The Corporation of The City of North Bay – Asset Management Plan – Infrastructure

An overview of the City's Asset Management Practices based on the Ontario Ministry of Infrastructure's Building Together Initiative

Stantec

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Executive Summary

Municipalities are stewards of their community's infrastructure. Well-managed infrastructure fosters prosperity, growth, and quality of life for a community's residents, businesses, and visitors.

Most Canadian municipalities are struggling to maintain existing infrastructure under current tax and rate levels. They continue to deal with downloaded responsibilities and, at the same time, face growing needs to maintain and renew aged and decaying infrastructure.

The subject of asset management has been gaining increasing public awareness as a result of the introduction of Bill 175, the Sustainable Water and Sewage Systems Act in 2002. The emphasis is now being placed on not only knowing the true cost of providing services to your customers today, but also understanding what will be required to maintain the services in perpetuity (or as long as they are required), through the use of life cycle costing. In other words, we are moving towards a Sustainable Asset Management System.

Ontario's Ministry of Infrastructure has also recently released guidelines for the development of Municipal Asset Management Plans, which supports the Province's 10-year infrastructure plan "Building Together". This document follows the Ministry's guidelines for the development of an Asset Management Plan for the City of North Bay's infrastructure. The objective of these guidelines is to provide a basis for the standardization and consistency of asset management practices across Ontario's municipalities. The Asset Management Plan (AMP) is intended to provide a link between the City's Vision and Mission Statement, which are set out as follows in the City of North Bay's Corporate Business Plan:

Mission

To deliver quality municipal services to residents, businesses and community partners by enhancing the physical, leisure, economic and environmental quality of life for the community and region that is affordable, sustainable, and relevant.

Vision

An attractive and desirable place to live, work, play, and learn.

Table ES.1: City of North Bay Mission Statement and Values

Mission Statement	Alignment
To deliver quality municipal services to residents, business and community partners by enhancing the physical, leisure, economic and environmental quality of life for the community and region that is affordable, sustainable, and relevant.	The AMP will assist staff and council in identifying and planning for the future challenges associated with the management of the City's infrastructure assets.
City of North Bay Values	
Stewardship, Wise Management of Resources	The AMP will provide a document that can be presented to the community to outline the plan for addressing the future needs associated with maintaining the City's infrastructure assets.
Fiscal Plan, Infrastructure Investment, and Asset/Resource Management	The AMP provides the community with an overview of the plan to address the future rehabilitation and replacement requirements and sustainable funding levels of the infrastructure assets. Accountability & responsibility comes from ongoing reporting of the status of the activities outlined in the AMP.
Effective Communication, Customer Focused, Compliant with Legislation, Policies, Procedure, and By-Laws	Developing and implementing the AMP shows the community that staff and council are taking a professional approach to managing the infrastructure.

Figure ES.1 shows the City's Public Works assets broken down into replacement values per serviced property, based on approximately 15,000 serviced properties in the City.

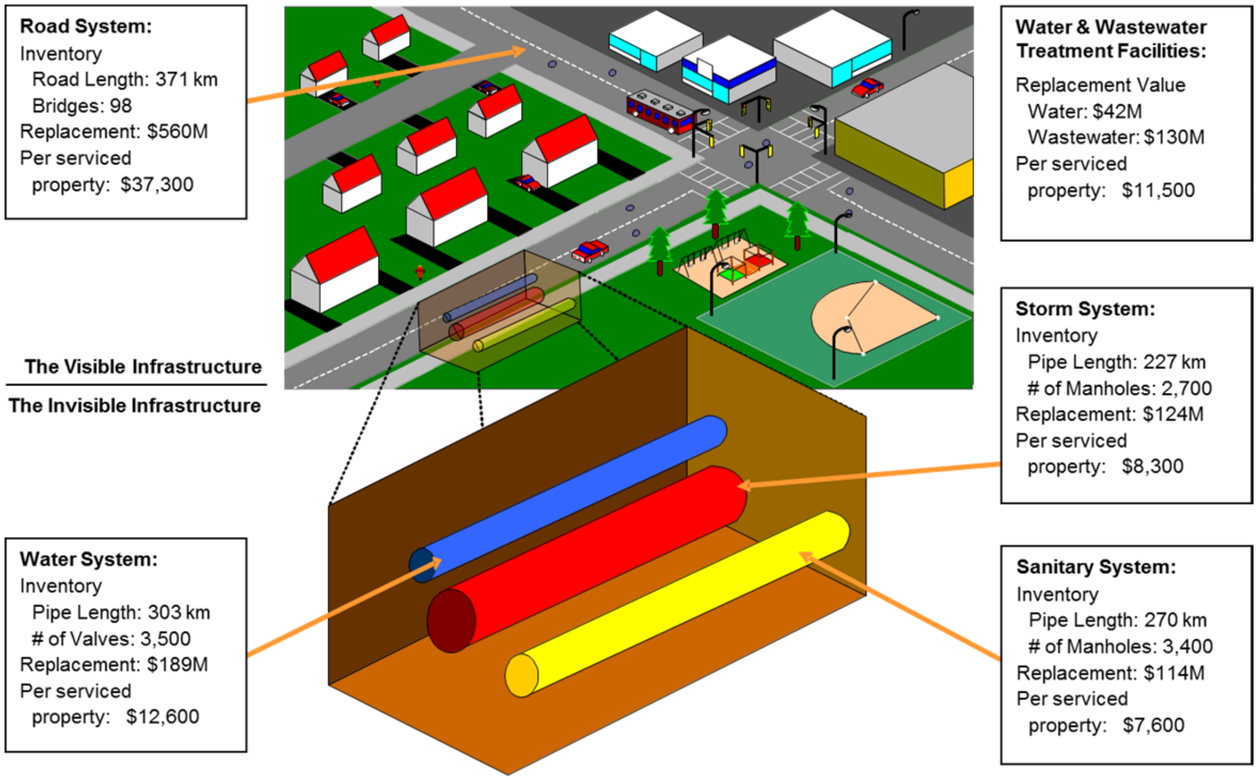


Figure ES.1: Asset Replacement Value per Serviced Property

The total value of the City's infrastructure assets is **$1.2 billion**. The current state of the local infrastructure as a rating for 2008 and 2012 as well as the trend for 2027, is shown in Table ES.2.

Table ES.2: Infrastructure Report Card

Asset Type	Rating 2008 SotI	Rating 2012	Trend 2027
Sanitary Network	C+	C	↓
Stormwater Network	Not included	C	↓
Water Network	B-	C+	↓
Treatment Facilities	Not included	B	↓
Road and Bridge Network	C	B-	↓

Given the current state of the infrastructure, the City must maintain or improve on these assets to provide sufficient levels of service to the residents and businesses within the City. This Asset Management Plan plays an important role in defining the future management of this infrastructure.

Within the Asset Management Plan, consideration is given to the various work activities that will be applied to the assets during their life cycle. The various stages in an asset's life cycle can be split into four distinct phases of activity. These activities are described in Table ES.3.

Table ES.3: Phases of Maintenance and Rehabilitation Activities

Activity	Definition	Asset Age
Minor Maintenance	Planned activities such as monitoring, cleaning and lubricating, visual inspections, etc.	0-25% of asset life
Major Maintenance	Maintenance and repair activities are generally unplanned; however, they can be anticipated and would generally be accounted for with the City's annual operating budget.	25-100% of asset life
Rehabilitation	Major activity required to upgrade or rehabilitate the asset so that it can continue to provide service for an additional time period.	50-75% of asset life
Replacement	Some assets will reach the end of their structural and/or service useful life and require replacement. Experience in other communities has shown that the expected life of an asset will vary greatly, depending upon growth and a variety of mechanical, structural and environmental factors.	75-100% of asset life

The assets owned and operated by the City facilitate the delivery of various services to the community. These include clean water, wastewater removal and treatment and safe dependable transportation networks. Future discussions on the City infrastructure assets should focus on the services provided to the community and not just the hard assets.

The Asset Management Plan discusses the setting of Levels of Service (LOS). Clearly defined LOS help to facilitate discussion between staff, Council, and the community with respect to the expectations for services. The City must develop LOS for each asset, on the basis of a number of criteria: regulatory requirements, good management requirements, health and safety, risk management, cost, and service recipient expectations to name a few. Council approval is recommended for LOS; these need to be rationalized, and become the benchmark against which current operations are measured.

The City only anticipates the decommissioning of a few assets, such as bridges, that are at the end of their service life and where their function can be provided elsewhere at a better value. Modest growth is expected for the future, and to accommodate this growth, expansion activities are reflected in the City's Official Plan and are subject to Environmental Assessment studies; these studies evaluate the necessity for the expansion of the asset portfolio and assess overall impact on the community's environment.

It is important to note that the addition of new assets to the infrastructure portfolio comes at a cost in future years as the assets move through their life cycle and require more expensive treatments including rehabilitation and replacement. The investment requirements shown within this Asset Management Plan do not address the future asset funding needs associated with the projected growth.

The 10-year estimate of the sustainable revenues and capital budget and funding sources were used to calculate the average annual deficit or surplus for the years 2014-2023. The projected and sustainable revenues for the City, along with the overall deficit or surplus are shown in Table ES.4.

Table ES.4: Sustainable Revenue (Millions)

Program	2014-2023 Projected Revenue (average annual, in millions)		Projected Sustainable Revenue (average annual, in millions)[1]		Overall Surplus/(Deficit), in millions
	O & M	Capital	O & M	Capital[2]	
Sanitary Sewer	$2.20	$2.4	$3.19	$4.10	($2.69)
Storm Sewer	$0.68	$0.65	$2.16	$3.50	($4.33)
Water	$5.90	$4.7	$3.19	$6.20	$1.21
Treatment Facilities	$4.30	$1.3	$2.58	$4.60	($1.58)
Roads and Bridges	$5.90	$12.6	$7.93	$25.90	($15.33)
TOTAL	**$18.98**	**$21.65**	**$19.05**	**$44.30**	**($22.72)**

[1] 2012 State of the Infrastructure sustainable revenues to give 2014 dollars
[2] Capital sustainable revenue requirements inflated at 4.5%/annum based on 10-year average of Statistics Canada Non-residential Building Construction Index

The 10-year capital investment and sustainable funding required is shown in Figure ES.2.

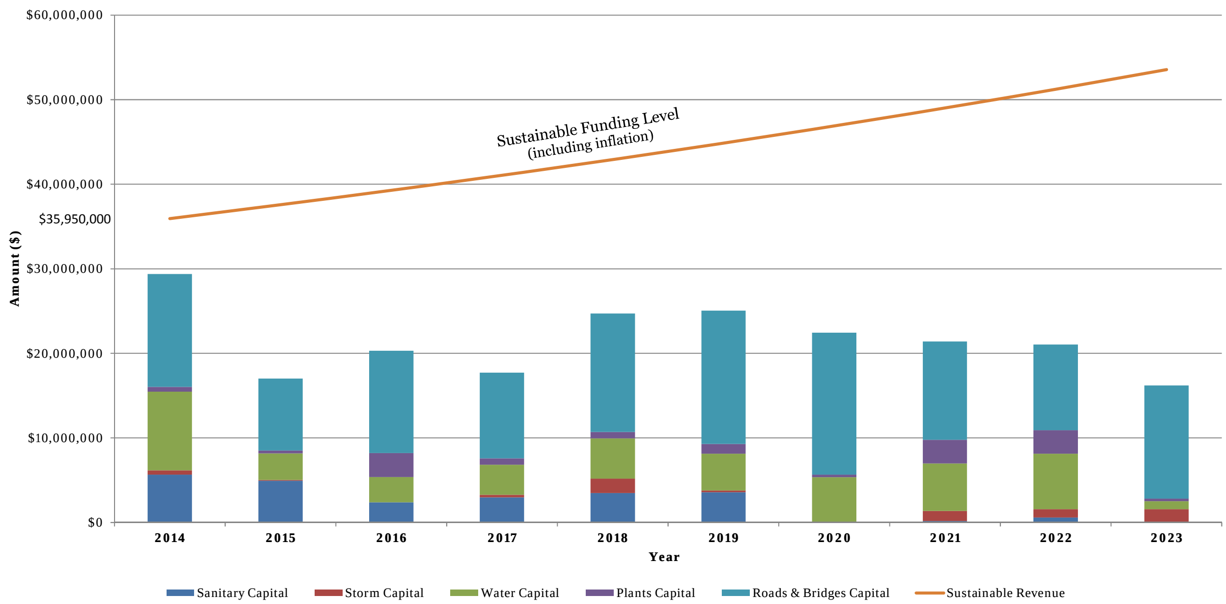


Figure ES.2: 10-Year Capital Investment and Sustainable Revenue Requirements

The City like many other municipalities traditionally followed a pay-as-you-go financing approach, which meant that there was hesitation to assume debt as part of an overall financing strategy. Additionally, over a period of time, most notably in the 1990's, public pressures resulted in many years of lower than inflation increases in rates and taxes that lead to increasing deficits in capital renewal and operating programs. Much of the City's infrastructure is buried and unnoticeable such as the water mains, stormwater sewers, sanitary sewers, etc.; these assets which have a service life of more than 50 years continued to perform without obvious defects.

Following the City's 2008 State of the Infrastructure Report that identified a significant backlog in capital renewal and operating deficits, the City's financing strategy was considerably reformed with Council's adoption of the Long Term Capital Funding Policy. This policy instituted a plan to slowly increase the pay-as-you-go component as well as the City's debt levels to move towards a balanced sustainable funding model. The inclusion of borrowing as a component of the increase in funding lessens the burden on the City's taxpayer, specifically, the increase in funding is not derived entirely from increasing taxes.

The Asset Management Plan strengthens the link between the funding plan and the infrastructure needs and becomes a strong foundation for the integration of the tools identified in the City's "Financial Planning Policies – A Long-term Perspective" document. The funding plan and its gradual increase in funding is the key to addressing the funding gap (i.e. the shortfall between current funding and sustainable funding), which is evident in Table ES.4 and on Figure ES.2.

At this time support of infrastructure is being provided through the annual Federal Gas Tax Fund and is being directed towards roads reconstruction and rehabilitation projects in which the City applies by a strategic approach. This approach coordinates reconstruction and rehabilitation efforts for all services (water stormwater and wastewater) that require renewal in the same area. In this sense, the Federal Gas Tax Funding is contributing to all areas of backlog beyond current taxation and rate revenues.

Therefore, this will increase the pressure on Council to stay the course with respect to achieving sustainability in the funding of maintenance and renewal of the core infrastructure covered by this Asset Management Plan.

Abbreviations

AMP	Asset Management Plan
AWWA	American Water Works Association
BCI	Bridge Condition Index
CCTV	Closed Circuit Television
CP	Cathodic Protection
GIS	Geographic Information System
HVAC	Heating, Ventilation and Air Conditioning
LCCA	Life-cycle Cost Analysis
LOS	Level of Service
MCC	Motor Control Centre
ML	Million litres
PAYGO	Pay As You Go
PQI	Pavement Quality Index
PSAB	Public Sector Accounting Board
RCI	Ride Comfort Index
RSL	Remaining Service Life
SAI	Structural Adequacy Index
SCADA	Supervisory Control and Data Acquisition
SDI	Surface Distress Index
SotIR	State of the Infrastructure Report
VFD	Variable Frequency Drive

Glossary

AutoCAD	computerized system for creating engineering drawings
GIS	computerized mapping system which is used to track infrastructure and building assets
Hansen	computerized asset management system used by the City to manage asset data and monitor work activities associated with managing the infrastructure assets
Level of Service	Defines the expected quality of service delivered by an activity (i.e. time taken to repair a pothole)
Life Cycle	the period during which an asset will be used by the City from construction through to replacement
Life Cycle Costs Analysis	an assessment of all costs associated with the construction, maintenance and replacement of assets throughout their life cycle
Pay As You Go	describes a financial strategy which emphasizes the use of available funds to pay for asset operation, maintenance, rehabilitation and replacement
Performance Objective	A statement on how the City wants to manage the asset portfolios
Performance Target	a measure that can be used to compare the performance of an asset over time
WaterCAD	computerized modeling system used by the City to model the performance of the water network

Preface

The scope and format of this document follows the Ministry of Infrastructure's Building Together: Guide for Municipal Asset Management Plans. The Guide outlines the specific elements of a detailed asset management plan, which includes:

1. Executive Summary
2. Introduction
3. State of Local Infrastructure
4. Desired Levels of Service
5. Asset Management Strategy
6. Financing Strategy

The City has developed the Asset Management Plan following the Ministry's guidelines and suggested format for roads, bridges, and water and wastewater systems. The City is not responsible for social housing, an asset group to be included, if applicable, as per the Ministry's guide.

1.0 Introduction

Municipalities are stewards of its community's infrastructure. Well-managed infrastructure fosters prosperity, growth, and quality of life for a community's residents, businesses, and visitors.

Most Canadian municipalities are struggling to maintain existing infrastructure under current tax and rate levels. They continue to deal with downloaded responsibilities and, at the same time, face growing needs to maintain and renew aging and decaying infrastructure.

The subject of asset management has been gaining increasing public awareness as a result of the introduction of Bill 175, the Sustainable Water and Sewage Systems Act in 2002, and the implementation of "Full Cost Accounting" through the Public Sector Accounting Board (PSAB). The emphasis is now being placed on not only knowing the true cost of providing services to your customers today, but also understanding what will be required to maintain the services in perpetuity (or as long as they are required), through the use of life cycle costing. In other words, we are moving towards a Sustainable Asset Management System.

Ontario's Ministry of Infrastructure has also recently released guidelines for the development of Municipal Asset Management Plans, which supports the Province's 10-year infrastructure plan "Building Together". This document follows the Ministry's guidelines for the development of an Asset Management Plan for the City of North Bay's infrastructure. The objective of these guidelines is to provide a basis for the standardization and consistency of asset management practices across Ontario's municipalities. The Asset Management Plan (AMP) is intended to provide a link between the City's Vision and Mission Statement, which are in the City's Corporate Business Plan.

The Guide for Municipal Asset Management Plans, published by the Ministry of Infrastructure in Ontario, defines core services as water, sewer, drainage, and road networks, which are used to provide safe drinking water, sewage removal, and basic transportation services to the citizens in the City of North Bay.

As identified in the city's Official Plan and Corporate Business Plan the viability of the City is highly dependent on the infrastructure and how it supports economic activity and improves the quality of life for its citizens. These assets are essential for the City to "deliver quality municipal services to residents, business, and community partners by enhancing the physical, leisure, economic, and environmental quality of life for the community and region that is affordable, sustainable, and relevant".

Table 1.1 includes excerpts from the City's plans and describes how they align with the Asset Management Plan (AMP).

Table 1.1: City of North Bay Mission Statement and Values

Mission Statement	Alignment
To deliver quality municipal services to residents, business and community partners by enhancing the physical, leisure, economic and environmental quality of life for the community and region that is affordable, sustainable, and relevant.	The AMP will assist staff and council in identifying and planning for the future challenges associated with the management of the City's infrastructure assets.
City of North Bay Values	
Stewardship, Wise Management of Resources	The AMP will provide a document that can be presented to the community to outline the plan for addressing the future needs associated with maintaining the City's infrastructure assets.
Fiscal Plan, Infrastructure Investment, and Asset/Resource Management	The AMP provides the community with an overview of the plan to address the future rehabilitation and replacement requirements and sustainable funding levels of the infrastructure assets. Accountability & responsibility comes from ongoing reporting of the status of the activities outlined in the AMP.
Effective Communication, Customer Focused, Compliant with Legislation, Policies, Procedure, and By-Laws	Developing and implementing the AMP shows the community that staff and council are talking a professional approach to managing the infrastructure.

This Asset Management Plan was prepared by Stantec Consulting in collaboration with City staff and builds upon the extensive work that has already been completed in the development of the State of the Infrastructure Reports in 2008 and 2012. As with the State of the Infrastructure Reports, the analysis for all of the assets, with the exception of the roads and bridges, relied upon a high level assessment of asset life expectancy and date of construction. Therefore, as more detailed information becomes available through condition assessment and tracking of maintenance activities a better understanding of the performance of these assets can be developed. As a result the Asset Management Plan can be further refined to reflect the actual condition and performance of the assets.

The Asset Management Plan is a living document which will require regular review and updates as more data becomes available and the levels of service required by the community are defined through public consultation. It is anticipated that the document will be reviewed by staff annually and adjusted accordingly to ensure that it reflects the current priorities of Council and the community; the asset management plan will be updated on a five-year cycle to incorporate all adjustments identified within the annual reviews. All updates will be published to the City's website.

Through the implementation of the Official Plan, it is the goal of Council and the community to grow and develop North Bay in a sustainable manner. The term "sustainability" means that the community will continue to work towards maintaining and enhancing its attributes and improve conditions that lead to a better quality of life for future generations. The three elements of sustainable development (economic, social/cultural and environment) are considered in an integrated manner by Council in order to make planning decisions.

The Official Plan concludes that the City of North Bay is well positioned to experience steady residential and non-residential growth over the medium- and long-term forecast period. Over the 22-year forecast period covered by the Official Plan, the City's total number of households is forecasted to increase from 22,962 in 2009 to 26,081 in 2031, a total increase of approximately 3,119 units. It should be noted that approximately 15,000 of the current households are serviced.

This growth will add new assets to the City's infrastructure portfolios which will increase the challenges of funding the maintenance and replacement of the assets in the future. Therefore, it is essential that the City recognizes that the funding challenges outlined in this Asset Management Plan only deal with the existing assets and do not account for the asset associated with this projected growth.

1.1 THE ASSET MANAGEMENT PLAN

This Asset Management Plan is intended to provide a linkage or "line of sight" between the City's mission and values, and builds upon the previously completed State of the Infrastructure Reports and Asset Framework studies, to provide the City with a medium-term business plan for ensuring long-term sustainability of the City's infrastructure.

The State of the Infrastructure Reports were developed at a high level using a 100 year time horizon in order to capture the full lifecycle of the assets. This long-term data was used in the Asset Management Plan, but in the medium-term, the plan generally focuses on the 10 years in the 2014 capital budget.

The Asset Management Plan will form the basis of a communication document which defines a clearer path as to how the management of the City's assets contributes to the physical, leisure, economic, and environmental quality of life for the community that is affordable, sustainable, and relevant.

A structured approach is used to identify the levels of service (LOS) required by the community and the level of investment to maintain the City's assets.

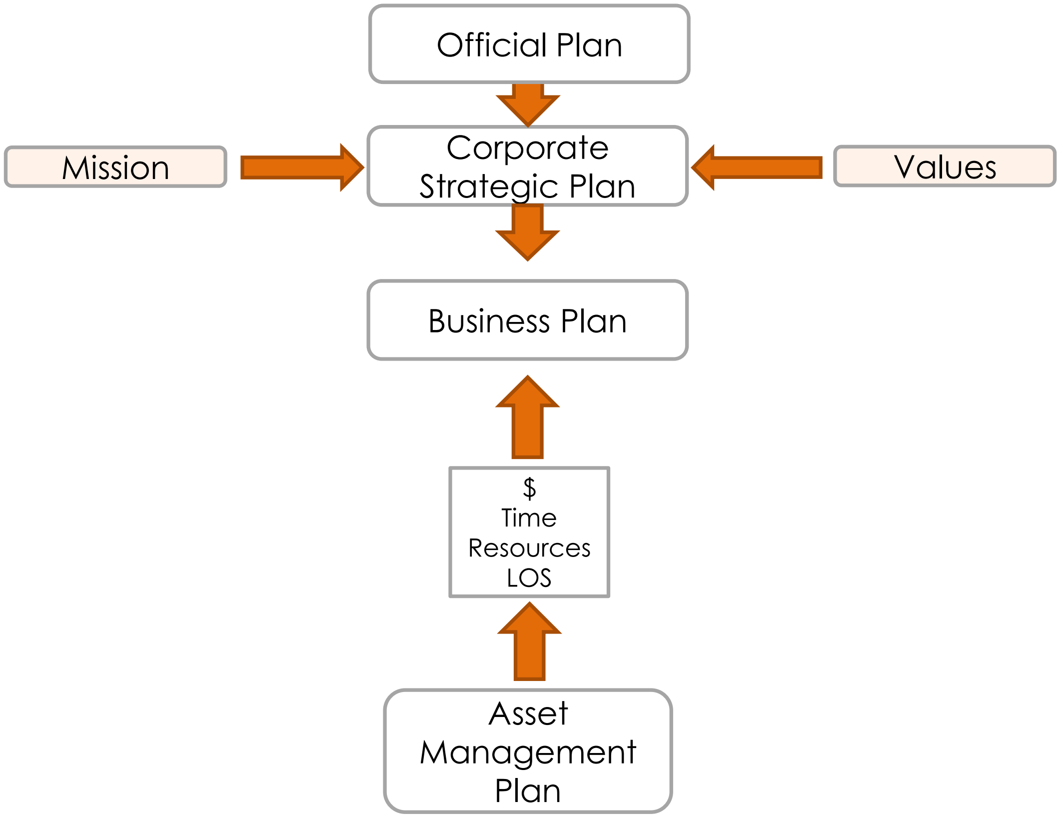


Figure 1.1: Asset Management Plan Relationship to Strategic Plans

1.2 LEVELS OF SERVICE WITHIN THE ASSET MANAGEMENT PLAN

Levels of Service for the City's assets are a combination of the community's expectations and the City's required and desired maintenance and performance targets to meet legislative requirements and industry best practices. At this time the City meets the legislated or technical levels of service which govern the service offered by the assets included in this Asset Management Plan.

Prior to completing future iterations of this Asset Management Plan, the City will seek Community input to assist in further refining its service level targets. Under consideration will be:

- Determine a desired condition Index for each of the assets
- Determine a maximum desired backlog of work
- Determine funding and service goals for maintenance versus rehabilitation/replacement
- Community focused expectations and targets

2.0 State of Local Infrastructure

To mitigate the problem of the backlog of repair and maintenance of the City's infrastructure, which is similar to the backlog faced by the majority of municipalities in North America, an Asset Management Plan has been developed.

The first step is to determine the City's State of the Infrastructure; the 2008 and 2012 State of the Infrastructure Reports (SotIR) have provided the City with an understanding of the true cost of maintaining the infrastructure that is required to provide the services to the community.

The SotIRs were based on a high-level life cycle analysis of the replacement, rehabilitation, and maintenance needs of the City's Public Works assets that included the City' sanitary and storm sewers, road and bridge network, and water network. This included the preparation of a report on the current and assumed future state of these assets. In addition, a Report Card was produced that evaluates the current state of various Public Works assets within the City, and predicts their status in 2027, should the current management approach be maintained.

2.1 INFRASTRUCTURE INVENTORY

The following sections are descriptions of the various assets in the City's infrastructure, as defined in the Guide for Municipal Asset Management Plans. The assets, shown in Figure 2.1, include:

- Water and Wastewater Treatment Facilities;
- Sanitary and Stormwater System;
- Water Network; and
- Road and Bridge Network.

The sources for inventory data include as-constructed and AutoCAD drawings, GIS, Hansen, historical staff knowledge, and WaterCAD.

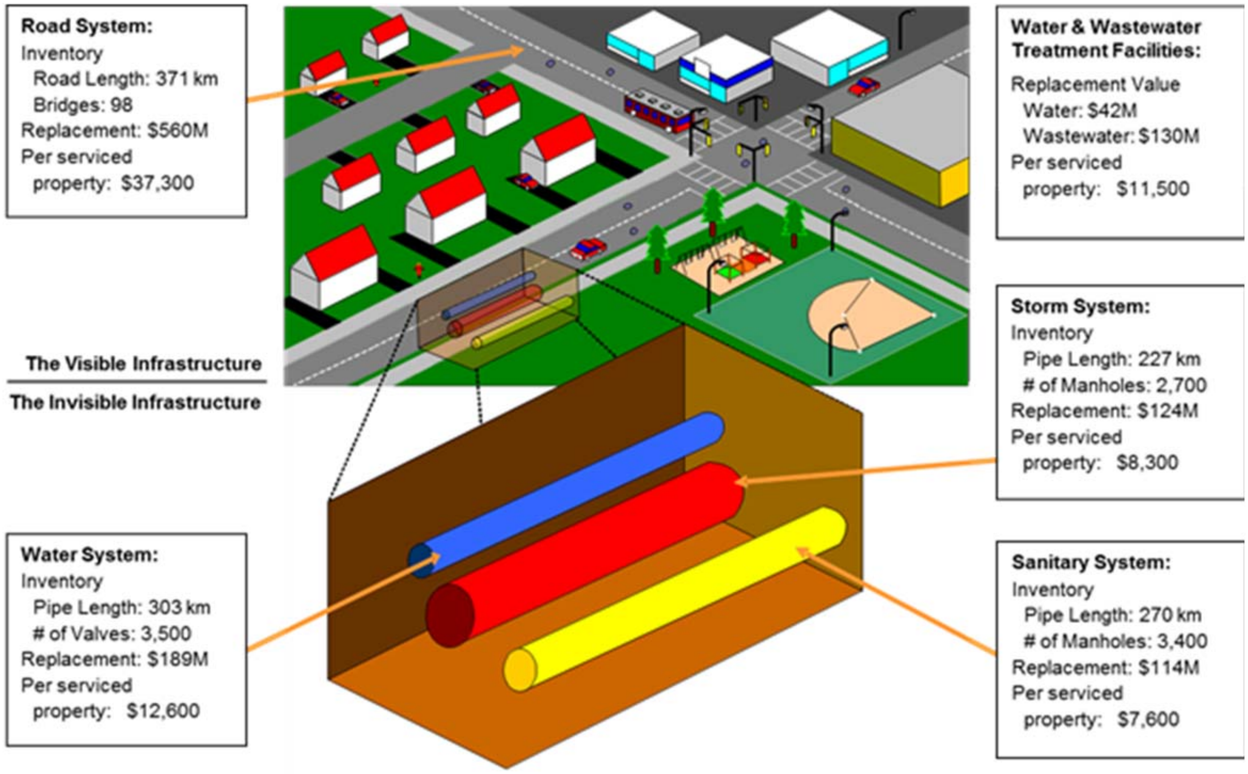


Figure 2.1: Asset Replacement Value per Serviced Property

2.1.1 Water Treatment Facilities

The City currently owns and operates two treatment facilities. The Wastewater Treatment Facility is located on Memorial Drive, and is used to treat all of North Bay's Wastewater/Sewage. The original Wastewater Treatment Facility was built in 1962 and was expanded in 1973 and 1984. The Facility is a conventional activated sludge facility, which uses the following treatment processes: raw sewage pumping, sewage grinding and screening, grit removal, primary settling, aeration, final settling, chemical phosphorus removal, and chlorination for effluent disinfection.

The construction of North Bay's Water Treatment Facility began in April 2006, and the Facility became operational February 17, 2010. The Facility operates using a multi-barrier approach to meet its treatment goals.

The primary barrier in this Facility is a microfiltration system, which is made up of 11 parallel membrane racks, each equipped with dozens of pressure vessels that house thousands of hollow-fibre membranes. These membranes provide an effective barrier to physically separate the various contaminants in the City's drinking water.

The secondary treatment barrier is the UV disinfection system, which inactivates any organisms that are present in the water, using high intensity light. The water is then injected with chlorine, to kill off any viruses and bacteria that are able to bypass the previous systems. The raw water for the Facility is drawn from an intake pipe that extends 300 metres off the shore, into Trout Lake. An average of 42 million litres (ML) of water run through the facility every day.

These treatment facilities consist of a group of components, including building structures, pipes, valves, pumps, Supervisory Control and Data Acquisition (SCADA) systems, and so forth. The State of the Infrastructure analysis of these components was based upon existing inventories.

Table 2.1 on the next page summarizes these inventories.

Table 2.1: Water and Wastewater Facility Components

Asset Component	What's Included	
Sanitary System	• Excavation and concrete • Structural Steel • Tanks	• Tunnels (Walkway passages) • Structural Walls
Building Shell & Interior	• Doors • Roof • Windows • Floor • Interior Walls • Brick, exterior wall finishes (siding, aluminum, etc.)	• Lights • Ceiling • Non-structural steel • Masonry walls • Sheds • Health & Safety Equipment (ladders, railings, etc.)
Building Services & Equipment	• HVAC • Plumbing Potable • Plumbing Waste • Electrical services/lighting	• Sprinklers - fire protection • Health and safety Equipment (fire protection, eye wash stations, etc.) • Yard service piping (water mains/sanitary/storm sewers)
Siteworks	• Other utilities (gas, etc.) • Roads (including related excavation) • Parking lots	• Sidewalks • Grading/landscaping • Health and safety Equipment (railings, steps, wheelchair ramps, etc.)
Piping	• Piping for all processes • Inside Piping • Outside Piping	• Specialty Piping • Chemical Piping • Intakes/outfalls
Mechanical	• Ozone • Conveyor • Automatic Transfer Switches • Cranes • Pumps • Filters • Screens	• Mixers • Gates • Valves • Disinfection equipment • Flights and chains • Motors • Diesel Generators • Actuators
Electrical	• Starters • Stand-alone motors	• MCCs • VFDs
Instrumentation & Supervisory Control And Data Acquisition (SCADA)	• Switches • Monitors • Detectors	• Health & Safety Equipment (Fire/gas alarms, etc.)

The current replacement value of these facilities is identified as $172 million and is divided between the assets as follows:

- Water - $42 million
- Wastewater – $130 million

2.1.2 Sanitary and Stormwater System

The City's Sanitary and Stormwater network consists of a group of components, including manholes, forcemains, pumping stations, culverts, stormwater management ponds, and so forth, which are summarized in Table 2.2.

Table 2.2: Sanitary and Stormwater Network Inventory Summary

Asset Type	Asset Component	Inventory	Typical Useful Life (years)	Total Replacement Value (millions)
Sanitary System	Gravity, Siphon, and Forcemain Pipes	270 km	70	$59
	Sanitary Manholes	3,378	90	$17
	Sanitary Services	15,000	60	$30
	Pumping Station Structures	21	70	$6
	Pumping Station Equipment	21	20	$2
Stormwater System	Pipes	227 km	90	$68
	Manholes	2,710	50	$16
	Catchbasins	4,184	40	$9.20
	Storm Inlet	34	75	$0.03
	Storm Outlet	44	75	$0.40
	Pumping Stations - Mechanical	1	20	$0.09
	Pumping Stations - Structural	1	50	$0.26
	Service Lines to Property Line	15,000	90	$30
	Stormceptors	5	50	$0.01
	Culverts	210	25	$0.03
	Stormwater Management Ponds	5	5	$1.00

2.1.3 Water Network

The City's water network consists of a group of components, including pipes, valves, hydrants, storage reservoirs, and so forth, which are summarized in Table 2.3.

Table 2.3: Water Network Inventory Summary

Asset Type	Asset Component	Inventory	Typical Useful Life (years)	Total Replacement Value (millions)
Water Network	Pipes	303 km	70	$142
	Valves	3,502	70	$5.30
	Hydrants	1,401	50	$5.70
	Chambers	128	50	$0.70
	Service Connections	15,000	60	$27.00
	Storage Reservoirs – Equipment	4	20	$1.40
	Storage Reservoirs – Structure		70	
	Booster Stations – Equipment	18	20	$6.50
	Booster Stations – Structure		70	

2.1.4 Road and Bridge Network

The City's road and bridge network consists of a group of components, including road sections, curbs, signs, bridges, culverts, and so forth, which is summarized in Table 2.4.

Table 2.4: Road and Bridge Network Inventory Summary

Asset Type	Asset Component	Inventory	Typical Useful Life (years)	Total Replacement Value (millions)
Road Network	Road Sections Local Rural Collector Major Arterial	371 km (777 ln-km) 217 km (433 ln-km) 78 km (155 ln-km) 27 km (55 ln-km) 52 km (132 ln-km)	12 - 20	$355.00
	Sidewalk	199 km	35	$14.00
	Curb	199 km	50	$16.00
	Signs	25,850	10	$3.90
	Street Lighting	5,170	35	$25.80
	Walkways	1 km	25	$0.10
	Retaining Wall	100	75	$0.10
	Signals	46	15	$11.50
	Pavement Marking	386 km	1	$1.90
	Bridges (includes Culverts >1.5m diameter)	98	60	$82.00
	Level RR Crossings	20	15	$1.90
	Shoulders	281 km	50	$2.80
	Ditches	470 km	25	$7.00
	Guard Rails	7.8 km (assumed)	30	$0.40
	Driveway Culverts	18,600	30	$37.20

2.2 INFRASTRUCTURE REPORT CARD

The SotIR provided an assessment of the current conditions of the City's infrastructure assets and presented the condition in the form of an Infrastructure Report Card, which is shown in Table 2.5.

Table 2.5: Infrastructure Report Card

Infrastructure Report Card				
Asset Group	Rating 2008	Rating 2012	Comments	Trend 2027
Treatment Facilities	Not included	B	The City's water treatment facility was commissioned in 2011 and is projected to meet the needs of the community until 2031 and possibly beyond. It is important to note that although this asset group is new and the current investment needs for maintenance and rehabilitation will be relatively low the City must ensure that there are sufficient reserves available to fund the increasing needs as the assets age. Many components with the wastewater treatment facility are reaching the end of their useful lives and as a result require a significant increase in the investment in rehabilitation in the next 5 – 10 years. The 10-year capital budget shows that the investment in the facility will be increased from 2016 onwards to meet some of these demands. Funding of the treatment facilities is currently estimated to be $2.4 million per annum below the level required for sustainability.	↓
Sanitary System	C+	C	A recent high-level condition assessment indicates that the sanitary system is in relatively good condition; however, a more detailed assessment of the pipe network will be required to gauge the true condition of the network. The 2012 O & M and Capital budgets for the sanitary sewer network appear to be at a level that is consistent with the long-term sustainability of the network. However, a review of the 10-year capital budget shows that the funding available for the rehabilitation of the sanitary sewer network will be reduced significantly from 2015 onwards, to compensate for increased expenditures at the wastewater treatment facility. The average 10-year annual investment will be approximately 30% of the 2012 investment level.	↓
Stormwater System	Not included	C	A recent high-level condition assessment indicates that the stormwater system is in relatively good condition; however, a more detailed assessment of the pipe network will be required to gauge the true condition of the network. Funding of the storm sewer network is currently estimated to be $3.4 million per annum below the level required for sustainability.	↓
Water Network	B-	C+	The challenges for the water network is that much of the network is constructed with cast and ductile iron pipe. Pipes are being replaced as required to meet the demands of development, and in conjunction with road reconstruction. Funding of the water network appears to be adequate at present; however, a review of the 10-year capital budget shows that there is a significant investment being made in expansion and growth related projects over the next 10 years, which will not contribute to sustaining the existing infrastructure. It is anticipated that additional funding will also be required to maintain and rehabilitate the reservoirs and standpipes.	↓
Road and Bridge Network	C	B-	Since the initial 2008 SotI analysis, the road system has seen increases in funding and, as a result, the network condition has generally been showing signs of improvement. Some of these additional funds resulted from Provincial grants and cannot be guaranteed in future years, therefore, the City must continue to strive to develop funding sources that are sustainable. Through the use of pavement management philosophies, the investment needs for the road network will be optimized to ensure that the available funding is targeted towards projects that provide the greatest return on investment. Funding of the road network is currently estimated to be $7.7 million per annum below the level required for sustainability.	↓

The Infrastructure Report Card provides valuable insight into condition of the City's infrastructure assets. In general it can be seen that these assets are deteriorating and the trend for the future will continue to downwards unless the City is proactive in addressing the gap between existing funding levels and the sustainable funding needs identified within the State of the Infrastructure Reports.

2.3 REPLACEMENT VALUE AND VALUATION

The SotIR indicated that the City's Public Works assets have a replacement value of **$1.2 billion**. The breakdown of those replacement values per serviced property, based on approximately 15,000 serviced properties in the City, is illustrated in Figure 2.1.

The relative distribution of the assets included in this AMP can be seen in Figure 2.2 (all values in millions of dollars).

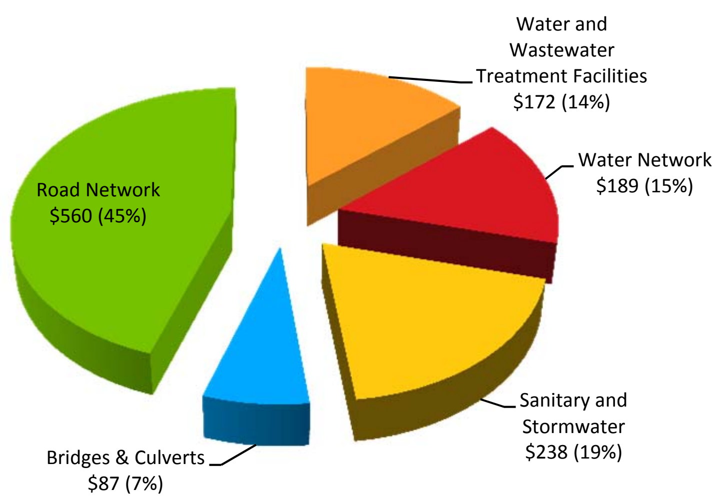


Figure 2.2: Asset Replacement Value Distribution ($ millions)

As can be seen from Figure 2.2 the City's roads and bridges account for over one-half of the total asset portfolio. The roads are exposed to more stresses that contribute to accelerated deterioration including winter freeze-thaw cycles and increased traffic loading, therefore, typically have lower life expectancies that the other assets. As a result the investment needs for rehabilitation and replacement occur on a more frequent cycle.

Based upon the City's 2012 Financial Information Return (FIR) filed with the Ministry of Municipal Affairs the Net Book Value of the City's infrastructure at the end of 2012 was **$333.2 million**, which is summarized in Table 2.6 below along with the estimated current replacement value of the infrastructure network. For each of the approximately 15,000 serviced properties, the total asset replacement value of **$1.2 billion** translates to each serviced property being responsible for approximately **$77,200** for the City's assets.

Table 2.6: FIR Schedule of Tangible Capital Assets (Schedule 51) and Replacement Costs

Asset Type	Asset Component	2012 Net Book Value ($)	Asset Replacement Cost ($)
Sewer Systems	Wastewater collection/conveyance	$39,301,440	$239,020,000
	Urban storm sewer system	$47,179,466	
		$86,480,906	
Water Network	Water distribution/transmission	**$46,420,328**	**$188,600,000**
Facilities	Wastewater Treatment and Disposal	$8,573,545	**$172,000,000**
	Water Treatment Facility	$39,491,073	
		$48,064,618	
Bridges	Bridges and Culverts	**$24,447,904**	**$119,200,000**
Roads	Paved	$124,720,597	**$ 440,400,000**
	Unpaved	$1,984,552	
	Traffic Operations & Roadside	$653,850	
	Street lighting	$414,873	
		$127,773,872	
	Total	**$333,187,628**	**$1,159,220,000**

Table 2.6 illustrates the contrast between the accounting valuation or depreciated value and current replacement value of the City's infrastructure assets. The Net Book value shows the current value of these assets and is reported on the City's financial statements or Financial Information Returns to the Ministry of Municipal Affairs and Housing. However, in contrast the replacement value provides an indication of the level of investment required today for the City to replace the asset portfolio based on current construction costs. For the purposes of asset management the replacement valuation is more relevant when making long-term decisions on the financial needs associated with the management of the City's infrastructure.

2.4 AGE AND REMAINING SERVICE LIFE

A useful life span can be assigned to each asset type, such as 75 years of useful life for the sewer network; however, there are many conditions that can affect the true life of an asset, such as: design, construction, and manufacture quality, maintenance standards, and quantity of use, surrounding environment, construction material, and so forth. The expected useful lives used in the development of the State of the Infrastructure Report (SotIR) are shown within Section 2.1 of this document.

For the purposes of the SotI analysis, a failure distribution model was utilized to provide a more realistic representation of the actual asset replacement quantities than would be achieved if the analysis only assumed a fixed time of failure for all assets. This failure distribution model can be seen in Appendix B

At a high level, age is a key component of the analysis required to estimate the timing of the major interventions such as replacement.

It should be noted that the analysis conducted on the water and sewer networks was based upon assumed date of construction and associated life expectancies, therefore, the replacement profiles will be similar. As the data on construction dates and condition of these assets become available these replacement analyses will be updated to include the actual condition of these assets.

2.4.1 Sanitary and Stormwater Systems

As can be seen from Figure 2.3 approximately 55% of the sanitary and stormwater system is approaching the end of its design life. This aggregated value masks the fact that within the sanitary sewer network approximately 77% of the pipes are estimated to be at or nearing the end of their useful life.

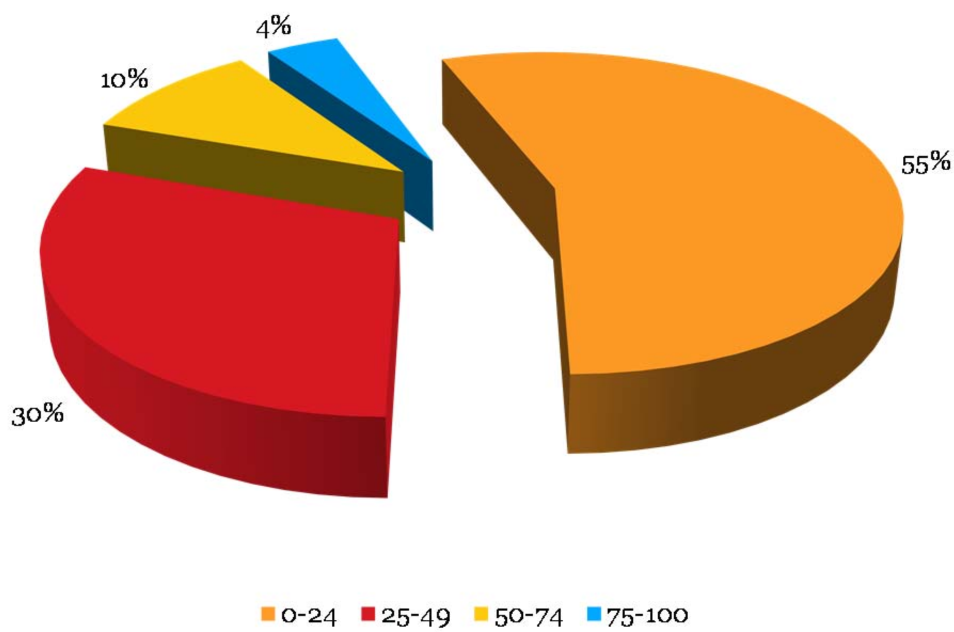


Figure 2.3: Sanitary and Stormwater Systems Estimated Remaining Service Life (years)

Given this high level assessment and the fact the over the next 15 years the City would not be able to replace all of the sewers that are potentially reaching the end of their useful life, the City will continue to assess the sanitary and stormwater system with inspections and will develop a strategic plan to address deterioration, prioritization and servicing needs. More detailed inspections will be targeted on assets with higher risk potential based on the consequences of failure and probability of failure such as pipes where the age of the asset is high and its location might suggest that it will cause significant disruption if it were to fail.

2.4.2 Water Network

Similar to the sanitary sewer network, the water network is also estimated to have approximately 76% of the pipes approaching the end of their design life, as can be seen from Figure 2.4. Therefore, over the next 10 -15 years, the City will need to assess the overall condition of the water network in more detail, to determine the level of effort and associated funding required to meet the rehabilitation and replacement needs.

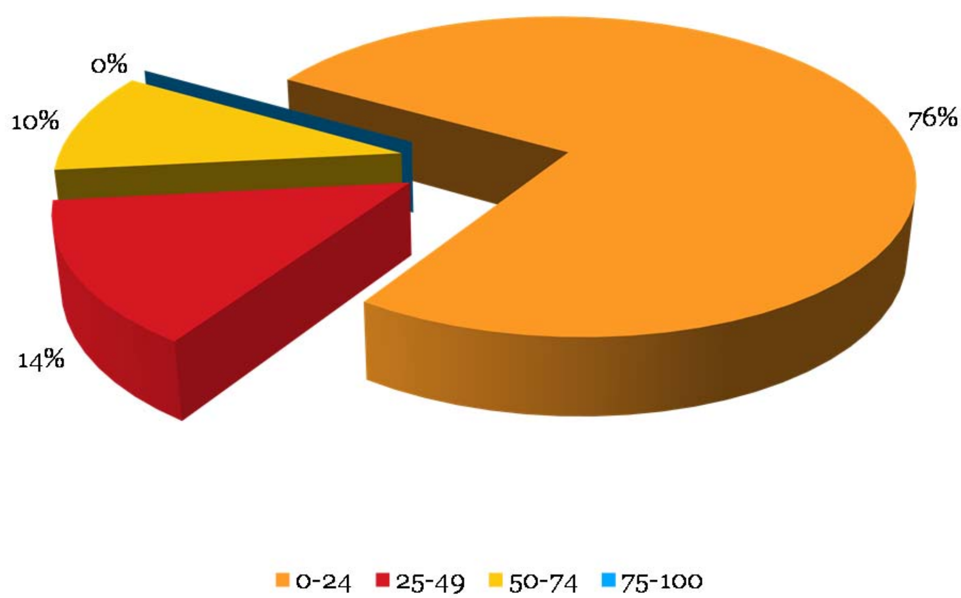


Figure 2.4: Water Network Estimated Remaining Service Life (years)

2.4.3 Bridges

This group of assets includes bridges and culverts which are greater than 1.5 metres in diameter. The useful life for this group of assets can be assigned as 75 and 50 years, respectively. However, there are many conditions that can affect the true life of an asset, such as: design, construction, and manufacture quality, maintenance standards, quantity of use, surrounding environment, construction material, and so forth. Figure 2.5 indicates the Remaining Service Life distribution of the City's bridges and culverts.

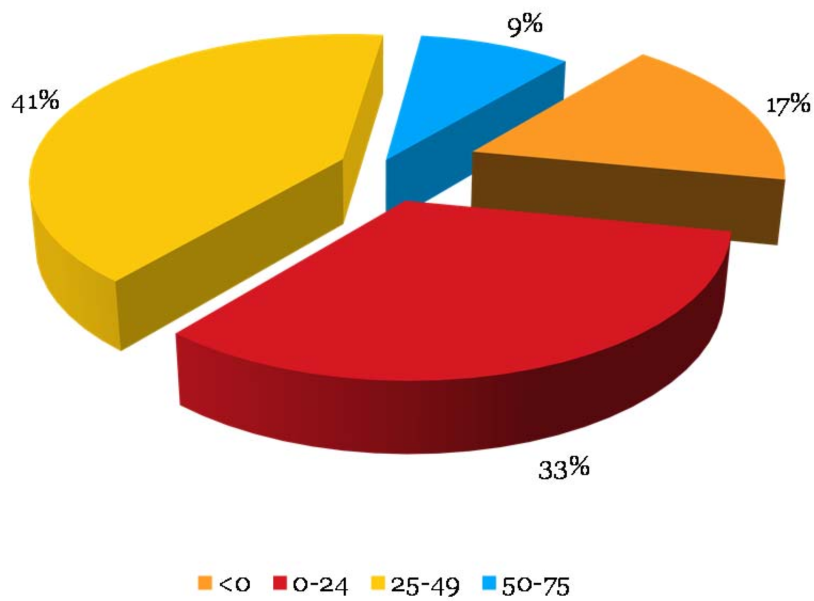


Figure 2.5: Bridges Estimated Remaining Service Life (years)

As can be seen from Figure 2.5, approximately 50% of the City's bridges and large culverts are either beyond their expected service life, or are have less than 25 years of remaining service life. Regular inspections of all bridges and culverts are mandated by the Province. The City is taking a proactive approach to managing its assets by hiring a consultant to undertake the required inspections; each structure is being inspected on a two year cycle as required by the province. The result of the inspections is a condition assessment of every structure, recommended repair/rehabilitation/replacement treatments and estimated cost, as well as a suggested priority.

2.4.4 Road Network

The City utilizes a pavement management system (RoadMatrix) to calculate pavement age and remaining service life for each pavement segment within the City's entire pavement network. Figure 2.6 indicates that the road network is currently at a point where approximately 40% (310 lane-km) of the network will require some form of rehabilitation intervention within the next ten years.

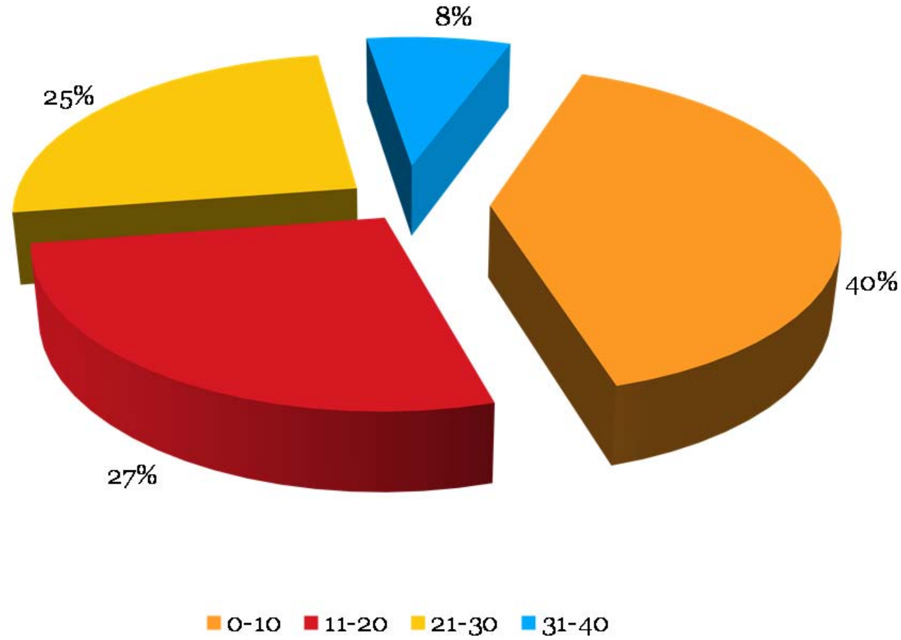


Figure 2.6: Road Network Estimated Remaining Service Life (years)

2.5 ASSET CONDITION ASSESSMENTS

This section provides an overview of the best practice for condition assessment for the infrastructure components owned and operated by the City of North Bay.

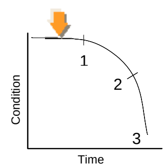
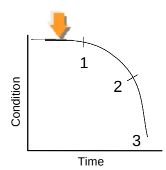
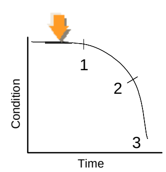
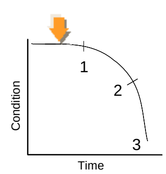
2.5.1 Inspections – Water & Wastewater Treatment Facilities

City staff, accompanied by consultants, undertake regular condition assessments of the treatment facilities in order to identify maintenance and rehabilitation requirements.

2.5.2 Water & Wastewater Treatment Facilities Condition Ratings

Table 2.7 and Table 2.8 show the high-level condition assessment of the water and wastewater treatment facilities, respectively. These were developed through discussions with City staff during the development of the SotIR in 2012.

Table 2.7: Water Treatment Facility High-level Condition Assessment

Asset Type	Asset Component	Condition	Rating (A, B, C, D or F)		Overall Rating (A, B, C, D or F)	2025 Rating
Water Treatment Facility	Building Services & Equipment		Condition & Performance	A	**A**	↓
			Capacity vs. Need	A		
			Funding vs. Need	A		
	Building Shell & Interior		Condition & Performance	A	**A**	↓
			Capacity vs. Need	A		
			Funding vs. Need	A		
	Building Sitework		Condition & Performance	A	**A**	↓
			Capacity vs. Need	A		
			Funding vs. Need	A		
	Building Substructure		Condition & Performance	A	**A**	↓
			Capacity vs. Need	A		
			Funding vs. Need	A		

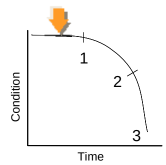
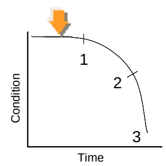
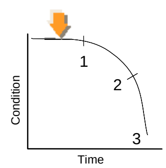
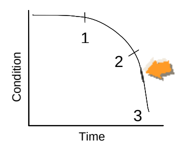
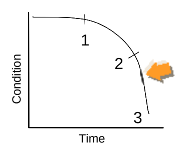
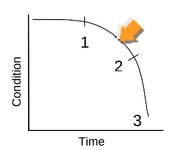
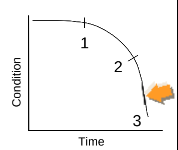
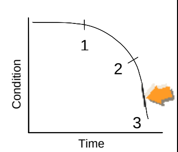
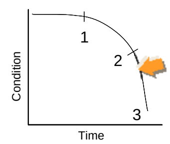
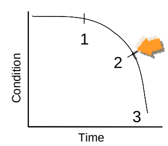
Asset Type	Asset Component	Condition	Rating (A, B, C, D or F)		Overall Rating (A, B, C, D or F)	2025 Rating
Water Treatment Facility	Electrical		Condition & Performance	A	**A**	
			Capacity vs. Need	A		
			Funding vs. Need	A		
	Mechanical		Condition & Performance	A	**A**	
			Capacity vs. Need	A		
			Funding vs. Need	A		
	Piping		Condition & Performance	A	**A**	
			Capacity vs. Need	A		
			Funding vs. Need	A		

Table 2.8: Wastewater Treatment Facility High-level Condition Assessment

Asset Type	Asset Component	Condition	Rating (A, B, C, D or F)		Overall Rating (A, B, C, D or F)	2025 Rating
Wastewater Treatment Facility	Building Services & Equipment		Condition & Performance	C-	**D**	
			Capacity vs. Need	D		
			Funding vs. Need	F		
	Building Shell & Interior		Condition & Performance	D	**D+**	
			Capacity vs. Need	B		
			Funding vs. Need	F		
	Siteworks		Condition & Performance	B	**B**	
			Capacity vs. Need	B		
			Funding vs. Need	B		
	Building Substructure		Condition & Performance	D	**D+**	
			Capacity vs. Need	B		
			Funding vs. Need	F		
	Electrical		Condition & Performance	D	**D+**	
			Capacity vs. Need	C-		
			Funding vs. Need	D		

Asset Type	Asset Component	Condition	Rating (A, B, C, D or F)		Overall Rating (A, B, C, D or F)	2025 Rating
Wastewater Treatment Facility	Pumping Station – Mechanical		Condition & Performance	C-	C	
			Capacity vs. Need	B-		
			Funding vs. Need	C		
	Pumping Station – Structural		Condition & Performance	C	C	
			Capacity vs. Need	B		
			Funding vs. Need	D		

2.5.3 Sanitary and Stormwater System Condition Ratings

Table 2.9 and Table 2.10 show the high-level condition assessments for the sanitary and the stormwater systems, respectively. These have been developed through discussions with City staff, and reflect the current understanding of the condition of the assets within the Sanitary and storm systems.

In addition to the review detailed within the worksheet below, the City has also completed a Zoom Camera inspection across the sanitary system in 2007 and 2008. A similar inspection was completed on the stormwater system in 2008 and 2009. Based upon the condition assessment, it appears that the sanitary and stormwater pipes are in generally good condition.

Since 2011, the City has also undertaken a sanitary sewer grouting contract that included Closed Circuit Television (CCTV) inspection of the sewers. As well, post construction inspections of the sanitary sewers have also confirmed that the sanitary sewer network is in good condition.

However, while Zoom Camera and these limited targeted inspections provide a quick assessment of the condition of the pipes, the results may not be truly representative of the overall condition of the network.

Additional CCTV inspection of critical sewers within the sanitary sewer network, identified within the earlier asset management reviews, should be completed to gather more detailed condition data for the pipes where the City's tolerance for failure would be low.

Table 2.9: Sanitary System High-level Condition Assessment

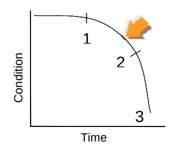
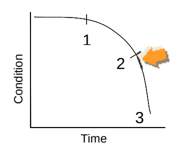
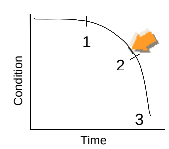
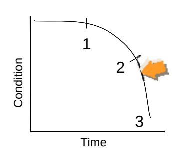
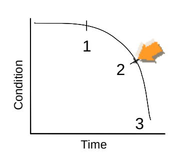
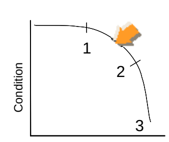
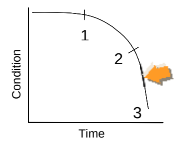
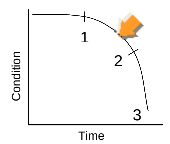
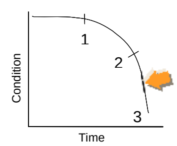
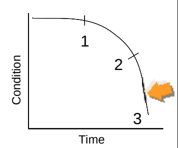
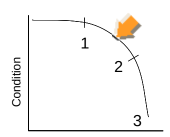
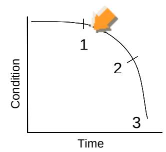
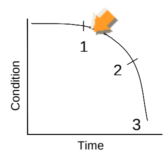
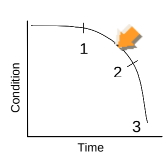
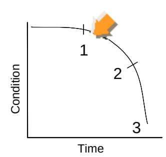
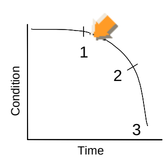
Asset Type	Asset Component	Condition	Rating (A, B, C, D or F)		Overall Rating (A, B, C, D or F)	2025 Rating
Sanitary System	Pipes		Condition & Performance	C	**C+**	↓
			Capacity vs. Need	A		
			Funding vs. Need	D		
	Manhole		Condition & Performance	D	**C-**	↓
			Capacity vs. Need	B		
			Funding vs. Need	D-		
	Sanitary Services		Condition & Performance	C	**B-**	↓
			Capacity vs. Need	A		
			Funding vs. Need	C		
	Pumping Stations - Structure		Condition & Performance	D	**C-**	↓
			Capacity vs. Need	A		
			Funding vs. Need	F		
	Pumping Stations - Equipment		Condition & Performance	D	**C-**	↓
			Capacity vs. Need	A		
			Funding vs. Need	F		
	Force Mains		Condition & Performance	C	**B-**	↓
			Capacity vs. Need	A		
			Funding vs. Need	C		

Table 2.10: Stormwater System High-level Condition Assessment

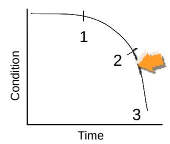
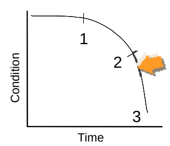
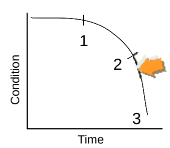
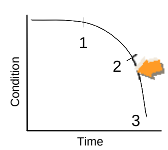
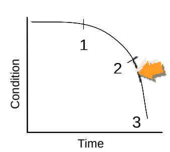
Asset Type	Asset Component	Condition	Rating (A, B, C, D or F)		Overall Rating (A, B, C, D or F)	2025 Rating
Stormwater System	Pipes		Condition & Performance	C	**C+**	
			Capacity vs. Need	A		
			Funding vs. Need	D-		
	Manholes		Condition & Performance	D	**C-**	
			Capacity vs. Need	B		
			Funding vs. Need	D-		
	Catchbasins		Condition & Performance	D	**D+**	
			Capacity vs. Need	C		
			Funding vs. Need	D		
	Storm Inlets		Condition & Performance	D	**D+**	
			Capacity vs. Need	C		
			Funding vs. Need	D		
	Storm Outlets		Condition & Performance	C	**C-**	
			Capacity vs. Need	C		
			Funding vs. Need	D		

Asset Type	Asset Component	Condition	Rating (A, B, C, D or F)		Overall Rating (A, B, C, D or F)	2025 Rating
Stormwater System	Pumping Station – Mechanical		Condition & Performance	C+	**C**	↓
			Capacity vs. Need	B		
			Funding vs. Need	D		
	Pumping Station – Structural		Condition & Performance	C+	**C**	↓
			Capacity vs. Need	B		
			Funding vs. Need	D		
	Service Lines		Condition & Performance	C	**C-**	↓
			Capacity vs. Need	C		
			Funding vs. Need	D		
	Stormceptors		Condition & Performance	B	**C**	↓
			Capacity vs. Need	C		
			Funding vs. Need	D		
	Small Culverts		Condition & Performance	C	**C-**	↓
			Capacity vs. Need	C		
			Funding vs. Need	D		

2.5.4 Water Network Condition Ratings

Table 2.11, Table 2.12, and Table 2.13 show the asset condition worksheets that have been developed through discussions with City staff during the development of the SotIR in 2012, and reflect the current understanding of the condition of the assets within the water network.

Table 2.11: Water Network High-level Condition Assessment

Asset Type	Asset Component	Condition	Rating (A, B, C, D or F)		Overall Rating (A, B, C, D or F)	2025 Rating
Water Network	Pipes		Condition & Performance	C	**D+**	
			Capacity vs. Need	D		
			Funding vs. Need	D-		
	Valves		Condition & Performance	C	**C+**	
			Capacity vs. Need	B		
			Funding vs. Need	C		
	Hydrants		Condition & Performance	C	**C**	
			Capacity vs. Need	C		
			Funding vs. Need	C		
	Chambers		Condition & Performance	C	**C-**	
			Capacity vs. Need	C		
			Funding vs. Need	D		
	Meters – Industrial		Condition & Performance	D	**D+**	
			Capacity vs. Need	B		
			Funding vs. Need	F		

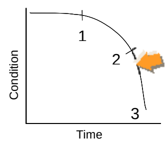
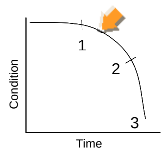
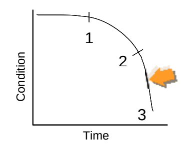
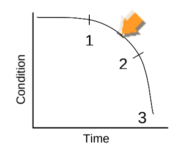
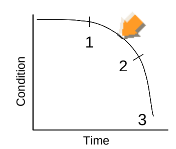
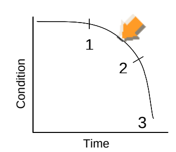
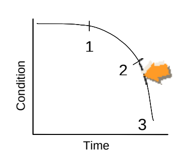
Asset Type	Asset Component	Condition	Rating (A, B, C, D or F)		Overall Rating (A, B, C, D or F)	2025 Rating
Water Network	Services and Connections		Condition & Performance	D	**C-**	
			Capacity vs. Need	B		
			Funding vs. Need	D		
	Pressure-Reducing Stations		Condition & Performance	B	**C+**	
			Capacity vs. Need	C		
			Funding vs. Need	C		

Table 2.12: Water Reservoirs High-level Condition Assessment

Asset Type	Asset Component	Condition	Rating (A, B, C, D or F)		Overall Rating (A, B, C, D or F)	2025 Rating
Water Reservoirs	Building Services & Equipment		Condition & Performance	D	**D-**	
			Capacity vs. Need	D		
			Funding vs. Need	F		
	Building Shell & Interior		Condition & Performance	B	**B**	
			Capacity vs. Need	B		
			Funding vs. Need	B		
	Building Sitework		Condition & Performance	B	**C-**	
			Capacity vs. Need	D		
			Funding vs. Need	D		
	Building Substructure		Condition & Performance	B	**C-**	
			Capacity vs. Need	D		
			Funding vs. Need	D		
	Electrical		Condition & Performance	C	**C**	
			Capacity vs. Need	B		
			Funding vs. Need	D		

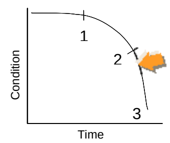
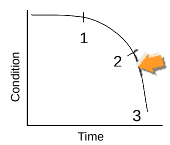
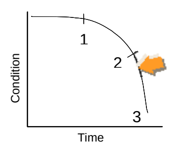
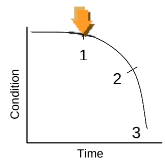
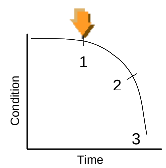
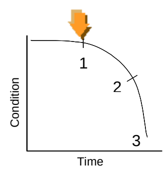
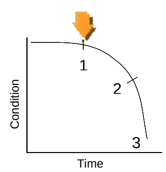
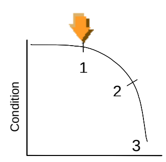
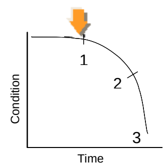
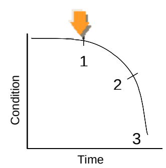
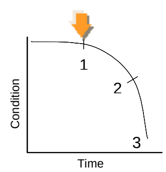
Asset Type	Asset Component	Condition	Rating (A, B, C, D or F)		Overall Rating (A, B, C, D or F)	2025 Rating
Water Reservoirs	Mechanical		Condition & Performance	C	**C**	
			Capacity vs. Need	B		
			Funding vs. Need	D		
	Piping		Condition & Performance	C	**D+**	
			Capacity vs. Need	D		
			Funding vs. Need	D		
	Supervisory Control and Data Acquisition (SCADA) System		Condition & Performance	C	**C**	
			Capacity vs. Need	B		
			Funding vs. Need	D		

Table 2.13: Water Standpipes High-level Condition Assessment

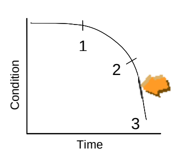
Asset Type	Asset Component	Condition	Rating (A, B, C, D or F)		Overall Rating (A, B, C, D or F)	2025 Rating
Water Standpipes	Building Services & Equipment		Condition & Performance	B	**B**	
			Capacity vs. Need	B		
			Funding vs. Need	B		
	Building Shell & Interior		Condition & Performance	B	**B**	
			Capacity vs. Need	B		
			Funding vs. Need	B		
	Building Sitework		Condition & Performance	B	**B**	
			Capacity vs. Need	B		
			Funding vs. Need	B		
	Building Substructure		Condition & Performance	B	**B**	
			Capacity vs. Need	B		
			Funding vs. Need	B		
	Electrical		Condition & Performance	B	**B**	
			Capacity vs. Need	B		
			Funding vs. Need	B		

Asset Type	Asset Component	Condition	Rating (A, B, C, D or F)		Overall Rating (A, B, C, D or F)	2025 Rating
Water Standpipes	Mechanical		Condition & Performance	B	**B**	
			Capacity vs. Need	B		
			Funding vs. Need	B		
	Piping		Condition & Performance	B	**B**	
			Capacity vs. Need	B		
			Funding vs. Need	B		
	Supervisory Control And Data Acquisition (SCADA) System		Condition & Performance	B	**B**	
			Capacity vs. Need	B		
			Funding vs. Need	B		

2.5.5 Bridges

Table 2.14 shows the Bridge asset condition worksheets that was prepared through discussions with City staff during the development of the SotIR in 2012, and reflect the current understanding of the condition of all of the assets associated with the City's bridges and large culverts.

Table 2.14: Bridges High-level Condition Assessment

Asset Type	Asset Component	Condition	Rating (A, B, C, D or F)		Overall Rating (A, B, C, D or F)	2025 Rating
Bridges	**Bridges (includes culverts >1.5m)**		Condition & Performance	D	**C**	
			Capacity vs. Need	B		
			Funding vs. Need	C-		

2.5.6 Road Network

The City's RoadMatrix pavement management system stores current pavement conditions, predicts future pavement performance, and allows for various types of analyses, including recommendations of maintenance and rehabilitation programs based on needs, budgetary limits, or desired levels of service.

The City conducts a network-wide pavement condition assessment on a four year cycle, with the most recent completed in the fall of 2011, and previously in 2007.

2.5.6.1 Survey Results

Using the pavement condition data, the present status of the network is determined during the RoadMatrix analysis, and is summarized using an index known as the Pavement Quality Index (PQI). The PQI represents the overall performance of the pavement and is evaluated on a scale of zero (0) to 100, where 100 is indicative of a "perfect" pavement. A value of 20 or less represents a failed pavement requiring replacement.

The City's current average network PQI value is approximately 55. This is considered to be a "Fair" condition. The average PQI values per functional class are summarized in Table 2.15 below.

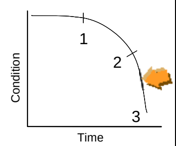
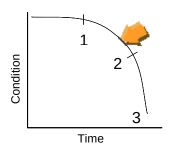
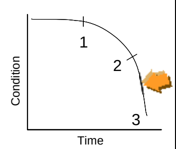
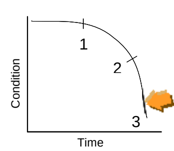
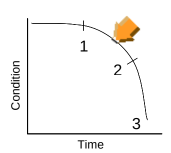
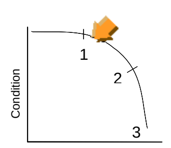
Table 2.15: Pavement Conditions by Functional Class

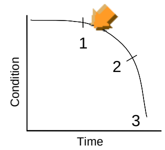
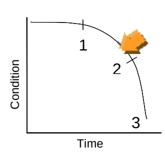
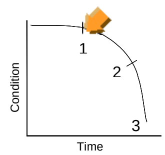
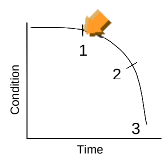
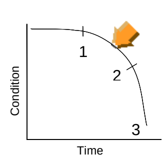
Functional Class	Average PQI	Pavement Condition (Lane-km)			
		Excellent (PQI>85)	Good (70<PQI<85)	Fair (50<PQI<70)	Poor (PQI<50)
Arterial	58.6	21.9	22.6	33.8	53.4
Collector	55.8	6.7	13.1	13.6	22.1
Rural	63.6	26.3	38.4	48.6	42.5
Urban Local	50.1	38.5	55.6	107.6	232.1
Average[1]	54.6	93.4	129.7	203.6	350.1

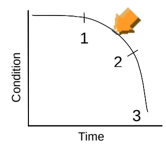
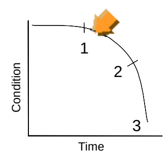
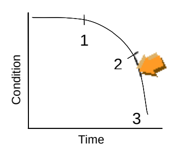
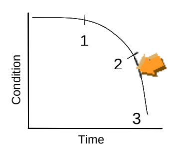
[1] weighted by lane-km

Table 2.16 shows the Road Network asset condition worksheets that have been developed through discussions with City staff during the development of the SotIR in 2012, and reflect the current understanding of the condition of all of the assets associated with the road network.

Table 2.16: Road Network High-level Condition Assessment

<table>
<tr><th>Asset Type</th><th>Asset Component</th><th>Condition</th><th colspan="2">Rating
(A, B, C, D or F)</th><th>Overall Rating
(A, B, C, D or F)</th><th>2025 Rating</th></tr>
<tr><td rowspan="18">Road Network</td><td rowspan="3">Urban Road Centreline</td><td rowspan="3"></td><td>Condition & Performance</td><td>D+</td><td rowspan="3">C</td><td rowspan="3"></td></tr>
<tr><td>Capacity vs. Need</td><td>B-</td></tr>
<tr><td>Funding vs. Need</td><td>C</td></tr>
<tr><td rowspan="3">Rural Road Centreline</td><td rowspan="3"></td><td>Condition & Performance</td><td>C+</td><td rowspan="3">B</td><td rowspan="3"></td></tr>
<tr><td>Capacity vs. Need</td><td>A</td></tr>
<tr><td>Funding vs. Need</td><td>C+</td></tr>
<tr><td rowspan="3">Sidewalk and Boulevard</td><td rowspan="3"></td><td>Condition & Performance</td><td>D+</td><td rowspan="3">C</td><td rowspan="3"></td></tr>
<tr><td>Capacity vs. Need</td><td>A</td></tr>
<tr><td>Funding vs. Need</td><td>F</td></tr>
<tr><td rowspan="3">Curb</td><td rowspan="3"></td><td>Condition & Performance</td><td>D-</td><td rowspan="3">F</td><td rowspan="3"></td></tr>
<tr><td>Capacity vs. Need</td><td>-</td></tr>
<tr><td>Funding vs. Need</td><td>F</td></tr>
<tr><td rowspan="3">Signs</td><td rowspan="3"></td><td>Condition & Performance</td><td>B</td><td rowspan="3">B+</td><td rowspan="3"></td></tr>
<tr><td>Capacity vs. Need</td><td>-</td></tr>
<tr><td>Funding vs. Need</td><td>A</td></tr>
<tr><td rowspan="3">Lighting</td><td rowspan="3"></td><td>Condition & Performance</td><td>B</td><td rowspan="3">B-</td><td rowspan="3"></td></tr>
<tr><td>Capacity vs. Need</td><td>C</td></tr>
<tr><td>Funding vs. Need</td><td>B</td></tr>
</table>

Asset Type	Asset Component	Condition	Rating (A, B, C, D or F)		Overall Rating (A, B, C, D or F)	2025 Rating
Road Network	**Walkways**		Condition & Performance	B	**C+**	→
			Capacity vs. Need	C		
			Funding vs. Need	C		
	Retaining Wall		Condition & Performance	B	**C**	↓
			Capacity vs. Need	-		
			Funding vs. Need	D		
	Signals		Condition & Performance	B+	**B**	→
			Capacity vs. Need	B		
			Funding vs. Need	B		
	Pavement Markings		Condition & Performance	A	**A**	→
			Capacity vs. Need	A		
			Funding vs. Need	A		
	Level RR Crossings		Condition & Performance	B	**B**	→
			Capacity vs. Need	B+		
			Funding vs. Need	B		

Asset Type	Asset Component	Condition	Rating (A, B, C, D or F)		Overall Rating (A, B, C, D or F)	2025 Rating
	Shoulders		Condition & Performance	B	**B**	
			Capacity vs. Need	-		
			Funding vs. Need	B		
	Guard Rails		Condition & Performance	C+	**B-**	
			Capacity vs. Need	B		
			Funding vs. Need	B		
	Ditches		Condition & Performance	D	**C**	
			Capacity vs. Need	C		
			Funding vs. Need	B		
	Driveway Culverts		Condition & Performance	C	**B-**	
			Capacity vs. Need	B		
			Funding vs. Need	B		

These asset condition worksheets included within this section were used to develop the asset report card shown in Table 2.5. In general it can be seen that these assets are deteriorating and the trend for the future will continue to downwards unless the City is proactive in addressing the funding gap between existing funding levels and the sustainable funding needs identified within the State of the Infrastructure Reports.

3.0 Desired Levels of Service

Levels of Service for the City's assets are a combination of the community's expectations and the City's required and desired maintenance and performance targets to meet legislative requirements and industry best practices. At this time the City meets the legislated or technical levels of service which govern the service offered by the assets included in this Asset Management Plan.

Prior to completing future iterations of this Asset Management Plan, the City will seek Community input to assist in further refining its service level targets. Under consideration will be:

- Determine a desired condition Index for each of the assets
- Determine a maximum desired backlog of work
- Determine funding and service goals for maintenance versus rehabilitation/replacement
- Community focused expectations and targets

These Levels of Service should be based on community input and will require an outreach program to determine the expectations of the various users of the City's services. In addition to the legislated and regulated levels of service that the City has to comply with future levels of service should also recognize the following customer values:

- Accessibility
- Affordability
- Customer Service
- Health and Safety
- Reliability
- Benefits whole community
- Sustainability

Once the levels of service are defined it will then be possible for staff to develop performance measures against which the services can be measured and would form the basis of future reports on performance to the community.

3.1 SANITARY SYSTEM, STORMWATER SYSTEM, AND WATER NETWORKS AND WATER TREATMENT FACILITIES

Some typical examples of performance objectives are:

- Produce high quality, safe, potable water and environmentally sound effluent
- Minimize environmental damage
- Maximize facility treatment capacity
- Minimize water losses
- Maximize hydraulic capacity
- Minimize customer complaints
- Prevent sewer backups due to blockages on the main lines
- Avert dry weather flow (average flow) overflows
- Reduce structural deterioration and operational problems due to poor maintenance

- Perform system rehabilitation at the optimum point in the deterioration cycle
- Conducting benchmarking both internally and with other similar communities

3.2 BRIDGES

Some typical examples of performance objectives for bridges and large culverts are:

- Maintain bridges and culverts to ensure that they remain structurally sound
- Minimize the number of structures with reduced loading requirements
- Perform structure rehabilitation at the optimum point in the deterioration cycle to reduce costs
- Explore options for closing or divesting structures if they are no longer required
- A maximum desired backlog of work
- A determination of funding and service goals for maintenance versus rehabilitation/replacement activities
- Seek Community input to further refine expectations and targets

3.3 ROAD NETWORK

The City's network average Pavement Quality Index is currently calculated to be a value of approximately 55. In order to maintain this network average PQI (weighted by lane-km), it is estimated that the City will need to spend approximately $48 million on pavement rehabilitation and maintenance activities over the next ten years.

The City has identified that its desired level of service for roads is to maintain its average network condition at its current state (i.e., at an average value of PQI=55). This goal is in line with the City's understanding of Community expectations and with currently available funding levels.

Within future iterations of this Asset Management Plan, further refinements under consideration will be:

- Different desired service levels for different functional classes
- A desired PQI distribution (for the network and/or for each functional class)
- A maximum desired backlog of work
- A determination of funding and service goals for maintenance versus rehabilitation/replacement activities

4.0 Asset Management Strategy

The State of the Infrastructure Reports have provided the City with insight into the challenges that the community will face as the existing asset portfolios age and require either rehabilitation or replacement to ensure that they continue to operate at an appropriate level to deliver services to the community.

4.1 PROJECTED INVESTMENT NEEDS

Based on the life cycle analysis which was completed for the State of the Infrastructure Reports the City will be facing significant infrastructure replacement needs over the next 10-20 years.

It should be noted that the investment needs presented in Sections 4.1.1 through Section 4.1.3 are shown in 2014 dollars and, therefore, do not include allowances for inflation or Net Present Value.

4.1.1 Water and Wastewater Treatment Facilities

Figure 4.1 illustrates the replacement investment profiles for the water and wastewater facilities. For the purposes of this analysis, we have assumed a construction date of 2010 for the water treatment facility and used the actual year of construction for the major components of the wastewater treatment Facility.

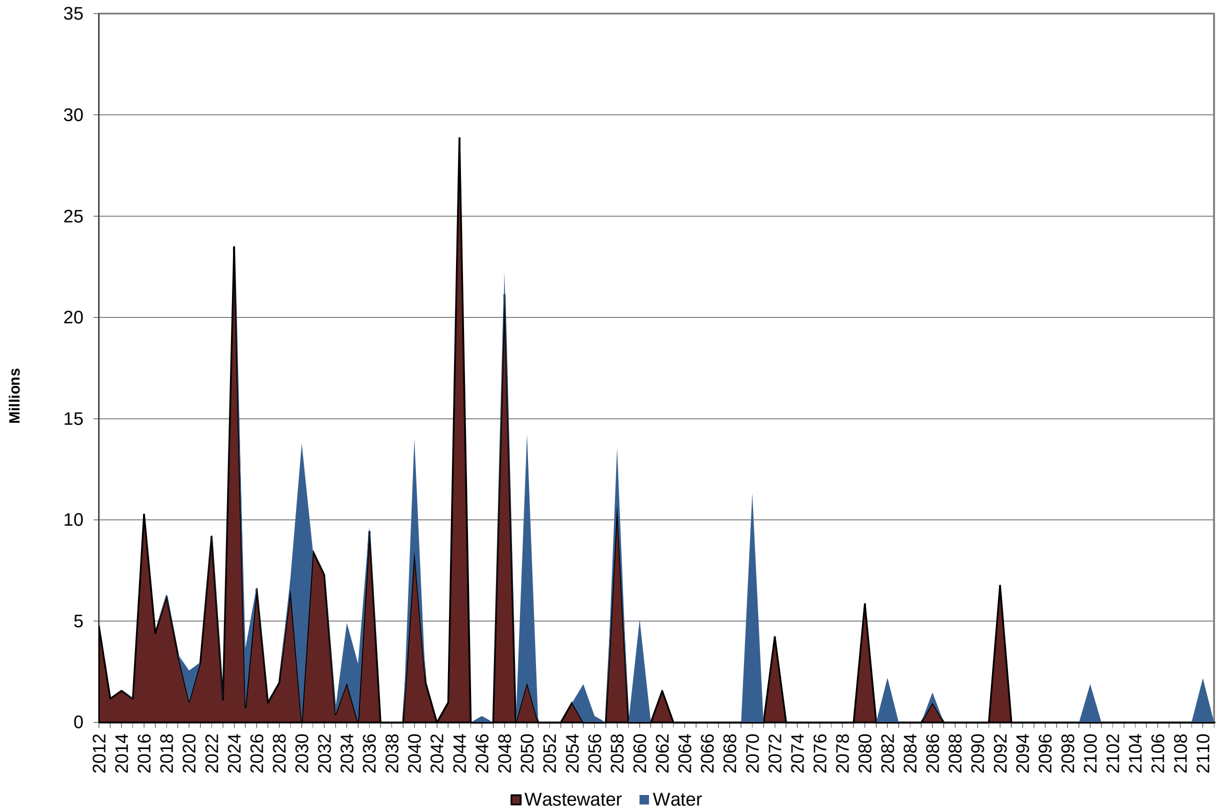


Figure 4.1: Reinvestment and Replacement Profile Water Treatment Facilities

4.1.2 Sanitary and Stormwater Network

The 100-year capital investment profiles for the sanitary and stormwater assets are shown in Figure 4.2 and Figure 4.3 respectively. The following profiles represent the replacement of the sanitary and stormwater assets, and do not include any form of rehabilitation. There are a number of techniques that may be applicable for the rehabilitation of the pipes to extend the useful life.

However, while rehabilitation may appear to be an attractive option to reduce the cost associated with maintaining the structural integrity of the pipes, in some cases, the unit cost of the treatment can be similar to that of replacement. Rehabilitation costs are dependent upon other factors such as the scale of the project. Larger projects can achieve economies of scale, or the availability of local contractors that are capable of delivering the service.

It should be noted that there are also situations where rehabilitation would not be appropriate, such as when the pipe requires upsizing to service growth, or the pipe is subject to frequent submersion due to high water tables, in areas near the lake, that would increase costs associated with dewatering during the rehabilitation process.

This type of analysis is beyond the scope of the Asset Management Plan, but should be considered as part of a more detailed review and subsequent development of a tactical plan with respect to the sanitary and stormwater network.

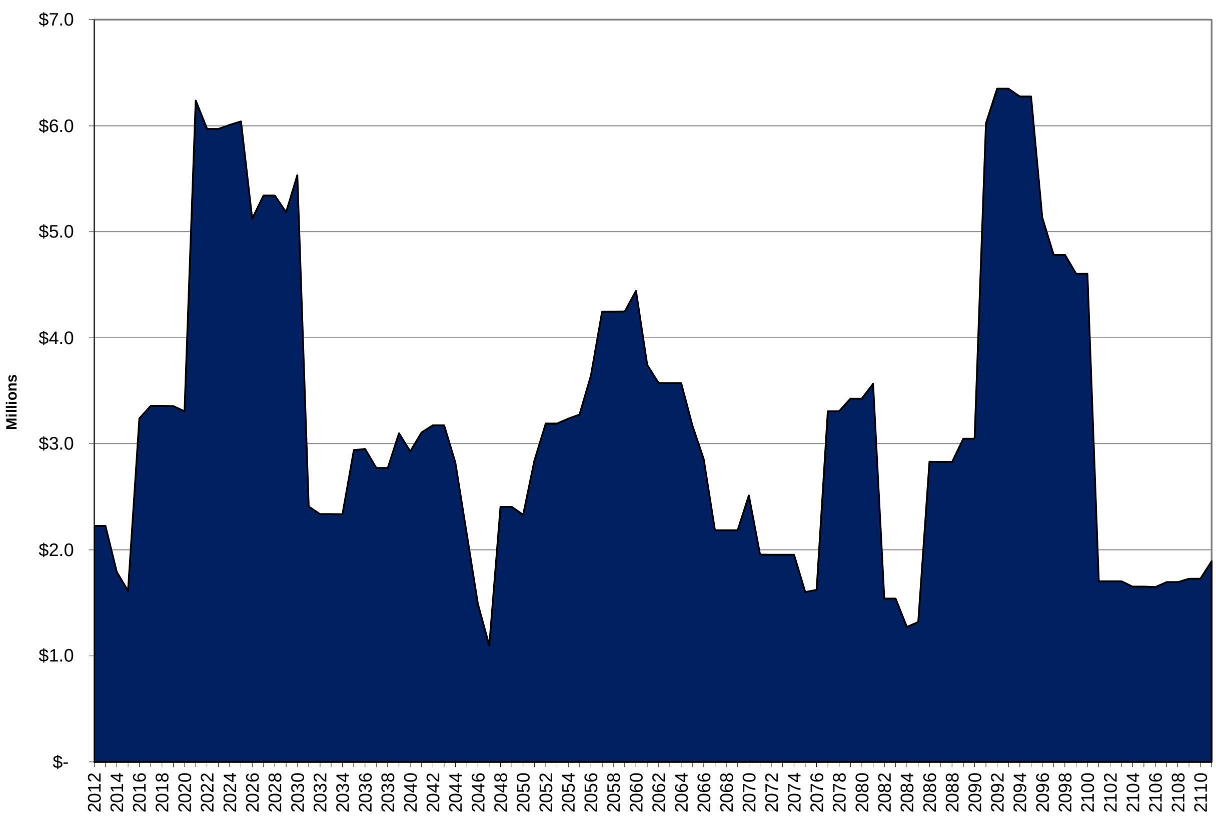


Figure 4.2: Sanitary Sewer Network Capital Requirements

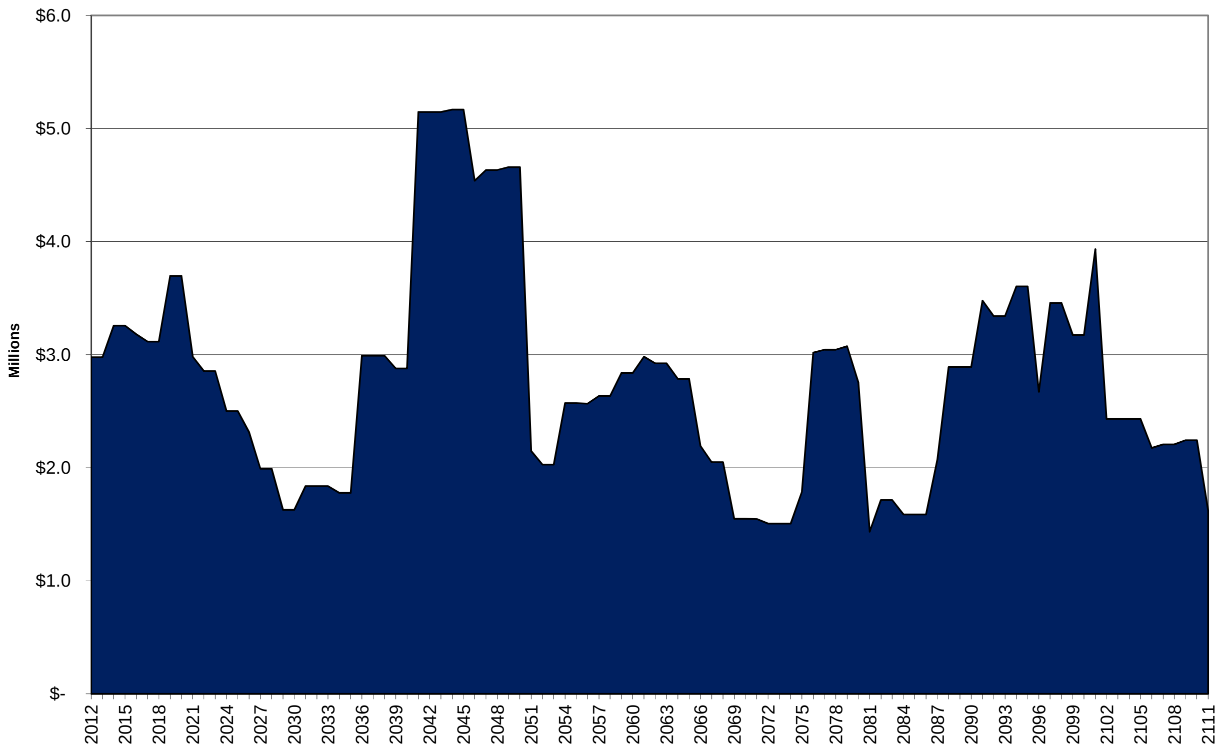


Figure 4.3: Stormwater Network Capital Requirements

4.1.3 Water Network

The 100-year capital investment profile displayed in Figure 4.4 represents the replacement profile for all of the water assets, and does not include any form of rehabilitation. There are a number of rehabilitation techniques for pipes that may be applicable and considered for each water pipe project, to add to the useful life. Applying such techniques at an appropriate point, prior to the end of an asset's useful life, would have the effect of flattening the profile.

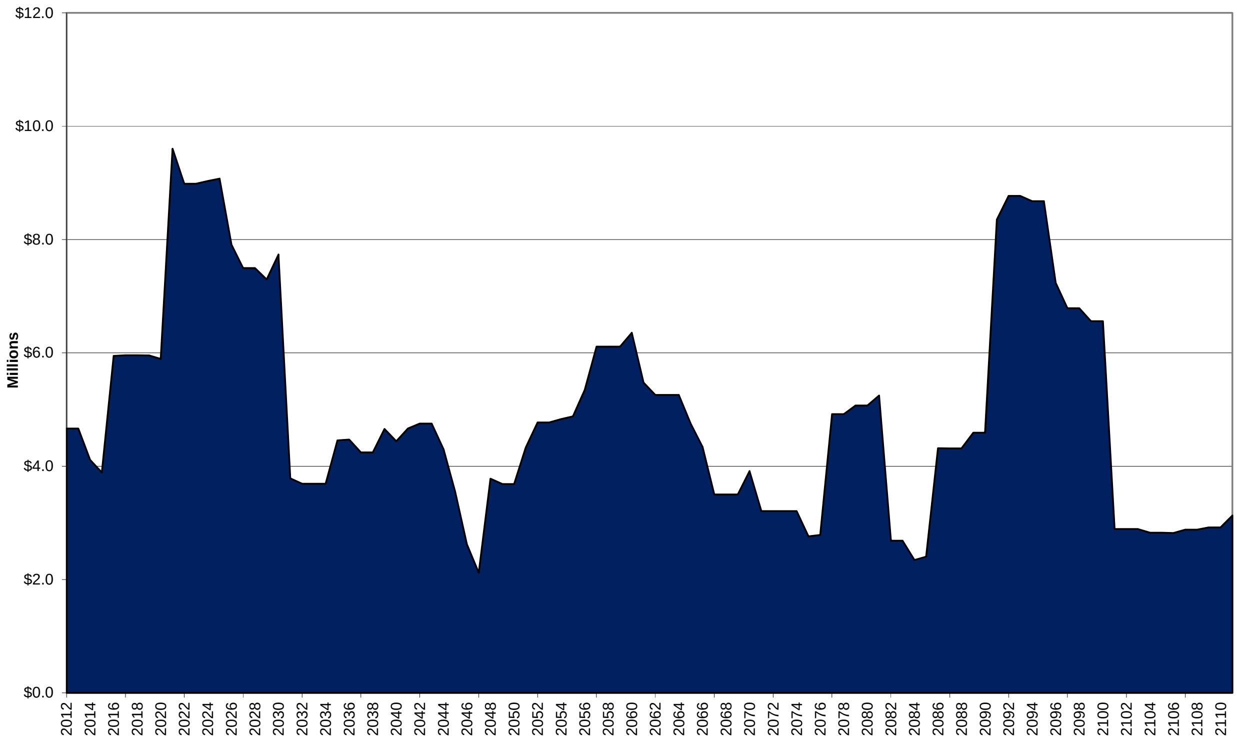


Figure 4.4: Water Network Capital Investment Requirements

4.2 REPLACEMENT ACTIVITIES

The previous section illustrates the level of investment required to replace the City's infrastructure assets as they reach the end of their useful life. However, through effective asset management the City will minimize the replacement of these assets where appropriate through the use of innovative technologies such as trenchless rehabilitation of the sewer and water pipes.

These alternative options will be evaluated against replacement on a project by project basis, in addition by taking a proactive approach in assessing the condition of the assets the City will be able to program the use of rehabilitation options earlier in the asset's life-cycle.

The field of asset renewal and rehabilitation continues to provide asset managers with an ever increasing portfolio of tools and techniques that can be used to minimize the need to resort to the costly option of asset replacement. Therefore, the City will continue to evaluate the use of new technologies as they become available in the future.

4.3 NON-INFRASTRUCTURE SOLUTIONS

Accurate and reasonable population growth forecasting allows the City to adequately plan the water, sanitary, stormwater, water & wastewater facilities, and road network expansion activities, and ensure that infrastructure is built only to meet reasonable demands.

On a project-by-project basis, Environmental Assessment studies and other studies will explore various options, including alternatives to building new infrastructure, for any major developments being considered in the City.

Planned actions and policies can lower the costs or extend the useful life of assets. The City actively pursues non-infrastructure solutions to ease the burden of the Asset Management Plan on its taxpayers. The following are examples of this approach:

- The City's Official plan aims to encourage development in areas with infrastructure that can handle added development
- The City uses process optimization to reduce costs, increase efficiencies, and find new cost efficient methods to extend the useful life of assets.
- Integrated planning to optimize lifecycle costs including coordinating reconstruction or rehab work with local utilities (Union Gas, North Bay Hydro, and telecommunication companies), and water and sewer.
- Through by-law 2004-45, reduced load restrictions are implemented on some roads during the spring to mitigate potential damage during the freeze/thaw portion of the year.

4.4 MAINTENANCE AND REHABILITATION ACTIVITIES

The various stages in an asset's life cycle can be split into four distinct phases of activity. These activities are described in Table 4.1.

Table 4.1: Phases of Maintenance and Rehabilitation Activities

Activity	Definition	Asset Age
Minor Maintenance	Planned activities such as monitoring, cleaning and lubricating, visual inspections, etc.	0-25% of asset life
Major Maintenance	Maintenance and repair activities are generally unplanned; however, they can be anticipated and would generally be accounted for within the City's annual operating budget and capital budget.	25-100% of asset life
Rehabilitation	Major activity required to upgrade or rehabilitate the asset so that it can continue to provide service for an additional time period.	50-75% of asset life
Replacement	Some assets will reach the end of their structural and/or service useful life and require replacement. Experience in other communities has shown that the expected life of an asset will vary greatly, depending upon growth and a variety of mechanical, structural and environmental factors.	75-100% of asset life

4.4.1 Typical Maintenance and Rehabilitation Activities

Table 4.2 shows typical activities conducted for maintenance and rehabilitation for the assets in the City's infrastructure. Specific details of the maintenance and rehabilitation programs can be found in the corresponding pages in Appendix A.

Table 4.2: Typical Maintenance and Rehabilitation Strategies for City of North Bay Infrastructure

Program	Maintenance/Rehabilitation Strategy	Type	Appendix
Water Treatment Facilities	Pump Maintenance	Maintenance	Appendix A.1
	Electrical Maintenance		
	Routine Building Inspections		
Sanitary and Stormwater System	Open Cut Construction	Rehabilitation	Appendix A.2
	Sliplining		
	Diameter Reduction Sliplining		
	Fold and Form Sliplining		
	Cured-in-Place Pipe (CIPP)		
	Pipe Bursting		
	Horizontal Directional Drilling (HDD)		
	Internal Joint Seals		
	Panel and Section Insert Linings		
	Chemical Grouting		
	Full Tunneling and Micro-Tunneling		
	Auger Boring		
	Pipe Eating		
Water Network	Cleaning	Maintenance	Appendix A.3
	Valve Inspection and Exercising		
	Flow Testing Hydrants		
	Monitor/Implement Cathodic Protection Systems		
	Sliplining	Rehabilitation	
	Diameter Reduction Sliplining		
	Fold and Form Sliplining		
	Cured-in-Place Pipe (CIPP)		
	Spray-applied Lining		
	Pipe Bursting		
	Horizontal Directional Drilling (HDD)		
	Internal Joint Seals		
	Full Tunneling and Micro-Tunneling		

Program	Maintenance/Rehabilitation Strategy	Type	Appendix
Bridges and Culverts	Cleaning and Flushing	Maintenance	Appendix A.4
	Crack Sealing		
	Asphalt Surface Treatment		
	Asphaltic Concrete Overlay		
	Clean Expansion Joints and Replace Joint Filler		
	Culvert Inspections		
	Culvert Stream Maintenance		
Roads	Crack/Chip Seal	Maintenance	Appendix A.5
	Mill + Overlay	Rehabilitation	
	Pulverize and Pave		
	Reconstruction	Reconstruction	

When maintenance and renewal/rehabilitation approaches are not feasible or cost effective and an asset has reached the end of its useful life, the asset may need to be replaced or reconstructed. Effective asset management emphasizes the importance of intervening at the right point within the asset's life cycle to ensure that the useful life can be extended through the use of maintenance and rehabilitation options where possible. Allowing the assets to reach the end of their life which then requires full replacement is the least desirable option.

4.5 ASSET DATA MAINTENANCE STRATEGY

Maintaining the asset data is an important component of any asset management plan. The key benefits of maintaining current condition and attribute data are as follows:

- Allows estimation of the future condition of the assets to determine the rehabilitation/replacement requirements.
- Provides data to allow the identification of feasible rehabilitation alternatives for the assets and, based on this information, assemble rehabilitation programs to refine budget requirements.

Data collection frequencies for the City's roads and bridges are as follows:

- Roads – 4-year cycle for surface data collection to update the RoadMatrix pavement management system
- Bridges & Culverts – 2-year cycle for all bridges and large culverts (with a span greater than 3 metres) in accordance with Provincial guidelines.

In the case of the sanitary, stormwater and water networks there is no formal inspection program identified. However, as discussed previously the City has completed Zoom Camera inspections on the entire sanitary and stormwater systems from 2007 through 2009; these inspections have also been supplemented with Closed Circuit Television (CCTV) inspection of the portions of the network in conjunction with the reconstruction projects. While limited inspections have shown that the sanitary and stormwater network are in good condition, the City will initiate an inspection program for these systems which targets pipes which have been identified as critical assets.

There are few options available for the inspection of water mains, therefore, the condition of these pipes will be monitored through the review of break information, flow testing and flushing records.

4.6 REPLACEMENT AND DISPOSAL ACTIVITIES

The City only anticipates the decommissioning of a few assets, such as bridges, that are at the end of their service life and where their function can be provided elsewhere at a better value.

4.7 EXPANSION ACTIVITIES

The City of North Bay expects modest growth in the foreseeable future. Expansion activities are reflected in the City's Official Plan. As discussed in other sections of this document, the costs associated with the maintenance and operation of these new assets has not been included in the investment projections presented.

Currently, growth costs are mainly funded through capital funding and development charges, which to some extent are offset by the increase in assessment as development improves the land use in the new growth areas.

4.8 PROCUREMENT METHODS

To ensure the most efficient allocation of resources and funds, the City will consider:

- Bundling projects when issuing tenders, to realize cost-benefits of economy of scale
- Working with nearby municipalities to share resources where appropriate
- Consider the use of Public Private Partnerships (P3) for project delivery

For any purchases made by the City, the City adheres to Purchasing By-Law No. 2013-200, which can be found on the City's website (http://www.cityofnorthbay.ca/cityhall/bylaws/result?BYLAW_NO=2013_200).

The By-Law enshrines the following principles:

a. Ensure the City conducts fair, objective, transparent and consistent purchasing practices;
b. Maintain the integrity of the procurement process by ensuring that, whenever possible, competitive methods of procurement will be utilized to obtain Best Value for the City;
c. Clearly define the circumstances which allow for non-competitive procurement;
d. Ensure that the procurement process is conducted in a manner that enables departments of the City to operate efficiently and effectively;
e. Protect the interests of the City, public and persons participating in the procurement process by providing a clear statement of how Goods and Services will be acquired;
f. Clearly define the roles and responsibilities of those involved in the procurement process; and
g. Outline the process for disposing of Surplus Goods.

4.9 RISKS

Table 4.3 identifies several risks that could prevent the City from reaching/maintaining its target level of service for the City of North Bay's infrastructure assets:

Table 4.3: Risks Associated with Not Reaching Defined Level of Service Targets

Potential Risk	Potential Impact
Required Funding Not Secured	• Assets deteriorate further • Condition decreases • Assets deteriorate beyond a condition where rehabilitation is a viable option • Backlog of work increases • More costly rehabilitation is required
Substantial Increase in O&M Unit Costs in Future	• Inability to complete all planned projects with allotted budget levels • Condition decreases • Assets deteriorate beyond a condition where rehabilitation is a viable option • Backlog of work increases • More costly rehabilitation is required
Environmental Changes (e.g., severe weather, high population growth)	• Increased infiltration, insufficient capacity • Underestimated funding needs • More costly treatments are required to increase capacity • Asset expansion/upgrading is required

4.10 ASSET MANAGEMENT PLAN FUTURE UPDATES

The Asset Management Plan for the City's infrastructure is a living document, and will require regular review and refinement. Specifically, the City will:

- Review the Asset Management Plan annually, track and confirm validity of assumptions
- Publish updated Asset Management Plans every five years
- Commit to regular updates/upgrades of the infrastructure systems and adhere to regular inspections
- Update all pertinent attribute and modeling data in the asset management system
- For the road network, update all pertinent attribute and modeling data in its pavement management software.
- Further refine its level of service targets by engaging in a community outreach program, to help identify the desired levels of service of the citizens.

5.0 Financing Strategy

5.1 SUSTAINABLE FUNDING REQUIREMENTS

The State of the Infrastructure Reports provide an overview of the funding required to maintain the existing infrastructure owned by the City. Table 5.1 illustrates the sustainable funding requirement for the City's major Public Works assets and anticipated 10-year projected Operating and Maintenance (O&M) and Capital funding levels.

Table 5.1: Sustainable Revenue (Millions)

Program	2014-2023 Projected Revenue (average annual, in millions)		Projected Sustainable Revenue (average annual, in millions)[1]		Overall Surplus/(Deficit), in millions
	O & M	Capital	O & M	Capital[2]	
Sanitary Sewer	$2.20	$2.4	$3.19	$4.10	($2.69)
Storm Sewer	$0.68	$0.65	$2.16	$3.50	($4.33)
Water	$5.90	$4.7	$3.19	$6.20	$1.21
Treatment Facilities	$4.30	$1.3	$2.58	$4.60	($1.58)
Roads and Bridges	$5.90	$12.6	$7.93	$25.90	($15.33)
TOTAL	**$18.98**	**$21.65**	**$19.05**	**$44.30**	**($22.72)**

[1] 2012 State of the Infrastructure sustainable revenues to give 2014 dollars

[2] Capital sustainable revenue requirements inflated at 4.5%/annum based on 10-year average of Statistics Canada Non-residential Building Construction Index

The 10-year capital investment, operating and maintenance expenditures, sustainable funding required, and the growing deficit is shown in Figure 5.1. As can be seen from Figure 5.1, a the gap between the sustainable funding requirements and the proposed funding levels will not be closed without initiating increases in funding. A strategy for closing the funding gap has been presented within the following section.

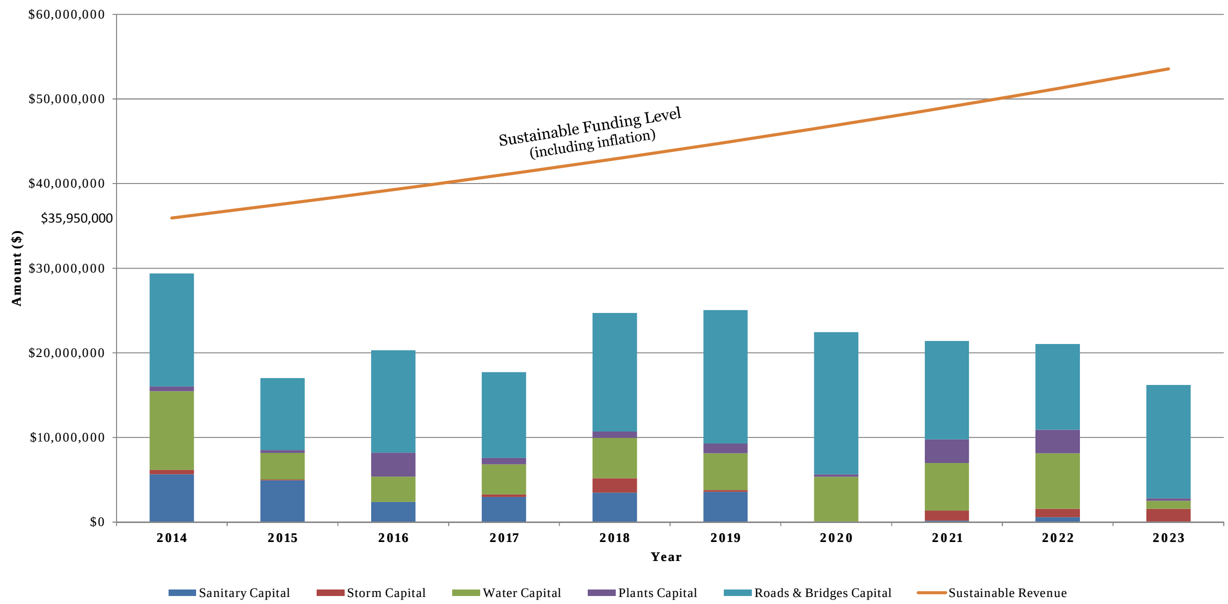


Figure 5.1: 10-Year Investment and Sustainable Revenue Requirements

5.2 LONG TERM FINANCIAL PLAN

The City of North Bay, like many other municipalities, had traditionally followed a pay-as-you-go financing approach; which there was hesitation to assume debt as part of an overall financing strategy. Additionally, over a period of time, most notably in the 1990's, public pressures resulted in many years of lower than inflation increases in rates and taxes that lead to incremental increased deficits in capital renewal and operating programs. Infrastructure, being mostly buried and unnoticeable, with service life of more than 50 years continued to perform without obvious defects or failures. A number of public infrastructure failures in other jurisdictions and ensuing regulations are changing the understanding of the need to fully finance the full life cycle cost of infrastructure from both a capital and operating perspective that will continue delivery of core services to the City into the future.

Regulations associated with the Safe Drinking Water Act have required the development of Asset Management and Sustainable Financial Plans that take into account aging infrastructure and all aspects of the water system. The City has submitted a plan under Ontario Regulation 453/07 with the study conducted by BMA Management Consulting Inc. – Development of Long-Range Financial Plan Water and Wastewater Operations in Accordance with O. Reg. 453/07 062-301A.

Following the City's 2008 State of the Infrastructure Report that identified a significant backlog in capital renewal and operating deficits, the City's financing strategy was considerably reformed with Council's adoption of the Long Term Capital Funding Policy. This policy instituted a plan to slowly increase the pay-as-you-go component as well as the City's debt levels to move towards a balanced sustainable funding model. The Asset Management Plan strengthens the link between the funding plan and the infrastructure needs and becomes a strong foundation for the integration of the tools identified in the City's "Financial Planning Policies – A Long-term Perspective" document. The key data that formed the foundation of the policies adopted by the City includes the 2008 State of the Infrastructure Reports. In 2012 the State of the Infrastructure Report was updated and demonstrated that overall the City is moving in the right direction in terms of funding. The Asset Management Plan takes all of the City's hard work and compiles it into a single document that demonstrates the complexities of the City's plans, policies and infrastructure.

At this time support for infrastructure is being provided through the annual Federal Gas Tax Fund and is being directed towards roads reconstruction and rehabilitation projects in which the City applies by a strategic approach. This approach coordinates reconstruction and rehabilitation efforts for all services (water, stormwater, and wastewater) that require renewal in the same area. In this sense, the Federal Gas Tax Funding is contributing to the all areas of backlog beyond current taxation and rate revenues.

While the Federal Government has confirmed that Gas Tax Funding will be made permanent and will be index linked, it should be noted that the range of eligible projects will be expanded to include disaster relief, cultural and community projects. Therefore, this will increase the pressure on the City's Council to stay the course with respect to sustainability in the funding of infrastructure maintenance and renewal.

5.3 LONG TERM CAPITAL FUNDING POLICY

The City's Long Term Capital Funding Policy goals and objectives are:

- To provide maximum annual funding for all capital projects;
- To provide maximum funding for special major capital projects;
- To control, but not eliminate the level of long term capital debt and commitments each year;
- To provide for the effects of inflation through annual adjustments; and
- To gradually increase the level of funding for capital projects to maintain sustainable infrastructure

The policy also speaks to the utilization of all available funding sources such as:

Debt Financing

In order to proceed with capital projects, the City enters into debt agreements to fund the City's portion of the capital expenditures that are not funded by tax levies (pay-as-you-go) or other funding sources (development charges, donations, federal grants, provincial grants, etc.)

In recent years, the City has increased its debt issuance by $500,000 annually to its current maximum amount of $12 million annually (water and general combined).

User Rates

User rates have been adjusted by 2% plus inflation on an annual basis since 2008 and were used to calculate the costs of water and sewage services in the financing plan submitted to the Province for water and sewer sustainability. Currently, the City is in the final stages of installing water meters and is undertaking a new water rate study that will provide a new sustainable funding model. This new study will provide a financial sustainable plan with 10-year forecasting of water and sewer rate increases.

A number of municipalities in Canada have begun a user rate structure for stormwater management. This approach will not be considered by the City within the current 10-year horizon.

Development Charges

Development charges are currently under review with the 2014 Background Study. The goal is to ensure that revised rates driven by growth are fairly funded by development activities.

The Long-term Capital Funding Policy also demonstrates that the City will not achieve the identified sustainable capital funding level of $35 million within 15 years.

The following graph (Figure 5.2)shows the theoretical annual funding investment per the Long-term Capital Funding Policy, for a medium-term time period that includes the 2014 10-year Capital Budget (including an annual non-residential building construction inflationary adjustment, per the policy). Recognizing that the $35 million sustainable investment has no consideration for operating and maintenance costs. Also, the identified sustainable investment requirement does not include the City's entire infrastructure such as facilities, parks, sports fields, etc. (and as such, understates the actual amount of investment required). The graph also identifies the City's 10-year funding plan by source, illustrating the portion of taxpayer dollars that annually fund the capital investment (pay-as-you-go).

Therefore, the City is currently using all financing tools available under the *Municipal Act 2001*, S.O. 2001, c.25, as amended, including: Debt, Pay-as-you-go (tax levy), Development Charges, Federal Gas Tax, User Fees (water and wastewater rates) and any third party funding that is available to leverage the City's investment.

As noted in the plan, this infrastructure gap does not include other critical assets that make the City an attractive and desirable place to "***live, work, play and learn!***". In order to determine the required level of sustainable investment for facilities such as City Hall, Capitol Centre, arenas, park structures etc., the same detailed life cycle costing analysis is necessary. These will be included in future Asset Management Plans.

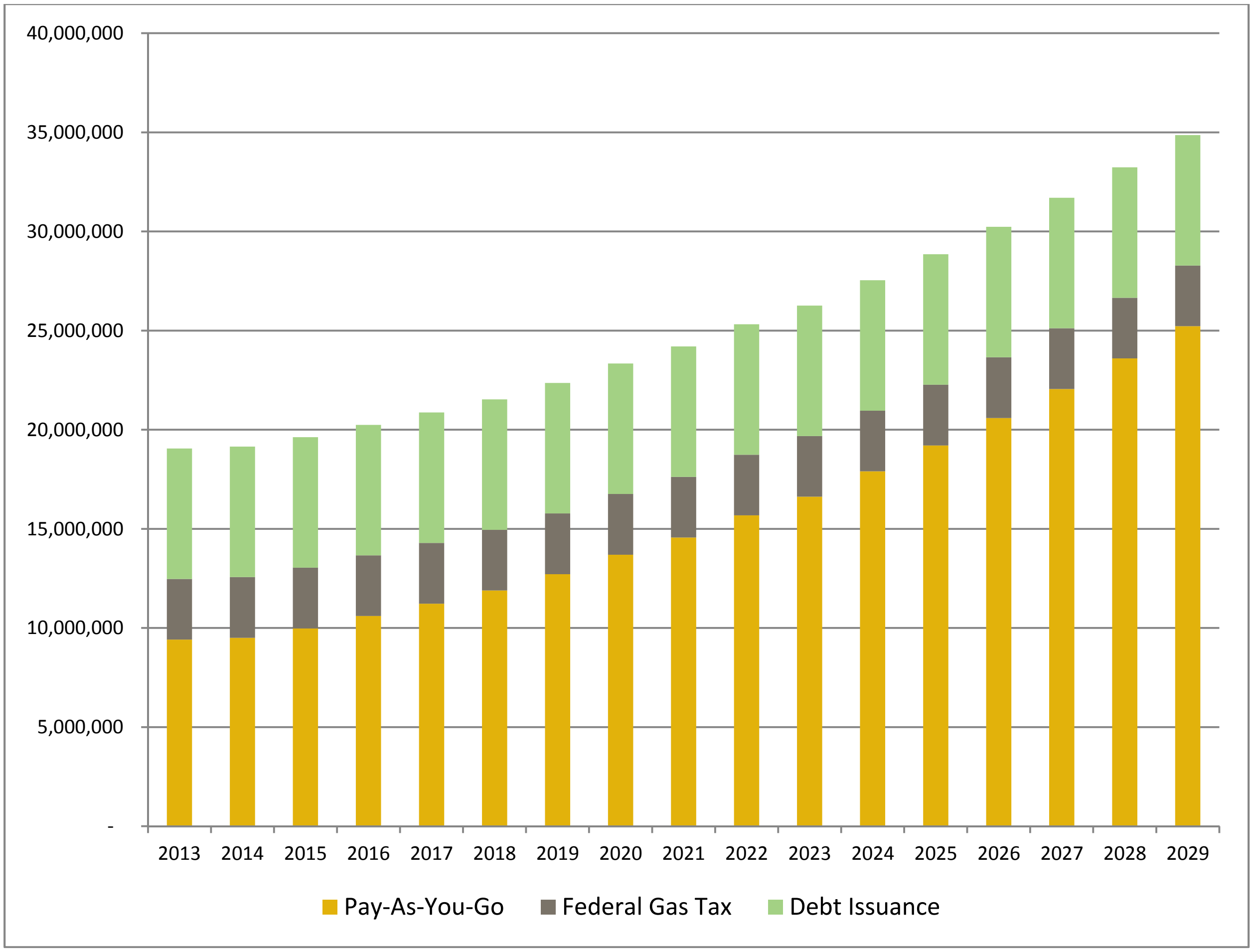


Figure 5.2: Capital Funding Plan by Source

5.3.1 Leveraging Provincial & Federal Grants

The City strives to maintain a portfolio of shovel ready projects in order to appropriately leverage third-party funding as it becomes available. The assistance of the Provincial and Federal government programs over the years have allowed the City to achieve benefits that would have been extremely difficult if left to only debt, tax and rate payer funding. Below are some key transformational projects and benefits that the City has leveraged since 2008. Note, the list does not include the allocations received by the Federal Gas Tax.

Table 5.2: Key Transformational Projects and Benefits that the City of North Bay has Leveraged since 2008

Grant	Project	Provincial Funding Received	Federal Funding Received	Total Project Cost	Benefit
COMRIF	New Water Treatment Plant	$15,000,000	$15,000,000	$45,500,000	Provide safe drinking water to City residents
Infrastructure Stimulus Fund Canada	Algonquin / Front Rehabilitation	$4,666,667	$4,666,667	$14,500,000	Replace aging and failing above and below ground infrastructure and provide services to area previously occupied by CN rail line
FedNor-Community Competitiveness and NOHFC-Infrastructure and Community Development	Airport Industrial Park Design and Development	$2,050,000	$2,225,000	$6,500,000	City's existing industrial parks at capacity. This development provided much needed space for future industrial growth.
FedNor-Industrial / Commercial Component NOHFC-Infrastructure and Community Development	Waterfront Park Final Stage	$1,000,000	$1,000,000	$7,075,000	Underground services, City Plaza, parking to attract residents and visitors to waterfront and downtown.
Build Canada	Universal Water Metering Project	$2,333,334	$2,333,334	$7,000,000	Residential water meters installed city wide for water conservation, leak detection and a fairer method of billing for water usage
Municipal Rural Infrastructure Fund (MRIF)	Airport Hill Upgrade of water distribution system		$1,766,667	$7,870,000	Improve water capacity to Airport Hill area to assist in growth at airport and to improve fire protection facilities
FedNor-Community Competitiveness and NOHFC-Infrastructure and Community Development	Pinewood Park Dr Sanitary Sewer Extension	$1,000,000	$1,300,000	$9,000,000	The extension of sanitary sewer services will incent both residential and commercial development in the south end of the City
Municipal Infrastructure Investment Initiative (MIII)	Oak Street, Fraser to Ferguson	$2,300,000		$2,600,000	Major infrastructure upgrades will support the downtown area and future development of the north-west quadrant of the City

Grant	Project	Provincial Funding Received	Federal Funding Received	Total Project Cost	Benefit
FedNor-Community Competitiveness and NOHFC-Infrastructure and Community Development	Oak Street, Ferguson to Wyld	$1,000,000	$500,000	$3,400,000	Major infrastructure upgrades will support the downtown area and future development of the north-west quadrant of the City
Community Competitiveness	Dyno Nobel/PGI/Fabrene Servicing		$117,452	$352,389	Provide water services to industrial development in south end of City to retain

5.4 RESERVE POLICY

The City funds capital projects directly via the tax levy (pay-as-you-go), debt issuance or other sources of funding. Capital Reserves are established for one-time expenses or one-time revenues. The capital reserve target is to have a reserve equal to 40% of the annual capital expenditure limit. This reserve is intended to be used for emergency capital costs or as a funding tool for unexpected capital project contingencies. The reserves are funded primarily by savings experienced in completed capital projects.

The City's primary capital reserves are as follows:

- General completed capital reserves
- Water completed capital reserves
- Sewer capital reserves

The reserve policy recognizes the need to protect the taxpayer from the risks of significant budget impacts arising from uncontrollable events and activities. The policy clearly addresses the need to enhance the financial stability and flexibility of the municipality.

5.5 HISTORICAL OPERATING EXPENDITURES

Table 5.3 summarizes the 2011 and 2012 expenditures associated with the City's infrastructure assets.

Table 5.3: Infrastructure Expenditures for 2011 and 2012

	Asset	2011 Total Expenditures ($)	2012 Total Expenditures ($)
Treatment Facilities	Waste Water Treatment/Disposal	$ 2,185,155	$ 2,365,975
	Water Treatment	$ 2,722,877	$ 2,710,529
		$ 4,908,032	$ 5,076,504
Sanitary/Stormwater System	Waste Water Collection/Conveyance	$ 2,425,076	$ 2,657,905
	Storm Sewer System	$ 839,329	$ 1,034,828
		$ 3,264,405	$ 3,692,733
Water Network	Water distribution/transmission	$ 6,580,640	$ 5,190,692
Bridges and Culverts	Bridges and Culverts	$ 610,069	$ 747,054

	Asset	2011 Total Expenditures ($)	2012 Total Expenditures ($)
Road Network	Paved	$ 8,285,429	$ 6,020,978
	Unpaved	$ 913,009	$ 52,474
	Traffic Operations & Roadside	$ 914,140	$ 963,864
	Street lighting	$ 958,165	$ 870,850
		$ 11,070,743	$ 7,908,166
	Total Expenditures	**$ 26,433,889**	**$ 22,615,149**

5.6 CAPITAL BUDGET AND 10-YEAR CAPITAL FORECAST

This is a public and Council endorsed plan that addresses short term financing needs for infrastructure through the annual budget process. The infrastructure needs are based on systematic integrated condition assessment processes in which the infrastructure needs based on condition are reviewed and prioritized and matched to available funding.

Typically, specific projects are identified in the 10-year capital forecast document. These include projects that are renewal based on condition assessments, estimates and projected available funding. Some particularly large projects may be identified in the later years. At this time, unfunded infrastructure renewal needs are not published as part of the budget process but are identified with the Asset Management Plan. The current plan does identify annual funding for design and planning costs associated to some unfunded projects. This allows many of these projects to be in the process of preliminary design to enable the project to start-up in a relatively short time should additional funding opportunities become available.

Appendix A Details of Maintenance and Rehabilitation Activities

A.1 WATER TREATMENT FACILITIES

Turbine Pumps – Inspection (vibration analysis/leaks) and Maintenance every 6 months.

Other Pumps – Routine maintenance or as required

Generators – Monthly inspections (temperature, oil leaks, etc.). Replace filters every two years. Routine maintenance or as required.

Electrical (Substations/Transfer switches) – Routine maintenance or as required.

Supervisory Control and Data Acquisition (SCADA) Systems – Upgrade systems as required.

Wastewater Treatment Membranes – New Microfiltration system. Replace every 10 years. Routine maintenance or as required.

Wastewater Treatment Clarifiers – Annual inspection (leaks). Repair concrete as required.

Water Reservoirs/Towers – Drain, clean and inspect every 5 years. Repair as required.

Buildings – Routine Inspections (e.g. Thermal Testing). Routine maintenance, repair or replace components (ex. roof) as required.

A.2 SANITARY/STORMWATER SYSTEM

A.2.1 Open Cut Construction

The open cut construction method refers to the installation or replacement of sewers by trenching (NRC, 2001). This construction method has been used for many years, and the technique is well known.

A.2.2 Trenchless Methods

Sliplining

Sliplining refers to the introduction of a flexible liner into a sewer. The liner is a continuous or discrete segment of pipe that is essentially pushed through the existing one. This results in the creation of a new pipe inside the old sewer – all without the need for excavation. The sliplined pipe is then simply reconnected to the existing sewer at both free ends. Sliplining can be applied to almost any pipe, is quick, and disruption of other nearby utilities is generally minimal. It is best used for pipes with few connections, and often installation can be accomplished without the need for bypass pumping.

Diameter Reduction Sliplining

This method of sliplining involves the insertion of a thermoplastic tube, temporarily deformed into the existing pipe. The tube is then returned to the proper diameter to create a close fit between the lining and the pipe wall. To reduce the diameter initially, the tube is passed through a set of dies, a process called swageing, or through compression rollers, and then inserted using a winch. When the tension on the winch is removed, the lining resumes its original shape. Thus, there is minimal loss of pipe diameter and no grouting is necessary compared to the original technique. Furthermore, the liner can provide full structural integrity if needed.

Fold and Form Sliplining

Using this technique, the liner is heated and folded at the factory before being transported to the work site. It is subsequently entered into the pipe and reformed with heat and pressure. PE liners are best used for pressure applications while PVC is optimal for use within gravity sewers. As with the other sliplining techniques, this method can be used in most pipes, is quick, and causes minimal site disturbance.

Cured-in-Place Pipe (CIPP)

With this method, a fabric tube is either injected with a thermosetting or ambient cured polyester, or an epoxy resin. The resin, once cured, then creates a stiff pipe. This new pipe can be engineered to have full structural or semi-structural capacity. As well, the tube can be designed for non-circular sections of pipe if needed, and the liners can turn through 90-degree bends.

Pipe Bursting

The method of pipe bursting involves the replacement of a defective sewer by breaking the old pipe and simultaneously inserting a replacement in the void produced. A pneumatic, hydraulic, or static bursting mechanism is used to break the host pipe, in turn, compressing the pipe fragments into the surrounding soil. Then the new pipe is pulled or pushed to fill the void left behind.

Horizontal Directional Drilling (HDD)

This technique involves several stages. Initially, a bore is made with a drilling rig, which is guided to make a hole at the required line and grade. Reamers are then used to enlarge the diameter of the hole to the required size. In the last stage of reaming, the service pipe is pulled back into the bore.

Internal Joint Seals

Internal joint seals are used to repair leaking pipes and are used mostly for water or force mains. The internal seal is flexible and water tight, while it allows water to flow without causing turbulent conditions. These joints are made of EPDM (ethylene propylene diene monomer) synthetic rubber. Since the application of these seals requires people to access the sewer, it must be sufficiently large to be a good contender.

Panel and Section Insert Linings

These are typically used only when person entry to the pipe can be done. GRP (glass-reinforced plastic), GRC (glass reinforced concrete), and Ferro-cement are the materials commonly used for this application. Panels are designed to be close fitting with fixed spacers, which are then grouted in position. Sewers large in diameter can be lined with sections instead of panels. The sections are brought into the pipe and then joined together in situ before being grouted in place.

Chemical Grouting

Chemical grouting is used mostly for spot repairs, typically to seal joints and cracks. This type of grouting reduces or stops the movement of water into or out of the pipe by creating an external impermeable mass in the soil surrounding the location of the repair.

Full Tunneling and Micro-tunneling

Deep installations generally use full tunneling or micro-tunneling techniques. While these methods are primarily used for new installations, they can also be utilized for the redirection of existing sewers when necessary.

Auger Boring

The process of simultaneously jacking casing through the earth, between two pre-sunk shafts, while removing the spoil inside the encasement, with a rotating flight auger.

Pipe Eating

Pipe eating is a method similar to micro-tunneling, where a pipe is replaced by excavating it with the surrounding soil. The replacement pipe is attached to the back of the tunneling shield and the existing pipe is substituted.

On a project-by-project basis, the City will review the available technologies to determine which activity is the most appropriate given the pipe condition and associated prevailing conditions.

A.3 WATER NETWORK

A.3.1 Cleaning

Cleaning of watermains typically involves flushing and swabbing. Flushing is the process of passing water through a section of pipe at a higher velocity than is normally seen, and discharging that water out of the system, usually through a hydrant. Flushing can be helpful in removing sediment or biofilms that accumulate in the pipe over time. Flushing can be implemented in known trouble spots, once a problem appears; however, preventative maintenance would employ a regular flushing program to remove sediment and biofilm before it becomes a problem. A uni-directional flushing approach is most effective. This approach starts at the treatment facility, with the highest diameter pipes, and proceeds to the extremities (lower diameter pipes).

Swabbing is the process of flushing a foam swab through a main, and out a dismantled hydrant. This process is more effective at removing solids, including some tuberculation. Swabbing also uses less water than flushing, but is more costly and more time consuming.

A.3.2 Valve Inspection and Exercising

The purpose of valve inspection is to ensure proper functioning of the equipment. It is possible that valves can be neglected until required in a critical situation (i.e. major leak), at which point they are inoperable. The only defense against this situation is regular maintenance. Exercising valves on a regular schedule will improve their length of service and the likelihood that they will be operable at critical times.

A valve-exercising program should be composed of four parts: locate the valves, fully exercise the valves, maintain valve records, and perform needed valve maintenance/repairs. AWWA states, "Each valve should be operated through a full cycle and returned to its normal position on a schedule that is designed to prevent a buildup of tuberculation [rust formation in pipes as a result of corrosion] or other deposits that could render the valve inoperable or prevent a tight shutoff. The interval of time between operations of valves in critical locations or valves subjected to severe operating conditions should be shorter than for other less important installations, but can be whatever time period is found to be satisfactory based on local experience."

A.3.3 Flow Testing Hydrants

Hydrants must be tested on a regular basis, to ensure that they are capable of delivering water at a pressure and rate of flow for public health and effective firefighting operation. Measurements of system pressure should be taken at a nearby hydrant, when a given hydrant is being flow tested. The following precautions relate to fire hydrant flow testing.

- Schedule routine testing for warm weather to avoid freezing,
- Limit time of test to avoid flooding

- Diffuse / direct flow to avoid erosion and property damage
- Notify customers who may be affected by flow tests in advance
- Avoid water hammer by careful opening and closing of valves

A.3.4 Monitor / Implement Cathodic Protection Systems

The City currently has a program in place for installing and marinating cathodic protection on its metal (Cast and Ductile Iron) pipes.

Cathodic protection (CP) systems employ sacrificial anodes to protect metallic pipes from galvanic corrosion. If CP has been installed in the City's network, it should be monitored on a regular basis to ensure that adequate protection is being provided. Good cathodic protection designs will provide test facilities and procedures for monitoring the system once it is in operation (NACE International, 1992).

A.3.5 Rehabilitation Activities

The rehabilitation approach for a water distribution pipe has historically been to replace the offending section with a new pipe. In the more recent past, however, trenchless technologies have proliferated. Each one has its own unique characteristics and a brief description is provided below, along with a discussion of open cut construction.

Sliplining

Sliplining refers to the introduction of a flexible liner into a pipe. The liner is a continuous or discrete segment of pipe that is essentially pushed through the existing one. This results in the creation of a new pipe inside the old one – all without the need for excavation. The sliplined pipe is then simply reconnected to the existing one, at both ends. Cleaning of the pipe and grouting of the annulus between pipes is necessary prior to insertion. Sliplining can be applied to almost any pipe, is quick, and disruption of other nearby utilities is generally minimal. It is best used for pipes with few connections.

Diameter Reduction Sliplining

This method of sliplining involves the insertion of a thermoplastic tube, temporarily deformed into the existing pipe. The tube is then returned to the proper diameter to create a close fit between the lining and the pipe wall. To reduce the diameter initially, the tube is passed through a set of dies, a process called swageing, or through compression rollers, and then inserted using a winch. When the tension on the winch is removed, the lining resumes its original shape. Thus, there is minimal loss of pipe diameter and grouting of the annulus is not necessary compared to the original technique. Furthermore, the liner can provide full structural integrity if needed.

Fold and Form Sliplining

Using this technique, the liner is heated and folded at the factory before being transported to the work site. It is subsequently entered into the pipe and reformed with heat and pressure. As with the other sliplining techniques, this method can be used in most pipes, is quickly installed, and causes minimal site disturbance. In addition to the benefits mentioned in the previous two sections, this method can cut and reinstate service connections using robotic equipment to reduce excavation requirements.

Cured-in-Place Pipe (CIPP)

With this method, a fabric tube is either injected with thermosetting or ambient cured polyester, or an epoxy resin. The resin, once cured, then creates a stiff pipe. This new pipe can be engineered to have full structural or semi-structural capacity. .

Spray-applied Lining

Spray-applied linings are typically either cement-mortar or epoxy. The process involves excavation of the pipe to be rehabilitated at the beginning and end of the length to be lined. The pipe is typically cleaned with a mechanical scraper, and either swabbed or flushed of any debris. Mortar or epoxy is then applied by a special machine with a rapidly revolving head. The material is applied by centrifugal force as the machine moves through the pipe. The speed of the machine and the amount of material being pumped can be adjusted to match the desired thickness. Spray-applied linings are typically 1mm thick in the case of epoxy linings to 5+ mm for cement-mortar lining.

Pipe Bursting

The method of pipe bursting involves the replacement of a defective pipe by breaking the old pipe and simultaneously inserting a replacement in the void produced. A pneumatic, hydraulic, or static bursting mechanism is used to break the host pipe, in turn, compressing the pipe fragments into the surrounding soil. Then the new pipe is pulled or pushed to fill the void left behind.

Horizontal Directional Drilling (HDD)

This technique involves several stages. Initially, a bore is made with a drilling rig, which is guided to make a hole at the required line and grade. Reamers are then used to enlarge the diameter of the hole to the required size. In the last stage of reaming, the service pipe is pulled back into the bore.

HDD is normally favoured when an open cut excavation is not suitable and the new watermain needs to be realigned.

Internal Joint Seals

Internal joint seals are used to repair leaking pipes and are used mostly for water or force mains. The internal seal is flexible and water tight, while it allows water to flow without causing turbulent conditions. These joints are made of EPDM (ethylene propylene diene monomer) synthetic rubber. The pipe is prepared initially by ensuring that the joints are clear of all debris, both on the inner and outer surfaces. Then, a Portland cement grout is used to fill the joint and made flush with the internal surface of the pipe. The area is then cleaned using a dry brush and soap (that must be compatible with the seal about to be used). The seal is then positioned and stainless steel retaining bands are installed in the seal's grooves. A hydraulic expanding device applies a specific pressure to the bands to keep the seal in the correct location.

Full Tunneling and Micro-tunneling

Deep installations generally use full tunneling or micro-tunneling techniques. While these methods are primarily used for new installations, they can also be utilized for the redirection of existing watermains when necessary.

Full tunneling refers to a method whereby an opening below ground is created that is large enough to allow individuals to "access and erect a ground support system" in the location of the excavation. Alternatively, micro-tunneling "uses a remotely controlled boring machine combined with the pipe jacking technique to install pipelines directly." Since no human entry is needed, safety concerns are reduced, and it can be used even when unstable ground conditions persist.

A.3.6 Replacement Activities

Open Cut Construction

The open cut construction method refers to the installation or replacement of watermains by trenching (NRC, 2001). This construction method has been used for many years, and the technique is well known.

A.4 BRIDGE AND CULVERT NETWORK

Table A.1 through to Table A.7 describe the maintenance activities for Bridges and Culvert

Table A.1: Cleaning and Flushing

Activity Name	Cleaning and Flushing
Activity Description	Cleaning and flushing of concrete decks, drains, expansion joints, lower chords, bent caps and other elements. All drainage devices including curb outlets, pipe drains, floor drains, downspouts, etc., should be adequately cleaned to prevent ponding of water on the deck. Includes cleaning of drainage system to remove items such as bottles, cans, rubbish, debris, etc.
Recommended Frequency	Annual – typically in spring
Purpose/Benefits	Ponding of water on the deck leads to safety issues for vehicles such as hydroplaning or skidding on ice in winter. Structural deterioration occurs when water carrying deicing chemicals penetrate the concrete causing eventual deterioration, especially in cracks and joints. Removal of salt-laden dirt and debris assists in slowing the following distresses: • scaling of concrete surfaces • corrosion of reinforcing steel and subsequent spalling of concrete • deterioration of paint systems and corrosion of supporting members • corrosion and "freezing" of expansion bearings which can cause excessive tensile stresses to be transmitted to the concrete under the bearing pad after sudden drops in temperature which causes the structure to contract rapidly • Clear deck drainage systems will reduce or avoid ponding water, which can lead to vehicle safety issues such as hydroplaning or skidding on ice. Continued ponding will promote rapid concrete deck deterioration.
Costs/Concerns	It is critical that dirt, debris, and trash be removed from the lower chord and floor beam flanges and connections on truss spans. Failure to do so can lead to loss of section in the steel members at these points. Ensure any drainage that discharges onto supporting members is directed away from these members.

Table A.2: Crack Sealing

Activity Name	Crack Sealing
Activity Description	Sealing individual longitudinal, transverse, or random cracks with asphalt or other suitable materials.
Recommended Frequency	As required or at 5 year intervals, whichever is the shorter
Purpose/Benefits	Cracks can be caused when moisture, which carries deicing chemicals, enters the deck cracks. The moisture and chemicals can cause the reinforcing steel to corrode. When the moisture and chemicals swell or expand, the concrete will spall over the reinforcing steel. When the moisture remains trapped in the crack, freezing temperatures or traffic action will also contribute to spall development. Therefore, prevention of moisture and deicing chemicals from entering the cracks will slow the deterioration of the concrete deck. It should be noted that deicing salts in solution can also enter uncracked concrete by permeating the surface. This can cause corrosion of the embedded steel and subsequent cracking.
Costs/Concerns	

Table A.3: Asphalt Surface Treatment

Activity Name	Asphalt Surface Treatment
Activity Description	Asphalt or equivalent sealer can be applied to the surface of significantly cracked or extensively patched decks.
Recommended Frequency	A surface treatment can restore the functional properties of the pavement on the deck, including the smoothness and surface condition. The application of a functional overlay assumes that the structural integrity of the pavement has not been compromised through the various load and environmental conditions. A functional overlay is expected to last from five to eight years.
Purpose/Benefits	Provides protection against the effects of moisture and deicing chemicals for decks that are subjected to frequent freezing and thawing cycles, high moisture, and/or frequent exposure to salt brine.
Costs/Concerns	Traffic volume, grade, and bridge alignment should be considered prior to sealing since these factors will greatly influence the successful performance of the seal. Seal the entire bridge deck including the curb outlets (except for inside the curb outlets when the coverstone is broadcast on the deck). It is important to keep the deck expansion devices free of the sealant material since this may interfere with their proper functioning and movement. Remove any material that enters the expansion device promptly and completely. For a short time after sealant application, remove excess coverstone from the deck daily in order to reduce windshield damage and avoid blockage of drains. Remove excess coverstone from the substructure caps and lower chords of the truss spans. This material may be reused for scalping and sealing areas around timber abutments and abutment wings or for sealing gutters at the bridge ends.

Table A.4: Asphaltic Concrete Overlay

Activity Name	Asphaltic Concrete Overlay
Activity Description	An overlay is a new lift or lifts placed on an existing pavement. The thickness of an overlay varies depending on the severity and extent of the distresses visible on the pavement surface, the roughness of the riding surface, and the structural improvement required to meet the traffic loads. Specific distresses are typically repaired either through milling or patching prior to the placement of the overlay. (TAC 97) Milling can be included prior to the asphaltic concrete overlay where moderate to severe surface distresses on the deck are present.
Recommended Frequency	An overlay would be considered a functional overlay that restores the functional properties of the pavement on the bridge deck, including the smoothness and surface condition. The application of a functional overlay assumes that the structural integrity of the pavement has not been compromised through the various load and environmental conditions. A functional overlay is expected to last from 5 -8 years. Milling and replacing the top course of asphalt is expected to last 15 years.
Purpose/Benefits	Provide a smooth riding surface and help reduce damaging impact to the deck. Can be used as a protective wearing surface for penetration asphalt, membrane waterproofing systems or other deck sealers. End dams should be provided at expansion joints to protect the overlay next to the joint and to keep overlay material out of the joint.
Costs/Concerns	Asphaltic concrete overlays are relatively porous and therefore, do not provide an effective seal. The porosity can entrap salt-laden moisture, which can promote deck deterioration in the absence of an effective deck sealer. A multiple-course penetration asphalt surface treatment, membrane or other deck sealer should always be applied prior to an Asphaltic concrete overlay. Periodic inspection of asphaltic overlays on concrete bridge decks for cracking and debonding from the concrete, commonly found around curbs, expansion joints and at locations where the overlay is cracked. The overlay in these loose areas should be removed and replaced. For good adhesion, the concrete deck must be dry and primed with an effective sealer and bonding agent before placing the asphaltic overlay and all cracks should be sealed to prevent entry of water.

Table A.5: Clean Expansion Joints and Replace Joint Filler

Activity Name	Clean Expansion Joints and Replace Joint Filler
Activity Description	Filled expansion joints should be cleaned of all incompressible materials. Replacing joint filler with asphalt impregnated felt or polyurethane foam topped with poured-in-place rubber asphalt, polyvinyl chloride, polysulfide, neoprene, butyl rubber, or polyurethane, if filler is required.
Recommended Frequency	Replace strip seals after 5 to 15 years and replace the entire joint assembly after 15 to 30 years.
Purpose/Benefits	Incompressible material such as dirt, sand, coverstone, debris, etc., found in expansion joints will inhibit the expansion and contraction of the bridge. This may cause the concrete deck and/or the girder ends to crack or crush when expanding which can cause undue pressure on the superstructure bearings. This can result in cracking and spalling of a concrete substructure cap. Deterioration of the adjacent deck can also be caused by joints filled with debris, moisture, and deicing chemicals.
Costs/Concerns	

Table A.6: Culvert Inspections

Activity Name	Inspections
Activity Description	Careful and systematic inspection in order to identify areas that require attention before they require major rehabilitation or become potential failures.
Recommended Frequency	Biennial inspections. Culverts with three to six metre spans and retaining walls in good condition can be inspected every four years.
Purpose/Benefits	Identification of defects may suggest rehabilitation of culvert based on inspection observations. Inspections are required in order to identify performance deficiencies such as pedestrian and vehicular hazards.
Costs/Concerns	Defects identified during inspections require correction.

Table A.7: Stream Maintenance

Activity Name	Stream Maintenance
Activity Description	Cleaning and removal of items such as bottles, cans, rubbish, debris, etc., from the stream. Redefine stream where meandering and channelization has occurred.
Recommended Frequency	As required
Purpose/Benefits	Ensure stream is clear of obstruction. Ensures stream flow is directed through the channel.
Costs/Concerns	Activities should be reviewed with the respective Authorities to ensure that the risk of potential contamination of the watercourse is minimized.

A.5 ROAD NETWORK

The City abides by the Ministry's minimum maintenance standards (Ontario Regulation 239/02), which specifies the frequency that roads need to be patrolled, and issues, including potholes, cracking, winter maintenance, and so forth, be addressed, based on road classification.

The City's Municipal Performance Measurement Program summarizes operating costs for roads, and specifies percentage of roads in desirable condition.

In addition to routine maintenance activities, based on requirements and/or operations guidelines, the City uses a pavement management system to determine optimal timing for preventive maintenance and rehabilitation work; this is described further in the section below.

A well-implemented pavement management system allows the City to realize the benefits of lower-cost treatments such as preventive maintenance and light rehabilitation activities, by targeting interventions within the network, before more costly treatments, or full replacement, become necessary. The management philosophy applied within the City, with respect to the road network, is to "Apply the right treatment to the right asset at the right time".

The City uses the RoadMatrix pavement management software to set service level targets, and determine the most cost-beneficial pavement maintenance and rehabilitation strategies to be applied, at the most optimal time.

The system uses the results of the pavement condition survey, coupled with predictive pavement deterioration curves and decision tree models, to determine appropriate Maintenance and Rehabilitation (M&R) treatments for each pavement segment in the City's road network.

For each combination of pavement type and functional class, a unique decision tree model has been developed and implemented. A sample tree for asphalt Arterial Roads is illustrated in Figure A.1.

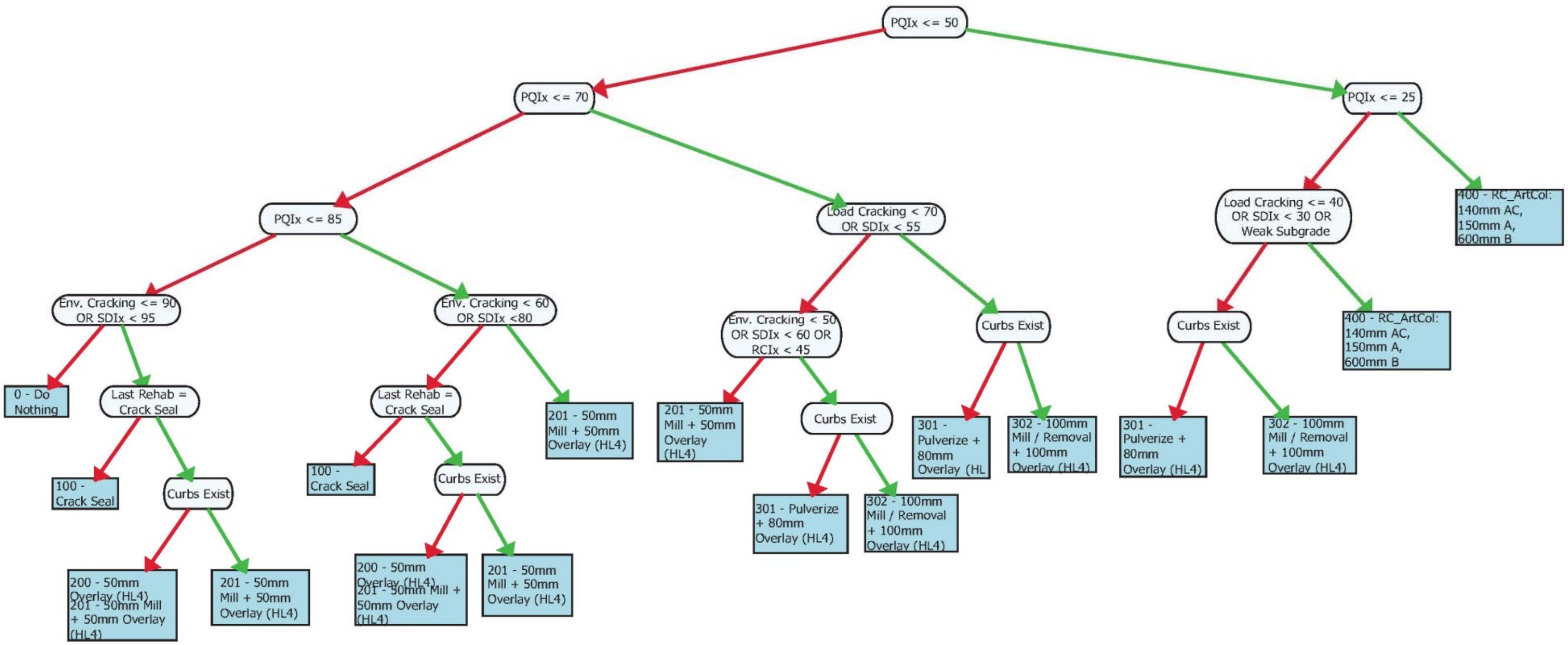


Figure A.1: Arterial/Flexible Pavement Decision Tree

The decision trees allow the City to identify maintenance and light rehabilitation treatments early in a pavement's life, when surface conditions are good and the pavement has not begun to experience more rapid deterioration due to weather, traffic loadings, and age. Applying early intervention strategies extends the life of the pavement significantly at a low cost; therefore, the cost-benefit of these types of interventions is typically high.

Using a combination of appropriate decision tree matrices (Figure A.1) and cost-benefit analyses is an optimal approach to identifying maintenance and light rehabilitation work, minimizing the need for costly reconstruction activities (Figure A.2).

Allowing pavements to deteriorate further, triggers the need for heavier rehabilitation strategies. Although heavy rehabilitation is typically less cost-effective than maintenance and light rehabilitation, it is still preferable to apply this type of treatment, instead of the more costly full reconstruction of a road section.

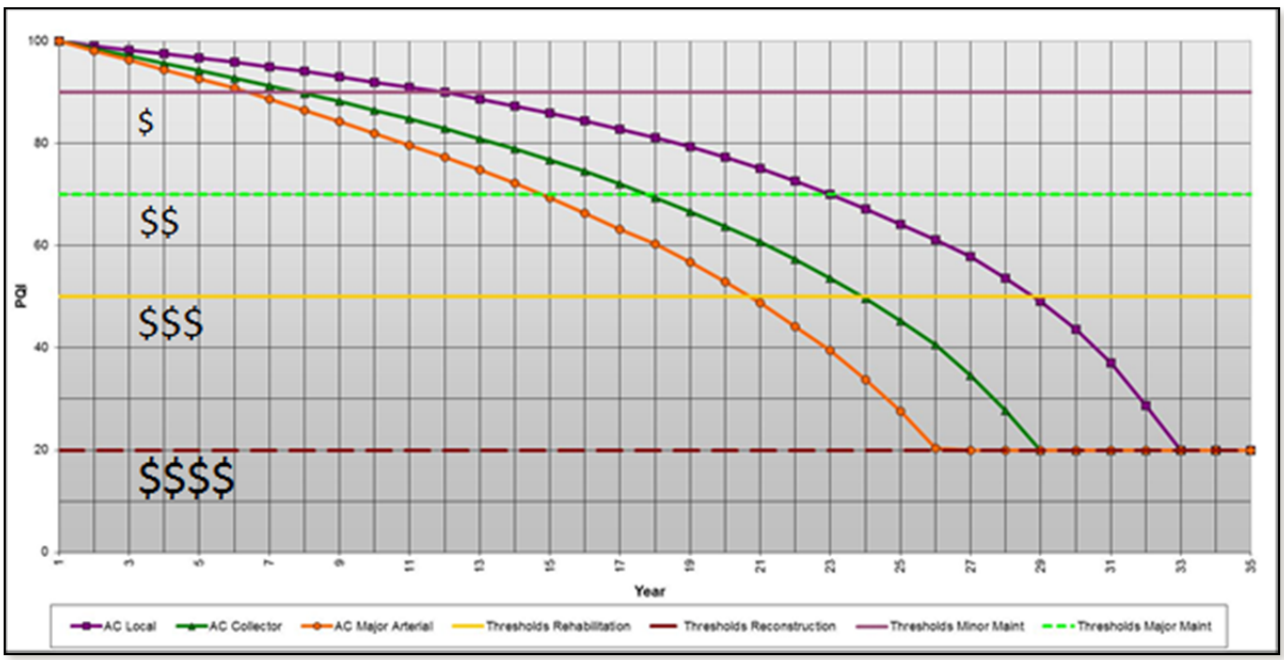


Figure A.2: Conceptual Representation of Trigger Points for M&R Activities, and their Relative Costs

The City has taken a proactive approach in implementing its pavement maintenance and rehabilitation program. Following its most recent pavement condition survey in 2011/2012, the City reviewed and refined its pavement management system parameters, including deterioration curves, decision trees, and treatment benefits. These improvements allow for a more comprehensive cost-benefit analysis of the network. Pavement treatment benefits are summarized in the table below.

Table A.8, below, summarizes the types of treatments and their associated "benefits" that will be theoretically realized when applied to the roads. For example, a segment where a "Crack Seal" maintenance activity is applied, will improve the surface condition of the road segment by eight points (in a scale of 1 – 100), and that value will be held for two years, before it begins to deteriorate. A 50mm overlay will increase the overall thickness of the road section, which in turn, will improve the ride quality and the surface condition of the road section by 10 points and 35 points, respectively. It should be noted that the pavement management system models assume that the pavement structure will continue to deteriorate as soon as the treatment applied.

These benefit values, weighed against their corresponding costs, allow for detailed cost-benefit analyses and determination of best timing for intervention, based on desired level of service and/or funding limitations. This allows the City to apply the right treatment to the right road at the right time.

Table A.8: Pavement Management System Treatment Benefits

Description	O&M Category	EGT Increase	EGT	Subgrade	RCI Increase	SDI Increase	RCI Max	SDI Max	SDI Hold Yrs
Crack Seal	Maintenance	0				8	70	98	2
Chip Seal	Maintenance	5				20	70	98	4
50mm Overlay (HL4)	Rehabilitation	100			10	35	75	98	
50mm Mill + 50mm Overlay (HL4)	Rehabilitation	0			50	50	75	100	
Localized 50mm Mill + 50mm Overlay (HL4)	Rehabilitation	0			20	40	75	90	
Pulverize + 50mm Overlay (HL4)	Rehabilitation	100			80	100	80	100	
Pulverize + 80mm Overlay (HL4)	Rehabilitation	160			80	100	80	100	
100mm Mill / Removal + 100mm Overlay (HL4)	Rehabilitation	0			80	100	80	100	
150mm Rural Overlay (RAP)	Rehabilitation	262.5			80	100	80	100	
Cold Placed 150mm RAP + 50mm Overlay (HL4)	Rehabilitation	362.5			50	100	85	100	
RC_ArtCol: 140mm AC, 150mm A, 600mm B	Reconstruction	0	832	Strong	85	100	85	100	
RC_Local: 90mm AC, 150mm A, 450mm B	Reconstruction	0	631.5	Strong	85	100	85	100	

Description	O&M Category	EGT Increase	EGT	Subgrade	RCI Increase	SDI Increase	RCI Max	SDI Max	SDI Hold Yrs
RC_Rural: 150mm RAP, 150mm A, 450mm B	Reconstruction	0	412.5	Strong	85	100	85	100	
RC: Interlock Paver	Reconstruction	0	443.8	Strong	85	100	85	100	

Appendix B Life Cycle Analysis and Assessing Sustainable Funding Requirements

The assessment of Sustainable Funding Requirements is firmly grounded in the asset management principles contained within the National Infrastructure Guide (InfraGuide) and is based upon the seven questions identified in the Best Practice for Municipal Infrastructure Asset Management, produced by InfraGuide in November 2003. These questions are:

1 What do you have and where is it? (Inventory)
2 What is it worth? (Costs/replacement Rates)
3 What is its condition and expected remaining service life? (Condition and Capability Analysis)
4 What is the level of service expectation, and what needs to be done? (Capital and Operating Plans)
5 When do you need to do it? (Capital and Operating Plans)
6 How much will it cost and what is the acceptable level of risk(s)? (Short- and Long-term Financial Plan identified by City Staff)
7 How do you ensure long-term affordability? (Short- and Long-term Plan resulting from the study)

The questions above have been paraphrased to form the basis of our analytical framework. The following sections identify the questions that were asked by Stantec, why they are asked, what they mean, and how they were utilized. The framework is identified in Figure B.1 below. Note that the State of the Infrastructure Report provides the basis for defining the way forward to answer the seventh and final question, but the answer to that question lies in the City's hands and is addressed within Section 5 if the Asset Management Plan.

The City of North Bay completed its first State of the Infrastructure (SotI) study in 2008, employing the above framework. An updated State of the Infrastructure report, and asset frameworks studies, were completed in 2011/2012. These studies have been acknowledged by the Ministry of Infrastructure as essential building blocks on the road to developing detailed asset management plans (http://www.moi.gov.on.ca/en/infrastructure/building_together_mis/local_infrastructure.asp).

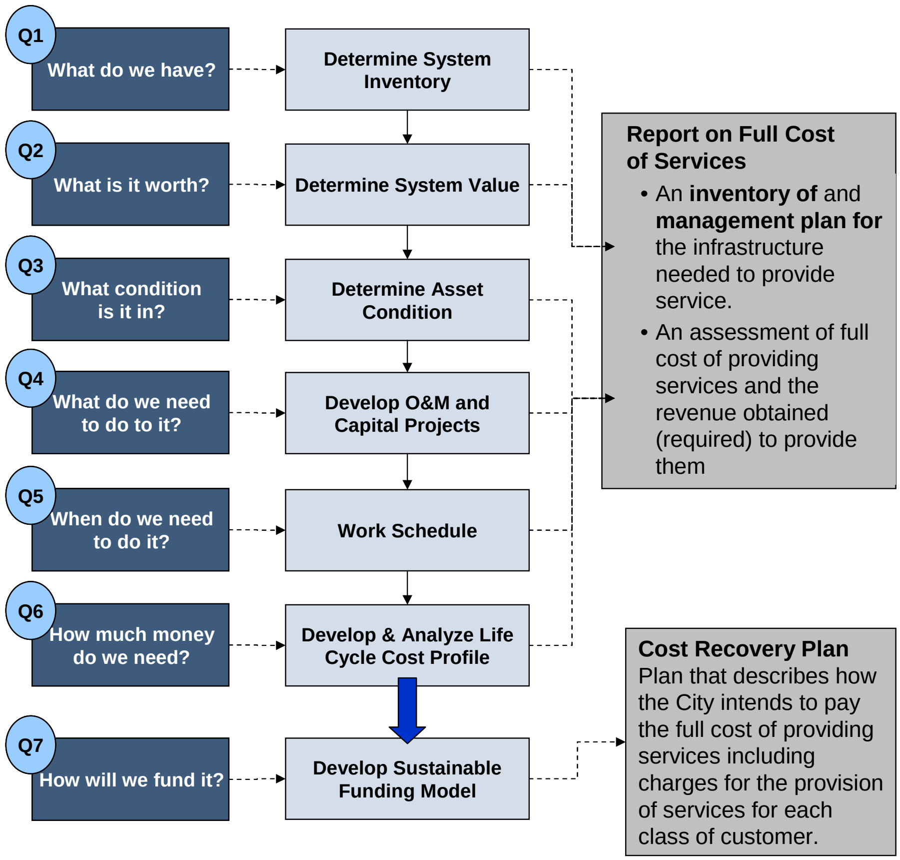


Figure B.1: Seven Questions

B.1 WHAT DO WE HAVE?

"What do we have?" is answered in large part by the inventory currently maintained by the City of North Bay within databases, hard copy records, or based on inventory estimates made by City staff. This information is incorporated into Stantec's systems to be analyzed. Table B.1 provides an example of how the inventory would be represented and utilized for the analysis.

Table B.1: Inventory Component

Asset Type	Asset Component	Inventory	Unit Replacement Cost	Overall Replacement Value (M)	Typical Useful Life (years)
Water System	Service Connections	15,000	$1,400 ea	$21	60

B.2 WHAT IS IT WORTH?

Based on industry knowledge and input from the City's staff, a unit cost and a useful life were established for each asset. As shown in Table B.1, an overall replacement value was calculated and combined with the useful life in the analysis, to determine the sustainable funding requirements for the asset type.

B.3 WHAT CONDITION IS IT IN?

Initially, the condition of the assets was identified through the assessment of each asset's remaining life, based upon the date of construction and the useful life of the asset. These remaining lives formed the basis of a financial analysis.

In addition, during a series of interviews with City staff, each asset type was rated using a modified ASCE alphabetic system as outlined in Table B.2. This approach was utilized for all asset types.

Table B.2: ASCE Ratings

ASCE	Description
A	Exceptional
B	Good
C	Mediocre
D	Poor
F	Inadequate/Fail

In order to accomplish this high-level assessment, a five-step process was completed during the interview process, as outlined below.

Step 1: Sub-division of Asset Types

Step 2: Overall Rating of Current Physical Condition Only

Step 3: Detailed Rating of Current Condition

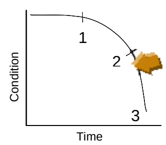
- Condition and Performance
- Capacity versus Need
- Funding versus Need

Step 4: Blended Rating

Step 5: Projected Rating of Future Condition (improving↑, status quo→, deteriorating↓)

Table B.3 illustrates a completed Condition Assessment Table for one component of the Water System.

Table B.3: Condition Assessment Table

Asset Component	Condition	Useful Life (Years)	Rating (A, B, C, D or F)		Overall Rating (A, B, C, D or F)	Trend (2027)
Services and Connections		60 (40 – 80)	Condition & Performance	D	**C-**	
			Capacity vs. Need	B		
			Funding vs. Need	D		

B.4 WHAT DO WE NEED TO DO TO IT?

For high-level and financial planning, an asset's life cycle will typically consist of four distinct phases during its useful life. These phases are summarized below, and Figure B.2 shows how they are related.

1 Minor Maintenance - required for the first 25% of the asset's useful life
2 Major Maintenance - required from 25% of the asset's useful life until rehabilitation or reconstruction of the asset
3 Rehabilitation - generally required between 50 to 75% of the asset's useful life
4 Replacement - required between 75 to 100% of asset's useful life

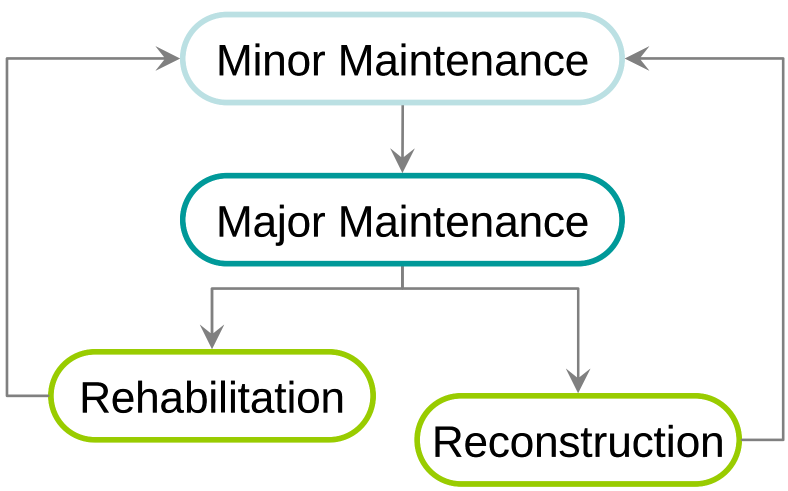


Figure B.2: Life Cycle Phases

Minor maintenance includes:

- Planned activities that are required for an asset to function properly and at an expected level of service

Major maintenance refers to the additional services that are required as assets are depleted through aging and regular use. It includes:

- Continued performance of minor maintenance activities
- More intensive regular maintenance
- Unscheduled or emergency maintenance activities.

As an asset reaches the later stages of its useful life, it must be decided whether to rehabilitate or reconstruct that asset. Rehabilitation involves rejuvenating the existing asset through a single, capital-funded activity. After rehabilitation is complete, the asset's useful life and condition should be near or at the level of a new asset. Reconstruction involves completely removing the existing asset and replacing it with an entirely new asset. This approach provides a new asset with a service life and possibly capacity that meets or exceeds that of the asset it replaced. However, reconstruction costs are significantly greater than the costs of rehabilitation.

Rehabilitation, though generally considered to be more economical, is not always the most viable option. There are many situations in which reconstruction is the more favourable, or even the only option. For example, if the condition of the asset as deteriorated below the level at which rehabilitation can be performed satisfactorily, then reconstruction of the asset becomes the only option available. Or if the demand on that asset has changed or is expected to change in the near future, replacing that asset with one that provides the required service capacity could be more economical than rehabilitating the existing asset and maintaining an inappropriate service capacity. Also, assets can only be rehabilitated a limited number of times before the original components wear excessively and the entire asset needs to be reconstructed.

B.5 WHEN DO WE NEED TO DO IT?

B.5.1 Deterioration Models and Assumptions

The New Zealand Infrastructure Asset Valuation and Depreciation Guidelines define failure as "the point where assets fail to achieve required levels of service".

A useful life span can be assigned to an asset type, such as 90 years of useful life for a water main. However, there are many conditions that can affect the true life of an asset, such as: design, construction, and manufacture quality, maintenance standards, quantity of use, surrounding environment, construction material, and so forth.

With the exception of Road Sections, where pavement deterioration models were available, the following intuitive failure distribution model was utilized to provide a more realistic representation of the actual asset replacement quantities than would be achieved if the analysis only assumed a fixed time of failure for all assets. The following example, based upon longer-lived assets such as water or sewer pipes, illustrates the failure model that was used. For an asset with a longer life, an assumption was made that: 5% would fail at 50% of the asset life; 15% would fail at 75% of the asset life; 15% would fail at 125% of the asset life; and the balance, or 65%, would fail at the prescribed or fixed asset life. An example this method applied to an asset with a 100-year design life is represented graphically in Figure B.3.

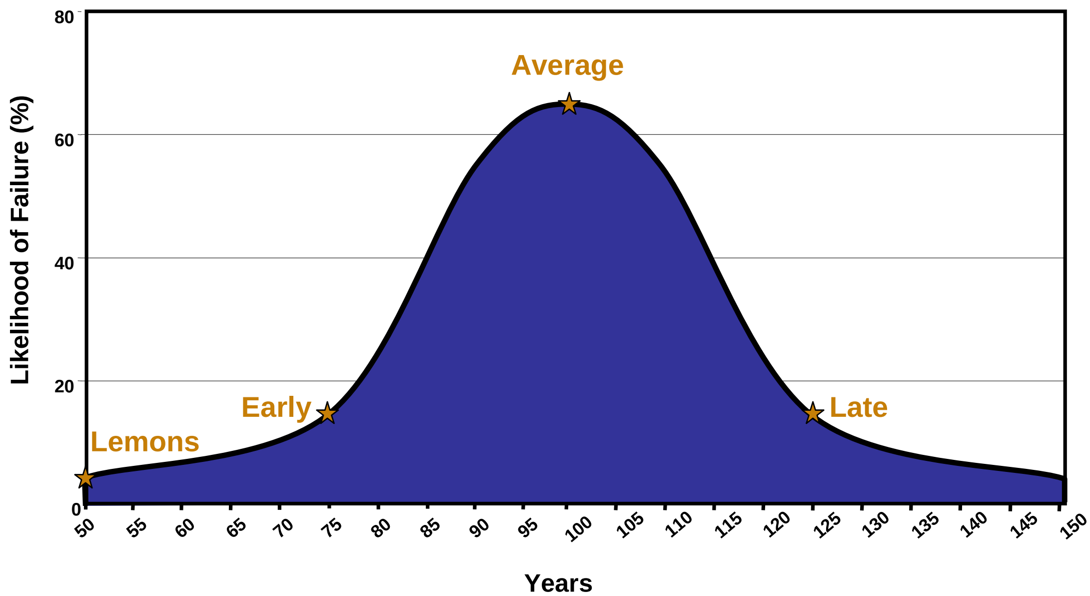


Figure B.3: Failure Distribution

This principle was applied against Water, Sanitary and Storm pipes.

The level of intervention on infrastructure will vary significantly over the life cycle of an asset. The process of maintenance, rehabilitation, and failure is a very dynamic system. Therefore, it is essential that we take a life cycle approach to assessing the financial needs for the future.

This dynamic process of asset aging has a significant financial impact attached to it that can be quantified. Therefore, our financial analysis is based upon a life cycle model that identifies upcoming trends in asset replacement and, hence, funding needs.

B.5.2 Window of Opportunity

"Doing the right thing; at the right time; to the right asset" - this is a guiding principle of Asset Management. The life cycle analysis utilized within this report identifies when work should be done, based on fixed points in time, and the resulting costs. However, if we look at the window of opportunity, we will discover that there are time lines within which certain work can and should be done. The window of opportunity is the time line along the deterioration of an asset, from the point where an activity could be performed to the point where it is no longer practical to perform that activity. Figure B.4 shows an example of the windows of opportunity for pavement treatment on a local asphalt road.

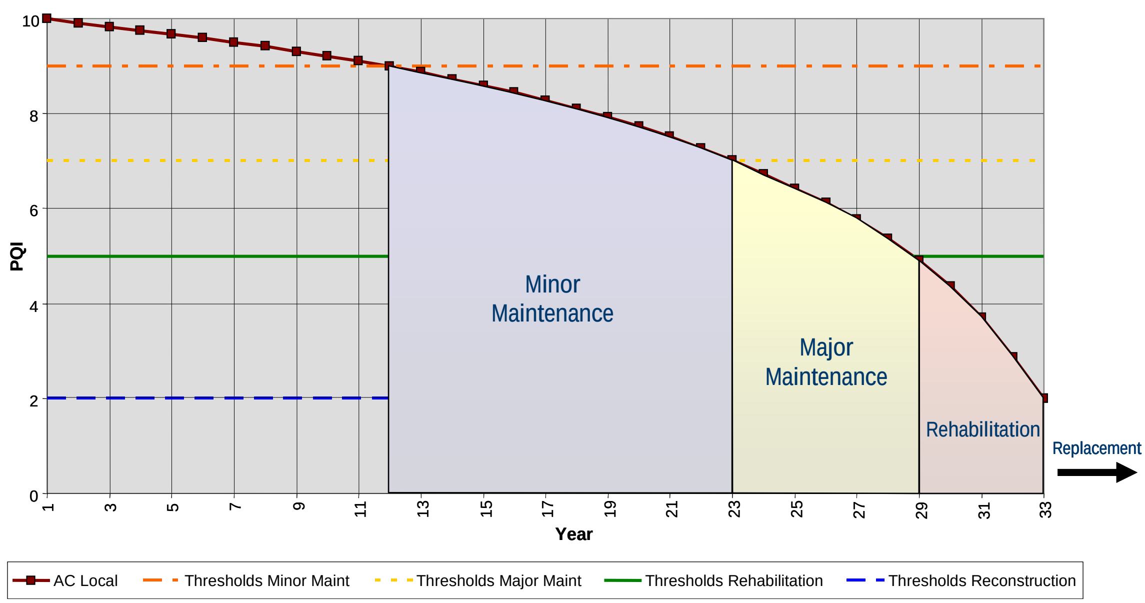


Figure B.4: Window of Opportunity

A typical practice within municipal government is to stabilize the budget and expenditures so there are only minor changes in the actual expenditure from one year to the next. This practice is contrary to the guiding Asset Management principle, since the required activity in the required year may exceed the available budget. Alternatively, the budget could actually be reduced since it is not cost-effective to proceed with work too early, but funds need to be available in the future, for when the work should be done. In other words, timeliness should be the objective and not the amount of money that was invested the previous year. The window of opportunity does provide some leeway to move an activity forward or backward in time, allowing staff flexibility to adjust the schedule to fit within the available budget. This type of analysis is beyond the scope of this report. The Asset Manager needs to plan ahead, placing money into reserves to deal with peaks in funding requirements, and not try to make "required" work fit the annual budget. Hence, doing the right thing to the right asset, at the right time.

B.6 HOW MUCH MONEY DO WE NEED?

B.6.1 Financial Assumptions

Figure B.5 provides a listing of financial assumptions that have been used as a starting point within the project; these assumptions are consistent with those used within the 2008 report.

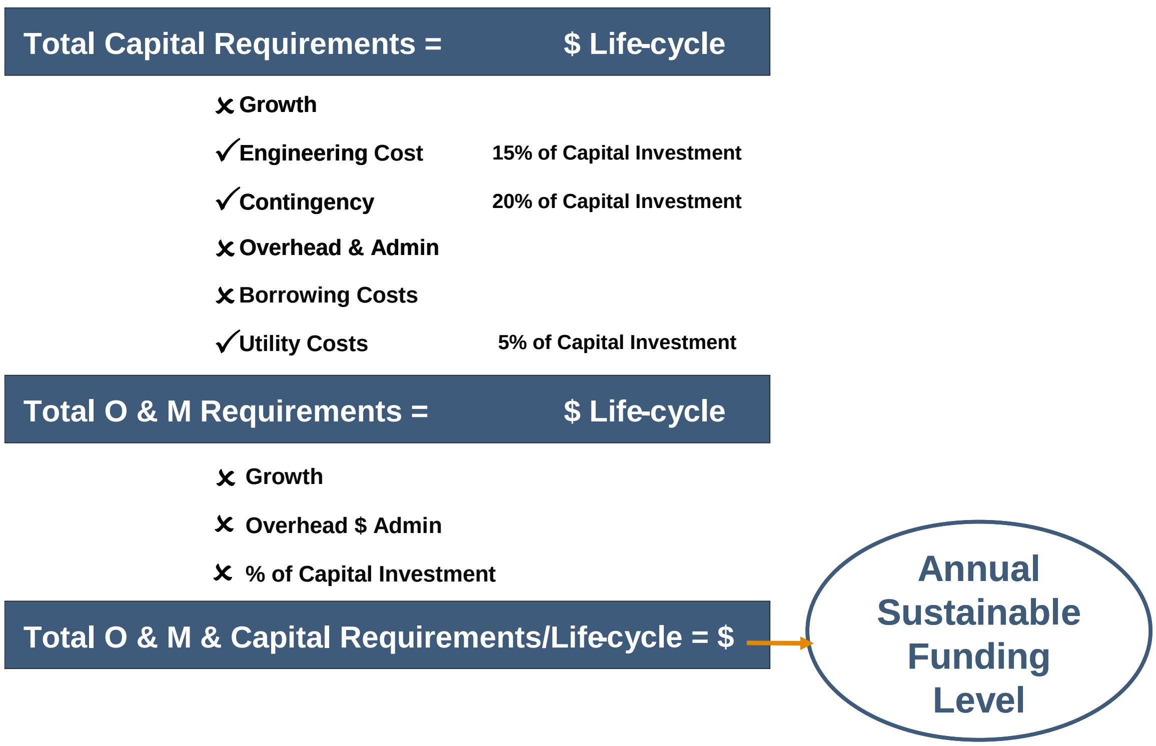


Figure B.5: Financial Assumptions

The following basic financial assumptions were used in writing this report, with exceptions and details noted as required:

- Costs are shown in current dollars.
- No discount rate was used, since net present value calculations were not incorporated.
- No inflation was used, and neither was interest gained on reserve funds. These would have a tendency to balance out over time.

B.6.2 Operations and Maintenance Costs

Since an age distribution was not known for all of the asset components an overall O&M percentage was determined. Based upon the assumed construction profile of the linear asset component a constant O&M percentage was calculated which was used for the non-linear assets. These percentages are indicated in Table B.4.

Table B.4: O&M Percentages

Asset Type	Linear Asset Component	Current Linear Asset Length	O&M as a Percent of Replacement
Water System	Water Pipes	315 km	1.6%
Sanitary System	Sanitary Pipes	268 km	1.8%
Road Network	Road Sections	371 km	1.4%
Storm System	Storm Pipe	227km	1.7%

For the Treatment Facilities the overall average percentage applied to determine the O & M investments was 1.6% per annum of the facility replacement values.

As can be seen from the profile in Figure B.6, O&M costs fluctuate based on the current age of the assets. This would indicate that O&M funding should also fluctuate and not stay constant from year to year. At first, this appears to be counterintuitive, but as shown, it is a logical extension of that most basic premise of cost-effective asset management: doing the right thing, at the right time, to the right asset.

Ultimately, the City may choose not to actually minimize dramatic fluctuations in the O&M budget, and instead establish a base budget and request a more detailed work plan for additional funding in any given year.

A more detailed assessment of O&M requirements, based on each asset type, would provide a clearer picture of what the additional O&M funding would be used for and when it would be required. As the City moves forward with the population of the Hansen Asset Management system it will become much easier to track the costs of O & M, thereby, allowing future updates of this report to reflect the actual costs to the City.

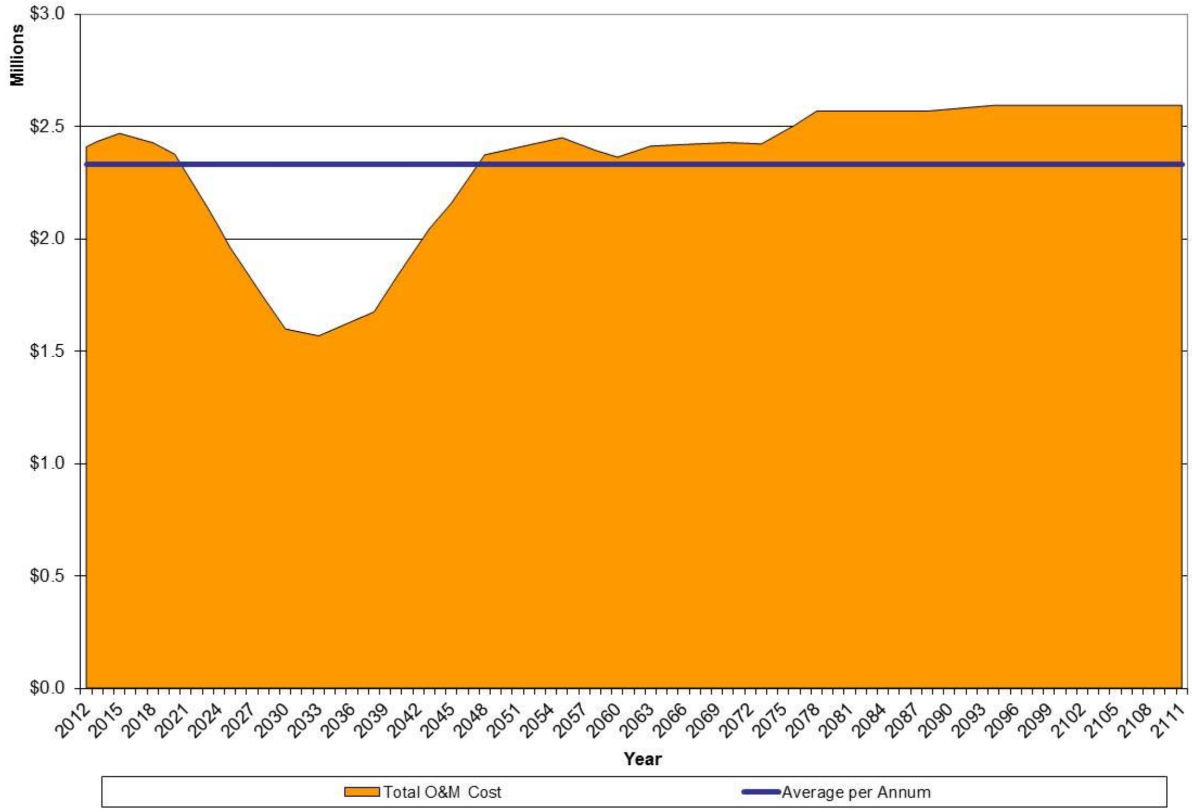


Figure B.6: Water Pipe O&M Distribution

B.6.3 Sustainable Funding Level

The sustainable funding level is based on the average level of expenditure over a 100-year analysis period. However, it is recognized that many components will not last 100 years and reasonable individual life expectancies were assigned and built into the models. In those cases where the useful life of an asset component is less than the 100-year analysis period, that asset was simply calculated as being replaced a number of times, i.e. a component with a projected 25-year life would be replaced 4 times over the period of the analysis.

Therefore, the sustainable funding level identified within this report represents the annual revenue that the City must generate through taxes, rates, or user fees, to sustain the services that are currently provided to the community.