements, thereby potentially extending useful life and reducing lifecycle cost. Rehabilitation techniques considered by the strategy included stabilization, lining, trenchless point repairs, external point repairs, augmented lining (point repairs followed by lining), and full segment replacements. The technique selected will also depend on co-ordination with other asset renewal projects (e.g. sanitary sewer replacements and road reconstruction works).

- **Storm Structures**

  The rehabilitation strategy for storm structures focuses on opportunities for rehabilitation that are opportunistic or driven by inspection data, while ensuring that the system is operating safely. Because portions of a storm structures are located at the road surface, surficial rehabilitation activities (e.g. manhole lid resets) may be carried out independent of a storm sewer rehabilitation work stream (which seeks to maximize the use of trenchless rehabilitations and minimize pavement disruption/full segment replacements). The State of the Infrastructure established that on the basis of age and expected service life, storm structures are predicted to account for a significant portion of the City's backlog (i.e. assets that are past their expected service life). As this is only based on age, this "backlog" would need to be confirmed through condition assessments. In addition, the estimated structures "backlog" his does not account for the City's ongoing roads operations, which often reinstate or replace storm structures through operations and road surfacing. These activities are logged within invoices and other methods of financial reporting but are not documented at the "asset level". It is recommended that the City begin to log these activities to ensure that investments in infrastructure are fully recognized and future forecasts can be improved.

- **Stormwater Ponds**

  Rehabilitation of stormwater management ponds requires planning for the dredging of sediment for quality and quantity control purposes and maintaining the appurtenances of the facility that provide conveyance or other supporting functions. Removing sediment from a stormwater facility can be a significant expense. Predicting when it needs to occur can be estimated through regular sediment measurements to determine an "average sedimentation rate" and then determining when the basin's capacity is reduced to the point that it can no longer provide sufficient detention to fulfill its regulatory requirements (or design standards). The cost of dredging will be dependent on the size of the basin, the amount of sediment to be removed, environmental considerations (i.e. the presence of aquatic life), the need for bypass pumping, the level of contamination within the sediment, and the distance required to travel to dispose of the sediment.

- **Ditches**

  Ditches are open channels that convey stormwater. They are typically not "replaced" as a pipe would be replaced but will need to be cleaned out and regraded from time to time. The cost associated with maintaining ditches is an operational expense captured by the formalized O&M plan. However, the roadside culverts in line with ditches have a finite service life that should be managed by a replacement strategy.

- **Culverts**

  Due to a short-estimated service life, corrugated steel pipe (CSP) culverts currently occupy a significant component of the City's current backlog. While the City has reported that CSP will be replaced with more durable materials within the sewer system, the use of CSP for culverts will continue due to its exposure to the environment and depth of cover. At present, the lifecycle analysis of culverts is based on a collection of original installation date information, which does not account for any repairs made by City roads operators (an active program) as well as those by homeowners along roadsides. Given the assumed age of the inventory and City observations about expected service life, it can be assumed that some culverts have already been replaced. If no action had been taken, the City would face a significant backlog as demonstrated by the State of the Infrastructure report. The inspection strategy is predicted to help address this issue by documenting the current condition of the assets.

  The culvert replacement strategy is further complicated by the varying owners of culverts. The roadside culverts in the City's stormwater system are either owned by the City or by homeowners. Private culverts are the responsibility of the homeowner to replace, but the City offers two methods of assistance:

  - The City can replace the culvert at cost to the homeowner. The City provides materials and schedules the work for the homeowner. The City will also replace the culvert free of charge if it heaves within one year of installation;
  - The culvert can be replaced by a private contractor, and the work will be inspected by the City. The City will subsidize the cost of the culvert based on the User Fees By-Law.

  While it is recognized that the cost of the City replacing private culverts can be recovered in part, the City still requires the resources to carry out replacement activities. Therefore, the capital improvement plan funding levels for culverts consider both City owned culverts and those in the inventory that are located underneath driveways. While the approach to replacing culverts and the cost incurred by the City may vary, it should be recognized that the private culverts are still part of the stormwater system and lifecycle activities need to be properly anticipated.

4.4.4 Decision Making

While the capital improvement strategies and plan can be considered the optimal approach for the Stormwater Asset Management Plan, this does not reflect the realities of most utility corridors within the city. Municipal rights-of-way are typically comprised of multiple systems of infrastructure assets including roadways, bridges, water, sanitary sewers and stormwater pipes, sidewalks, and chambers, to name but a few. This means having to manage a broad range of assets within a portfolio, with each asset deteriorating at a different rate and requiring interventions that often are not optimally coordinated to reduce cost and limit disruption to customers. When implementing the stormwater capital improvements strategy, the City will need to integrate the stormwater assets with the rest of its assets to perform integrated decision making. The capital improvement strategy emphasizes the need for trenchless and independent work streams for each asset class so the optimal interventions can be made, but the City will also need to consider the optimal solution when multiple interventions within the same corridor are plausible. The Stormwater Asset Management Plan recommends that the City adopt a decision support software tool to assist in this process.

Refer **Appendix E – Technical Memorandum #4: Risk & Criticality Assessment** for additional information.

5. Operations and Maintenance Plan

The City's approach to O&M is guided by its Asset Management Policy which states that maintenance practices should aim to "maximize asset lifecycle and reliability by carrying out interventions at the right place and the right time considering budgetary and resource constraints". The understanding of the City's O&M program and the overview of the O&M planning process used for the AMP shown in **Section 4** served as the basis for developing a full O&M Plan that shows the cost of the activities and proposed changes based on requirements for sustainability, industry best practice, or desired Levels of Service.

5.1 Current Practices

The City has Standard Operating Procedures (SOPs) for various maintenance activities for assets within it's existing O&M program. These SOPs provide a brief description of the objectives, step-by-step procedure, labour, equipment & material requirements along with quantities and operating procedure achievements. These SOPs can generally be categorized by asset class.

A line-by-line review of the City's SOPs was performed to identify existing activities that are applicable to stormwater assets. Refer to

Table 10 for a list of existing O&M activities that were included in the proposed O&M program. In some cases, the work order (WO) activity description titles were updated for the proposed O&M program for greater clarity.

Table 10: Existing Stormwater O&M Activities

Asset Class	Activity Code	WO Activity Title (Old)	O&M Activity Name
Roads	1941	Manual Sweeping	
	1942	Machine Sweeping - Summer	Machine Sweeping Summer - Arterial Roads
	1943	Intersection Sweeping	Cleaning Major Intersections Summer
	1945	Street Sweeping – Elephant Vac	
	1951	Street Flushing – Own Crews	Street Flushing Summer
	6141	Spring Cleanup - Manual	
	6142	Spring Clean Up-Catch basin	
	6143	Spring - Clean Up – Flusher & Sweeper	Spring Cleanup Machine Sweeping & Flushing - All Roads & Streets
	6144	Spring-Clean Up- Sidewalk Sweeping	Spring Cleanup - Sidewalk Sweeping
Ditches	4001	Mechanical Ditching - Spot (Own Crews) and Contract	Roadside Ditching - Rural
	4002	Roadside Ditching - Urban	
	4021	Manual Ditching - Backyards	
	4091	Other Ditching Maintenance	
	6041	Open Ditches & Catch Basins – Manually	Open Culverts - Manual
	6042	Steam Ditches & Catch Basins	Open Culverts - Steam
	6043	Opening Ditches - Mechanical	Open Ditches/Culverts - Mechanical
Culverts	4141	Bridge & Culvert Maintenance – Maintenance and Inspection	Culvert Inspection - Small < 400mm Culvert Inspection - Medium - 400 mm to 900 mm
	4311	Road Culvert Maintenance	
	4401	Culvert Maintenance – Roadway Culvert Cleaning	Culvert Cleaning
	4411	Entrance Culvert - Resets	
	4412	Culvert Maintenance – Entrance Replacement	
	4421	New Entrance Culverts	
	4591	Screens & Inlets Maintenance	Screens and Inlets Maintenance
Sewer	4501	Storm Drainage Repairs	Storm Sewer Repairs
	4521	Storm Drainage Clean and Inspect	Storm Sewer Flushing
Structures	4522	Storm Sceptor Cleaning	
	4551	Catch Basin / Manhole Cleaning	Catch Basin Cleaning Manhole Cleaning (2 separate activities)
	4561	Catch basin/Manhole Repairs<1FT	
	4562	Catch Basin/Manhole Repairs>1FT	

Not all activities within the City's stormwater SOPs are captured the same way in

Table 10. This is because existing O&M activities were slightly modified for the proposed O&M program. For instance, certain O&M activities specifying inspection and cleaning as a part of the same work order were split in to two different activities requiring separate work orders with specific achievements.

5.2 Proposed Program

In addition to activities defined by the City's SOPs, new activities were also developed for the recommended O&M program to meet the desired Levels of Service. **Table 11** lists recommended new O&M activities.

Table 11: List of New O&M Activities

Asset Class	WO Activity Title
Ditches	Ditch Inspection
Structures	Inspection (Catch Basins & Manholes)
	Open Catch Basins - Manual
	Leaf Pickup Program
Storm Sewers	Storm Sewer Inspection / Condition Assessment (CCTV)
OGS	Inspect Units (MH)
	Repair Units (MH)
	Inspect Units (Chamber)
	Repair Units (Chamber)
	Clean Units (Chamber)
Municipal Drains	Inspect Municipal Drains
	Other Maintenance – Beaver Trappings
	Mechanical Brushing
	Repair & Clean-Out
Facilities	Inspection
	Routine Maintenance
	Non-Routine Maintenance
	Stormwater Monitoring

The City's SOPs formed the basis to develop the proposed O&M framework for each stormwater asset class, with emphasis to labour, material and equipment requirements along with activity achievements defined in the SOPs for each activity and matching them with the standard rates provided by the City for developing activity cost estimates.

Activity 431-1 Road Culvert Maintenance

Description: Roadway Culvert Maintenance: This activity is used to repair road culverts including repairs to the road base when performed at the same time. It includes excavation, backfilling and repairing to the travelled surfaces. Any resurfacing with asphalt is to be carried out under the appropriate asphalt patching activity. Accomplishments are measured in linear metres.

Method: Roadway Culvert Replacement

Purpose: To maintain the flow of water in culverts by repairing defective culverts or by replacing culverts that are interfering with traffic such as when a broken, collapsed or heaved culvert is restricting the flow of water and causing damage to the roadway.

Procedure:

1. First generate and discuss traffic control and complete circle check. (15 minutes)
2. Break the surface with a backhoe and or hand tools to remove pipe and roll to one side.
3. Clean the excavation to allow new pipe to sit properly adding more bedding if required.
4. Place new pipe using any available stones to hold in place and backfill in and around the pipe with new granular material and compact in no more than six inch layers to the level of the remaining roadway.
5. Sweep excess to the roadside then load old pipe and any leftover material and then move to new site.
6. At the end of the shift, return to the yard and gas up and ensure all tools and equipment are cleaned.
7. Report any necessary repairs and hand in the complete crew card to the foreman.
8. At the back of the crew card, indicate where the work was completed by the street address or by some other reference point

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Suggested Crew Size: LABOUR

1 Lead Hand	8 Hrs
2 Truck Driver	16 Hrs
1 Equipement Operator A	4 Hrs
2 Utilityperson	16 Hrs

Suggested Equipment: EQUIPMENT

1 ¾ Ton Truck	4 Hrs
2 Multi Function Tandems	16 Hrs
1 Backhoe/ Loader	4 Hrs
1 Utility Tandem Trailer	8 Hrs
1 Solartech Arrowboard	8 Hrs
1 Backhoe w/ Hoeram	6.04 Hrs
1 Bomag/ Trailer (Double Drum)	1 Hr

Materials: MATERIAL

Granular A	22 Tonnes
Galv. Lockseam Pipe	16 Metres
Couplers Corrigated	2

Achievements:
16 Linear Metres

Figure 13: Sample Work Order Activity Description (SOP)

To achieve the WO requirements, the City also contracts out certain O&M activities (**Table 12**). However, most of these activities do not cover the entire asset inventory. For instance, Spring Cleanup Machine Sweeping & Flushing - All Roads & Streets, 75% of the inventory is contracted while 25% is managed in-house.

Table 12: List of Contracted O&M Activities

Asset Class	Activity Code	Activity Name
Municipal Drains	409-1	Other Drainage Maintenance - Beaver Trappings
Sewers	450-1	Storm Sewer Repairs
Structures	455-1	Catch Basin Cleaning
Culverts	459-1	Screens & Inlets Maintenance
Structures	614-2	Spring Clean Up-Catchbasin
Roads	614-3	Spring Cleanup Machine Sweeping & Flushing - All Roads & Streets

Upon defining the proposed O&M framework, the desired frequencies of O&M activities were determined based on industry best management practices to maintain service levels and develop the program O&M budget.

Appendix F describes the process for developing the O&M framework inputs, including the creation of new activity costs, and a fully developed proposed O&M framework that combines inputs to present a budget. A summary of annual budget requirements and gap analysis is presented below.

5.3 Summary

Bringing together the results of the proposed O&M program, the various changes can be aggregated to assess the total change in the proposed budget. The total proposed budget for stormwater O&M activities is $8.9M, compared to $6.8M that is spent currently on the O&M activities that were examined. Here, it is understood that the total budget for operators is currently larger than $6.8M, but that this includes activities that are being addressed in the capital improvement plan or not classified as stormwater. The budget will increase from $8.9M to $9.5M in later years following the transfer of sewer management activities from the capital plan to the operational plan (e.g. inspection and cleaning).

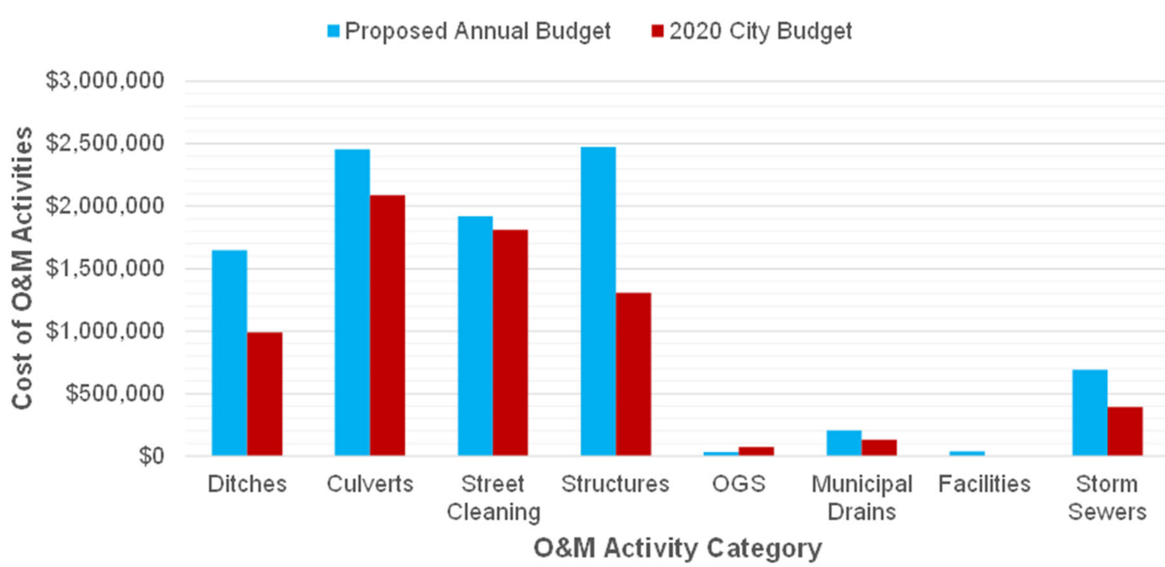

Figure 14: Existing and Proposed O&M Budget

As stated throughout the discussions of Levels of Service, O&M activities, and activity targets, the proposed budget represents the cost of maintaining a sustainable stormwater system. The major proposed changes to the budget include:

- Dedicated visual inspection program for ditches, culverts, and storm structures. These programs integrate the use of data gathering methodologies that can be used to determine maintenance planning.
- Improved sediment management through street cleaning, catch basin/manhole cleaning, and sewer flushing. The City does not currently perform sediment management at a level commensurate with the amount of road sand that is applied each year, leading to an accumulation within the system and the environment.
- Full consideration of assets not currently addressed by the O&M program, including ditches outside the GIS inventory and the introduction of new asset classes (oil grit separators, stormwater management ponds).
- Update to most activity frequencies to shift the outlook to a medium-long term, with an emphasis on the sustainability of the system and service levels.
- New structure of activities and breakdowns to facilitate modern maintenance management and analysis, as well as a shift from reactive to preventative works.

While capital forecasts can vary significantly from year to year, the O&M program is structured in a manner that allows funding to be predicted with relative certainty. Although requirements will vary from year to year, the use of activity frequencies to plan for medium to long term time horizons mean that expenses can be predicted with the proper planning. The O&M forecast is intended to align with the capital improvement plan, which covers the initial costs of sewer CCTV and flushing before shifting the expense to operations. This is summarized in **Figure 15**.

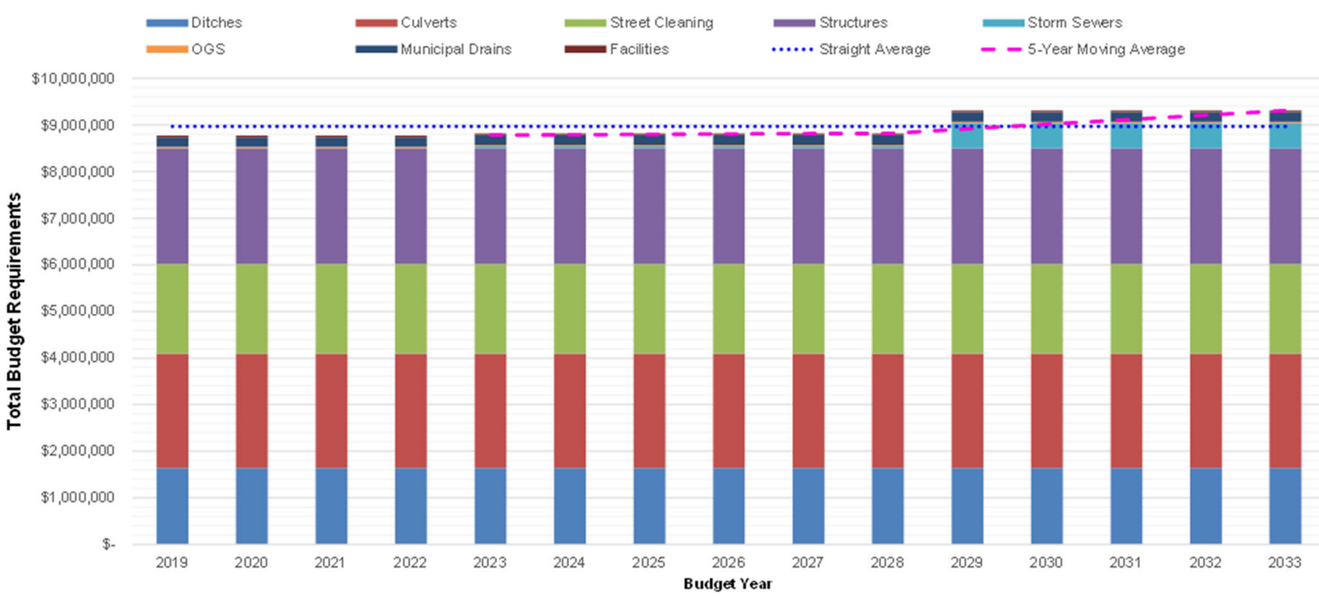

Figure 15: Annual Stormwater O&M Budget Forecast by Asset Class

Refer to **Appendix F – Technical Memorandum #5: Operation and Maintenance Plan** for additional information.

6. Capital Improvement Plan

Using strategies outlined in **Section 4**, the Capital Improvement Plan (CIP) provides the City with a series of asset-level plans that can be executed upon. Each plan, when paired with the underlying strategy, should provide key action items at the asset level with a scope, methodology, cost, and business case. Asset-level plans provide both items for immediate action and implementation, as well as longer termed insights into budget forecasting and plans for capital spending. Each asset-level plan highlights the proposed timescale. Many plans involve initial assessments that may lead to further activities. All plans provide the City with tools and the methodology to obtain the information required to take further actions in stormwater asset management.

6.1 Gravity Sewer CCTV Program

A CCTV program underpins the City's rehabilitation plans for gravity sewers and aims to first prioritize highly critical assets for inspection before working to establish baseline conditions for the entire system as prescribed by the inspection strategy. The timeline for establishing baseline conditions is suggested as 10 years. At a cost of $2.00 per meter (the City reported $1.54 per meter and a slight contingency was added), the cost of establishing baseline conditions can be summarized (**Table 13**):

Table 13: Summary of Camera Work Costs

Sewer Category	Total Length	Unit Cost	Total Cost
High Consequence of Failure	34.96 kilometres	$2.00 / meter	**$69,939**
Medium Consequence of Failure	75.92 kilometres	$2.00 / meter	**$151,853**
Low Consequence of Failure	347.75 kilometres	$2.00 / meter	**$695,501**

Flushing is a requirement for CCTV inspection when sediment and debris obstruct visual assessment of the pipe's internal wall for defects. The City uses a significant amount of road sand in the winter, which can impact the success of a CCTV inspection due to the accumulation in storm sewer pipes. At present, the City performs some sewer flushing through a combination of internal operations and contracted services. The City has reported that sewer flushing attainment levels do not always align with expectations as sewers are found to be heavily impacted with sand, which increases time needed for cleaning and reduces the overall quantity of cleaning that can be completed in a typical shift. In 2018, the City spent approximately $170,000 on storm sewer flushing.

Flushing is included in the CIP because of its alignment with the requirements for CCTV inspections. It is expected to be a significant expense that meets the definition of a capital activity. A larger level of effort will be required to flush all sewers prior to baseline inspections than what is required to maintain the sewers operationally. Once the buildup of sand associated with several years of limited/no flushing is removed, maintaining the "status-quo" on an on-going basis is expected to be less costly than what is proposed for determining the baseline condition over the next 10 years (back-log reduction). Based on historical costs reported by the City, sewer flushing is estimated to cost $30 per meter. This is much higher than what is observed in southern Ontario, where costs typically range from $10 to $20 per meter. The City reported contractors are currently paid by the hour rather than by the meter because of how long the flushing takes. **Table 14** summarizes the cost of flushing all City sewers, followed by a breakdown of proposed annual costs that combines camera work and flushing (**Table 15**).

Table 14: Breakdown of Flushing Costs for CCTV

Sewer Category	Length of Sewer	Unit Cost of Flushing	Estimated Fraction of Required Sewers	Total Cost
High Consequence of Failure	34.96 kilometers	$30 / meter	50%	**$524,541**
Medium Consequence of Failure	75.92 kilometers	$30 / meter	50%	**$1,138,900**
Low Consequence of Failure	347.75 kilometers	$30 / meter	50%	**$5,216,255**

Table 15: Proposed Timeline for CCTV Baseline Inspection

Year	2019	2020	2021	2022 – 2028
Program Cost	$628,000	$628,000	$628,000	$845,000 (annually)
Program Scope	**Baseline inspection – Priority Sewers (Medium + High CoF)**			**Baseline Inspection – Non-Priority Sewers (Low CoF)**

Upon completion of the CCTV inspection program, monitoring can be performed at a lower level of effort. As well, flushing becomes significantly less expensive due to backlog being addressed. For the remainder of the 30-year plan (2029 to 2047), these expenses become operational (*Refer* ***Appendix F – Technical Memorandum #5: Operation and Maintenance Plan*** *for additional details*).

6.2 Lining and Replacement Program

Using the proposed rehabilitation strategy, the City can begin to plan for rehabilitations and replacements using the outcomes of an inspection program. At present, the candidates for the program are only estimates based on age. In the future, using results of the CCTV inspection program, the actual condition of sewers can be used to further refine the capital improvements program.

Using available information, there are two main components of the capital improvements program:

- Replacing sewers that have reached the end of their service life. The State of the Infrastructure work suggests some sewers could be currently reaching the end of their service life. Until conditions can be verified with CCTV, the City should assume this is a replacement requirement. The lifecycle analysis can be used to suggest the required funding level. At a minimum, preparing for end of life replacements is a requirement for the City.
- Trenchless repairs are staged earlier in the asset lifecycle. By applying point repairs and linings, the structural integrity of the sewer can be maintained and the period where deterioration from infiltration and soil loss could be mitigated is maximized. This type of program is proactive based on CCTV inspection and is intended to minimize total lifecycle costs. Because data is not available to support the planning of this program at present, the cost of the program will be based on high-level assumptions.

The cost inputs for gravity sewer replacements are derived from the State of the Infrastructure work and are summarized in **Figure 16**. This serves as a high-level estimated forecast of replacement requirements in the absence of an understanding of the baseline condition of the storm sewer network.

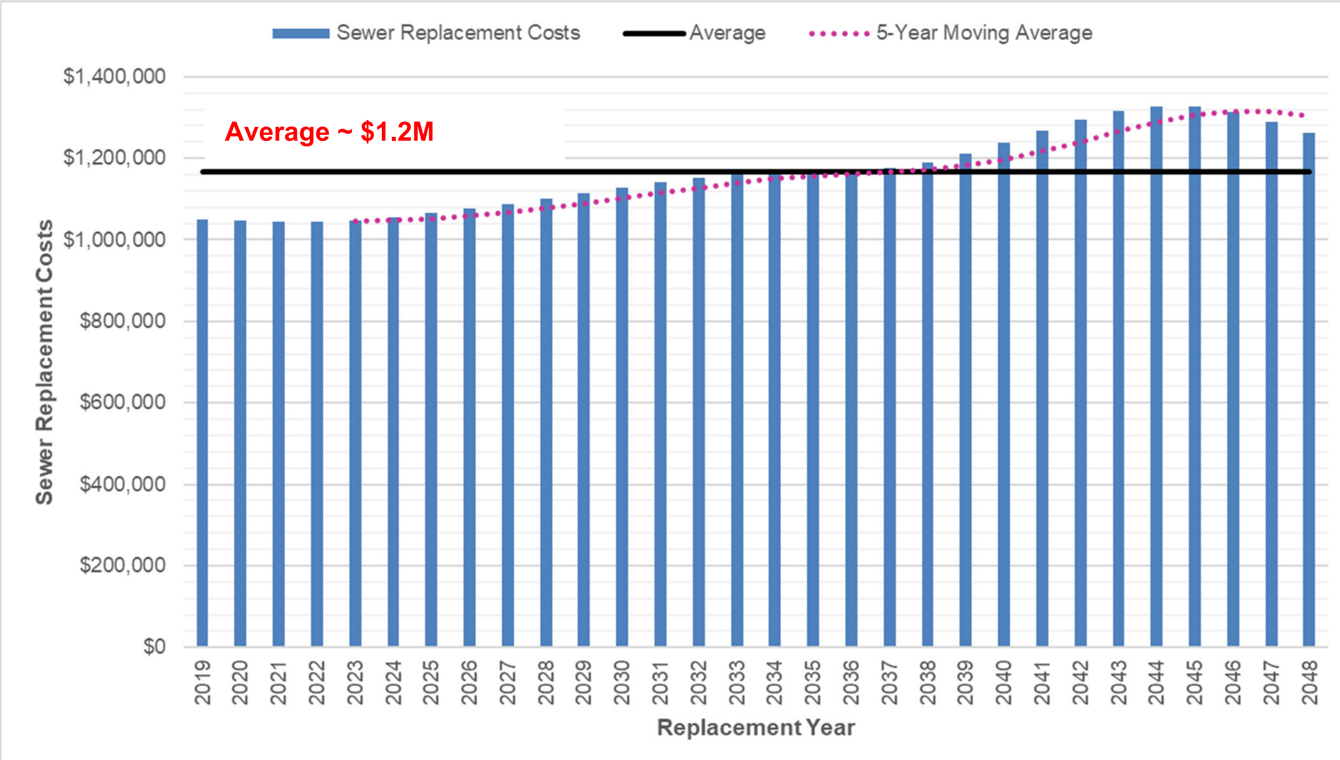

Figure 16: Sewer Replacement Costs from Lifecycle Analysis

As the City inspects sewers, it should have funds and resources ready to mobilize when defects are discovered. The discovery of defects is on-going as the CCTV program continues. To support budget planning, it is assumed that 5% of all inspected sewers will have defects eligible for trenchless repairs. It is further assumed that a lining will be used (as opposed to other trenchless technologies). Finally, it is assumed that the repairs for defects will be spread out over several years after the introduction of CCTV and continuing after baseline inspections are complete (approximately 10 years). These assumptions are significant and should not be relied upon once data becomes available but provides the City with a starting point. These assumed cost inputs are summarized in **Table 16**.

Table 16: Trenchless Repairs Budget, Inputs and Assumptions

Length of Sewer System	Assumed Quantity of Defects	Unit Cost of Lining	Total Cost of Defects	Years to Address Defects	Estimated Annual Funding Level
458,678 (m)	5% (22,934 m)	$450/m	$10,320,255	20	$516,012

Table 16 indicates that based on a series of assumptions, a lining program could cost $516,012 per year if the City were to address all eligible defects. This value has been rounded to $500,000 to avoid implying that estimates are precise or accurate, which they are not.

6.3 Storm Structure Replacement Program

Lifecycle analysis establishes the need to replace manholes and catch basins, which the State of the Infrastructure work estimated to have a shorter expected service life than gravity sewers. The State of the Infrastructure report notes that the cost of manholes was included within the cost of gravity sewer replacement candidates. Therefore, manhole replacements can be considered a part of the proposed budget for sewer replacements. While manholes were accounted for here, catch basins were not. The replacement of catch basins has historically been handled operationally by Roads operators, but it is proposed as having budget allocated through the CIP due to the scope and cost of the activity.

Using the results of lifecycle analysis, the proposed level of funding for catch basin replacements as a combination of backlog reduction (calculated as approximately $300,000 per year) and forecasted replacements was provided (**Figure 17**). The increase in cost by the end of the 30-year plan is attributable to a significant portion of the asset inventory reaching the end of their estimated service life based on age. Many catch basins were installed in the 1970s and 1980s and are estimated to have a 50-year service life.

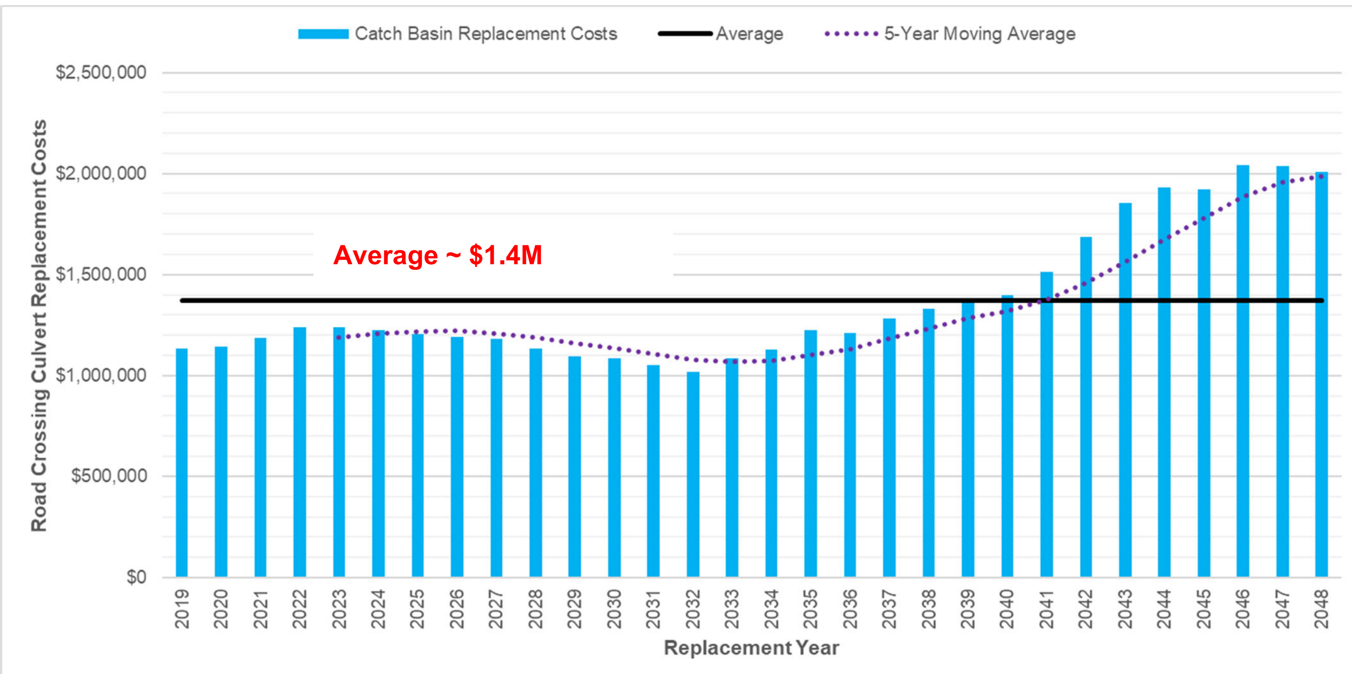

Figure 17: Catch Basin Replacement Costs for Lifecycle Analysis

6.4 Culvert Replacement Program

The combined observations about asset data (the culvert inventory within GIS is incomplete if you consider private driveway culverts) and the options for financing replacements (the City could replace its own culverts only, subsidize the cost and resources for private replacements, or assume the full cost of private replacements with the goal of full governance of the stormwater system) means that the funding levels for culvert replacements have a wide range of possibilities.

As a starting point, funding levels have been limited to culvert replacements for City-owned, road crossing culverts. The funding levels are based on an age-based assessment. It is assumed that all culverts (road crossing and driveway) will be inspected and condition will be documented as part of operations which could refine these estimates (**Figure 18**).

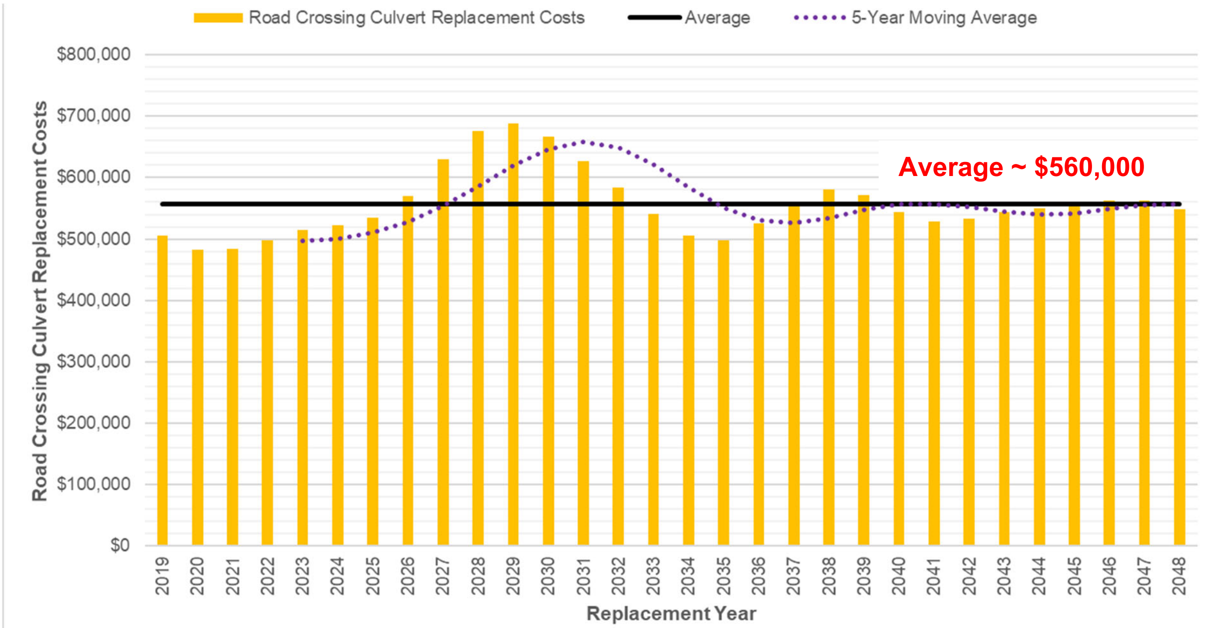

Figure 18: Road Crossing Culvert Replacement Costs

Roadside and driveway culverts occupy a significant component of the City's drainage system: the inventory is incomplete, and if private responsibilities are continued the City still needs to apply a governance framework and whole portfolio considerations. Given the size of the inventory, a full replacement program is estimated to cost millions of dollars per year. As a next step, the City should evaluate these financial implications as they apply to both the City and homeowners. Once some of the assumptions are verified, the City can select its desired approach to culvert management and budget the culvert improvement program accordingly.

6.5 Stormwater Management Pond Program

The Stormwater Management Pond program is a combination of detailed inspection and rehabilitation activities. They are periodic, which is why they are not covered operationally. Details about inspection and rehabilitation requirements are summarized in **Table 17** and **Table 18**.

Table 17: Summary of Detailed Stormwater Management Pond Inspections in the Capital Improvement Plan

	Stormwater Pond Condition Assessment	Bathymetric Survey
Description	A condition assessment is required once for each stormwater pond at a minimum. This process will inventory all assets within the stormwater pond site, establish their condition state, and identify any remedial actions. Since the City has limited knowledge of its ponds, this process is the starting point for stormwater pond management (at which point subsequent inspection/assessment activities can be handled operationally).	Bathymetric Surveys are an important part of the stormwater pond inspection strategy and involves monitoring accumulated sediment to plan for large sediment removal projects. Bathymetric surveys are intended as a periodic monitoring tool for wet ponds only. In addition to capital planning, they can support monitoring and reporting of regulatory requirements related to sediment removal.
Scope and Quantity	15 Stormwater Pond Sites	6 Wet Ponds
Frequency	Once	5 times over 10 years
Unit Cost	$1500*	$3600*
	Unit costs are slightly higher than what is observed in the Greater Toronto Area, as these activities may have a more limited pool of vendors in Sudbury.	

Using the results of inspections, the City will use the acquired data to plan for sediment removals and asset renewals. This CIP does not include the potential cost of renewing stormwater pond components (e.g. control structures, signs/fencing, conveyance assets, etc.) An update to the City's asset inventory through a stormwater pond condition assessment could add to or change the CIP forecast. Sediment removals are typically triggered using a combination of bathymetric survey results and environmental performance monitoring data. In the absence of this data, it was assumed that a pond will accumulate 2.5% each year from the time of construction, and that a cleanout would occur when the pond was 50% full. This was accomplished using basin volumes and "built-by" dates within the City's Environmental Compliance Approvals, as summarized in **Table 18**. The cost of sediment removals assumes a total cost of $150 per cubic meter for dewatering, storage, transportation, and disposal.

Table 18: Summary of Pond Dredging Costs

Facility	Environmental Compliance Approval	Built By	Basin Volume (m^3)	Dredging Cycle	Assumed Dredging Year	Assumed Sediment Volume (50% of Basin, m^3)	Dredging Cost
Hidden Ridge	0904-8GPJ6Q	2011	5320	25 Years	2036	2660	**$399,000**
Spruce Meadows Subdivision - Ph 2, 3 & 4	7400-7XFL3P	2009	1445		2034	722.5	**$108,375**
Lavallee Drain	0535-889KK4	2009	16683		2034	8341.5	**$1,251,225**
Royal Meadow Subdivision	0761-7XNTZT	2010*	4187		2035	2093.5	**$314,025**
Redwood Subdivision-Ph 2	2793-8LRHPH	2011	903		2036	451.5	**$67,725**
Second Ave.	5693-5RGJ2Z	2005*	10275**		2030	5137.76983	**$770,665**
Assumptions	**Two ponds did not have a "built-by" date recorded within the Environmental Compliance Approval. In absence of a date, the average of the City's 14 facilities with "built-by" information was taken (2015). The City has reported that "built-by" dates are conservative and that some ponds were constructed earlier. The first round of bathymetric surveys will help to address these gaps in data by establishing the potential timeline for dredging.* ***One pond did not have a basin volume available. To remediate this, permanent pool surface areas of the 5 wet ponds with volume information were used to obtain a very rough "height" dimension estimate, converted from volume. Values ranged from 0.5 m to 1.6 m for wet ponds. The average of these values (1.0 m) was used to estimate the basin volume of the pond with missing data. The design drawings for the pond should be reviewed to replace this assumed value given that this pond is the second largest*						

6.6 Summary

During the development of the Stormwater Asset Management Plan, several strategies were put forward that formulated the proposed Capital Improvement Plan. The overall asset management plan is intended to provide the City with a series of initial first steps that can be used to gather information and continuously improve capital forecasts over time. The 30-year forecast is intended to translate the results of lifecycle analysis into a costed stormwater capital plan that the City can expect in upcoming budget cycles. It is strongly recommended that the City update the capital plan with new data as it becomes available. The total cost of the proposed Capital Improvement Plan, which is based on available data, previously mentioned strategies and assumptions, and AECOM's recommendations, is shown in **Figure 19**.

Refer **Appendix G – Technical Memorandum #6: Capital Improvement Plan** for additional discussion regarding the capital improvement plan.

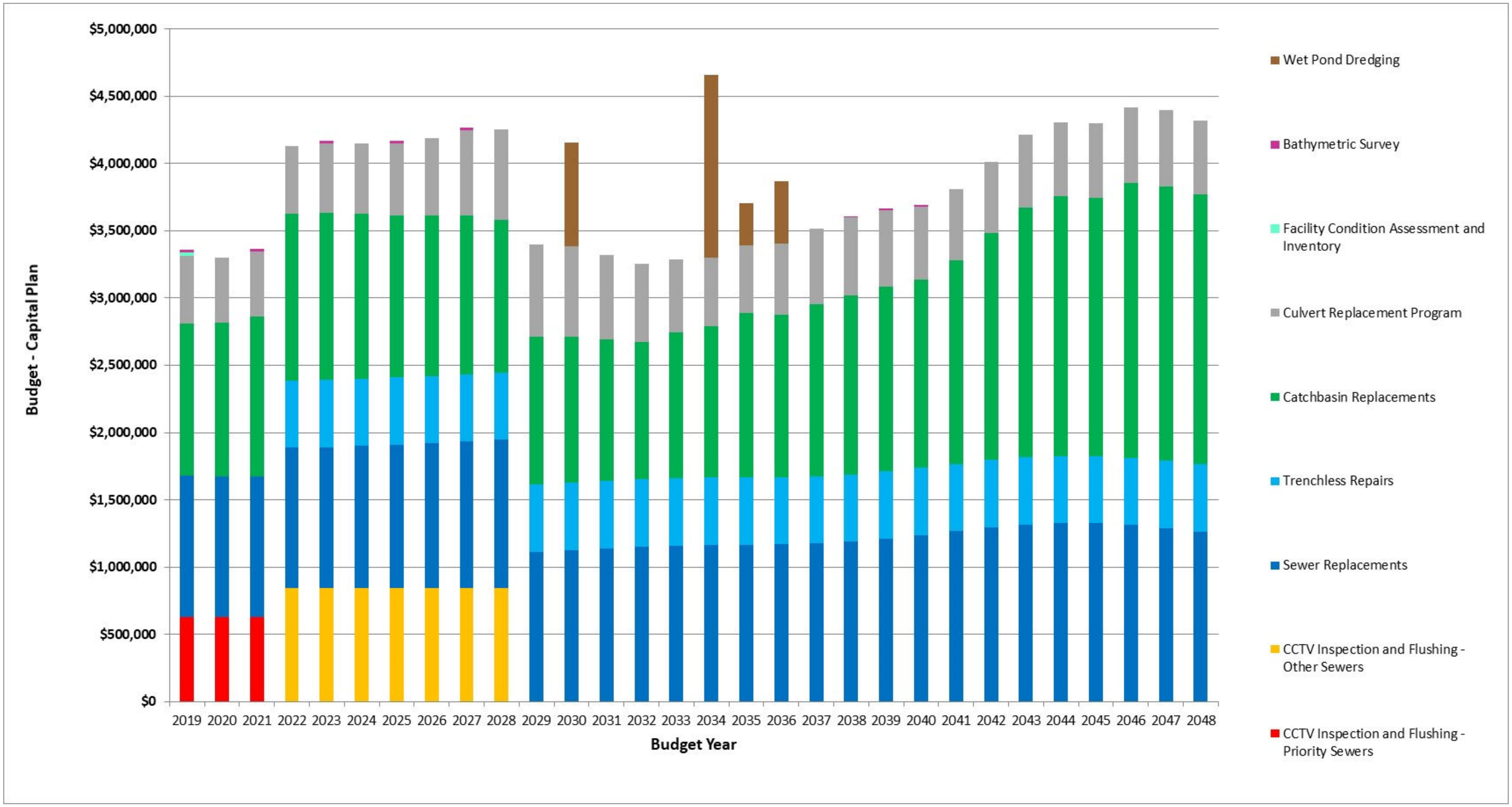

Figure 19: Budget Summary - 30 Year Stormwater Capital Improvement Plan

7. Financial Plan

The Financial Plan includes the total forecasted stormwater program cost, the underlying principles of the forecast, and the necessary contributions to infrastructure reserves. The goal of the Financial Plan is to provide a medium to long term horizon of expected investment needs, based on delivering the requirements for Levels of Service and a sustainable stormwater asset network. Recognizing that the proposed Financial Plan is a distinct shift from current practice, implementation is also discussed.

7.1 Program Costs

The results of **Section 5** and **Section 6** provide the City with a comprehensive view of potential funding requirements for stormwater assets based on the proposed O&M and Capital Improvement plans.

Figure 20 provides the results of integrating forecasted capital and operational expenses for City assets across a 30-year time horizon. The average cost of system requirements for the proposed program are approximately $13.3 M per year. In this figure, the O&M costs are fairly consistent due to their cyclical nature. The City should monitor the trend of O&M costs to determine if they are escalating over time, for example due to the inclusion of new assets.

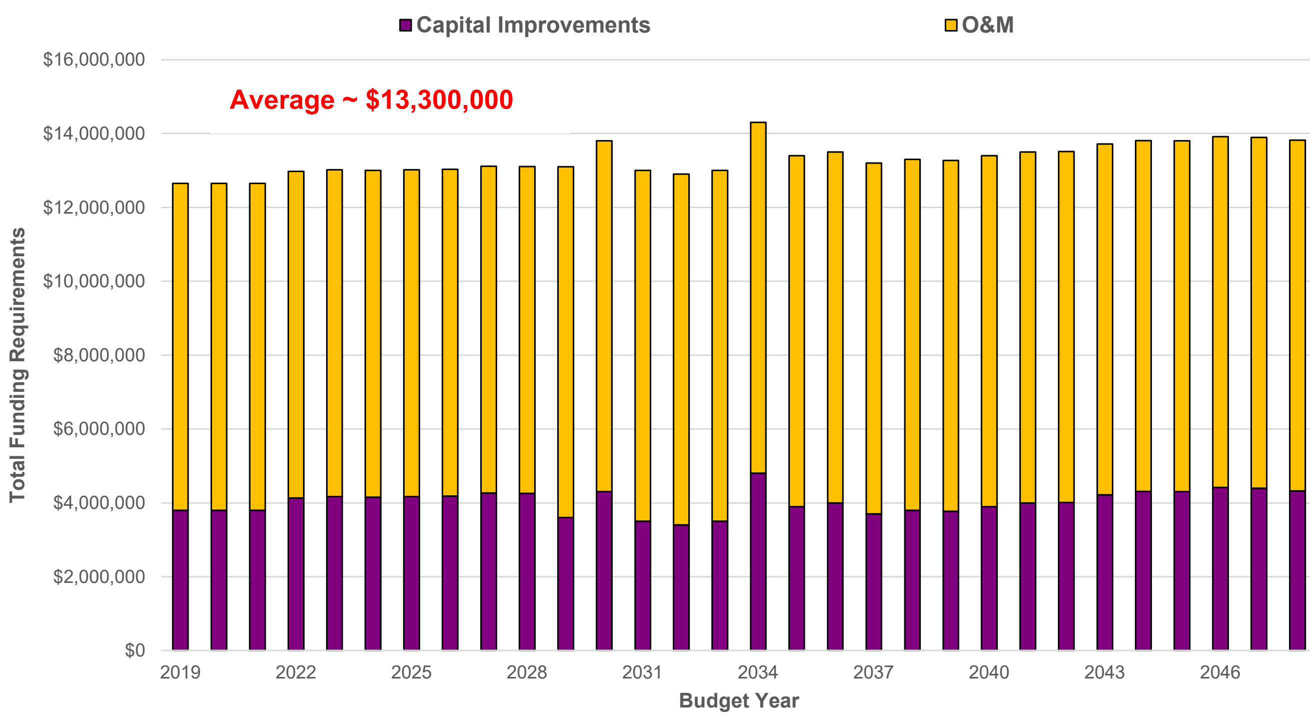

Figure 20: Summary Budget Forecast of Capital and Operational Plans

7.2 Program Cost Observations, Assumptions, and Recommendations

The total cost of the proposed stormwater asset management program is a combination of operational and capital plans that are both linked to Levels of Service and the need to ensure that the stormwater system is sustainable over the long term. At present, operational costs are greater than capital costs. This is shown in **Figure 21**, which warrants further discussion.

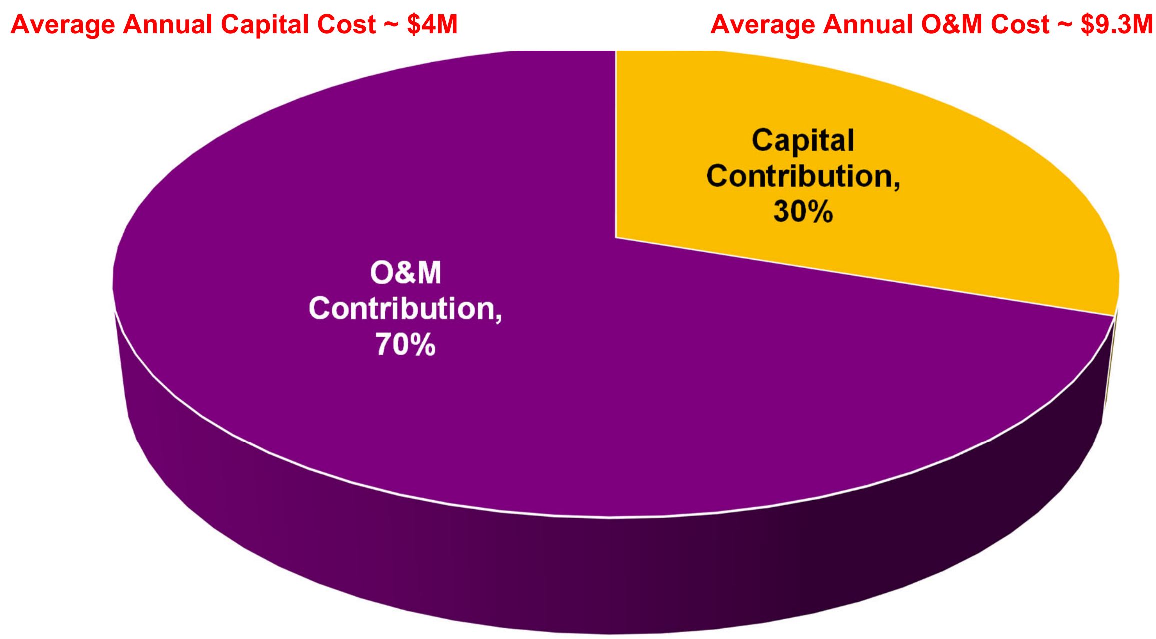

Figure 21: Summary of Program Cost Allocation Between Capital and Operational Expenses

The greater cost of the O&M program that is shown in **Figure 21** is based on several underlying principles within the AM Plan. Important points of discussion include the overall mix of capital and operational expenses, levels of capital improvement funding relative to the lifecycle analysis shown in the State of the Infrastructure and supporting inputs from the AM plan that justify overall funding levels.

- **Allocating Capital Improvement Costs**

  The capital improvement plan is partially based on the lifecycle analysis provided within the State of the Infrastructure; however, these are not the same thing. The lifecycle analysis is an age-based method of assessing the medium to long term implications and potential funding requirements for an aging network. It serves as the starting point for understanding future requirements before they are augmented by additional data or information. The lifecycle analysis demonstrates that, based on age, the City would be required to spend approximately $9.6M per year on capital replacements over the next 30 years (recall the limitations of age-based methods shown in **Section 3**). The proposed capital investment plan is forecasted to be less than the age-based projections of the lifecycle analysis. The proposed capital improvement plan assumes that a full O&M program will be one of the driving factors in reducing backlog and documenting asset conditions, which would refine future needs. As well, the funding levels proposed at the outset are meant to be achievable, meaning the program could be implemented. The City should still be monitoring its long-term spending against the lifecycle analysis while refining the State of the Infrastructure with new asset condition data.

- **Infrastructure Reserves**

  The lifecycle analysis demonstrates that in the medium to long term, the City must prepare for a wave of replacements as the system constructed in the 1960s and 1970s ages and reaches the need for renewal. To prepare for upcoming replacement requirements, the City will need to begin building stormwater infrastructure reserves now.

- **Balancing Capital and Operational Expenses**

  The initial emphasis on O&M in the total cost forecast is due to the ability of the proposed O&M program to extend the useful life of the assets and maximize the coverage of the asset management plan Whereas a capital-intensive program could fully replace some aging assets, many system needs would not be addressed, resulting in data gaps and potentially unforeseen asset failures etc. Conversely, a comprehensive O&M program allows for the inspection of all assets to gain condition data and the use of preventative and planned corrective maintenance to ensure system performance, and potentially to avoid asset failures. When taking this overall approach and integrating the capital and operational program, the O&M program can be used to inform and adjust the capital program over time. As more information about the system is gained, the program can become more capital intensive if inspection program identify or justify the need.

- **Asset Management Strategy**

  The proposed financial plan also assumes full use of the asset management strategy. So far, the use of asset data to refine the program as well as the underlying capital/O&M strategies were discussed. The funding levels are also assuming that the City will apply a risk-based approach to asset lifecycle activities. This is reflected within the capital improvement plan, which was developed largely based on reducing risk exposure. Here, it is assumed that low risk assets will have a greater emphasis on O&M, while higher risk assets will receive more in capital improvements. Moving forward, it is recommended that O&M planning also incorporate risk profiles once more information is gleaned from the condition assessment baseline.

7.3 Infrastructure Reserve for Sustainable Asset Management

Figure 20 provides the results of integrating forecasted capital and operational expenses for City assets across a 30-year time horizon. The cost of system requirements for the proposed program are approximately $13.3 M per year. Evident from **Figure 20** is that the City will require funding less than $13.3M until 2029, however, the funding needs will increase in 2030 and after 2033. This means that when the City does not spend the full $13.3M amount on stormwater assets, the unspent money still needs to be allocated to an infrastructure reserve so the City can properly prepare for the upcoming replacements. If the City did not contribute or waited to start contributing, the upcoming obligation would be the same, but the funding gap would become larger.

7.4 Next Steps – Funding Strategy

Evident from the results of analyzing total lifecycle cost is that a funding strategy is required to meet the current needs of the assets without compromising those of the future. With asset management planning in place, the focus of the City should shift towards the study of sustainable funding to evaluate options for funding the desired program. Given that there is no dedicated source of funds for stormwater projects as a utility (stormwater needs are currently funded from the tax base), this is a pivotal next step. **Figure 22** summarizes the work completed by the City to achieve sustainable stormwater management as well as the next steps.

Figure 22: Path to Sustainable Stormwater Management

Although municipal governments are responsible for managing almost all aspects of stormwater within their jurisdiction, they have limited flexibility and autonomy in generating dedicated revenue. Despite new regulations, there are limited federal or provincial funding sources to achieve these more stringent outcomes, thereby increasing budgetary pressures. With property tax funded SWM program, annual stormwater budgets must compete with other vital public services.

In cases where the resource requirements placed upon a community far exceed the available resources appropriated by elected officials, the implementation of capital projects or the extent/frequency of O&M activities becomes dependent on the availability of funds rather than based on need. This situation only contributes to the infrastructure funding gap. As a result, it is expected that competing demands for limited public funds will continue, forcing municipalities to pursue alternative financing mechanisms to provide a financially sustainable program.

Sustainable infrastructure funding is defined as the level of funding required to sustain assets in such a manner that meet present infrastructure needs without compromising the ability of future generations to meet their infrastructure needs. Reaching an understanding of what sustainable funding is required for the owner of an asset portfolio is a key outcome of the Stormwater Asset Management Plan.

7.4.1 Linking the Funding Strategy to Levels of Service

Evident from the dilemma outlined above is that the conventional method of financing stormwater assets limits the ability of the City to deliver the desired levels of service. To address this challenge, a paradigm shift in the funding for stormwater assets is required. At present, decision makers may not have the information required to make informed decisions about the funding requirements of existing stormwater assets. This project changes this reality by defining the objectives of the assets through Levels of Service (**Section 3**), and forecasting the cost associated with providing the Level of Service (through capital and O&M activities). If the funding requirements cannot be met, the City then must understand that the desired level of service cannot be delivered. Levels of Service can therefore be used as the mechanism to renegotiate funding, with all parties having a full understanding of what can be achieved with a given budget level and what the implications of increasing or decreasing funding will be. If activities are not funded, decision makers will also recognize the implications for regulatory requirements (e.g., failure to meet minimum requirements), customer service, and infrastructure sustainability. The links between Level of Service and funding stormwater asset management is shown in **Figure 23**.

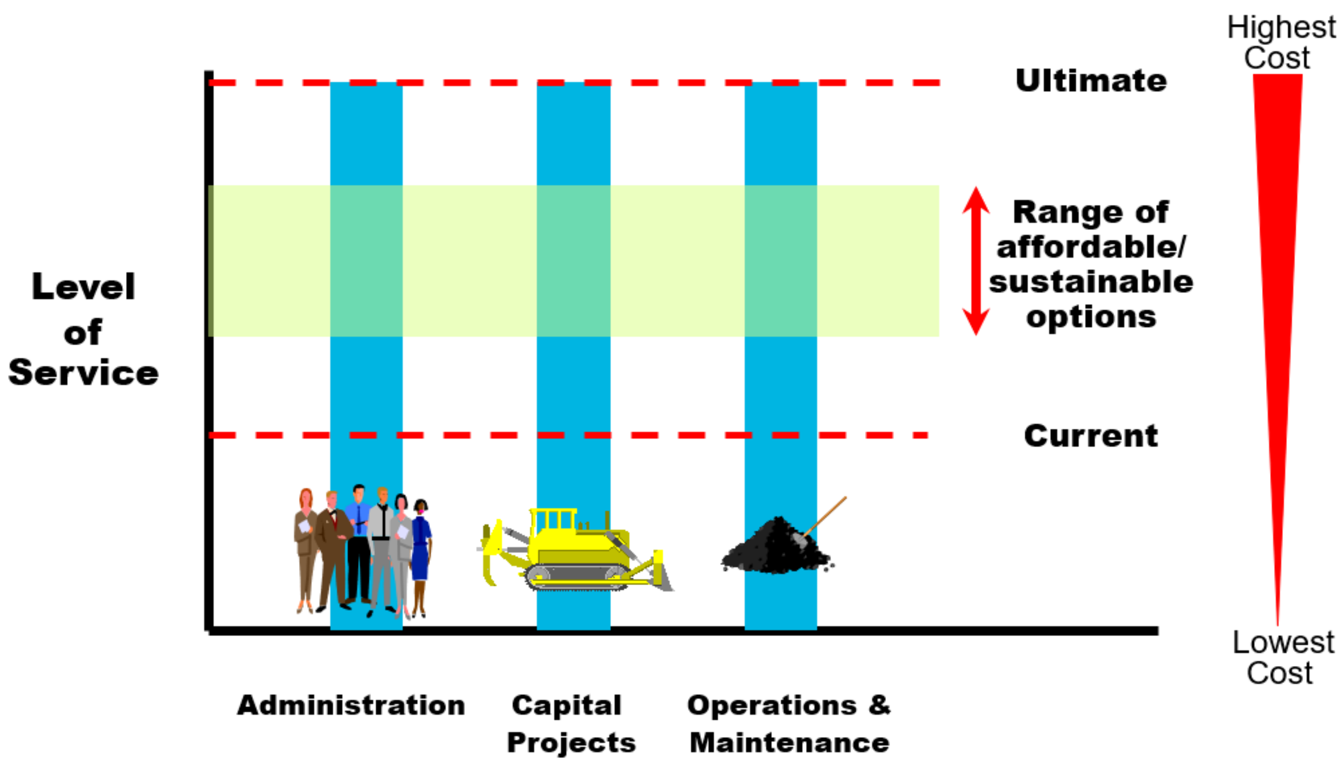

Figure 23: Levels of Service can be used to Determine Sustainable Options for Funding Existing Stormwater Assets

Given the impact Levels of Service will have on budget requirements, it is a good practice to have Levels of Service adopted by Council. This provides a formalized agreement to the asset objectives and gives the City a clear directive to complete the asset lifecycle activities. It will also establish the clear need for dedicated funding.

7.4.2 How Do You Pay for It?

The Asset Management Plan is an intermediate step in creating a framework for sustainable stormwater asset management. During this study, the total funding requirements for existing stormwater assets were established. With this understanding, the focus should now turn to how to pay for the necessary investments in infrastructure.

One way to accomplish this is through a Financing Study, the pivotal next step that is recommended given that the City does not currently fund the stormwater asset at the levels identified by the Asset Management Plan.

A Financing Study will analyze present and future program expenditures (capital projects, O&M, administration, growth, etc.) to assess funding options (taxes, fees, special levies, development, partnerships, debt financing, grant funding, or a combination of the above). A Financing Study would then use this information to evaluate the feasibility of different funding models for stormwater assets and the path forward for implementation. It can provide information and recommendations for decision makers who will determine the path forward for financing stormwater assets. It is strongly recommended that the City consider a Financing Study, given the magnitude of the necessary funding for stormwater assets.

8. Recommendations

To continue to improve the Asset Management Plan (AMP) AECOM recommends the following:

1. Develop new work order task codes and stormwater operating procedures for new activities identified in Operation and Maintenance Plan and modify the work order achievements for activities that do not measure the number of assets serviced.
2. Complete data collection activities for rural road ditches, screens, and sidewalks. These asset quantities could significantly impact potential budget requirements. The proposed data collection strategy for each asset class is as follows:
3. Ditches can be collected in GIS using ortho-imagery and street view imagery.
4. Sidewalks can be collected with collaboration from other engineering and roads departments.
5. Screens/grills should be collected using operator knowledge and a field tagging program.
6. Introduce a capital CCTV and flushing program to establish baseline conditions for the entire system.
7. Use updated condition data to revisit risk frameworks and develop a criticality profile for all stormwater assets.
8. Revise and update capital and operating plans (and financial forecasts) system criticality.

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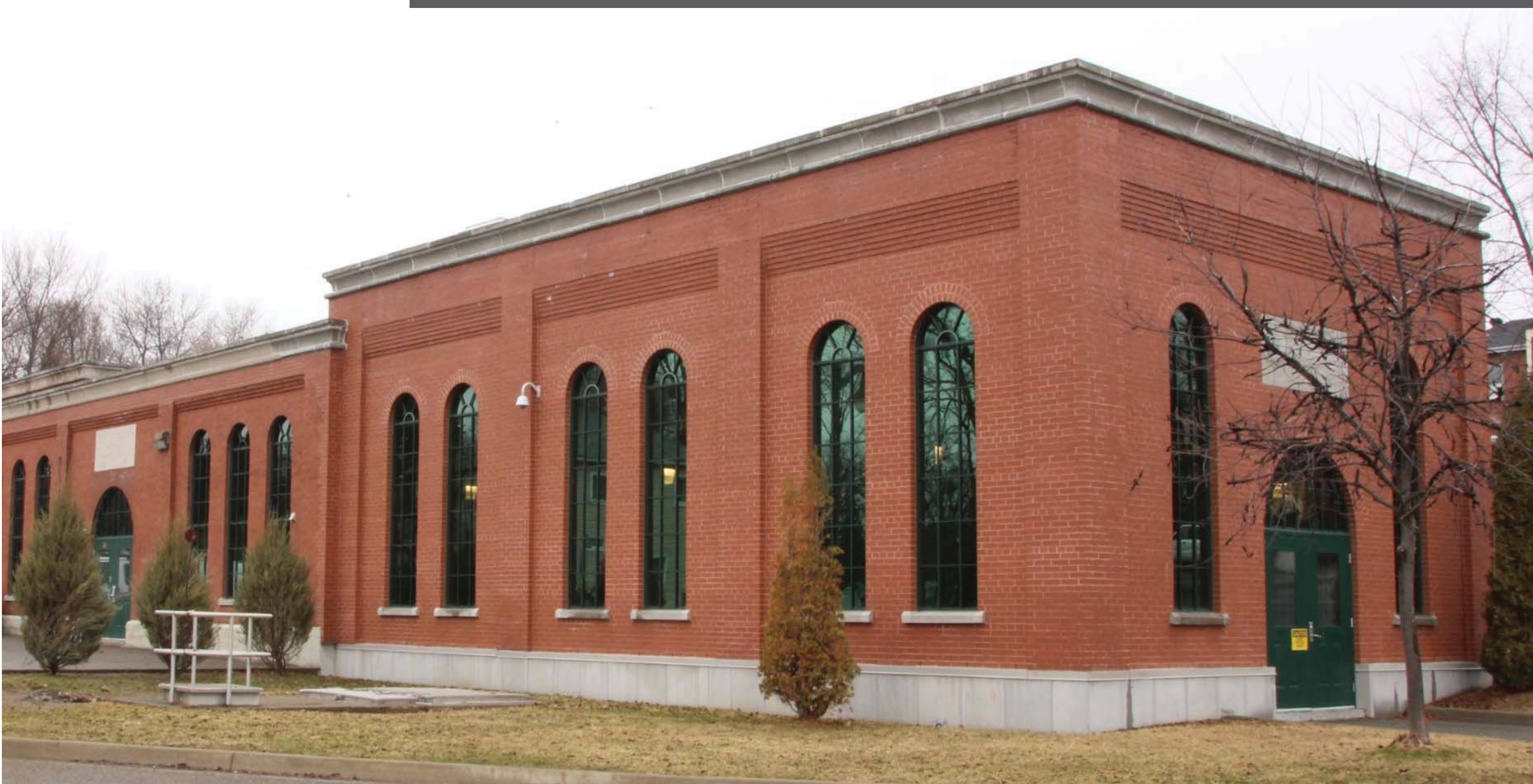
ASSET MANAGEMENT PLAN
WATER AND WASTEWATER



ASSET MANAGEMENT PLAN

WATER AND WASTEWATER

CITY OF GREATER SUDBURY

FINAL

PROJECT NO.: 121-23026-00
DATE: JUNE 2018

WSP

WSP.COM

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

WSP was retained to undertake the development of a Water and Wastewater Asset Management Plan (AMP) that the City of Greater Sudbury (City, CGS) can utilize to assist with decisions regarding the building, operating, maintaining, renewing, replacing, disposing and funding of their water and wastewater infrastructure assets.

This Asset Management Plan was prepared in accordance with the Ontario Ministry of Infrastructure's "Guide for Municipal Asset Management Plans" and has been structured based on the following sections as outlined for a detailed Asset Management Plan.

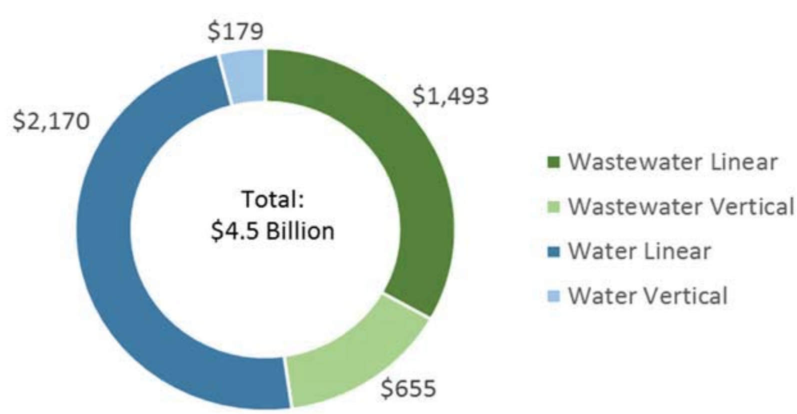
0. Executive Summary
1. Introduction
2. State of Infrastructure
3. Levels of Service
4. Asset Management Strategy
5. Financing Strategy
6. Next steps

The scope of this project encompasses the water and wastewater infrastructure owned and operated by the City of Greater Sudbury. The Plan also integrates the on-going Water and Wastewater Master Plan recommendations, adding additional asset management costs to those projects and building a consolidated capital expenditure forecast and strategic plan for the City's water and wastewater infrastructure.

ES 1. STATE OF INFRASTRUCTURE

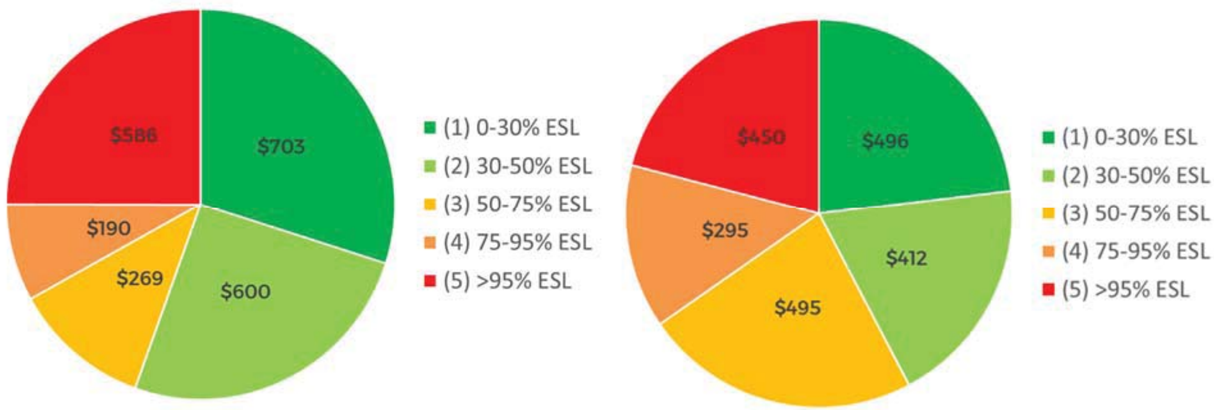
The City's water and wastewater infrastructure consists of approximately 997 km of watermains, 791 km of wastewater mains, appurtenances, and 143 Water and Wastewater facilities, with a total replacement cost of approximately 4.5 billion dollars (2017 CAD). These figures do not include infrastructure that is privately owned and maintained.

Figure ES 0-1 Cost Distribution of Water Wastewater Infrastructure



Various data sources were integrated for this study, including the City's GIS, the City's Tangible Capital Asset Inventory, and available hydraulic models. The condition of the City's infrastructure was estimated using the best available information; expected service lives were estimated for each asset type using industry accepted standards and local experience by the City staff, and an estimated replacement value and year of installation was associated with each asset. A considerable portion of the infrastructure, up to 25% of the water and up to 50% of the wastewater infrastructure, by value, was found to have reached or exceeded its estimated service life (Figure ES 0-2). This group of assets is typically in very poor condition, heavily affecting O&M costs and capital investment needs.

Figure ES 0-2 Percent Expended Service Life of Water (Left) and Wastewater (Right) Infrastructure, by total Replacement Cost (2017 CAD, $M)



A risk framework was developed, and each individual asset was assigned a risk score based on a calculated Consequence and Probability of Failure.

The Consequence of Failure was estimated based on asset-specific engineering principles, customer impacts, and environmental impacts. These were gathered from the City's GIS as well as water and wastewater models, applying customized tools, and manually identifying high-risk portions of the network.

The Probability of Failure for the linear assets was determined utilizing customized deterioration models derived using the City's failure data. The Probability of Failure for facilities has been determined according to asset lifecycle categories / discipline groups (e.g., structural, architectural, electrical, site works, etc.) within the facility. The Probability of Failure for each category was taken as proportional to the age versus its estimated service life, utilizing an age-based deterioration model.

A comprehensive asset-level inventory is provided with the digital media accompanying this report, along with a corresponding GIS data set, documenting the estimated value, condition, age and risk for the City's water and wastewater assets.

ES 2. LEVELS OF SERVICE

Levels of service provide the means to measure customers' needs and expectations of the City and the services provided, and offers a mechanism for communicating costs of services. The level of service metrics selected are driven by the City's Vision, Mission and Values and are therefore focused on the impact to citizens, communities and the natural environment. This section outlines an initial set of levels of service targets for CGS's water and wastewater systems.

MISSION, VISION AND VALUES	OBJECTIVE	IMPLICATION TO ASSET MANAGEMENT PLAN
To support a growing community with quality municipal services	To ensure that all growth is well managed, well designed and sustainable.	New/upgraded infrastructure projects are focused in designated areas as outlined in the City's strategic planning documents. The recommendations from the Water and Wastewater Master Plan have been explicitly integrated into the Asset Management Plan's financial strategy.
To demonstrate innovative leadership amongst northern communities	Embrace infrastructure asset management as a best practice throughout the organization and become an Asset Management leader amongst Northern Ontario Municipalities	This first edition of the Asset Management Plan aims to move beyond basic asset management practices. Its development has included updates to the asset registry through data scrubbing efforts, identification of initial Levels of Service aligned with the City's core objectives, a detailed Risk analysis considering actual infrastructure failure records and advanced deterioration modeling, and a corridor-based Long-Term Financial Plan integrated with the City's Water and Wastewater Master Plan that will support future efforts to provide sustainable services to the community.
Acting today in the interests of tomorrow	Develop a strategic Asset Management Plan that relies upon social, environmental and financial risk as a means to prioritize infrastructure investment decisions	A risk-based prioritization framework has been introduced in this AMP to facilitate strategic infrastructure decision-making. Further, integration of the Water and Wastewater Master Plan recommendations provides an overall Plan that considers not only the ongoing management of existing infrastructure but also development to meet future needs.

A customer satisfaction survey or measure of willingness to pay, was not undertaken as part of this iteration of the City's Asset Management Plan. Future asset management initiatives and updates to the Asset Management Plan should focus on stakeholder and community engagement in developing Levels of Service.

Some of the City's stakeholders include:

- Regulatory bodies
- City of Greater Sudbury community, visitors
- Local industry
- City Council
- City Departments

ES 3. ASSET MANAGEMENT STRATEGY

Recommended works were classified based on four (4) lifecycle strategies (operations & maintenance strategies, renewal / rehabilitation strategies, capital replacement strategies, and disposal strategies), expansion strategies and non-infrastructure strategies. Following the identification of investments expected over the full asset lifecycles, the projected reinvestment needs were compared to the current annual capital budget to determine the adequacy of the funding for the sustainability of the infrastructure.

The importance of prioritizing the implementation of these strategies based on a risk-driven framework has been emphasized. A set of maps and prioritized lists have been developed to this end: A summary of the vertical inventory and detailed risk maps for the linear network are attached as Appendices A and B to this report respectively. The digital media accompanying this report includes asset-level risk rates, and also digital versions of prioritized lists of projects for (1) Facilities Renewal Projects (2) Watermains Projects (3) Sanitary Sewer Projects and (4) Water system valves. These are projects that have been identified as critical and aging infrastructure, and should be monitored and inspected to ensure acceptable levels of risk.

Additional work was completed to assess the watermains. Historic break data has been geocoded, and capital projects have been prioritized based on this failure data and the AMP's criticality framework; a prioritized list is attached as Appendix C to this report. Combined, the age-based approach and the failure driven approach serve as a first step towards a risk-driven asset renewal framework; further development of this framework into comprehensive physical and economic lifecycle models will enable optimized asset renewal decision making.

ES 4. FINANCIAL STRATEGY

To answer the question "What is the right level of capital investment necessary to achieve long-term sustainability?" a decision support framework was developed specifically for the CGS inventory, to simulate the long-term impact of varying funding scenarios over the entire asset portfolio.

Applying the risk framework and deterioration models, different funding scenarios were simulated and the impacts to the overall system risk and level of service were assessed. Optimal expenditure forecasts were identified to determine the annual investment required for infrastructure sustainability, and these projected infrastructure investment needs were compared to the City's historical expenditures to identify potential funding gaps. A long term annual capital expenditure of $50M was identified as being a sustainable investment for asset renewal strategies on the existing system; integrating the Master Plan recommendations along with additional costs that have been associated with these projects from an asset management perspective, require an average annual capital expenditure of $100M until at least 2036. Recommended Capital expenditures are presented in the following table for five 5-year horizons:

Horizon	Annual Capital Budget (Million $)	Annual Capital Budget (Million $) – Including Master Plan Recommendations
2018-2021	50	110
2022- 2026	50	90
2027-2031	50	110
2032-2036	50	90
2037-2041	50	50

ES 5. NEXT STEPS

Next steps have been provided at the end of each section of this Plan to identify how the City can continue to develop and update this Asset Management Plan in the future. A summary of these next steps is provided in the following table.

SECTION	CATEGORY	RECOMMENDATIONS
2 - State of Infrastructure	General	• Implement comprehensive asset identification standards • Refine and improve risk framework introduced in this AMP
	Linear Infrastructure	• Define clear relationship and editing procedures between the hydraulic model and the GIS; minimize double efforts and provide one source of data • Capture installation dates from all relevant sources • Accurately link pipe failure and condition data to allow for seamless computation. Implement mobile solutions for on-site capturing of high resolution data. • Implement corridor based strategic planning
	Vertical Infrastructure	• Enhance vertical infrastructure asset inventory granularity, accuracy, and completeness
3 - Levels of Service	Community and Technical Levels of Service	• Collect and document Performance Measures • Identify customer expectations and willingness to pay through a Public Consultation Process
4 - Asset Management Strategy	Lifecycle Interventions	• Review and refine strategies
	Risk-based prioritization	• Refinement of the deterioration model for gravity mains, sanitary sewer mains and watermains • Develop and refine practices for documenting and maintaining critical customers and assets • Develop physical and economic failure models • Develop risk ratings for each W&WW facility • Undertake detailed condition assessments for each facility
5 - Financial Strategy	Funding Sources	• Determine the appropriate strategies to fund the identified investment needs and recommendations.

The key challenges and next steps identified in this AMP for the management of the City of Greater Sudbury's water and wastewater systems are (1) Securing a sustainable budget as identified in this AMP for both the Master Plan recommendations and the ongoing asset renewal needs (2) Updating the Levels of Service framework with input from a public consultation process (3) Implementing a risk driven infrastructure management framework (4) Implementing a corridor based planning approach that takes into consideration needs of other infrastructure disciplines, mainly roads (5) Continuous improvement of data collection and management practices.

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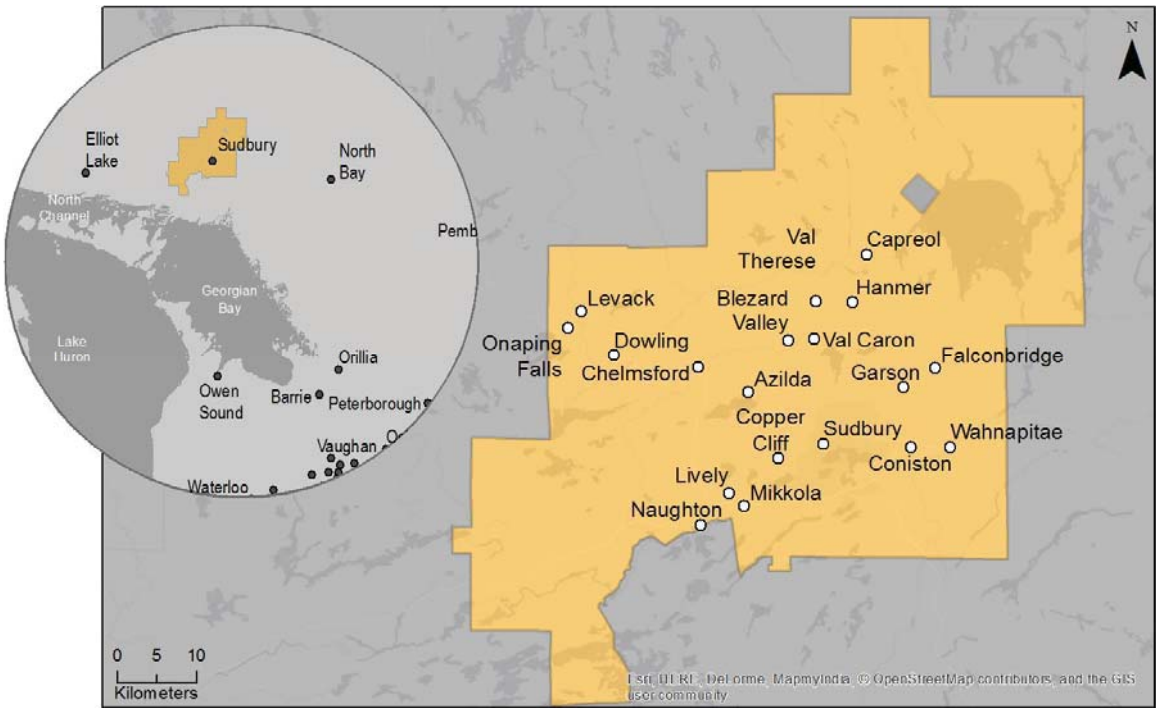
INTRODUCTION

1 INTRODUCTION

1.1 CITY OF GREATER SUDBURY

The City of Greater Sudbury (City, CGS) is located in Northeastern Ontario at the convergence of Trans-Canada Highway and Highway 69 south (Map 1-1). Formed on January 1st, 2001, the City is geographically the largest municipality in Ontario and serves as the regional capital of Northeastern Ontario

Map 1-1 City of Greater Sudbury



1.2 BACKGROUND & CONTEXT OF THE ORGANIZATION

1.2.1 INTERNAL CONTEXT

The City has established the following vision, mission, and values:

VISION - A growing community, recognized for innovation, leadership, resourcefulness and a great northern lifestyle.

MISSION - Providing quality municipal services and leadership in the social, environmental and economic development of the City of Greater Sudbury.

VALUES - As stewards of the City of Greater Sudbury, we believe in recognizing the specific needs of all our citizens in urban, rural and suburban areas, and are guided by our belief in:

- Acting today in the interests of tomorrow
- Providing quality service with a citizen focus
- Embodying openness and transparency
- Communicating honestly and effectively
- Creating a climate of trust and a collegial working environment to manage our resources efficiently, responsibly and effectively
- Encouraging innovation, continuous improvement and creativity
- Fostering a culture of collaboration
- Ensuring an inclusive, accessible community for all
- Respecting our people and our places.

As part of the City's "open doors" theme of Open Government, strategic planning in the City of Greater Sudbury is a valuable tool for performance measurement with a focus on who the municipality serves, what the municipality does and why, in both the immediate and long-term. Strategic planning can help define where the City is going and evaluate outcomes for success. This strategic planning is used to set priorities, focus energy and resources, strengthen operations, establish common goals for employees and elected officials, achieve agreement on intended outcomes, and assess and adjust operations in response to a changing environment.

This Asset Management Plan supports the City's internal objectives by linking planned asset strategies with the City's mission of providing quality municipal services in a transparent, open manner.

1.2.2 EXTERNAL CONTEXT

The Ontario Ministry of Infrastructure's "Building Together Guide" (June 2011), indicates that any municipality seeking provincial infrastructure funding must demonstrate how its proposed project fits within a detailed Asset Management Plan. This helps to ensure that limited resources are directed to the most critical needs.

Ontario Bill 6, Infrastructure for Jobs and Prosperity Act, received Royal Assent on June 4, 2015. The purpose of the Act was to establish mechanisms to encourage principled, evidence-based and strategic long-term infrastructure planning. Clause 6 of the Bill states that every broader public sector entity must prepare infrastructure Asset Management Plans. Proposed projects are anticipated to be evaluated, in part, on whether or not they were contemplated by the established Plans.

WSP was retained to undertake the development of a comprehensive Water and Wastewater Asset Management Plan (AMP, Plan) that the City of Greater Sudbury can utilize to assist with decisions regarding the building, operating, maintaining, renewing, replacing, disposing and funding of their water and wastewater infrastructure assets. This Plan has been developed in compliance with the *Building Together* Guide, Ontario Bill 6, and in general conformance with the requirements of ISO 55001. In accordance with the Ontario Ministry of Infrastructure's "Guide for Municipal Asset Management Plans," the Plan has been structured based on the following sections.

0. Executive Summary	**4.** Asset Management Strategy
1. Introduction	**5.** Financing Strategy
2. State of Infrastructure	**6.** Next steps
3. Levels of Service	

1.3 PURPOSE

The objective of this Water and Wastewater Asset Management Plan is to provide a strategic document that will guide decisions related to how the City's water and wastewater infrastructure will be managed to most efficiently and effectively allocate resources in a manner that will meet the City stakeholders desired levels of service for the lowest overall lifecycle costs.

The purpose of developing this Asset Management Plan for the City is to identify the costs and benefits of infrastructure investment decisions across the organization's water and wastewater asset portfolio. Over-investment in one area can lead to an under-investment in another. To demonstrate the impact of investment decisions, target Levels of Services were set so that performance against these targets could be measured. A Financial Plan is included in the Financial Strategy section of this document which shows how current levels of investment are measuring up against the investments needs. This Plan will help to demonstrate the impacts of investment decisions across the organization.

1.3.1 RELATIONSHIP TO OTHER PLANNING DOCUMENTS

This Asset Management Plan does not stand apart, or alone in assisting the City in the sustainable planning of infrastructure investment. Reliance upon other targeted planning documents is how the overall asset strategy will be formulated. This document has already drawn upon the valuable work completed under other planning documents such as the

— City of Greater Sudbury Water and Wastewater Master Plan, WSP (on-going)

— City of Greater Sudbury Transportation Master Plan, WSP|MMM (on-going)

— Inventory and Valuation of Tangible Capital Assets Report, RV Anderson (2009)

— Condition Assessment of Lift Stations, Associated Engineering (2016)

— Condition Assessment and Capital Needs Plan – Valley East WWTP, AECOM (2016)

— Other internally developed planning resources

1.4 SCOPE OF THE ASSET MANAGEMENT PLAN

This Asset Management Plan only documents the asset management strategy for the City's Water and Wastewater systems, and does not include infrastructure that is privately owned and maintained. It is to be noted here, that the AMP did not include other infrastructure in the same corridor of the water/wastewater infrastructure, such as roadways, sidewalks etc. The City of Greater Sudbury has an enormous Water & Wastewater System servicing various communities. It contains six distinct water systems and 13 independent wastewater systems. The linear infrastructure consists of approximately:

Water

- 997 km of watermains;
- 533 km of service connections;
- 5,699 hydrants;
- 8,950 system valves;
- 90 control valves;

Wastewater

- 769 km of gravity mains;
- 22.2 km of rock tunnel;
- 9.3 km of pressurized sanitary sewer mains;
- 381 km of lateral service connections;
- 11,726 maintenance holes;

- 2,792 valve chambers;
- 47,940 water meters;
- 6 water meter stations.
- 21 drop shafts;
- 70 control valves.

The City is also responsible for the operating and maintenance of approximately 143 water and wastewater facilities. There are 60 water facilities including 12 booster stations, 13 small water systems, 1 raw water pump station, 1 pressure control building, 9 water storage facilities, 2 water treatment plants, 2 small treatment facilities, as well as 20 water well houses. Additionally, there are 83 wastewater facilities including 69 lift stations, 4 wastewater lagoons, as well as 10 wastewater treatment plants.

This Plan has been developed considering a twenty-five year planning horizon, from 2017 to 2041. Readers should keep in mind that forecasts towards the end of the planning horizon are intrinsically less reliable than those that can be associated with recent condition assessments. As such, it is anticipated that this Plan will be treated as a living document to be updated as contexts change and at no less frequent a rate than once every five years.

1.5 ASSET MANAGEMENT OBJECTIVES

The objectives of this AMP are:

- To identify the current state of the City's water and wastewater infrastructure from the perspective of condition, performance, and risk;
- To establish an initial Level of Service for the City's water and wastewater infrastructure that enables measurement of initiatives associated with "providing quality municipal services;"
- To forecast water and wastewater infrastructure needs, aligned with corporate objectives, over a twenty-five year planning horizon; and
- To identify opportunities for improvement to the City's asset management system, in support of the City's vision of innovation.

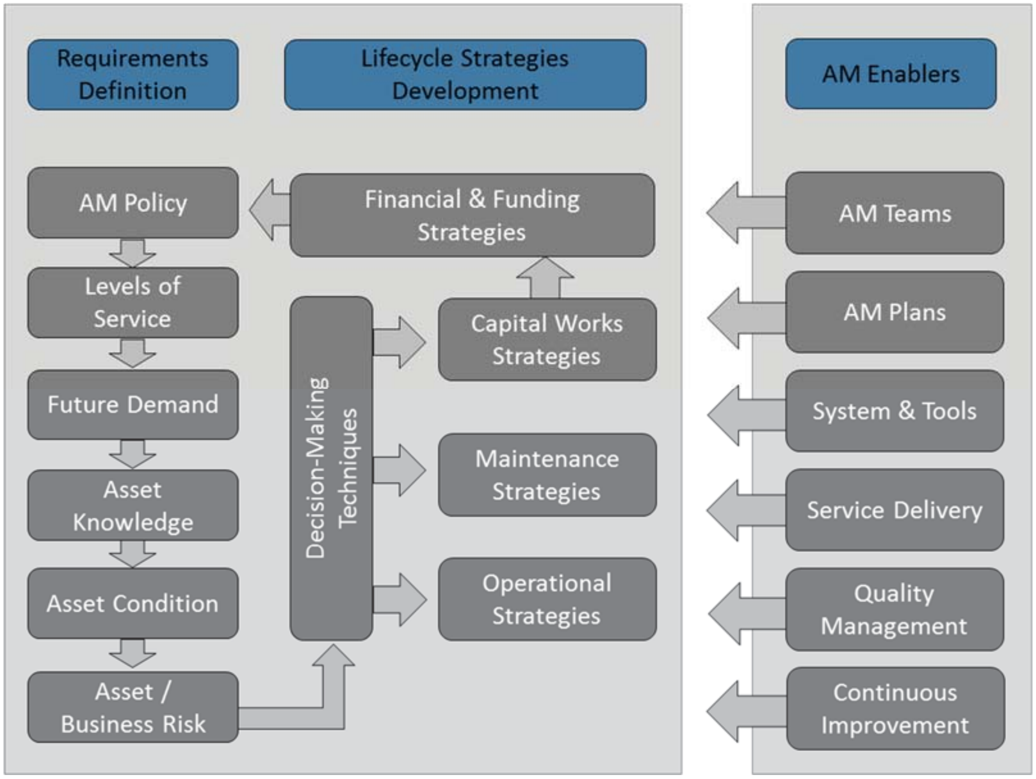
1.6 DEVELOPMENT OF THE ASSET MANAGEMENT PLAN

Future government funding of infrastructure projects will be contingent on an Asset Management Plan and therefore these asset categories were selected as a starting point for Asset Management within the City of Greater Sudbury to match with potential future funding programs.

This document should be re-evaluated on a five year basis. This Asset Management Plan has been developed so that regular updates can be made to reflect the changing needs and funding levels of the City's infrastructure.

The management framework presented in the International Infrastructure Management Manual (Figure 1-1) outlines the relationship between the processes and procedures being presented in this Plan.

Figure 1-1 Typical Asset Management Framework



An asset management strategy as presented in this document is a way of managing assets with the intention of delivering the City's services at the lowest lifecycle cost. This Plan is a framework that presents a strategy for best management of the City's infrastructure on an annual basis. Although certain principles of asset management such as Condition Assessment, Levels of Service and Capital Planning are addressed within this document, these are high level approaches and assessments that are to be refined as the City's asset management strategies grow. This Asset Management Plan will require on-going and continual work to ensure its success.

1.7 ASSET MANAGEMENT PLAN NEXT STEPS

This Plan is recommended to be re-evaluated on a five year basis. The timeline for the revision is as follows:

Year 1 - 2018: Validate asset inventory, track and develop reporting practices and procedures

Year 2 - 2019: Update inventory, collect condition and performance information

Year 3 - 2020: Audit results from previous AMP, collect condition and performance information

Year 4 - 2021: AMP development to begin

Year 5 - 2022: Publish revised AMP

Revision of this subject area AMP will be led by Water/Wastewater services, but coordinated with Infrastructure Capital Planning to ensure continuity between divisional Plans.

STATE OF INFRASTRUCTURE

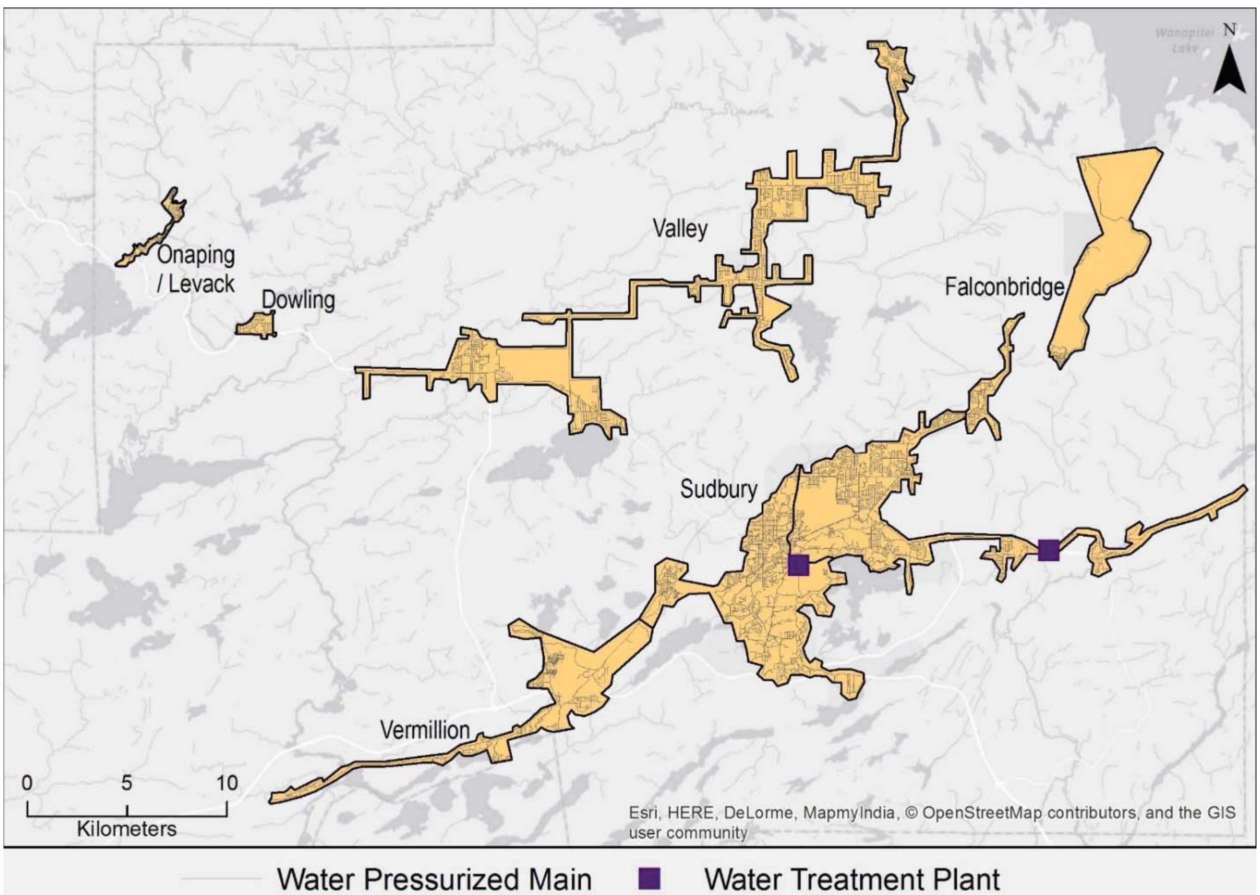
2 STATE OF INFRASTRUCTURE

2.1 SYSTEM OVERVIEW

The City of Greater Sudbury owns and operates six (6) municipal water supply systems (Map 2-1) and thirteen (13) independent wastewater systems (Map 2-2) that service the various communities in the City.

Key asset inventory information including location, size, length, material, year of installation and other attribute information is included in the digital asset inventory provided with this AMP.

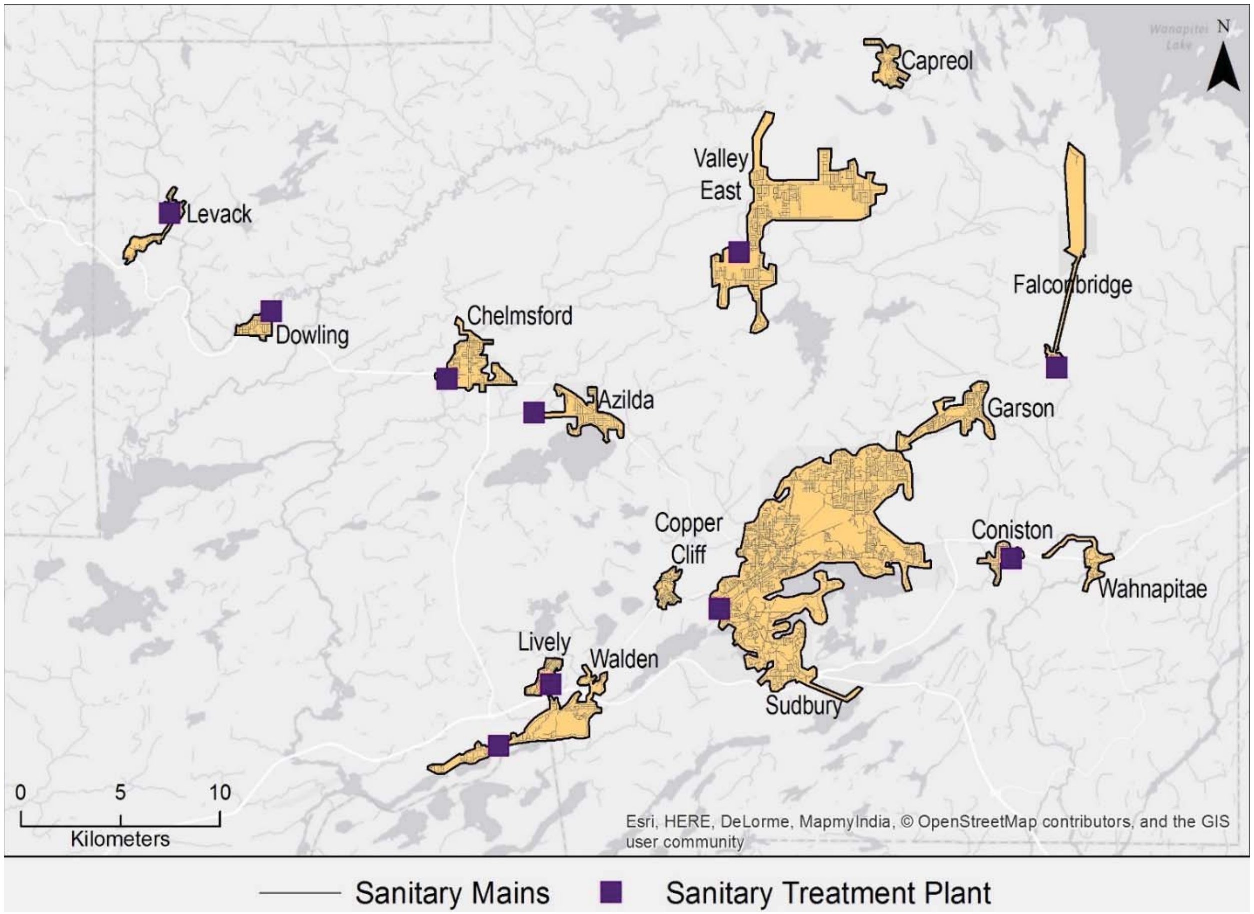
Map 2-1 Greater Sudbury Water System Map



The City of Greater Sudbury's Water System consists of:

- Valley Water System
- Onaping - Levack Water System
- Dowling Water System
- Vermilion Water System
- Sudbury Water System
- Falconbridge Water System

Map 2-2 Greater Sudbury Wastewater System Map



The City of Greater Sudbury's Wastewater System consists of:

- Onaping - Levack Wastewater System
- Dowling Wastewater System
- Chelmsford Wastewater System
- Valley Wastewater System
- Azilda Wastewater System
- Copper Cliff Wastewater System
- Lively / Walden Wastewater System
- Sudbury Wastewater System
- Coniston Wastewater System
- Wahnapitae Wastewater System
- Garson Wastewater System
- Falconbridge Wastewater System
- Capreol Wastewater System

2.2 DATA SOURCES

The foundational information used for the development of the state of vertical infrastructure in this Asset Management Plan is based on the 2015 City's Water and Wastewater Tangible Capital Asset Inventory. This information was augmented by the 2016 City of Greater Sudbury Water and Wastewater infrastructure Geographic Information System (GIS) data as well as the Water and Wastewater Master

Plan hydraulic model. Where more recent data meeting the requirements of this Plan was available, best efforts were made to incorporate the newer data.

The main data source for the linear inventory is the CGS 2016 GIS database. Where available, data from the hydraulic models of the W&WW Master Plan were used to supplement missing data, mainly for missing diameters, materials and installation years.

The following sections describe the City of Greater Sudbury's Water and Wastewater asset portfolio in terms of (1) quantity, (2) replacement value, (3) age, (4) condition, and (5) risk. A detailed asset-level inventory is attached as digital media to this report. In addition, a summarized Facility Inventory is provided as Appendix A to this report; and a complete set of Linear Risk Map is provided as Appendix B. These lists and summaries provide an overview of the City's water and wastewater portfolio based on desktop estimations for the different aspects of the existing infrastructure. These estimations will then serve as the basis for forecasting the expenditure needs in the following sections.

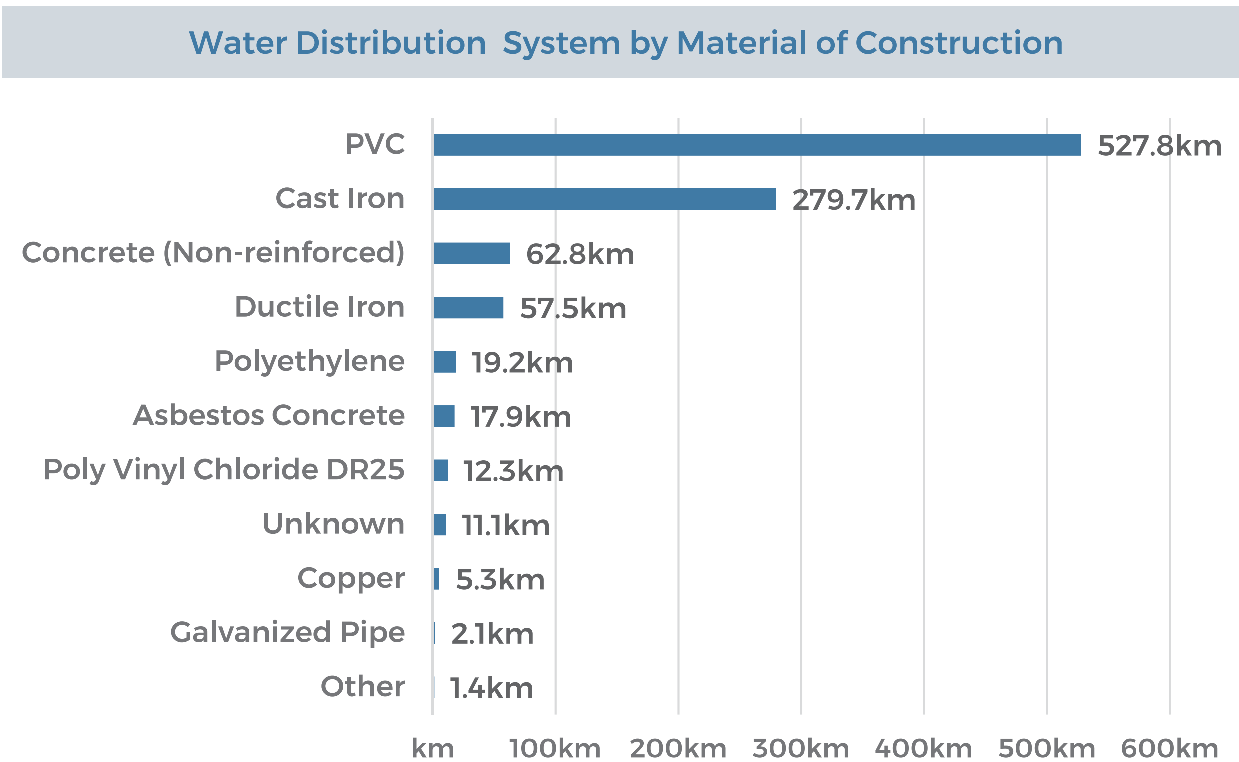
2.3 ASSET PORTFOLIO SUMMARY

2.3.1 PORTFOLIO BY QUANTITY

WATER SYSTEM

The City of Greater Sudbury is responsible for the operation and maintenance of approximately 997 km of watermains (Figure 2-1), 5,699 fire hydrants, 8,950 valves, 2792 valve chambers, 533 km of service connections, 90 control valves, 47,940 water meters, and 6 water meter stations. Within the City of Greater Sudbury, the Sudbury municipal water system includes 553 km of watermains, making it the largest independent water distribution system. The second largest water distribution system is the Valley Water System (281 km of watermains). Both systems contribute approximately 84% to the total length of the watermains in the City.

Figure 2-1 Watermains Length by Material

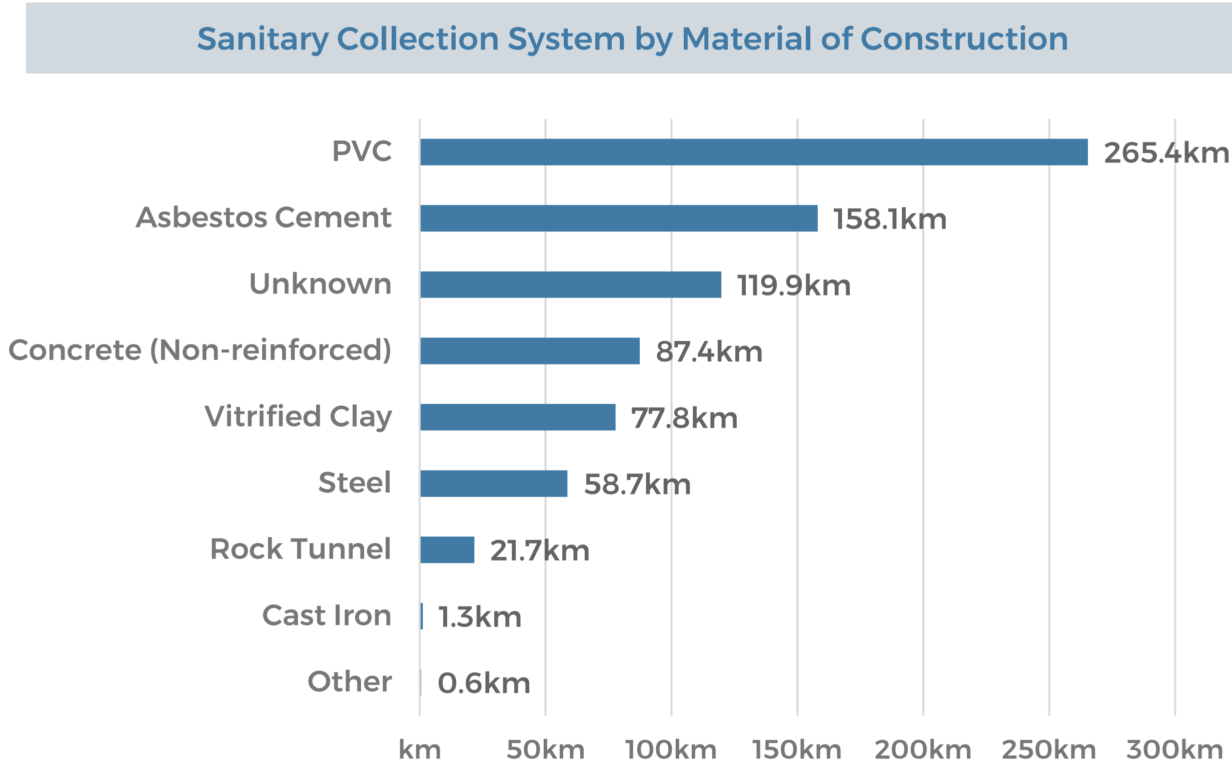


The City is also responsible for the operation and maintenance of approximately 60 water facilities, including 12 booster stations, 13 small water systems, 1 raw water pump station, 1 pressure control building, 9 water storage facilities, 2 water treatment plants, 2 small treatment facilities, and 20 water well houses. As is common with asset inventories, some discrepancies have been noted in datasets utilized in preparing this AMP. Best practice recommends continual verification and validation of asset data through future works. It is recommended that the Valley Water System dataset be given priority for verification, because of known or suspected discrepancies in the record data.

WASTEWATER SYSTEM

The City of Greater Sudbury is responsible for the operation and maintenance of approximately 791 km of sanitary sewers including 21.7 km of rock tunnel (Figure 2-2) , with 381 km of service connections, 9.7 km of sanitary pressurized sewers, 11,726 maintenance holes, 70 control valves and 21 drop shafts.

Figure 2-2 Sanitary Sewers Length by Material



The City is also responsible for the operation and maintenance of approximately 83 wastewater facilities, including 69 lift stations, 4 wastewater lagoons, and 10 wastewater treatment facilities.

2.3.2 PORTFOLIO BY REPLACEMENT VALUE

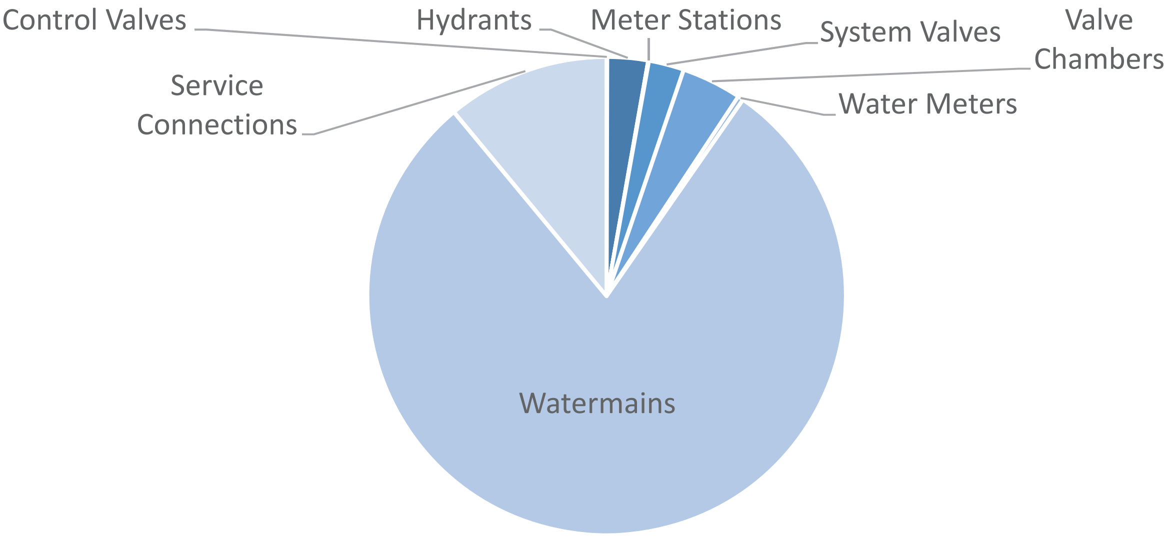
A 2017 estimated replacement value for each asset was developed for all assets in the water and wastewater portfolio. The assumed vertical infrastructure replacement values used in this Plan are based on the replacement costs assigned to each facility under the 2015 Tangible Capital Asset reporting update and escalated forward to 2017 at a rate of 2% per year to determine the 2017 replacement cost. The linear infrastructure replacement costs used in this Plan are based on the Linear Water Infrastructure Cost Estimation parameters, developed for the Master Plan. Summaries for the water linear, water vertical, wastewater linear and wastewater vertical infrastructure are provided in the following pages; total replacement for the entire inventory is estimated at $4.5 Billion.

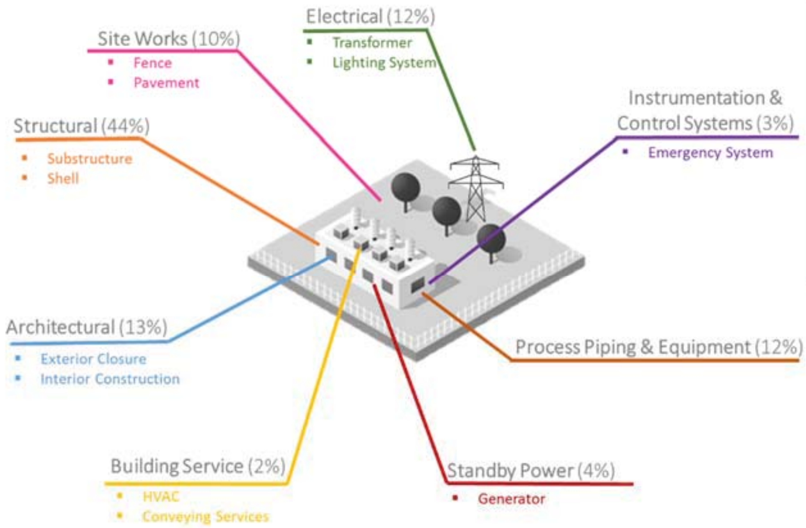
Water Linear Infrastructure Replacement Value: $2,170M

Table 2-1 Water Linear Infrastructure Replacement Value by Asset Type

ASSET TYPE	QUANTITY	REPLACEMENT VALUE (MILLION)
Watermains (km)	997	$1,720.9
Service Connections (km)	533	$239.2
System Valves	8950	$51.8
Control Valves	90	$0.8
Hydrants	5699	$59.6
Meter Stations	6	$1.2
Valve Chambers	2792	$87.9
Water Meters	47940	$8.23

Figure 2-3 Water Linear Infrastructure Replacement Value by Asset Type





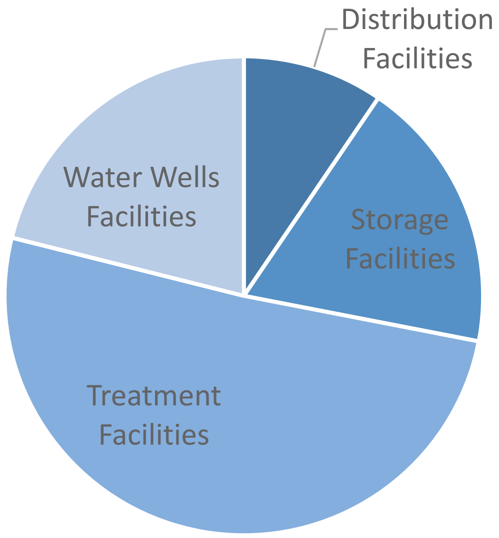
Water Vertical Facilities Replacement Value:

$179M

Table 2-2 Water Vertical Facilities Replacement Value by Facility Type

FACILITY TYPE	QUANTITY	REPLACEMENT VALUE (MILLION)
Distribution Facilities	26	$17.0
Storage Facilities	9	$33.3
Treatment Facilities	2	$91.2
Water Wells Facilities	20	$37.8

Figure 2-4 Water Vertical Facilities Replacement Value by Facility Type



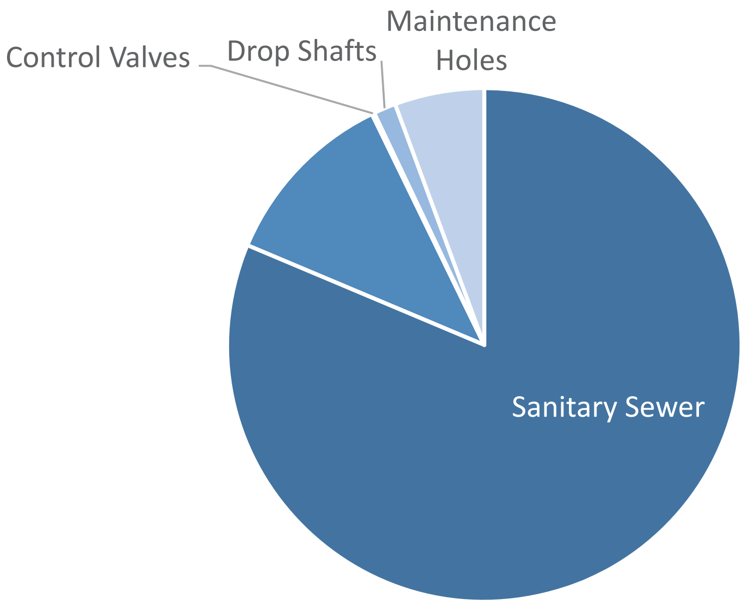
Wastewater Linear Infrastructure Replacement Value:

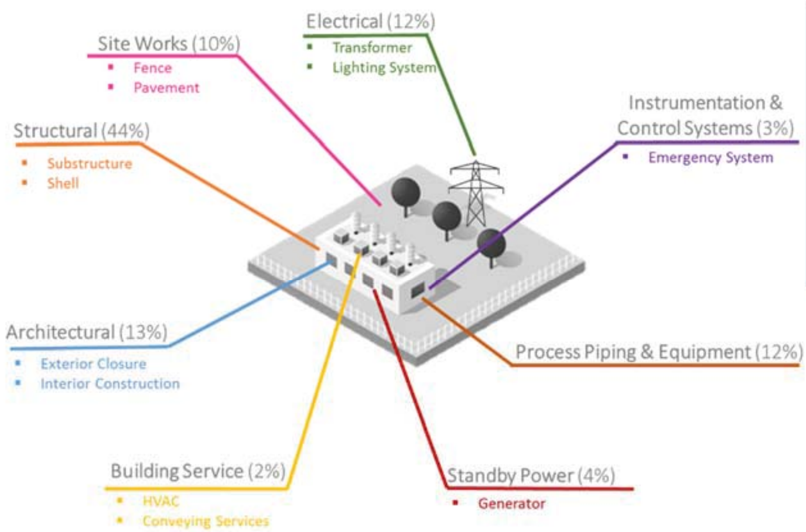
$1,493M

Table 2-3 Wastewater Linear Infrastructure Replacement Value by Asset Type

ASSET TYPE	QUANTITY	REPLACEMENT VALUE (MILLION)
Sanitary Sewer (km)	791 km	$1,215
Lateral Connections (km)	381 km	$171
Control Valves	70	$2.4
Drop Shafts	21	$21
Maintenance Holes	11,726	$84

Figure 2-5 Wastewater Linear Infrastructure Replacement Value by Asset Type





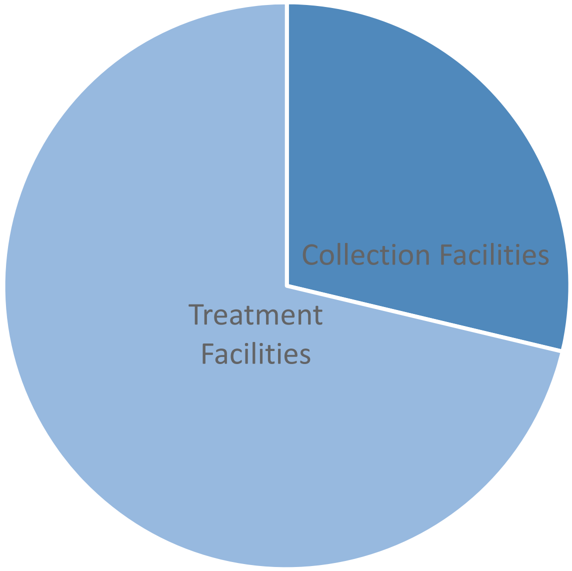
Wastewater Vertical Facilities Replacement Value:

$655M

Table 2-4 Wastewater Vertical Facilities Replacement Value by Facility Type

FACILITYFUNCTION	QUANTITY	REPLACEMENT VALUE (MILLION)
Collection Facility	69	$188.0
Treatment Facility	14	$466.5

Figure 2-6 Wastewater Vertical Facilities Replacement Value by Facility Type



2.3.3 PORTFOLIO BY ASSET AGE

EXPECTED SERVICE LIFE

Asset service life estimates (Table 2-5, Table 2-6, Table 2-7) were developed based on industrial accepted standards and local experience of City staff. In cases where material data was missing, this field was populated based on the material used in the hydraulic model, if available.

Table 2-5 Linear Asset Expected Service Life (Years) by Material

Material	Description	Water Mains	Sewers
AC	Asbestos Cement	55	55
CI	Cast iron	60	60
CIPP	Cured in place	80	-
COP	Copper	60	-
CP	Concrete (non-reinforced)	95	90
DI	Ductile iron	40	40
GP	Galvanized pipe	60	-
HDPE	High density polyethylene	80	80
PE	Polyethylene	55	55
PVC	Poly vinyl chloride	105	105
SP	Steel	60	60
UNK	Unknown	60	60
VC	Vitrified Clay	-	55

Table 2-6 Expected Service Life (Years) for Water Appurtenances

Description	Expected Service Life
Hydrants	60
System Valves	40
Control Valves (PRV, SRV, ARV)	30
Service Connections	60
Water Meters	20
Maintenance Holes and Chambers	70

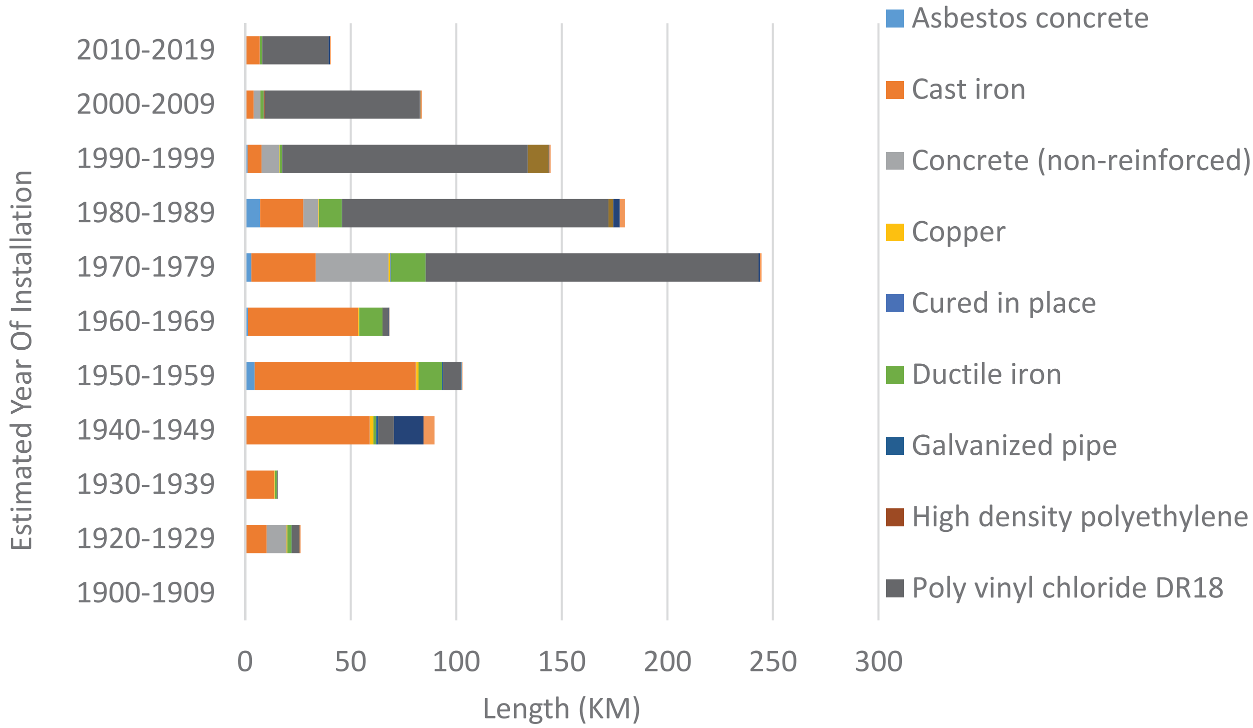
Table 2-7 Vertical Facility Assets Expected Service Life (Years)

Lifecycle Category	Water	Wastewater
Structural	80	80
Architectural	20	20
Building Services	20	20
Site Works	25	25
Process Piping & Equipment (PP&E)	30	25
Electrical	30	30
Instrumentation & Control Systems and Life Safety & Compliance Systems (I&CS)	15	15
Standby Power	25	25
Sanitary Forcemain	-	Varies by material per linear inventory

WATER SYSTEM

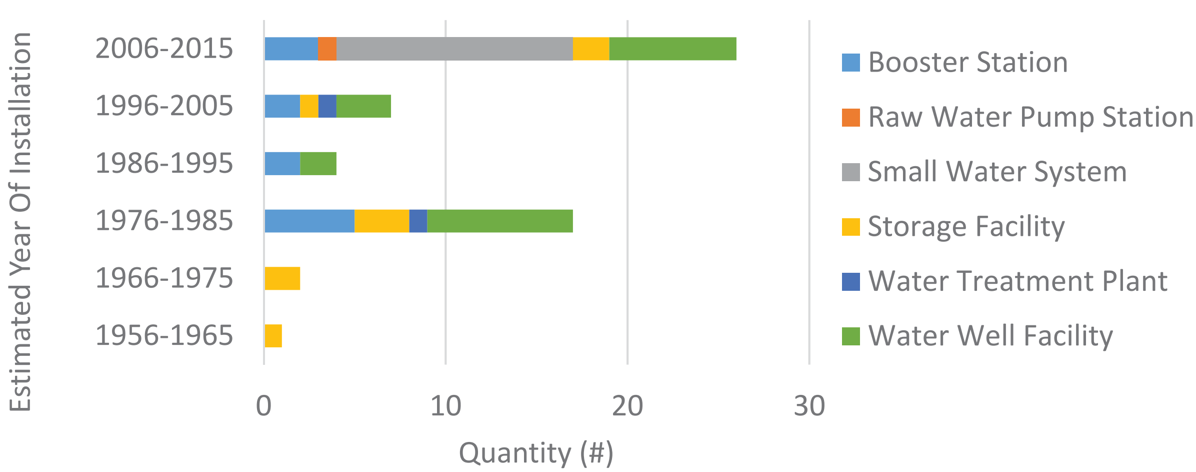
Installation dates for the linear water dataset were captured from both the City's GIS dataset and the hydraulic models; Considerable GIS analysis was applied to integrate those two data sets, and to estimate missing installation dates based on adjacent infrastructure. Examination of the age distribution of watermains in the City of Greater Sudbury (Figure 2-7) shows that the 1970's –1990's have witnessed a considerable construction phase, along with the wide spread implementation of PVC pipes.

Figure 2-7 Watermains Material Distribution by Year of Installation and Length[1]



The majority of the water facilities in the City of Greater Sudbury were constructed in the 2000s. The Falconbridge Tank is one of the oldest water facilities in the City. A summary of age distribution by facility type is shown in Figure 2-8.

Figure 2-8 Water Facilities Age Distribution by Facility Type

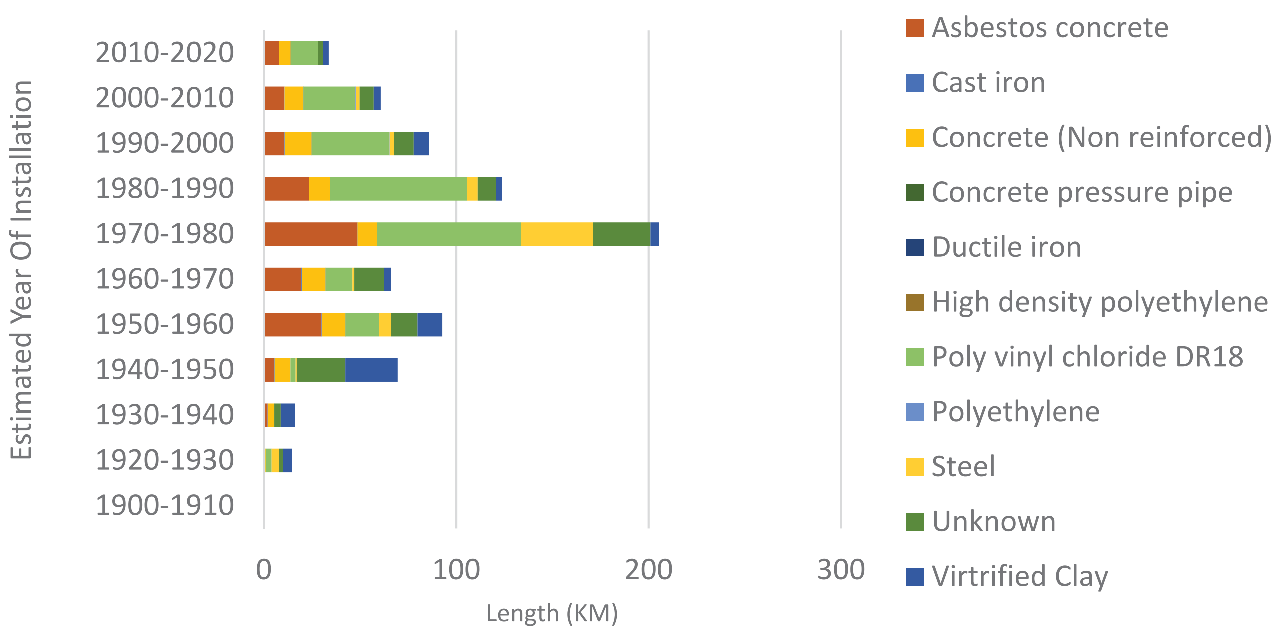


[1] In some cases, material documented for infrastructure that has been replaced\rehabilitated may still reflect the originally installed material.

WASTEWATER SYSTEM

Installation dates for the sanitary sewers were not available and were estimated based on adjacent watermains. The ages of the sanitary sewers in the City of Greater Sudbury (Figure 2-9) is expected to follow a similar distribution as the water linear infrastructure, with considerable installations in the 1970's – 1990's.

Figure 2-9 Sanitary Sewer Age Distribution



The majority of the wastewater facilities in the City of Greater Sudbury were constructed before the 1980s. The St. Charles, Nickel, Lagace Lift Station and Lakeview Lift Station are among the oldest wastewater facilities in the City. They were originally constructed in 1946. A summary of age distribution of facilities is shown in Figure 2-10.

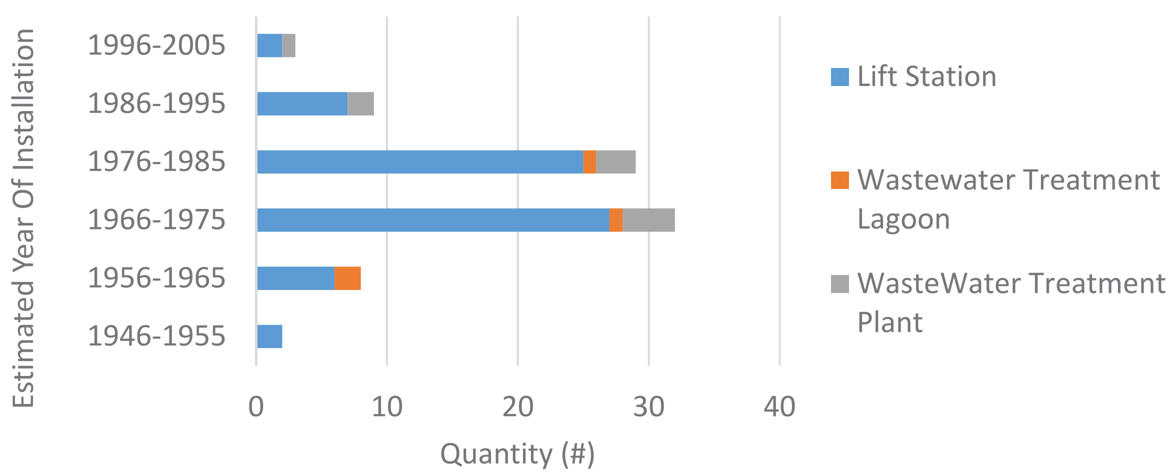


Figure 2-10 Wastewater Facilities Age Distribution

2.3.4 PORTFOLIO BY CONDITION

CONDITION RATING SCALE

Asset condition was assigned to the City's Water and Wastewater infrastructure based on asset life expectancy and asset age. Condition scores (Table 2-8) were assigned using a rating system of 1 (early stage of lifecycle) to 5 (reaching or beyond expected useful service life).

Table 2-8 Asset Condition Rating Scale

Rating	Grade	Definition	Description
1.0 – 1.3	A+	0-30% of Expected Service Life	Typically very good condition; perform normal maintenance
1.4 – 1.6	A		
1.7 – 1.9	A-		
2.0 – 2.3	B+	30-50% of Expected Service Life	Typically good condition; perform normal maintenance.
2.4 – 2.6	B		
2.7 – 2.9	B-		
3.0 – 3.3	C+	50-75% of Expected Service Life	Typically fair condition; significant maintenance, small dollar amount
3.4 – 3.6	C		
3.7 – 3.9	C-		
4.0 – 4.3	D+	75-95% of Expected Service Life	Typically poor condition; requires major rehabilitation, large dollar amount
4.4 – 4.6	D		
4.6 – 4.9	D-		
5.0	F	>95% of Expected Service Life	Typically very poor condition; requires asset replacement, replacement cost.

WATER SYSTEM

While the majority of linear assets in the City of Greater Sudbury's water portfolio, by length, are at their first half of expected service life and are therefore assumed to be in good condition (Figure 2-11), approx. 25% of the network is assumed to be in very poor condition, in many cases having significantly surpassed the infrastructure's useful lives. These portions of the network typically heavily affect O&M costs and capital investment needs; the financial impact of this group of assets is demonstrated in the financial strategy section of this report. The assumed condition of the watermains varies significantly by material (Table 2-9).

Figure 2-11 Watermains Expended Service Life by Length (km.)

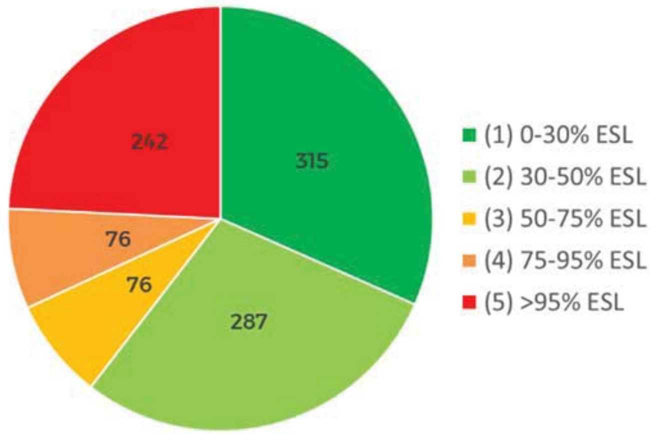


Table 2-9 Watermains Condition By Material

MATERIAL	AVERAGE AGE (YEARS)	EXPECTED SERVICE LIFE (YEARS)	AVERAGE CONDITION RATING	CONDITION GRADE
PVC	31	105	1.5	A
Concrete	47	95	2.3	B+
High Density Polyethylene	10	80	1.1	A+
Cured in place	38	80	2	B+
Steel	17	60	1.4	A
Galvanized pipe	66	60	4.7	D-
Copper	62	60	4.4	D
Cast iron	58	60	4.2	D+
Polyethylene	61	55	4.4	D
Asbestos Concrete	44	55	3.7	C
Ductile Iron	49	40	4.6	D

Most water facilities in the City due to their age, are expected to be in good condition (Figure 2-12, Table 2-10). Yet once again the dominant "Very Poor" group greatly affects the overall condition of the facilities and drives the maintenance and rehabilitation needs which will be discussed further.

Figure 2-12 Water Facilities Expended Service Life by Replacement Cost

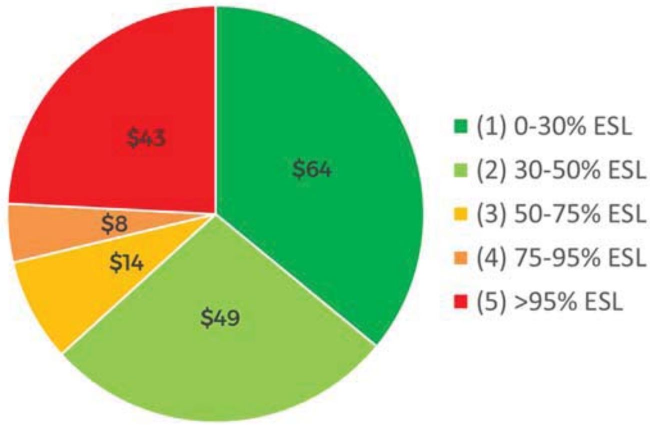


Table 2-10 City of Greater Sudbury Average Facility Condition by Facility Type

FACILITY TYPE	NUMBER OF FACILITIES	AVERAGE AGE	AVERAGE CONDITION	CONDITION GRADE
Water Well Facilities	20	22	2.6	B
Small Water Systems	13	10	1.4	A
Booster Stations	12	23	2.6	B
Storage Facilities	9	33	2.5	B
Water Treatment Plants	2	27	3.0	C+
Small Treatment Facilities	2	15	2.0	B+
Raw Water Pump Station	1	10	1.4	A
Pressure Control Building	1	7	1.1	A+

WASTEWATER SYSTEM

Based on the estimated age and expected service lives, over half of the City of Greater Sudbury's sanitary sewer network, by length, has surpassed 50% of the expected service life, and is assumed to be in fair condition; once again with a significant group of 23% of assets estimated to be in very poor condition (Figure 2-13). The assumed condition for individual sewer materials is displayed in Table 2-11.

Figure 2-13 Sanitary Sewer Expended Service Life by Length (km)

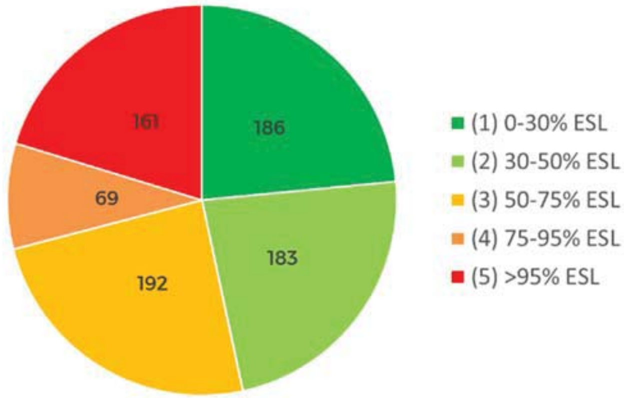


Table 2-11 City of Greater Sudbury Average Sanitary Sewer Condition by Material

MATERIAL	AVERAGE AGE (YEARS)	EXPECTED SERVICE LIFE (YEARS)	AVERAGE CONDITION RATING	CONDITION GRADE
PVC	35	105	1.7	A-
Concrete	41	90	2.3	B+
High density polyethylene	12	80	1	A+
Steel	47	60	3.3	C+
Cast Iron	58	60	3.7	C-
Polyethylene	16	55	1.2	A+
Asbestos Cement	43	55	3.5	C
Vitrified Clay	50	55	3.8	C-
Ductile Iron	17	40	1.5	A

Based on asset age and expected service life, the condition for facilities is generally poor (Figure 2-14, Table 2-12) as a result of a majority of facility assets having reached or approaching the end of their useful service life.

Figure 2-14 Wastewater Facilities Expended Service Life by Facilities' Replacement Cost

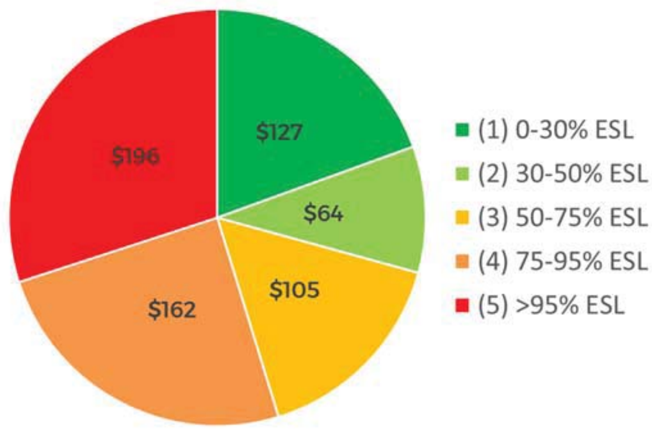


Table 2-12 City of Greater Sudbury Average Facility Condition by Facility Type

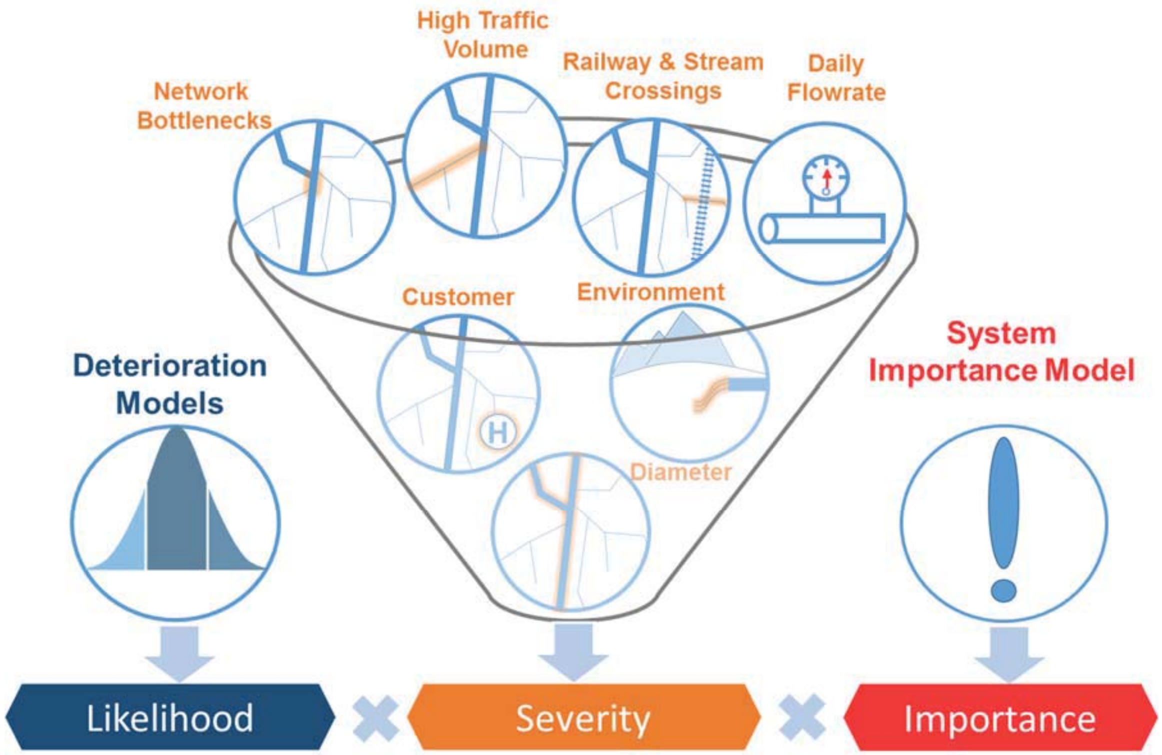
FACILITY TYPE	NUMBER OF FACILITIES	AVERAGE AGE (YEARS)	AVERAGE CONDITION	AVERAGE CONDITION DESCRIPTION	CONDITION GRADE
Lift Stations	69	42	3.3	Fair to Poor	C+
Wastewater Treatment Lagoons	4	46	4.8	Very Poor	D-
Wastewater Treatment Plants	10	36	3.9	Poor	C-

2.3.5 ASSET RISK

RISK ASSESSMENT METHODOLOGY OVERVIEW

Understanding risks is important for maintaining the functionality and safety of the City's infrastructure, and serves as a means for prioritizing the investment of available resources. A risk score was calculated system wide on all asset types individually expressed as the product of Likelihood of Failure, Severity of Failure, and Importance factor. These terms are illustrated in Figure 2-15 and are described below. In section 5 – Financing Strategy, the overall system average of these risk scores is then used as a bench mark for assessing the long term impact of varying investment scenarios.

Figure 2-15 Risk Methodology



PROBABILITY OF FAILURE (LIKELIHOOD)

Probability of Failure represents the chance that an asset will not be able to fulfill its intended purpose, expressed as a decimal between 0 and 1. A Probability of Failure of 0 implies that there is no chance that the asset will fail in a given year, whereas a probability of failure of 1 implies that the asset is statistically certain to fail in the given year. Both values are theoretical since at a given year the probability of failure will never be 0 or 1.

For linear infrastructure, material-specific deterioration models were developed utilizing watermain break data between the years 1990-2014. Where statistically significant, the models were utilized to determine the future behavior of watermain segments. If a material-specific model could not be applied due to limited failure records, a generic model for the deterioration of all materials was also derived. For linear appurtenances an age-based deterioration model was implemented that assessed an asset's risk relative to its age and expected service life.

Facilities were discretized into separate asset lifecycle categories / discipline groups (e.g., structural, architectural, electrical, site works, etc.). The Probability of Failure for each category was taken as proportional to the category age versus its estimated service life applying an age-based deterioration model.

CONSEQUENCE OF FAILURE (SEVERITY)

Consequence of failure represents the impact to stakeholders if an asset fails to fulfill its intended purpose, and is a relative representation of an asset within its discipline group. As an example, Consequence of Failure can be used to communicate the relative severity of one watermain failing compared to another watermain. The Consequence of Failure is determined for the different assets and asset types based on their geographic and engineering contexts. For this AMP, Consequence of Failure has been expressed as an integer between 1 and 5 (Table 2-13).

Table 2-13 Consequence of Failure Rating System

SEVERITY	DESCRIPTION	RATING
Insignificant	No disruption to normal operation, no environmental impact, no financial investment.	1
Minor	Some manageable operation disruption, minor environmental impact, small financial investment.	2
Moderate	Significant modification to normal operation but manageable, easy to mitigate environmental impact, moderate financial investment.	3
Major	Reduced production with inability to meet demand imminent, significant environmental impact, large financial investment.	4
Catastrophic	Inability to meet demand, potential injury, severe environmental impact, significant financial investment.	5

Separate factors were assessed within each asset category to determine the final Consequence of Failure rating. These factors or summarized by asset category in Table 2-14.

Table 2-14 Risk Factors by Asset Category

Asset Category	Risk Type	Parameter
Linear Assets	Technical	Capacity
		Network Bottlenecks (number of directly affected customers)
		Railway and River Crossings
		Road Hierarchy and Traffic Volume
	Community	Affected Critical Customers
	Environment	Nepahwin and Ramsey Lakes underwater mains
		Adjacent to major Water Bodies in natural environment
Lift Station	Wet Weather Flowrate_2 year Storm (m3/day)	
Water Storage Tank	Storage Capacity (mL: million Liter)	
Wastewater Treatment Facility & Lagoon	Wastewater Facility Rated Capacity(m3/day)	
Water Treatment Facility	Rated Capacity(m3/day)	
Booster Station	Pump Total Capacity (L/s)	

IMPORTANCE FACTOR

In order to compare risk across different asset groups and allow for computation of system wide risk rates, the above Probability and Consequence of Failure scores were translated into a universal value using an Importance Factor to rank and prioritize specific asset groups based on various considerations such as redundancy, ease of repair and backup measures/strategies should the asset fail. An Importance Factor table was developed using an Analytic Hierarchy Process to determine relative weightings between the importance of the various asset types across the water and wastewater portfolios.

APPLICATION OF RISK

A risk score was applied to each individual asset using the framework described in the previous section, gathering technical attributes and applying GIS tools to assess geospatial data contributing to the Consequence of Failure for linear assets.

CORRIDOR-BASED PROJECT LIMITS

To more realistically identify linear infrastructure projects, linear assets were grouped into corridor-based projects for analysis purposes. These projects address both water and sewer mains, as well as associated appurtenances, but at this iteration of the AMP are not associated with road corridors and infrastructure. These W&WW corridor-based projects were identified through geospatial automation, grouping adjacent linear mains and appurtenances roughly defined as junction-to-junction segments. It is important to keep in mind that these project limits are approximations; when the decision is made to rehabilitate or replace infrastructure, the linear assets to be included in the scope of work may vary and therefore the capital investment requirements should be reassessed at the project planning stage.

2.4 NEXT STEPS

The City of Greater Sudbury currently does not have a policy in place for the ongoing management of Asset Management Data. A suitable policy, including an associated data dictionary, should be established for future iterations of the AMP.

Greater Sudbury is part of a select group of municipalities to have committed to adopting the ambitious “open by default” standard. “Open Data by Default” is the first principle of the G8 Open Data Charter, which was adopted by Canada in 2013. Open by default means that data approvals should start from a position of data openness and that data should be released unless privacy, security, legal or other restrictions exist.

Dataset releases must follow the requirements of the Municipal Freedom of Information and Protection of Privacy Act, R.S.O. 1990, c. M.56 [MFIPPA], Personal Health Information Protection Act, 2004, S.O. 2004, c. 3, Sched. A, and all other applicable legislation. Datasets containing personally identifiable information or subject to any privacy, security, legal or other restrictions will not be released as open data. The City may also have contractual or other obligations, all of which may limit the data which can be published on the Open Data Portal. When a dataset cannot be released as-is due to any restrictions, staff will evaluate whether a modified version of the dataset can be released that would comply with such requirements.

The State of Local Infrastructure has been prepared based on the most complete data set for each asset category. Moving forward, the asset inventory will need to be maintained and augmented to support the objectives of the City's Asset Management Planning framework and improve accuracy of future Asset Management Plan iterations.

Next steps have been identified and are provided in Table 2-15

Table 2-15 State of Infrastructure Next Steps

<table>
<tr><th>Category</th><th>Details</th></tr>
<tr><td>General Infrastructure</td><td>Implement comprehensive asset identification standard that will be used in all relevant data sets including GIS, Hydraulic Model and PSAB, and in associated capital and O&M project lists.
Refine and improve risk framework introduced in this AMP; develop lists of critical assets, customers and environments and re-evaluate assigned weights.</td></tr>
<tr><td>Linear Infrastructure</td><td>GIS vs. hydraulic model:
Capture data existing in the hydraulic models (such as material and installation dates) and integrate into GIS.
Significantly improve topology of GIS, to allow for small-scale trace analysis and to meet the hydraulic modelling requirements.
Define clear relationship between the hydraulic model and the GIS; develop standard editing procedures for these two datasets with the aim of minimizing duplicate efforts and costs, and providing one source of data.
Capture installation dates from all relevant sources, including GIS, hydraulic model, as-built drawings and staff knowledge.
Accurately link pipe failure and condition data to allow for seamless computation. It is recommended that mobile GIS solutions be implemented for on-site digitization of data at a high resolution.
It is recommended that the City undertake a project to develop a corridor segmentation strategy that will enable realistic statistical computation of condition and risk ratings; and will further allow for the implementation of corridor based planning across different infrastructure disciplines, mainly roads.</td></tr>
<tr><td>Vertical Infrastructure</td><td>Enhance vertical infrastructure asset inventory granularity, accuracy, and completeness including:
Construction or in-service year
Acquisition, replacement cost
Condition assessments and expected service lives
Risk assessment – consequence of failure in terms of regulatory requirements, environment and health and safety
Conduct detailed condition assessments to arrive at actual condition and needs</td></tr>
</table>

LEVELS OF SERVICE

3 LEVELS OF SERVICE

Levels of service provide the means to measure customers' needs and expectations of the City and the services provided, and offers a mechanism for communicating costs of services. The level of service metrics selected are driven by the City's Vision, Mission and Values and are therefore focused on the impact to citizens, communities and the natural environment. This section outlines the expected levels of service for the CGS's water and wastewater systems.

Since the objectives of this Asset Management Plan have been developed based on the City's documented objectives (Table 3-1), the asset management decision-making process can also be said to follow the City's Mission, Vision, and Values.

Table 3-1 Alignment of Asset Management Plan with Corporate Objectives

Mission, Vision and Values	Objective	Implication to Asset Management Plan
To support a growing community with quality municipal services	To ensure that all growth is well managed, well designed and sustainable.	New/upgraded infrastructure projects are focused in designated areas as outlined in the City's strategic planning documents. The recommendations from the Water and Wastewater Master Plan have been explicitly integrated into the Asset Management Plan's financial strategy.
To demonstrate innovative leadership amongst northern communities	Embrace infrastructure asset management as a best practice throughout the organization and become an Asset Management leader amongst Northern Ontario Municipalities	This first edition of the Asset Management Plan aims to move beyond basic asset management practices. Its development has included updates to the asset registry through data scrubbing efforts, identification of initial Levels of Service aligned with the City's core objectives, a detailed Risk analysis considering actual infrastructure failure records and advanced deterioration modeling, and a corridor-based Long-Term Financial Plan integrated with the City's Water and Wastewater Master Plan that will support future efforts to provide sustainable services to the community.
Acting today in the interests of tomorrow	Develop a strategic Asset Management Plan that relies upon social, environmental and financial risk as a means to prioritize infrastructure investment decisions	A risk-based prioritization framework has been implemented throughout this AMP to facilitate strategic infrastructure decision-making. Further, integration of the Water and Wastewater Master Plan recommendations provides an overall Plan that considers not only the ongoing management of existing infrastructure but also development to meet future needs.

3.1 STAKEHOLDER ANALYSIS

A customer satisfaction survey or measure of willingness to pay, was not undertaken as part of this iteration of the City's Asset Management Plan. Future asset management initiatives and updates to the Asset Management Plan should focus on stakeholder and community engagement in developing Levels of Service.

Some of the City's stakeholders include:

- Regulatory bodies
- City of Greater Sudbury community, visitors
- Local industry
- City Council
- City Departments

3.2 REGULATORY REQUIREMENTS

Regulatory bodies represent one of the City's critical stakeholders. As a minimum level of service, there are regulatory requirements associated with the CGS water and wastewater infrastructure that must be met (Table 3-2). These represent an absolute minimum level of service targets that must be met by the City, but are not expressly tracked within this Plan.

Table 3-2 Minimum Regulatory Requirements

ASSET CATEGORY	REGULATORY REQUIREMENTS
Water and Wastewater Infrastucture	Environmental Protection Act Ontario Water Resources Act, R.S.O. 1990 Safe Drinking Water Act, 2002
Facilities	Building Code Act, 1992(Ontario Regulation 332/12) Accessibility for Ontarians with Disabilities Act (AODA)

3.3 CUSTOMER LEVELS OF SERVICE

Levels of service are defined in terms of Customer Level of Service and Technical Level of Service. Customer levels of Service are Qualitative statements about the expectations of the customers served by the infrastructure. Technical Levels of Service are Quantitative objectives about the infrastructure that the City can measure their performance against.

Customer Levels of Service focus on the Quality, Function and Capacity of the infrastructure.

Quality How good is the service?

Function Does the service meet users' needs?

Capacity Is the service over- or under-utilized?

The City of Greater Sudbury water and wastewater division has established the following statement, describing its mission and commitment:

> *"The City of Greater Sudbury's Water and Wastewater Services Division is committed to providing its customers with safe, reliable, and environmentally responsible municipal water and wastewater services through a sustainable, cost effective approach."*

Specific performance measures, targets, and timelines have been established for water (Table 3-3) and wastewater (Table 3-4).

Table 3-3 Customer Level of Service Targets and Performance – Water

Service Attribute	Service Objective	Performance Measure	Current Performance	Future Objective
Quality	High quality potable water	Taste/Odour/Colour complaints	21	Complaints remain at/below the current level
Function	Minimal disruptions to service	Number of unplanned System Outages	TBD	Number of unplanned interruptions remain at the current level
Capacity /Utilization	Water supply system is adequately maintained and upgraded to meet current and future demands	Water pressure and water volume are meet / exceed minimum design requirements	TBD	Maintain 100% conformance

Table 3-4 Customer Level of Service Targets and Performance – Wastewater

Service Attribute	Service Objective	Performance Measure	Current Performance	Future Objective
Quality	Provide wastewater treatment meeting / exceeding effluent objectives	Number of non-conforming events i.e. sewage bypasses	33 /year	Number of bypass events remain at current levels
Function	Minimal disruptions to service	Number of City side sewer backups reported	52 /year	Number of backups remain at the current level

Service Attribute	Service Objective	Performance Measure	Current Performance	Future Objective
Capacity /Utilization	Collection and Treatment systems are adequately designed, maintained and operated to meet system requirements	Collection and Treatment facilities meet service requirements identified in design and planning documents	28% of system non-conforming	Reduction in % of non-conformance

3.4 TECHNICAL LEVELS OF SERVICE

Technical Levels of Service connect Customer Levels of Service to the physical characteristics of the asset(s). These measures are also used to relate the Customer Level of Service to resources required to achieve the specified targets.

Technical levels of service have been defined for both water (Table 3-5) and wastewater (Table 3-6) infrastructure, along with future objectives. Considering the City's considerable infrastructure renewal backlog and the significant infrastructure deficiencies identified through the Water and Wastewater Master Plan, affordable initial Level of Service targets have been selected.

Table 3-5 Technical Level of Service Performance Measures – Water

TECHNICAL PERFORMANCE MEASURE	UNIT	Current Performance	Future Objective
Water main breaks	No/year	98	Number of breaks remain at current level
Number of connection-days where a boil water advisory notice is in place	No/year	TBD	Boil water advisory notices remain at the current level
Cleaning and swabbing of small diameter water mains	KM/year	90	90
System valves inspected, operated and documented	No.	TBD	3,000
Planned vs. unplanned maintenance in facilities	%	TBD	Ratio remain at the current level

Table 3-6 Technical Level of Service Performance Measures – Wastewater

TECHNICAL PERFORMANCE MEASURE	UNIT	Current Performance	Future Objective
Total number of sewer and service connection blockages that resulted in a back up	No/ 100km/yr	13.35	Sewer blockages remain at the current level

TECHNICAL PERFORMANCE MEASURE	UNIT	Current Performance	Future Objective
CCTV inspection and flushing/cleaning program	KM/year	72	72
Total number of reported overflows	No.	10	Overflows remain at the current level
Number of bypasses	No/year	33	Number of bypass events remain at current level
Planned vs. unplanned maintenance in facilities	%	TBD	Ratio remain at current level

3.5 NEXT STEPS

The following recommendations have been identified:

Table 3-7 Levels of Service Next Steps

CATEGORY	DETAILS
Performance Measures	Continue to collect and report on performance measures currently tracked, while developing collection and reporting strategies for newly identified performance measures
Desired Levels of Service and Public Consultation Process	While select Levels of Service and Key Performance Indicators were identified for measuring the implementation of this AMP, additional work is recommended to identify and detail the true customer expectations. We recommend that the City approach its stakeholders and, through a public consultation process, document their expectations and desired service levels while gauging the willingness to pay. By connecting services provided with the money spent or forecast for the work to the stakeholder expectations, a complete line of sight can be provided that will support the City in providing justification for asset management decisions.

ASSET MANAGEMENT STRATEGY

4 ASSET MANAGEMENT STRATEGY

This section outlines strategies based on four (4) lifecycle strategies (operations & maintenance strategies, renewal / rehabilitation strategies, capital replacement strategies, and disposal strategies), expansion strategies and non-infrastructure strategies.

4.1 LIFECYCLE STRATEGIES

Implementing an annual maintenance program and completing timely renewal works will keep the infrastructure performing at the desired levels of service and at the same time prolong the life of the infrastructure and reduce overall spending. Therefore, the most cost effective strategy for managing the City's infrastructure is to perform annual maintenance and complete timely renewal works.

4.1.1 OPERATIONS & MAINTENANCE STRATEGIES

Maintenance is essential to managing infrastructure, as the expected level of service often relies on maintenance activities. Regular maintenance can also add significant life to assets. In addition to ongoing observations of condition and performance established during regular operation, it is important that the City schedule regular inspections of its assets to identify maintenance and capital requirements. An initial recommended inspection and testing strategy for the water and wastewater facilities has been developed (Table 4-1); it is recommended that the City continue to refine these strategies as the City's asset management practices evolve.

Table 4-1 Recommended Inspection and Testing Strategy for Water and Wastewater Facilities

Facility	Recommended Treatment	Timing (Years)	Estimated Annual Cost (2017 $)	Description
Water Reservoirs	Water Storage Facility Cleaning & Inspection	Every 3 Years	$80,000	Remotely operated vehicle (ROV) inspection program
Water Treatment Plants	Inspect Plant Intake Structure	Every 10 Years	$65,000	ROV/Diver inspection program
Wastewater Treatment Plants	Piping Inspection and Condition Assessment	Every 5 Years	$75,000	Non-destructive inspection and testing
Water Treatment Plants	Piping Inspection and Condition Assessment	Every 5 Years	$75,000	Non-destructive inspection and testing
Wastewater Treatment Plants	Transformer and MCC Inspection & Maintenance	Biannually	$15,000	Maintenance Testing and Inspection per ANSI/NETA MTS-2015

Facility	Recommended Treatment	Timing (Years)	Estimated Annual Cost (2017 $)	Description
Water Treatment Plants	Transformer and MCC Inspection & Maintenance	Biannually	$15,000	Maintenance Testing and Inspection per ANSI/NETA MTS-2015
Water Wells	Well Inspection	Every 3 Years	$310,000	Water Well Inspection program
W\WW Facilities	Facility Audits	10 Year Cycle	$300,000	Audits on all Facilities on a 10 year Cycle

It is recommended that the City undertake regular condition assessments of its infrastructure and apply maintenance records, local knowledge, and CCTV records of piping to update asset condition ratings. The City should use this information to develop suitable predictive and preventative maintenance strategies for assets as is commensurate with the inherent risk and importance of the assets, including refinement of the inspection and testing schedule.

Initial operations and maintenance strategies for the water and wastewater facilities have been recommended (Table 4-2); it is recommended that the City continue to refine these strategies as the City's asset management practices evolve.

Table 4-2 Recommended O&M Strategy for Water and Wastewater Facilities

Facility Assets	Recommended Treatment	Timing (Years)	Intervention Cost (% of Replacement Cost)	Description	Estimated Annual Cost (2017 $)
Architectural Components	Architectural Inspection/ Maintenance	Every 5 Years	5.0%	Roof debris removal (2x annually), visual inspection (2x annually), and minor roof membrane repairs	$700,000
Building Services	Building Services Equipment Inspection	Annually	1.0%	Heat, ventilation equipment inspection	$270,000
Electrical Components	Electrical System Inspection & Maintenance	Every 4 Years	1.0%	Electrical service & distribution system inspection and maintenance	$175,000
I&C Systems and Life Safety Systems	Instrumentation & Control Systems Inspection	Annually	2.0%	Maintenance & inspection of instrumentation and inspection/testing of health & safety systems i.e. Fire extinguishers, hoists, anchor points	$380,000

Facility Assets	Recommended Treatment	Timing (Years)	Intervention Cost (% of Replacement Cost)	Description	Estimated Annual Cost (2017 $)
W\WW Facilities	Tempered Water Upgrade Program for Water and Wastewater Facilities	As required	-	Assumed 10 water facility upgrades and 10 wastewater facility upgrades at $10,000 each	$200,000

A more detailed operation and maintenance strategy should be developed as the granularity of the asset inventory increases. The City should track the sufficiency and efficacy of its ongoing maintenance expenditures over time, and adjust as needs dictate.

Recommended infrastructure studies and programs (Table 4-3) should continue to be updated as the City's understanding of system behavior evolves.

Table 4-3 Recommended O&M Strategy for Linear Infrastructure

System	Recommended Strategies	Timing (Years)	Estimated Cost (CAD)	Description
Water Distribution	Corrosion Protection Program	Annually	$200,000	Combination of annual capital expenditures for cathodic protection installation and monitoring
Water Distribution	Transient (Air Release Valve) Studies	Annually	$40,000	Transient analysis (estimated 2 studies per year)
Water Distribution	Valve Chamber Inspection Program	Annually	$60,000	Structural inspection of valve chambers on 15-year cycle (200/year @ $300/chamber)
Water Distribution	Valve Turning Program	Annually	$180,000	Inspect and operate system valves once every three years (based on current costs)
Water Distribution	Water main Cleaning and Swabbing Program	Annually	400,000	Cleaning and swabbing all small diameter watermains on 10-year cycle (90km/year @ Current Cost)
Water Distribution	CPP condition assessment	Annually	$250,000	CPP condition assessment (Based on 5-10 cycle over 63 km @ 30,000\km)

System	Recommended Strategies	Timing (Years)	Estimated Cost (CAD)	Description
Water Distribution	Watermain Physical Failure Study	Every 10 Years	$150,000	System wide analysis to understand break frequency and potential mitigation measures
Water Distribution	Valve Criticality Study	As Required	$50,000	Engineering study to determine valve criticality
Water Distribution	Fire Hydrant Testing and Inspection Program	Annually	$800,000	Fire Hydrant Pressure Testing and Winter Inspection Program (based on current costs)
Wastewater Collection	Low Pressure Sewer System Inspection Program	Annually	$60,000	CCTV inspection of low pressure collection system on 10-year cycle (1,200m/year @ $50/m)
Wastewater Collection	Rock Tunnel Inspection and Mapping Program	Annually	$100,000	Inspection and mapping of rock tunnel
Wastewater Collection	Manhole & Sewer Inspection and Maintenance Program	Annually	$750,000	CCTV inspection and flushing/cleaning program (70km/year @ current costs)
Other	Other Strategic State of Good Repair Studies	Annually	250,000	Other strategic state of good repair studies

4.1.2 RENEWAL / REHABILITATION STRATEGIES

Rehabilitation is necessary when an asset does not perform to its desired level of service. Significant repairs designed to extend the life of the asset are determined through regular inspections. Rehabilitation over replacement is advantageous when there are only a few components that need repair.

The initial rehabilitation strategy recommended for the water and wastewater facilities (Table 4-4) and linear infrastructure (Table 4-5) should be revised as the City’s asset management practices evolve;

Table 4-4 Recommended Renewal / Rehab Strategy for Water and Wastewater Facilities

Facility Assets	Recommended Treatment	Timing (Years)	Intervention Cost (% of Replacement Cost)	Description
Structural Components	Minor Structural Rehabilitation	Every 15 Years	2.0%	Concrete and masonry minor repairs
Structural Components	Minor Structural Rehabilitation	At 50% of Service Life	10.0%	Caulking replacement, minor repairs of floor construction and roof construction etc.
Structural Components	Major Structural Rehabilitation	At 75% of Service Life	20.0%	Building cladding rehabilitation
Architectural Components	Minor Architectural Repair	Every 15 years	18.5%	Roof covering doors, windows, and interior stairs minor repairs
Site Works	Minor Site Works Rehabilitation	Every 5 Years	5.0%	Minor site works rehabilitation including repairs of fence, barbed wire, facility gates, posts, pavement, etc.
Site Works	Minor Site Works Replacement	Every 10 Years	10.0%	Minor site works rehabilitation including repairs of fencing, asphalt and pavers.
Wastewater Facility Process Piping & Equipment	Minor Process Piping & Equipment Rehabilitation	Every 5 Years	10.0%	Minor equipment and process piping maintenance
Water Facility Process Piping & Equipment	Minor Process Piping & Equipment Rehabilitation	Every 5 Years	5.0%	Minor equipment and process maintenance, including well inspection and maintenance
Water Facility Process Piping & Equipment	Minor Process Piping & Equipment Rehabilitation	Every 10 Years	20.0%	Major equipment and process maintenance. May include membrane filter or media replacement
Electrical Components	Electrical System Inspection & Maintenance	Every 4 Years	1.0%	Electrical service & distribution system inspection and maintenance
I&C Systems and Life Safety Systems	Life Safety & Compliance Systems Replacement	Every 10 Years	20.0%	Replacement of life safety equipment

Table 4-5 Recommended Renewal / Rehab Strategy for Water and Wastewater Linear Infrastructure

Asset Type	Recommended Treatment	Timing (Years)	Estimated Cost (% Of Replacement Cost)	Description
Mains	Relining	As Required	25%-100%	Relining

A more detailed renewal/rehabilitation strategy should be developed as the granularity of the asset inventory increases. The City should track the sufficiency and efficacy of its ongoing renewal and rehabilitation initiatives over time, and adjust as needs dictate.

Maintenance hole rehabilitation recommendations were not included in this iteration of the AMP.

4.1.3 CAPITAL REPLACEMENT STRATEGIES

Occasionally, the extent of damage or deterioration to an asset is too great and rehabilitation is deemed unfeasible. At this point, replacement is necessary. As an asset approaches the end of its service life, more frequent inspection may be necessary to determine if replacement of the asset is critical in the short-term, or if deferral of the asset replacement is possible.

Recommended lifecycle rehabilitation for the water and wastewater facilities (Table 4-6) should be updated as the City's asset management practices evolve.

Table 4-6 Recommended Capital Replacement Strategy for Water and Wastewater Facilities

Facility Assets	Recommended Treatment	Timing (Years)	Intervention Cost (% of Replacement Cost)	Description
Architectural Components	Major Architectural	End Of Service Life	100.0%	Replacement of roof coverings, celling, door, windows, floor, etc.
Building Services	Building Services	End of Service Life	100.0%	Replace all heating, ventilation and air conditioning (HVAC), air distribution system, and water supply systems (excludes piping).
Site Works	Major Site Works Replacement	End of Service Life	50.0%	Full replacement not anticipated, resurface asphalt, sidewalks pavers and retaining walls. Underground services i.e. Piping and valve chambers inspection/rehabilitation.

Facility Assets	Recommended Treatment	Timing (Years)	Intervention Cost (% of Replacement Cost)	Description
Wastewater Facility Process Piping & Equipment	Major Process Piping & Equipment Replacement	End of Service Life	50.0%	Major process equipment replacement, full replacement not anticipated, replace pumps, motors, motor starters, etc.
Water Facility Process Piping & Equipment	Major Process Piping & Equipment Replacement	End of Service Life	60.0%	Major process equipment replacement, full replacement not anticipated, replace pumps, motors, motor starters etc.
Electrical Components	Major Electrical Replacement	End of Service Life	100.0%	Electrical service & distribution system replacement, lighting and branch wiring replacement, communication & security system replacement
I&C Systems and Life Safety Systems	Instrumentation & Control Systems Replacement	End of Service Life	80.0%	Replacement of instrumentation & general control systems
Standby Power	Standby Power Replacement	End of Service Life	100.0%	Full replacement of standby power equipment
Wastewater Facility Sanitary Forcemain	Sanitary Forcemain	End of Service Life	100.0%	Sanitary forcemain replacement

A more detailed operation and maintenance strategy should be developed as the granularity of the asset inventory increases. The City should track the sufficiency and efficacy of its ongoing renewal and rehabilitation initiatives over time, and adjust as needs dictate.

Recommended replacement for the water distribution system and wastewater collection system (Table 4-7) include the replacement at the end of service life.

Table 4-7 Recommended Capital Replacement Strategy for Linear Infrastructure

Asset Type	Recommended Treatment	Timing (Years)	Estimated Cost (% Of Replacement Cost)	Description
Mains, Appurtenances and Meters	Replacement	End of Service Life	100.0%	Full replacement of infrastructure at the end of their service life

4.1.4 DISPOSAL STRATEGIES

Disposal costs that have been specifically identified in the Master Plan were integrated for the estimation of overall expenditures; asset disposal costs associated with other infrastructure replacement activities are generally included with the estimates made for asset replacement. This section refers to disposal costs associated with the reduction of services or elimination of demands placed on systems. By establishing target levels of service, an organization can clearly determine whether or not infrastructure or particular assets are needed.

No assets were identified in the process of developing this AMP that were not required to deliver the specified levels of service.

4.2 EXPANSION ACTIVITIES

Expansion activities are required to extend services to previously un-serviced areas or to expand services to accommodate growth demands. The City of Greater Sudbury had a population of 166,300 in 2011, and is expected to grow to a population of 176,800 in 2036. The current Water and Wastewater Master Plan has identified the needs for infrastructure expansion, upgrade and/or replacement in order to meet the water and wastewater system requirements. The Master Plan recommended projects have been included in the financial analysis for this Asset Management Plan in order to address the City's objectives such as cost effectiveness, environmental responsibility, reliability and safety.

4.3 NON INFRASTRUCTURE SOLUTIONS

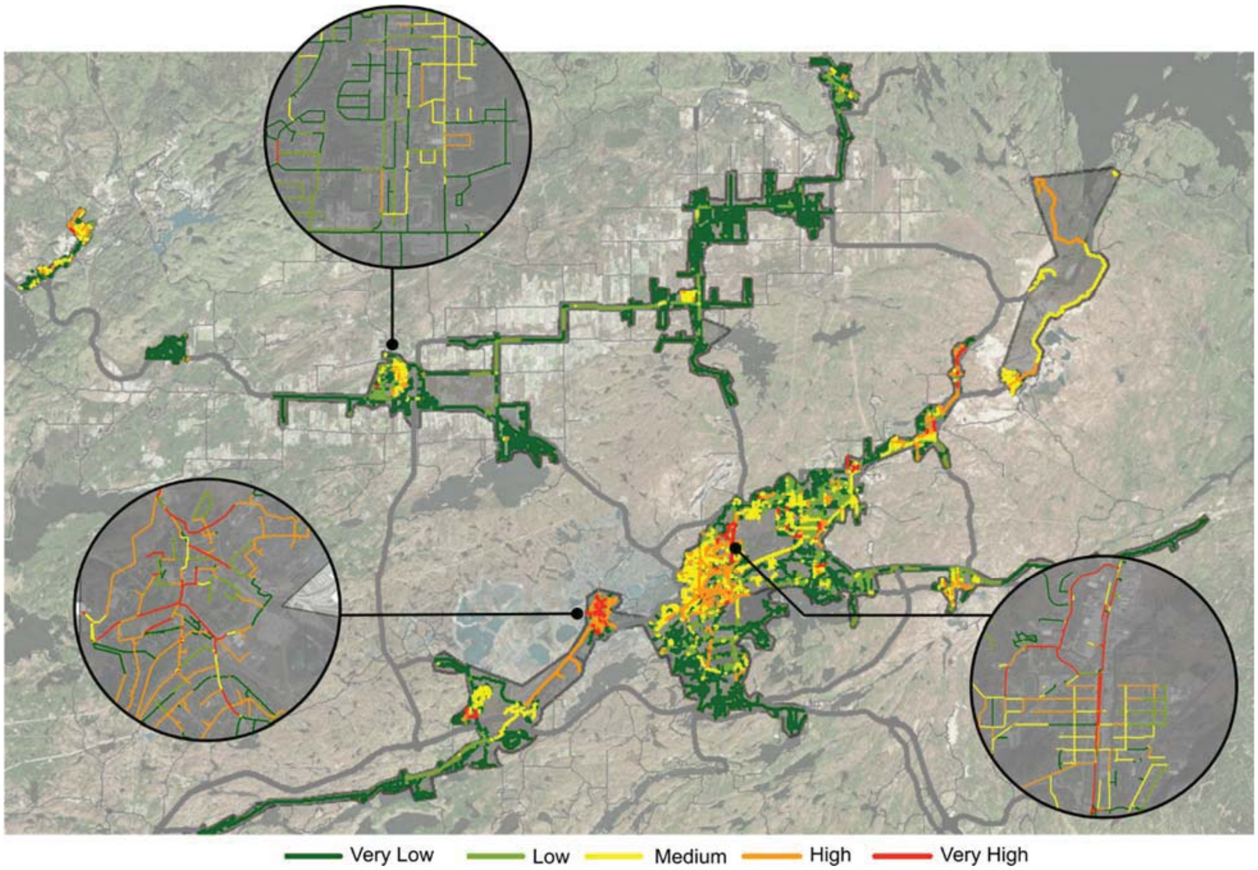
Non-infrastructure solutions produce lower costs for long-term asset sustainability. Cost and time savings are optimized by implementing an organizational approach for all infrastructure works. Important non-infrastructure solutions include implementation of an Asset Management Plan and regular inspections of the various infrastructure assets. A key non-infrastructure strategy identified in this AMP is implementing a corridor based strategy, combining priorities of other divisions (i.e. Roads) with the priorities of the Water and Wastewater Department for linear infrastructure. In this AMP, an initial aggregation of the linear assets from both the water and wastewater inventories has been introduced, and a recommendation has been included for a systematic segmentation of the network to allow for strategic and realistic corridor based planning.

4.4 RISK-BASED PRIORITIZATION AND PROJECT LISTS

The scheduling and the application of the above described strategies within the CGS's aging system and limited capital, O&M and staffing resources, requires careful allocation of the available resources and prioritizing critical and aging assets.

The risk framework introduced in this AMP and described above in section 2 - State of Infrastructure can guide the City with this prioritization process. A summary of the vertical inventory, including risk rates, is attached as appendix A to this AMP. Risks for the linear network have been mapped; an overview is presented in Figure 4-1, and a set of detailed maps is attached as Appendix B to this report. The digital media accompanying this report includes a digital version of the entire inventory with asset-level risk rates, and in addition, includes prioritized lists, in the form of four spreadsheets for (1) Facilities Renewal Projects, (2) Watermains Projects, (3) Sanitary Sewer Projects, and (4) Water system valves. These lists have been developed based on desktop estimations and condition has largely been estimated based on age and expected service life. It is recommended that these critical assets be monitored and prioritized in terms of maintenance, inspections and asset renewal strategies, and that over time the City develop and refine its practices for documenting and maintaining its critical infrastructure.

Figure 4-1 Linear Risk, based on age/material and Criticality (a set of detailed maps is included as appendix B)



While condition across the asset portfolio was initially assessed based on age and expected service life, an additional more detailed study was conducted on the City's watermains, based on historical break data provided by the City. This dataset was geocoded as part of this AMP, and an initial prioritization framework has been developed, where failing watermains were identified and weighed based on their criticality scores. A prioritized list of these watermains projects is attached as Appendix C to this report. It should be mentioned that the City is currently working on linking its historic break data to GIS, which is expected to greatly improve the accuracy of this data. As the underlying dataset improves it is also recommended that this study will be enhanced to take into consideration additional factors such as pipe material, failure characteristics, soil type and spatiotemporal patterns to develop a more robust physical failure model that can then be combined with an economic failure model for optimized decision making. It is important to note that in lack of more detailed physical and economic models, a failure driven approach alone is not sufficient for strategic asset management. At the same time, the critical and aging portions of the network that have been identified through the age-based risk assessment described above, should be monitored and inspected to ensure acceptable levels of risk. Large diameter pipes typically experience less failure, and the direct and indirect costs associated with a potential failure of a critical watermain might easily prioritize it over other failing not-critical watermains.

4.5 NEXT STEPS

The following next steps have been identified for the asset management strategies section:

Table 4-8 Asset Management Strategies Next Steps

CATEGORY	DETAILS
Lifecycle interventions	• The City should review and update its lifecycle interventions strategies as the City's asset management practices evolve.
Risk-based prioritization	• Critical assets should be monitored and prioritized in terms of maintenance and inspections, and that over time the City develop and refine its practices for documenting and maintaining its critical infrastructure. • As the watermains failure data management advances, physical and economical failure models should be developed taking into consideration factors such as pipe material, failure characteristics, soil type and spatiotemporal patterns together with direct and indirect failure costs, to allow for optimized decision making. • Base risk ratings of facilities on detailed condition assessments

FINANCING STRATEGY

5 FINANCING STRATEGY

5.1 METHODOLOGY

Building on the current state of infrastructure (section 2) and asset management strategies (section 4), different capital funding scenarios were tested and their impact on the overall system risk was assessed in order to answer one fundamental question:

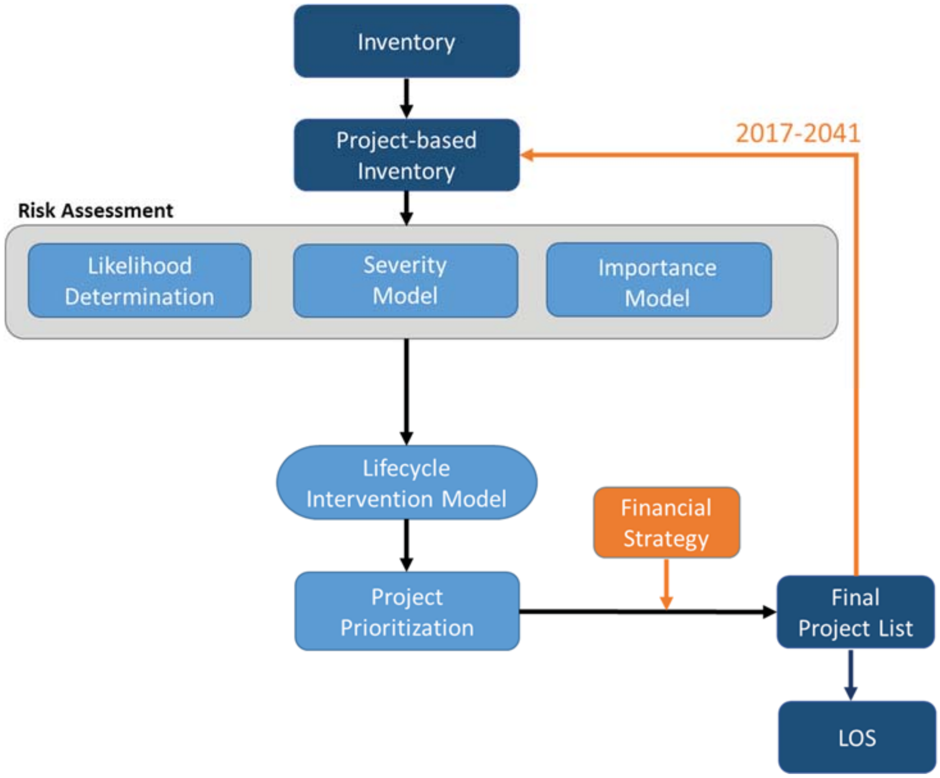
What is the right level of capital investment necessary to achieve long-term sustainability?

A decision support system was developed specifically to answer this question based on the CGS inventory, prioritizing investments and simulating the long-term impact of funding scenarios over the entire asset portfolio. The process iterates over the following steps over a time horizon of 25 years (Figure 5-1)

1. Set annual available capital (user input)
2. Apply asset specific risk models to all assets and determine risk rating; linear assets have been aggregated to the corridor-project level for this assignment.
3. Assign renewal strategies by asset type.
4. Prioritize renewal projects based on asset risk.
5. Create a project list identified as the highest priority projects, feasible within available capital; unused budget from a given year is set aside in reserves for use in future years.
6. Move on to the next year, triggering the creation of a new inventory that reflects the results of the previous year's projects. Probability of failure and resulting risk score are recalculated across the updated portfolio taking into account the characteristics of the newly replaced assets, and the aging of the entire inventory by one year.
7. Calculate expected levels of service expressed as average system risk.

The result of this simulation process is a series of year-specific inventories that reflect the impact of the annual investment that has been tested. Multiple scenarios have been run to arrive at the desired expenditures; these are presented below.

Figure 5-1 Simulation Model Flow Chart

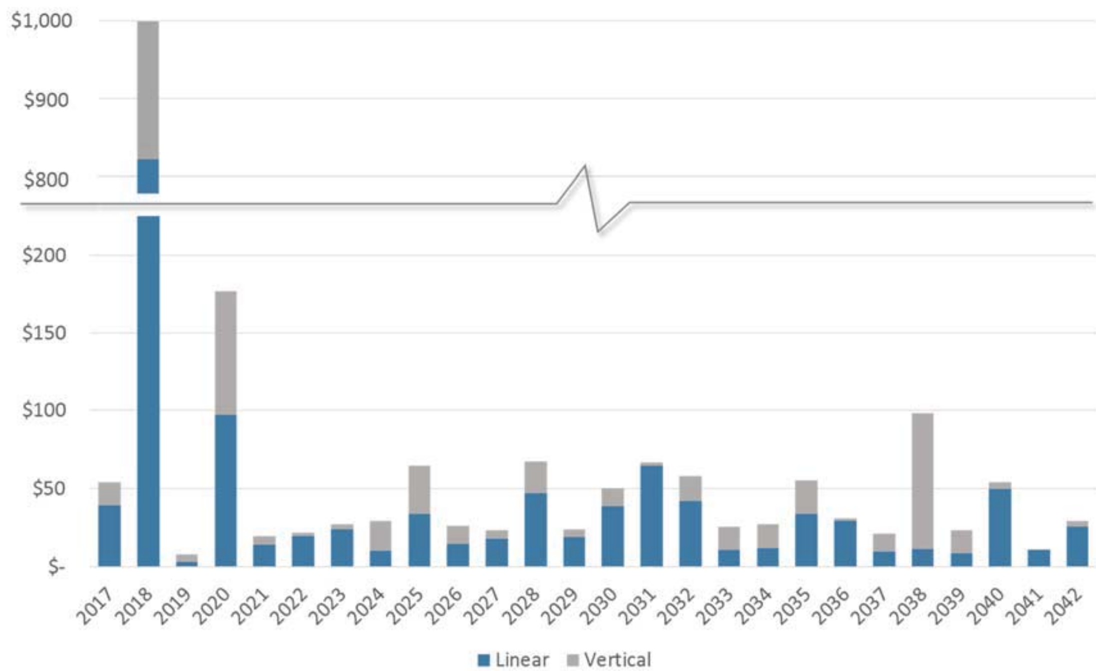


In the following sections, the infrastructure funding gap and infrastructure backlog are identified, and two scenarios are analyzed: first, a "business as usual" scenario which identifies sustainable long-term funding, not yet taking into account the ongoing W&WW Master Plan's recommendations, and in the second scenario integrating the Master Plan recommendations with the asset management renewal needs.– The first scenario is important for understanding infrastructure renewal needs without taking into account the Master Plan growth and upgrade projects and enables a comparison with current City expenditures. The second scenario identifies a comprehensive and sustainable long-term capital plan for the City's Water and Wastewater infrastructure that incorporates growth, demographic changes, and other operational issues.

5.2 IDENTIFYING THE FUNDING GAP

Based on the asset life expectancies and asset management strategy outlined in section 4, a significant infrastructure backlog has been identified. Figure 5-2 demonstrates the system's *needs*, not yet taking into consideration any budgeting limitations. An immediate need of approximately one billion dollars reflects the current significant infrastructure gap. In the theoretical scenario where this backlog is completely addressed at the year 2018, the identified level of infrastructure renewal drops to an average of $43M annually.

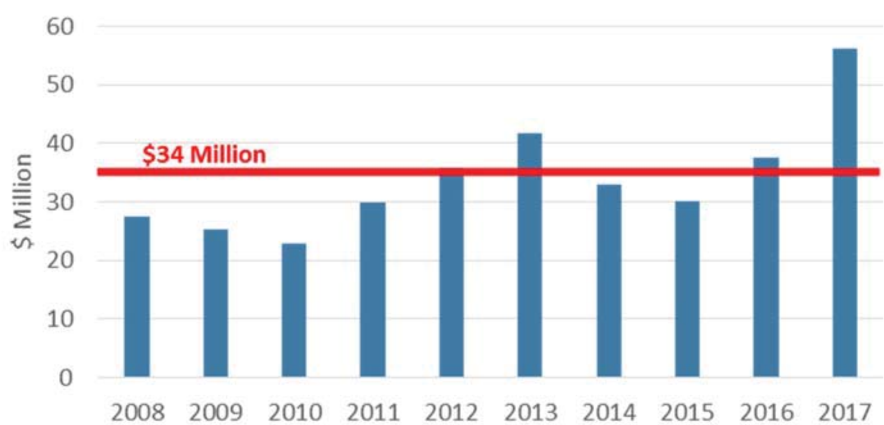
Figure 5-2 Forecasted Renewal Needs



These figures reflect good practice asset management strategies that have been presented in the AMP. If the infrastructure backlog was to be spread over 25 years, the required average infrastructure renewal investment would be $82M annually.

Figure 5-3 summarizes the CGS's actual capital investments in the water and wastewater systems over the last 10 years, with an average of $34 million. Although the historical capital investment is below the projected sustainable level of investment of $88 Million identified by KPMG in 2016, it should be noted that the CGS is on track towards a sustainable level of capital investment and have budgeted $56 Million dollars in 2017 for infrastructure renewal.

Figure 5-3 Historic Capital Investment



The infrastructure and capital investment gaps of the last decade are apparent, but the long term consequences of this deficit need to be assessed prior to arriving at a recommendation for annual investment rates. A number of scenarios were explored to identify sustainable funding requirements, these are presented in the following section.

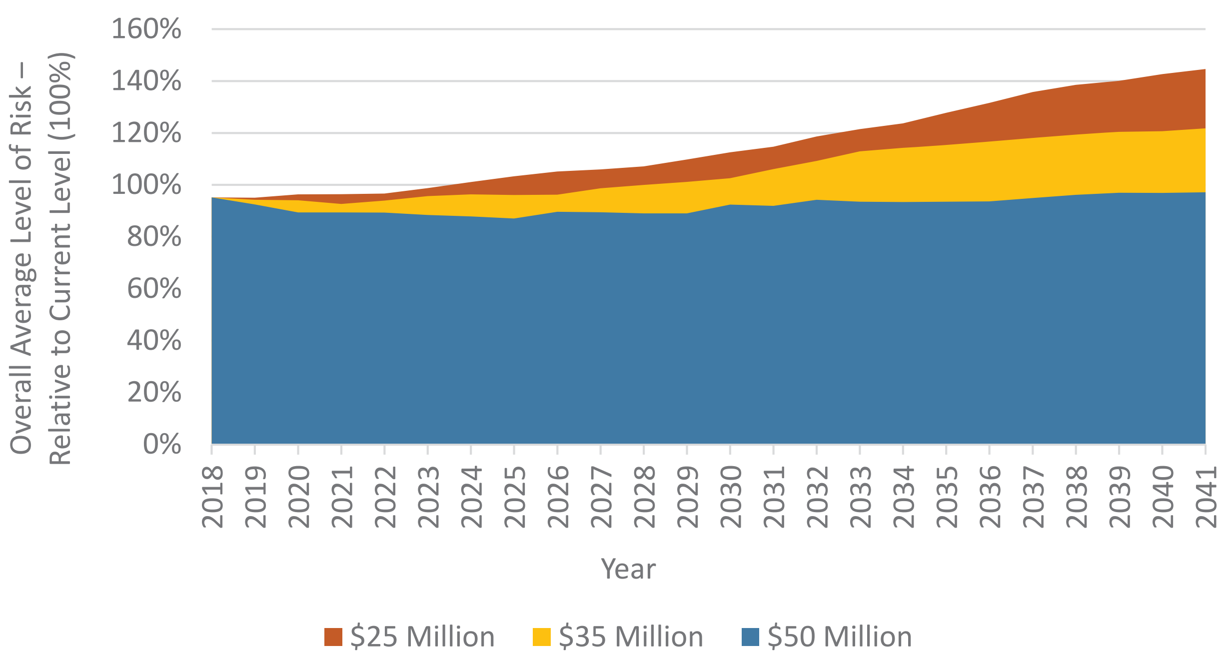
5.3 IDENTIFYING SUSTAINABLE FUNDING

5.3.1 ANALYSIS OF REINVESTMENT FINANCIAL STRATEGIES

Three capital budgeting scenarios of $25, $35 and $50 million annual expenditures were tested against the forecasted system renewal needs.

Figure 5-4 presents the result of this analysis, where the percentages on the y-axis reflect the overall system level of risk, relative to the current level (100%). As described above, these results reflect a risk-based prioritization methodology, that simulates the long term effect by reassessing levels of risk on an annual basis, taking into consideration the previous year's projects that were completed as high priority and feasible within the budget limits.

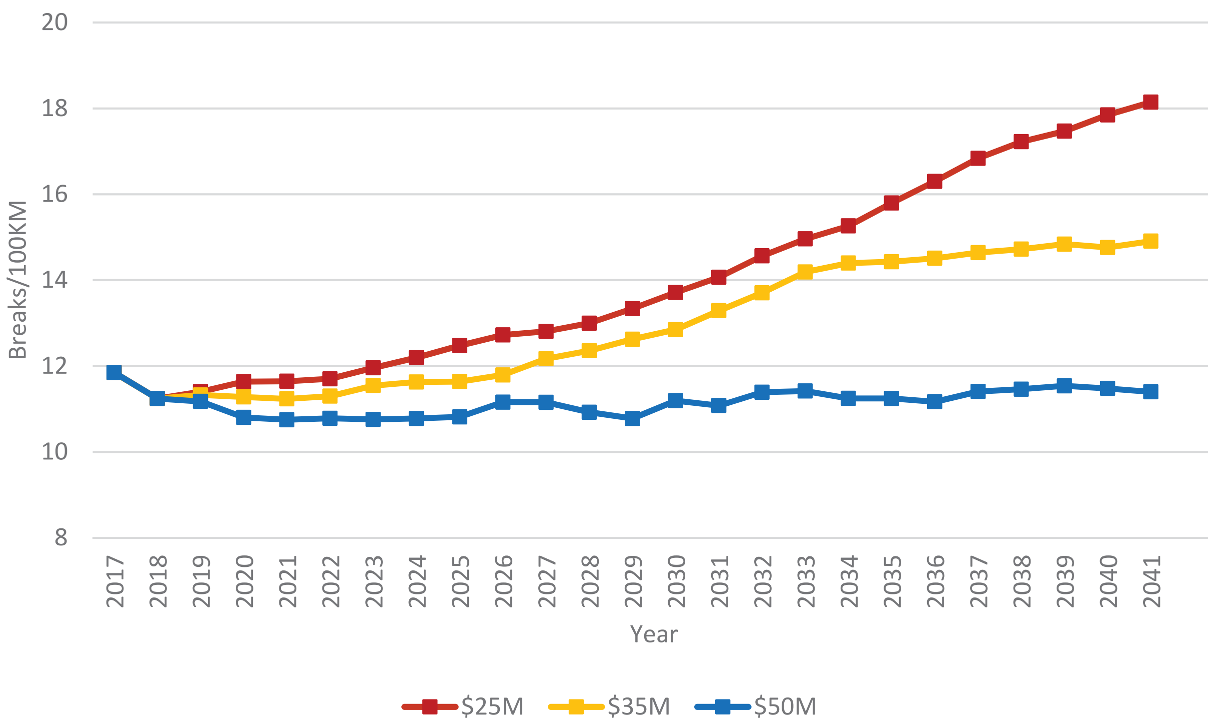
Figure 5-4 Risk Simulation by Annual Expenditure



Under a 25 million dollar reinvestment strategy it can be seen that the overall system risk at the end of the 25-year horizon rises to over 140% of the current levels of risk. This increase in overall system deterioration will lead to increased levels of reactive maintenance and emergency repairs, unplanned water outages and sewage spills. Under a 35 million dollar reinvestment strategy levels of risk rise up to over 120%. It is only under a 50 million dollar reinvestment strategy that the overall system risk stays relatively constant in the mid and long term. This level of reinvestment should provide the City with a reliable water and wastewater system at or slightly better than current conditions.

The levels of risk has been calculated for all water and wastewater linear and vertical infrastructure. Quantifying the consequences of increasing system level risk is difficult and requires high resolution data inputs, yet we are able to relate these strategies in to the level of watermain breaks experienced each year. The watermain breaks per year per 100KM were forecasted under the three funding scenarios (Figure 5-5).

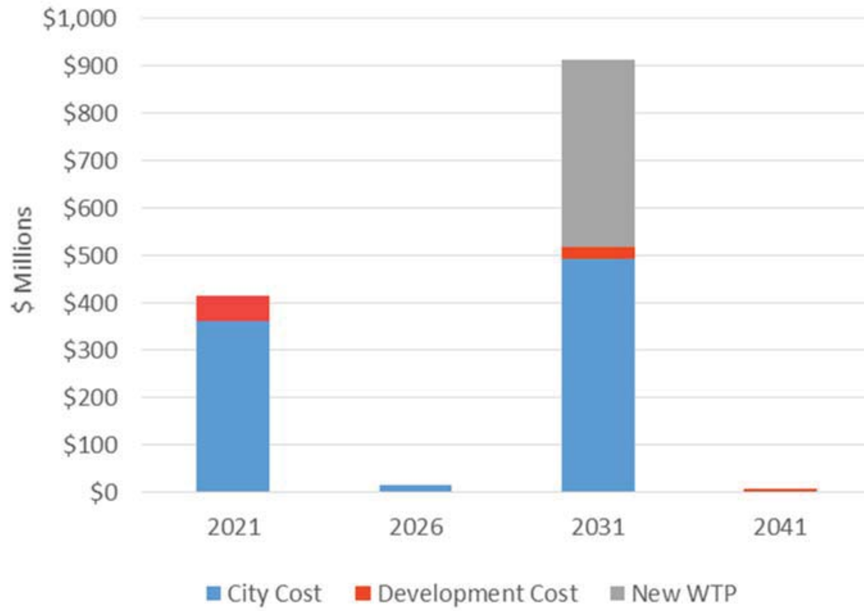
Figure 5-5 Projected Watermain Breaks by Funding Scenario



5.3.2 INTEGRATING MASTER PLAN RECOMMENDATIONS

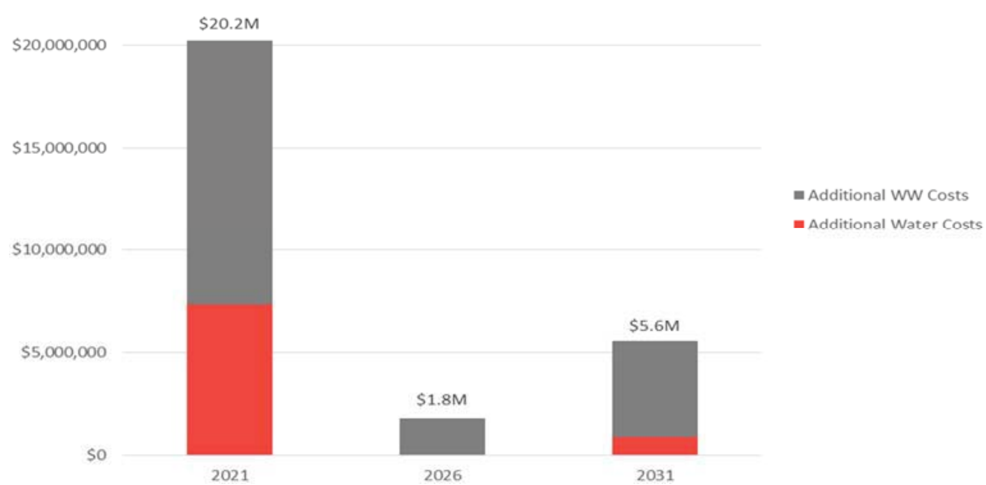
This AMP is being developed at the same time as the CGS Water and Wastewater Master Plan recommendations are being finalized. Substantial costs are allocated to the 1st and 3rd five-year-ranges: years 2017-2021 and 2027-2031 (Figure 5-6). These costs and their considerable consequences on comprehensive asset management will be discussed below.

Figure 5-6 Master Plan Water and Wastewater Recommendations Cost by Implementation Year



To integrate the financial strategy of this Asset Management Plan with the recommendations from the Master Plan, linear assets that have reached the end of their service life, or are near to reaching it, that are located in the same corridors as the W&WW Master Plan projects have been planned for renewal to coincide with the W&WW Master Plan identified project. For instance, a W&WW Master Plan recommendation for a replacement of a water main is likely to include the sanitary sewer main located in the same corridor or portions of it if that sanitary sewer has reached or is very near to reaching its end of service life. These assets are recommended to be replaced together with the W&WW Master Plan projects (Figure 5-7). A detailed list is attached as Appendix D to this report.

Figure 5-7 Additional Corridor Based Costs Associated with Master Plan Recommendations



The total City costs for W&WW Master Plan projects Plus corridor based additional costs reach $898M (Table 5-1, Figure 5-1).

Table 5-1 Master Plan Total Costs Including Corridor Based Additional Costs

YEAR	EXPENDITURE REQUIRED (MILLION $)
2017-2021	$382
2022-2026	$16
2027-2031	$500
Total:	$898

Spreading these costs over the corresponding ranges of 5 years results in significant expenditure needs. For instance, after taking into consideration the current 2017 budget of $56.2M for the 2017-2021 projects, an annual average investment of over $80M is needed for the remaining years 2018-2021. Adding the previously-identified $50M would result in an annual investment need of over $130M. However, since the W&WW Master Plan projects themselves are driven by capacity and reliability needs and are in some instances replacing aging assets, they too are contributing to the overall level of service of the system. In other words, the Master Plan and Asset Management Plan are not two entirely independent approaches; rather, they partially overlap common goals and should therefore be treated as a comprehensive set of recommendations. The Master Plan recommendations have therefore been integrated with the AMP renewal recommendations and risk simulations were run once again on different funding scenarios.

Development projects have been included in these simulations in order to assess total system risk, yet development projects have been assigned a separate external funding source and therefore do not affect the forecasted City's capital requirements. Running these simulations showed that an average annual investment of approximately $100M was needed between 2017 and 2036 to maintain sustainable levels of risk. After 2036 sustainability can be maintained with an annual investment of $50M. To address the highly differentiated investment needs identified in the Master Plan between the different five-year ranges, this amount of $100M was then slightly redistributed, allocating more to the years with intensive Master Plan recommendations (2017-2021 and 2027-2031) and less to the years with less needs (Table 5-2).

Table 5-2 Recommended 25 Year Capital Budget

YEAR	REQUIRED ANNUAL BUDGET (MILLION $)
2017	56.2 *approved budget
2018-2021	110
2022- 2026	90
2027-2031	110
2032-2036	90
2037-2041	50

Building on the recommended capital plan, the following table summarizes by planning horizon the funds that are available for Master Plan upgrade projects, and funds that are available for asset renewal projects.

Table 5-3 Projected Budget Allocation for Upgrade/Renewal Projects

PLANNING HORIZON	TOTAL BUDGET	BUDGETED UPGRADE PROJECTS (MASTER PLAN)	BUDGET AVAILABLE FOR RENEWAL PROJECTS (AMP)
2017-2021	$496	$382	$114 (Annual $23)
2022- 2026	$450	$16	$434 (Annual $87)
2027-2031	$550	$500	$50 (Annual $10)
2032-2036	$450	$0	$450 (Annual $90)
2037-2041	$250	$0	$250 (Annual $50)

5.4 NEXT STEPS

The following next steps have been identified for the financing strategy section:

Table 5-4 Financing Strategy Next Steps

CATEGORY	DETAILS
Funding Sources	• Determine the appropriate strategies going forward to fund the identified investment needs and recommendations.

NEXT STEPS

6 NEXT STEPS

"Next steps" tables have been provided at the end of each of the previous sections; a compiled list is presented below (Table 6-1).

Table 6-1 Compiled List of Next Steps

Section	Category	Details
State of Infrastructure	General Infrastructure	• Implement comprehensive asset identification standard that will be used in all relevant data sets including GIS, Hydraulic Model and PSAB, and in associated capital and O&M project lists. • Refine and improve risk framework introduced in this AMP; develop lists of critical assets, customers and environments and re-evaluate assigned weights.
	Linear Infrastructure	• GIS vs. hydraulic model: ▪ Capture data existing in the hydraulic models (such as material and installation dates) and integrate into GIS. ▪ Significantly improve topology of GIS, to allow for small-scale trace analysis and to meet the hydraulic modelling requirements. ▪ Define clear relationship between the hydraulic model and the GIS; develop standard editing procedures for these two datasets with the aim of minimizing double efforts and costs, and providing one source of truth. • Capture installation dates from all relevant sources, including GIS, hydraulic model, as-built drawings and staff knowledge. • Accurately link pipe failure and condition data to allow for seamless computation. It is recommended that mobile GIS solutions be implemented for on-site digitization of data at a high resolution. • It is recommended that the City undertake a project to develop a corridor segmentation strategy that will enable realistic statistical computation of condition and risk ratings; and will further allow for the implementation of corridor based planning across different infrastructure disciplines, mainly roads.

Section	Category	Details
	Vertical Infrastructure	• Enhance vertical infrastructure asset inventory granularity, accuracy, and completeness including: o Construction or in-service year o Acquisition, replacement cost o Condition assessments and expected service lives o Risk assessment – consequence of failure in terms of regulatory requirements, environment and health and safety • Conduct detailed condition assessments to arrive at actual rates
Levels of Service	Collect Performance Measures	Continue to collect and report on performance measures currently tracked, while developing collection and reporting strategies for newly identified performance measures
	Desired Levels of Service and Public Consultation Process	While select Levels of Service and Key Performance Indicators were identified for measuring the implementation of this AMP, additional work is recommended to identify and detail the true customer expectations. We recommend that the City approach its stakeholders and, through a public consultation process, document their expectations and desired service levels while gauging the willingness to pay. By connecting services provided with the money spent or forecast for the work to the stakeholder expectations, a complete line of sight can be provided that will support the City in providing justification for asset management decisions made.
Asset Management Strategy	Lifecycle interventions	• The City should review and update its lifecycle interventions strategies as the City's asset management practices evolve.

Section	Category	Details
	Risk-based prioritization	• Critical assets should be monitored and prioritized in terms of maintenance and inspections, and that over time the City develop and refine its practices for documenting and maintaining its critical infrastructure. • As the watermains failure data management advances, physical and economical failure models should be developed taking into consideration factors such as pipe material, failure characteristics, soil type and spatiotemporal patterns together with direct and indirect failure costs, to allow for optimized decision making. • Base risk ratings of facilities on detailed condition assessments
Financing Strategy	Funding Sources	• Determine the appropriate strategies going forward to fund the identified investment needs and recommendations.

Going forward, the key challenges identified in this AMP for the management of the City of Greater Sudbury's water and wastewater systems can be divided into those related to the maintenance and renewal of the existing infrastructure, and those specifically related to the Master Plan recommendations.

With regard to optimizing the maintenance and renewal of the existing infrastructure, the challenges are securing a sustainable budget, establishing a comprehensive framework for defining, tracking and securing levels of service and implementing a robust risk-driven infrastructure management framework. The framework introduced in this AMP should be developed and refined on an ongoing basis, and guide the City's maintenance and renewal efforts. Another key factor for success will be the implementation of corridor based planning, taking into consideration not only water and wastewater assets, but also other infrastructure disciplines, mainly roads.

With regard to the implementation of the Master Plan projects, careful review of project limits should be undertaken to ensure adjacent aging water/wastewater infrastructure is captured within the corridor, maximizing the benefits of the project from an asset management point of view. Securing the considerable costs associated with these recommendations is essential to ensure that the on-going renewal efforts can continue at the same time and are not unreasonably deferred.

Finally, good asset management relies on good data management. Several recommendations have been provided in this AMP regarding data management; the City of Greater Sudbury has developed an impressive data set that has made this AMP possible, and is continuously improving its data collection and management practices. As the City's asset and data management practices evolve, so will its ability to optimize its decision making process.

Fleet and Equipment Asset Management Plan

Version No. 1

June 2021

Contents

Figures

Tables

1. Executive Summary

1.1. Purpose

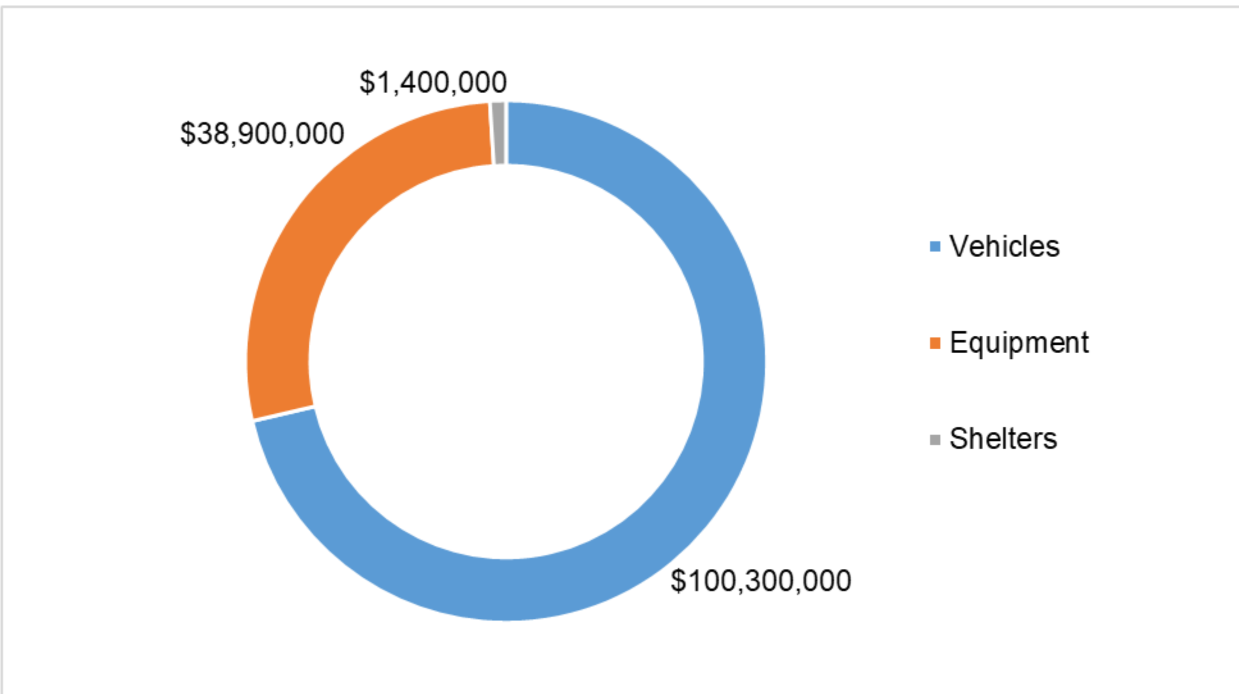
Asset management is the systematic and coordinated activities and practices of an organization to optimally and sustainably deliver on its service objectives through cost-effective lifecycle management of assets.

This asset management plan details information about fleet and equipment infrastructure assets including the actions required to provide the existing level of service in a cost effective manner while outlining the associated risks of asset ownership. The plan defines the existing services provided, how the services are provided and what funds are required to maintain the services over a 20-year planning period.

1.2. State of the Infrastructure

The scope of the plan encompasses the fleet and equipment owned and operated by the City of Greater Sudbury. The replacement value of fleet and equipment assets that are included in the plan are summarized in Figure E1.

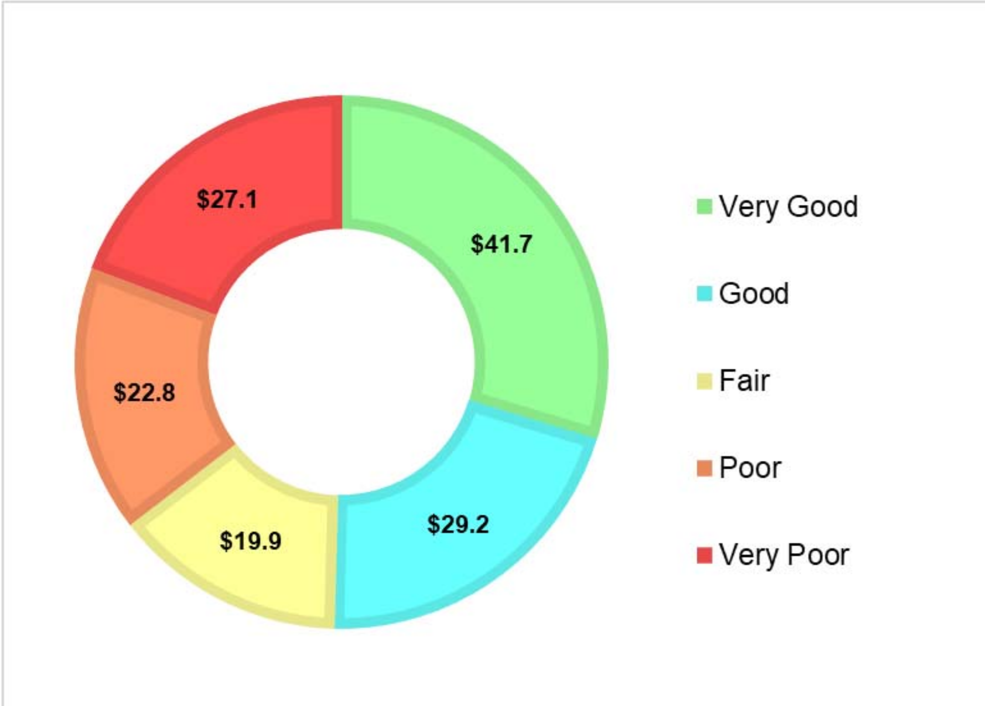
Figure E1: Replacement Value Distribution of Fleet and Equipment Assets



The fleet and equipment assets have a replacement value of $140,600,000.

The data analyzed to develop the plan is integrated from a work order management system, the City's Tangible Capital Asset Database and data spreadsheets. The details behind the development of condition and inspection frameworks are attached in Appendix A. Figure E2 outlines the replacement value and condition of the fleet and equipment inventory.

Figure E2: Condition and Valuation of the Fleet and Equipment Inventory in Millions



1.3. Level of Service

A service level is a direction or requirement for a particular service area against which performance may be measured. For assets, technical data like performance specifications inform service levels.

Service levels have been defined within 3 the categories below.

- **Community**: Qualitative descriptions that define the community, stakeholder and individual expectations.
- **Strategic**: Qualitative and Quantitative measures that describe what is being provided to the community. Examples of how this can be defined can include reliability, legislative compliance, quantity, quality and safety.
- **Asset (Technical)**: An asset level of service is a quantitative measure that defines the performance expectations for a given asset in order to produce the desired levels of service. These services are measures and can include asset conditions, responsiveness, expenditure, and asset value.

1.4. Asset Management Strategy

The lifecycle intervention strategies for fleet and equipment discussed within this report include best practice activities. Best practices for the management of fleet and equipment assets are applied with intervention decisions to strive for the lowest lifecycle cost. These best practices include:

- The fleet and equipment inspection program protocols discussed in Section 3.4 Asset Useful Life;
- Document issues identified from asset users;
- Adhere to the manufacturer's scheduled maintenance;
- Retain certified asset users when applicable and provide additional training to address proper use and maintenance for each asset;
- Monitor the condition of assets annually.

1.5. Failure Prediction and Risk Management

A risk framework was developed and each individual asset is assigned a risk score based on a calculated probability and consequence of failure.

The probability of failure is an estimate of the likelihood of an asset is to not meeting its service expectations. The consequence of failure is an estimate of the effect on outcomes if an asset actually fails.

1.6. Long-Term Need

Table E1 details the 20-year average annual reinvestment requirement (AAR_{20}) by asset class. The AAR_{20} represents the estimated annual amount of capital the City requires to reinvest in the fleet and equipment inventory. Investment was analyzed on a 20 year period to capture the theoretical useful life of fleet and equipment. The 20-year annual average reinvestment requirement for all fleet and equipment assets is $12M.

Table E1: 20-Year Average Annual Reinvestment Requirement	
Asset Class	**AAR_{20}**
Heavy Duty Vehicles	1,920,000
Medium Duty Vehicles	680,000
Light Duty Vehicles	520,000
M&E General	1,110,000
M&E Heavy	350,000
M&E MTs and Light Diesel	530,000
Paramedic Vehicles	900,000
Paramedic Equipment	500,000
Fire Vehicles	1,260,000
Fire Equipment	380,000
Transit	3,580,000
Parks and Recreation	300,000
AAR_{20} =	**12,000,000**

1.7. Future Demand

The City's fleet and equipment is monitored for future demand requirements. The most significant future demand driver for fleet and equipment is population health, growth and aging population. The City has implemented preventative measures in anticipation of the demand drivers.

1.8. Climate Change

In September 2020, Council approved the Community Energy Emissions Plan (CEEP) that is the long-term plan to reduce carbon emissions and pollution in Greater Sudbury. The CEEP is a response the City of Greater Sudbury Council's Climate Emergency declaration in May 2019. The CEEP outlines 18 goals that need to be met to attain the City's target of becoming a net-zero GHG emission community by 2050. For further information with respect to the Community Energy Emissions Plan, please visit: https://www.greatersudbury.ca/live/environment-and-sustainability1/net-zero-2050/.

The City is beginning to monitor the effects of climate change on its infrastructure assets. Global Climate Models for the Greater Sudbury geographic area are reviewed and discussed.

1.9. Next Steps

Table E2 identifies the next steps that emerged during the development of the asset management plan.

Table E2: Next Steps		
Section	**Category**	**Action Item**
State of the Infrastructure	Inventory	• Monitor and refine the Parks Services asset inventory to reduce the quantity of data assumptions • Implement a digital solution to track, monitor and analyze fleet and equipment data • Expand the use of the current asset identification standard that will encompass all fleet and equipment
Level of Service	Asset Level of Service	• Develop target service levels for Council review
Asset Management Strategy	Lifecycle Management Plan	• Review and refine strategies as necessary
Failure Prediction Risk Management	Risk Assessment and Exposure	• Monitor and refine the deterioration model for fleet and equipment assets as necessary
Long-Term Needs	Funding Sources	• Develop a sustainability strategy to achieve target levels of service for Council review, discussion and approval. • Determine funding source for infrastructure need.

2. Introduction

The City of Greater Sudbury is responsible for managing a fleet of 570 vehicles and 4738 pieces of equipment. Fleet Services purchases, manages and maintains vehicles, equipment and fuel. In addition to performing repair and maintenance to City owned vehicles, the City's Fleet facility is licensed to conduct repairs, maintenance and inspections on Ambulances from neighbouring municipalities to assist in the delivery of emergency services.

Ultimately Fleet Services supports service delivery for all departments across the City. For example:

- Transportation of community members with Greater Sudbury Transit;
- Transportation of City employees that provide municipal services;
- Achieving winter maintenance standards for municipal roads;
- Achieving response time standards for Emergency Services;
- Maintaining Fleet in a suitable operating condition;
- Vehicle specification development and procurement;
- Fuel and oil supply and management including fill station oversight;
- Hazardous material handling and disposal;
- Parts procurement and inventory control.

The City owned fleet is managed across four areas: Corporate Fleet (Roads and Transportation, Engineering, Water/Wastewater, Environmental, Leisure and Parks, Cemetery, Buildings Controls and Facilities, By-Law, Long-Term Care and Housing Operations), Transit, Fire and Paramedic Services.

The corporate fleet consists of 75 heavy duty vehicles, 136 medium duty vehicles, 181 light duty vehicles and 614 pieces of fleet related equipment. A wide variety of services are delivered by the corporate fleet including: snow removal, waste disposal, excavation, arena ice resurfacing, cemetery maintenance and internments, and supporting operating departments for example social housing.

The City's Parks and Arena Services manage a parks and recreation fleet of 533 pieces of off-road equipment to perform various levels of maintenance for arenas, over 300 outdoor and indoor sport playing surfaces, 1,400 hectares of parkland and 177 km of trails. Outdoor sports playing surfaces include playgrounds, soccer and baseball fields, basketball courts, tennis and pickleball courts, skating paths and outdoor rinks, ski hills, BMX and skate parks and splash pads.

The City of Greater Sudbury Paramedic Services is responsible for safely and efficiently delivering emergency medical and paramedic care to the community. The service is provided through land ambulance and emergency response.

The City owned assets that are managed by Paramedic Services include but are not limited to: ambulances, paramedic response units (PRUs), command units, special response units and various machinery and equipment such as off-road vehicles, trailers, stretchers, defibrillators, etc.

Emergency Medical Services are provided to the municipal geographic area of 3,625 km^2; the largest municipality in Ontario by land area. The scope of the City's Paramedics offers service to a population of 161,531 community members.

Extensive service requirements have a significant impact on paramedic assets. For example, the paramedic weighted vehicle in-service hours per 1,000 population is 596 hours per 1,000k. This is the second largest value from the 2019 Data Call of participating municipalities that reported to Municipal Benchmarking Network Canada (MBNCan).

The Ontario Ministry of Health and Long-Term Care (MOHLTC) requires the City's Paramedic Services to develop response time performance plans as described in the *O.Reg. 257/00: General under the Ambulance Act, R. S. O. 1990*. In response, the City of Greater Sudbury Paramedic Services has developed the System Status Plan which outlines the City Council approved global response time targets that are included in Table 1.

Table 1: Paramedic Services Global Response Time Targets

Level of Acuity	**Time**	**Percentile %**
Sudden Cardiac Arrest	6 minutes (set by MOHLTC)	70%
CTAS* 1 (Resuscitation)	8 minutes (set by MOHLTC)	80%
CTAS 2 (Emergent)	10 minutes	85%
CTAS 3 (Urgent)	15 minutes	85%
CTAS 4 (Less Urgent)	15 minutes	85%
CTAS 5 (Non-Urgent)	15 minutes	85%

*CTAS is the Canadian Triage and Acuity Scale that has been developed to define a patient's need for care.

To consistently achieve the global response time targets paramedic infrastructure assets must be in a state-of-good-repair (SoGR) to support the efforts of Paramedic Services staff. SoGR is the condition that an asset is able to operate at a full level of performance. Other staff operational performance measures that support the global response time targets are available in the following Table 2.

Table 2: Paramedic Services Supporting Performance Measures		
Measure	**Type**	**Target**
Paramedic Mobilization Times	Emergency Calls	Two Minutes (00:02:00)
	Non-Urgent Calls	Five Minutes (00:05:00)
Paramedic Return to Readiness Times	Advance Life Support (ALS) Calls	Thirty Minutes (00:30:00)
	Basic Life Support (BLS) Calls	Twenty Minutes (00:20:00)

The City of Greater Sudbury Fire Services provides fire protection services and is responsible for public education with respect to fire safety and prevention.

Similar to Paramedics, Fire Services are provided to the municipal geographic area of 3,625 km^2; the largest municipality in Ontario by land area.

The City owned assets that are managed by Fire include but are not limited to: Fire Trucks, support vehicles and various equipment such as auto-extrication, bunker gear, SCBA breathing apparatus, HAZMAT tent and trailer, boats, hoses, gas detectors, etc.

The City of Greater Sudbury Transit Services (GOVA) is responsible for safely and efficiently delivering public transportation to the community.

The GOVA fleet consists of 59 buses that provide conventional transportation. The fleet consists of accessible forty foot buses that operate on 23 defined public transportation routes. The GOVA route system covers an area of 225.4 km^2 for a total of 4,463,961 vehicle kms and 189,887 vehicle operating hours as per the Canadian Urban Transit Association (CUTA) Factbook 2019. The reach of the City’s transit system offers service to a population of 149,667 community members.

3. State of the Infrastructure

3.1. Asset Data Inventory

Fleet and equipment inventories are stored within a work order management system and the tangible capital asset database. The City's fleet inventory is summarized in Table 3.

Table 3: Fleet and Equipment Asset Inventory		
Service Area	**Asset Type**	**Quantity**
Corporate Fleet	Vehicles - Heavy Duty	75
	Vehicles - Medium Duty	136
	Vehicles - Light Duty	181
	Machinery and Equipment General	544
	Machinery and Equipment Heavy	24
	Machinery and Equipment MTs and Light Diesel	46
	Parks and Recreation Equipment	533
Paramedic Services	Ambulance	23
	Licensed Vehicles - Light and Medium Duty	16
	Conveyance Equipment	51
	Defibrillators	37
	Kit Bags	168
	Operating Equipment	168
Fire Services	Fire Trucks	30
	Fire Trucks - Bush/Support/Spare and Training	29
	Licensed Vehicles - Light and Medium Duty	21
	Auto Extrication	50
	Hoses	1469
	SCBA and PPE Bunker Gear	1057
	Operating Equipment	591
Transit	Transit Bus	59
	Bus Stop Shelters	115
Subtotal Vehicles		570
Subtotal Equipment		4738
Subtotal Shelters		115
Grand Total		5423

The asset inventory of fleet and equipment is updated annually.

3.2. Asset Valuation

Asset valuation is determined in either one of two ways; historical cost inflated to current year dollars or where vehicles have attributes that evolve, costs are reviewed to incorporate legislation, recent purchases and current market demand. For example, evolving legislation, emission testing, potential life-saving technology, or a significant funding program from a senior level of government can lead to a sharp increase in purchase price over a short duration and an increase in market demand to meet legislation.

3.3. Estimated Asset Value

A summary of the City's fleet and equipment value is provided in Table 4.

Table 4: Fleet and Equipment Value		
Service Area	**Asset Type**	**Replacement Cost**
Corporate Fleet	Vehicles - Heavy Duty	$19,910,000
	Vehicles - Medium Duty	$6,840,000
	Vehicles - Light Duty	$5,250,000
	Machinery and Equipment General	$13,560,000
	Machinery and Equipment Heavy	$4,970,000
	Machinery and Equipment MTs and Light Diesel	$5,940,000
	Parks and Recreation Equipment	$4,690,000
Paramedic Services	Ambulance	$4,520,000
	Licensed Vehicles	$1,810,000
	Conveyance Equipment	$1,170,000
	Defibrillators	$1,390,000
	Kit Bags	$140,000
	Operating Equipment	$940,000
Fire Services	Fire Trucks	$14,930,000
	Fire Trucks – Bush/Support/Spare and Training	$8,150,000
	Vehicles – Fire Licensed Light and Medium	$1,030,000
	Auto Extrication	$900,000
	Hoses	$530,000
	SCBA and PPE Bunker Gear	$2,220,000
	Operating Equipment	$2,420,000
Transit	Transit Bus	$37,870,000
	Bus Stop Shelters	$1,420,000
Subtotal Vehicles		$100,310,000
Subtotal Equipment		$38,870,000
Subtotal Shelters		$1,420,000
Grand Total		$140,600,000

The estimated replacement value of the City's Fleet is $140,600,000. This value represents 1.34% of the replacement value of the City's total asset inventory.

3.4. Asset Useful Life

As part of an inspection program as specified by fleet vehicle and equipment manufacturers, fleet assets are inspected at regular intervals. By adhering to the inspection program, fleet and equipment is monitored for regulatory compliance and identification of changes in condition that will impact remaining useful life.

In general, the fleet and equipment inspection program follows the following protocol:

- Regular scheduled preventative maintenance as per manufacturer recommendations and best practices;
- Visual inspections prior to use;
- Legislated and safety inspections and certifications;
- Conformance with fire underwriters survey frequency of fire apparatus acceptance and service tests;
- Discussions with the asset users, operators and stakeholders regarding the performance of an asset.

Additional inspections are carried out on vehicles and equipment as the in-service life of an asset extends beyond its estimated useful life. Once an asset has reached actual end of useful life, it is removed from service and disposed of.

3.5. Asset Condition Assessment

All licensed vehicles have mileage collected. Mileage is collected during servicing, at City owned and operated fill stations and with the AVL (Automatic Vehicle Locator) system. The mileage collected is used to expand upon the age-based condition deterioration that the City has adopted.

A bus has a significantly longer estimated useful life than other fleet vehicles and the average annual mileage for a transit bus is 71,263 km. The City strives to intervene to extend the longevity of a bus every 7 years or 600,000 km when funding levels permit. Bus renewal includes the engine, rear axle and transmission. The renewal allows a bus to carry out a longer useful life duration and accumulate extensive mileage. However due to scarce capital dollars, bus renewal is often triggered by a failed component.

Engine run time hours are collected for Machinery and Equipment Heavy, MTs and Light Diesel. Machinery and Equipment Heavy includes Loaders and Graders while the MTs and Light Diesel includes Sidewalk Plows, various MT Tractors and lighter duty diesel equipment such as a Bobcat or Kubota.

Each year, existing bus stops and shelters are evaluated using a point based system to create a list of potential areas of merit and improvement. Locations identified on the list that are affected by future road construction projects will be prioritized.

For further details on methodology behind the assigned conditions to fleet and equipment assets, please refer to Appendix A.

3.6. Current Asset Condition

The average condition of the City's fleet and equipment is provided in Table 5.

Table 5: Fleet and Equipment Average Condition

Service Area	Asset Type	Average Condition
Corporate Fleet	Vehicles - Heavy Duty	62 - Good
	Vehicles - Medium Duty	51 - Fair
	Vehicles - Light Duty	53 - Fair
	Machinery and Equipment General*	31 - Poor
	Machinery and Equipment Heavy	58 - Fair
	Machinery and Equipment MTs and Light Diesel	51 - Fair
	Parks and Recreation Equipment*	46 - Fair
Paramedic Services	Ambulance	71 - Good
	Licensed Vehicles	67 - Good
	Conveyance Equipment*	59 - Good
	Defibrillators*	26 - Poor
	Kit Bags*	55 - Fair
	Operating Equipment*	63 - Good
Fire Services	Fire Trucks	72 - Good
	Fire Trucks – Bush/Support/Spare and Training	55 - Fair
	Vehicles – Fire Licensed Light and Medium	66 - Good
	Auto Extrication*	59 - Fair
	Hoses*	59 - Fair
	SCBA and PPE Bunker Gear*	66 - Good
	Operating Equipment*	61 - Good
Transit	Transit Bus	45 - Fair
	Bus Stop Shelters*	78 - Good

*Does not have mileage or engine runtime collected

The following Table 6 provides a condition breakdown for fleet and equipment.

Table 6: Fleet Vehicle and Equipment Condition

Condition	Corporate Fleet		Paramedic		Fire		Transit		Parks	Total	%
	Veh	Equip	Veh	Equip	Veh	Equip	Veh	Shelter	Equip		
Very Good	122	36	14	110	27	911	19	42	32	1313	24%
Good	61	59	15	2	24	1242	7	35	47	1492	28%
Fair	54	128	6	227	15	337	0	24	370	1161	21%
Poor	95	244	4	71	12	636	11	11	34	1118	21%
Very Poor	60	147	0	14	2	41	22	3	50	339	6%
Totals	392	614	39	424	80	3167	59	115	533	5423	100%

The data analyzed to develop conditions are from the City's Tangible Capital Asset Database, the City's Fleet maintenance management software, the Paramedic Services AVL System and Excel spreadsheets.

4. Levels of Service

4.1. Community and Strategic Level of Service

Community and strategic levels of service are provided in Table 7.

Table 7: Community and Strategic Level of Service	
Service	**Level of Service**
Fleet Services	**Community:** • Fleet is safe and well maintained • Fleet quality and availability meet program service requirements • Fleet vehicles and equipment are efficient and cost effective
	Strategic: • Fleet is prepared, maintained and available to avoid service interruptions • Timely intervention and processing of fleet procurement • Ensure 100% fuel availability at owned stations or alternative locations • Ensure all regulatory requirements are met 100% of the time
Paramedic Services	**Community:** • Rapid response times • Service excellence in medical care • Comply with legislation • 24/7 emergency ambulatory care • Properly staffed, trained and certified personnel • Fleet and equipment are safe, available and in a state of good repair
	Strategic: • Maintain compliance with Global Response Time Targets • Provide emergency response to calls for service on a 24/7 basis; Primary Care Paramedics (PCPs) respond to all calls; Advanced Care Paramedics (ACPs) for more urgent call types. • In 2019 Paramedics responded to 27,729 calls for service involving 32,708 unit responses with 19,424 patients being transported.
Fire Services	**Community:** • Rapid response times • Service excellence in firefighting • Comply with legislation • 24/7 emergency fire response • Properly staffed, trained and certified personnel • Fleet and equipment are safe, available and in a state of good repair
	Strategic: • Provide emergency response on a 24/7 basis in accordance with Bylaw 2020-58 to Establish and Regulate the City of Greater Sudbury Fire Services. • In 2019 Fire Services responded to 4725 incidents including: 288 Fires, 1141 Fire Alarms, 689 Vehicle Collisions, 207 Open Air Burning Response, 955 Medical Assistance, and 1445 other incidents. • Maintain the requirements of the Fire Underwriters Survey discussed in Section 4.2.

Table 7: Community and Strategic Level of Service	
Service	**Level of Service**
Transit Services	**Community:** • Properly staffed, trained and certified personnel • Public transportation fleet and equipment are safe, available and in a state of good repair • Bus stop shelters are clean and in a state of good repair • GOVA routes are executed on time with defined stops made within the scheduled stop window • Transportation to a safe place if delivery to original destination is not possible • Service compliance with legislation such as the Accessibility for Ontarians with Disabilities Act (AODA)
	Strategic: • Provide transit services 7 days/week, 364 days/year based on a schedule developed through public consultation • Provide Shelters per the Bus Shelter Request Policy and capital availability. Currently, 115 of the 1250 GOVA bus stops have shelters or 9.2% of stops have shelters.

4.2. Fire Underwriters Survey

The City of Greater Sudbury Fire Services follows the Fire Underwriters Survey (FUS) requirements. FUS provides data to program subscribers regarding public fire protection for fire insurance evaluation. The Public Fire Protection Classification (PFPC) is a numerical grading system to evaluate the ability of a community's fire protection programs to prevent and control fires within various facility classifications or construction developments. The following is from the FUS:

"The public fire service is unique compared to other emergency services in that fire apparatus vehicles are not continuously in use. However, when in use, the apparatus is subject to considerable mechanical stress due to the nature of its function. This stress does not normally manifest itself on the exterior of the equipment. It is effectively masked in most departments by a higher standard of aesthetic care and maintenance. Lack of replacement parts further complicate long term use of the apparatus. Truck and pump manufacturers maintain a parts inventory for each model year for a finite time. After that period, obtaining necessary parts may be difficult. This parts shortage is particularly acute with fire apparatus due to the narrow market for these devices."

"Fire apparatus should respond to first alarms for the first fifteen years of service. During this period it has reasonably been shown that apparatus effectively responds and performs as designed without failure at least 95% of the time. For the next five years, it should be held in reserve status for use at major fires or used as a temporary replacement for out-of-service first line apparatus. Apparatus should be retired from service at twenty years of age. Present practice indicates the recommended service periods and protocols are usually followed by the first purchaser. However, at the end of that period, the apparatus is either traded in for new apparatus or sold to another fire department. At this juncture, the unit may have one or more faults which preclude effective use for emergency service. These deficiencies include:

- Inadequate braking system;
- Slow pick-up and acceleration;
- Structurally weakened chassis due to constant load bearing and/or overloading;
- Pump wear."

The service schedule for fire apparatus for fire insurance grading purposes are discussed in Section 6.5 Risk Response.

4.3. Asset Level of Service

Asset (technical) levels of service are provided in the following Table 8.

Table 8: Asset Level of Service

	Asset Class	Existing	Implication	Target
Fleet Services	Heavy Duty Vehicles	Licensed heavy vehicle fleet is at a condition rating = **B (Good)**	Replace heavy fleet between 12 - 15 years and prior to 300,000 km	Maintain licensed heavy vehicle fleet at a condition rating = **TBD**
	Medium Duty Vehicles	Licensed medium vehicle fleet is at a condition rating = **C (Fair)**	Replace medium fleet by 10 years and prior to 250,000 km	Maintain licensed medium vehicle fleet at a condition rating = **TBD**
	Light Duty Vehicles	Licensed light vehicle fleet is at a condition rating = **C (Fair)**	Replace light fleet by 10 years and prior to 250,000 km	Maintain licensed light vehicle fleet at a condition rating = **TBD**
	Machinery and Equipment General	Machinery and equipment is at a condition rating = **D (Poor)**	Replace machinery and equipment at end of life	Maintain machinery and equipment at a condition rating = **TBD**
	Machinery and Equipment Heavy	Machinery and equipment heavy is at a condition rating = **C (Fair)**	Replace M&E heavy by 15 years and prior to 20,000 engine hours	Maintain machinery and equipment heavy at a condition rating = **TBD**
	Machinery and Equipment MTs and Light Diesel	Machinery and equipment MTs and light diesel is at a condition rating = **C (Fair)**	Replace M&E MTs and light diesel by 12 years and prior to 15,000 engine hours	Maintain machinery and equipment MTs and light diesel at a condition rating = **TBD**
	Parks and Recreation Equipment	Parks equipment is at a condition rating = **C (Fair)**	Replace machinery and equipment at end of life	Parks equipment is at a condition rating = **TBD**
	All Fleet	Schedule maintenance work order hours = **52%** Non-planned repair work order hours = **48%**	Maintain specified maintenance schedules to allow asset to perform for duration of service life	Scheduled maintenance work orders = **TBD%** Non-planned repair work order hours = **TBD%**

	Table 8: Asset Level of Service			
	Asset Class	**Existing**	**Implication**	**Target**
Paramedic Services	Ambulance	Ambulance fleet is at a condition rating = **B (Good)**	Replace ambulances by 7 years	Maintain ambulance fleet at a condition rating = **TBD**
Paramedic Services	Paramedic Licensed Vehicles (Primary Response Units and Mobile Command Unit)	Paramedic licensed vehicle fleet is at a condition rating = **B (Good)**	Replace paramedic vehicles by 7 years	Maintain paramedic licensed vehicle fleet at a condition rating = **TBD**
Paramedic Services	Conveyance Equipment	Conveyance equipment is at a condition rating = **B (Good)**	Replace conveyance equipment between 7 - 12 years	Maintain conveyance equipment at a condition rating = **TBD**
Paramedic Services	Defibrillators	Defibrillators are at a condition rating = **D (Poor)** *Defibrillators are scheduled for replacement	Replace aging defibrillators	Maintain defibrillators at a condition rating = **TBD**
Paramedic Services	Kit Bags	Kit Bags are at a condition rating of = **C (Fair)**	Replace contents as needed	Kit Bags are at a condition rating of = **TBD**
Paramedic Services	Paramedic Operating Equipment	Paramedic operating equipment is at a condition rating = **B (Good)**	Replace Paramedic operating equipment at end of life	Maintain Paramedic operating equipment at a condition rating = **TBD**
Fleet and Paramedic Services	Ambulance and Paramedic Licensed Vehicles	Scheduled maintenance work order hours = **80%** Non-planned repair work order hours = **20%**	Maintain specified maintenance schedules to allow asset to perform for duration of service life	Scheduled maintenance work orders = **TBD%** Non-planned repair work order hours = **TBD%**

Table 8: Asset Level of Service				
	Asset Class	Existing	Implication	Target
Fire Services	Fire Truck	Fire truck fleet is at a condition rating = **B (Good)**	Rotate fire truck to reserve status by 15 years to meet Fire Underwriters Survey requirements	Maintain fire truck fleet at a condition rating = **TBD**
Fire Services	Fire Truck - Bush/Support/Spare and Training	Fire truck bush/support/spare and training fleet is at a condition rating = **C (Fair)**	Replace fire truck bush/support/spare and training fleet by 20 years	Maintain fire truck bush/support/spare and training fleet at a condition rating = **TBD**
Fire Services	Fire Licensed Vehicles	Fire licensed vehicle fleet is at a condition rating = **B (Good)**	Replace vehicles by 10 years	Maintain Fire licensed vehicle fleet at a condition rating = **TBD**
Fire Services	Auto Extrication	Auto Extrication equipment is at a condition rating = **C (Fair)**	Replace auto extrication equipment by 15 years	Maintain extinguishing equipment at a condition rating = **TBD**
Fire Services	Hoses/Extinguishing Equipment	Extinguishing equipment is at a condition rating = **C (Fair)**	Replace extinguishing equipment	Maintain extinguishing equipment at a condition rating = **TBD**
Fire Services	SCBA and Bunker Gear	SCBA and bunker gear is at a condition rating = **B (Good)**	Replace SCBA and bunker gear	Maintain SCBA and bunker gear at a condition rating = **TBD**
Fire Services	Fire Operating Equipment	Fire operating equipment is at a condition rating = **B (Good)**	Replace Fire operating equipment at end of life	Maintain Fire operating equipment at a condition rating = **TBD**
Fleet and Fire Services	Fire Truck and Fire Licensed Vehicles	Scheduled maintenance work order hours = **67%** Non-planned repair work order hours = **33%**	Maintain specified maintenance schedules to allow asset to perform for duration of service life	Scheduled maintenance work orders = **TBD%** Non-planned repair work order hours = **TBD%**

Table 8: Asset Level of Service				
	Asset Class	**Existing**	**Implication**	**Target**
Transit Services	Public Transportation Bus	Bus fleet is at a condition rating = **C (Fair)**	Replace transit bus by 15 years and prior to 1,200,000 km	Maintain bus fleet at a condition rating = **TBD**
Transit Services	Public Transportation Demand	Public Need Service Hours = **180,000/year**	Provide routes and schedule developed through public consultation	Maintain Public Need Service Hours = **180,000/year**
Transit Services	Bus Stop Shelters	Bus stop shelters are at a condition rating = **B (Good)**	Inspect shelter for SoGR.	Maintain bus stop shelters at a condition rating = **TBD**
Fleet and Transit Services	Public Transportation Bus	Scheduled maintenance work order hours = **38%** Non-planned repair work order hours = **62%**	Maintain specified maintenance schedules to allow asset to perform for duration of service life. Non-planned repair work order hours are elevated due to minor repairs resulting from daily driver reports.	Scheduled maintenance work orders = **TBD%** Non-planned repair work order hours = **TBD%**

5. Asset Management Strategy

5.1. Maintain or Adjust Level of Service

Departments manage their fleet to maintain existing levels of service. Fleet and equipment are disposed at end of life.

5.2. Lifecycle Management Plan

Best practices for the management of fleet and equipment assets are applied with intervention decisions to strive for the lowest lifecycle cost. These best practices include:

- The fleet and equipment inspection program protocols discussed in Section 3.4 Asset Useful Life;
- Document issues identified from asset users;
- Adhere to the manufacturer's scheduled maintenance;
- Retain certified asset users when applicable and provide additional training to address proper use and maintenance for each asset;
- Monitor the condition of assets annually.

The majority of fleet and equipment are maintained in-house by certified technicians. The maintenance program performed by the technicians is designed to enable assets to operate to their service potential.

Once an asset has reached the end of useful life, a needs assessments is conducted prior to replacement.

6. Failure Prediction and Risk Management

Risk management is a major component of asset lifecycle management. The City's risk management goals involve identifying, understanding and managing the potential for infrastructure assets to meet planned service objectives.

Risk assessment is applied to prioritize and optimize capital spending and decision making. The City evaluates both the Probability of Failure (PoF) and the Consequence of Failure (CoF) when prioritizing for the capital budget. This helps clarify and build a shared understanding about the risk associated with a decision to not engage in a project.

6.1. Failure Prediction

Failure prediction is performed to assess the potential for an asset to deliver an expected level of service over time. Current and historical condition and performance data is analyzed to determine the current position of an asset within its lifecycle. This information informs a judgment about how much remaining service life is available. For this asset management plan, the remaining life of fleet and equipment assets have been determined by condition.

6.2. Probability of Failure (PoF)

The probability of failure is an estimate of the likelihood of an asset is to not meeting its service expectations. The PoF for fleet and equipment has been derived from asset condition. Table 9 demonstrates the rationale to determine the PoF of fleet and equipment assets.

Table 9: Probability of Failure (PoF) Fleet and Equipment			
Asset Condition translates to → Likelihood and PoF			
Condition		**Likelihood**	**PoF**
F (Very Poor)	Less than 20	Almost Certain: 80% of Greater	**P5**
D (Poor)	20 - 39	Likely: 60 – 79%	**P4**
C (Fair)	40 - 59	Possible: 40 – 59%	**P3**
B (Good)	60 - 79	Unlikely: 20 – 39%	**P2**
A (Very Good)	80 - 100	Rare: Less than 20%	**P1**

6.3. Consequence of Failure (CoF)

The consequence of failure is an estimate of the effect on outcomes if an asset actually fails. The consequences of failure could range from a service interruption to a catastrophic result depending on the asset criticality. The fleet and equipment criticality and consequence of failure is detailed in Table 10. The CoF has been developed to adhere to the Corporate Impact and Likelihood Criteria for Enterprise Risk Management recommended by the City's Auditor General. The City also has planned mitigation already in place to maintain service objectives should an asset fail. The availability and quantity of mitigation or redundancy was considered with the development of the CoF.

Table 10: Fleet and Equipment Criticality and Consequences of Failure					
Asset Criticality Criteria translates to → Consequences of Failure					
Critically	**Score**	**Criteria**	**Impact**	**CoF**	**Assets**
Critical	5	• Life safety or critical to deliver essential service • Legislated • Significant financial loss	Severe	**C5**	• Ambulance and PRUs • Firetruck • Defibrillators and EMS Kit Bags • Auto Extrication, Bunker Gear and SCBA breathing apparatus
Essential	4	• Threatens delivery of public transportation, cemetery or sanitation service level • Serious Injury or legal judgement • Financial loss	Major	**C4**	• Snowplows • Transit Bus • Sidewalk plows, Loaders, Graders, Solid Waste Packers, Dump Truck, Hydrovac • Paramedic Conveyance Equipment & Controlled Medication Supply Cabinet • Structural Fire Hose, Gas Detection, Marine Rescue • Fuel Dispensing Equip
Strategic	3	• Threatens the integrity of defined service level • Injury • Moderate financial loss	Moderate	**C3**	• Various equipment (ie. Litter Vacuum, Line Paint Truck, Medication Supply Vending Machines, Survey Control) • Supervisory vehicles • Fire support vehicles
Enhancement	2	• Simplifies the delivery of defined service level • Reportable injury • Inefficient process leading to financial loss	Minor	**C2**	• Corporate Fleet transporting personnel and supplies • Various equipment such as trailers
Deferrable	1	• Service target can be 90% achieved without a particular asset	Insignificant	**C1**	• Various light duty vehicles and equipment

Fleet and equipment assets are assessed for risk annually when they are prioritized as part of the capital budget. Items that are reviewed are discussed in Table 11.

Table 11: Failure Prediction and Risk Prioritization

Service or Asset at Risk	What Can Happen	Risk Prioritization	Failure Mode
Emergency Services	• Vehicle or equipment failure • Non-conformance • Failure to deliver emergency or life safety service	Very High	Condition
Winter Maintenance	• Plow or equipment failure • Non-conformance of legislated Emergency Service Delivery • Economic impact on public and private industry	Very High	Condition
Sanitation or Environmental	• Vehicle or equipment failure • Non-conformance • Minor environmental damage • Economic impact on public and private industry	High	Condition
Public Transit	• Reduction in available buses • Route cancellation • Economic impact on public and private industry	High	Condition
Vehicles and Equipment	• Collision or accident due to premature failure	High	Condition
Heavy, Medium, Light Duty Vehicles and Machinery and Equipment	• Failure to deliver a defined Level of Service • Potential for problems preparing for cemetery internments • Vehicle or equipment failure • Potential for non-conformance	Medium	Condition

6.4. Risk Assessment and Exposure

The probability and consequences of failure allow the corporation to focus on assets that have the greatest impact on service delivery. The following formula demonstrates the PoF and CoF are multiplied to determine risk exposure.

Risk Exposure = Probability of Failure x Consequence of Failure

The risk exposure for all of the City's fleet and equipment assets has been mapped in the risk matrix provided in Figure 1. For additional details such as the specific fleet and equipment assets and where they fit in the risk map, please refer to Appendix B and Appendix C.

Consequence		P1	P2	P3	P4	P5
	C5	337 Assets $10,689,301	764 Assets $11,154,167	296 Assets $5,989,525	28 Assets $2,285,512	26 Assets $553,560
	C4	604 Assets $24,305,173	193 Assets $11,364,633	126 Assets $6,181,751	395 Assets $12,899,201	69 Assets $17,411,165
	C3	223 Assets $3,051,158	404 Assets $3,992,783	303 Assets $3,133,653	566 Assets $3,863,995	94 Assets $4,210,580
	C2	136 Assets $3,648,866	105 Assets $2,596,962	293 Assets $4,305,884	102 Assets $3,546,633	105 Assets $4,203,965
	C1	13 Assets $33,697	26 Assets $55,786	143 Assets $259,835	27 Assets $176,508	45 Assets $677,749

Probability

Where:

- Crtitical
- Significant
- Medium
- Low

Figure 1: Fleet and Equipment Risk Exposure

6.5. Risk Response

The City's operating departments have risk response built-in to daily operations. Risk response includes contingency plans and mitigation strategies that have been developed with the experience of delivering levels of service to the community.

The steps to eliminate or avoid risk by reducing the probability and consequences of failure vary by department. Typical mitigation includes additional back-up internal fleet vehicles and contracted external vehicles from vendors. Examples of risk response planning to reduce the disruption of service delivery includes:

- Fleet Services works with the operating departments to plan and schedule maintenance. For example the annual and/or semi-annual fitness of vehicles and equipment.
- Transit Services operates 59 buses, 58 of which provide public transportation on 23 GOVA routes. Typically, 46 buses are on route with 3 spares on standby, 2 to 3 buses down for annual inspection, 2 to 4 down for major repairs and 4 to 6 that require reactive maintenance.
- Paramedic Services operates 23 Ambulances; 3 of which are spares. One ambulance is typically undergoing repairs and maintenance, while a second unit may be under repair. Another ambulance is on standby should it be required to replace an ambulance that is in-service. Paramedic vehicles are replaced at the 7 year mark of their service life.

  Paramedic Services operates 10 Paramedic Response Units (PRU's): 8 are assigned to frontline operations, Platoon Superintendents and the Community Paramedic (CP) Program, 1 is a spare and 1 is to cover routine maintenance and repairs. Paramedic Services has 4 administrative and command vehicles required to support operations, logistics and Community Paramedicine.

A City of Greater Sudbury Paramedic Services Fleet Rationalization was prepared in 2019. The recommendation of the report included the purchase of one new ambulance and no changes in to the PRU fleet at this time. The increase in ambulance fleet to 24 ambulances is recommended to accommodate daily deployment needs. For the purposes of this asset management plan, the existing fleet of 23 ambulances are considered until such a time that Council approves a revised service level.

- Very few corporate fleet vehicles have spares as short term replacements are readily available through a rental, lease, purchase, or coordination of vehicle sharing with departments.

- The City is responsible for winter maintenance on a total of 67 sand and/or salt beats. Of the 67 beats, 55 are maintained by heavy duty multi's (snowplows). The City owns 41 snowplows that operate on 28 beats; this allows for 13 spare snowplows. Spares are required to account for planned maintenance and the higher percentage of reactive maintenance required for snowplows. To support the City maintained winter maintenance beats, the corporate fleet includes various heavy equipment such as graders and loaders.

  The City also has a contractor fleet of snowplows prepared for service as required. The approximate proportion of contractor maintained to city maintained road beats is 58:42. However, the amount of plows on the road is dependent on the severity of an event and winter events may overlap.

  In addition to the City maintained beats, the City provides bus-stop snow removal at various bus-stop locations.

- Fire Services follows the direction set out in Table 12 from the Fire Underwriters Survey.

Table 12: Service Schedule for Fire Apparatus for Fire Insurance Grading Purposes

Apparatus Age	Major Cities [3]	Medium Sized Cities [4]	Small Communities [5] and Rural Centres
0 – 15 Years	First Line Duty	First Line Duty	First Line Duty
16 – 20 Years	Reserve	2nd Line Duty	First Line Duty
20 – 25 Years [1]	No Credit in Grading	No Credit in Grading *or* *Reserve [2]*	No Credit in Grading *or* *2nd Line Duty [2]*
26 – 29 Years [1]	No Credit in Grading	No Credit in Grading *or* *Reserve [2]*	No Credit in Grading *or* *Reserve [2]*
30 Years +	No Credit in Grading	No Credit in Grading	No Credit in Grading

1 All listed fire apparatus 20 years of age and older are required to be service tested by recognized testing agency on an annual basis to be eligible for grading recognition. (NFPA 1071)

2 Exceptions to age status may be considered in a small to medium sized communities and rural centres conditionally, when apparatus condition is acceptable and apparatus successfully passes required testing.

3 Major Cities are defined as an incorporated or unincorporated community that has:
- *a populated area (or multiple areas) with a density of at least 400 people per square kilometre; AND*
- *a total population of 100,000 or greater.*

4 Medium Communities are defined as an incorporated or unincorporated community that has:
- *a populated area (or multiple areas) with a density of at least 200 people per square kilometre; AND/OR*
- *a total population of 1,000 or greater.*

5 Small Communities are defined as an incorporated or unincorporated community that has:
- *no populated areas with densities that exceed 200 people per square kilometre; AND*
- *does not have a total population in excess of 1,000.*

7. Long-Term Needs

The capital need detailed in the 20-Year Capital Need analysis is based on lifecycle management strategies for various fleet and equipment asset types and condition assessment data. For this asset management plan, the lifecycle analysis represents the capital investment needed to rehabilitate and replace assets; the cost of operational maintenance is not included. Operational maintenance costs will be included in future updates to the asset management plan as part of full lifecycle cost analysis.

A period of 20-years was selected for analysis because the 20-year period will capture the entire service life of the majority of fleet and equipment assets that the City owns.

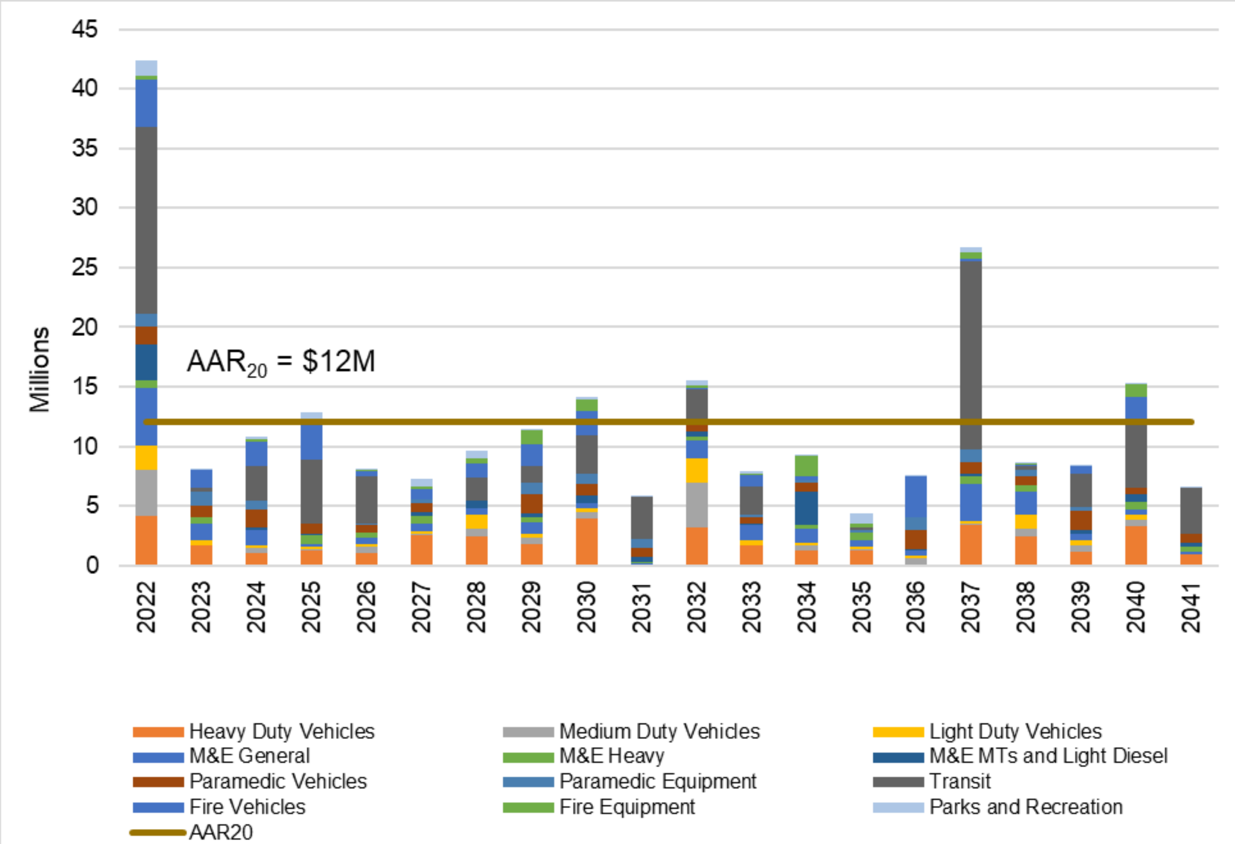
The 20-year average annual reinvestment requirement (AAR_{20}) is the mean annual capital investment required over a 20-year period. The AAR_{20} is useful for defining the required rate of funding based on the investment profile. It is recognized that spending will vary from year to year, however this value provides a benchmark upon which to measure whether the fleet and equipment is being renewed at a rate that is financially sustainable. With the average annual reinvestment requirement value, the City may either benchmark infrastructure investment against the metric while monitoring the variability year to year, or contribute to reserves in years where the annual investment is short of the average annual reinvestment requirement value.

It is anticipated that a significant quantity of assets will represent an expenditure backlog for replacement or significant capital expenditure. The risk based assessment discussed in Section 6 along with a 20-year average annual reinvestment requirement will prioritize investment to address the highest priority of backlog expenditure.

Note that the 20-year average annual reinvestment requirement does not reflect improvements to current asset management practices such as those outlined in the fleet services business process review.

Figure 2 provides the 20-year average capital reinvestment need for fleet and equipment assets. This represents the estimated amount of capital the City requires to reinvest in the fleet and equipment inventory. The 20-year annual average reinvestment requirement (AAR_{20}) for all fleet and equipment assets is $12M.

Figure 2: 20-Year Capital Need Summary



20-Year Capital Need Assumptions

The long-term needs for fleet and equipment is based on the following assumptions:

- Vehicles and equipment are being replaced with a similar function and utility;
- 20-year average annual reinvestment requirement does not consider service expansion or reduction;
- Risk exposure equivalency of 20 or higher as discussed in Section 6 Failure Prediction and Risk Management and Figure 1 Fleet and Equipment Risk Exposure is considered to be immediate need in the year 2022;
- Fleet and equipment is scheduled for replacement at end of life;
- Calculated in 2020 Canadian Dollars where actual costs vary with currency fluctuations.

7.1. Infrastructure Reinvestment Financing Strategy

In order to address the 20-Year Capital Need, the City has recently been approved for the Investing in Canada Infrastructure Program (ICIP) that is being applied to the City's accelerated bus replacement project. The ICIP is a federal program designed to create long-term economic growth, build inclusive, sustainable and resilient communities and support a low-carbon economy. The Province of Ontario is a cost sharing partner in the ICIP program. The accelerated bus replacement project is funded through: 40% Federal, 33.33% Provincial and 26.67% Municipal and is committed for a period of 8 years beginning in 2021. Buses purchased under this program will come into service beginning in 2022.

Figure 3 provides the 20-year average capital reinvestment need for fleet and equipment assets including the approved funding for the accelerated bus replacement project. The 20-year annual average reinvestment requirement (AAR_{20}) for all fleet and equipment assets is reduced to $10.6M. The funding surplus visible for transit through the years 2027 to 2030 represent funding committed from the ICIP program reaching an equilibrium with transit infrastructure capital need.

Figure 3: 20-Year Capital Need Summary including Grant Funding Outlook

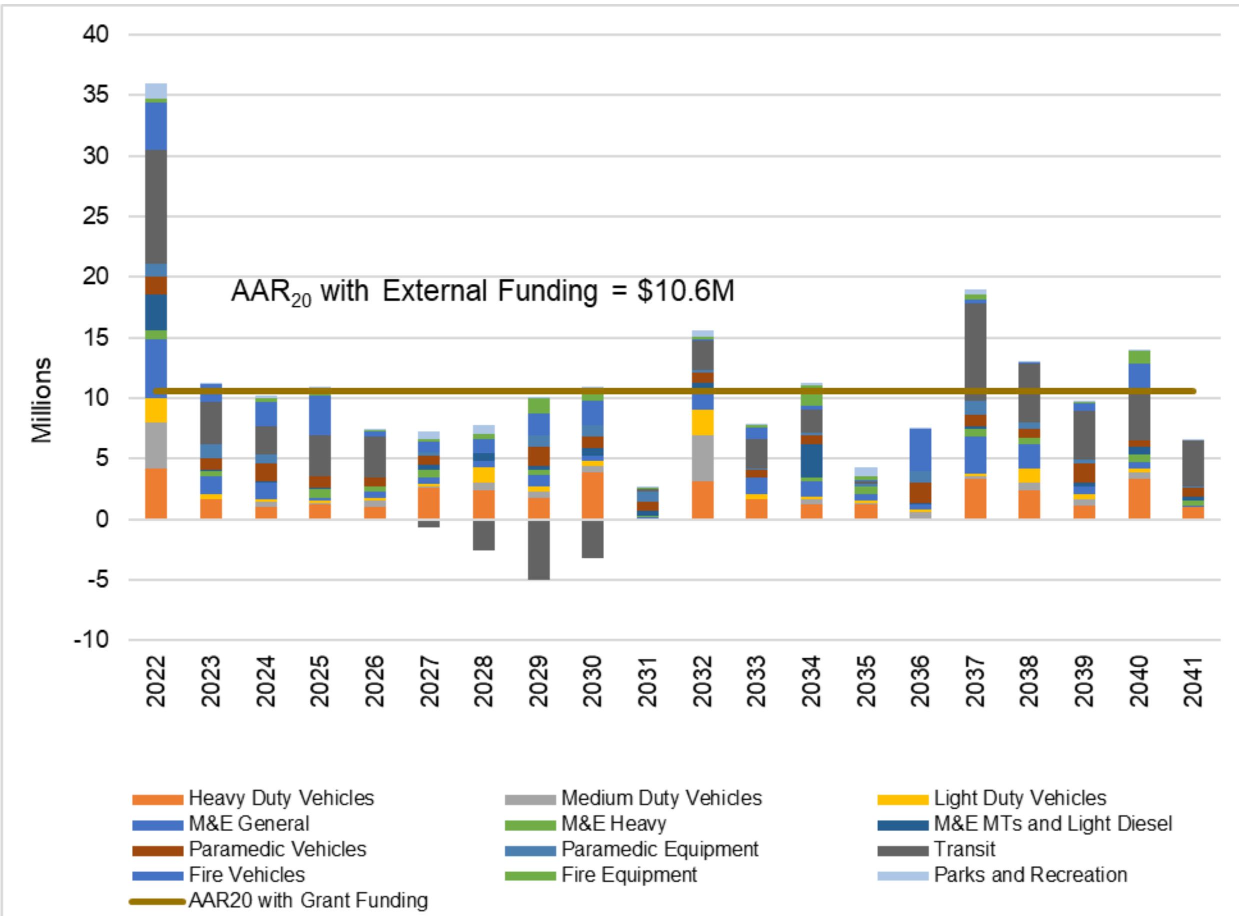
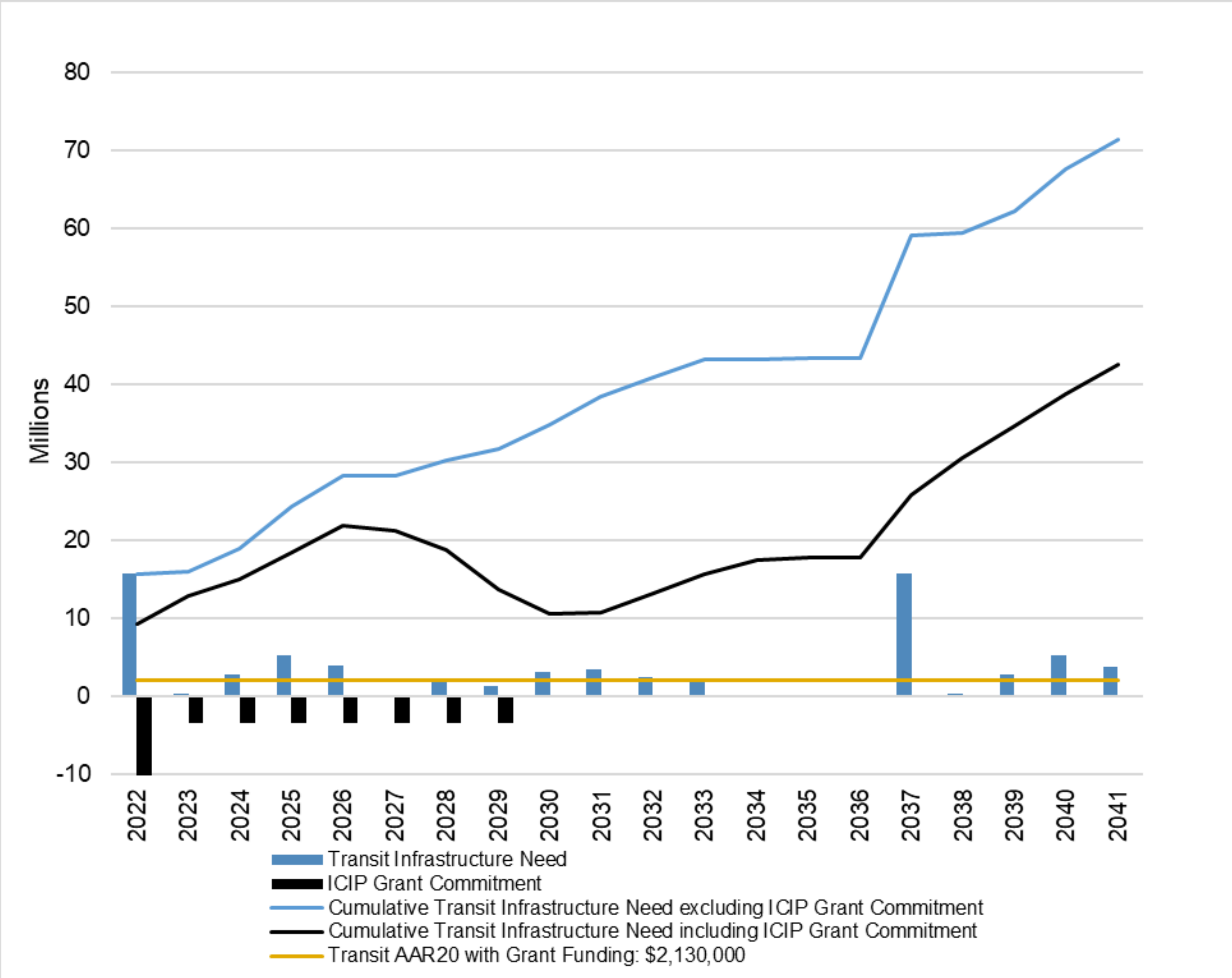


Figure 4 has been prepared in order to demonstrate the financial impact of the ICIP grant on transit infrastructure capital need.

Figure 4: 20-Year Transit Capital Need Summary including ICIP Grant Outlook



For details on the 20-year average annual reinvestment requirement by asset class, please refer to Table 13. The table is prepared to include the ICIP funding treatment discussed above.

Table 13: AAR_{20} including Approved Grant Outlook		
Asset Class	**AAR_{20}**	**AAR_{20} with Grant Funding**
Heavy Duty Vehicles	1,920,000	1,920,000
Medium Duty Vehicles	680,000	680,000
Light Duty Vehicles	520,000	520,000
M&E General	1,110,000	1,110,000
M&E Heavy	350,000	350,000
M&E MTs and Light Diesel	530,000	530,000
Paramedic Vehicles	900,000	900,000
Paramedic Equipment	500,000	500,000
Fire Vehicles	1,260,000	1,260,000
Fire Equipment	380,000	380,000
Transit	3,580,000	2,130,000
Parks and Recreation	300,000	300,000
AAR_{20} =	**12,000,000**	**10,600,000**

State of good repair (SoGR) is the condition that an asset is able to operate at a full level of performance. To maintain the City's infrastructure assets in a state of good repair, capital work is financed through tax supported capital reserve and utility rate supported capital reserve. The Fleet and Equipment Asset Management Plan in conjunction with the annual capital budget proposes and prioritizes the City's infrastructure investment requirements according to their respective financing sources.

The 20-year average annual reinvestment requirement is compared to historical expenditure from a period of 5 years to demonstrate the financial risk associated with asset ownership known as a funding gap. The funding gap is the unfunded capital value of infrastructure renewal needs that require attention as of the current year. It is important to note that additional expenditure from the operating budget helps to further reduce the funding gap. Maintenance expenditure can contribute to extending the actual service life of infrastructure. Table 14 demonstrates the fleet and equipment funding gap.

Table 14: Funding Gap (Capital)			
Asset Class	**5 Yr Expenditure (Mean)**	**AAR_{20} with Grant Funding**	**Funding Gap**
Fleet Heavy Duty	$1,850,000	$1,920,000	**$70,000**
Fleet Medium Duty	$450,000	$680,000	**$230,000**
Fleet Light Duty	$400,000	$520,000	**$120,000**
M&E Fleet General	$680,000	$1,110,000	**$430,000**
M&E Fleet Heavy	$320,000	$350,000	**$30,000**
M&E Fleet MTs and Light Diesel	$390,000	$530,000	**$140,000**
Paramedic Vehicles	$750,000	$900,000	**$150,000**
Paramedic Equipment	$350,000	$500,000	**$150,000**
Fire Vehicles	$1,210,000	$1,260,000	**$50,000**
Fire Equipment	$310,000	$380,000	**$70,000**
Transit	$1,210,000	$2,130,000	**$920,000**
Parks and Recreation	$90,000	$300,000	**$210,000**
Total	**$8,000,000**	**$10,600,000**	**$2,600,000**

7.2. Sustainability Strategy

The existing level of service for fleet and equipment detailed in Section 4 Levels of Service drive the reinvestment forecasts in the asset management plan. Levels of service are based on regulation, standards, and Council approved service levels. Following the asset management roadmap, Council will be provided with the opportunity to determine level of service targets to manage infrastructure within the City's capacity to renew and maintain assets, and accept the associated risk.

7.3. Next Steps

Ensuing Council approval of the Fleet and Equipment Asset Management Plan, target level of service options will be prepared for Council review, discussion and approval. The target level of service framework may require additional key performance indicators and will be the main driver of the sustainability strategy. When target level of service is reviewed, Council will have the option to select service levels that lead to either a reduction or an increase of assets that are in-service and require financing.

Table 15 identifies the next steps that emerged during the development of the asset management plan.

Table 15: Next Steps		
Section	**Category**	**Action Item**
State of the Infrastructure	Inventory	• Monitor and refine the Parks Services asset inventory to reduce the quantity of data assumptions • Implement a digital solution to track, monitor and analyze fleet and equipment data • Expand the use of the current asset identification standard that will encompass all fleet and equipment
Level of Service	Asset Level of Service	• Develop target service levels for Council review
Asset Management Strategy	Lifecycle Management Plan	• Review and refine strategies as necessary
Failure Prediction Risk Management	Risk Assessment and Exposure	• Monitor and refine the deterioration model for fleet and equipment assets as necessary
Long-Term Needs	Funding Sources	• Develop a sustainability strategy to achieve target levels of service for Council review, discussion and approval. • Determine funding source for infrastructure need.

8. Future Demand

8.1. Demand Drivers

Drivers affecting demand include parameters such as population, legislation, demographics, seasonal factors, technological advancement, economic, environmental awareness and Council directed service revisions.

8.2. Demand Forecasts and Impact on Assets

The present position and projections for demand drivers that may impact future service delivery and use of assets were identified and documented in Table 16. The present position and projection statistics are from the City of Greater Sudbury Outlook for Growth to 2046 that was developed in March 2018.

8.3. Demand Management Plan

The City will regulate the demand on assets through a combination of managing existing assets, upgrading of existing assets and providing new assets to meet demand. Opportunities identified for demand management are provided in Table 16. Further opportunities will be developed in future versions of the asset management plan.

Table 16: Demand Drivers, Projections, Impact on Services and Management Plan				
Demand Driver	**Present Position**	**Projection**	**Impact on Services**	**Demand Management Plan**
Population	City of Greater Sudbury Population: 166,130	Population (2046): • Low: 165,090 • Mid-Range: 172,990 (Reference Scenario) • High: 181,290	The City's population is anticipated to remain relatively constant. This will minimize the impact on fleet and equipment assets.	The City will continue to monitor population. Should the population deviate from the expected constant, the data will be analyzed to formulate an appropriate plan.
Legislation	Vehicles are being purchased to meet legislative requirements.	Additional legislative requirements are anticipated. For example implementation and enforcement for an accessible Ontario by 2025.	Replacement cost of fleet and equipment assets are expected to increase with evolving legislation.	The replacement value of fleet and equipment is monitored annually to reflect market demand resulting from legislation, latest technology and limited number of suppliers.
Demographic	Households: 69,152	Households (2046): • Low: 72,890 • Mid-Range: 75,250 (Reference Scenario) • High: 77,590	The anticipated increase in housing will be monitored against the services provided by fleet and equipment assets.	The City has an expansive geographic area of 3,228 km^2 that is serviced by fleet and equipment assets. With an increase in housing, the City will monitor the services provided to the area. For example the adequacy of planned transit or plow routes.
Population Health	Paramedic Services Community Paramedicine section is evolving the delivery of health promotions and other clinical services, collaborating with health care stakeholders in the NE.	This is a new service designed as a preventative measure to optimally distribute resources around the City.	The Health Promotion Services will monitor repeat callers, deliver clinical services in patient homes and develop predictive modeling for service needs.	Three (3) new staff members were added in 2019 to work on this program, specifically mental health and addiction. The predictive modeling suggests that there will be an increased need in PRUs, and the need for ambulances may potentially decrease. Paramedic Services is also exploring the possibility of utilizing hybrid light duty vehicles as a substitute for PRUs to undertake the duties of the Health Promotions Service. However this is not approved in the Ambulance Act at this time.

Table 16: Demand Drivers, Projections, Impact on Services and Management Plan				
Demand Driver	**Present Position**	**Projection**	**Impact on Services**	**Demand Management Plan**
Aging Population	Median Age from 2016 Canada Census: 43.2	There is an anticipated increase in median age of population. By 2037 the population of seniors (75+) in Ontario is expected to increase to 2.1 times its current size.	The inevitable increase in median age of population is expected to have an impact on Paramedic fleet and equipment assets.	The City will monitor aging population trends and the impact on Paramedic assets. With the implementation of the Health Promotions Service discussed above, one of the goals will be to minimize the impact on Paramedic assets. The increase in median age population is expected to increase the need for the GOVA Plus system (formerly Handi-Transit). The City will anticipate an increase in program applications, subsidies and also must consider additional GOVA Plus Fleet by contracting out additional services to vendors.
Seasonal Factors	Drastic shifts in temperature and precipitation from summer to winter months	Per climate change models, drastic shifts in temperature and precipitation from summer to winter months are expected to continue for the foreseeable future.	The shifts in temperature and precipitation will be monitored against the services provided by fleet and equipment assets.	Fleet and equipment will be monitored for its durability to withstand the shifts in temperature and precipitation. Departments maintain 'spare' fleet vehicles for assets that are identified as critical, in preparation for additional requirements due to a significant event or asset failure.
Technological Advancement	The City monitors available technology to improve the level of service provided by fleet and equipment assets.	The need for additional investment in technology is anticipated.	Replacement cost of fleet and equipment assets are expected to increase with technological advancement.	The replacement value of fleet and equipment is monitored annually to reflect market demand resulting from legislation, latest technology and limited number of suppliers.
Economic	Jobs: 79,440	Jobs (2046): • Modest: 81,230 • Mid-Range: 85,750 (Reference Scenario) • High: 90,460	The City's employment is expected to grow with the minor projected increase in population. Impact on fleet and equipment assets is anticipated to be minimal.	The City will continue to monitor employment. Should the employment deviate from the expected constant, the data will be analyzed to formulate an appropriate plan.

Table 16: Demand Drivers, Projections, Impact on Services and Management Plan				
Demand Driver	**Present Position**	**Projection**	**Impact on Services**	**Demand Management Plan**
Environmental Awareness	Through legislation and the City's own actions, the City has demonstrated that it recognizes the need for environmental and climate protection. The City is considering the development of a Green Fleet Policy.	In recent years, environmental awareness has received considerably more attention. This is expected to continue. Environmental awareness is anticipated to result in additional legislative requirements and stricter best practices.	New fleet and equipment assets are being developed to produce lower emission outputs. Replacement cost of assets are expected to increase as environmental awareness increases.	The replacement value of fleet and equipment is monitored annually to reflect market demand resulting from legislation, latest technology and limited number of suppliers. A policy that will cover the procurement of electric vehicles or vehicles that operate with alternative fuels will be generated.

9. Climate Change

In September 2020, Council approved the Community Energy Emissions Plan (CEEP) that is the long-term plan to reduce carbon emissions and pollution in Greater Sudbury. The CEEP is a response to the City of Greater Sudbury Council's Climate Emergency declaration in May 2019. The CEEP outlines 18 goals that need to be met to attain the City's target of becoming a net-zero GHG emission community by 2050. For further information with respect to the Community Energy Emissions Plan, please visit: https://www.greatersudbury.ca/live/environment-and-sustainability1/net-zero-2050/.

Global climate models for the Greater Sudbury geographic area are available thought various online resources, namely:

- Climatedata.ca, undertaken with the support of Environment and Climate Change Canada;
- Climateatlas.ca, undertaken with the support of Environment and Climate Change Canada, Public Health Agency of Canada, and Health Canada.

The City is beginning to monitor the effects of climate change on its infrastructure assets. The data provided in the aforementioned websites suggest that it is a possibility that there will be an increase in precipitation and an overall increase in mean temperature for the municipality. The climate projection scenarios from climateatlas.ca suggest that the increase in mean temperature within the Greater Sudbury area may result in the possibility a decrease of freeze-thaw days, additional summer days, more very hot days and additional tropical nights.

For context, when reading the data and analytics from either of the information sources, RCP means Representative Concentration Pathway which is a greenhouse gas concentration trajectory. The greenhouse gas concentration trajectory is not to be confused with current emissions, although emissions impact the atmospheric concentrations.

Climatedata.ca analyzes the RCP2.6, RCP4.5 and RCP8.5, while climateatlas.ca analyzes RCP4.5 and RCP8.5. RCP scenario definitions are provided below:

RCP 2.6: This pathway is very stringent because it would require that carbon dioxide (CO_2) emissions were significantly declining in 2020 and achieve zero emissions by 2100. The pathway also requires methane gas (CH_4) emissions be halved by 2020 and sulphur dioxide (SO_2) emissions to decline to approximately 10% of the SO_2 emission level from 1980. This scenario requires negative CO_2 emissions equivalent to a minimum of 2 Gigatons/year every year from natural sources such as trees to keep the global temperature rise below 2°C by the year 2100.

RCP 4.5: This pathway is intermediate because global emissions would peak by 2040. CO_2 emissions must reduce to half of the 2050 levels by 2100, CH_4 emissions must decline by 75% in the decade leading to the year 2050, and SO_2 emissions must decline by 80% of the SO_2 emission level from 1980. Similar to RCP 2.6, this scenario requires negative CO_2 emissions equivalent to a minimum of 2 Gigatons/year every year from natural sources to keep the global temperature rise between 2°C and 3°C by the year 2100. Many plant and animal species will not be able to adapt to the effects of RCP 4.5 or higher.

RCP 8.5: This pathway is business as usual. Emission will continue to rise on the current global pace throughout the 21st century.

Global Climate Models depict how the climate is likely to change in the future. As no single climate model is correct, the asset management plan consider the effect of Low Carbon (RCP 4.5) and High Carbon (RCP 8.5) on the fleet and equipment assets. The two scenarios are appropriate as RCP 4.5 assumes a drastic and sustained reduction of emissions in the coming decades, while RCP 8.5 represents the current global pace; emission of very large amounts of carbon dioxide from the burning of fossil fuels.

The following Table 17 provides the results of several Global Climate Models for the City of Greater Sudbury geographic area with high and low carbon emission scenarios and the anticipated impact on fleet and equipment assets. It is important to note that the anticipated impact is of climate change on infrastructure, not the potential impact of infrastructure contribution to climate change. Also, the climate projections suggest the variable outcomes are possibilities and not absolute certainty.

Table 17: Climate Change Scenarios and Anticipated Impact on Services

Variable	Current Mean	RCP	2021 - 2050 Mean	2051 - 2080 Mean	Anticipated Impact
Precipitation (mm)	848	High 8.5	904	938	The increase in precipitation may require additional winter maintenance activities.
		Low 4.5	890	924	
Mean Temperature	4.3°C	High 8.5	6.5°C	8.8°C	No specific impact.
		Low 4.5	6.3°C	7.3°C	
Tropical Nights (+20°C)	1	High 8.5	5	17	No specific impact.
		Low 4.5	4	7	
Very Cold Days (-30°C)	5	High 8.5	1	0	A transit bus may be used as a warming station, demand for warming stations will increase.
		Low 4.5	2	1	
Very Hot Days (+30°C)	6	High 8.5	18	39	A transit bus may be used as a cooling station, demand for cooling stations will increase.
		Low 4.5	16	24	
Frost-Free Season (days)	137	High 8.5	163	184	The decrease in frost days will shorten the winter maintenance season.
		Low 4.5	157	168	
Freeze Thaw Cycles	68	High 8.5	64.2	61.5	The decrease in freeze-thaw cycles may ease pressure on the plow fleet.
		Low 4.5	65.4	64.3	
Mild Winter Days (-5°C)	120.1	High 8.5	103.6	84.2	The decrease in mild winter days will reduce winter maintenance activity.
		Low 4.5	104.5	96.6	
Summer Days (+25°C)	42.9	High 8.5	68.9	93.8	Potential for an increase in risk of brush fires.
		Low 4.5	65.2	77.4	
Winter Days (-15°C)	58.4	High 8.5	42	24.8	The decrease in winter days will reduce winter maintenance activity.
		Low 4.5	43.9	35.3	

10. Improvement Opportunity

The City will take the following steps towards sustainability:

- Develop and implement a Fleet Services business process review with the goal of optimizing level of service delivery;
- Maintain full compliance with legislation;
- Increase the emphasis on consistent proactive maintenance and lower the volume of reactive maintenance;
- Environmentally sustainable initiatives;
- Monitor asset lifecycles for scheduled replacements;
- Monitor scheduling of equipment as it relates to operating department service level needs (ie. Truck and plow conversion, bus service seven days a week);
- Monitor vehicle usage and optimize assets via utilization;
- Advance technologies and maintain in house expertise;
- Look for opportunity to improve training and departmental manpower depth.
- Council will be provided with the opportunity to adjust the level of service provided to the community.
    - Fire Services intends to investigate the requirements of adopting the National Fire Protection Association (NFPA) 1710 *Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments* and NFPA 1720 *Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Volunteer Fire Departments.* The NFPA standards are not currently provided and therefore, not considered in the current asset management plan.
    - Transit Services intend to investigate and pursue decreasing the age of the GOVA bus fleet from a theoretical useful life of 15 years down to 12 years. A bus is subject to an extensive quantity of kilometers that results in an increase in maintenance cost due to a significantly higher volume of reactive maintenance. The current average condition of the bus fleet is on the line of fair and poor, with 11 buses in poor condition, and 22 buses in very poor condition.

The City will aim to ensure that the right vehicle or equipment is available for the right job at the right time.

Appendix A – Fleet and Equipment Condition Range

Fleet and equipment have been assigned conditions as detailed in following Table A1 through Table A8.

Table A1: Heavy Duty Fleet Condition Range

Condition	Service Life Consumption	Mileage (kms)	Condition Score
Very Good	0% to 40%	0 to 50,000	80 to 100
Good	41% to 60%	50,001 to 100,000	60 to 79
Fair	61% to 75%	100,001 to 150,000	40 to 59
Poor	71% to 90%	150,001 to 225,000	20 to 39
Very Poor	>90%	>225,000	0 to 19

Table A2: Light and Medium Duty Fleet Condition Range

Condition	Service Life Consumption	Mileage (kms)	Condition Score
Very Good	0% to 40%	0 to 50,000	80 to 100
Good	41% to 60%	50,001 to 100,000	60 to 79
Fair	61% to 75%	100,001 to 150,000	40 to 59
Poor	76% to 90%	150,001 to 200,000	20 to 39
Very Poor	>90%	>200,000	0 to 19

Table A3: Ambulance Condition Range

Condition	Service Life Consumption	Mileage (kms)	Condition Score
Very Good	0% to 40%	0 to 75,000	80 to 100
Good	41% to 60%	75,001 to 150,000	60 to 79
Fair	61% to 75%	150,001 to 200,000	40 to 59
Poor	76% to 90%	200,001 to 250,000	20 to 39
Very Poor	>90%	>250,000	0 to 19

Table A4: Fire Truck Condition Range

Condition	Service Life Consumption	Mileage (kms)	Condition Score
Very Good	0% to 40%	0 to 75,000	80 to 100
Good	41% to 60%	75,001 to 150,000	60 to 79
Fair	61% to 75%	150,001 to 200,000	40 to 59
Poor	76% to 90%	200,001 to 250,000	20 to 39
Very Poor	>90%	>250,000	0 to 19

Table A5: Bus Fleet Condition Range			
Condition	**Service Life Consumption**	**Mileage (kms)**	**Condition Score**
Very Good	0% to 40%	0 to 240,000	80 to 100
Good	41% to 60%	240,001 to 480,000	60 to 79
Fair	61% to 75%	480,001 to 720,000	40 to 59
Poor	76% to 90%	720,001 to 960,000	20 to 39
Very Poor	>90%	>960,000	0 to 19

Table A6: Machinery and Equipment Heavy Condition Range			
Condition	**Service Life Consumption**	**Engine Runtime Hours**	**Condition Score**
Very Good	0% to 20%	0 to 5,000	80 to 100
Good	21% to 40%	5,001 to 9,000	60 to 79
Fair	41% to 60%	9,001 to 13,000	40 to 59
Poor	61% to 80%	13,001 to 16,000	20 to 39
Very Poor	>80%	>16,000	0 to 19

Table A7: Machinery and Equipment MTs and Light Diesel Condition Range			
Condition	**Service Life Consumption**	**Engine Runtime Hours**	**Condition Score**
Very Good	0% to 20%	0 to 3,000	80 to 100
Good	21% to 40%	3,001 to 6,000	60 to 79
Fair	41% to 60%	6,001 to 9,000	40 to 59
Poor	61% to 80%	9,001 to 12,000	20 to 39
Very Poor	>80%	>12,000	0 to 19

Table A8: Machinery and Equipment without Engine Run Time Hours Collected		
Condition	**Service Life Consumption**	**Age-Based Condition Score**
Very Good	0% to 20%	80 to 100
Good	21% to 40%	60 to 79
Fair	41% to 60%	40 to 59
Poor	61% to 80%	20 to 39
Very Poor	>80%	0 to 19

Appendix B – Fleet and Equipment Risk Exposure

Fleet and equipment risk exposure is detailed in following Figure B1 through Figure B12.

Figure B1: Vehicles - Heavy Duty Risk Exposure

Consequence	P1	P2	P3	P4	P5
C5	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0
C4	23 Assets $7,164,492	14 Assets $3,797,899	12 Assets $2,947,942	6 Assets $1,101,678	6 Assets $1,871,267
C3	2 Assets $570,035	4 Assets $1,290,550	0 Assets $0	0 Assets $0	2 Assets $244,231
C2	1 Assets $65,421	0 Assets $0	3 Assets $566,920	0 Assets $0	2 Assets $285,770
C1	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0

Probability

Where:
Crtitical
Significant
Medium
Low

Figure B2: Vehicles - Medium Duty Risk Exposure

Consequence	P1	P2	P3	P4	P5
C5	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0
C4	5 Assets $344,375	0 Assets $0	2 Assets $142,380	0 Assets $0	2 Assets $162,833
C3	3 Assets $187,323	0 Assets $0	0 Assets $0	2 Assets $118,376	1 Assets $50,466
C2	37 Assets $1,569,482	16 Assets $667,411	11 Assets $685,881	30 Assets $1,552,101	27 Assets $1,358,645
C1	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0

Probability

Where:
Crtitical
Significant
Medium
Low

Figure B3: Vehicles - Light Duty Risk Exposure

Consequence	P1	P2	P3	P4	P5
C5	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0
C4	2 Assets $80,000	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0
C3	14 Assets $450,159	3 Assets $111,099	2 Assets $45,501	11 Assets $358,476	2 Assets $87,590
C2	35 Assets $998,095	24 Assets $612,276	24 Assets $617,499	46 Assets $1,381,523	18 Assets $505,064
C1	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0

Probability

Where:
- Crtitical
- Significant
- Medium
- Low

Figure B4: Machinery and Equipment General Risk Exposure

Consequence	P1	P2	P3	P4	P5
C5	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0
C4	1 Assets $365,818	3 Assets $125,488	6 Assets $365,939	3 Assets $765,883	8 Assets $476,680
C3	12 Assets $1,272,805	35 Assets $790,036	91 Assets $1,284,037	200 Assets $2,050,020	82 Assets $3,526,888
C2	4 Assets $80,698	11 Assets $474,407	13 Assets $285,333	8 Assets $324,329	22 Assets $795,635
C1	1 Assets $13,997	0 Assets $0	3 Assets $32,091	11 Assets $70,002	30 Assets $463,046

Probability

Where:
- Crtitical
- Significant
- Medium
- Low

Figure B5: Machinery and Equipment Heavy Risk Exposure

Consequence	P1	P2	P3	P4	P5
C5	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0
C4	8 Assets $1,598,572	4 Assets $1,045,567	6 Assets $1,266,171	4 Assets $694,706	2 Assets $365,026
C3	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0
C2	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0
C1	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0

Probability

Where:
- Crtitical
- Significant
- Medium
- Low

Figure B6: Machinery and Equipment MT and Light Diesel Risk Exposure

Consequence	P1	P2	P3	P4	P5
C5	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0
C4	10 Assets $1,579,488	6 Assets $832,077	8 Assets $1,094,708	17 Assets $2,096,253	3 Assets $314,802
C3	0 Assets $0	0 Assets $0	1 Assets $10,894	1 Assets $14,238	0 Assets $0
C2	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0
C1	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0

Probability

Where:
- Crtitical
- Significant
- Medium
- Low

Figure B7: Paramedic Vehicles Risk Exposure

Consequence	P1	P2	P3	P4	P5
C5	13 Assets $2,111,300	12 Assets $1,867,152	5 Assets $703,186	4 Assets $662,828	0 Assets $0
C4	1 Assets $90,639	3 Assets $834,175	1 Assets $55,755	0 Assets $0	0 Assets $0
C3	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0
C2	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0
C1	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0

Probability

Where:
Crtitical
Significant
Medium
Low

Figure B8: Paramedic Equipment Risk Exposure

Consequence	P1	P2	P3	P4	P5
C5	55 Assets $93,171	0 Assets $0	184 Assets $724,249	11 Assets $404,306	10 Assets $397,560
C4	51 Assets $428,768	1 Assets $25,364	43 Assets $281,786	23 Assets $921,679	2 Assets $65,277
C3	4 Assets $34,444	0 Assets $0	0 Assets $0	37 Assets $180,242	1 Assets $21,245
C2	0 Assets $0	1 Assets $23,932	0 Assets $0	0 Assets $0	0 Assets $0
C1	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0	1 Assets $40,998

Probability

Where:
Crtitical
Signific ant
Medium
Low

Figure B9: Fire Vehicles Risk Exposure

Consequence	P1	P2	P3	P4	P5
C5	17 Assets $7,475,003	19 Assets $7,858,925	10 Assets $4,051,007	4 Assets $1,204,878	0 Assets $0
C4	1 Assets $36,847	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0
C3	6 Assets $350,442	4 Assets $194,465	3 Assets $1,584,443	8 Assets $988,355	2 Assets $190,862
C2	3 Assets $91,482	1 Assets $32,984	2 Assets $43,506	0 Assets $0	0 Assets $0
C1	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0

Probability

Where:
- Crtitical
- Significant
- Medium
- Low

Figure B10: Fire Equipment Risk Exposure

Consequence	P1	P2	P3	P4	P5
C5	252 Assets $1,009,827	733 Assets $1,428,090	97 Assets $511,083	9 Assets $13,500	16 Assets $156,000
C4	483 Assets $420,696	155 Assets $210,992	48 Assets $27,070	331 Assets $258,462	24 Assets $34,200
C3	176 Assets $153,950	354 Assets $1,565,548	192 Assets $126,632	296 Assets $104,288	1 Assets $48,058
C2	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0
C1	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0

Probability

Where:
- Crtitical
- Significant
- Medium
- Low

Figure B11: Transit Bus and Shelters Risk Exposure

Consequence	P1	P2	P3	P4	P5
C5	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0
C4	19 Assets $12,195,478	7 Assets $4,493,071	0 Assets $0	11 Assets $7,060,540	22 Assets $14,121,080
C3	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0
C2	42 Assets $519,624	35 Assets $433,020	24 Assets $296,928	11 Assets $136,092	3 Assets $37,116
C1	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0

Probability

Where:
- Crtitical
- Significant
- Medium
- Low

Figure B12: Parks and Recreation

Consequence	P1	P2	P3	P4	P5
C5	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0
C4	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0
C3	6 Assets $32,000	4 Assets $41,085	14 Assets $82,146	11 Assets $50,000	3 Assets $41,240
C2	14 Assets $324,064	17 Assets $352,932	216 Assets $1,809,817	7 Assets $152,588	33 Assets $1,221,735
C1	12 Assets $19,700	26 Assets $55,786	140 Assets $227,744	16 Assets $106,506	14 Assets $173,705

Probability

Where:
- Crtitical
- Significant
- Medium
- Low

Appendix C – Fleet and Equipment Risk Exposure and Condition Ranking

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Appendix C - Fleet and Equipment Risk Exposure and Condition Ranking							
Asset ID	TCA ID	Name	Asset Class	Quantity	Condition	Criticality	Risk Exposure
	20709	Defibrillator	Paramedic Equipment	1	0	5	25
	20710	Defibrillator	Paramedic Equipment	1	0	5	25
	20711	Defibrillator	Paramedic Equipment	1	0	5	25
	20712	Defibrillator	Paramedic Equipment	1	0	5	25
	20713	Defibrillator	Paramedic Equipment	1	0	5	25
		Auto Ex - Hydraulics / E-droli	Fire Equipment	4	0	5	25
		Auto Ex - Hydraulics / E-droli	Fire Equipment	4	0	5	25
		Water Rescue Suits	Fire Equipment	8	0	5	25
	21010	2014 Defibrillator AR14D007	Paramedic Equipment	1	10	5	25
	21012	2014 Defibrillator AR14D007	Paramedic Equipment	1	10	5	25
	21014	2014 Defibrillator AR14D007	Paramedic Equipment	1	10	5	25
	21016	2014 Defibrillator AR14D007	Paramedic Equipment	1	10	5	25
	21017	2014 Defibrillator AR14D007	Paramedic Equipment	1	10	5	25
R0292A	1822	Trailer with Generator	M&E General	1	0	4	20
R735	18332	Mobile Generator (R-735)	M&E General	1	0	4	20
R730	18333	Mobile Generator (R-730)	M&E General	1	0	4	20
R736	18334	Mobile Generator (R-736)	M&E General	1	0	4	20
R737	18335	Mobile Generator (R-737)	M&E General	1	0	4	20
R705	18336	Mobile Generator (R-705)	M&E General	1	0	4	20
R710	18337	Mobile Generator (R-710)	M&E General	1	0	4	20
Old 5000	152	Argo Avenger	Paramedic Equipment	1	0	4	20
Old 5001	182	Special Ops Unit Trailer	Paramedic Equipment	1	0	4	20
		Portable Generator	Fire Equipment	2	0	4	20
		Portable Generator	Fire Equipment	2	0	4	20
		Portable Generator	Fire Equipment	2	0	4	20
		Gas Detection	Fire Equipment	1	0	4	20
		Gas Detection	Fire Equipment	10	0	4	20
		Gas Detection	Fire Equipment	1	0	4	20
T751	593	BUS L208 - Low Floor	Transit Bus	1	0	4	20
T752	594	BUS L208 - Low Floor	Transit Bus	1	0	4	20
T753	595	BUS L208 - Low Floor	Transit Bus	1	0	4	20
15-01	AK 23088	FORD	Vehicle Medium Duty	1	5	4	20
		Water Rescue Boat	Fire Equipment	1	5	4	20
		Boat Motor	Fire Equipment	1	5	4	20
T761	596	Bus L250 - Low Floor	Transit Bus	1	5	4	20
T762	597	Bus L250 - Low Floor	Transit Bus	1	5	4	20
T763	598	Bus L250 - Low Floor	Transit Bus	1	5	4	20
T764	599	Bus L250 - Low Floor	Transit Bus	1	5	4	20
T765	600	Bus L250 - Low Floor	Transit Bus	1	5	4	20
T766	601	Bus L251 Inter-Urban Coach	Transit Bus	1	5	4	20
T767	602	Bus L251 Inter-Urban Coach	Transit Bus	1	5	4	20
S182	2091	Loader	M&E Heavy	1	10	4	20
		Gas Detection	Fire Equipment	4	10	4	20
T770	603	Bus L293 - Low Floor	Transit Bus	1	10	4	20
T771	604	Bus L293 - Low Floor	Transit Bus	1	10	4	20
T772	605	Bus L293 - Low Floor	Transit Bus	1	10	4	20
T773	606	Bus L293 - Low Floor	Transit Bus	1	10	4	20
T774	607	Bus L294 Inter-Urban Coach	Transit Bus	1	10	4	20
T775	608	Bus L294 Inter-Urban Coach	Transit Bus	1	10	4	20
S181	2090	Loader	M&E Heavy	1	12.5	4	20
S839	2054	Garbage Packer	Vehicle Heavy Duty	1	15	4	20
S1204	2080	Vactor	Vehicle Heavy Duty	1	15	4	20
S1102	8429	Diesel Tandem Truck	Vehicle Heavy Duty	1	15	4	20
S66910	18292	2010 Freightliner Tandem Mu	Vehicle Heavy Duty	1	15	4	20
S66810	18293	2010 Freightliner Tandem Mu	Vehicle Heavy Duty	1	15	4	20
R8152 wa	22604	Dump Truck/Plow	Vehicle Medium Duty	1	15	4	20
	22976	Fuel Storage Dispensing and	M&E General	1	15	4	20

Asset ID	TCA ID	Name	Asset Class	Quantity	Condition	Criticality	Risk Exposure
S02440	2110	MT5 Tractor	M&E Light Diesel & MTs	1	15	4	20
S02510	2117	MT5T Tractor	M&E Light Diesel & MTs	1	15	4	20
R-8032	2121	MT5T Tractor	M&E Light Diesel & MTs	1	15	4	20
T783	5497	Autobus	Transit Bus	1	15	4	20
T784	5498	Autobus	Transit Bus	1	15	4	20
T781	5499	Autobus	Transit Bus	1	15	4	20
T782	5500	Autobus	Transit Bus	1	15	4	20
T785	5501	Autobus	Transit Bus	1	15	4	20
T786	5502	Charter Bus	Transit Bus	1	15	4	20
S836	2053	Garbage Packer	Vehicle Heavy Duty	1	17.5	4	20
L5348	20292	Primary Response Unit	Vehicle Paramedic	1	20	5	20
		Water Rescue Suits	Fire Equipment	9	20	5	20
	21312	2015 Defibrillator AR15F013(	Paramedic Equipment	1	25	5	20
	21343	2015 Defibrillator AR15F013(	Paramedic Equipment	1	25	5	20
	21344	2015 Defibrillator AR15F013(	Paramedic Equipment	1	25	5	20
	21345	2015 Defibrillator AR15F013(	Paramedic Equipment	1	25	5	20
	21346	2015 Defibrillator AR15F013(	Paramedic Equipment	1	25	5	20
	21347	2015 Defibrillator AR15F013(	Paramedic Equipment	1	25	5	20
	21348	2015 Defibrillator AR15F013!	Paramedic Equipment	1	25	5	20
	21349	2015 Defibrillator AR15F013(	Paramedic Equipment	1	25	5	20
	21350	2015 Defibrillator AR15F013!	Paramedic Equipment	1	25	5	20
	21351	2015 Defibrillator AR15F013!	Paramedic Equipment	1	25	5	20
	21352	2015 Defibrillator AR15F013!	Paramedic Equipment	1	25	5	20
L5127	20705	Ambulance	Vehicle Paramedic	1	27.5	5	20
F153 F01!	78	Pumper 15	Vehicle Fire	1	30	5	20
F029 F00;	26	Tank 4	Vehicle Fire	1	30	5	20
F037 F00:	33	Pump 5	Vehicle Fire	1	35	5	20
F061 F00(	43	Bush 20	Vehicle Fire	1	35	5	20
L5136	21005	Ambulance Type III #5136	Vehicle Paramedic	1	37.5	5	20
L5135	21008	Ambulance Type III #5135	Vehicle Paramedic	1	37.5	5	20
S1205	2081	Vactor	Vehicle Heavy Duty	1	20	4	16
S1108	8428	Diesel Tandem Truck	Vehicle Heavy Duty	1	20	4	16
S1413	8459	Loader	M&E Heavy	1	20	4	16
S17611	19542	2011 John Deere Loader	M&E Heavy	1	20	4	16
		Hoses 100mm (Structural Ho	Fire Equipment	8	20	4	16
		Hoses 100mm (Structural Ho	Fire Equipment	3	20	4	16
T793	18048	Bus low floor	Transit Bus	1	20	4	16
T794	18049	Bus Low Floor	Transit Bus	1	20	4	16
T791	18050	Bus Low Floor	Transit Bus	1	20	4	16
T792	18051	Bus low floor	Transit Bus	1	20	4	16
S1240	2082	MT5T Tractor	M&E Light Diesel & MTs	1	22.5	4	16
S1418	8460	Loader	M&E Heavy	1	25	4	16
S248	2114	MT5T Tractor	M&E Light Diesel & MTs	1	25	4	16
S1246	8454	MT5T Tractor	M&E Light Diesel & MTs	1	25	4	16
	21313	Power Load Stretcher 15014	Paramedic Equipment	1	25	4	16
	21314	Power Load Stretcher 15014	Paramedic Equipment	1	25	4	16
	21315	Power Load Stretcher 15014	Paramedic Equipment	1	25	4	16
	21316	Power Load Stretcher 15014	Paramedic Equipment	1	25	4	16
	21317	Power Load Stretcher 15014	Paramedic Equipment	1	25	4	16
	21318	Power Load Stretcher 15014	Paramedic Equipment	1	25	4	16
	21319	Power Load Stretcher 15014	Paramedic Equipment	1	25	4	16
	21320	Power Load Stretcher 15014	Paramedic Equipment	1	25	4	16
	21321	Power Load Stretcher 15014	Paramedic Equipment	1	25	4	16
	21322	Power Load Stretcher 15014	Paramedic Equipment	1	25	4	16
	21323	Power Load Stretcher 15014	Paramedic Equipment	1	25	4	16
	21324	Power Load Stretcher 15014(	Paramedic Equipment	1	25	4	16
	21325	Power Load Stretcher 15014	Paramedic Equipment	1	25	4	16
	21326	Power Load Stretcher 15014	Paramedic Equipment	1	25	4	16

Asset ID	TCA ID	Name	Asset Class	Quantity	Condition	Criticality	Risk Exposure
	21328	Power Load Stretcher 15014	Paramedic Equipment	1	25	4	16
	21329	Power Load Stretcher 15014	Paramedic Equipment	1	25	4	16
	21331	Power Load Stretcher 15014	Paramedic Equipment	1	25	4	16
	21332	Power Load Stretcher 15014	Paramedic Equipment	1	25	4	16
	21333	Power Load Stretcher 15014	Paramedic Equipment	1	25	4	16
	21334	Power Load Stretcher 15014	Paramedic Equipment	1	25	4	16
	21335	Power Load Stretcher 15014	Paramedic Equipment	1	25	4	16
	21336	Power Load Stretcher 15014	Paramedic Equipment	1	25	4	16
	21338	Power Load Stretcher 15014	Paramedic Equipment	1	25	4	16
		Hoses 100mm (Structural Ho	Fire Equipment	5	25	4	16
		Hoses 100mm (Structural Ho	Fire Equipment	10	25	4	16
		Hoses 100mm (Structural Ho	Fire Equipment	7	25	4	16
		Hoses 100mm (Structural Ho	Fire Equipment	8	25	4	16
		Hoses 100mm (Structural Ho	Fire Equipment	16	25	4	16
F0020	92	Evinrude 25HP	Fire Equipment	1	25	4	16
		Boat Trailer	Fire Equipment	1	25	4	16
		Boat Trailer	Fire Equipment	1	25	4	16
		Portable Generator	Fire Equipment	2	25	4	16
		Gas Detection	Fire Equipment	7	25	4	16
T801	18911	Bus - Low Floor	Transit Bus	1	25	4	16
T802	18912	Bus-Low Floor	Transit Bus	1	25	4	16
T803	18913	Bus-Low Floor	Transit Bus	1	25	4	16
T804	18914	Bus-Low Floor	Transit Bus	1	25	4	16
T806	18917	Bus-Low Floor	Transit Bus	1	25	4	16
T807	18919	Bus-Low Floor	Transit Bus	1	25	4	16
T808	18922	Bus-Low Floor	Transit Bus	1	25	4	16
S1104	8752	Dump Truck	Vehicle Heavy Duty	1	27.5	4	16
S1110	8753	Dump Truck	Vehicle Heavy Duty	1	27.5	4	16
S417	2141	Loader	M&E Heavy	1	27.5	4	16
S10310	18320	Dump Truck	Vehicle Heavy Duty	1	30	4	16
S11710	18321	Dump Truck	Vehicle Heavy Duty	1	30	4	16
S01243	2084	MT5T Tractor	M&E Light Diesel & MTs	1	30	4	16
S232	2099	MT5T Tractor	M&E Light Diesel & MTs	1	30	4	16
S234	2101	MT5T Tractor	M&E Light Diesel & MTs	1	30	4	16
S1250	8452	MT5T Tractor	M&E Light Diesel & MTs	1	30	4	16
S1260	8453	MT5T Tractor	M&E Light Diesel & MTs	1	30	4	16
		Hoses 100mm (Structural Ho	Fire Equipment	8	30	4	16
		Hoses 100mm (Structural Ho	Fire Equipment	5	30	4	16
		Hoses 100mm (Structural Ho	Fire Equipment	17	30	4	16
		Hoses 65mm (Structural Hos	Fire Equipment	11	30	4	16
		Hoses 65mm (Structural Hos	Fire Equipment	10	30	4	16
		Hoses 65mm (Structural Hos	Fire Equipment	13	30	4	16
		Hoses 65mm (Structural Hos	Fire Equipment	8	30	4	16
		Hoses 65mm (Structural Hos	Fire Equipment	16	30	4	16
		Hoses 65mm (Structural Hos	Fire Equipment	12	30	4	16
		Hoses 100mm (Structural Ho	Fire Equipment	7	30	4	16
		PPV Fans	Fire Equipment	10	30	4	16
S231	2097	MT5T Tractor	M&E Light Diesel & MTs	1	32.5	4	16
S1252	18267	MT6 Off-road vehicle	M&E Light Diesel & MTs	1	32.5	4	16
	22977	Fuel Storage Dispensing and	M&E General	1	35	4	16
	22993	Fuel Storage Dispensing and	M&E General	1	35	4	16
	22995	Fuel Storage Dispensing and	M&E General	1	35	4	16
S1242	2083	MT5T Tractor	M&E Light Diesel & MTs	1	35	4	16
S1249	18268	MT6 Off-road vehicle	M&E Light Diesel & MTs	1	35	4	16
		Hoses 100mm (Structural Ho	Fire Equipment	6	35	4	16
		Hoses 65mm (Structural Hos	Fire Equipment	51	35	4	16
		Hoses 65mm (Structural Hos	Fire Equipment	14	35	4	16
		Hoses 65mm (Structural Hos	Fire Equipment	4	35	4	16

Asset ID	TCA ID	Name	Asset Class	Quantity	Condition	Criticality	Risk Exposure
		Hoses 100mm (Structural Ho	Fire Equipment	1	35	4	16
		Hoses 100mm (Structural Ho	Fire Equipment	1	35	4	16
		Hoses 100mm (Structural Ho	Fire Equipment	1	35	4	16
		Hoses 100mm (Structural Ho	Fire Equipment	1	35	4	16
		Hoses 100mm (Structural Ho	Fire Equipment	1	35	4	16
		Hoses 100mm (Structural Ho	Fire Equipment	1	35	4	16
		Hoses 100mm (Structural Ho	Fire Equipment	1	35	4	16
		Hoses 100mm (Structural Ho	Fire Equipment	1	35	4	16
		Hoses 100mm (Structural Ho	Fire Equipment	1	35	4	16
		Hoses 100mm (Structural Ho	Fire Equipment	1	35	4	16
		Hoses 65mm (Structural Hos	Fire Equipment	1	35	4	16
		Hoses 65mm (Structural Hos	Fire Equipment	1	35	4	16
		Hoses 65mm (Structural Hos	Fire Equipment	1	35	4	16
		Hoses 65mm (Structural Hos	Fire Equipment	1	35	4	16
		Hoses 65mm (Structural Hos	Fire Equipment	1	35	4	16
		Hoses 65mm (Structural Hos	Fire Equipment	1	35	4	16
		Hoses 65mm (Structural Hos	Fire Equipment	1	35	4	16
		Hoses 65mm (Structural Hos	Fire Equipment	1	35	4	16
		Hoses 65mm (Structural Hos	Fire Equipment	1	35	4	16
		Hoses 65mm (Structural Hos	Fire Equipment	1	35	4	16
		Hoses 65mm (Structural Hos	Fire Equipment	1	35	4	16
		Hoses 65mm (Structural Hos	Fire Equipment	1	35	4	16
		Hoses 65mm (Structural Hos	Fire Equipment	1	35	4	16
		Hoses 65mm (Structural Hos	Fire Equipment	1	35	4	16
		Hoses 65mm (Structural Hos	Fire Equipment	1	35	4	16
		Hoses 100mm (Structural Ho	Fire Equipment	1	35	4	16
		Hoses 65mm (Structural Hos	Fire Equipment	38	35	4	16
		Hoses 100mm (Structural Ho	Fire Equipment	6	35	4	16
C105	17228	Utility Vehicle w/ Cab Kubota	M&E Light Diesel & MTs	1	37.5	4	16
C106	17229	Utility Vehicle w/ Cab Kubota	M&E Light Diesel & MTs	1	37.5	4	16
C102	17230	Mini Excavator w/Cab Caterp	M&E Light Diesel & MTs	1	37.5	4	16
C101	17887	Mini Excavator w/Cab Caterp	M&E Light Diesel & MTs	1	37.5	4	16
S1251	18266	MT6 Off-road vehicle	M&E Light Diesel & MTs	1	37.5	4	16
R00760	1811	Cold Planer	M&E General	1	0	3	15
R00770	1812	Cold Planer	M&E General	1	0	3	15
R01620	1813	Forklift	M&E General	1	0	3	15
R02700	2056	Ashphalt Recycler	M&E General	1	0	3	15
S08090	2145	Litter Collector	M&E General	1	0	3	15
Hoist #3	2159	Forward Hoist #3	M&E General	1	0	3	15
	17915	Trimble DiNi Precise Digital L	M&E General	1	0	3	15
	17921	Coherent Water Resonator	M&E General	1	0	3	15
	18995	AMMCO 12,000LB 4 post lift	M&E General	1	0	3	15
	19387	2011 Yamaha ATV	M&E General	1	0	3	15
	19687	GIS-Survey Equipment with (	M&E General	1	0	3	15
	19688	GIS Survey Equipment with (	M&E General	1	0	3	15
	19689	GIS-Survey Equipment with (	M&E General	1	0	3	15
R02670	22971	Boiler	M&E General	1	0	3	15
	21353	Respirator Fit Tester	Paramedic Equipment	1	0	3	15
F126 F012	22180	2010 GMC 3500 F0126	Vehicle Fire	1	0	3	15
	104	Hazmat Tent	Fire Equipment	1	0	3	15
	P1510	Bombardier	M&E Parks & Recreation	1	0	3	15
	P315	Bombardier	M&E Parks & Recreation	1	0	3	15
R09750	2076	Zamboni	M&E General	1	5	3	15
S0237-3	2106	60" Angling Sweeper	M&E General	1	5	3	15
R09740	23334	Zamboni	M&E General	1	5	3	15
	P1510	Bombardier	M&E Parks & Recreation	1	5	3	15
S09911	18943	Truck - Single Axle Cab & Ch	Vehicle Heavy Duty	1	7.5	3	15
	681	Farebox - OD019920	M&E General	1	10	3	15

Asset ID	TCA ID	Name	Asset Class	Quantity	Condition	Criticality	Risk Exposure
	682	Farebox - OD019903	M&E General	1	10	3	15
	683	Farebox - OD019871	M&E General	1	10	3	15
	684	Farebox - OD019907	M&E General	1	10	3	15
	685	Farebox - OD019881	M&E General	1	10	3	15
	686	Farebox - OD019896	M&E General	1	10	3	15
	687	Farebox - OD019912	M&E General	1	10	3	15
	688	Farebox - OD019870	M&E General	1	10	3	15
	689	Farebox - OD019908	M&E General	1	10	3	15
	690	Farebox - OD019902	M&E General	1	10	3	15
	691	Farebox - OD019894	M&E General	1	10	3	15
	692	Farebox - OD019879	M&E General	1	10	3	15
	693	Farebox - OD019872	M&E General	1	10	3	15
	694	Farebox - OD019914	M&E General	1	10	3	15
	695	Farebox - OD019910	M&E General	1	10	3	15
	696	Farebox - OD019901	M&E General	1	10	3	15
	697	Farebox - OD019880	M&E General	1	10	3	15
	698	Farebox - OD019863	M&E General	1	10	3	15
	699	Farebox - OD019890	M&E General	1	10	3	15
	700	Farebox - OD019883	M&E General	1	10	3	15
	701	Farebox - OD019868	M&E General	1	10	3	15
	702	Farebox - OD019884	M&E General	1	10	3	15
	703	Farebox - OD019897	M&E General	1	10	3	15
	705	Farebox - OD019923	M&E General	1	10	3	15
	706	Farebox - OD019909	M&E General	1	10	3	15
	707	Farebox - OD019875	M&E General	1	10	3	15
	708	Farebox - OD019895	M&E General	1	10	3	15
	709	Farebox - OD019886	M&E General	1	10	3	15
	710	Farebox - OD019893	M&E General	1	10	3	15
	711	Farebox - OD019866	M&E General	1	10	3	15
	712	Farebox - OD019891	M&E General	1	10	3	15
	713	Farebox - OD019916	M&E General	1	10	3	15
	714	Farebox - OD019905	M&E General	1	10	3	15
	715	Farebox - OD019917	M&E General	1	10	3	15
	716	Farebox - OD019922	M&E General	1	10	3	15
	717	Farebox - OD019898	M&E General	1	10	3	15
	718	Farebox - OD019888	M&E General	1	10	3	15
	719	Farebox - OD019918	M&E General	1	10	3	15
	720	Farebox - OD019874	M&E General	1	10	3	15
	722	Farebox - OD019899	M&E General	1	10	3	15
	723	Farebox - OD019904	M&E General	1	10	3	15
	724	Farebox - OD019919	M&E General	1	10	3	15
	725	Farebox - OD019864	M&E General	1	10	3	15
	726	Farebox - OD019911	M&E General	1	10	3	15
	727	Farebox - OD019889	M&E General	1	10	3	15
	728	Farebox - OD019900	M&E General	1	10	3	15
	729	Farebox - OD019915	M&E General	1	10	3	15
	730	Farebox - OD019906	M&E General	1	10	3	15
	731	Farebox - OD019892	M&E General	1	10	3	15
	732	Farebox - OD019921	M&E General	1	10	3	15
	733	Farebox - OD019926	M&E General	1	10	3	15
	734	Farebox - OD019869	M&E General	1	10	3	15
	735	Farebox - OD019882	M&E General	1	10	3	15
	736	Farebox - OD019873	M&E General	1	10	3	15
	737	Farebox - OD019877	M&E General	1	10	3	15
	738	Farebox - OD019924	M&E General	1	10	3	15
	739	Farebox - OD019925	M&E General	1	10	3	15
	740	Farebox - OD019887	M&E General	1	10	3	15
	741	Farebox - OD019855	M&E General	1	10	3	15

Asset ID	TCA ID	Name	Asset Class	Quantity	Condition	Criticality	Risk Exposure
	742	Farebox - OD019913	M&E General	1	10	3	15
	743	Farebox - OD019867	M&E General	1	10	3	15
R09620	2063	Zamboni	M&E General	1	10	3	15
R09630	2064	Zamboni	M&E General	1	10	3	15
	22982	Rotary 18,000 Portable Vehic	M&E General	1	10	3	15
S08310	18948	2010 TE Diesel ATLV 4300 L	Vehicle Heavy Duty	1	12.5	3	15
S48909	18280	2009 Ford Escape 4x4	Vehicle Light Duty	1	15	3	15
R09730	2074	Zamboni	M&E General	1	15	3	15
S56010	18932	2010 Ford F 450 Dually w/Du	Vehicle Medium Duty	1	17.5	3	15
08-1	BA50252	FORD	Vehicle Light Duty	1	17.5	3	15
F062 F006	18926	Deputy 1	Vehicle Fire	1	17.5	3	15
L5350	20714	ERV Command Ford Explore	Vehicle Paramedic	1	40	5	15
	21916	2016 Defibrillator AR16D018	Paramedic Equipment	1	40	5	15
	21917	2016 Defibrillator AR16D018	Paramedic Equipment	1	40	5	15
	21918	2016 Defibrillator AR16D018	Paramedic Equipment	1	40	5	15
	21919	2016 Defibrillator AR16D018	Paramedic Equipment	1	40	5	15
	21920	2016 Defibrillator AR16D018	Paramedic Equipment	1	40	5	15
	21921	2016 Defibrillator AR16D018	Paramedic Equipment	1	40	5	15
	21922	2016 Defibrillator AR16D018	Paramedic Equipment	1	40	5	15
	21923	2016 Defibrillator AR16D018	Paramedic Equipment	1	40	5	15
	21924	2016 Defibrillator AR16D018	Paramedic Equipment	1	40	5	15
	21925	2016 Defibrillator AR16D018	Paramedic Equipment	1	40	5	15
	21926	2016 Defibrillator AR16D018	Paramedic Equipment	1	40	5	15
	21927	2016 Defibrillator AR16D018	Paramedic Equipment	1	40	5	15
	21928	2016 Defibrillator AR16D018	Paramedic Equipment	1	40	5	15
	21929	2016 Defibrillator AR16D018	Paramedic Equipment	1	40	5	15
	21930	2016 Defibrillator AR16D018	Paramedic Equipment	1	40	5	15
		Bunker Gear	Fire Equipment	12	40	5	15
		Bunker Gear	Fire Equipment	12	40	5	15
		Bunker Gear	Fire Equipment	19	40	5	15
		Bunker Gear	Fire Equipment	6	40	5	15
		Bunker Gear	Fire Equipment	2	40	5	15
		Bunker Gear	Fire Equipment	16	40	5	15
		Bunker Gear	Fire Equipment	15	40	5	15
was L5008	20293	ERV Command (PRU)	Vehicle Paramedic	1	42.5	5	15
F060 F006	42	Pump 21	Vehicle Fire	1	42.5	5	15
F127 F012	70	Pumper 7	Vehicle Fire	1	42.5	5	15
F034 F003	30	Pump 15	Vehicle Fire	1	45	5	15
F066 F006	47	Pump 23	Vehicle Fire	1	45	5	15
F110 F011	62	Bush 11	Vehicle Fire	1	45	5	15
F151 F015	76	Bush 3	Vehicle Fire	1	47.5	5	15
L5130	21341	Ambulance Type III #5130	Vehicle Paramedic	1	50	5	15
		Auto Ex - Hydraulics / E-droli	Fire Equipment	1	50	5	15
		Auto Ex - Hydraulics / E-droli	Fire Equipment	3	50	5	15
		Auto Ex - Hydraulics / E-droli	Fire Equipment	3	50	5	15
		Auto Ex - Hydraulics / E-droli	Fire Equipment	3	50	5	15
		Auto Ex - Hydraulics / E-droli	Fire Equipment	1	50	5	15
		Auto Ex - Hydraulics / E-droli	Fire Equipment	1	50	5	15
		Auto Ex - Hydraulics / E-droli	Fire Equipment	3	50	5	15
L5184	21339	Ambulance Type III #5184	Vehicle Paramedic	1	52.5	5	15
F067 F006	48	Pumper 13	Vehicle Fire	1	52.5	5	15
	22173	2017 Defibrillator AR17G025	Paramedic Equipment	1	55	5	15
		Circulation Bag	Paramedic Equipment	42	55	5	15
		Airway Breathing Bag	Paramedic Equipment	42	55	5	15
		Trauma Bag	Paramedic Equipment	42	55	5	15
		Pediatric Bag	Paramedic Equipment	42	55	5	15
F063 F006	44	Engine 24	Vehicle Fire	1	55	5	15
F065 F006	46	Engine 8	Vehicle Fire	1	55	5	15

Asset ID	TCA ID	Name	Asset Class	Quantity	Condition	Criticality	Risk Exposure
F026 F002	23	Engine 11 (aerial)	Vehicle Fire	1	55	5	15
L5131	21342	Ambulance Type III #5131	Vehicle Paramedic	1	57.5	5	15
S54809	18275	2009 Ford Escape 4x4	Vehicle Light Duty	1	20	3	12
R09600	2062	Zamboni	M&E General	1	20	3	12
R09760	2077	Zamboni	M&E General	1	20	3	12
S1808	8463	Sidewalk Sweeper	M&E General	1	20	3	12
	22964	Sokkia Total Station - 2012	M&E General	1	20	3	12
F030 F003	27	Suppport 10	Vehicle Fire	1	20	3	12
		Ladder	Fire Equipment	6	20	3	12
		Ladder	Fire Equipment	9	20	3	12
		Ladder	Fire Equipment	7	20	3	12
		Ladder	Fire Equipment	2	20	3	12
S04510	18933	2010 Ford F 450 Dually w/du	Vehicle Medium Duty	1	22.5	3	12
S49813	20665	2013 F-150 Pickup	Vehicle Light Duty	1	22.5	3	12
08-2	346 2XA	FORD	Vehicle Light Duty	1	22.5	3	12
10-01	190 4ZA	FORD	Vehicle Light Duty	1	22.5	3	12
S43913	20668	2013 F-150 Pickup	Vehicle Light Duty	1	25	3	12
07-1	327 1VX	FORD	Vehicle Light Duty	1	25	3	12
07-2	AV34376	FORD	Vehicle Light Duty	1	25	3	12
10-02	AH 57592	FORD	Vehicle Light Duty	1	25	3	12
R09690	2070	Zamboni	M&E General	1	25	3	12
R78	18317	Cold Planer MTCP Grinder	M&E General	1	25	3	12
R74	18318	Cold Planer MTCP Grinder	M&E General	1	25	3	12
R75	18319	Cold Planer MTCP Grinder	M&E General	1	25	3	12
	21546	Brine Makers	M&E General	2	25	3	12
F042 F004	37	Support 16	Vehicle Fire	1	25	3	12
F079 F007	18927	Car 12	Vehicle Fire	1	25	3	12
		Zamboni Propane Edger	M&E Parks & Recreation	1	25	3	12
		Zamboni Propane Edger	M&E Parks & Recreation	1	25	3	12
		Zamboni Propane Edger	M&E Parks & Recreation	1	25	3	12
		Zamboni Propane Edger	M&E Parks & Recreation	1	25	3	12
		Propane Edger	M&E Parks & Recreation	1	25	3	12
		Propane Edger	M&E Parks & Recreation	2	25	3	12
		Propane Edger	M&E Parks & Recreation	1	25	3	12
		Propane Edger	M&E Parks & Recreation	1	25	3	12
		Propane Edger	M&E Parks & Recreation	1	25	3	12
		Propane Edger	M&E Parks & Recreation	1	25	3	12
F005 F000	18925	Fleet 3	Vehicle Medium Duty	1	27.5	3	12
S44512	20195	2012 Dodge Ram 1500	Vehicle Light Duty	1	27.5	3	12
F075 F007	21235	Support 5 E350	Vehicle Fire	1	27.5	3	12
F048 F004	5537	Car 15 Ford Escape	Vehicle Fire	1	27.5	3	12
S48413	20674	2013 F-150 Pickup	Vehicle Light Duty	1	30	3	12
	8455	Ice Resurfacing Machine Zar	M&E General	1	30	3	12
	8456	Ice Resurfacing Machine Zar	M&E General	1	30	3	12
	20561	AVL / GPS - Roads	M&E General	170	30	3	12
	20994	Automatic Vehicle Location S	M&E General	7	30	3	12
	21247	Automatic Vehicle Location S	M&E General	11	30	3	12
C103	17226	Hydraulic Rock Breaker w/Me	M&E Light Diesel & MTs	1	30	3	12
	20708	Automatic Vehicle Location S	Paramedic Equipment	37	30	3	12
F051 F005	41	Support 6	Vehicle Fire	1	30	3	12
		Wajax Pump	Fire Equipment	6	30	3	12
F0157	105	Hazmat trailer	Fire Equipment	1	30	3	12
F074 F007	21238	Support 9 E350	Vehicle Fire	1	32.5	3	12
S54713	20675	2013 F-150 Pickup	Vehicle Light Duty	1	35	3	12
F154 F015	79	Support 1	Vehicle Fire	1	35	3	12
		Hoses 38mm (Forestry Hose	Fire Equipment	27	35	3	12
		Hoses 38mm (Forestry Hose	Fire Equipment	25	35	3	12
		Hoses 38mm (Forestry Hose	Fire Equipment	18	35	3	12

Asset ID	TCA ID	Name	Asset Class	Quantity	Condition	Criticality	Risk Exposure
		Hoses 38mm (Forestry Hose	Fire Equipment	20	35	3	12
		Hoses 38mm (Forestry Hose	Fire Equipment	8	35	3	12
		Hoses 38mm (Forestry Hose	Fire Equipment	16	35	3	12
		Hoses 38mm (Forestry Hose	Fire Equipment	20	35	3	12
		Hoses 38mm (Forestry Hose	Fire Equipment	23	35	3	12
		Hoses 38mm (Forestry Hose	Fire Equipment	64	35	3	12
		Hoses 38mm (Forestry Hose	Fire Equipment	20	35	3	12
		Hoses 38mm (Forestry Hose	Fire Equipment	24	35	3	12
S67012	20214	2013 Tandem Multi-Function	Vehicle Heavy Duty	1	40	4	12
R673	18338	8" Diesel Trash Pump	M&E General	1	40	4	12
R704	21108	Generator Thawing Machine	M&E General	1	40	4	12
S24510	18938	MT6 Off-road vehicle with sn	M&E Light Diesel & MTs	1	40	4	12
S25610	18939	MT6 Off-road vehicle with sn	M&E Light Diesel & MTs	1	40	4	12
17-01		Trackless MT6	M&E Light Diesel & MTs	1	40	4	12
	21911	Power Load Stretcher 16013	Paramedic Equipment	1	40	4	12
		Gas Detection	Fire Equipment	7	40	4	12
S67512	20213	2013 Tandem Multi-Function	Vehicle Heavy Duty	1	42.5	4	12
S1393	8457	Backhoe Loader	M&E Heavy	1	42.5	4	12
S05412	20204	2012 Ford F450	Vehicle Medium Duty	1	45	4	12
S60109	18167	Valve Operating Machine	M&E General	1	45	4	12
R625	18492	Diesel Pump 6"	M&E General	1	45	4	12
R626	18795	Diesel Pump 6"	M&E General	1	45	4	12
S414	2139	Loader	M&E Heavy	1	45	4	12
C109	19390	Kubota Wheel Loader (R320	M&E Light Diesel & MTs	1	45	4	12
L5012	20291	2012 Ford Explorer with Upfit	Vehicle Paramedic	1	45	4	12
		Hoses 65mm (Structural Hos	Fire Equipment	20	45	4	12
		Hoses 65mm (Structural Hos	Fire Equipment	14	45	4	12
		Portable Generator	Fire Equipment	2	45	4	12
S63414	20682	Tandem Multi-Function Dump	Vehicle Heavy Duty	1	47.5	4	12
S64815	21097	2015 Tandem Diesel multi-fu	Vehicle Heavy Duty	1	47.5	4	12
S39710	18945	2010 John Deere 310SJ Bac	M&E Heavy	1	47.5	4	12
S35411	18983	G960 Motor Grader	M&E Heavy	1	47.5	4	12
S25713	21704	MT6 - Winter Control Portion	M&E Light Diesel & MTs	1	47.5	4	12
S12012	20211	2013 Freightliner Single Axle	Vehicle Heavy Duty	1	50	4	12
S13415	21084	2015 Tandem Diesel Multi-Fu	Vehicle Heavy Duty	1	50	4	12
S57211	19517	2011 Ford F450 (White) with	Vehicle Medium Duty	1	50	4	12
	18949	Fuel Dispenser and Pump	M&E General	1	50	4	12
	22612	Panasonic Toughbook Comp	Paramedic Equipment	41	50	4	12
		Hoses 100mm (Structural Ho	Fire Equipment	1	50	4	12
		Hoses 100mm (Structural Ho	Fire Equipment	1	50	4	12
		Portable Generator	Fire Equipment	1	50	4	12
S62214	20679	Tandem Multi-Function Dump	Vehicle Heavy Duty	1	52.5	4	12
S62114	20680	Tandem Multi-Function Dump	Vehicle Heavy Duty	1	52.5	4	12
S66714	20683	Tandem Multi-Function Dump	Vehicle Heavy Duty	1	52.5	4	12
S67915	21098	2015 Tandem diesel multi-fur	Vehicle Heavy Duty	1	52.5	4	12
S25912	20186	Series MT6 Off-road Vehicle	M&E Light Diesel & MTs	1	52.5	4	12
C107	20781	Bobcat 5600 Toolcat 2013	M&E Light Diesel & MTs	1	52.5	4	12
S63514	20681	Tandem Multi-Function Dump	Vehicle Heavy Duty	1	55	4	12
S61915	21096	2015 Tandem Diesel multi-fu	Vehicle Heavy Duty	1	55	4	12
S35311	18985	G960 Motor Grader	M&E Heavy	1	55	4	12
S25313	21703	MT6 - Winter Control Portion	M&E Light Diesel & MTs	1	55	4	12
	22365	Power Load Stretcher 17094	Paramedic Equipment	1	55	4	12
		Boat Trailer	Fire Equipment	1	55	4	12
		Gas Detection	Fire Equipment	1	55	4	12
S19012	20184	2012 Road Grader with Elimi	M&E Heavy	1	57.5	4	12
S532	1974	F350	Vehicle Medium Duty	1	0	2	10
S01709	18285	2009 Ford E350	Vehicle Medium Duty	1	0	2	10
S01809	18286	2009 Ford E350	Vehicle Medium Duty	1	0	2	10

Asset ID	TCA ID	Name	Asset Class	Quantity	Condition	Criticality	Risk Exposure
S02509	18295	2009 Ford E350	Vehicle Medium Duty	1	0	2	10
S1541	1660	Silverado	Vehicle Light Duty	1	0	2	10
	657	Air compressors: T30	M&E General	1	0	2	10
	658	Air compressors: EBERDC	M&E General	1	0	2	10
	668	Coin Sorter	M&E General	1	0	2	10
	669	Coin Wrapper	M&E General	1	0	2	10
	673	Shredder	M&E General	1	0	2	10
	679	Security System	M&E General	1	0	2	10
R630	1835	Trailer Mounted Auto. Valve (	M&E General	1	0	2	10
R07210	1837	Heated Asphalt Transporter	M&E General	1	0	2	10
R07220	1838	Heated Asphalt Transporter	M&E General	1	0	2	10
R07280	1840	Woodchipper	M&E General	1	0	2	10
R07550	1845	Chipper	M&E General	1	0	2	10
R09670	2068	Snow Blower - back up unit	M&E General	1	0	2	10
	8443	8'x20' office drag trailer	M&E General	1	0	2	10
	18976	2 Ton Hot Box Reclaimer	M&E General	1	0	2	10
	22962	GPS Unit	M&E General	1	0	2	10
	22963	GPS Unit	M&E General	1	0	2	10
	22978	Computrol - Gate Controller a	M&E General	1	0	2	10
	P17270	John Deere	M&E Parks & Recreation	1	0	2	10
	P301	John Deere	M&E Parks & Recreation	1	0	2	10
	P304	Kubota	M&E Parks & Recreation	1	0	2	10
	P305	John Deere	M&E Parks & Recreation	1	0	2	10
	P306	John Deere	M&E Parks & Recreation	1	0	2	10
	P307	Cushman	M&E Parks & Recreation	1	0	2	10
	P310	Ford / New Holland	M&E Parks & Recreation	1	0	2	10
	P311	Ford / New Holland	M&E Parks & Recreation	1	0	2	10
	P312	Kubota	M&E Parks & Recreation	1	0	2	10
	P317	John Deere	M&E Parks & Recreation	1	0	2	10
	P321	Kubota	M&E Parks & Recreation	1	0	2	10
	P373	Ford	M&E Parks & Recreation	1	0	2	10
	P376	Ford	M&E Parks & Recreation	1	0	2	10
	P378	Ford	M&E Parks & Recreation	1	0	2	10
	P379	Ford	M&E Parks & Recreation	1	0	2	10
	P380	John Deere	M&E Parks & Recreation	1	0	2	10
	P381	Ford	M&E Parks & Recreation	1	0	2	10
	P382	Toro	M&E Parks & Recreation	1	0	2	10
	P383	John Deere	M&E Parks & Recreation	1	0	2	10
	P389	John Deere	M&E Parks & Recreation	1	0	2	10
	P698	Bobcat	M&E Parks & Recreation	1	0	2	10
	P7270	John Deere	M&E Parks & Recreation	1	0	2	10
	P7470-2	John Deere	M&E Parks & Recreation	1	0	2	10
	P7480-2	John Deere	M&E Parks & Recreation	1	0	2	10
	P7490	John Deere	M&E Parks & Recreation	1	0	2	10
	P7500	Bolens	M&E Parks & Recreation	1	0	2	10
	P7600	Bannerman	M&E Parks & Recreation	1	0	2	10
	P7790	Bannerman	M&E Parks & Recreation	1	0	2	10
S1065	1954	F350	Vehicle Medium Duty	1	2.5	2	10
T627	23337	Flat Deck	Vehicle Heavy Duty	1	5	2	10
S1569	1966	F450	Vehicle Medium Duty	1	5	2	10
	666	Tire Changer	M&E General	1	5	2	10
S60311	18990	2011 International	Vehicle Heavy Duty	1	7.5	2	10
S1570	1967	F450	Vehicle Medium Duty	1	7.5	2	10
S578	8424	2008 Ford F350	Vehicle Medium Duty	1	7.5	2	10
S55311	18968	2011 Ford E350	Vehicle Medium Duty	1	7.5	2	10
R8130	23003	F250	Vehicle Medium Duty	1	7.5	2	10
S529 R81	1721	F150	Vehicle Medium Duty	1	10	2	10
S1062	8422	2008 Ford F350	Vehicle Medium Duty	1	10	2	10

Asset ID	TCA ID	Name	Asset Class	Quantity	Condition	Criticality	Risk Exposure
S02111	18967	2011 Ford E350	Vehicle Medium Duty	1	10	2	10
S09211	18988	2011 Ford F250	Vehicle Medium Duty	1	10	2	10
R8108	1654	F150	Vehicle Light Duty	1	10	2	10
R8045	1751	Crown Vic	Vehicle Light Duty	1	10	2	10
S09860	1799	Crown Vic	Vehicle Light Duty	1	10	2	10
S09509	18279	2009 Ford Escape 4x4	Vehicle Light Duty	1	10	2	10
R8151 wa	22600	Silverado	Vehicle Light Duty	1	10	2	10
R849	22967	Impala - retired vehicle pool	Vehicle Light Duty	1	10	2	10
R08420	22968	Transport Van	Vehicle Light Duty	1	10	2	10
S09400	22970	Crown Vic	Vehicle Light Duty	1	10	2	10
R8115	22999	Crown Vic	Vehicle Light Duty	1	10	2	10
S09510	23001	Crown Vic	Vehicle Light Duty	1	10	2	10
R01743-B	1814	Stump Grinder	M&E General	1	10	2	10
R05290	1833	Compressor	M&E General	1	10	2	10
	P371	Jacobsen	M&E Parks & Recreation	1	10	2	10
	P7820	Land Pride	M&E Parks & Recreation	1	10	2	10
S1048	1951	F450	Vehicle Medium Duty	1	12.5	2	10
S1051	1952	F350	Vehicle Medium Duty	1	12.5	2	10
S00209	18288	2009 Ford E350	Vehicle Medium Duty	1	12.5	2	10
S1951	1670	Prius Hybrid	Vehicle Light Duty	1	12.5	2	10
S523	8432	2008 Ford F150	Vehicle Light Duty	1	12.5	2	10
S1579	1969	F450	Vehicle Medium Duty	1	15	2	10
S588	1994	F450	Vehicle Medium Duty	1	15	2	10
S1564	8441	2009 Dodge RAM	Vehicle Medium Duty	1	15	2	10
S1580	18271	2009 Ford F450 White truck	Vehicle Medium Duty	1	15	2	10
S05710	18936	2010 Ford F 450	Vehicle Medium Duty	1	15	2	10
S98809	18278	2009 Ford Escape 4x4	Vehicle Light Duty	1	15	2	10
S06109	18300	2009 Grand Caravan, white	Vehicle Light Duty	1	15	2	10
S91610	18963	2010 Dodge Grand Caravan	Vehicle Light Duty	1	15	2	10
S44412	20194	2012 Dodge Ram 1500	Vehicle Light Duty	1	15	2	10
R682	1836	Load Bank Trailer	M&E General	1	15	2	10
	2161	Gantry adjustable legs	M&E General	1	15	2	10
	P153	Ford	M&E Parks & Recreation	1	15	2	10
	P7890	Toro	M&E Parks & Recreation	1	15	2	10
	P7980	Toro	M&E Parks & Recreation	1	15	2	10
R8075	1899	F250 Crew Cab	Vehicle Medium Duty	1	17.5	2	10
S589	1995	F450	Vehicle Medium Duty	1	17.5	2	10
S1028	8425	2008 Ford F450	Vehicle Medium Duty	1	17.5	2	10
S57111	18973	2011 Ford F450	Vehicle Medium Duty	1	17.5	2	10
S56211	18986	2011 Ford F450 4x2	Vehicle Medium Duty	1	17.5	2	10
S90409	18272	2009 Ford Escape Hybrid 4x	Vehicle Light Duty	1	17.5	2	10
		1730	Transit Shelter	1	18	2	10
		4120	Transit Shelter	1	18	2	10
		6195	Transit Shelter	1	18	2	10
F024 F002	21	Ladder 1	Vehicle Fire	1	60	5	10
F102 F010	57	Tank 24	Vehicle Fire	1	60	5	10
F131 F013	73	Tanker 8	Vehicle Fire	1	60	5	10
		Auto Ex - Hydraulics / E-droli	Fire Equipment	5	60	5	10
		SCBA Cylinders	Fire Equipment	701	60	5	10
L5352	21932	2016 Chevrolet Tahoe ERU	Vehicle Paramedic	1	62.5	5	10
F004 F000	4	Aerial 6 (FA06)	Vehicle Fire	1	62.5	5	10
F104 F010	58	Tanker 11	Vehicle Fire	1	62.5	5	10
F155 F015	80	Tanker 12	Vehicle Fire	1	62.5	5	10
L5187	21912	Ambulance #5187	Vehicle Paramedic	1	65	5	10
L5353	22171	2017 Chevrolet Tahoe Comm	Vehicle Paramedic	1	65	5	10
F039 F003	5532	Reserve 1 (pumper)	Vehicle Fire	1	65	5	10
		Auto Ex - Hydraulics / E-droli	Fire Equipment	1	65	5	10
		Auto Ex - Hydraulics / E-droli	Fire Equipment	2	65	5	10

Asset ID	TCA ID	Name	Asset Class	Quantity	Condition	Criticality	Risk Exposure
		Auto Ex - Hydraulics / E-droli	Fire Equipment	3	65	5	10
		SCBA Fill Stations	Fire Equipment	1	65	5	10
L5183	21908	Ambulance #5183	Vehicle Paramedic	1	67.5	5	10
L5181	21913	Ambulance #5181	Vehicle Paramedic	1	67.5	5	10
L5185	21914	Ambulance #5185	Vehicle Paramedic	1	67.5	5	10
L5011	21337	Primary Response Unit #501	Vehicle Paramedic	1	67.5	5	10
F041 F004	19127	Engine 3	Vehicle Fire	1	67.5	5	10
F040 F004	19128	Engine 2	Vehicle Fire	1	67.5	5	10
F015 F001	13	Bush 23	Vehicle Fire	1	67.5	5	10
F016 F001	14	Bush 7	Vehicle Fire	1	67.5	5	10
F017 F001	15	Bush 22	Vehicle Fire	1	67.5	5	10
F071 F007	50	Pumper 14	Vehicle Fire	1	70	5	10
F059 F005	19129	Engine 8	Vehicle Fire	1	70	5	10
		SCBA Fill Stations	Fire Equipment	2	70	5	10
		SCBA Fill Stations	Fire Equipment	1	70	5	10
		SCBA Fill Stations	Fire Equipment	1	70	5	10
		Water Rescue Suits	Fire Equipment	16	70	5	10
L5188	22177	Ambulance #5188	Vehicle Paramedic	1	72.5	5	10
L5182	22178	Ambulance #5182	Vehicle Paramedic	1	72.5	5	10
L5189	22176	Ambulance #5189	Vehicle Paramedic	1	75	5	10
L5342	22172	2017 Chevrolet Tahoe Comm	Vehicle Paramedic	1	75	5	10
F057 F005	18034	Engine 10	Vehicle Fire	1	75	5	10
F052 F005	5534	Tanker 17	Vehicle Fire	1	75	5	10
L5137	22611	Ambulance Type III #5137	Vehicle Paramedic	1	77.5	5	10
F055 F005	18033	Engine 16	Vehicle Fire	1	77.5	5	10
F047 F004	5533	Fire Tanker 21	Vehicle Fire	1	77.5	5	10
F053 F005	5535	Bush 18	Vehicle Fire	1	77.5	5	10
	19690	Furniture 2011-Planning & De	M&E General	1	40	3	9
	20985	AVL - Water	M&E General	3	40	3	9
	20986	AVL - Water	M&E General	5	40	3	9
	20987	AVL - WasteWater	M&E General	62	40	3	9
	20988	AVL - WasteWater	M&E General	9	40	3	9
	22314	Survey Equipment S/N 37048	M&E General	1	40	3	9
F031 R81:	28	Car 4 FPO - FISHER	Vehicle Light Duty	1	42.5	3	9
R632-09	18168	Trailer hose reel system (with	M&E General	1	45	3	9
	20182	Rotary 4 Post Lift	M&E General	1	45	3	9
	20402	Portable Electronic Truck Sca	M&E General	1	45	3	9
S80412	20427	Litter Collector	M&E General	1	45	3	9
	20273	Mobile Crane	M&E Light Diesel & MTs	1	45	3	9
		Hoses 38mm (Forestry Hose	Fire Equipment	24	45	3	9
		Saws - Gas Powered	Fire Equipment	1	45	3	9
		Ladder	Fire Equipment	6	45	3	9
		Ladder	Fire Equipment	9	45	3	9
		Ladder	Fire Equipment	8	45	3	9
		Ladder	Fire Equipment	3	45	3	9
F050 F005	40	Support 18	Vehicle Fire	1	47.5	3	9
S50614	21089	2014 F-150 Pick up	Vehicle Light Duty	1	50	3	9
	19652	Zamboni-Countryside	M&E General	1	50	3	9
Hoist #27	22986	Hoist #27	M&E General	1	50	3	9
F019 F001	17	Reserve 5 (aerial Platform) S	Vehicle Fire	1	50	3	9
F111 F011	21893	2016 Ford F150	Vehicle Fire	1	50	3	9
		Pagers	Fire Equipment	140	50	3	9
		Saws - Gas Powered	Fire Equipment	1	50	3	9
		Olympia Ice Edger	M&E Parks & Recreation	1	50	3	9
		CAT 1,800 lb Forklift	M&E Parks & Recreation	1	50	3	9
		Glass Lifters	M&E Parks & Recreation	2	50	3	9
		Ice Edger	M&E Parks & Recreation	1	50	3	9
		Honda	M&E Parks & Recreation	1	50	3	9

Asset ID	TCA ID	Name	Asset Class	Quantity	Condition	Criticality	Risk Exposure
		Honda	M&E Parks & Recreation	1	50	3	9
		Honda	M&E Parks & Recreation	1	50	3	9
		Honda	M&E Parks & Recreation	1	50	3	9
		Honda	M&E Parks & Recreation	1	50	3	9
		Honda	M&E Parks & Recreation	1	50	3	9
		Honda	M&E Parks & Recreation	1	50	3	9
		Honda	M&E Parks & Recreation	1	50	3	9
R968-12	20187	2012 Zamboni 525	M&E General	1	55	3	9
R975-12	20188	2012 Zamboni 525	M&E General	1	55	3	9
S486-15	21523	Truck Mounted Valve Turner	M&E General	1	55	3	9
S485-15	21524	Truck Mounted Valve Turner	M&E General	1	55	3	9
		Zamboni Edger Electric	M&E Parks & Recreation	1	55	3	9
S1058	1953	F350	Vehicle Medium Duty	1	20	2	8
S55509	18283	2009 Ford E350	Vehicle Medium Duty	1	20	2	8
S05309	18287	2009 Ford E350	Vehicle Medium Duty	1	20	2	8
S01009	18291	2008 Ford E250	Vehicle Medium Duty	1	20	2	8
S57310	18934	2010 Ford F 450	Vehicle Medium Duty	1	20	2	8
S98609	18315	2009 toyota Prius Hybrid	Vehicle Light Duty	1	20	2	8
S50811	18955	2011 Ford Escape Hybrid	Vehicle Light Duty	1	20	2	8
	656	Air compressors: MAWP200	M&E General	1	20	2	8
	663	Paint Booth - moved to Lorne	M&E General	1	20	2	8
R02610	1817	Pressure Washer	M&E General	1	20	2	8
	18166	Quick View Sewer Camera	M&E General	1	20	2	8
	P386	National	M&E Parks & Recreation	1	20	2	8
	P388	Toro	M&E Parks & Recreation	1	20	2	8
	P7460	National	M&E Parks & Recreation	1	20	2	8
	P7940	Rittenhouse	M&E Parks & Recreation	1	20	2	8
S1035	8426	2008 Ford F450	Vehicle Medium Duty	1	22.5	2	8
S03709	18282	2009 Ford E350	Vehicle Medium Duty	1	22.5	2	8
S45211	18966	2011 Ford E350	Vehicle Medium Duty	1	22.5	2	8
S57511	18972	2011 Ford F450	Vehicle Medium Duty	1	22.5	2	8
S1949	1669	Prius Hybrid	Vehicle Light Duty	1	22.5	2	8
S1020	8438	2008 Ford F150	Vehicle Light Duty	1	22.5	2	8
S54111	19706	2011 Chevrolet Silverado 15(	Vehicle Light Duty	1	22.5	2	8
S1551	8440	2009 Dodge RAM	Vehicle Medium Duty	1	25	2	8
S03309	18284	2009 Ford E350	Vehicle Medium Duty	1	25	2	8
S46011	18987	2011 Ford F450 4x2	Vehicle Medium Duty	1	25	2	8
S09111	18989	2011 Ford F250	Vehicle Medium Duty	1	25	2	8
S1924	1668	Prius Hybrid	Vehicle Light Duty	1	25	2	8
S1011	8439	2008 Ford F150	Vehicle Light Duty	1	25	2	8
S98909	18313	2009 toyota Prius Hybrid	Vehicle Light Duty	1	25	2	8
S49211	19536	2011 Chev Silverado 1500	Vehicle Light Duty	1	25	2	8
S48011	19537	2011 Chev Silverado 1500	Vehicle Light Duty	1	25	2	8
S49513	20671	2013 F-150 Pickup	Vehicle Light Duty	1	25	2	8
S49013	20672	2013 F-150 Pickup	Vehicle Light Duty	1	25	2	8
S50911	22996	2011 Dodge Grand Caravan	Vehicle Light Duty	1	25	2	8
S92509	23088	2009 toyota Prius Hybrid	Vehicle Light Duty	1	25	2	8
	20984	Aquascan 610 Leak Detector	M&E General	1	25	2	8
	P308	Honda	M&E Parks & Recreation	1	25	2	8
	P309	Honda	M&E Parks & Recreation	1	25	2	8
	P387	Toro	M&E Parks & Recreation	1	25	2	8
S11910	18937	High capacity trailer tow pack	Vehicle Medium Duty	1	27.5	2	8
S48811	19525	2011 Dodge Ram 2500	Vehicle Medium Duty	1	27.5	2	8
S49411	19526	2011 Dodge Ram 250	Vehicle Medium Duty	1	27.5	2	8
S49311	19539	2011 Dodge Ram 2500	Vehicle Medium Duty	1	27.5	2	8
S06711	22992	2011 Ford F250	Vehicle Medium Duty	1	27.5	2	8
S1920	1667	Prius Hybrid	Vehicle Light Duty	1	27.5	2	8
S99409	18273	2009 Ford Escape Hybrid 4x	Vehicle Light Duty	1	27.5	2	8

Asset ID	TCA ID	Name	Asset Class	Quantity	Condition	Criticality	Risk Exposure
S96709	18301	2009 Grand Caravan, white	Vehicle Light Duty	1	27.5	2	8
S43412	20189	2012 Dodge Ram 1500	Vehicle Light Duty	1	27.5	2	8
S46409	18289	2009 Ford Econoline	Vehicle Medium Duty	1	30	2	8
S57610	18935	2010 Ford F 450	Vehicle Medium Duty	1	30	2	8
S1901	1664	Prius Hybrid	Vehicle Light Duty	1	30	2	8
S1916	1666	Prius Hybrid	Vehicle Light Duty	1	30	2	8
S1078	18269	2008 GMC Savana Passeng	Vehicle Light Duty	1	30	2	8
S95509	18306	2009 toyota Prius Hybrid	Vehicle Light Duty	1	30	2	8
S43614	21087	2014 F-150 pick up	Vehicle Light Duty	1	30	2	8
T52611 wa	22601	2011 Ford Escape Hybrid	Vehicle Light Duty	1	30	2	8
S59012	22983	2012 Chevrolet Silverado	Vehicle Light Duty	1	30	2	8
	18964	Brush Chipper	M&E General	1	30	2	8
	19388	Change Machine	M&E General	1	30	2	8
R747-12	20183	Asphalt Heater	M&E General	1	30	2	8
S51411	19540	2011 Dodge Ram 250	Vehicle Medium Duty	1	32.5	2	8
S56712	20202	2012 GMC Sierra Crew Cab	Vehicle Medium Duty	1	32.5	2	8
S48515	21111	2014 F-450	Vehicle Medium Duty	1	32.5	2	8
S96509	18314	2009 toyota Prius Hybrid	Vehicle Light Duty	1	32.5	2	8
S94810	18951	2010 Dodge Grand Caravan	Vehicle Light Duty	1	32.5	2	8
S91512	20193	2012 Chrystler 200 LX	Vehicle Light Duty	1	32.5	2	8
S53312	20196	2012 Dodge Ram 1500	Vehicle Light Duty	1	32.5	2	8
S52809	22974	2009 Ford Escape 4x4	Vehicle Light Duty	1	32.5	2	8
S46609	23006	2009 Grand Caravan, white	Vehicle Light Duty	1	32.5	2	8
S45811	18969	2011 Ford E350	Vehicle Medium Duty	1	35	2	8
S00612	20206	2012 Ford F450	Vehicle Medium Duty	1	35	2	8
S05212	20207	2012 Ford F450	Vehicle Medium Duty	1	35	2	8
S48615	21104	2014 F-450	Vehicle Medium Duty	1	35	2	8
S96809	18297	2009 Grand Caravan, white	Vehicle Light Duty	1	35	2	8
S91309	18305	2009 toyota Prius Hybrid	Vehicle Light Duty	1	35	2	8
S94411	19527	2011 Dodge Caliber SXT	Vehicle Light Duty	1	35	2	8
F02111 F(	19533	Car 5	Vehicle Light Duty	1	35	2	8
S43012	20190	2012 Dodge Ram 1500	Vehicle Light Duty	1	35	2	8
S90909	22980	2009 Ford Focus	Vehicle Light Duty	1	35	2	8
S98110	22991	2010 Dodge Grand Caravan	Vehicle Light Duty	1	35	2	8
S1465	22997	Caravan SE	Vehicle Light Duty	1	35	2	8
		1785	Transit Shelter	1	36	2	8
		1875	Transit Shelter	1	36	2	8
		3315	Transit Shelter	1	36	2	8
		5105	Transit Shelter	1	36	2	8
		5485	Transit Shelter	1	36	2	8
		5575	Transit Shelter	1	36	2	8
		5745	Transit Shelter	1	36	2	8
		5755	Transit Shelter	1	36	2	8
		6300	Transit Shelter	1	36	2	8
		6350	Transit Shelter	1	36	2	8
		7300	Transit Shelter	1	36	2	8
S04611	19515	2011 Freightliner Cab & Chas	Vehicle Medium Duty	1	37.5	2	8
S55712	20203	2012 GMC Sierra Crew Cab	Vehicle Medium Duty	1	37.5	2	8
S08212	20205	2012 Ford F450	Vehicle Medium Duty	1	37.5	2	8
F069 S54	18299	Car 11	Vehicle Light Duty	1	37.5	2	8
S93609	18303	2009 toyota Prius Hybrid	Vehicle Light Duty	1	37.5	2	8
S90009	18310	2009 toyota Prius Hybrid	Vehicle Light Duty	1	37.5	2	8
S97609	18311	2009 toyota Prius Hybrid	Vehicle Light Duty	1	37.5	2	8
S49613	20664	2013 F-150 Pickup	Vehicle Light Duty	1	37.5	2	8
S98409	22975	2009 toyota Prius Hybrid	Vehicle Light Duty	1	37.5	2	8
S96609	22979	2010 Ford Focus	Vehicle Light Duty	1	37.5	2	8
S60516	21387	2016 Tandem Multi-Function	Vehicle Heavy Duty	1	60	4	8
S35111	19535	Volvo Motor Grader G960	M&E Heavy	1	60	4	8

Asset ID	TCA ID	Name	Asset Class	Quantity	Condition	Criticality	Risk Exposure
13-01		Trackless MT6	M&E Light Diesel & MTs	1	60	4	8
5001	21931	2017 Stealth 20' V Nose Trai	Paramedic Equipment	1	60	4	8
		Hoses 65mm (Structural Hos	Fire Equipment	16	60	4	8
		Portable Generator	Fire Equipment	2	60	4	8
S13116	21369	2016 Tandem Multi-Function	Vehicle Heavy Duty	1	62.5	4	8
S13316	21372	2016 Tandem Multi-Function	Vehicle Heavy Duty	1	62.5	4	8
S35012	20185	2012 Road Grader with Elimi	M&E Heavy	1	62.5	4	8
S18014	21085	John Deere 624K wheel load	M&E Heavy	1	62.5	4	8
S60416	21370	2016 Tandem Multi-Function	Vehicle Heavy Duty	1	65	4	8
S60616	21371	2016 Tandem Multi-Function	Vehicle Heavy Duty	1	65	4	8
R5900	20800	4" Trailer Mounted Diesel Tra	M&E General	1	65	4	8
R5901	20801	4" Trailer Mounted Diesel Tra	M&E General	1	65	4	8
L5009	18650	Tow vehicle for mobile comm	Vehicle Paramedic	1	65	4	8
		Hoses 65mm (Structural Hos	Fire Equipment	10	65	4	8
		Hoses 100mm (Structural Ho	Fire Equipment	14	65	4	8
		Hoses 100mm (Structural Ho	Fire Equipment	15	65	4	8
		Hoses 65mm (Structural Hos	Fire Equipment	16	65	4	8
		Hoses 38mm (Structural Hos	Fire Equipment	13	65	4	8
		PPV Fans	Fire Equipment	7	65	4	8
S23516	21373	MT6	M&E Light Diesel & MTs	1	67.5	4	8
16-03		Bobcat	M&E Light Diesel & MTs	1	67.5	4	8
	18649	Mobile Command Unit	Vehicle Paramedic	1	67.5	4	8
	22453	Quench Buggy Trailer - Refu	M&E General	1	70	4	8
S23616	21374	MT6	M&E Light Diesel & MTs	1	70	4	8
L5359	21915	2016 Chevrolet Tahoe Comn	Vehicle Paramedic	1	70	4	8
		Hoses 100mm (Structural Ho	Fire Equipment	1	70	4	8
		Hoses 100mm (Structural Ho	Fire Equipment	6	70	4	8
		Hoses 65mm (Structural Hos	Fire Equipment	14	70	4	8
		Hoses 65mm (Structural Hos	Fire Equipment	8	70	4	8
		Hoses 100mm (Structural Ho	Fire Equipment	12	70	4	8
		Water Rescue Boat	Fire Equipment	1	70	4	8
		Water Rescue Boat	Fire Equipment	1	70	4	8
		Boat Motor	Fire Equipment	1	70	4	8
		Gas Detection	Fire Equipment	2	70	4	8
		Blowhard Fans - Battery	Fire Equipment	10	70	4	8
S61519	22661	2018 Multi-Purpose Plow Tru	Vehicle Heavy Duty	1	72.5	4	8
14-01		John Deere	M&E Heavy	1	72.5	4	8
T805	18916	Bus-Low Floor	Transit Bus	1	72.5	4	8
S60718	22200	S60718 - 2018 Multi-Purpose	Vehicle Heavy Duty	1	75	4	8
S61018	22201	S61018 - 2018 Multi-Purpose	Vehicle Heavy Duty	1	75	4	8
S60918	22202	S60918 - 2018 Multi-Purpose	Vehicle Heavy Duty	1	75	4	8
S61118	22203	S61118 - 2018 Multi-Purpose	Vehicle Heavy Duty	1	75	4	8
		Hoses 65mm (Structural Hos	Fire Equipment	6	75	4	8
S61618	22204	S61618 - 2018 Multi-Purpose	Vehicle Heavy Duty	1	77.5	4	8
S61218	22205	S61218 - 2018 Multi-Purpose	Vehicle Heavy Duty	1	77.5	4	8
S60818	22207	S60818 - 2018 Multi-Purpose	Vehicle Heavy Duty	1	77.5	4	8
S63918	22208	S63918 - 2018 Multi-Purpose	Vehicle Heavy Duty	1	77.5	4	8
S23716	21850	MT6-2044	M&E Light Diesel & MTs	1	77.5	4	8
S25816	21851	MT6-2045	M&E Light Diesel & MTs	1	77.5	4	8
T811	19581	LFS Transit Bus	Transit Bus	1	77.5	4	8
T812	19582	LFS Transit Bus	Transit Bus	1	77.5	4	8
T813	19583	LFS Transit Bus	Transit Bus	1	77.5	4	8
T814	19584	LFS Transit Bus	Transit Bus	1	77.5	4	8
T815	19585	LFS Transit Bus	Transit Bus	1	77.5	4	8
T816	19586	LFS Transit Bus	Transit Bus	1	77.5	4	8
S60109	18281	2009 Hino Truck	Vehicle Heavy Duty	1	40	2	6
S97509	18307	2009 toyota Prius Hybrid	Vehicle Light Duty	1	40	2	6
S97709	18312	2009 toyota Prius Hybrid	Vehicle Light Duty	1	40	2	6

Asset ID	TCA ID	Name	Asset Class	Quantity	Condition	Criticality	Risk Exposure
S48111	18959	2011 Ford Escape Hybrid	Vehicle Light Duty	1	40	2	6
S97011	19531	2011 Dodge Caliber SXT	Vehicle Light Duty	1	40	2	6
S91411	19532	2011 Dodge Caliber SXT	Vehicle Light Duty	1	40	2	6
S96111	22990	2011 Ford Escape Hybrid	Vehicle Light Duty	1	40	2	6
	672	Coin Wrapper (new)	M&E General	1	40	2	6
	8446	120 Ton Ironworker - refurbis	M&E General	1	40	2	6
R205-11	19521	Haulmark Cargo Trailer	M&E General	1	40	2	6
	20901	Aggregate Screens	M&E General	3	40	2	6
R26015	21386	Trailer Mounted Pressure Wa	M&E General	1	40	2	6
	22478	Sokkia Satelite Receivers - D	M&E General	2	40	2	6
S116W	23005	Welding Machine	M&E General	1	40	2	6
	P401-14	Kubota	M&E Parks & Recreation	1	40	2	6
	P406-13	Bobcat	M&E Parks & Recreation	1	40	2	6
S56812	20208	2012 Ford F450	Vehicle Medium Duty	1	42.5	2	6
S58312	20209	2012 Ford F450	Vehicle Medium Duty	1	42.5	2	6
S97409	18308	2009 toyota Prius Hybrid	Vehicle Light Duty	1	42.5	2	6
S47711	19538	2011 Chev Silverado 1500	Vehicle Light Duty	1	42.5	2	6
S95312	20192	2012 Chrystler 200 LX	Vehicle Light Duty	1	42.5	2	6
S55912	20201	2012 GMC Sierra Crew Cab	Vehicle Medium Duty	1	45	2	6
S09314	21083	2014 Ford cargo van	Vehicle Medium Duty	1	45	2	6
F02811 F(	19524	Car 8	Vehicle Light Duty	1	45	2	6
S99713	20687	2013 Chevrolet Equinox	Vehicle Light Duty	1	45	2	6
	P314-12	Toro	M&E Parks & Recreation	1	45	2	6
	P318-12	Toro	M&E Parks & Recreation	1	45	2	6
	P7710	Jacobsen	M&E Parks & Recreation	1	45	2	6
	P7750	Jacobsen	M&E Parks & Recreation	1	45	2	6
	P7810	Jacobsen	M&E Parks & Recreation	1	45	2	6
S07111	19516	2011 Ford F450 Intersection	Vehicle Medium Duty	1	47.5	2	6
S58512	19541	2012 Ford F450	Vehicle Medium Duty	1	47.5	2	6
S58412	20210	2012 Ford F450	Vehicle Medium Duty	1	47.5	2	6
S99913	20686	2013 Chevrolet Equinox	Vehicle Light Duty	1	47.5	2	6
F00212 F(	20191	Fleet 1	Vehicle Fire	1	47.5	2	6
S74113	20659	2013 International 4300 (4x2)	Vehicle Heavy Duty	1	50	2	6
S62712	20212	2012 Ford F450	Vehicle Medium Duty	1	50	2	6
S03412	20215	2012 Ford F450	Vehicle Medium Duty	1	50	2	6
S99311	19530	2011 Dodge Caliber SXT	Vehicle Light Duty	1	50	2	6
S99812	20197	2012 Chrystler 200 LX	Vehicle Light Duty	1	50	2	6
S51213	20669	2013 F-150 Pickup	Vehicle Light Duty	1	50	2	6
S45413	22984	Dodge Grand Caravan 2013	Vehicle Light Duty	1	50	2	6
R1528	8448	Air Compressor	M&E General	1	50	2	6
R1253	8449	Air Compressor	M&E General	1	50	2	6
	P1520-1	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-10	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-10(	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-10'	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-10:	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-10:	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-10	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-10!	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-11	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-12	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-13	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-14	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-15	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-16	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-17	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-18	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-19	Husqvuarna	M&E Parks & Recreation	1	50	2	6

Asset ID	TCA ID	Name	Asset Class	Quantity	Condition	Criticality	Risk Exposure
	P1520-2	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-20	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-21	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-22	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-23	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-24	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-25	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-26	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-27	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-28	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-29	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-3	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-30	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-31	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-32	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-33	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-34	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-35	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-36	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-37	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-38	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-39	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-4	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-40	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-41	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-42	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-43	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-44	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-45	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-46	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-47	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-48	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-49	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-5	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-50	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-51	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-52	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-53	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-54	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-55	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-56	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-57	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P1520-58	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P1520-59	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P1520-6	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P1520-60	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P1520-61	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P1520-62	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P1520-63	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P1520-64	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P1520-65	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P1520-66	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P1520-67	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P1520-68	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P1520-69	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P1520-7	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P1520-70	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P1520-71	Cub Cadet	M&E Parks & Recreation	1	50	2	6

Asset ID	TCA ID	Name	Asset Class	Quantity	Condition	Criticality	Risk Exposure
	P1520-72	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P1520-73	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P1520-74	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P1520-75	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P1520-76	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P1520-77	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P1520-78	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P1520-79	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P1520-8	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P1520-80	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P1520-81	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P1520-82	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P1520-83	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P1520-84	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P1520-85	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P1520-86	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P1520-87	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P1520-88	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P1520-89	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P1520-9	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P1520-90	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P1520-91	John Deere	M&E Parks & Recreation	1	50	2	6
	P1520-92	John Deere	M&E Parks & Recreation	1	50	2	6
	P1520-93	John Deere	M&E Parks & Recreation	1	50	2	6
	P1520-94	John Deere	M&E Parks & Recreation	1	50	2	6
	P173	John Deere	M&E Parks & Recreation	1	50	2	6
	P210-1	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P210-10	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P210-11	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P210-12	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P210-13	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P210-14	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P210-15	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P210-16	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P210-17	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P210-18	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P210-19	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P210-2	Cub Cadet	M&E Parks & Recreation	1	50	2	6
	P210-20	Lawn Boy	M&E Parks & Recreation	1	50	2	6
	P210-21	Lawn Boy	M&E Parks & Recreation	1	50	2	6
	P210-22	Lawn Boy	M&E Parks & Recreation	1	50	2	6
	P210-23	Lawn Boy	M&E Parks & Recreation	1	50	2	6
	P210-24	Lawn Boy	M&E Parks & Recreation	1	50	2	6
	P210-25	Toro	M&E Parks & Recreation	1	50	2	6
	P210-26	Toro	M&E Parks & Recreation	1	50	2	6
	P210-27	Toro	M&E Parks & Recreation	1	50	2	6
	P210-28	Toro	M&E Parks & Recreation	1	50	2	6
	P210-29	Toro	M&E Parks & Recreation	1	50	2	6
	P210-3	Toro	M&E Parks & Recreation	1	50	2	6
	P210-30	Toro	M&E Parks & Recreation	1	50	2	6
	P210-31	Toro	M&E Parks & Recreation	1	50	2	6
	P210-32	Toro	M&E Parks & Recreation	1	50	2	6
	P210-33	Toro	M&E Parks & Recreation	1	50	2	6
	P210-34	Toro	M&E Parks & Recreation	1	50	2	6
	P210-35	Toro	M&E Parks & Recreation	1	50	2	6
	P210-36	Toro	M&E Parks & Recreation	1	50	2	6
	P210-37	Toro	M&E Parks & Recreation	1	50	2	6
	P210-38	Toro	M&E Parks & Recreation	1	50	2	6

Asset ID	TCA ID	Name	Asset Class	Quantity	Condition	Criticality	Risk Exposure
	P210-39	Toro	M&E Parks & Recreation	1	50	2	6
	P210-4	Toro	M&E Parks & Recreation	1	50	2	6
	P210-40	Toro	M&E Parks & Recreation	1	50	2	6
	P210-41	Toro	M&E Parks & Recreation	1	50	2	6
	P210-42	Toro	M&E Parks & Recreation	1	50	2	6
	P210-43	Toro	M&E Parks & Recreation	1	50	2	6
	P210-44	Toro	M&E Parks & Recreation	1	50	2	6
	P210-45	Toro	M&E Parks & Recreation	1	50	2	6
	P210-46	Toro	M&E Parks & Recreation	1	50	2	6
	P210-47	Toro	M&E Parks & Recreation	1	50	2	6
	P210-48	Toro	M&E Parks & Recreation	1	50	2	6
	P210-49	Toro	M&E Parks & Recreation	1	50	2	6
	P210-5	Toro	M&E Parks & Recreation	1	50	2	6
	P210-50	Toro	M&E Parks & Recreation	1	50	2	6
	P210-6	Toro	M&E Parks & Recreation	1	50	2	6
	P210-7	Toro	M&E Parks & Recreation	1	50	2	6
	P210-8	Toro	M&E Parks & Recreation	1	50	2	6
	P210-9	Toro	M&E Parks & Recreation	1	50	2	6
	P230-1	Toro	M&E Parks & Recreation	1	50	2	6
	P230-2	Toro	M&E Parks & Recreation	1	50	2	6
	P230-3	Toro	M&E Parks & Recreation	1	50	2	6
	P270-1	Stihl	M&E Parks & Recreation	1	50	2	6
	P270-10	Stihl	M&E Parks & Recreation	1	50	2	6
	P270-11	Stihl	M&E Parks & Recreation	1	50	2	6
	P270-12	Stihl	M&E Parks & Recreation	1	50	2	6
	P270-2	Stihl	M&E Parks & Recreation	1	50	2	6
	P270-3	Stihl	M&E Parks & Recreation	1	50	2	6
	P270-4	Stihl	M&E Parks & Recreation	1	50	2	6
	P270-5	Stihl	M&E Parks & Recreation	1	50	2	6
	P270-6	Stihl	M&E Parks & Recreation	1	50	2	6
	P270-7	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P270-8	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P270-9	Husqvuarna	M&E Parks & Recreation	1	50	2	6
	P300	Bobcat	M&E Parks & Recreation	1	50	2	6
	P302-1	Toro	M&E Parks & Recreation	1	50	2	6
	P302-10	Toro	M&E Parks & Recreation	1	50	2	6
	P302-11	Toro	M&E Parks & Recreation	1	50	2	6
	P302-12	Toro	M&E Parks & Recreation	1	50	2	6
	P302-13	Toro	M&E Parks & Recreation	1	50	2	6
	P302-14	Toro	M&E Parks & Recreation	1	50	2	6
	P302-15	Toro	M&E Parks & Recreation	1	50	2	6
	P302-2	Toro	M&E Parks & Recreation	1	50	2	6
	P302-3	Toro	M&E Parks & Recreation	1	50	2	6
	P302-4	Toro	M&E Parks & Recreation	1	50	2	6
	P302-5	Toro	M&E Parks & Recreation	1	50	2	6
	P302-6	Toro	M&E Parks & Recreation	1	50	2	6
	P302-7	Toro	M&E Parks & Recreation	1	50	2	6
	P302-8	Toro	M&E Parks & Recreation	1	50	2	6
	P302-9	Toro	M&E Parks & Recreation	1	50	2	6
	P303	Toro	M&E Parks & Recreation	1	50	2	6
	P313	Case	M&E Parks & Recreation	1	50	2	6
	P372-10	Swisher	M&E Parks & Recreation	1	50	2	6
	P372-10	Swisher	M&E Parks & Recreation	1	50	2	6
	P408	Kubota	M&E Parks & Recreation	1	50	2	6
	P408-15	Kubota	M&E Parks & Recreation	1	50	2	6
	P410-14	Kawasaki	M&E Parks & Recreation	1	50	2	6
	P697	Toro	M&E Parks & Recreation	1	50	2	6
	P7650-1	York Rake	M&E Parks & Recreation	1	50	2	6

Asset ID	TCA ID	Name	Asset Class	Quantity	Condition	Criticality	Risk Exposure
	P7650-2	York Rake	M&E Parks & Recreation	1	50	2	6
	P7650-3	York Rake	M&E Parks & Recreation	1	50	2	6
	P7650-4	York Rake	M&E Parks & Recreation	1	50	2	6
	P7650-5	York Rake	M&E Parks & Recreation	1	50	2	6
	P7950	Naden	M&E Parks & Recreation	1	50	2	6
	P7990	Jacobsen	M&E Parks & Recreation	1	50	2	6
		CAT	M&E Parks & Recreation	1	50	2	6
		CAT	M&E Parks & Recreation	1	50	2	6
		Exmark	M&E Parks & Recreation	1	50	2	6
		Exmark	M&E Parks & Recreation	1	50	2	6
		Husqvarna	M&E Parks & Recreation	1	50	2	6
		Husqvarna	M&E Parks & Recreation	1	50	2	6
		Kubota	M&E Parks & Recreation	1	50	2	6
		Naden 9.9HP Motor	M&E Parks & Recreation	1	50	2	6
		Stihl	M&E Parks & Recreation	1	50	2	6
		Western	M&E Parks & Recreation	1	50	2	6
		Western	M&E Parks & Recreation	1	50	2	6
			M&E Parks & Recreation	1	50	2	6
S95713	20662	2013 Chrysler 200 LX	Vehicle Light Duty	1	52.5	2	6
S45513	20677	Dodge Grand Caravan 2013	Vehicle Light Duty	1	52.5	2	6
		1145	Transit Shelter	1	54	2	6
		1680	Transit Shelter	1	54	2	6
		2305	Transit Shelter	1	54	2	6
		2925	Transit Shelter	1	54	2	6
		3030	Transit Shelter	1	54	2	6
		3145	Transit Shelter	1	54	2	6
		3265	Transit Shelter	1	54	2	6
		3295	Transit Shelter	1	54	2	6
		4040	Transit Shelter	1	54	2	6
		4065	Transit Shelter	1	54	2	6
		4185	Transit Shelter	1	54	2	6
		4845	Transit Shelter	1	54	2	6
		5020	Transit Shelter	1	54	2	6
		5035	Transit Shelter	1	54	2	6
		5555	Transit Shelter	1	54	2	6
		5715	Transit Shelter	1	54	2	6
		5740	Transit Shelter	1	54	2	6
		5775	Transit Shelter	1	54	2	6
		6590	Transit Shelter	1	54	2	6
		6595	Transit Shelter	1	54	2	6
		7375	Transit Shelter	1	54	2	6
		7431.704394	Transit Shelter	1	54	2	6
		7487.702304	Transit Shelter	1	54	2	6
		Lively across from school	Transit Shelter	1	54	2	6
T821	20127	2012 Ford F450	Vehicle Medium Duty	1	55	2	6
S55414	21094	2015 F450	Vehicle Medium Duty	1	55	2	6
S97212	20199	2012 Chrystler 200 LX	Vehicle Light Duty	1	55	2	6
S96412	20200	2012 Chrystler 200 LX	Vehicle Light Duty	1	55	2	6
S53713	20666	2013 F-150 Pickup	Vehicle Light Duty	1	55	2	6
S43813	20667	2013 F-150 Pickup	Vehicle Light Duty	1	55	2	6
S51113	20673	2013 F-150 Pickup	Vehicle Light Duty	1	55	2	6
	19838	Hydrant cutting & grooving e(	M&E General	1	55	2	6
F08313 F(	20678	Car 10	Vehicle Fire	1	55	2	6
S62013	20657	2013 Multifunction Truck 4x2	Vehicle Heavy Duty	1	57.5	2	6
S51914	21091	2014 F-150 pick up	Vehicle Light Duty	1	57.5	2	6
R20712	20412	Trailer Mounted Valve Exerci	M&E General	1	60	3	6
	22133	AVL - Waste Collection	M&E General	10	60	3	6
	22496	AVL - WasteWater	M&E General	7	60	3	6

Asset ID	TCA ID	Name	Asset Class	Quantity	Condition	Criticality	Risk Exposure
	22965	AVL Construction Services	M&E General	11	60	3	6
		Wajax Pump	Fire Equipment	6	60	3	6
		Wajax Pump	Fire Equipment	12	60	3	6
	P1510	Bombardier	M&E Parks & Recreation	1	60	3	6
	Skandic 4	Bombardier	M&E Parks & Recreation	1	60	3	6
	Skandic 5	Bombardier	M&E Parks & Recreation	1	60	3	6
S20611	19520	2011 Road Line Painting Tru	Vehicle Heavy Duty	1	65	3	6
R978-14	21082	Zamboni	M&E General	1	65	3	6
R101	21384	Tennant Ride-on Sweeper	M&E General	1	65	3	6
F045 F004	38	Support 11	Vehicle Fire	1	65	3	6
		Saws - Gas Powered	Fire Equipment	12	65	3	6
S82011	19514	2011 Freightliner Water/Stree	Vehicle Heavy Duty	1	67.5	3	6
F086 F008	21355	Car 18	Vehicle Fire	1	67.5	3	6
S20011	19518	2011 Street Sweeper	Vehicle Heavy Duty	1	70	3	6
R40214	21110	Toyota lift truck	M&E General	1	70	3	6
R40414	21113	Walk behind Forklift Stacker	M&E General	1	70	3	6
R965-16	21389	Zamboni	M&E General	1	70	3	6
F087 F008	21894	2016 Chevrolet Tahoe	Vehicle Fire	1	70	3	6
		Hoses 38mm (Forestry Hose	Fire Equipment	41	70	3	6
		Hoses 38mm (Forestry Hose	Fire Equipment	37	70	3	6
		Hoses 45mm (Forestry Hose	Fire Equipment	8	70	3	6
		Hoses 38mm (Forestry Hose	Fire Equipment	30	70	3	6
		Hoses 45mm (Forestry Hose	Fire Equipment	36	70	3	6
		Hoses 45mm (Forestry Hose	Fire Equipment	19	70	3	6
		Hoses 38mm (Forestry Hose	Fire Equipment	16	70	3	6
		TIC Camera	Fire Equipment	13	70	3	6
		Saws - Gas Powered	Fire Equipment	2	70	3	6
		Ladder	Fire Equipment	6	70	3	6
		Ladder	Fire Equipment	9	70	3	6
		Ladder	Fire Equipment	8	70	3	6
		Ladder	Fire Equipment	3	70	3	6
		Truck Radios	Fire Equipment	60	70	3	6
		Repeater Radios	Fire Equipment	36	70	3	6
16-01	AP 13450	FORD	Vehicle Light Duty	1	75	3	6
16-02	AP 13449	FORD	Vehicle Light Duty	1	75	3	6
R96617	21882	Zamboni	M&E General	1	75	3	6
		Olympia Ice Edger	M&E Parks & Recreation	1	75	3	6
S82114	21103	2013 Flusher	Vehicle Heavy Duty	1	77.5	3	6
S44317	21862	S443-17 2016 Ford F150	Vehicle Light Duty	1	77.5	3	6
F096 F009	22168	2018 F150	Vehicle Fire	1	77.5	3	6
R03000	1823	Utility Vehicle	M&E General	1	0	1	5
R03200	1825	Utility Vehicle	M&E General	1	0	1	5
R749	1847	MT Flail Mower	M&E General	1	0	1	5
R03430	17194	Utility Trailer	M&E General	1	0	1	5
R03450	17196	Utility Trailer	M&E General	1	0	1	5
R03490	17199	Utility Trailer	M&E General	1	0	1	5
R03560	17204	Utility Trailer	M&E General	1	0	1	5
R03570	17205	Utility Trailer	M&E General	1	0	1	5
R04770	17210	Utility Trailer	M&E General	1	0	1	5
R04840	17212	Utility Trailer	M&E General	1	0	1	5
R04850	17213	Utility Trailer	M&E General	1	0	1	5
R04870	17214	Utility Trailer	M&E General	1	0	1	5
R709	17217	Utility Trailer	M&E General	1	0	1	5
R07110	17218	Utility Trailer	M&E General	1	0	1	5
R07160	17219	Utility Trailer	M&E General	1	0	1	5
R723	17220	Utility Trailer	M&E General	1	0	1	5
CL - 12 Ma	18164	CL Tapping Machine (Specia	M&E General	1	0	1	5
	18329	Coherent EOS-200 Resonato	M&E General	1	0	1	5

Asset ID	TCA ID	Name	Asset Class	Quantity	Condition	Criticality	Risk Exposure
R02040	21784	Utility Trailer	M&E General	1	0	1	5
	E12 24N	H-72	M&E General	1	0	1	5
	20290	Mannequin - Patient Training	Paramedic Equipment	1	0	1	5
		Perygord Floor Scrubber	M&E Parks & Recreation	1	0	1	5
		Floor Scrubber	M&E Parks & Recreation	1	0	1	5
		Floor Scrubber	M&E Parks & Recreation	1	0	1	5
		Snow Blower	M&E Parks & Recreation	1	0	1	5
	P240	Brower	M&E Parks & Recreation	1	0	1	5
	P250	Little Wonder	M&E Parks & Recreation	1	0	1	5
	P319	Olathe	M&E Parks & Recreation	1	0	1	5
	P7380	Ryan	M&E Parks & Recreation	1	0	1	5
	P7390	Ryan	M&E Parks & Recreation	1	0	1	5
	P7640	Bannerman	M&E Parks & Recreation	1	0	1	5
R03580	17206	Utility Trailer	M&E General	1	5	1	5
		Commercial Fryer	M&E Parks & Recreation	1	5	1	5
		Commercial Fryer	M&E Parks & Recreation	1	5	1	5
		Commercial Fryer	M&E Parks & Recreation	1	5	1	5
S01243-3	2085	component of S01243	M&E General	1	10	1	5
S0231-3	2098	component of S02310	M&E General	1	10	1	5
S0232-3	2100	component of S02320	M&E General	1	10	1	5
S0234-3	2102	component of S02340	M&E General	1	10	1	5
	H51 001	UNIT	M&E General	1	10	1	5
	P320	Smithco	M&E Parks & Recreation	1	10	1	5
R02000	17179	Utility Trailer	M&E General	1	15	1	5
R02180	17188	Utility Trailer	M&E General	1	15	1	5
R03480	17198	Utility Trailer	M&E General	1	15	1	5
R03500	17200	Utility Trailer	M&E General	1	15	1	5
L5119	22608	Ambulance Type III #5119	Vehicle Paramedic	1	80	5	5
		2017 Video Laryngoscope (M	Paramedic Equipment	1	80	5	5
		2017 Video Laryngoscope (M	Paramedic Equipment	1	80	5	5
		2017 Video Laryngoscope (M	Paramedic Equipment	1	80	5	5
		2017 Video Laryngoscope (M	Paramedic Equipment	1	80	5	5
		2017 Video Laryngoscope (M	Paramedic Equipment	1	80	5	5
		2017 Video Laryngoscope (M	Paramedic Equipment	1	80	5	5
		2017 Video Laryngoscope (M	Paramedic Equipment	1	80	5	5
		2017 Video Laryngoscope (M	Paramedic Equipment	1	80	5	5
		2017 Video Laryngoscope (M	Paramedic Equipment	1	80	5	5
		2017 Video Laryngoscope (M	Paramedic Equipment	1	80	5	5
		2017 Video Laryngoscope (M	Paramedic Equipment	1	80	5	5
		2017 Video Laryngoscope (M	Paramedic Equipment	1	80	5	5
		2017 Video Laryngoscope (M	Paramedic Equipment	1	80	5	5
		2017 Video Laryngoscope (M	Paramedic Equipment	1	80	5	5
		2017 Video Laryngoscope (M	Paramedic Equipment	1	80	5	5
		2017 Video Laryngoscope (M	Paramedic Equipment	1	80	5	5
		2017 Video Laryngoscope (M	Paramedic Equipment	1	80	5	5
		2017 Video Laryngoscope (M	Paramedic Equipment	1	80	5	5
		2017 Video Laryngoscope (M	Paramedic Equipment	1	80	5	5
		2017 Video Laryngoscope (M	Paramedic Equipment	1	80	5	5
		2017 Video Laryngoscope (M	Paramedic Equipment	1	80	5	5
		2017 Video Laryngoscope (M	Paramedic Equipment	1	80	5	5
		2017 Video Laryngoscope (M	Paramedic Equipment	1	80	5	5
		2017 Video Laryngoscope (M	Paramedic Equipment	1	80	5	5
		2017 Video Laryngoscope (M	Paramedic Equipment	1	80	5	5
		2017 Video Laryngoscope (M	Paramedic Equipment	1	80	5	5
		2017 Video Laryngoscope (M	Paramedic Equipment	1	80	5	5
		2017 Video Laryngoscope (M	Paramedic Equipment	1	80	5	5
		2017 Video Laryngoscope (M	Paramedic Equipment	1	80	5	5
		2017 Video Laryngoscope (M	Paramedic Equipment	1	80	5	5
		2017 Video Laryngoscope (M	Paramedic Equipment	1	80	5	5

Asset ID	TCA ID	Name	Asset Class	Quantity	Condition	Criticality	Risk Exposure
		2017 Video Laryngoscope (M	Paramedic Equipment	1	80	5	5
		2017 Video Laryngoscope (M	Paramedic Equipment	1	80	5	5
		2017 Video Laryngoscope (M	Paramedic Equipment	1	80	5	5
		2017 Video Laryngoscope (M	Paramedic Equipment	1	80	5	5
		2017 Video Laryngoscope (M	Paramedic Equipment	1	80	5	5
F056 F005	18032	Engine 4	Vehicle Fire	1	80	5	5
		Auto Ex - Hydraulics / E-droli	Fire Equipment	1	80	5	5
L5121	22609	Ambulance Type III #5121	Vehicle Paramedic	1	85	5	5
L5349	22606	2018 Chevrolet Tahoe Comm	Vehicle Paramedic	1	85	5	5
F077 F007	20692	Pumper Tanker 9	Vehicle Fire	1	85	5	5
L5118	22610	Ambulance Type III #5118	Vehicle Paramedic	1	87.5	5	5
F078 F007	20693	Pumper Tanker 22	Vehicle Fire	1	87.5	5	5
F093 F009	21901	Engine 4	Vehicle Fire	1	87.5	5	5
F010 F001	20689	Bush Truck 08	Vehicle Fire	1	87.5	5	5
F013 F001	20690	Bush Truck 12	Vehicle Fire	1	87.5	5	5
F014 F001	20691	Bush Truck 14	Vehicle Fire	1	87.5	5	5
L5120	23096	Ambulance Type III #5120	Vehicle Paramedic	1	90	5	5
L5122	23097	Ambulance Type III #5122	Vehicle Paramedic	1	92.5	5	5
L5124	23098	Ambulance Type III #5124	Vehicle Paramedic	1	92.5	5	5
F090 F009	21898	Engine 18	Vehicle Fire	1	92.5	5	5
F091 F009	21899	Engine 12	Vehicle Fire	1	92.5	5	5
F092 F009	21900	Engine 20	Vehicle Fire	1	92.5	5	5
F094 F009	21902	Engine 1	Vehicle Fire	1	92.5	5	5
F095 F009	21903	Engine 16	Vehicle Fire	1	92.5	5	5
L5126	23390	Ambulance Type III #5126	Vehicle Paramedic	1	95	5	5
L5128	23391	Ambulance Type III #5128	Vehicle Paramedic	1	95	5	5
L5129	23392	Ambulance Type III #5129	Vehicle Paramedic	1	95	5	5
L5354	23388	2020 Chevrolet Tahoe Param	Vehicle Paramedic	1	95	5	5
L5347	23389	2020 Chevrolet Tahoe Param	Vehicle Paramedic	1	95	5	5
L5013	23393	2020 Chevrolet Tahoe Param	Vehicle Paramedic	1	95	5	5
		Power Air Purifier Respirator	Paramedic Equipment	20	95	5	5
F007	23100	F007 International Tanker Fir	Vehicle Fire	1	95	5	5
F009	23101	F009 International Tanker Fir	Vehicle Fire	1	95	5	5
F027	23450	F027 Tanker Fire Truck	Vehicle Fire	1	95	5	5
F022	23451	F022 Tanker Fire Truck	Vehicle Fire	1	95	5	5
F097	23452	F097 E-One Aerial 100' Ladd	Vehicle Fire	1	95	5	5
		Auto Ex - Hydraulics / E-droli	Fire Equipment	15	95	5	5
		Bunker Gear	Fire Equipment	120	95	5	5
		Bunker Gear	Fire Equipment	115	95	5	5
		SCBA Fill Stations	Fire Equipment	1	95	5	5
		Floor Scrubber	M&E Parks & Recreation	1	20	1	4
R02190	17189	Utility Trailer	M&E General	1	25	1	4
		Freezer	M&E Parks & Recreation	1	25	1	4
		Snow Blower	M&E Parks & Recreation	1	25	1	4
		Walk Behind Floor Machine	M&E Parks & Recreation	1	25	1	4
		Commercial Fryer	M&E Parks & Recreation	1	25	1	4
		Walk behind floor machine	M&E Parks & Recreation	1	25	1	4
		Ride on Floor Scrubber	M&E Parks & Recreation	1	25	1	4
		Floor Scrubber	M&E Parks & Recreation	1	25	1	4
		Popcorn Machine	M&E Parks & Recreation	1	25	1	4
		Floor Scrubber	M&E Parks & Recreation	1	25	1	4
		Ride on Floor Scrubber	M&E Parks & Recreation	1	25	1	4
		Commercial Fryer	M&E Parks & Recreation	1	25	1	4
		Barber	M&E Parks & Recreation	1	25	1	4
R02020	17180	Utility Trailer	M&E General	1	30	1	4
R726	17222	Utility Trailer	M&E General	1	30	1	4
	19386	6 ft Sickle bar Mower	M&E General	1	30	1	4
		Snow Blower	M&E Parks & Recreation	1	30	1	4

Asset ID	TCA ID	Name	Asset Class	Quantity	Condition	Criticality	Risk Exposure
		Snow Blower	M&E Parks & Recreation	1	30	1	4
	P744	Vermeer	M&E Parks & Recreation	1	30	1	4
R01211	17174	Utility Trailer	M&E General	1	35	1	4
R01743-A	17178	Utility Trailer	M&E General	1	35	1	4
R02090	17183	Utility Trailer	M&E General	1	35	1	4
R02140	17185	Utility Trailer	M&E General	1	35	1	4
R02210	17191	Utility Trailer	M&E General	1	35	1	4
R727	17223	Utility Trailer	M&E General	1	35	1	4
R02200	22973	Utility Trailer	M&E General	1	35	1	4
S58715	21107	2014 Ford Truck	Vehicle Medium Duty	1	60	2	4
S02315	21363	2015 Mercedes-Benz Sprinte	Vehicle Medium Duty	1	60	2	4
S99613	20661	2013 Chrysler 200 LX	Vehicle Light Duty	1	60	2	4
S50414	21088	2014 F-150 Ford Pick up	Vehicle Light Duty	1	60	2	4
S52714	21093	2014 F-150 pick up	Vehicle Light Duty	1	60	2	4
S94914	21101	2014 Chevrolet Cruze	Vehicle Light Duty	1	60	2	4
R048-14	21109	Riding Asphalt Vibratory Roll	M&E General	1	60	2	4
	21114	Walk behind vibratory Roller	M&E General	1	60	2	4
	22074	Aggregate Screen	M&E General	1	60	2	4
	22075	Aggregate Screen	M&E General	1	60	2	4
	22966	GPS Units - construction ser	M&E General	2	60	2	4
	22981	Air Compressor	M&E General	1	60	2	4
	22994	Air Compressor	M&E General	1	60	2	4
	21909	Vendnovation Medical Supply	Paramedic Equipment	1	60	2	4
	P403-14	Bobcat	M&E Parks & Recreation	1	60	2	4
	P404-14	Bobcat	M&E Parks & Recreation	1	60	2	4
	P405-14	Bobcat	M&E Parks & Recreation	1	60	2	4
		Kubota	M&E Parks & Recreation	1	60	2	4
S51514	21090	2015 F250	Vehicle Medium Duty	1	62.5	2	4
S56514	21095	2014 F350	Vehicle Medium Duty	1	62.5	2	4
S04716	22987	S047-16 Ford Transit Cargo	Vehicle Medium Duty	1	62.5	2	4
S98213	20663	2013 Chrysler 200 LX	Vehicle Light Duty	1	62.5	2	4
S52414	21092	2014 F-150 pick up	Vehicle Light Duty	1	62.5	2	4
S00116	21383	2016 Dodge Caravan	Vehicle Light Duty	1	62.5	2	4
S91113	22998	2013 Chrysler 200 LX	Vehicle Light Duty	1	62.5	2	4
S08015	21112	2014 F-450	Vehicle Medium Duty	1	65	2	4
S59218	22196	S59218 2018 F150	Vehicle Light Duty	1	65	2	4
	20128	Air Compressor (200 Amp)	M&E General	1	65	2	4
	20990	Mobile Video Surveillance Sy	M&E General	1	65	2	4
	P173	Kubota	M&E Parks & Recreation	1	65	2	4
	P401	Kubota	M&E Parks & Recreation	1	65	2	4
	P401	Kubota	M&E Parks & Recreation	1	65	2	4
	P407-15	CAT	M&E Parks & Recreation	1	65	2	4
	P411-16	Kawasaki	M&E Parks & Recreation	1	65	2	4
		Kubota	M&E Parks & Recreation	1	65	2	4
S07015	21105	2014 F-450	Vehicle Medium Duty	1	67.5	2	4
S09016	23010	S090-16 Ford Transit Cargo	Vehicle Medium Duty	1	67.5	2	4
S06915	21106	2014 F-450	Vehicle Medium Duty	1	70	2	4
S09616	21855	S096-16 - 2016 Ford Transit	Vehicle Medium Duty	1	70	2	4
S04916	23009	S049-16 Ford Transit Cargo	Vehicle Medium Duty	1	70	2	4
S43214	21086	2014 F-150 Ford pick up	Vehicle Light Duty	1	70	2	4
S98714	21102	2014 F-150 pick up	Vehicle Light Duty	1	70	2	4
S51816	21377	2016 Chevrolet Silverado	Vehicle Light Duty	1	70	2	4
S59118	22197	S59118 2018 F150	Vehicle Light Duty	1	70	2	4
R722-16	21881	Hot Mix Transporter	M&E General	1	70	2	4
	P374-11	Avant	M&E Parks & Recreation	1	70	2	4
	P375	John Deere	M&E Parks & Recreation	1	70	2	4
	P412-16	Bobcat	M&E Parks & Recreation	1	70	2	4
	P413-16	Husqvarna	M&E Parks & Recreation	1	70	2	4

Asset ID	TCA ID	Name	Asset Class	Quantity	Condition	Criticality	Risk Exposure
	P414-14	Bobcat	M&E Parks & Recreation	1	70	2	4
		1330	Transit Shelter	1	72	2	4
		1530	Transit Shelter	1	72	2	4
		1540	Transit Shelter	1	72	2	4
		1585	Transit Shelter	1	72	2	4
		1670	Transit Shelter	1	72	2	4
		1745	Transit Shelter	1	72	2	4
		1750	Transit Shelter	1	72	2	4
		1790	Transit Shelter	1	72	2	4
		1805	Transit Shelter	1	72	2	4
		1820	Transit Shelter	1	72	2	4
		2130	Transit Shelter	1	72	2	4
		2185	Transit Shelter	1	72	2	4
		2695	Transit Shelter	1	72	2	4
		2945	Transit Shelter	1	72	2	4
		2955	Transit Shelter	1	72	2	4
		3035	Transit Shelter	1	72	2	4
		3040	Transit Shelter	1	72	2	4
		3285	Transit Shelter	1	72	2	4
		3860	Transit Shelter	1	72	2	4
		3875	Transit Shelter	1	72	2	4
		3905	Transit Shelter	1	72	2	4
		4240	Transit Shelter	1	72	2	4
		4245	Transit Shelter	1	72	2	4
		4320	Transit Shelter	1	72	2	4
		4740	Transit Shelter	1	72	2	4
		5010	Transit Shelter	1	72	2	4
		5590	Transit Shelter	1	72	2	4
		5655	Transit Shelter	1	72	2	4
		5700	Transit Shelter	1	72	2	4
		6205	Transit Shelter	1	72	2	4
		6315	Transit Shelter	1	72	2	4
		6325	Transit Shelter	1	72	2	4
		7025	Transit Shelter	1	72	2	4
		7355	Transit Shelter	1	72	2	4
		7435	Transit Shelter	1	72	2	4
S90714	21100	2014 Chevrolet Cruze	Vehicle Light Duty	1	72.5	2	4
S91716	21378	2016 Dodge Caravan	Vehicle Light Duty	1	72.5	2	4
S90316	21379	2016 Dodge Caravan	Vehicle Light Duty	1	72.5	2	4
S46716	21380	2016 Dodge Caravan	Vehicle Light Duty	1	72.5	2	4
S00517	21865	S005-17 2016 Ford F150	Vehicle Light Duty	1	72.5	2	4
S59318	22198	S59318 2018 F150	Vehicle Light Duty	1	72.5	2	4
S50515	21364	2015 Mercedes-Benz Sprinte	Vehicle Medium Duty	1	75	2	4
S06616	21854	S066-16 - 2016 Ford Transit	Vehicle Medium Duty	1	75	2	4
S55216	21870	S552-16 Ford F250	Vehicle Medium Duty	1	75	2	4
S44817	21876	S448-17 F250	Vehicle Medium Duty	1	75	2	4
S51617	21861	S516-17 2016 Ford F150	Vehicle Light Duty	1	75	2	4
S52117	21863	S521-17 2016 Ford F150	Vehicle Light Duty	1	75	2	4
S54017	21864	S540-17 2016 Ford F150	Vehicle Light Duty	1	75	2	4
		Gas Powered Ice Painting Ec	M&E Parks & Recreation	1	75	2	4
		Blec	M&E Parks & Recreation	1	75	2	4
S52917	21878	S529-17 F250	Vehicle Medium Duty	1	77.5	2	4
S92416	21381	2016 Dodge Caravan	Vehicle Light Duty	1	77.5	2	4
S92717	22189	S92717 2017 Ford Transit Co	Vehicle Light Duty	1	77.5	2	4
F132 F01	21853	F0132 - 2016 Ford Transit Ca	Vehicle Fire	1	77.5	2	4
S61318	22206	S61318 - 2018 Multi-Purpose	Vehicle Heavy Duty	1	80	4	4
18-01	AW17700	FORD	Vehicle Medium Duty	1	80	4	4
R95216	21883	Loader Mounted Blower	M&E Heavy	1	80	4	4

Asset ID	TCA ID	Name	Asset Class	Quantity	Condition	Criticality	Risk Exposure
S24317	22183	S24317 MT7-1105 Off Road	M&E Light Diesel & MTs	1	80	4	4
5002	22174	2018 Stealth Mustang 8.5 x 1	Paramedic Equipment	1	80	4	4
5000	22175	2016 John Deere XUV 8251	Paramedic Equipment	1	80	4	4
		Boat Trailer	Fire Equipment	1	80	4	4
S56116	21871	S561-16 Dodge Ram 5500	Vehicle Medium Duty	1	82.5	4	4
C108	22126	Kubota Tractor	M&E Light Diesel & MTs	1	82.5	4	4
S23817	22184	S23817 MT7-1105 Off Road	M&E Light Diesel & MTs	1	82.5	4	4
T831	20699	LFS Transit Bus	Transit Bus	1	82.5	4	4
T833	20700	LFS Transit Bus	Transit Bus	1	82.5	4	4
T832	20701	LFS Transit Bus	Transit Bus	1	82.5	4	4
S81216	21368	2015 Vactor	Vehicle Heavy Duty	1	85	4	4
S25419	22676	MT7 Off Road Vehicle #S254	M&E Light Diesel & MTs	1	85	4	4
S23919	22677	MT7 Off Road Vehicle #S239	M&E Light Diesel & MTs	1	85	4	4
L5313 was	21910	2016 Ford F350 (not PRU)	Vehicle Paramedic	1	85	4	4
		Hoses 45mm (Structural Hos	Fire Equipment	17	85	4	4
		Hoses 100mm (Structural Ho	Fire Equipment	1	85	4	4
		Hoses 45mm (Structural Hos	Fire Equipment	1	85	4	4
		Hoses 45mm (Structural Hos	Fire Equipment	1	85	4	4
		Hoses 45mm (Structural Hos	Fire Equipment	1	85	4	4
		Hoses 45mm (Structural Hos	Fire Equipment	1	85	4	4
		Hoses 45mm (Structural Hos	Fire Equipment	1	85	4	4
		Hoses 45mm (Structural Hos	Fire Equipment	38	85	4	4
		Hoses 45mm (Structural Hos	Fire Equipment	18	85	4	4
		Hoses 45mm (Structural Hos	Fire Equipment	11	85	4	4
		Hoses 45mm (Structural Hos	Fire Equipment	11	85	4	4
		Hoses 45mm (Structural Hos	Fire Equipment	12	85	4	4
		Hoses 45mm (Structural Hos	Fire Equipment	21	85	4	4
		Hoses 45mm (Structural Hos	Fire Equipment	12	85	4	4
		Hoses 45mm (Structural Hos	Fire Equipment	21	85	4	4
		Hoses 45mm (Structural Hos	Fire Equipment	12	85	4	4
		Hoses 45mm (Structural Hos	Fire Equipment	8	85	4	4
		Hoses 45mm (Structural Hos	Fire Equipment	8	85	4	4
		Hoses 45mm (Structural Hos	Fire Equipment	19	85	4	4
		Hoses 45mm (Structural Hos	Fire Equipment	20	85	4	4
		Hoses 45mm (Structural Hos	Fire Equipment	16	85	4	4
		Hoses 45mm (Structural Hos	Fire Equipment	4	85	4	4
		Hoses 45mm (Structural Hos	Fire Equipment	14	85	4	4
		Boat Motor	Fire Equipment	1	85	4	4
S84018	22655	2018 Garbage Packer #S840	Vehicle Heavy Duty	1	87.5	4	4
S84118	22656	2018 Garbage Packer #S841	Vehicle Heavy Duty	1	87.5	4	4
S61719	22660	2018 Multi-Purpose Plow Tru	Vehicle Heavy Duty	1	87.5	4	4
S61819	22662	2018 Multi-Purpose Plow Tru	Vehicle Heavy Duty	1	87.5	4	4
S62519	22663	2019 Multi-Purpose Plow Tru	Vehicle Heavy Duty	1	87.5	4	4
18-04	CFVV609	FORD	Vehicle Light Duty	1	87.5	4	4
S40917	22195	S40917 John Deere Loader	M&E Heavy	1	87.5	4	4
S26118	22862	S261-18 Wille Sidewalk Plow	M&E Light Diesel & MTs	1	87.5	4	4
S26218	22863	S262-18 Wille Sidewalk Plow	M&E Light Diesel & MTs	1	87.5	4	4
T851	21487	LFS Transit Bus	Transit Bus	1	87.5	4	4
T852	21488	LFS Transit Bus	Transit Bus	1	87.5	4	4
T853	21489	LFS Transit Bus	Transit Bus	1	87.5	4	4
T854	21490	LFS Transit Bus	Transit Bus	1	87.5	4	4
T855	21491	LFS Transit Bus	Transit Bus	1	87.5	4	4
S84219	22678	Garbage Packer #S842-19	Vehicle Heavy Duty	1	90	4	4
S83919	22679	Garbage Packer #S839-19	Vehicle Heavy Duty	1	90	4	4
S56619	22672	2018 F350 #S566-19	Vehicle Medium Duty	1	90	4	4
	22988	Fuel Storage Dispensing and	M&E General	1	90	4	4
		2019 Power Stair Chair (Ferr	Paramedic Equipment	1	90	4	4
		2019 Power Stair Chair (Ferr	Paramedic Equipment	1	90	4	4

Asset ID	TCA ID	Name	Asset Class	Quantity	Condition	Criticality	Risk Exposure
		2019 Power Stair Chair (Ferr	Paramedic Equipment	1	90	4	4
		2019 Power Stair Chair (Ferr	Paramedic Equipment	1	90	4	4
		2019 Power Stair Chair (Ferr	Paramedic Equipment	1	90	4	4
		2019 Power Stair Chair (Ferr	Paramedic Equipment	1	90	4	4
		2019 Power Stair Chair (Ferr	Paramedic Equipment	1	90	4	4
		2019 Power Stair Chair (Ferr	Paramedic Equipment	1	90	4	4
		2019 Power Stair Chair (Ferr	Paramedic Equipment	1	90	4	4
		2019 Power Stair Chair (Ferr	Paramedic Equipment	1	90	4	4
		2019 Power Stair Chair (Ferr	Paramedic Equipment	1	90	4	4
		2019 Power Stair Chair (Ferr	Paramedic Equipment	1	90	4	4
		2019 Power Stair Chair (Ferr	Paramedic Equipment	1	90	4	4
		2019 Power Stair Chair (Ferr	Paramedic Equipment	1	90	4	4
		2019 Power Stair Chair (Ferr	Paramedic Equipment	1	90	4	4
		2019 Power Stair Chair (Ferr	Paramedic Equipment	1	90	4	4
		2019 Power Stair Chair (Ferr	Paramedic Equipment	1	90	4	4
		2019 Power Stair Chair (Ferr	Paramedic Equipment	1	90	4	4
		2019 Power Stair Chair (Ferr	Paramedic Equipment	1	90	4	4
		2019 Power Stair Chair (Ferr	Paramedic Equipment	1	90	4	4
		2019 Power Stair Chair (Ferr	Paramedic Equipment	1	90	4	4
		2019 Power Stair Chair (Ferr	Paramedic Equipment	1	90	4	4
		2019 Power Stair Chair (Ferr	Paramedic Equipment	1	90	4	4
		2019 Power Stair Chair (Ferr	Paramedic Equipment	1	90	4	4
		2019 Power Stair Chair (Ferr	Paramedic Equipment	1	90	4	4
		2019 Power Stair Chair (Ferr	Paramedic Equipment	1	90	4	4
L5013 nov	22607	2018 Ford Explorer Intercept	Vehicle Fire	1	90	4	4
		Hoses 125mm (Structural Ho	Fire Equipment	15	90	4	4
		Hoses 45mm (Structural Hos	Fire Equipment	12	90	4	4
		Hoses 45mm (Structural Hos	Fire Equipment	10	90	4	4
		Hoses 100mm (Structural Ho	Fire Equipment	1	90	4	4
		Hoses 45mm (Structural Hos	Fire Equipment	1	90	4	4
		Hoses 45mm (Structural Hos	Fire Equipment	1	90	4	4
		Hoses 45mm (Structural Hos	Fire Equipment	1	90	4	4
		Hoses 45mm (Structural Hos	Fire Equipment	1	90	4	4
		Hoses 45mm (Structural Hos	Fire Equipment	1	90	4	4
		Hoses 45mm (Structural Hos	Fire Equipment	1	90	4	4
		Hoses 45mm (Structural Hos	Fire Equipment	1	90	4	4
		Hoses 45mm (Structural Hos	Fire Equipment	1	90	4	4
		Hoses 45mm (Structural Hos	Fire Equipment	1	90	4	4
T861	21886	LFS Transit Bus	Transit Bus	1	90	4	4
T862	21887	LFS Transit Bus	Transit Bus	1	90	4	4
T863	21888	LFS Transit Bus	Transit Bus	1	90	4	4
T864	21889	LFS Transit Bus	Transit Bus	1	90	4	4
T865	21890	LFS Transit Bus	Transit Bus	1	90	4	4
S62620	23165	Multi-Purpose Plow Truck S6	Vehicle Heavy Duty	1	92.5	4	4
S61420	23166	Multi-Purpose Plow Truck # S	Vehicle Heavy Duty	1	92.5	4	4
S62320	23167	Multi-Purpose Plow Truck # S	Vehicle Heavy Duty	1	92.5	4	4
19-03	BB18524	FORD	Vehicle Medium Duty	1	92.5	4	4
19-01	BB14249	FORD	Vehicle Light Duty	1	92.5	4	4
S39519	23162	John Deere Backhoe #S3951	M&E Heavy	1	92.5	4	4
S40119	23163	John Deere Backhoe #S4011	M&E Heavy	1	92.5	4	4
S24719	23143	MT7 Off Road Vehicle #S247	M&E Light Diesel & MTs	1	92.5	4	4
S26019	23144	MT7 Off Road Vehicle #S260	M&E Light Diesel & MTs	1	92.5	4	4
T871	22209	T871 LFS Transit Bus	Transit Bus	1	92.5	4	4
T872	22210	T872 LFS Transit Bus	Transit Bus	1	92.5	4	4
T873	22211	T873 LFS Transit Bus	Transit Bus	1	92.5	4	4
T881	22619	LFS Transit Bus #T881	Transit Bus	1	92.5	4	4
T882	22620	LFS Transit Bus #T882	Transit Bus	1	92.5	4	4
T883	22621	LFS Transit Bus #T883	Transit Bus	1	92.5	4	4

Asset ID	TCA ID	Name	Asset Class	Quantity	Condition	Criticality	Risk Exposure
S64320	23164	Multi-Purpose Plow Truck S6	Vehicle Heavy Duty	1	95	4	4
S83420	23395	Garbage Packer #S83420	Vehicle Heavy Duty	1	95	4	4
S83520	23396	Garbage Packer #S83520	Vehicle Heavy Duty	1	95	4	4
S83320	23397	Garbage Packer #S83320	Vehicle Heavy Duty	1	95	4	4
S64021	23435	S64021 Multi-Purpose Plow T	Vehicle Heavy Duty	1	95	4	4
S63621	23436	S63621 Multi-Purpose Plow T	Vehicle Heavy Duty	1	95	4	4
S62421	23437	S62421 Multi-Purpose Plow T	Vehicle Heavy Duty	1	95	4	4
S64621	23438	S64621 Multi-Purpose Plow T	Vehicle Heavy Duty	1	95	4	4
S64221	23439	S64221 Multi-Purpose Plow T	Vehicle Heavy Duty	1	95	4	4
S64121	23440	S64121 Multi-Purpose Plow T	Vehicle Heavy Duty	1	95	4	4
S64521	23441	S64521 Multi-Purpose Plow T	Vehicle Heavy Duty	1	95	4	4
20-02 or 1	BE94478	GMC	Vehicle Medium Duty	1	95	4	4
S39620	23399	2020 Caterpillar Backhoe Loa	M&E Heavy	1	95	4	4
S63120	23400	2020 International Underbody	M&E Heavy	1	95	4	4
S41220	23401	S41220 John Deere 624L Wl	M&E Heavy	1	95	4	4
S41720	23402	S41720 John Deere 624L Wl	M&E Heavy	1	95	4	4
S24120	23417	S24120 MT7 Trackless Sidew	M&E Light Diesel & MTs	1	95	4	4
		Narcotic Security Cabinet Sy:	Paramedic Equipment	1	95	4	4
		Narcotic Security Cabinet Sy:	Paramedic Equipment	1	95	4	4
		Narcotic Security Cabinet Sy:	Paramedic Equipment	1	95	4	4
		Narcotic Security Cabinet Sy:	Paramedic Equipment	1	95	4	4
		Narcotic Security Cabinet Sy:	Paramedic Equipment	1	95	4	4
		Narcotic Security Cabinet Sy:	Paramedic Equipment	1	95	4	4
		Narcotic Security Cabinet Sy:	Paramedic Equipment	1	95	4	4
		Narcotic Security Cabinet Sy:	Paramedic Equipment	1	95	4	4
		Narcotic Security Cabinet Sy:	Paramedic Equipment	1	95	4	4
		Narcotic Security Cabinet Sy:	Paramedic Equipment	1	95	4	4
		Narcotic Security Cabinet Sy:	Paramedic Equipment	1	95	4	4
		Narcotic Security Cabinet Sy:	Paramedic Equipment	1	95	4	4
		Narcotic Security Cabinet Sy:	Paramedic Equipment	1	95	4	4
		Narcotic Security Cabinet Sy:	Paramedic Equipment	1	95	4	4
		Narcotic Security Cabinet Sy:	Paramedic Equipment	1	95	4	4
		Narcotic Security Cabinet Sy:	Paramedic Equipment	1	95	4	4
		Narcotic Security Cabinet Sy:	Paramedic Equipment	1	95	4	4
		Narcotic Security Cabinet Sy:	Paramedic Equipment	1	95	4	4
		Narcotic Security Cabinet Sy:	Paramedic Equipment	1	95	4	4
		Narcotic Security Cabinet Sy:	Paramedic Equipment	1	95	4	4
		Narcotic Security Cabinet Sy:	Paramedic Equipment	1	95	4	4
		Sanisport Sanitizing Machine	Paramedic Equipment	1	95	4	4
		Hoses 38mm (Structural Hos	Fire Equipment	60	95	4	4
		Hoses 125mm (Structural Ho	Fire Equipment	40	95	4	4
		Hoses 100mm (Structural Ho	Fire Equipment	20	95	4	4
		Hoses 65mm (Structural Hos	Fire Equipment	45	95	4	4
	23449	Zodiac Hurricane 633 Rescu	Fire Equipment	1	95	4	4
	18165	12" Tap Adapter (Air Power (	M&E General	1	40	1	3
2600		Popcorn Machine Super Pop	M&E Parks & Recreation	1	40	1	3
		Popcorn Machine	M&E Parks & Recreation	1	45	1	3
		Snow Blower	M&E Parks & Recreation	1	45	1	3
		Floor Polisher	M&E Parks & Recreation	2	45	1	3
		Walk Behind Floor Scrubber	M&E Parks & Recreation	1	45	1	3
		Ride on Floor Scrubber	M&E Parks & Recreation	1	45	1	3
		Floor Polisher	M&E Parks & Recreation	1	45	1	3
		Popcorn Machine	M&E Parks & Recreation	1	45	1	3
		Walk Behind Floor Machine	M&E Parks & Recreation	1	45	1	3
		Floor Polisher	M&E Parks & Recreation	1	45	1	3
		Floor Scrubber	M&E Parks & Recreation	1	45	1	3
		Popcorn Machine	M&E Parks & Recreation	1	45	1	3

Asset ID	TCA ID	Name	Asset Class	Quantity	Condition	Criticality	Risk Exposure
		Floor Scrubber	M&E Parks & Recreation	1	50	1	3
11147		Benchmark USA Silver Scree	M&E Parks & Recreation	1	50	1	3
VCS2000		Wells Fryer	M&E Parks & Recreation	1	50	1	3
		Benchmark Popcorn Maker	M&E Parks & Recreation	1	50	1	3
		Popcorn Machine	M&E Parks & Recreation	1	50	1	3
		Popcorn Machine	M&E Parks & Recreation	1	50	1	3
		Wells Fryer	M&E Parks & Recreation	1	50	1	3
		Gas Powered Broom	M&E Parks & Recreation	1	50	1	3
	P200-1	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-10	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-11	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-12	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-13	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-14	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-15	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-16	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-17	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-18	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-19	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-2	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-20	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-21	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-22	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-23	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-24	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-25	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-26	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-27	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-28	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-29	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-3	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-30	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-31	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-32	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-33	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-34	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-35	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-36	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-37	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-38	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-39	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-4	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-40	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-41	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-42	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-43	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-44	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-45	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-46	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-47	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-48	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-49	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-5	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-50	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-51	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-52	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-53	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-54	Stihl	M&E Parks & Recreation	1	50	1	3

Asset ID	TCA ID	Name	Asset Class	Quantity	Condition	Criticality	Risk Exposure
	P200-55	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-56	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-57	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-58	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-59	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-6	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-60	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-61	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-62	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-63	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-64	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-65	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-66	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-67	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-68	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-69	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-7	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-70	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-71	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-72	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-73	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-74	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-75	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-8	Stihl	M&E Parks & Recreation	1	50	1	3
	P200-9	Stihl	M&E Parks & Recreation	1	50	1	3
	P260-1	Honda	M&E Parks & Recreation	1	50	1	3
	P260-10	Honda	M&E Parks & Recreation	1	50	1	3
	P260-11	Cub Cadet	M&E Parks & Recreation	1	50	1	3
	P260-12	Cub Cadet	M&E Parks & Recreation	1	50	1	3
	P260-13	Cub Cadet	M&E Parks & Recreation	1	50	1	3
	P260-14	Cub Cadet	M&E Parks & Recreation	1	50	1	3
	P260-15	Cub Cadet	M&E Parks & Recreation	1	50	1	3
	P260-16	Cub Cadet	M&E Parks & Recreation	1	50	1	3
	P260-17	Echo	M&E Parks & Recreation	1	50	1	3
	P260-18	Echo	M&E Parks & Recreation	1	50	1	3
	P260-2	Honda	M&E Parks & Recreation	1	50	1	3
	P260-3	Honda	M&E Parks & Recreation	1	50	1	3
	P260-4	Honda	M&E Parks & Recreation	1	50	1	3
	P260-5	Honda	M&E Parks & Recreation	1	50	1	3
	P260-6	Honda	M&E Parks & Recreation	1	50	1	3
	P260-7	Honda	M&E Parks & Recreation	1	50	1	3
	P260-8	Honda	M&E Parks & Recreation	1	50	1	3
	P260-9	Honda	M&E Parks & Recreation	1	50	1	3
	P280-1	Stihl	M&E Parks & Recreation	1	50	1	3
	P280-10	Stihl	M&E Parks & Recreation	1	50	1	3
	P280-11	Stihl	M&E Parks & Recreation	1	50	1	3
	P280-12	Stihl	M&E Parks & Recreation	1	50	1	3
	P280-13	Stihl	M&E Parks & Recreation	1	50	1	3
	P280-2	Stihl	M&E Parks & Recreation	1	50	1	3
	P280-3	Stihl	M&E Parks & Recreation	1	50	1	3
	P280-4	Stihl	M&E Parks & Recreation	1	50	1	3
	P280-5	Stihl	M&E Parks & Recreation	1	50	1	3
	P280-6	Stihl	M&E Parks & Recreation	1	50	1	3
	P280-7	Milwuakee	M&E Parks & Recreation	1	50	1	3
	P280-8	Milwaukee	M&E Parks & Recreation	1	50	1	3
	P280-9	Milwaukee	M&E Parks & Recreation	1	50	1	3
	P402-13	Toro	M&E Parks & Recreation	1	50	1	3
	P7590	Ryan	M&E Parks & Recreation	1	50	1	3

Asset ID	TCA ID	Name	Asset Class	Quantity	Condition	Criticality	Risk Exposure
	P7610	Lely	M&E Parks & Recreation	1	50	1	3
	P7610	Levy	M&E Parks & Recreation	1	50	1	3
	P7680-1	Bannerman	M&E Parks & Recreation	1	50	1	3
	P7680-2	Bannerman	M&E Parks & Recreation	1	50	1	3
	P7700		M&E Parks & Recreation	1	50	1	3
	P902	Land Pride	M&E Parks & Recreation	1	50	1	3
		Ammann	M&E Parks & Recreation	1	50	1	3
		Mikasa	M&E Parks & Recreation	1	50	1	3
		Mikasa	M&E Parks & Recreation	1	50	1	3
		Toro	M&E Parks & Recreation	1	50	1	3
	19705	Utility Trailer	M&E General	1	55	1	3
	19708	Utility Trailer	M&E General	1	55	1	3
	P066	Bluebird	M&E Parks & Recreation	1	55	1	3
	23117	Scheduling Software	M&E General	1	80	3	3
	23137	Sokkia IX-505 Robotic Total S	M&E General	1	80	3	3
		2018 Vending Lockers statior	Paramedic Equipment	1	80	3	3
		2018 Vending Lockers statior	Paramedic Equipment	1	80	3	3
		2018 Vending Lockers statior	Paramedic Equipment	1	80	3	3
		2018 Vending Lockers statior	Paramedic Equipment	1	80	3	3
F088 F008	21895	2016 Chevrolet Tahoe	Vehicle Fire	1	80	3	3
F089 F008	21896	2016 Chevrolet Tahoe	Vehicle Fire	1	80	3	3
		Saws - Gas Powered	Fire Equipment	2	80	3	3
S81314	21099	2014 Street sweeper	Vehicle Heavy Duty	1	82.5	3	3
L5014	22605	2017 Ford Explorer Intercepto	Vehicle Light Duty	1	85	3	3
S01918	22649	2018 F150 #S019-18	Vehicle Light Duty	1	85	3	3
S52618	22669	2018 F150 #S526-18	Vehicle Light Duty	1	85	3	3
S54918	22670	2018 F150 #S549-19	Vehicle Light Duty	1	85	3	3
R959-18	22648	Zamboni R959-18	M&E General	1	85	3	3
		Pagers	Fire Equipment	50	85	3	3
		Saws - Gas Powered	Fire Equipment	2	85	3	3
Edger		Olympia Electric Edger	M&E Parks & Recreation	1	85	3	3
		Battery Operated Edger	M&E Parks & Recreation	1	85	3	3
		Battery Operated Edger	M&E Parks & Recreation	1	85	3	3
S81115	21385	2015 Street Sweeper	Vehicle Heavy Duty	1	87.5	3	3
S47318	22667	2018 F150 #S473-18	Vehicle Light Duty	1	87.5	3	3
18-05	CFVV627	FORD	Vehicle Light Duty	1	87.5	3	3
	23094	MS60 1" Survey Equipment s	M&E General	1	90	3	3
R26819	23273	Allu Transformer Bucket with	M&E General	1	90	3	3
F140 F014	22169	2017 F250	Vehicle Fire	1	90	3	3
		Hoses 45mm (Forestry Hose	Fire Equipment	8	90	3	3
		Wajax Pump	Fire Equipment	6	90	3	3
		Battery Operated Edger	M&E Parks & Recreation	1	90	3	3
		Battery Operated Edger	M&E Parks & Recreation	1	90	3	3
		Electric Pallet Jack	M&E Parks & Recreation	1	90	3	3
S53519	23148	2019 Nissan Frontier S53519	Vehicle Light Duty	1	92.5	3	3
S42519	23153	2019 Ford F150 #S42519	Vehicle Light Duty	1	92.5	3	3
19-02	BB14250	FORD	Vehicle Light Duty	1	92.5	3	3
F099 F009	22614	2019 Ford F250 #F0099	Vehicle Fire	1	92.5	3	3
S05619	23141	2019 Ford F350 Service Bod	Vehicle Medium Duty	1	95	3	3
S06019	23142	2019 Ford F350 Service Bod	Vehicle Medium Duty	1	95	3	3
S55019	23155	2019 Ford F250 Service Truc	Vehicle Medium Duty	1	95	3	3
S44719	23145	2019 Nissan Sentra #S44719	Vehicle Light Duty	1	95	3	3
S53419	23149	2019 Nissan Frontier S53419	Vehicle Light Duty	1	95	3	3
S51719	23151	2019 Ford F150 #S51719	Vehicle Light Duty	1	95	3	3
S47919	23152	2019 Ford F150 #S47919	Vehicle Light Duty	1	95	3	3
S01119	23154	2019 Ford F150 #S01119	Vehicle Light Duty	1	95	3	3
R96420	23398	Zamboni R96420	M&E General	1	95	3	3
S80020	23414	S80020 Madvac Litter Collec	M&E General	1	95	3	3

Asset ID	TCA ID	Name	Asset Class	Quantity	Condition	Criticality	Risk Exposure
S81420	23416	S81420 2020 Schwarze M6S	M&E General	1	95	3	3
R72520	23418	R72520 2020 KM4000T Asph	M&E General	1	95	3	3
R27321	23419	R27321 2020 Falcon 4 Ton T	M&E General	1	95	3	3
	23430	Rotary Lift SM18EL	M&E General	1	95	3	3
R97821	23431	R97821 2021 Zamboni	M&E General	1	95	3	3
F106	23099	Ford F250 #F106	Vehicle Fire	1	95	3	3
F025	23453	F025 2020 F450 Hazmat Veh	Vehicle Fire	1	95	3	3
		Hoses 38mm (Forestry Hose	Fire Equipment	29	95	3	3
		Pagers	Fire Equipment	50	95	3	3
		Thermal Camera	Fire Equipment	2	95	3	3
		Ladder	Fire Equipment	7	95	3	3
		Ladder	Fire Equipment	9	95	3	3
		Ladder	Fire Equipment	8	95	3	3
		Ladder	Fire Equipment	3	95	3	3
	P1510	Rittenhouse	M&E Parks & Recreation	1	60	1	2
GNP4330		Mad Dawg Hot Dog Maker	M&E Parks & Recreation	1	65	1	2
		Snow Blower	M&E Parks & Recreation	1	65	1	2
		Hot Dog Roller	M&E Parks & Recreation	1	65	1	2
		Snow Blower	M&E Parks & Recreation	1	65	1	2
FP-DS		Integra Floor Scrubber	M&E Parks & Recreation	1	75	1	2
		Floor Scrubber	M&E Parks & Recreation	1	75	1	2
		Polisher/Burnisher	M&E Parks & Recreation	1	75	1	2
PFC5700		Perfect Fri Company Fryer	M&E Parks & Recreation	1	75	1	2
		TX Floor Burnisher	M&E Parks & Recreation	1	75	1	2
		Advance Sc400 Floor Scrubb	M&E Parks & Recreation	1	75	1	2
		20 Plus Floor Scrubber	M&E Parks & Recreation	1	75	1	2
		High Speed Rabbit Scrubber	M&E Parks & Recreation	1	75	1	2
		Advance Floor Stripper Mach	M&E Parks & Recreation	1	75	1	2
WB63369748		Frigidaire Fridge	M&E Parks & Recreation	1	75	1	2
		Frigidaire Stand Up Freezer	M&E Parks & Recreation	1	75	1	2
		GE Fridge	M&E Parks & Recreation	1	75	1	2
		Freezer	M&E Parks & Recreation	1	75	1	2
		Freezer	M&E Parks & Recreation	1	75	1	2
		Floor Cleaner	M&E Parks & Recreation	2	75	1	2
		Floor Polisher	M&E Parks & Recreation	1	75	1	2
		Floor Scrubber	M&E Parks & Recreation	1	75	1	2
		Popcorn Machine	M&E Parks & Recreation	1	75	1	2
		Popcorn Machine	M&E Parks & Recreation	1	75	1	2
		Popcorn Machine	M&E Parks & Recreation	1	75	1	2
S05016	21856	S050-16 - 2016 Ford Transit	Vehicle Medium Duty	1	80	2	2
S57417	21873	S574-17 F350	Vehicle Medium Duty	1	80	2	2
S50717	21874	S507-17 F250	Vehicle Medium Duty	1	80	2	2
S55617	21875	S556-17 F250	Vehicle Medium Duty	1	80	2	2
S53617	21877	S536-17 F250	Vehicle Medium Duty	1	80	2	2
S49917	21880	S499-17 F250	Vehicle Medium Duty	1	80	2	2
S50216	21375	2016 Chevrolet Silverado	Vehicle Light Duty	1	80	2	2
S52216	21376	2016 Chevrolet Silverado	Vehicle Light Duty	1	80	2	2
S46816	21382	2016 Dodge Caravan	Vehicle Light Duty	1	80	2	2
R525-15	22985	Compressor HOP049548	M&E General	1	80	2	2
R530-15	23000	Compressor HOP049546	M&E General	1	80	2	2
R252-15	23002	Compressor HOP049549	M&E General	1	80	2	2
F134 F013	21859	F0134 - 2016 Ford Transit Ca	Vehicle Fire	1	80	2	2
	P415-17	Husqvarna	M&E Parks & Recreation	1	80	2	2
	P416-17	Husqvarna	M&E Parks & Recreation	1	80	2	2
	P417-17	Husqvarna	M&E Parks & Recreation	1	80	2	2
S55817	21872	S558-17 F350	Vehicle Medium Duty	1	82.5	2	2
S52017	21879	S520-17 F350	Vehicle Medium Duty	1	82.5	2	2
S53817	22191	S53817 2017 Ford F550	Vehicle Medium Duty	1	82.5	2	2

Asset ID	TCA ID	Name	Asset Class	Quantity	Condition	Criticality	Risk Exposure
S44617	23007	S44617 2017 Ford 250 Trans	Vehicle Medium Duty	1	82.5	2	2
S51318	22671	2018 F150 #S513-18	Vehicle Light Duty	1	82.5	2	2
S50116	21866	S501-16 Ford F250 - EMS Po	Vehicle Medium Duty	1	85	2	2
S94517	22193	S94517 2017 Ford 250 Trans	Vehicle Medium Duty	1	85	2	2
S93017	22188	S93017 2017 Ford Transit Co	Vehicle Light Duty	1	85	2	2
S45617	22190	S45617 2017 Ford Transit Co	Vehicle Light Duty	1	85	2	2
S42718	22651	2018 Ford Escape #S427-18	Vehicle Light Duty	1	85	2	2
S54218	22665	2018 F150 #S442-18	Vehicle Light Duty	1	85	2	2
S96217	22989	S96217 2017 Ford Transit Co	Vehicle Light Duty	1	85	2	2
R720-18	22658	Big A 2 Ton Hot Box Reclaim	M&E General	1	85	2	2
F133 F013	21860	F0133 - 2016 Ford Transit Ca	Vehicle Fire	1	85	2	2
	P172-18	CAT	M&E Parks & Recreation	1	85	2	2
	p418-18	Exmark	M&E Parks & Recreation	1	85	2	2
	P969	Toro	M&E Parks & Recreation	1	85	2	2
T76017	21892	2017 Ford F550 4x4	Vehicle Heavy Duty	1	87.5	2	2
S54317	22192	S54317 2017 Ford F550	Vehicle Medium Duty	1	87.5	2	2
S45318	22652	2018 Ford Transit #S453-18	Vehicle Medium Duty	1	87.5	2	2
S01617	23008	S01617 2017 Ford F550 Wel	Vehicle Medium Duty	1	87.5	2	2
S42618	22650	2018 Ford Escape #S426-18	Vehicle Light Duty	1	87.5	2	2
S50318	22653	2018 Ford F150 #S503-18	Vehicle Light Duty	1	87.5	2	2
S44018	22664	2018 F150 #S440-18	Vehicle Light Duty	1	87.5	2	2
S47118	22668	2018 F150 #S471-18	Vehicle Light Duty	1	87.5	2	2
F128 F012	22185	F0126 2017 Dodge Grand Ca	Vehicle Fire	1	87.5	2	2
S47618	22659	2018 F350 S476-18	Vehicle Medium Duty	1	90	2	2
S44119	22673	2019 F350 #S441-19	Vehicle Medium Duty	1	90	2	2
S03919	22674	2019 F350 Transit #S039-19	Vehicle Medium Duty	1	90	2	2
S03019	22675	2019 F350 Transit #S030-19	Vehicle Medium Duty	1	90	2	2
S52518	22654	2018 F150 #S525-18	Vehicle Light Duty	1	90	2	2
S95118	22657	2018 Ford Escape #S951-18	Vehicle Light Duty	1	90	2	2
S53018	22666	2018 F150 #S530-18	Vehicle Light Duty	1	90	2	2
		1095	Transit Shelter	1	90	2	2
		1160	Transit Shelter	1	90	2	2
		1791	Transit Shelter	1	90	2	2
		2015	Transit Shelter	1	90	2	2
		2055	Transit Shelter	1	90	2	2
		2230	Transit Shelter	1	90	2	2
		2325	Transit Shelter	1	90	2	2
		2462	Transit Shelter	1	90	2	2
		2620	Transit Shelter	1	90	2	2
		2725	Transit Shelter	1	90	2	2
		2780	Transit Shelter	1	90	2	2
		3165	Transit Shelter	1	90	2	2
		3235	Transit Shelter	1	90	2	2
		3425	Transit Shelter	1	90	2	2
		3455	Transit Shelter	1	90	2	2
		3610	Transit Shelter	1	90	2	2
		3630	Transit Shelter	1	90	2	2
		3640	Transit Shelter	1	90	2	2
		3660	Transit Shelter	1	90	2	2
		3670	Transit Shelter	1	90	2	2
		3940	Transit Shelter	1	90	2	2
		4310	Transit Shelter	1	90	2	2
		4315	Transit Shelter	1	90	2	2
		4635	Transit Shelter	1	90	2	2
		5425	Transit Shelter	1	90	2	2
		5450	Transit Shelter	1	90	2	2
		5495	Transit Shelter	1	90	2	2
		5505	Transit Shelter	1	90	2	2

Asset ID	TCA ID	Name	Asset Class	Quantity	Condition	Criticality	Risk Exposure
		5520	Transit Shelter	1	90	2	2
		5565	Transit Shelter	1	90	2	2
		5790	Transit Shelter	1	90	2	2
		5830	Transit Shelter	1	90	2	2
		6320	Transit Shelter	1	90	2	2
		6585	Transit Shelter	1	90	2	2
		6605	Transit Shelter	1	90	2	2
		6780	Transit Shelter	1	90	2	2
		6930	Transit Shelter	1	90	2	2
		6995	Transit Shelter	1	90	2	2
		7000	Transit Shelter	1	90	2	2
		7095	Transit Shelter	1	90	2	2
		7475	Transit Shelter	1	90	2	2
		7520	Transit Shelter	1	90	2	2
	P1520	Kubota	M&E Parks & Recreation	1	90	2	2
	P1520-95	Toro	M&E Parks & Recreation	1	90	2	2
	P1520-96	Toro	M&E Parks & Recreation	1	90	2	2
	P1520-97	Toro	M&E Parks & Recreation	1	90	2	2
	P1520-98	Toro	M&E Parks & Recreation	1	90	2	2
	P1520-99	Toro	M&E Parks & Recreation	1	90	2	2
T78718	22616	2018 Ford Escape Bus Drive	Vehicle Light Duty	1	92.5	2	2
T78818	22617	2018 Ford Escape Bus Drive	Vehicle Light Duty	1	92.5	2	2
T81918	22618	2018 Ford Escape Bus Drive	Vehicle Light Duty	1	92.5	2	2
S00719	23156	2019 Nissan Cargo #S00719	Vehicle Medium Duty	1	95	2	2
S58619	23157	2019 Ford F450 #S08619	Vehicle Medium Duty	1	95	2	2
S47819	23158	2019 Ford F250 #S47819	Vehicle Medium Duty	1	95	2	2
S48319	23159	2019 Ford F250 #S48319	Vehicle Medium Duty	1	95	2	2
S46919	23160	2019 Ford F250 #S46919	Vehicle Medium Duty	1	95	2	2
S51019	23161	2019 Ford F250 #S51019	Vehicle Medium Duty	1	95	2	2
S09520	23420	S09520	Vehicle Medium Duty	1	95	2	2
S58120	23421	S58120 Ford F350	Vehicle Medium Duty	1	95	2	2
S56920	23422	S56920 2020 Ford F450	Vehicle Medium Duty	1	95	2	2
S57020	23423	S57020 2020 Ford F450	Vehicle Medium Duty	1	95	2	2
S58820	23424	S58820 2-2- Ford F450	Vehicle Medium Duty	1	95	2	2
S54421	23425	S54421 2021 Ford F250	Vehicle Medium Duty	1	95	2	2
S44921	23426	S44921 2021 Ford F250	Vehicle Medium Duty	1	95	2	2
S05921	23427	S05921 2020 Ford F250	Vehicle Medium Duty	1	95	2	2
S8001	23428	S8001 2020 Ford F250	Vehicle Medium Duty	1	95	2	2
S8002	23429	S8002 2020 Ford F250	Vehicle Medium Duty	1	95	2	2
S8003	23433	S8003 2020 Ford F250	Vehicle Medium Duty	1	95	2	2
S56321	23434	S56321 2020 Ford F250	Vehicle Medium Duty	1	95	2	2
S45919	23146	2019 Nissan NV200 Passeng	Vehicle Light Duty	1	95	2	2
S42819	23147	2019 Nissan Frontier S4281	Vehicle Light Duty	1	95	2	2
S00319	23150	2019 Ford F150 #S00319	Vehicle Light Duty	1	95	2	2
T78920	23345	T78920 2020 Nissan Kicks D	Vehicle Light Duty	1	95	2	2
S94620	23403	S94620 2019 Nissan Qashqa	Vehicle Light Duty	1	95	2	2
S95220	23404	S95220 2019 Nissan Qashqa	Vehicle Light Duty	1	95	2	2
S01420	23405	S01420 2019 Nissan Frontie	Vehicle Light Duty	1	95	2	2
S59421	23406	S59421 2021 Chevrolet Colo	Vehicle Light Duty	1	95	2	2
S49821	23407	S49821 2021 Chevrolet Colo	Vehicle Light Duty	1	95	2	2
S59521	23408	S59521 2021 Chevrolet Colo	Vehicle Light Duty	1	95	2	2
S54621	23409	S54621 2021 Chevrolet Colo	Vehicle Light Duty	1	95	2	2
S44421	23410	S44421 2021 Chevrolet Colo	Vehicle Light Duty	1	95	2	2
S48921	23411	S48921 2021 Chevrolet Colo	Vehicle Light Duty	1	95	2	2
S53121	23412	S53121 2021 Chevrolet Colo	Vehicle Light Duty	1	95	2	2
S04221	23413	S04221 Chevrolet Colorado	Vehicle Light Duty	1	95	2	2
S95020	23432	S95020 2019 Dodge Grand (	Vehicle Light Duty	1	95	2	2
		Electric Painting Equipment I	M&E Parks & Recreation	2	95	2	2

Asset ID	TCA ID	Name	Asset Class	Quantity	Condition	Criticality	Risk Exposure
R74817	22199	R74817 Boom Flail Mower	M&E General	1	80	1	1
AFC1526DW3		Frigidaire Freezer	M&E Parks & Recreation	1	80	1	1
		Fridge	M&E Parks & Recreation	1	80	1	1
		Floor Machine	M&E Parks & Recreation	1	80	1	1
		Honda Snow Blower	M&E Parks & Recreation	1	85	1	1
DCF051A3WDD		Danby Chest Freezer	M&E Parks & Recreation	1	90	1	1
LFFH17F3QWC		Frigidaire Upright Freezer	M&E Parks & Recreation	1	95	1	1
		Danby Freezer	M&E Parks & Recreation	1	95	1	1
		Popcorn Machine	M&E Parks & Recreation	1	95	1	1
		Automatic Floor Sweepers	M&E Parks & Recreation	2	95	1	1
		Dry Floor Scrubbing Machine	M&E Parks & Recreation	2	95	1	1

Municipal Parking Asset Management Plan

Version No. 1

June 2021

Contents

Figures

Tables

1. Executive Summary

1.1. Purpose

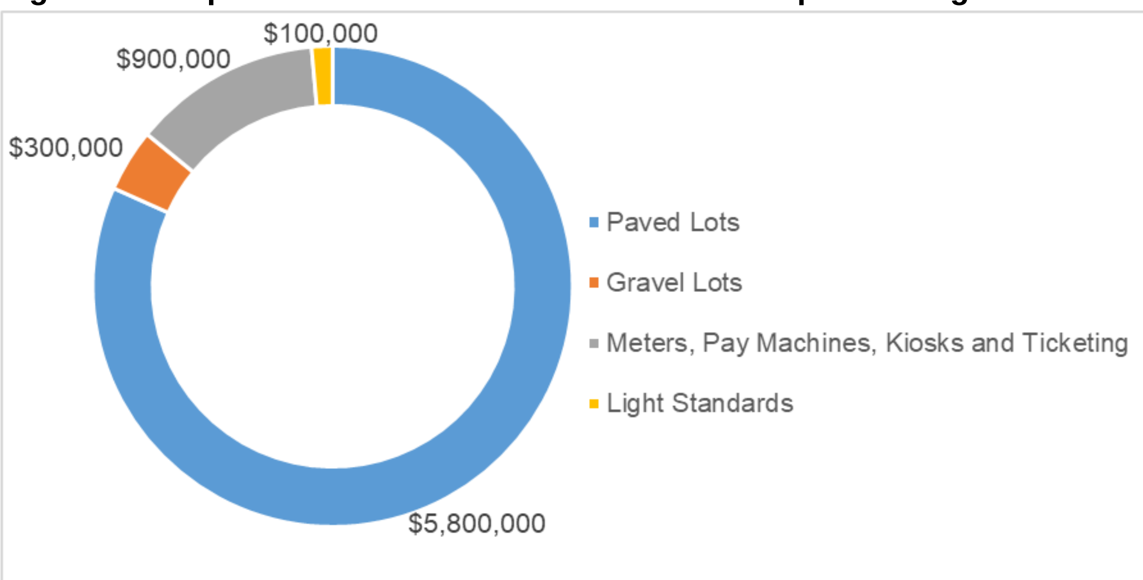
Asset management is the systematic and coordinated activities and practices of an organization to optimally and sustainably deliver on its service objectives through cost-effective life-cycle management of assets.

This asset management plan details information about municipal parking infrastructure assets including the actions required to provide the existing level of service in a cost effective manner while outlining the associated risks of asset ownership. The plan defines the existing services provided, how the services are provided and what funds are required to maintain the services over a 60-year planning period.

1.2. State of the Infrastructure

The scope of the project encompasses the municipal parking infrastructure owned and operated by the City of Greater Sudbury. The replacement value of municipal parking assets that are included in the plan are summarized in Figure E1.

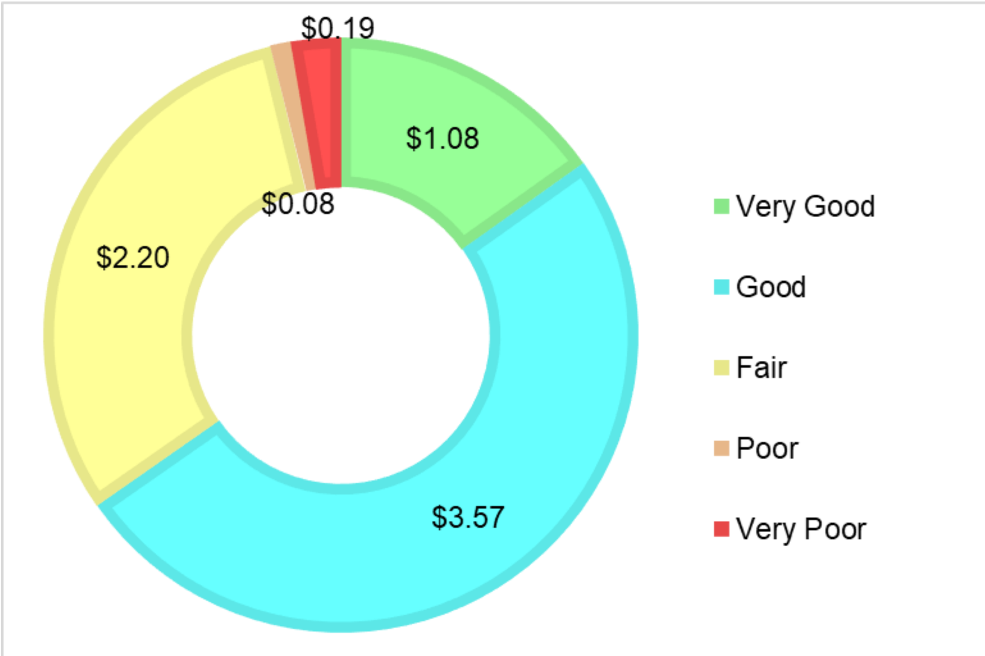
Figure E1: Replacement Value Distribution of Municipal Parking Assets



The municipal parking assets have a replacement value of $7,100,000.

The data analyzed to develop the plan is integrated from the City's Tangible Capital Asset Database and on-site condition inspections. The details behind the development of conditions and inspection frameworks are attached in Appendix A. Figure E2 outlines the replacement value and condition of the municipal parking inventory.

Figure E2: Condition and Valuation of Municipal Parking Inventory in Millions



1.3. Level of Service

A service level is a direction or requirement for a particular service area against which performance may be measured. For assets, technical data like performance specifications inform service levels.

There are 3 tiers of service level that are discussed in the plan, namely:

- **Community**: Qualitative descriptions that define the community, stakeholder and individual expectations.
- **Strategic**: These include qualitative and quantitative measures that describe what is being provided to the community. Examples of how this can be defined can include reliability, legislative compliance, quantity, quality and safety.
- **Asset (Technical)**: An asset level of service is a quantitative measure that defines the performance expectations for a given asset in order to produce the desired levels of service. These services are measured and can include asset condition, responsiveness, expenditure, and asset value.

1.4. Asset Management Strategy

The life cycle intervention strategies for paved municipal parking lots discussed within this report include: resurfacing, minor reconstruction, reconstruction and maintenance activities such as inspection, pot-hole repair, frost heave repair, localized ponding/settlement repair and line painting.

Granular surface parking lots are graded every spring and periodically receive a new surface coating of Granular A.

Parking meters may be renewed by swapping out the interior of the parking meter. Meters and pay machines are disposed and replaced at actual end of life. The City has been updating parking technology, for instance 27 Pay By Plate machines have recently been installed for on-street parking.

1.5. Failure Prediction and Risk Management

A risk framework was developed and each individual asset is assigned a risk score based on a calculated probability and consequence of failure.

The probability of failure is an estimate of the likelihood of an asset is to not meeting its service expectations. The consequence of failure is an estimate of the effect on outcomes if an asset actually fails.

1.6. Long-Term Need

Table E1 details the 60-year average annual reinvestment requirement (AAR_{60}) by asset class. The AAR_{60} represents the estimated annual amount of capital the City requires to reinvest in the parking inventory. Investment was analyzed on a 60 year period to capture the 60 year theoretical useful life of municipal lots. The 60-year annual average reinvestment requirement for all municipal parking assets is $0.19M.

Table E1: 60-Year Average Annual Reinvestment Requirement

Asset Class	AAR_{60}
Municipal Parking Lots	101,300
Meters, Pay Machines, Kiosks and Ticketing	91,500
Street Lights	2,100
Total AAR_{60} =	**194,900**

1.7. Future Demand

All of the City's municipal parking infrastructure is located in the Downtown area. The most significant future demand driver for municipal parking is the planned construction projects that will reshape the City's Downtown.

To address post construction target utilization of the Downtown area, there are a number of options that the City is considering to accommodate the increase in parking demand including:

- Development of a parking structure to accommodate an 85 – 90% utilization rate;
- Transportation Demand Management (TDM) that includes additional incentives for community members. For example: Transit Pass Programs, Emergency Ride Home, Bikeshare and Carshare Programs, Ridematching and Bicycle Parking;
- Investigate shared parking agreements with private entities;

- Surface parking expansion outside the Downtown core, for example Dufferin Street Road Allowance;

- Incentives to increase parking in the Downtown core periphery lots, for example Energy Court (Lot 11).

1.8. Climate Change

In September 2020, Council approved the Community Energy Emissions Plan (CEEP) that is the long-term plan to reduce carbon emissions and pollution in Greater Sudbury. The CEEP is a response the City of Greater Sudbury Council's Climate Emergency declaration in May 2019. The CEEP outlines 18 goals that need to be met to attain the City's target of becoming a net-zero GHG emission community by 2050. For further information with respect to the Community Energy Emissions Plan, please visit: https://www.greatersudbury.ca/live/environment-and-sustainability1/net-zero-2050/.

The City is beginning to monitor the effects of climate change on its infrastructure assets. Global Climate Models for the Greater Sudbury geographic area are reviewed and discussed.

1.9. Next Steps

Table E2 identifies the next steps that emerged during the development of the asset management plan.

Table E2: Next Steps

Section	Category	Action Item
Level of Service	Asset Level of Service	• Identify customer expectations associated with planned construction projects • Develop target service levels for Council review
Asset Management Strategy	Lifecycle Management Plan	• Review and refine strategies as necessary
Failure Prediction Risk Management	Risk Assessment and Exposure	• Monitor and refine the deterioration model for municipal parking lots as necessary
Long-Term Needs	Funding Sources	• Develop a sustainability strategy to achieve target levels of service for Council review, discussion and approval. • Determine funding source for infrastructure need.

2. Introduction

The City of Greater Sudbury recognizes the need to ensure that downtown land uses remain supported by an effective transportation infrastructure network. The Downtown Master Plan anticipates that the planned intensification of the downtown will be supported through incremental investments in active transportation infrastructure and parking.

The Downtown parking system provides two types of parking opportunities, permit and pay parking. Permit parking allows users to purchase monthly passes, while pay parking allows users to purchase parking time on demand on an hourly basis.

City owned assets that are managed by Security and By-Law Services include municipal parking lots, parking meters, parking ticket systems and pay and display machines.

Paid municipal parking spaces are provided across the City's downtown core. The number of paid parking spaces managed per 100,000 population is 1,291 spaces/100k. The average hourly rate for on-street parking is $1.30, the second smallest value reported to MBNCan with the 2019 Data Call.

The City owns and operates the municipal parking lot 7 located at the YMCA Center for Life. Part of the municipal parking lot runs underneath the Center for Life building structure. The City owns only the parking parcel and does not own the building structure. Therefore, the City owned municipal parking lot at the Center for Life is included within the asset management plan.

The Beech Street Municipal Parking Lot 12 is leased by the City. As a result, the condition of the parking lot surface and replacement cost for Lot 12 are not included within the asset management plan.

Furthermore, the City owns and operates 438 curbside parking spaces that form an integral part of the road structure. Therefore the curbside spaces are included within the roads and transportation asset management plan.

3. State of the Infrastructure

3.1. Asset Data Inventory

Parking inventories are stored within the tangible capital asset database and spreadsheets. The City's parking inventory is summarized in Table 1 below.

Table 1: Municipal Parking Asset Inventory	
Asset Type	**Quantity**
Paved Municipal Parking Lots	10
Gravel Municipal Parking Lots	2
Meters, Pay Machines, Kiosks and Ticketing	230
Light Standards	19

The parking asset inventory is updated annually.

3.2. Asset Valuation

Asset valuation is determined in either one of two ways; historical cost inflated to current year dollars or where assets have attributes that evolve, costs are reviewed to incorporate legislation, recent purchases and current market demand. For example, evolving efficiencies and technology, or a significant rebate program from a senior level of government can lead to an increase in purchase price over a short duration and an increase in market demand.

3.3. Estimated Asset Value

A summary of the City's municipal parking inventory value is provided in Table 2.

Table 2: Municipal Parking Inventory Value	
Asset Type	**Replacement Cost**
Paved Municipal Parking Lots including Lot 13 (TDS) and ramps	$5,800,000
Gravel Municipal Parking Lots	$300,000
Meters, Pay Machines, Kiosks and Ticketing	$900,000
Light Standards	$100,000
Grand Total	$7,100,000

The estimated replacement value of the City's parking assets is $7.1M. This value represents 0.07% of the replacement value of the City's total asset inventory.

3.4. Asset Useful Life

For the development of this asset management plan, the theoretical useful life of a paved and gravel parking lot is 60 years.

Pay and display ticket machines have a theoretical useful life of 10 years while parking meters have a theoretical useful life of 20 years as the meters are periodically reconstructed by swapping out the interior components.

3.5. Asset Condition Assessment

For further details on the methodology behind the assigned conditions to the municipal parking assets, please refer to Appendix A.

3.6. Current Asset Condition

The average condition of the City's municipal parking assets are provided in Table 3 below.

Table 3: Municipal Parking Average Condition	
Asset Type	**Average Condition**
Paved Municipal Parking Lots	68 - Good
Gravel Municipal Parking Lots	50 - Fair
Meters, Pay Machines, Kiosks and Ticketing	61 - Good
Light Standards	74 - Good

The following Table 4 provides a condition breakdown for municipal parking infrastructure.

Table 4: Municipal Parking Condition					
Condition	**Parking Lots**	**Meters and Pay Machines**	**Light Standards**	Total	%
Very Good	2	25	10	37	14.2%
Good	6	194	7	207	79.3%
Fair	4	2	0	6	2.3%
Poor	0	3	2	5	1.9%
Very Poor	0	6	0	6	2.3%
Totals	12	230	19	261	100%

4. Levels of Service

4.1. Community and Strategic Level of Service

Community and strategic levels of service are provided in Table 5.

<table>
<tr><th colspan="2">Table 5: Parking Level of Service</th></tr>
<tr><th>Service</th><th>Level of Service</th></tr>
<tr><td rowspan="2">Parking</td><td>Customer:
• Municipal parking lots are safe, convenient and in good repair
• Municipal parking in the downtown core is available
• Parking lots are accessible year round and during all weather conditions</td></tr>
<tr><td>Strategic:
• Administer and maintain 438 on-street parking spaces and 13 municipal parking lots for a total of approximately 2,140 parking spaces in the City's downtown. The City owns 12 of the 13 aforementioned lots and 1 municipal parking lot is leased.
• Provide quality infrastructure to meet the community's parking requirements</td></tr>
</table>

4.2. Asset Level of Service

Asset (technical) levels of service are provided in the following Table 6.

Table 6: Asset (Technical) Level of Service

	Asset Class	Existing	Implication	Target
Security and By-Law Services	Parking Lots	Paved parking lot condition rating = **B (Good)**	Rehabilitation activities to maintain SoGR	Maintain paved parking lots at a condition rating = **TBD**
		Gravel parking lot annual surfacing expenditure = **$2,820**	Rehabilitation activities to maintain SoGR	Maintain gravel parking lot annual surfacing expenditure = **TBD**
		Total number of parking spaces within municipal lots = **1721**	Performance through availability	Maintain total number of parking spaces within municipal lots = **TBD**
		Parking lot light pole condition rating = **B (Good)**	Rehabilitation activities to maintain SoGR	Maintain parking lot light poles at a condition rating = **TBD**
		Number of municipal parking lots with illumination = **6 including TDS Parking Garage**	Performance through security	Maintain number of municipal parking lots with illumination = **TBD**
	Curbside Parking	Total number of municipal curbside metered spaces = **438**	Performance through availability	Maintain total number of curbside metered spaces = **TBD**
	Parking Meters, Pay Machines, Kiosks and Ticketing	Parking equipment is at a condition rating = **B (Good)**	Replace parking equipment at end of life to maintain SoGR	Maintain parking equipment at a condition rating = **TBD**

5. Asset Management Strategy

5.1. Maintain or Adjust Level of Service

The current average parking lot condition is good. In order to maintain this performance, continued infrastructure investment is required.

5.2. Lifecycle Management Plan

Parking lot maintenance activities include inspection, pot-hole repair, frost heave repair, localized ponding/settlement repair and line painting.

The opportunity for a paved municipal parking lot rehabilitation project is explored with adjacent road reconstruction projects whenever possible. The rehabilitation could include:

1. Resurfacing is the removal and replacement of the top lift of asphalt. This is the most common type of municipal parking lot treatment.

2. Minor reconstruction is the removal of surface and base layers of asphalt where two layers are present.

3. Full reconstruction is the complete removal and replacement of the entire pavement structure including the granular base material. A municipal parking lot would have to experience extreme asphalt degradation and frost heave to require such a treatment.

Granular surface parking lots are graded every spring and periodically receive a new surface coating of Granular A. The trigger for a Granular A topping is visible granular loss due and contamination from the soils below the granular surface.

Parking meters may be renewed by swapping out the interior of the parking meter. The City has also been replacing parking meters with pay by plate technology.

6. Failure Prediction and Risk Management

Risk management is a major component of asset life-cycle management. The City's risk management goals involve identifying, understanding and managing the potential for infrastructure assets to meet planned service objectives.

Risk assessment is applied to prioritize and optimize capital spending and decision making. The City evaluates both the Probability of Failure (PoF) and the Consequence of Failure (CoF) when prioritizing for the capital budget. This helps clarify and build a shared understanding about the risk associated with a decision to not engage in a project.

6.1. Failure Prediction

Failure prediction is performed to assess the potential for an asset to deliver an expected level of service over time. Current and historical condition and performance data is analyzed to determine the current position of an asset within its life-cycle. This information informs a judgment about how much remaining service life is available. For this asset management plan, the remaining life of municipal parking assets have been determined by condition.

6.2. Probability of Failure (PoF)

The probability of failure is an estimate of the likelihood of an asset is to not meeting its service expectations. The PoF for municipal parking assets has been derived from asset condition. Table 7 demonstrates the rationale to determine the PoF of municipal parking assets.

Table 7: Probability of Failure (PoF) Municipal Parking			
Asset Condition translates to → Likelihood and PoF			
Condition		**Likelihood**	**PoF**
F (Very Poor)	Less than 20	Almost Certain: 80% of Greater	**P5**
D (Poor)	20 - 39	Likely: 60 – 79%	**P4**
C (Fair)	40 - 59	Possible: 40 – 59%	**P3**
B (Good)	60 - 79	Unlikely: 20 – 39%	**P2**
A (Very Good)	80 - 100	Rare: Less than 20%	**P1**

6.3. Consequence of Failure (CoF)

The consequence of failure is an estimate of the effect on outcomes if an asset actually fails. The consequences of failure could range from a service interruption to a catastrophic result depending on the asset criticality. The municipal parking criticality and consequence of failure is detailed in Table 8. The CoF has been developed to adhere to the Corporate Impact and Likelihood Criteria for Enterprise Risk Management recommended by the City's Auditor General. The City also has planned mitigation already in place to maintain service objectives should an asset fail. The availability and quantity of mitigation or redundancy was considered with the development of the CoF.

Table 8: Municipal Parking Criticality and Consequences of Failure					
Asset Criticality Criteria translates to → Consequences of Failure					
Critically	**Score**	**Criteria**	**Impact**	**CoF**	**Assets**
Critical	5	• Life safety or essential service • Legislated • Significant financial loss	Severe	**C5**	• None
Essential	4	• Threatens delivery of public transportation or sanitation service level • Serious Injury or legal judgement • Financial loss	Major	**C4**	• None
Strategic	3	• Threatens the integrity of defined service level • Injury • Moderate financial loss • Negative economic impact resulting in lost revenue for local business	Moderate	**C3**	• Municipal Parking Lots • Light Standards
Enhancement	2	• Simplifies the delivery of defined service level • Reportable injury • Inefficient process leading to financial loss	Minor	**C2**	• Pay and Display Stations • Parking Meters • Parking Ticket System
Deferrable	1	• Service target can be 90% achieved without a particular asset	Insignificant	**C1**	• None

Municipal parking assets are assessed for risk annually when they are prioritized as part of the capital budget. Items that are reviewed are discussed in Table 9.

Table 9: Failure Prediction			
Service or Asset at Risk	**What Can Happen**	**Risk Rating**	**Failure Mode**
Municipal Parking Lots	• Parking surface failure • Economic impact on public and private industry	Medium	Condition
Meters, Pay Machines, Kiosks and Ticketing	• Isolated or system outage • Economic impact on City through loss of revenue • Unable to enforce parking by-law	Low	Condition
Light Standards	• Isolated or system outage • Safety Concerns • Potential for crime and vandalism	Medium	Condition

6.4. Risk Assessment and Exposure

The probability and consequences of failure allow the corporation to focus on assets that have the greatest impact on service delivery. The following formula demonstrates the PoF and CoF are multiplied to determine risk exposure.

Risk Exposure = Probability of Failure x Consequence of Failure

The risk exposure for all of the City's municipal parking assets has been mapped in the risk matrix provided in Figure 1. For additional details such as the specific municipal parking assets and where they fit in the risk map, please refer to Appendix B and Appendix C.

Figure 1: Municipal Parking Risk Exposure

Consequence	P1	P2	P3	P4	P5
C5	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0
C4	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0
C3	12 Assets $789,225	13 Assets $3,495,822	4 Assets $1,896,959	2 Assets $12,000	0 Assets $0
C2	25 Assets $288,897	194 Assets $77,286	2 Assets $302,867	3 Assets $69,293	6 Assets $188,443
C1	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0

Probability

Where:
Crtitical
Significant
Medium
Low

6.5. Risk Response

The City has implemented a modernization of the municipal parking system to include alternate methods of payment while continually reviewing parking inventory to ensure that parking is appropriate for utilization.

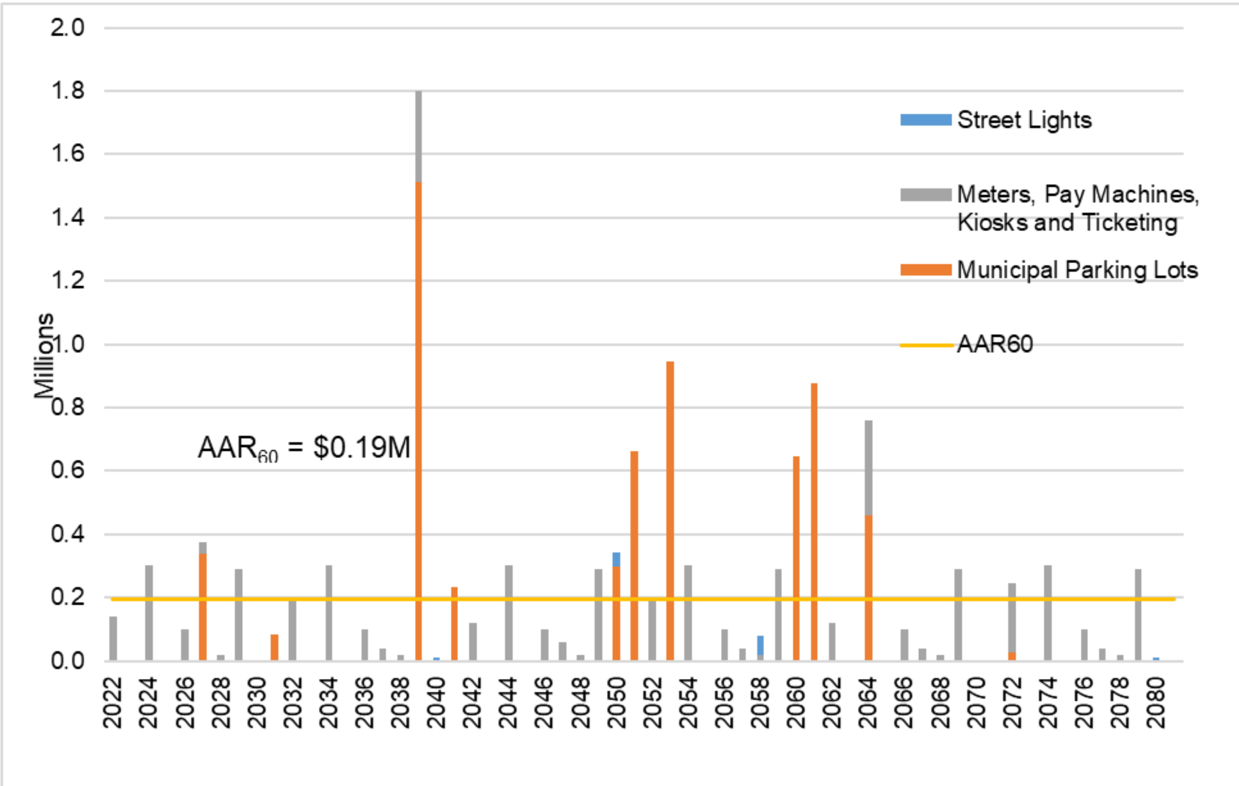
- Pay by Plate payment methods (pay by cellphone app) to replace parking meters and pay stations;
- Digital parking permits with license plate recognition to replace display tags for monthly parking permits;
- Integration of HotSpot technology to provide an alternative to the conventional pay stations. HotSpot tap pay system is an app installed on a user's cell phone that works in conjunction with Google Pay or Apple Pay systems;
- Modernization will help track peak parking usage at various locations and times of day. The information is used to plan for maintenance and potential lighting improvements. This applies to municipal lots and curbside spaces.

- To maintain user satisfaction, the City does not issue tickets if a payment system has failed.

7. Long-Term Needs

Figure 2 provides the 60-year average capital reinvestment need for municipal parking assets. This represents the estimated amount of capital the City requires to reinvest in the parking inventory. The 60-year annual average reinvestment requirement (AAR_{60}) for all municipal parking assets is $0.19M.

Figure 2: 60-Year Capital Need Summary



60-Year Capital Need Assumptions

The long-term needs for parking assets is based on the following assumptions:

- Replacements are with a similar function, utility and quantity;
- 60-year average annual reinvestment requirement does not consider service expansion or reduction;
- Risk exposure equivalency of 20 or higher is considered to be immediate need in the year 2022;
- Parking assets are scheduled for replacement at end of life;
- Calculated in 2020 Canadian Dollars.

The 60-Year Capital Need analysis is based on lifecycle management strategies for various municipal parking asset types and condition assessment data. For this plan, the lifecycle analysis represents the investment needed to rehabilitate and replace assets; the cost of operational maintenance, for example snow removal was not included. Operational maintenance costs will be included in future updates to the asset management plan as part of full lifecycle cost analysis.

Table 10 details the 60-year average annual reinvestment requirement by asset class.

Table 10: 60-Year Average Annual Reinvestment Requirement	
Asset Class	**AAR_{60}**
Municipal Parking Lots	101,300
Meters, Pay Machines, Kiosks and Ticketing	91,500
Street Lights	2,100
Total AAR_{60} =	**194,900**

7.1. Infrastructure Reinvestment Financing Strategy

State of good repair (SoGR) is the condition that an asset is able to operate at a full level of performance. To maintain the City's infrastructure assets in a state of good repair, capital work is financed through tax supported capital reserve and utility rate supported capital reserve. The Municipal Parking Asset Management Plan in conjunction with the annual capital budget proposes and prioritizes the City's infrastructure investment requirements according to their respective financing sources.

The 60-year average annual reinvestment requirement is compared to historical expenditure from a period of 5 years to demonstrate the financial risk associated with asset ownership known as a funding gap. The funding gap is the unfunded value of infrastructure renewal needs that require attention as of the current year. Table 11 demonstrates the municipal parking funding gap. Although Table 11 demonstrates a funding gap for municipal parking, it is not reflective of the annual revenue generated by parking within the downtown core, some of which may be diverted to address additional capital need as it arises on a year to year basis.

Table 11: Funding Gap (Capital)	
Asset Class	Municipal Parking
5-Yr Expenditure (Mean)	$107,000
AAR_{60}	$194,900
Funding Gap	$87,900
5-Yr Revenue (Mean)	(1,738,032)
Actual Funding Gap	$0

7.2. Sustainability Strategy

The existing level of service for municipal parking drive the reinvestment forecasts in the asset management plan. Levels of service are based on regulation, standards, and Council approved service levels. Following the asset management roadmap, Council will be provided with the opportunity to determine level of service targets to manage infrastructure within the City's capacity to renew and maintain assets, and accept the associated risk.

7.3. Next Steps

Ensuing Council approval of the Municipal Parking Asset Management Plan, target level of service options will be prepared for Council review, discussion and approval. The target level of service framework may require additional key performance indicators and will be the main driver of the sustainability strategy.

Table 12: Next Steps

Section	**Category**	**Action Item**
Level of Service	Asset Level of Service	• Identify customer expectations associated with planned construction projects • Develop target service levels for Council review
Asset Management Strategy	Lifecycle Management Plan	• Review and refine strategies as necessary
Failure Prediction Risk Management	Risk Assessment and Exposure	• Monitor and refine the deterioration model for municipal parking lots as necessary
Long-Term Needs	Funding Sources	• Develop a sustainability strategy to achieve target levels of service for Council review, discussion and approval. • Determine funding source for infrastructure need.

8. Future Demand

8.1. Demand Drivers

Drivers affecting demand include parameters such as population, legislation, demographics, seasonal factors, technological advancement, economic and environmental awareness.

8.2. Demand Forecasts and Impact on Assets

The present position and projections for demand drivers that may impact future service delivery and use of assets were identified and documented in Table 13. The present position and projection statistics are from the City of Greater Sudbury Outlook for Growth to 2046 that was developed in March 2018 and The City of Greater Sudbury Downtown Parking Study completed in November 2018.

Parking systems are considered “effectively full” at an occupancy of approximately 85-90%, depending on lot size and other characteristics.

The 2018 parking capacity assessment was completed considering a parking utilization target of 85%. Under 2018 conditions, the following system wide occupancies were estimated:

- Municipal off-street: 74% utilization;
- Municipal on-street: 71% utilization; and
- Private off-street: 79% utilization.

Currently, two new development are planned for Downtown Sudbury. The Places Des Arts, currently under development and The Junction, a City led development consisting of a Library, an Arts Gallery, and a Convention Centre with a hotel component. The new developments are planned to be located in such a manner that they have or will replace the following three municipal lots:

- Larch Street Lot (has already been decommissioned for The Places Des Arts development and 59 spaces lost);
- Sudbury Arena Lot (currently operational with the potential for 81 spaces lost);
- Minto Street Lot (currently operational with the potential for 165 spaces lost).

To develop post construction alternatives, an interactive process was adopted to analyze:

- Additional parking generated by the occupancy and anticipated event requirements of a convention centre for The Place Des Arts and The Junction during peak and off peak hours;
- Existing parking lot closures including a redistribution of parking within an acceptable walking distance of 300 – 400 m;

- Available municipal on-street parking; and
- Available private off-street parking.

To achieve a post construction target utilization of 85%, an additional 500 spaces are required. To achieve a post construction target utilization of 90%, an additional 315 spaces are required to accommodate the existing and additional parking requirements of Place Des Arts and The Junction.

8.3. Demand Management Plan

The City will regulate the demand on assets through a combination of managing existing assets, upgrading of existing assets and providing new assets to meet demand. Opportunities identified for demand management are provided in Table 13. Further opportunities will be developed in future revisions of the asset management plan.

To address the post construction target utilization of the Downtown area, there are a number of options that the City is considering to accommodate the increase in parking demand including:

- Development of a parking structure to accommodate an 85 – 90% utilization rate;
- Transportation Demand Management (TDM) that includes additional incentives for community members. For example: Transit Pass Programs, Emergency Ride Home, Bikeshare and Carshare Programs, Ridematching and Bicycle Parking;
- Investigate shared parking agreements with private entities;
- Surface parking expansion outside the Downtown core, for example Dufferin Street Road Allowance;
- Incentives to increase parking in the Downtown core periphery lots, for example Energy Court (Lot 11).

Table 13: Demand Drivers, Projections, Impact on Services and Management Plan				
Demand Driver	**Present Position**	**Projection**	**Impact on Services**	**Demand Management Plan**
Population	City of Greater Sudbury Population: 166,130	Population (2046): • Low: 165,090 • Mid-Range: 172,990 (Reference Scenario) • High: 181,290	The City's population is anticipated to remain relatively constant. This will minimize the impact on municipal parking assets.	The City will continue to monitor population. Should the population deviate from the expected constant, the data will be analyzed to formulate an appropriate plan.
Legislation	Parking lots are being constructed to meet legislative requirements.	Additional legislative requirements are anticipated. For example implementation and enforcement for an accessible Ontario by 2025.	Replacement cost of municipal parking assets may increase with evolving legislation. For example, accessibility space requirements and along sidewalks and walkways.	The replacement value of municipal parking assets is monitored annually to reflect market demand resulting from legislation and latest technology.
Demographic	Households: 69,152	Households (2046): • Low: 72,890 • Mid-Range: 75,250 (Reference Scenario) • High: 77,590	The anticipated increase in housing will be monitored against the services provided by municipal parking assets.	With an increase in housing, the City will monitor the municipal parking service requirements of the Downtown area.
Aging Population	Median Age from 2016 Canada Census: 43.2	Anticipated increase in median age of population	The anticipated increase in median age of population will be monitored against services provided by municipal parking assets.	The City will monitor aging population trends and the impact on parking assets.

Table 13: Demand Drivers, Projections, Impact on Services and Management Plan				
Demand Driver	**Present Position**	**Projection**	**Impact on Services**	**Demand Management Plan**
Seasonal Factors	Drastic shifts in temperature and precipitation from summer to winter months	Drastic shifts in temperature and precipitation from summer to winter months are expected to continue for the foreseeable future.	The shifts in temperature and precipitation will be monitored against the condition and life-cycle requirements of municipal parking assets.	Municipal parking lots will be monitored for their durability to withstand the freeze thaw associated with shifts in temperature and precipitation.
Technological Advancement	The City monitors available technology to improve the level of service provided by municipal parking assets.	The need for additional investment in technology is anticipated.	New technologies are expected to continue to evolve with the service provided.	The City will continue to monitor and implement technological improvements as needed. For example, the City has recently rolled out its new pay by plate system.
Economic	Jobs: 79,440	Jobs (2046): • Modest: 81,230 • Mid-Range: 85,750 (Reference Scenario) • High: 90,460	The City's employment is expected to grow with the minor projected increase in population. Impact on municipal parking need will continue to be monitored.	The City will continue to monitor employment. Should the employment deviate from the expected constant, the data will be analyzed to formulate an appropriate plan.
Environmental Awareness	Through legislation and the City's own actions, the City has demonstrated that it recognizes the need for environmental and climate protection.	In recent years, environmental awareness has received considerably more attention. This is expected to continue. Environmental awareness is anticipated to result in additional legislative requirements and stricter best practices.	The City is considering the possibility of incorporating electric vehicle charging stations into its municipal parking infrastructure.	A City fleet policy will be developed to cover the procurement of electric vehicles or vehicles that operate with alternative fuels. This policy may drive additional need for electric vehicle charging stations.

9. Climate Change

In September 2020, Council approved the Community Energy Emissions Plan (CEEP) that is the long-term plan to reduce carbon emissions and pollution in Greater Sudbury. The CEEP is a response to the City of Greater Sudbury Council's Climate Emergency declaration in May 2019. The CEEP outlines 18 goals that need to be met to attain the City's target of becoming a net-zero GHG emission community by 2050. For further information with respect to the Community Energy Emissions Plan, please visit: https://www.greatersudbury.ca/live/environment-and-sustainability1/net-zero-2050/.

Global climate models for the Greater Sudbury geographic area are available through various online resources, namely:

- Climatedata.ca, undertaken with the support of Environment and Climate Change Canada;
- Climateatlas.ca, undertaken with the support of Environment and Climate Change Canada, Public Health Agency of Canada, and Health Canada.

The City is beginning to monitor the effects of climate change on its infrastructure assets. The data provided in the aforementioned websites suggest that it is a possibility that there will be an increase in precipitation and an overall increase in mean temperature for the municipality. The climate projection scenarios from climateatlas.ca suggest that the increase in mean temperature within the area will result in a decrease of freeze-thaw days, additional summer days, more very hot days and additional tropical nights.

For context, when reading the data and analytics from either of the information sources, RCP means Representative Concentration Pathway which is a greenhouse gas concentration trajectory. The greenhouse gas concentration trajectory is not to be confused with current emissions, although emissions impact the atmospheric concentrations.

Climatedata.ca analyzes the RCP2.6, RCP4.5 and RCP8.5, while climateatlas.ca analyzes RCP4.5 and RCP8.5. RCP scenario definitions are provided below:

RCP 2.6: This pathway is very stringent because it would require that carbon dioxide (CO_2) emissions were significantly declining in 2020 and achieve zero emissions by 2100. The pathway also requires methane gas (CH_4) emissions be halved by 2020 and sulphur dioxide (SO_2) emissions to decline to approximately 10% of the SO_2 emission level from 1980. This scenario requires negative CO_2 emissions equivalent to a minimum of 2 Gigatons/year every year from natural sources such as trees to keep the global temperature rise below 2°C by the year 2100.

RCP 4.5: This pathway is intermediate because global emissions would peak by 2040. CO_2 emissions must reduce to half of the 2050 levels by 2100, CH_4 emissions must decline by 75% in the decade leading to the year 2050, and SO_2 emissions must decline by 80% of the SO_2 emission level from 1980. Similar to RCP 2.6, this scenario requires negative CO_2 emissions equivalent to a minimum of 2 Gigatons/year every year from natural sources to keep the global temperature rise between 2°C and 3°C by the year 2100. Many plant and animal species will not be able to adapt to the effects of RCP 4.5 or higher.

RCP 8.5: This pathway is business as usual. Emission will continue to rise on the current global pace throughout the 21st century.

Global Climate Models depict how the climate is likely to change in the future. As no single climate model is correct, the asset management plan consider the effect of Low Carbon (RCP 4.5) and High Carbon (RCP 8.5) on the municipal parking assets. The two scenarios are appropriate as RCP 4.5 assumes a drastic and sustained reduction of emissions in the coming decades, while RCP 8.5 represents the current global pace; emission of very large amounts of carbon dioxide from the burning of fossil fuels.

The following Table 14 provides the results of several Global Climate Models for the City of Greater Sudbury geographic area with high and low carbon emission scenarios and the anticipated impact on municipal parking assets. It is important to note that the anticipated impact is of climate change on infrastructure, not the potential impact of infrastructure contribution to climate change. Also, the climate projections suggest the variable outcomes are possibilities and not absolute certainty.

Table 14: Climate Change Scenarios and Impact on Services					
Variable	**Current Mean**	**RCP**	**2021 - 2050**	**2051 - 2080**	**Anticipated Impact**
			Mean	**Mean**	
Precipitation (mm)	848	High 8.5 Low 4.5	904 890	938 924	The increase in precipitation may increase the risk of flooding or washout and may increase stress on pavement structure. An increase in precipitation will likely lead to an increased need for gravel parking lot maintenance.
Mean Temperature	4.3°C	High 8.5 Low 4.5	6.5°C 6.3°C	8.8°C 7.3°C	No specific impact.
Tropical Nights (+20°C)	1	High 8.5 Low 4.5	5 4	17 7	No specific impact.
Very Cold Days (-30°C)	5	High 8.5 Low 4.5	1 2	0 1	The decrease in very cold days may help reduce the frost penetration depth.
Very Hot Days (+30°C)	6	High 8.5 Low 4.5	18 16	39 24	No specific impact.
Frost-Free Season (days)	137	High 8.5 Low 4.5	163 157	184 168	The decrease in frost days will likely reduce the stress on pavement structure.
Freeze Thaw Cycles	68	High 8.5 Low 4.5	64.2 65.4	61.5 64.3	The decrease in freeze-thaw cycles will likely ease pressure on the pavement structure.
Mild Winter Days (-5°C)	120.1	High 8.5 Low 4.5	103.6 104.5	84.2 96.6	The decrease in mild winter days will reduce winter maintenance activity.
Summer Days (+25°C)	42.9	High 8.5 Low 4.5	68.9 65.2	93.8 77.4	No specific impact.
Winter Days (-15°C)	58.4	High 8.5	42	24.8	The decrease in mild winter days will reduce winter maintenance activity.

10. Improvement Opportunity

The City will take the following steps towards sustainability:

- Maintain full compliance with legislation;
- Environmentally sustainable initiatives;
- Monitor asset life-cycles for scheduled replacements;
- Advance technologies.

Appendix A – Municipal Parking Asset Condition

Municipal parking assets have been assigned conditions as detailed in following Table A1 and Figure A1.

Table A1: Meters, Pay Machines, Kiosks, Ticketing and Light Standards		
Condition	**Service Life Consumption**	**Condition Score**
Very Good	0% to 20%	80 to 100
Good	21% to 40%	60 to 79
Fair	41% to 60%	40 to 59
Poor	61% to 80%	20 to 39
Very Poor	>81%	0 to 19

Figure A1: Municipal Parking Lot Inspection Form

Lot Name:		Lot Number:		Reviewer:				
Example								
No. of Barrier Free Spaces:		Total No. of Spaces		Date:			Surface Type:	
2		25					☒ ASPHALT	☐ GRAN A

Asphalt				**Asphalt**				
Crack Density:	**No. of Spaces with Cracks**			**Crack Severity:**	**Crack Width**	**No. of Spaces**		
Very Good	0 to 19%	0	0%	Very Good	<3 mm	10	0.06	
Good	20 to 39%			Good	3 mm to 10 mm	0	0.00	
Fair	40 to 59%			Fair	11 mm to 15 mm	5	0.40	
Poor	60 to 79%			Poor	16 mm to 20 mm	10	1.25	
Very Poor	80 to 100%			Very Poor	> 20 mm	0	0.00	
							0.341	

Asphalt				**Asphalt**				
Frost Heave or Rutting:	**ΔDepth or ΔHeight**	**No. of Spaces**		**Pot Holes:**	**Pot Hole Depth**	**Area m^2**	**No. of Spaces**	
Very Good	<12 mm	5	0.03	Very Good	< 25 mm	< 0.1	0	0.00
Good	13 mm to 25 mm	5	0.18	Good	25 mm to 50 mm	0.1 - 0.2	10	0.35
Fair	25 mm to 40 mm	5	0.40	Fair	51 mm to 75 mm	0.2 - 0.3	10	0.80
Poor	40 mm to 50 mm	5	0.63	Poor	76 mm to 100 mm	0.3 - 0.4	5	0.63
Very Poor	> 50 mm	5	0.95	Very Poor	> 100 mm	> 0.4	0	0.00
			0.4355					0.36

Pavement Condition Index for Municipal Parking Lots					
Crack Density	**95**	95	Where:	Very Good	81 to 100
Crack Severity	**65**	65		Good	61 to 80
Frost Heave or Rutting	**55**	55		Fair	41 to 60
Pot Holes	**60**	60		Poor	21 to 40
Asphalt Condition	**69**			Very Poor	0 to 20

Appendix B – Municipal Parking Risk Exposure

Municipal parking risk exposure is detailed in following Figure B1 through Figure B3.

Figure B1: Municipal Parking Lots

Consequence	P1	P2	P3	P4	P5
C5	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0
C4	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0
C3	2 Assets $729,225	6 Assets $3,453,822	4 Assets $1,896,959	0 Assets $0	0 Assets $0
C2	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0
C1	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0

Probability

Where:
- Crtitical
- Significant
- Medium
- Low

Figure B2: Meters, Pay Machines, Kiosks and Ticketing

Consequence	P1	P2	P3	P4	P5
C5	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0
C4	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0
C3	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0
C2	25 Assets $288,897	194 Assets $77,286	2 Assets $302,867	3 Assets $69,293	6 Assets $188,443
C1	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0

Probability

Where:
- Crtitical
- Significant
- Medium
- Low

Figure B3: Light Standards

Consequence	P1	P2	P3	P4	P5
C5	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0
C4	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0
C3	10 Assets $60,000	7 Assets $42,000	0 Assets $0	2 Assets $12,000	0 Assets $0
C2	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0	Assets $0
C1	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0	0 Assets $0

Probability

Where:
- Crtitical
- Significant
- Medium
- Low

Appendix C – Municipal Parking Risk Exposure and Condition Ranking

Intentionally Blank

Appendix C: Municipal Parking Risk Exposure and Condition Ranking							
Asset ID	TCA ID	Name	Asset Class	Quantity	Condition	Criticality	Risk Exposure
		Sudbury Arena	Light Standards	1	30	3	12
		Sudbury Arena	Light Standards	1	30	3	12
C0575	536	Pay and Display Machines Lo	Pay and Meters	1	0	2	10
C0576	537	Pay and Display Machines Lo	Pay and Meters	1	0	2	10
C0634	556	CP RAIL PARKING KIOSK	Pay and Meters	1	0	2	10
	557	Pay and Display Machines Lo	Pay and Meters	1	0	2	10
	21799	Parking Ticket System	Pay and Meters	1	0	2	10
Lot #4	22602	Pay and Display Machine Lot	Pay and Meters	1	10	2	10
	555	Energy Court	Municipal Lot	1	46	3	9
	8767	Minto Street	Municipal Lot	1	48	3	9
	20271	Shaughnessy Street Lot B	Municipal Lot	1	50	3	9
		Elgin Street/CP (Market Squa	Municipal Lot	1	50	3	9
Lot #1	20268	Pay & Display Machine - Lot	Pay and Meters	1	20	2	8
Lot #10	20269	Pay & Display Machine - Lot	Pay and Meters	1	20	2	8
Lot #??	20270	Pay & Display Machine - Lot	Pay and Meters	1	20	2	8
	21965	Parking Ticket System	Pay and Meters	0	20	2	8
C0533	20873	TDS Automated Parking Sys	Pay and Meters	1	40	2	6
C0533	20874	YMCA Automated Parking Sy	Pay and Meters	1	40	2	6
	8770	Shaughnessy St. West Side	Municipal Lot	1	60	3	6
	8765	Sudbury Arena	Municipal Lot	1	60	3	6
		Energy Court	Light Standards	1	65	3	6
		Energy Court	Light Standards	1	65	3	6
		Energy Court	Light Standards	1	65	3	6
		Energy Court	Light Standards	1	65	3	6
		Energy Court	Light Standards	1	65	3	6
		Energy Court	Light Standards	1	65	3	6
		Energy Court	Light Standards	1	65	3	6
	8769	Shaughnessy St. East Side	Municipal Lot	1	66	3	6
	8766	Larch @ Lisgar	Municipal Lot	1	73	3	6
	8774	Elgin at Larch Street Lot	Municipal Lot	1	74	3	6
		Tom Davies Square	Municipal Lot	1	75	3	6
	20267	Parking Meters	Pay and Meters	194	60	2	4
	8776	Medina Lane	Municipal Lot	1	86	3	3
	578	Centre for Life Complex	Municipal Lot	1	88	3	3
		Shaughnessy St. East Side	Light Standards	1	90	3	3
		Shaughnessy St. East Side	Light Standards	1	90	3	3
		Shaughnessy St. East Side	Light Standards	1	90	3	3
		Shaughnessy St. East Side	Light Standards	1	90	3	3
		Shaughnessy St. East Side	Light Standards	1	90	3	3
		Shaughnessy St. West Side	Light Standards	1	90	3	3
		Minto Street	Light Standards	1	90	3	3
		Minto Street	Light Standards	1	90	3	3
		Minto Street	Light Standards	1	90	3	3
		Minto Street	Light Standards	1	90	3	3
	23108	On Street Pay by Plate Solar	Pay and Meters	25	90	2	2