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City of Sault Ste. Marie Asset Management Plan Stormwater

August 8th , 2022

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AECOM: 2015-04-13

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Revision History

Revision	Revision date	Details	Authorized	Name	Position
Draft V0	June 30th, 2022	Draft Report – Stormwater AM Plan		Chris Lombard	Project Manager
Final Report	August 8th, 2022	Final Report – Stormwater AM Plan		Chris Lombard	Project Manager

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List of Abbreviations

Abbreviation	Description
AM	Asset Management
AMP	Asset Management Plan
CCTV	Closed Circuit Television Video
CIBI	Canadian Infrastructure Benchmarking Initiative
CMMS	Computerized Maintenance Management System
ESL	Estimated Service Life
FIPPA	Freedom of Information and Protection of Privacy Act
GIS	Geographic Information System
LoS	Level of Service
MFIPPA	Municipal Freedom of Information and Protection of Privacy Act
O&G	Oil and Grit
O&M	Operations and Maintenance
O. Reg.	Ontario Regulation
PUC	Public Utilities Commission
RSL	Remaining Service Life
TBD	To be determined

1. Introduction

AECOM Canada Ltd. (AECOM) was retained by The City of Sault Ste. Marie (the "City") to develop an asset management plan to comply with the first phase of the Ontario Regulation 588/17 (O. Reg. 588/17) requirements in respect to its core municipal infrastructure assets. The scope of work for this investigation is outlined in AECOM's proposal dated June 9th, 2021 and subsequent project correspondence.

1.1 Background

Sault Ste. Marie is a city located on the St. Mary's River, North of the United States of America, bordering on two of the Great Lakes with an estimated population of 73,368 (2016). The City provides a wide range of public services to their constituents with the expectation from the public that these services are expected to function efficiently at a certain level. The provision of these services requires the management of the physical assets to meet desired service levels, manage risks, and to provide long term financial sustainability. These assets include, but are not limited to roads, bridges, sidewalks, wastewater assets, stormwater management assets, landfill, fleets, buildings, and parks.

In accordance with the terms of reference for this assignment, it is understood that the City is proceeding with an asset management plan to comply with the first phase of the regulatory requirements in respect to its core municipal infrastructure assets, in accordance with O. Reg. 588/17, by July 1, 2022. The core assets to be included in the scope, as defined by the regulation, include the City's wastewater assets, stormwater management assets, roads, and bridges and culverts.

1.2 Scope and Objectives

In 2015, the City's first Asset Management Plan (AMP) was published. In 2019, by the City Council approval, the Strategic Asset Management (AM) Policy for the City came into effect.

Organizations that implement good AM practices will benefit from improved business and financial performance, effective investment decisions, and better risk management. Stakeholders can expect lower total asset life cycle costs, higher asset performance, and confidence in sustained future performance.

The objective of this AMP is to capture the core infrastructure assets and deliver a financial and technical roadmap for the management of the City's roads, bridges and culverts, wastewater assets, and stormwater assets. The intent of this plan is to provide the means for the City to maximize value from its assets, at the lowest overall expense while, at the same time, enhance service levels for its residents. Furthermore, the objective of this AMP is to align with the guidelines laid out in the City's Strategic AM Policy and Section 5 of O. Reg. 588/17.

As management of each core asset is not a consistent process due to maintenance and construction requirements, we have grouped the core assets as follows:

1. Roads, and Bridges and Culverts.
2. Stormwater Management Assets.
3. Wastewater Assets.

This AMP has been developed for the City's stormwater management system, as shown in **Table 1-1**.Wastewater, and Road and Bridges & Culverts AMPs are presented under separate reports.

Table 1-1: In-Scope Stormwater Assets

Asset Category	Sub-Assets
Stormwater Conveyance System	Sewers, Service Connections, Manholes & Chambers, Aqueducts, Ditches, Catch Basins, Catch Basin Leads, Road Crossing Culverts, Driveway Culverts, and Oil and Grit Separators.
Pump Stations	Structural, Process Mechanical, Building Mechanical, Electrical, Instrumentation and Control Assets.
Stormwater Other	Stormwater Management Ponds, Rain Gauges, Snow Dumps, and Shoreline Seawalls.

The following elements are included within the scope of this AMP:

- Asset hierarchy, a summary of the asset inventory, including the replacement cost of the assets, the average age of the assets, the condition of the assets, and data gaps analysis (**Sections 1**).
- The City's level of service objectives, stakeholder identification, current levels of service (LoS) determined in accordance with the qualitative descriptions and technical metrics outlined in O. Reg. 588/17, and future demand drivers (**Section 3.6**).
- Asset lifecycle management strategies and funding needs to maintain current LoS, minimize associated asset risks, and to optimize costs over the whole lifecycle of the asset (**Section 4** and **Section 5**).

1.3 Asset Management Provincial Requirements

The O. Reg. 588/17 came into effect in 2018 and stipulates specific AM requirements to be in place within Ontario municipalities by certain key dates (**Table 1-2**). The development of this AMP is one of the steps to guide the City towards meeting the July 1st, 2024 deadline.

Table 1-2: O. Reg. 588/17: AM Planning for Municipal Infrastructure

Description: A regulation made under the Infrastructure for Jobs and Prosperity Act, 2015, stating that every municipality shall prepare and update a Strategic AM Policy, and that every municipality shall prepare an AM Plan for its core infrastructure assets by July 1, 2022, and an AM Plan for all other infrastructure assets by July 1, 2024. The regulation outlines several requirements that each AM Plan must follow, such as including current and proposed level of service. Core municipal infrastructure assets include water, wastewater, stormwater, road, and bridge assets.	
Deadline Date	**Regulatory Requirement**
July 1st, 2019	All municipalities are required to prepare their first Strategic AM Policy.
July 1st, 2022	All municipalities are required to have an AM Plan for its entire core municipal infrastructure (i.e., water, wastewater, stormwater, roads, and bridges & culverts).
July 1st, 2024	All municipalities are required to have an AM Plan for infrastructure assets not included under their core assets.
July 1st, 2025	All AM Plans must include information about the level of service that the municipality proposes to provide, the activities required to meet those level of service, and a strategy to fund activities.

2. State of Infrastructure

Typically, stormwater originates from melted snow and rain that flows across the land. The City's system is transferring this stormwater to streams, rivers and lakes with a combination of sewers, culverts, aqueducts, as well as other vital components such as catch basins, ditches, service connections, manholes & chambers, a pump station, ponds, rain gauges, and snow dumps. The City also owns and maintains shoreline stabilization assets (i.e., seawalls) to protect municipal infrastructure from erosion.

The stormwater system plays a pivotal role to protect the well-being and the safety of society, as well as protecting the environment. Accordingly, the City is responsible for managing the stormwater network to maintain the asset serviceability and reliability at a satisfactory level.

2.1 Asset Hierarchy

To fulfill the requirements of O. Reg. 588/17 and to pave the way for robust long range asset management planning, the City of Sault Ste. Marie requires a logically segmented asset break down structure (hierarchy) under the scope of this AMP. To do so, the core stormwater assets must be sufficiently granular to recognize which individual assets are due for renewal. However, it is important to balance the fine trade-off between adequate granularity to provide the essential information, and too much granularity that the effort of which to collect and manage the information eclipses the usefulness of the data itself.

There is a wide range of stormwater system assets organized hierarchically as presented in **Figure 2-1**. This break down of the infrastructure is derived from the way that assets are presented within the data sources, which indicates program area's responsibilities and parent-child relationships within each asset type.

Figure 2-1 categorizes the City's stormwater system into three main sections namely, the conveyance system, pump stations, and other. Pump stations is then stratified into structural, process mechanical, electrical, and instrumentation & control. The conveyance system is broken down into sewers, service connections, culverts, ditches, manholes & chambers, catch basins, oil and grit separators, and aqueducts. Snow dumps, ponds, rain gauges, and seawalls fall into the other category.

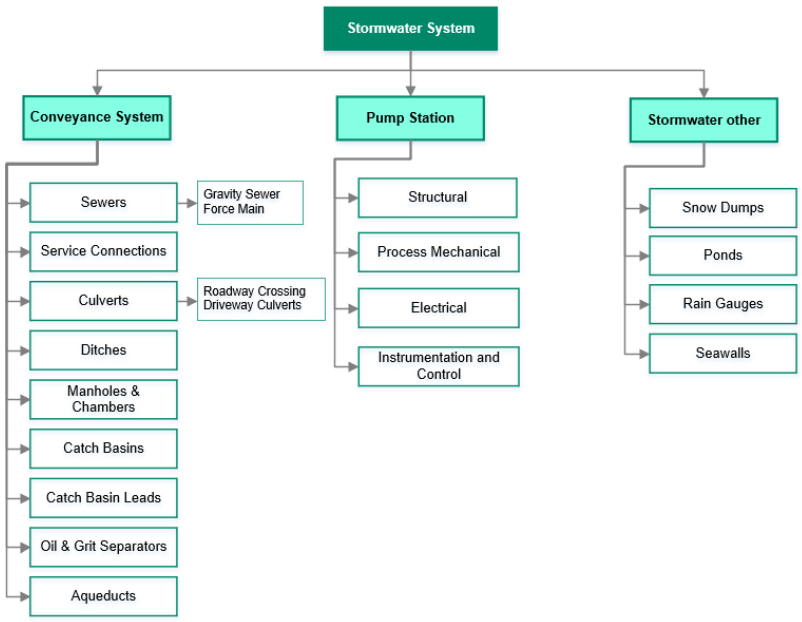


Figure 2-1: City of Sault Ste. Marie Stormwater Asset Hierarchy

2.2 Current State of the Assets

2.2.1 Asset Inventory

Table 2-1 summarizes the stormwater inventory for each asset category within the City's stormwater network.

Table 2-1: Stormwater Asset Inventory Summary

Asset Group	Asset Category	Asset Sub-Category	Quantity	Unit	Count of Assets
Stormwater Management System	Conveyance System	Sewers	287	km	4,976
		Road Crossing Culverts	10	km	553
		Driveway Culverts	79	km	8,987
		Aqueducts	14	km	56
		Catch Basin Leads	83	km	9,257
		Ditches	658	km	22,748
		Service Connections	78	km	7,714
		Catch Basins	9,243	Ea.	9,243
		Manholes & Chambers	4,299	Ea.	4,299
		O&G Separators	11	Ea.	11
	Pump Stations	Pump Stations	1	Ea.	8
	Stormwater Other*	Ponds	17	Ea.	17
		Rain Gauges	7	Ea.	7
		Snow Dumps	7	Ea.	7
		Seawalls	TBD*	TBD	TBD
Total					**67,940**

**Shoreline seawall assets inventory is currently not available. However, the capital needs for the seawalls are considered in the stormwater capital reinvestment planning.*

2.2.2 Current Asset Replacement Value

The City's Stormwater system is valued at approximately $1 Billion. **Table 2-2** presents current replacement value of each asset subcategory, as well as all subcategories. The total replacement value for the conveyance system is approximately $1 Billion. Pump stations and other stormwater assets account for almost $0.5 Million and $2 Million, respectively. The Aqueducts account for the highest replacement value, which is approximately $356 Million, followed by sewers, contributing to over $304 Million. The values presented in **Table 2-2** include a 45% markup to allow for the removal of existing infrastructure, engineering (design and contract administration), contingencies, and mobility.

Table 2-2: Stormwater Current Replacement Value

Asset Group	Asset Category	Asset Sub-Category	Unit Replacement Cost ($/Unit)	Total Replacement Value (2022)
Stormwater Management System	Conveyance System	Sewers	$360 - $2,100 / m	$304,431,000
		Road Crossing Culverts (< 3 m)	$250 - $2,500 / m	$10,076,000
		Driveway Culverts	$250 - $2,500 / m	$68,862,000
		Aqueducts	$13,000 - $24,000 / m	$355,778,000
		Catch Basin Leads	$360 - $800 / m	$49,355,000
		Ditches	$50 / m	$47,692,000

Asset Group	Asset Category	Asset Sub-Category	Unit Replacement Cost ($/Unit)	Total Replacement Value (2022)
		Service Connections	$300 - $730 / m	$40,674,000
		Catch Basins	$5,000 / Ea.	$67,614,000
		Manholes & Chambers	$10,000 - $40,000 / Ea.	$69,360,000
		O&G Separators	$12,000 - $76,000 / Ea.	$910,000
	Pump Stations	Pump Station	$5,000 - $200,000 / Ea. (per component)	$479,000
	Stormwater Other	Ponds	$70,000 / Ea.	$1,726,000
		Rain Gauges	$5,000 / Ea.	$51,000
		Snow Dumps	$30,000 / Ea.	$305,000
			Conveyance System	**$1,014,752,000**
			Pump Stations	**$479,000**
			Stormwater Other	**$2,082,000**
			Total	**$1,017,313,000**

2.2.3 Age and Remaining Service Life

In practice, various assets will deteriorate at different rates and not necessarily linearly over time. However, it is pivotal to keep in mind the level of effort required to predict failure compared with the asset value. More sophisticated deterioration modelling may be warranted for very high value assets, whilst the cost of deterioration modeling for low-value assets may very well exceed the replacement cost of the asset. The actual service life can vary significantly from the estimated service life (ESL). The latter is defined as the period over which an asset is available for use and able to provide the required LoS at an acceptable risk and serviceability (i.e., without unforeseen costs of disruption for maintenance and repair). In some instances, a variation in expected vs. actual service life is evident due to the following factors:

- **Operating conditions and demands:** Some assets are operated intermittently or even infrequently or are being operated at a lower demand than their designed capacity. Thus, the actual operating “age” of the asset is reduced.
- **Environment:** Some assets are exposed to very aggressive environmental conditions (e.g., corrosive chemicals), while other assets are in relatively benign conditions; thus, the deterioration of assets is affected differently.
- **Maintenance:** Assets are maintained through refurbishment or replacement of components, which prolongs the service life of the asset.
- **Technological Obsolescence:** Some assets can theoretically be maintained indefinitely, although considerations such as cost to maintain the asset, its energy efficiency, and the cost to upgrade to an updated technology that would result in cost savings are likely to render this approach uneconomical.

Table 2-3 and **Figure 2-2** present the weighted average age, weighted average ESL, and remaining service life (RSL) for various asset sub-categories within the City’s stormwater system. The average age of assets ranges from 12 to 40 years for rain gauges and aqueducts, respectively, and the average ESLs vary from 20 (rain gauges) to 100 (snow dumps) years. Based on the table, ponds, snow dumps, and service connections have the highest remaining service life with 66, 64, and 51 years, respectively.

Table 2-3: Stormwater Average Age, ESL, and Remaining Service Life

Asset Group	Asset Category	Asset Sub-Category	Weighted Average Age	Weighted Average ESL	Remaining Service Life
Stormwater System	Conveyance System	Sewers	40	80	40
		Road Crossing Culverts	28	60	32
		Driveway Culverts	23	25	2
		Catch Basins	38	80	42
		Aqueducts	33	80	47
		Catch Basin Leads	39	72	33
		Ditches	36	80	44
		Service Connections	29	80	51
		Manholes & Chambers	39	80	41
		O&G Separators	16	50	34
	Pump Stations	Pump Stations	35	66	31
	Stormwater Other	Ponds	14	80	66
		Rain Gauges	12	20	8
		Snow Dumps	36	100	64

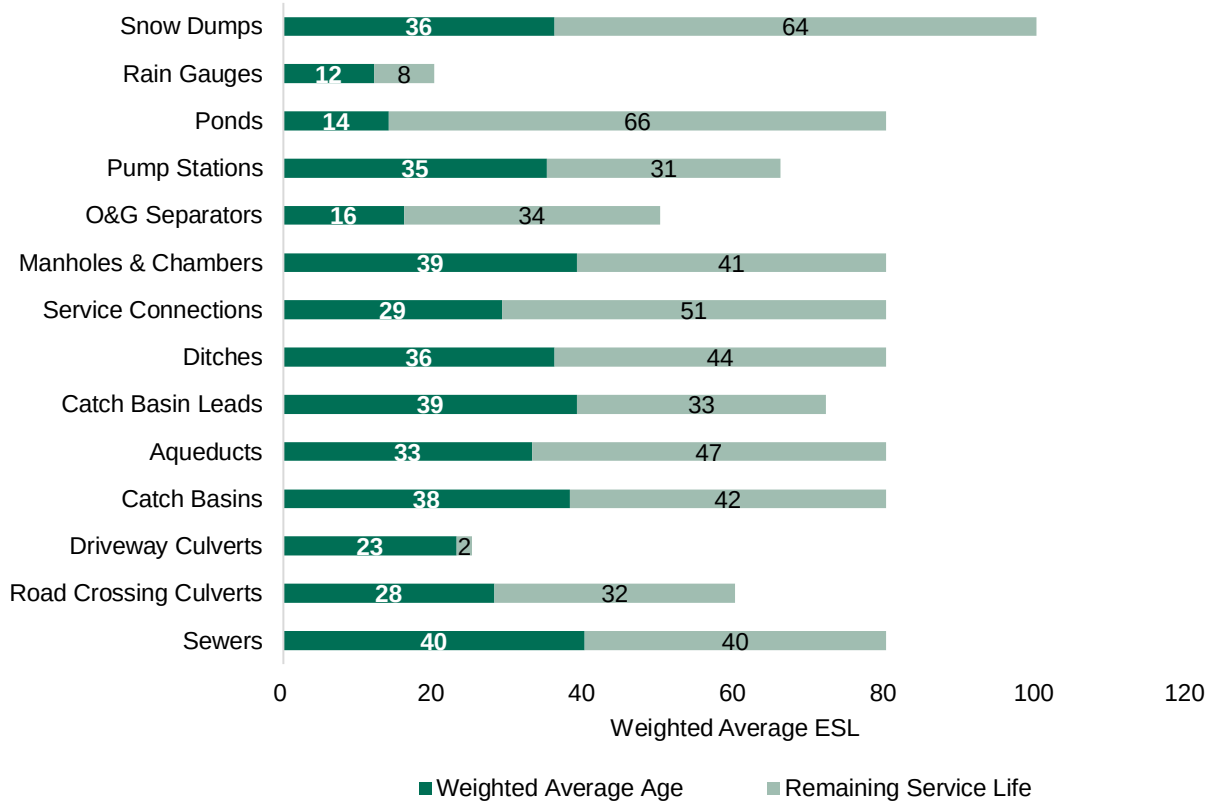


Figure 2-2: Stormwater System Weighted Average Age and Remaining Service Life

Figure 2-3 shows the installation profile of the City's stormwater management system, stratified based on different sub-categories. As seen, aqueducts have considerable contribution to installed assets prior to 1990 with a replacement

value of approximately $257 Million. As mentioned before, the total replacement value for aqueducts is almost $357 Million.

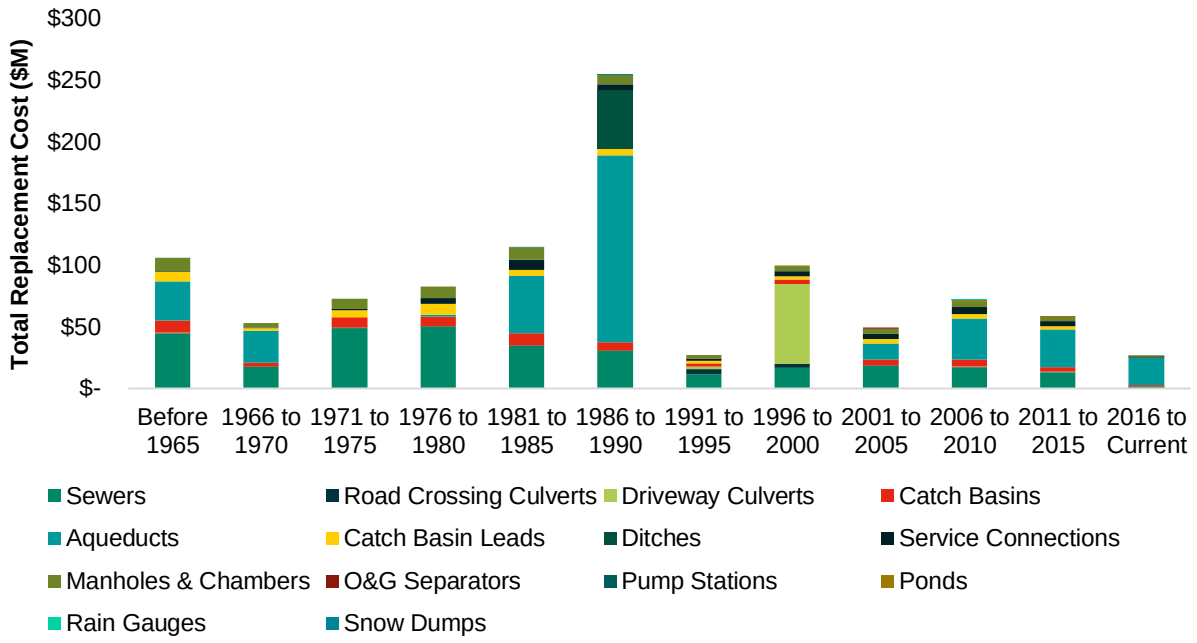


Figure 2-3: Stormwater Installation Profile

Figure 2-4 illustrates the stormwater conveyance assets profile based on the 10-year installation periods to better understand how much each asset subcategory is contributing to replacement values, by era of construction. A significant proportion of sewers was installed after 1951, with a spike between 1971 to 1980.

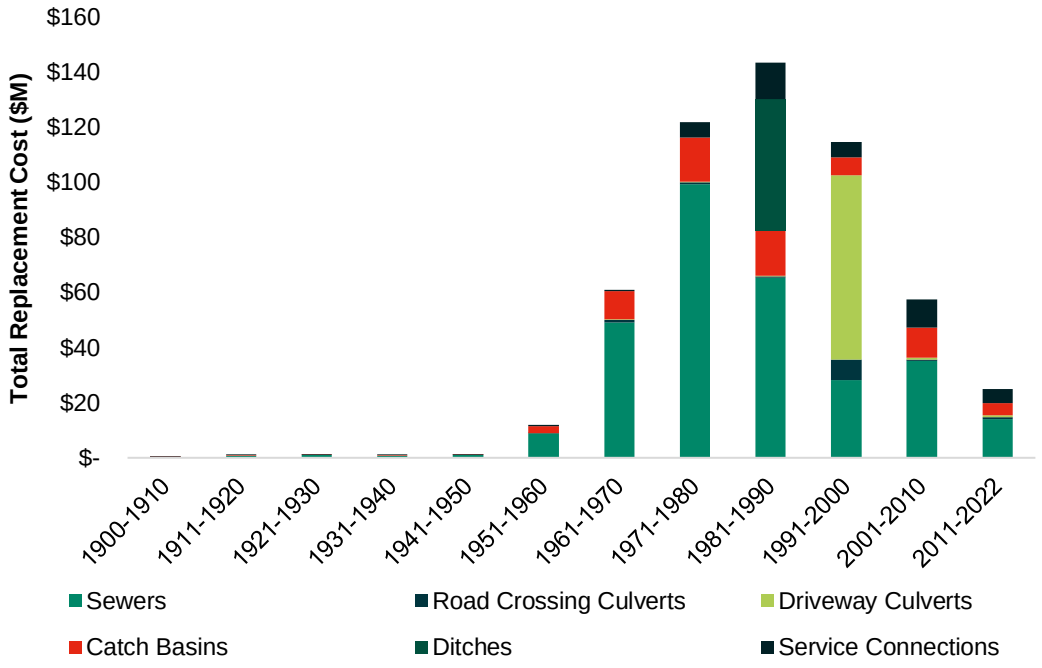


Figure 2-4: Installation Profile of Stormwater Conveyance system

2.2.3.1 Stormwater Sewers and Service Connections Materials

Table 2-4 indicates the material distribution for stormwater sewers and service connections. Most of the storm sewer mains are made of concrete and concrete cast in place, with almost 181 km and 18.8 km, respectively, followed by PVC, with approximately 51 km. The majority of service connections are made of PVC material (approximately 43 km). **Figure 2-5** and **Figure 2-6** highlight the percentage of length for each material type for stormwater sewers and service connections.

Table 2-4: Storm Sewer and Service Connections Material Distribution by Length

Asset Category	Material	Total Length (km)
Stormwater Sewers	Concrete	181.6
	Concrete Cast in Place	18.8
	Other (Asbestos Cement, Cast Iron, Clay, Corrugated PVC, Polypropylene, Vitrified Clay)	9.5
	PVC	50.9
	Unknown	25.8
Service Connections	Asbestos Cement	3.3
	Other (Vitrified Clay, Polyethylene)	0.7
	PVC	42.9
	Unknown	31.6

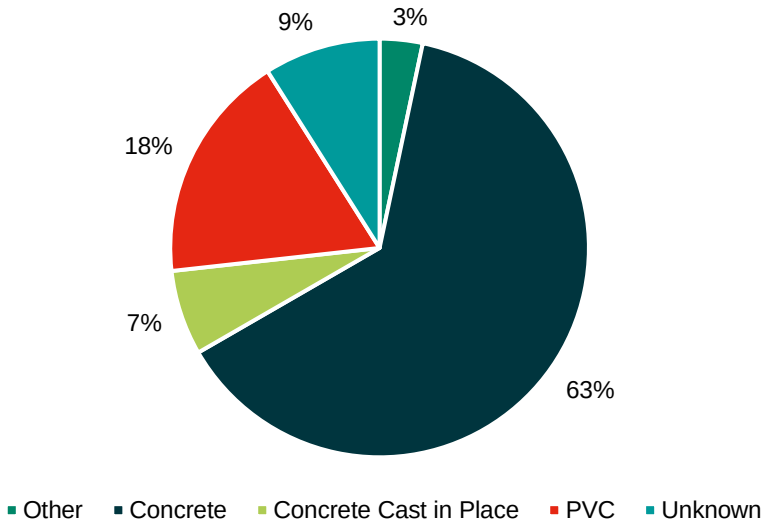


Figure 2-5: Stormwater Sewers Material Distribution by Length

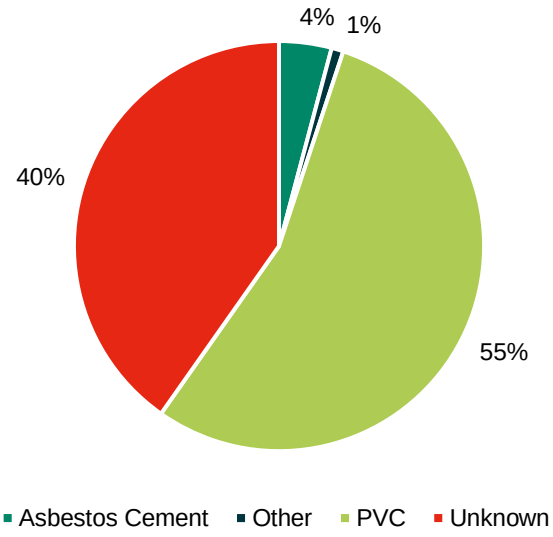


Figure 2-6: Service Connections Material Distribution by Length

2.2.4 Asset Condition

All assets are expected to deteriorate over their lifetime, and their assigned condition reflects the physical state of the asset. Field condition assessment for 25 sewer segments in the South Market area (Clark Creek Drainage System from Black Road to Bennett Blvd) were performed in 2020[1] and incorporated in this AMP. Cured-in-Place-Pipe Lining (CIPP) sewer rehabilitation strategy and the associated costs were suggested to resolve the observed defects. It should be noted that no on-site condition assessments were carried out for this project.

For storm sewers that do not have field condition assessment results, an age-based approach was applied to assess the condition. Accordingly, a two-parameter Weibull distribution function was used to assess the current condition of the stormwater assets. The Weibull distribution has been used extensively in reliability studies and lifetime prediction models in industries ranging from automotive to the oil & gas and provides a suitable distribution for this type of analysis.

The underlying premise of the Weibull-shaped deterioration is that while some assets fail prematurely due to severe conditions or improper installation, other assets are very long-lived and function well beyond their theoretical ESL. In order to perform a high order network-level analysis, it was assumed that assets would fail (and require replacement) within a deterioration envelope / curve approximated by a Weibull probability distribution. The two-parameter Weibull cumulative distribution has two parameters for scale and shape, as set out in Equation [1]:

$$f(x;\alpha,\beta) = e^{-\left(\frac{x}{\beta}\right)^{\alpha}} \quad [1]$$

Where: x = Age
α = Shape parameter (or slope)
β = Scale parameter

A set of Weibull cumulative distribution functions were leveraged to simulate a set of deterioration curves for assets with different ESLs as shown in **Figure 2-7**.

[1] AECOM. 2020. Technical Memorandum: Storm Sewer Assessment – South Market Area (Clark Creek Drainage System from Black Road to Bennett Blvd)

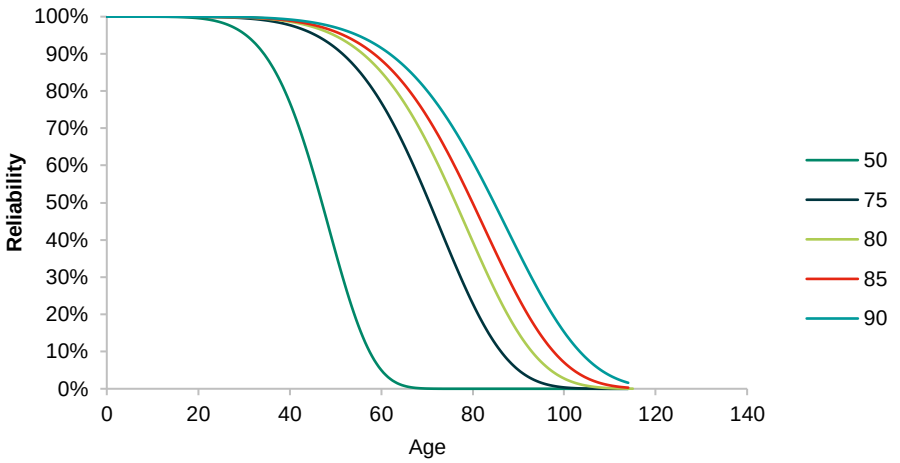


Figure 2-7: Asset Deterioration Curve Samples

Table 2-5 summarizes the condition grade of the City's stormwater assets with associated replacement values. Approximately 83% of the assets are in very good condition, with a total replacement value of approximately $845 Million, and only 1% of the stormwater assets are in the very poor condition with total replacement value of just over $9 Million. Good condition accounts for 9% of the existing infrastructure, having a replacement value of around $88 Million. Fair and poor condition assets make up 1% and 7%, respectively.

Table 2-5: Stormwater Condition Summary

Rank	Condition Rating	Replacement Value	% of Replacement Value
1	Very Good	$844,700,000	83%
2	Good	$88,138,000	9%
3	Fair	$7,832,000	1%
4	Poor	$67,301,000	7%
5	Very Poor	$9,339,000	1%

Additionally, **Figure 2-8** and **Table 2-6** granulates the condition of the assets based on asset sub-categories and their corresponding replacement values. As indicated within the bar chart, a significant proportion of sewers and aqueducts are in very good condition, with 86% and 91%, respectively. A negligible proportion of these assets are classified within the poor and very poor condition. Also, approximately 90% and 6% of the road crossing culverts are in very good and very poor conditions, respectively. Moreover, 95% of driveway culverts have been categorized in the poor condition with an almost $65 million replacement value.

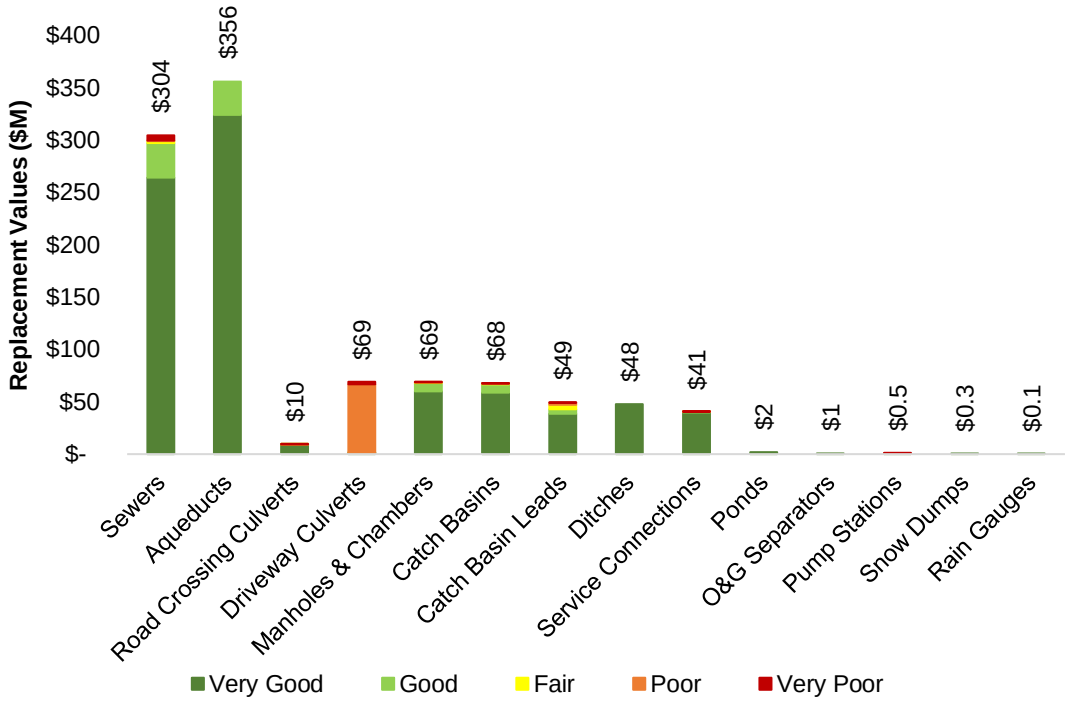


Figure 2-8: Stormwater Condition Summary

Table 2-6: Stormwater Condition Summary

Condition Rating	Sewers	Aqueducts	Road Crossing Culverts	Driveway Culverts	Manholes & Chambers	Catch Basins	Catch Basin Leads	Service Connections	Ponds	O&G Separators	Pump Stations	Rain Gauges
Very Good	86%	91%	90%	2%	86%	87%	79%	98.1%	100%	100%	79%	100%
Good	12%	9%	3%	-	12%	12%	8%	1.3%	-	-	-	-
Fair	1%	-	-	-	1%	1%	9%	0.2%	-	-	-	-
Poor	-	-	1%	95%	-	-	3%	0.1%	-	-	-	-
Very Poor	1%	-	6%	3%	1%	1%	1%	0.3%	-	-	21%	-

Note: Ditches and Snow Dumps not included in the condition summary analysis as do not have information on install dates.

2.2.4.1 Sewers

Table 2-7 and **Figure 2-9** present sewer condition distribution by diameter, categorized into four groups, <450mm, 450-1,500mm, >= 1,500mm, and Unknown. Pipes between 450mm and 1,500mm have the highest contribution to the replacement cost ($185 Million), followed by smaller than 450mm pipes ($78 Million). The highest replacement value for the very poor category belongs to 450-1500 mm pipes, which is approximately $2.5 Million. Unknown pipes and pipes with larger diameter than 1,500 mm account for approximately $23 Million and $18 Million, respectively.

Table 2-7: Sewers Condition by Diameter

Condition Rating	< 450mm	450 - 1,500mm	≥ 1,500mm	Unknown
Very Good	$57,716,000	$170,629,000	$15,354,000	$18,188,000
Good	$17,781,000	$11,297,000	$2,426,000	$3,799,000
Fair	$1,377,000	$488,000	-	$247,000
Poor	-	$626,000	-	-
Very Poor	$1,105,000	$2,461,000	$168,000	$775,000
Total	**$78,000,000**	**$185,500,000**	**$17,900,000**	**$23,000,000**

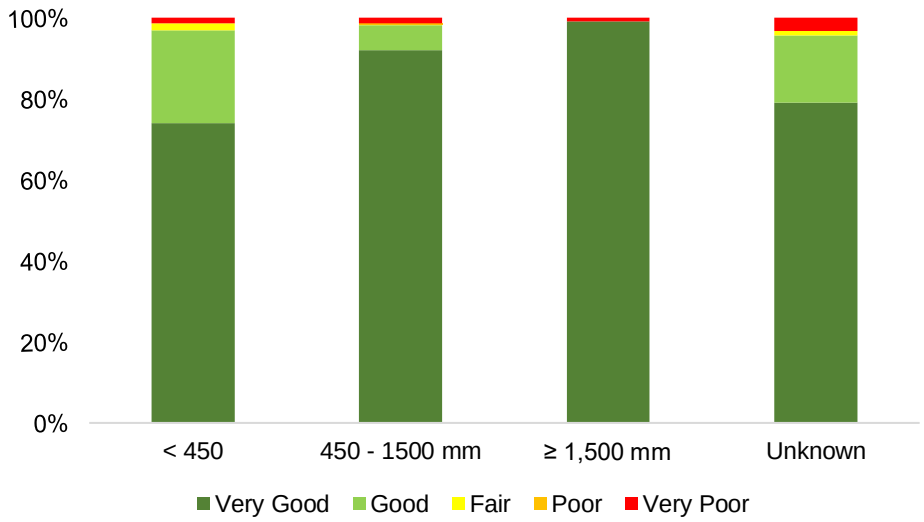


Figure 2-9: Stormwater Sewers Condition Distribution by Diameter

2.3 Asset Data Gap Analysis

This section summarizes the current state of the City's asset data by assessing the quality of the asset inventory. To determine the overall confidence in the current asset data, identify exiting data gaps, as well as to gather insight into the City's data management practices, AECOM facilitated a virtual State of Infrastructure and Data Gap Analysis Workshop with key staff across the in-scope assets. An online Data Management Gap Assessment Survey was also distributed to the AM Working Group to elicit further insights on the City's current and desired future state, as well as key challenges, regarding the City's overall data management.

2.3.1 Data Gap Observations

Table 2-8 provides a summary of observed data gaps in the compiled stormwater asset inventory across key data attributes that help to make informed decisions over the asset lifecycle for this AM plan.

Table 2-8: Observations on Asset Data Completeness

Asset Group	Inventory Completeness (%)						
	Asset ID	Name / Location	Install Date	Inspection Date	Condition	Expected Service Life	Replacement Cost
Stormwater	99.5%	100%	90%	0%	0%	0%*	0%*

* The gap was filled during the development of this AM plan.

2.3.2 Data Confidence

The quality of asset data is critical to effective AM, accurate financial forecasts, and informed decision-making. For this reason, it is important to know what the reliability of the information is for the State of Infrastructure analysis of the stormwater assets. **Table 2-9** provides a description for the data confidence grades used to classify the reliability of the asset data used in this data gap analysis. Through consultation with City staff during a Data Gap and State of Infrastructure Workshop, the asset attribute data for the stormwater in-scope assets were assigned the grades outlined in **Table 2-10**.

Table 2-9: Data Confidence Grading Scale

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

Table 2-10: High-Level Asset Data Confidence Grades

Asset Category	Data Confidence Average Grade		
	Inventory	Age	Condition
Stormwater	B	C	C

2.3.3 Data Management Practice

The asset data lifecycle is a sequence of stages that data goes through from its initial build (i.e., data capture and entry) to its eventual archival and/or deletion at the end of its useful life[2]. A clear definition and understanding of the organization's process for acquiring, storing, utilizing, assessing, improving, archiving, and deleting data (see **Figure 2-10**) will ensure good data management practices and help to sustain levels of data quality required to support AM activities.

[2] TechTarget Network, Definition: Data Life Cycle, 2020.

Figure 2-10: Asset Information Lifecycle

The seven key stages of the asset data lifecycle are described in more detail below:

1. **Acquiring New Data**: The majority of new asset data arises from asset creation, refurbishment and overhaul activities. New data may also come by way of inheritance or transfers from other business units, organizations, or third parties. As such, it is important to have clearly defined processes in place not only to add or update asset data, but to migrate and merge data from other sources.
2. **Storing Data**: The way asset data is stored is an important consideration for overall data quality. Having a planned approach to data storage will inevitably reduce the likelihood of duplication and inconsistencies across datasets within the organization. Depending on the needs of the organization, this stage may involve procuring a new software to adequately house the data, along with a data backup and recovery plan to ensure that the necessary data protection and privacy standards are met.
3. **Utilizing / Analysing Data**: This aspect of the asset information lifecycle is where users encounter the data to support data-driven activities within the organization. Data can be viewed, processed, edited, and published to allow users to access the data outside the organization. Critical data that has been modified should be fully traceable to maintain the integrity of the data. As such, it is important to communicate to the users why asset data is so important, and how it is used to inform decisions within the organization.
4. **Assessing Data**: Assessing the data quality helps to determine the level of confidence in the information and ensures that decision-makers are making informed decisions based on the quality of data available to them. Moreover, it is important to fully understand the availability and quality of the asset data before issuing information publicly. Some of the results of data degradation, due to improper or lack of assessment, may include:
    - Poor asset performance due to lack of information and understanding of asset behaviour.
    - Non-compliance with statutory regulations or safety requirements.
    - Safety incidents due to risks not being identified or reported.
    - Asset failure due to gaps in maintenance planning.
5. **Improving Data**: Improving data quality involves establishing clear targets which are intended to be communicated widely across the organization. It is imperative that the organization understands the costs, benefits, and risks associated with any data improvements since the cost of the improvement may outweigh the overall benefit. It is also important to note that *more* data does not necessarily mean *better* data. It is very possible to collect data that does not add value to the organization. As such, it is critical that the organization aligns its data improvement targets with its AM objectives, and considers the data-driven decisions staff need to make at the operational and strategic level, to ensure that the *right* data is being improved upon.

6. **Archiving Data**: Archiving data is the process of storing data that is no longer active or required but is able to be retrieved in case it is needed again. Data that is archived is stored in a location where no usage or maintenance occurs. It is recommended that a data archive strategy exists within an organization in order to lay out the data archival requirements, which considers the following:

    - What data should be archived and why?
    - Are there any legal obligations for retaining data records?
    - How long should data records be retained?
    - What is the risk associated with not being able to retrieve data records?
    - Who should be able to access archived data records?
    - What is the expected timeframe to retrieve archived data records?

    - Clearly communicating these requirements across the organization is key to ensuring staff are educated on why records are being archived, how they can access archived data records, and for how long archived data records can still be accessed.

7. **Deleting Data:** The deletion of data is the final component of the asset information lifecycle. Typically, within organizations there is a resistance to permanently delete data, otherwise known as data “squirrelling”, due to the overall capacity of storing data increasing and the cost decreasing. However, within the organization’s data archive strategy, a retention period should be specified to indicate when data should be deleted, along with any processes to follow, such as obtaining prior authorization.

2.3.3.1 Current Data Management State

The City’s Public Works and Engineering Services Department staff are involved in stormwater data management. The City’s stormwater data is currently stored in GIS, Excel spreadsheets, reports, and as-built drawings. Currently, the City updates assets in the GIS post-construction, and there may be a lag in obtaining as-builts and adding/updating data.The City is following the mandate in records retention procedures for municipalities as per Freedom of Information and Protection of Privacy Act (FIPPA) and the Municipal Freedom of Information and Protection of Privacy Act (MFIPPA).

2.3.3.2 Future Data Management State

The City will develop and implement a software strategy that helps streamline data management following this AMP. Eventually, the City plans to have a clear and efficient data management process and comprehensive and robust asset inventory to support their AM decision making. The implementation plan for data improvement is presented in **Section 6**.

3. Level of Service

3.1 Purpose

Levels of Service (LoS) support every aspect of the overall AM system. The objective of establishing clearly defined service levels is to help the City meet stakeholder values, achieve its strategic goals, make informed decisions, and implement effective asset lifecycle activities.

Documenting LoS is a proven practice that will enable the City to:

- Link corporate strategic objectives to customer expectations and technical operations.
- Balance customer needs and expectations while evaluating the effectiveness of operations to determine whether the right LoS is being provided at the right cost.
- Transition from an “Asset Stewardship” approach that focuses on making decisions based on maintaining assets in an acceptable condition to a “Serviceability” approach that is geared towards making decisions based on balancing the costs, risks, and goals for the LoS being provided by the City’s assets.
- Communicate the physical nature of infrastructure that the City owns and is financially responsible for and enable effective consultation with stakeholders regarding alternative funding options according to desired LoS outcomes.
- Make recommendations on strategies that the City can take now to minimize future renewal costs while ensuring that adequate LoS can be delivered without burdening future generations.
- Assess internal (e.g., program changes) and external (e.g., climate change) factors that have the potential to impact the City’s ability to deliver services and how these factors may impact the LoS being provided.
- Implement a corporate continuous improvement program to further optimize AM across all service areas.

The O. Reg. 588/17 requires that all AMPs include the current LoS being provided, determined in accordance with the qualitative descriptions and technical metrics provided (see **Section 1.3**).

3.2 Objectives

Defining LoS objectives is important for drawing a line of sight between the City’s corporate objectives and the tangible asset performance outcomes. To do so, the LoS objectives must take into consideration stakeholder interests to develop asset performance measures that aim to meet the needs and expectations of the community. By doing this, the City will ensure that their assets perform optimally, not only operationally, but economically, socially, and environmentally as well.

Stakeholders have interests in the service being provided. The City’s Comprehensive Background Report[3] (2021) for the New Official Plan outlined the overarching themes that reflect the City’s values, as shown in **Table 3-1**. Each overarching theme is also assigned a corporate service objective.

The development of level of service targets should be aligned with these corporate objectives which will be addressed during the later phases of the AM regulatory compliance process and before the July 1, 2025 deadline.

Table 3-1: The City’s Overarching Themes and Objectives

Overarching Themes	Corporate Objective
Healthy Community	Supports healthy living, active transportation, access to passive and active recreation, social interaction and the creation of spaces that are comfortable, safe, and accessible for all ages and abilities (the “8 to 80 Cities” concept).

[3] City of Sault Ste Marie. 2021. Comprehensive Background Report.

Overarching Themes	Corporate Objective
Environmental Sustainability	Supports energy conservation and efficiency, improved air quality, reduced greenhouse gas emissions and climate change adaptation.
Integrated Mobility	Supports accessibility and choice of diverse transportation modes.
Sense of Place	Fosters a welcoming place for all that establishes connection and provides a memorable experience to visitors.
Sustainable Growth	Stimulates reinvigoration of neighbourhoods to provide a complete range of housing, services, employment and recreation.
Economic Resiliency	Supports the growth and diversification of the city's economy.
Social Equity	Contributes to creating a welcoming and inclusive community, focusing on the removal of systemic barriers so that everyone has access to an acceptable standard of living and can fully participate in all aspects of community life.
Cultural Vitality	Celebrates the Sault's history, diverse communities and natural and cultural heritage, with the Downtown as the Sault's core destination for arts and culture.

3.3 Stakeholders Identification

A stakeholder is any person or organization that can affect, be affected by, or perceive themselves to be affected by a decision or an activity. Stakeholder analysis is the process of understanding stakeholder needs, expectations and perceptions relative to the stakeholder's level-of-interest and level-of-influence over the organization. The organization typically engage with its stakeholders to:

- Establish which activities or services matter most.
- Understand their risk appetite and risk threshold.
- Understand their willingness to pay for services.

Stakeholders can take many forms and may be internal (i.e., staff, Council) or external (i.e., the public, regulatory agencies, suppliers, neighbouring municipalities, etc.) to the organization. The following groups were identified as key stakeholders for stormwater at the LoS workshops. This is not intended to be an exhaustive list; however, the following groups provide a good starting point for the City to move forward to the next stage.

- Council.
- Residents.
- Industrial, Commercial, Institutional (ICI) property owners and tenants.
- Regulatory Agencies (i.e., Ministry of the Environment, Conservation and Parks [MECP], Fisheries and Oceans Canada [DFO], Sault Ste. Marie Region Conservation Authority [SSMRCA]).
- Other Government Agencies (i.e., Environment and Climate Change Canada [ECCC] and Michigan Department of Environment, Great Lakes, and Energy [EGLE], Michigan Environmental Protection Agency [EPA], Algoma Public Health, Chippew County Health Department Personal & Family Health).
- Neighbouring or Downstream Communities (i.e., First Nations including Garden River First Nation, Batchewana First Nation, and Echo Bay, and municipalities from the US including Chippewa County, Michigan, and the City of Sault Ste Marie, Michigan).
- Environmental groups (i.e., Bi-National Public Advisory Council [BPAC] (US & Canada joint committee), Clean North, Lake Superior Watershed Conservancy [LSWC], Streamkeepers, and Friends of the St Mary's River).
- Other City Department (e.g., Planning Department).
- Developers.
- Contractors and suppliers.

3.4 O. Reg. 588/17 Levels of Service Metrics

O. Reg. 588/17 requires legislated community levels of service for core assets. Community levels of service use qualitative descriptions to describe the scope or quality of service delivered by an asset category. O. Reg. 588/17

also requires legislated technical levels of service for core assets. Technical levels of service use metrics to measure the scope or quality of service being delivered by an asset category.

Table 3-2 presents a summary of the City's stormwater service levels for O. Reg. 588/17 Metrics. References are provided to show where the O. Reg. 588/17 requirement has been attained.

Table 3-2: O. Reg. 588/17 Levels of Service Metrics (Stormwater Services)

O. Reg. 588/17 LoS Performance Measure	Unit	Community or Technical LoS	Current LoS Performance (2021)
Description, which may include maps, of the user groups or areas of the municipality that are protected from flooding, including the extent of the protection provided by the municipal stormwater management system.	Text	Community	• Most properties are resilient to riverine flooding, except for some properties along creeks. • Most properties are resilient to pluvial flooding. The City's storm sewer models show areas that are at risk during extreme rainfall events. Problem areas and possible mitigation options are outlined in the City's Stormwater Master Plan. • Actual incidences of flooding during heavy rainfall have been recorded by the City. • Refer to **Appendix B** for the approximate regulated area from O. Reg. 176/06: Sault Ste. Marie Region Conservation Authority: Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses.
% of properties in municipality resilient to a 100-year storm.	%	Technical	• 61% of properties are resilient to pluvial flooding during the 100-year storm. • 97% of properties resilient to riverine flooding during the 100-year flood.
% of the municipal stormwater management system resilient to a 5-year storm.	%	Technical	• 80% of properties are resilient to the 5-year storm.

The Stormwater LoS performance data was collected and estimated based on information from SSMRCA's floodplain mapping, the City's trunk sewer models, and the City's Stormwater Master Plan.

The percentage of City properties resilient to riverine flooding during the 100-year flood was determined by the SSMRCA based on their floodplain mapping overlapped with the City's parcel data in GIS.

The percentage of the municipal stormwater management system resilient to pluvial flooding from a 100-year storm was estimated based on the percentage of the City's trunk sewers which are under-capacity during a 100-year storm, using the City's trunk sewer model. Likewise, the percentage of the municipal stormwater management system resilient to a 5-year storm was calculated based on prorating the percentage of the trunk sewers that are under-capacity in the City's trunk sewer model during the 2-year and 100-year storms.

3.5 Levels of Service Performance Targets

Establishing LoS targets is an important part of continual improvement and performance management. Without targets, it is difficult to ascertain whether goals are being met, or the extent of the gap if they are not. Incorporating targets into the City's LoS Framework helps to ensure that targets are reasonable, aligned with customer expectations, and evaluated on an objective basis using cost-benefit trade-offs.

One of the key challenges in setting targets in a municipal environment is that they can often become biased and/or politically motivated. Therefore, it is important to review LoS targets with internal and external stakeholders, especially the customers who will be impacted the most by changes in service delivery. An important aspect of evaluating LoS targets is determining how willing the user is to pay for the service. Regulatory requirements are an exception; however, as they are not optional and can be deemed the minimum service standard. Cost is still an

important parameter to consider when assessing the merits of service improvements. To deal with the financial realities, it is necessary to:

- Calculate how much the service costs based on current LoS.
- Determine the cost associated with varying the LoS.
- Assess the customers' willingness to pay.

It is important that any targets set be realistic and achievable. Therefore, it is not advisable that the City sets any firm targets until their current performance has been fully assessed. O. Reg. 588/17 require AMPs to include proposed levels of service and a formalized financial strategy by July 1, 2025.

3.6 Future Demand Drivers

Demand management is a critical component of managing the desired LoS in a sustainable manner, now and into the future. Understanding future demand drivers enables the City to proactively develop effective, long-term strategies that are suitable for the City's unique and evolving political, environmental, social and technological landscape.

Factors identified during the LoS workshop that would impact stormwater service levels now and into the future include, but are not limited to, the following:

- Aging infrastructure (e.g., old concrete sewers, etc.).
- Regulatory changes.
- Staff availability (i.e., technical skill availability, skill gaps from changing technology, etc.).
- Succession management & skills transfer.
- Funding (e.g., having proper AM plans to optimize service delivery at minimal cost).
- Contractor availability (e.g., contractors' availability for big projects, etc.).
- Climate change (e.g., greater risk of flooding from increased precipitation, higher water levels in Great Lakes, St. Mary's River etc.).
- Supply Chain (i.e., material and equipment availability for capital projects, etc.).
- Fluctuations on contract pricings.
- Increased development resulting in greater stormwater run-off.

On November 2, 2021, the City's Planning Division released the Comprehensive Background Report for updating the Official Plan[4]. The City's Official Plan guides the local decision-making on land use, development and public infrastructure over the next 20 years. The City's population is expected to reach to about 80,000 people in 10 years, by 2031, and 83,300 people by 2036. Employment is projected to grow by about 6,000 jobs, from approximately 31,000 jobs in 2016 to 36,900 jobs in 2036. An increase in population / employment will likely cause increased development, resulting in more impervious area and greater stormwater run-off.

When additional assets to accommodate this population and employment growth are introduced to the City's portfolio, additional human resources, training and funding are required to maintain and operate, and renew or replace those assets. O. Reg. 588/17 requires municipalities by July 1, 2025, to estimate capital expenditures and significant operating costs to achieve the proposed LoS and accommodate projected increases in demand caused by population and employment growth. This includes the estimated capital expenditures and significant operating costs related to new construction and / or to upgrade existing municipal infrastructure assets. The City will have to address these aspects during the later phases of the AM regulatory compliance process and before the July 1, 2025 deadline.

[4] City of Sault Ste Marie. 1996. Official Plan

4. Asset Management Strategies

4.1 Asset Lifecycle Management Introduction

Asset lifecycle management focuses on the specific activities that should be undertaken during all phases of the asset lifecycle. Considering entire asset lifecycles can ensure that the City makes sound decisions that consider present and future service delivery needs.

The overarching goal of life cycle management is to maximize the long-term benefits and services that our assets deliver while minimizing the associated costs and risks in the long run. Every asset has a lifecycle cost, which is the total cost of all the activities undertaken throughout its service life. Part of the purpose of the asset management planning process is to fully understand and predict the long-range financial requirements for the City's infrastructure to facilitate planning and resource management in the most cost-effective manner possible. **Figure 4-1** illustrates how costs typically accumulate over an asset's life. It is worth noting that the accumulation of the ongoing operations and maintenance, renewal & replacement and disposal costs is many multiples of the initial acquisition costs. As such, it is important to fully understand the entire lifecycle costs before proceeding with asset acquisition.

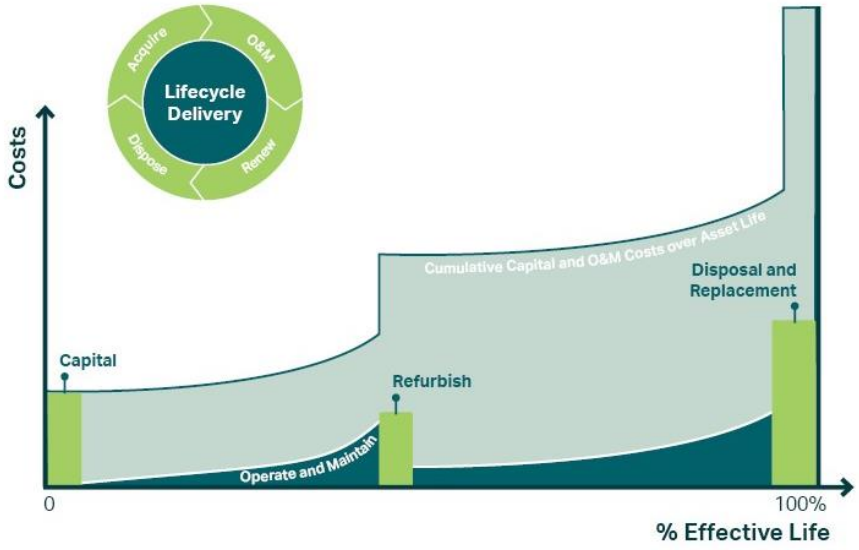


Figure 4-1: Lifecycle Cost Accumulation Over Asset Life

Asset lifecycle management strategies are typically organized into the following categories.

1. **Asset Acquisition / Procurement / Construction**: Acquisition includes expansion activities and upgrading activities to extend services to previously unserved areas or expand services to meet growth demands and to meet functional requirements. When acquiring new assets, the City should evaluate credible alternative design solutions that consider how the asset is to be managed at each of its life cycle stages. Asset management and full lifecycle considerations for the acquisition of new assets include, but are not limited to the following:
    - The asset's operability and maintainability.
    - Availability and management of spares.
    - Staff skill and availability to manage the asset.
    - The manner of the asset's eventual disposal.

2. **Asset Operations and Maintenance (O&M)**: As new infrastructure is commissioned, the City accepts the responsibility of operating and maintaining the infrastructure according to O&M standards to ensure that the infrastructure is safe and reliable. Operations staff provide the day-to-day support required to operate infrastructure. In few cases, operation costs are minor, but for most there are significant increases. For example, underground pipes require almost no operational support while a facility such as a pump station requires full-time staff to operate the facility safely and efficiently. Maintenance expenses include periodic preventive maintenance to ensure that the infrastructure can provide reliable service throughout the life of the asset and corrective maintenance that is required to repair defective assets as and when needed. Inadequate funding for O&M will have an adverse impact on the lifespan of assets. The amount of O&M resources required in any period is a function of the current inventory of infrastructure and total O&M needs required for each asset. As the inventory of infrastructure grows, total O&M requirements will also grow.

3. **Renewal and Replacement:** The third portion of full lifecycle costing relates to the renewal and replacement of infrastructure that has deteriorated to the point where it no longer provides the required service. Renewal cost is sometimes incurred during the life of an asset where an investment is made to improve the condition and / or functionality of the asset e.g., re-lining of a pipe. Replacement activities are expected to occur once an asset has reached the end of its useful life and rehabilitation is no longer an option.

4. **Decommissioning and Disposal:** There will inevitably come a point in time when an asset must be removed from service and, depending on the type of asset, there may be significant costs associated with its decommissioning and disposal. Factors that may influence the decision to remove an asset from service include changes to legislation that cause the asset to be in non-compliance, the inability of the asset to cope with increased service levels, technology advances that render the asset obsolete, the cost of retaining the asset is greater than the benefit gained, or the current risk associated with the asset's failure is not tolerable.

   Normally, major costs that may be incurred during disposal and decommissioning derive from the environmental impact of the disposal and, if required, the rehabilitation and decontamination of land. In some cases, there will be residual liabilities and risks to consider if a decision is made to partially abandon the asset as opposed to fully disposing of its components (e.g., leaving a non-functioning pipe in the ground, or an inactive building standing). However, some cost savings may be achieved through the residual value of the asset or by exploring alternative uses for the asset. In all cases, it is important to consider disposal and decommissioning as the strategy employed has the potential to attract significant stakeholder attention. For that reason, the costs and risks associated with disposal and decommissioning should be equally considered in the City's capital investment decision-making process.

4.2 Stormwater Assets Management Strategies

The asset management strategies that are employed by the City to manage the stormwater management system throughout their lifecycle is summarized in **Table 4-1**.

Table 4-1: Current Lifecycle Management Strategies for Stormwater Assets

Asset Group	Lifecycle Activity	Description of Activities Practiced by the City	Benefit or Risk Associated with the Activities
Stormwater	**Acquisition**	**All Stormwater Assets** • Assumption of subdivisions. • Pipes that do not meet capacity requirements are upsized to increase capacity. • Undertaking Environmental Compliance Approval (ECA).	• To extend services to previously unserved areas or expand services to accommodate asset enhancements. • Adequate planning and implementation of infrastructure projects help manage existing and potential growth pressures and address other demand factors.
	Operations and Maintenance	**Storm sewers gravity mains** • Flushing and cleaning. • Spot Repairs. • Reactive CCTV inspections of sewers. • Emergency blockage or failure responses.	• Flushing and cleaning activities can remove debris to ensure desired mains capacity and ensure a proper functioning sewer system. • Spot repair will fix mains that have or may collapse and cause disruptions to service, backups and / or overflows. • Emergency blockage responses will remove partial or full blockages from mains that cause disruptions to service, backups and / or overflows and restore the main operational functions.
		Manholes & Chambers • Routine inspections. • Performing maintenance as needed.	• Routine inspections for manholes & chambers to address flow concerns or easement flooding issues. • React to issues and ensures manholes are structurally and operationally sound.
		Service Connections • Performing maintenance as needed.	• Repair service connections or remove blockages that cause connection back ups to minimize the service impact and ensure assets are operationally and structurally sound. • Replacement of aged and / or substandard laterals to reduce potential failures.
		Catch Basins • Performing maintenance as needed. • Vacuuming out catch basins and sump pits.	• React to issues and ensure catch basins are structurally and operationally sound. • Clean catch basins to remove debris and improves drainage.
		Catch Basins Leads • Corrective maintenance as needed such as thawing frozen leads.	• Ensure proper drainage.
		Ditches • Routine maintenance. • Clean diches as required. • Ditching program.	• Ditch maintenance activities reduce / eliminate the possibility of ditch flooding and failure.

Asset Group	Lifecycle Activity	Description of Activities Practiced by the City	Benefit or Risk Associated with the Activities
		Road Crossing Culverts (<3 m) • Performing maintenance as needed.	• Prevent further damage to culverts and the ultimate failure of culverts which could lead to sinkholes and flooding
		Driveway Culverts • Performing maintenance as needed.	• Prevent further damage to culverts and the ultimate failure of culverts which could lead to flooding.
		O&G Separators • Proactive maintenance program.	• Ensure separator functions properly and reduce the amount of oil/sediment that could be disposed in the receiving environment / area.
		Aqueducts • Biennial inspections. • Coordination with Sault Ste. Marie Region Conservation Authority (SSMRCA) to make maintenance decisions.	• Inspect the condition of aqueducts to identify and locate deficiencies or problems.
		Pump Station • Weekly routine inspection. • Maintaining the electronic components that monitor station security, controls, and diagnostics. • Washing down and removing debris in the pump station chambers. • Annual oil change. • Emergency repairs.	• Regular inspections ensure stormwater facilities are operating properly and that potential maintenance issues are identified and prioritized for repairs to avoid equipment failure. • Regular maintenance activities at stormwater facilities ensure that the facilities continue operate properly. • Facilities' emergency repairs restore the condition of failed components.
		Stormwater Management Ponds • Regular inspections and maintenance.	• Visual inspection of pond sediment accumulation, vegetation, litter and trash, condition of structures, etc. help identify and prevent potential problems or issues with the ponds.
		Rain Gauges • Ongoing program to inspect and maintain electronical equipment such as batteries checkup and wireless data transmission equipment inspections.	• Ensures rain gauges are functioning properly.
		Snow Dumps • None currently.	• TBD
		Shoreline Seawalls • TBD.	
	Renewal and Replacement	**Storm sewers** • Coordination of sewer replacement with road reconstruction.	• Coordination sewer replacement with road reconstruction allow to manage a range of assets within any road right-of-

Asset Group	Lifecycle Activity	Description of Activities Practiced by the City	Benefit or Risk Associated with the Activities
			way to optimally coordinateleading to reduced cost and limited disruption to businesses and residents.
		Manholes & Chambers • Replace at the same time as the sewer mains.	• Bundling similar works to manage related assets and reduce overall lifecycle cost.
		Service Connections • Replace at the same time as the sewer mains.	
		Catch Basins • Replace at the same time as the sewer mains.	
		Catch Basins Leads • Replace at the same time as the sewer mains.	
		Ditches • Ditching program.	• Repair ditches and shoulders to improve drainage and reduce the risk of flooding.
		Road Crossing Culverts (<3 m) • Replace at end of life or in conjunction with road reconstruction.	• Failure to replace road crossing culverts and driveway culverts can cause drainage issues.
		Driveway Culverts • Replace at end of life.	
		O&G Separators • Replace at end of life.	• Reduce risk of failure ensuring continued service in preventing contaminants entering stream and rivers.
		Aqueducts • Coordination with Sault Ste. Marie Region Conservation Authority (SSMRCA) to make rehabilitation and reconstruction decisions.	• Renewal or replacement of underperformed components.
		Pump Stations • The small pump station is assessed annually in terms of priorities for renewal/replacement.	• Renewal or replacement of underperformed stormwater facility assets reduce potential loss of service caused by unplanned failure.
		Stormwater Management Ponds • Pond cleaning.	• Remove sediments to ensure proper function / capacity of ponds.

Asset Group	Lifecycle Activity	Description of Activities Practiced by the City	Benefit or Risk Associated with the Activities
		Rain Gauges • Replace at end of life.	• Reduce risk of failure ensuring continued service in rainfall monitoring.
		Snow Dumps • None currently.	• TBD
		Shoreline Seawalls • TBD.	
	Disposal	**All Stormwater Assets** • Removal and landfill disposal. • Metals are retained and brought to a facility as appropriate for recycling, etc.	• Ensure assets are disposed in compliance with waste regulations in Ontario.
	Non-Infrastructure	• Developing Master Plans and Official Plan.	• Master Plans and Official Plan include strategic planning / budgeting and project prioritization enable long-term decision making.

5. Funding Need Analysis

5.1 Reinvestment Forecast and Lifecycle Modeling

Table 5-1 shows the assumptions on the reinvestment rate forecast for each stormwater asset subcategory, the reinvestment target, and the resulting 10-year annual average reinvestment rate for the period 2023 to 2032.

In the future, when condition assessment programs are implemented, asset conditions are recommended to be used to update the renewal and replacement forecast to support improved decision making.

Table 5-1: Stormwater Reinvestment Assumptions

Asset Group	Asset Category	Measure	Target	2023- 2032 10-Yr. Annual Avg. Reinvestment Rate
Stormwater	Stormwater Mains	Percentage of mains exceed their expected service life replaced in 2023 and thereafter	100%	0.2%
	Service Connections	Percentage of required replacement of service connections when replacing mains addressed	100%	0.05%
	Manholes & Chambers	Percentage of required replacement of manholes & chambers when replacing mains addressed	100%	0.1%
	Catch Basins	Percentage of required replacement of catch basins when replacing mains addressed	100%	0.07%
	Catch Basin Leads	Percentage of required replacement of catch basin leads when replacing mains addressed	100%	0.9%
	Ditches	Percentage of ditches rehabilitated annually	2%	0.5%
	Road Crossing Culverts (<3 m)	Percentage of road crossing culverts replaced annually	Replace assets for a life cycle of 40 to 80 years, depending on material type	2.9%
	Driveway Culverts	Percentage of driveway culverts replaced annually	Replace assets for a life cycle of 25 to 50 years depending on material type	4.4%
	O&G Separators	Percentage of O&G Separators exceed their expected service life replaced in 2023 and thereafter	100%	0.0%
	Aqueducts	Percentage of capital reinvestment needs to sustain the current level of service addressed	100% (Equivalent to $1,600,000 annually – based on the current capital expenditure)	0.5%
	Pump Station	Percentage of stormwater pump station assets exceed their expected service life replaced in 2023 and thereafter	100%	2.1%
	Stormwater Management Ponds	Percentage of stormwater dry ponds cleaning and capital repair needs addressed	100% (Equivalent to $10,000 annually)	0.6%
	Rain Gauges	Percentage of rain gauges exceed their expected service life replaced in 2023 and thereafter	100%	11.7%
	Snow Dumps	Percentage of capital needs (installation of stormwater treatment OGS for each snow dump) and OGS unit cleaning needs addressed	100% (Equivalent to $100,000 every year for installing OGS in the first seven years, and $35,000 annually for OGS cleaning)	32%

Asset Group	Asset Category	Measure	Target	2023- 2032 10-Yr. Annual Avg. Reinvestment Rate
	Shoreline Seawalls	Percentage of capital reinvestment needs to sustain current level of service addressed	100% (Equivalent to $100,000 annually)	Asset inventory is not available

The lifecycle analysis was implemented within an MS Excel Stormwater Asset Lifecycle Model. The analysis involves integrating key asset attribute information including asset inventory, age, expected service lives, replacement values, and condition to create a theoretical asset replacement cycle for each asset. A financial dashboard was developed to present the lifecycle modeling results.

It should be noted that the nature of this type of analysis is based on a wide range of data inputs, currently available information, and a number of assumptions, and is therefore at best a high-level estimate of future funding needs. Project timing and cost should be further refined upon approach of the actual implementation date.

5.2 Capital Reinvestment Need Analysis

5.2.1 10-Year Reinvestment Need Analysis

The average annual reinvestment rate for the City's stormwater assets is $7.1 Million over the next 10 years in inflated dollar values. This is equivalent to a total of approximately $71 Million over the next 10-year period, as presented in **Figure 5-1**. The reinvestment funding needs for stormwater sewers account for the largest share in the 2023. The South Market Street Area pipe relining recommended based on the 2020 storm sewer condition assessment results were included in the 2023 sewer capital funding need to address pipe defects. Driveway culverts make up more than half of the reinvestment funding need throughout the rest of the forecast period as the majority of the City's driveway culverts were expected to last for 25 years based on local environmental conditions. The 2023 to 2032 reinvestment requirements for aqueducts were estimated based on the City's current expenditures and presented in inflated dollar values.

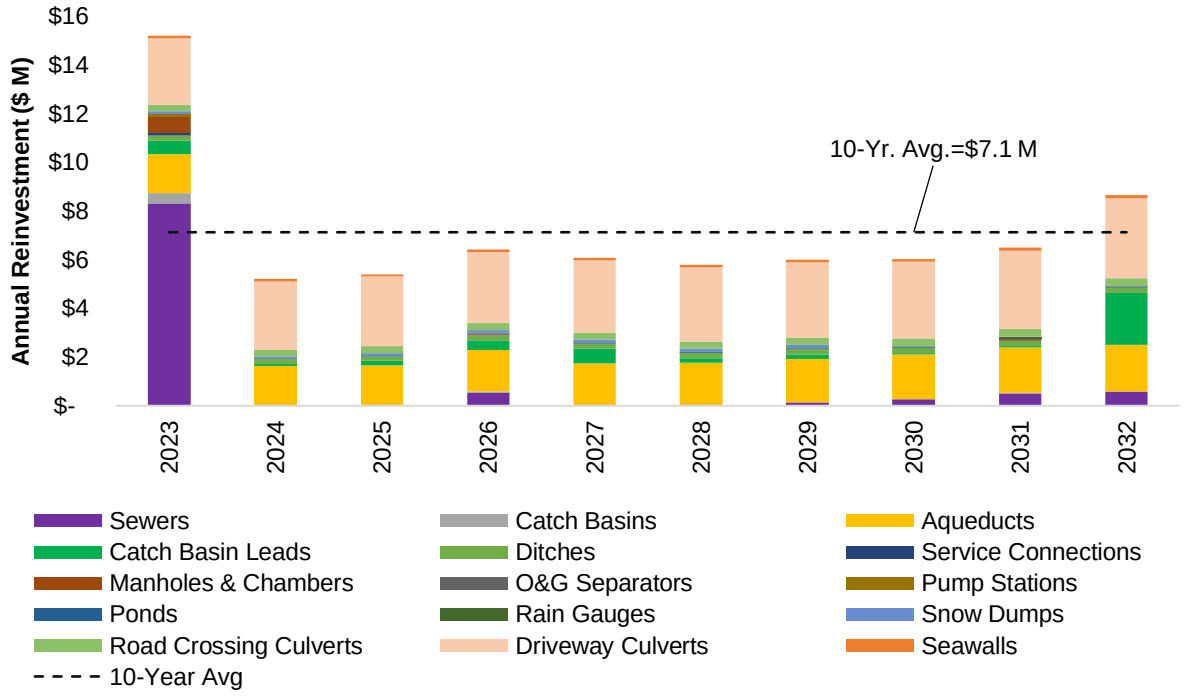


Figure 5-1: Stormwater 10-Year Reinvestment Needs

The detailed 10-year reinvestment needs for each stormwater asset sub-category are presented in **Table 5-2** in inflated dollar values.

Table 5-2: Stormwater 10-Year Total and Annual Average Reinvestment Need

Asset Sub-Category	Annual Average Need	10-Year Total
Sewers	$1,035,000	$10,350,000
Road Crossing Culverts	$290,000	$2,900,000
Driveway Culverts	$3,009,000	$30,090,000
Catch Basins	$49,000	$490,000
Aqueducts	$1,752,000	$17,520,000
Catch Basin Leads	$446,000	$4,460,000
Ditches	$216,000	$2,160,000
Service Connections	$19,000	$190,000
Manholes & Chambers	$79,000	$790,000
O&G Separators	$-	$-
Pump Stations	$10,000	$100,000
Ponds	$11,000	$110,000
Rain Gauges	$6,000	$60,000
Snow Dumps	$110,000	$1,100,000
Shoreline Seawalls	$99,000	$990,000
Total	**$7,131,000**	**$71,310,000**

5.2.2 50-Year Reinvestment Need Analysis

Looking ahead over the long term, the average annual reinvestment estimate for the City's stormwater assets is $32.5 Million over the next 50 years in inflated dollar value, for a total of approximately $1.6 Billion, as presented in **Figure 5-2**. Starting from approximately 2042, a significant proportion of the City's aged stormwater sewers will require renewal or replacement as they will exceed their expected service lives.

The 2023 to 2032 reinvestment needs for aqueducts were estimated based on the City's current expenditures, while the capital need after 2033 was based on asset age and ESL. Based on the current model significant aqueducts funding is required in 2065 and 2067. The aqueducts funding need for 2065 is attributed from the replacement need of a large aqueduct at East Davignon Creek (South of Bonney) to Douglas Street. As the construction dates for some aqueducts are not available, their construction date was assumed based on the available dates leading to the spike of needs in 2067. AECOM recommends that the City to continues to refine the rehabilitation and replacement needs assessment for aqueducts, especially after 2033, to better inform sustainable funding requirements.

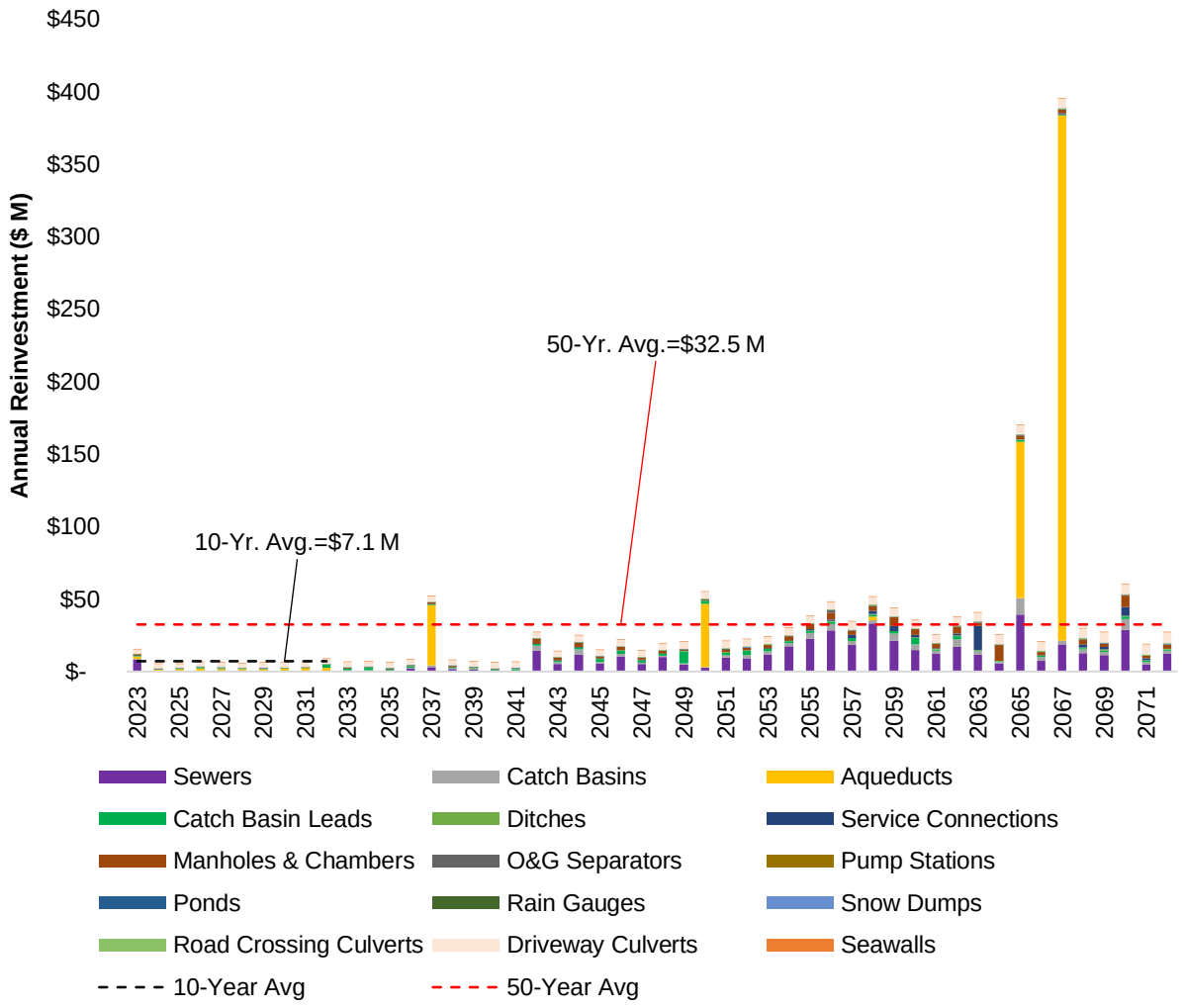


Figure 5-2: Stormwater 50-Year Reinvestment Needs

5.2.3 Benchmarking for Capital Reinvestment Needs

AECOM's Canadian Infrastructure Benchmarking Initiative (CIBI, see https://www.nationalbenchmarking.com/) is a partnership of over 50 Canadian municipalities, stretching from coast-to-coast, that annually collects and reports on water, wastewater, stormwater, and transportation LoS across operational, financial, environmental, and social "bottom lines". The findings from the CIBI serve as key inputs into establishing what constitutes industry best practice for asset management activities across Canadian municipalities. Capital reinvestment rate of stormwater management system from CIBI were reviewed and analyzed to provide the City with context and useful comparable information to make informed decisions.

Table 5-3 shows the capital reinvestment benchmarking results. The proposed capital reinvestment budgets for the stormwater management system are slightly above the group median indicating that this proposed capital reinvestment level is on par with the Canadian benchmarking municipalities' current stormwater capital reinvestment practice.

Table 5-3: Capital Reinvestment Benchmarking

Asset Category	Current Capital Budget	Proposed Capital Reinvestment Cost	Proposed Reinvestment Rate	CIBI Capital Reinvestment Rate Benchmarking Median	CIBI Capital Reinvestment Rate Benchmarking 25th percentile to 75th percentile
Stormwater	NA*	$7,130,000	0.84%	0.76%	0.45% - 1.28%

*The City's current 10-year stormwater management capital budget forecasts were not available to benchmark against the CIBI group statistics as the stormwater capital works were largely driven by roads capital works which makes it difficult to separate stormwater capital expenditures from the road capital budgets.

5.3 Full Funding Need Profile

Figure 5-3 shows a full picture of the City's stormwater funding need forecast over the next 10 years, which provides the City the full funding requirements to perform effective financial planning activities. The total annual reinvestment cost from **Figure 5-1** was overlaid with the City's annual stormwater O&M cost (approximately $0.7 Million annually in inflated dollar value).

The City's stormwater full funding requirement increases to approximately $78 Million over the next 10 years considering capital and O&M, which is equivalent to $7.8 Million per year in inflated dollar value.

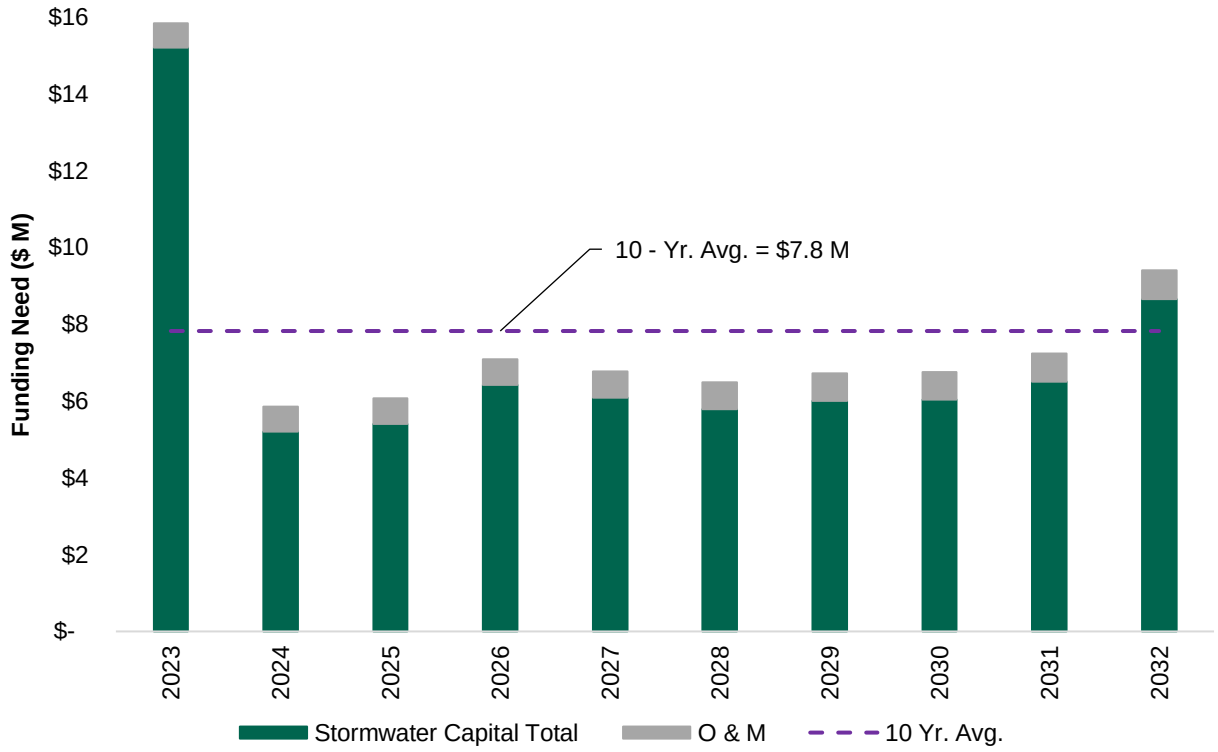


Figure 5-3: Stormwater Full Funding Need Profile

6. Implementation Plan and Continuous Improvement

Continuous improvement is an important component of any AM program and is achieved through the implementation of recommended improvement initiatives which support sustainable service delivery. While the City's stormwater assets are in a relatively good condition at the moment, there are future challenges that must be addressed considering the 50-year projection presented in **Figure 5-2**. It is important to address these challenges thoroughly and promptly to leave a positive legacy for future generations.

A suite of improvement initiatives has been identified for the next phase of AM planning for the City's stormwater assets, as outlined below:

- **Recommendation 1: Refine asset data and fill data gaps to make more informed and defensible decisions.**
  - Continue to collect data and fill gaps in the GIS inventory to have a more accurate representation of the current state of the stormwater infrastructure. For example, it is recommended to confirm the installation years and last treatment years of some aqueducts to improve the understanding of the current state.
  - Develop an inventory of shoreline seawall assets.
- **Recommendation 2: Develop a Data Governance Framework to provide a holistic and consistent approach to the City's stormwater data management practices**.

  A Data Governance Framework includes developing an Asset Information and Data Standards Strategy to clearly define what asset data exists, who is accountable for managing it, methods of data collection, and safeguarding data quality. The successful deployment of a Data Governance Framework aims to achieve the following benefits:
  - Enhanced data integrity to support reliable analysis.
  - Improved data management workflows and processes.
  - Improved AM reporting.
  - Clearly defined data management roles and responsibilities.
- **Recommendation 3: Review business process for asset acquisition and design workflow diagrams to formally document AM processes.**

  An opportunity exists for the City to continually reevaluate its business practices, including data management, to promote information sharing between roles, departments, and systems. The development of process maps is an excellent resource for visualizing the flow of information and formalizing procedures.
- **Recommendation 4: Develop a stormwater sewer condition assessment program**.

  Condition assessment is one of the primary steps utilized prior to performing maintenance, rehabilitation, or replacement activities. In sewers, the most commonly used inspection technique is CCTV for sewers up to 1,200 mm; larger sewers can be good candidates for multi-sensor inspection (MSI). The results from these inspections will be used to evaluate the internal condition of the pipeline to determine the structural and operational condition. A CCTV program will allow the City to:
  - Better forecast infrastructure renewal and rehabilitation needs.
  - Avoid infrastructure failures and the resulting economic, social, and environmental costs.
  - Leverage cost-effective methods to extend the life of assets before the asset becomes too deteriorated and must be replaced.
- **Recommendation 5: Refine the Levels of Service Framework.**

Considering the LoS deadline of July 1st, 2025, stipulated within the O. Reg. 588/17 regulations, the steps to refining the LoS framework and quantifying the gaps between existing and target service levels can include:

- Collecting asset performance data for key performance indicators (KPIs) that are not currently being tracked, including associated costs.
- Reviewing the LoS performance measures on an annual basis and updating asset performance data as required.
- Analyzing and monitoring asset performance data to determine trends and to establish annual performance benchmarks.
- Engaging in a discussion with key stakeholders to establish service level targets and identify associated costs to meet those targets.
- Once LoS targets have been decided upon, the City should develop strategies on how to meet service level targets considering its existing operating environment (i.e., staff availability, current funding, resources, etc.).
- Developing a Customer Consultation Plan to engage the public and other stakeholders on the LoS framework and to better understand customers' willingness to pay for enhanced LoS.
- Documenting information workflows, and clearly defining roles and responsibilities in the LoS continual improvement planning process. A component of collecting LoS performance data is ensuring that the right processes are in place to enable efficient LoS reporting. It is recommended that the City review its existing business process and identify opportunities to support cross-functional teamwork. This includes developing process maps and documenting clear roles and responsibilities so that key staff understand their role in data collection, recording, analysing, and monitoring.

- **Recommendation 6: Develop a Risk Assessment Framework and use risk scores to drive financial needs forecasting.**

  The use of a risk-based approach to inform financial needs provides a clear direction in maintenance, rehabilitation, and replacement work in terms of balancing priorities. It also provides transparency to the public and other stakeholders to demonstrate that decisions are made in an impartial and consistent manner, without unreasonable bias, and in accordance with agreed upon policy and priorities.

- **Recommendation 7: Implement a Computerized Maintenance Management System (CMMS) / Work Management System.**

  Implementation of a CMMS will ensure managing and tracking asset operations and maintenance on a consistent basis across all asset classes. The City will conduct an AM Software Strategy following the completion of this AM plan to identify future system requirements that may include enhancing existing software, adding-on, or replacing.

- **Recommendation 8: Refine the Stormwater lifecycle model and update the model periodically as new information becomes available.**

  The stormwater funding model is based on a wide range of data inputs, currently available information, and a number of assumptions, and is therefore at best a high-level estimate of future funding needs.

  - In light of the annual capital and O&M investments outlined in **Section 5**, the estimated funding requirement for the City's stormwater reinvestment and O&M is on average of $7.8 Million per year over the next 10 years. However, when considering the longer-term needs, the City may want to consider establishing reserves to address future renewals and replacement beyond the 10-year horizon.
  - Review financial modeling assumptions on ESLs and replacement values and update the financial model with new information as it becomes available (e.g., when the results from the CCTV inspection program or any advanced field inspection become available).

- **Recommendation 9: Continue to monitor growth needs and integrate growth related stormwater infrastructure funding needs into the financial forecast and update the stormwater AM Plan as appropriate.**

As referenced in **Section 3.6**, the City's stormwater system is expected to grow in line with an increase in the City's population. AECOM recommends that the City:

- Includes growth-related capital needs as part of the capital budgeting.
- Coordinates AM planning and development planning processes to ensure that the infrastructure systems that are built to serve new growth can be sustained over the long term.
- Ensures that the stormwater asset inventory is kept current at all times as new assets are added and existing assets are refurbished or retired.

- **Recommendation 10: Continue to find ways to improve AM initiatives across the City by maintaining a high level of AM awareness through training, AM buy-in, communication, and knowledge sharing.**

  ISO 55010[5] identifies that the financial and non-financial functions of AM within organizations are generally inadequately aligned. The lack of alignment between financial and non-financial functions can be attributed to silos in an organization, including reporting structures, functional / operational business processes, and related technical data. Financial and non-financial alignment needs to work both "vertically" and "horizontally", as follows:

  - Vertical Alignment: financial and non-financial asset-related directives by management are informed by accurate upward information flows, effectively implemented across the appropriate levels of the organization.
  - Horizontal alignment: financial and non-financial information that flow between departments conducting functions such as operations, engineering, maintenance, financial accounting, and management, etc. should use the same terminology and refer to the assets identified in the same way.

- **Recommendation 11: Develop a Knowledge Retention Strategy to document staff AM knowledge and experience for succession planning purposes.**

  Communicate AM improvement initiatives and enhance AM awareness internally through internal communication.

- **Recommendation 12: Develop a Change Management & Communications Plan.**

  AM buy-in and support are needed from all levels of the City to ensure that AM standards, practices, and tools are properly adopted and incorporated into day-to-day work activities. A successful Change Management & Communications Plan will depend on the following factors:

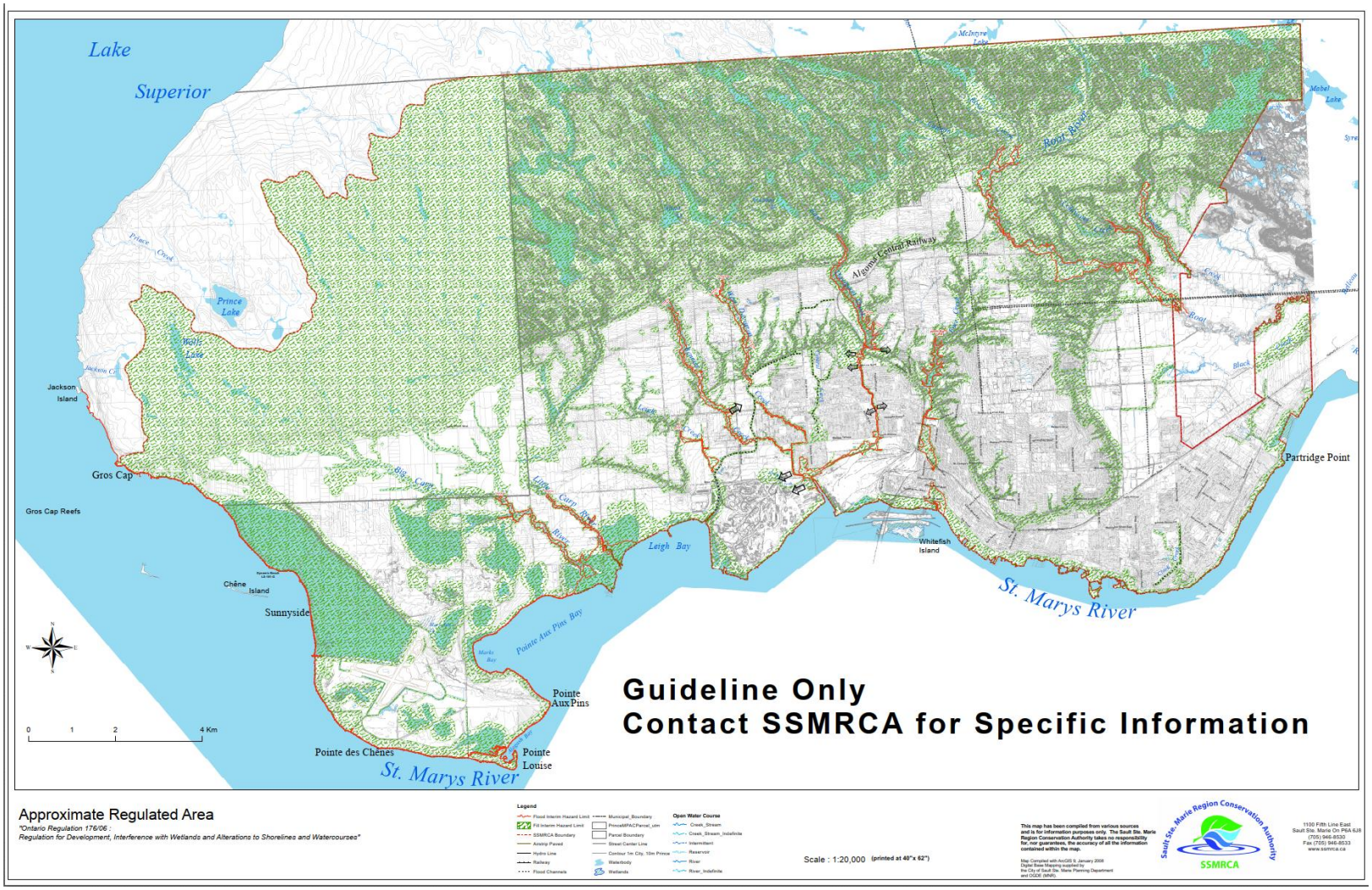
  - AM buy-in from Council, senior management, staff, and departments.
  - AM objectives are realistic and achievable.
  - AM improvement initiatives are appropriately resourced.
  - A network of AM champions is developed and empowered across the City.

[5] International Organization for Standardization (2019): ISO 55010 - Asset management — Guidance on the alignment of financial and non-financial functions in asset management

Appendix A - Stormwater Asset Inventory

The City's stormwater asset inventory is presented as a separate MS Excel file.

Appendix B - Stormwater Approximate Regulated Area



Source: O. Reg. 176/06: Sault Ste. Marie Region Conservation Authority: Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses.

Figure B-1: Stormwater Approximate Regulated Area

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