



**Sustainability &
Asset Management**

2024 Asset Management Plan City of Markham

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Definitions

Asset

An item, thing or entity that has potential or actual value to an organization. The value can be tangible or intangible, financial or non-financial, and includes consideration of risks and liabilities.

Asset Category

A category of municipal infrastructure assets that is an aggregate of assets.

Asset Hierarchy

A logical digital index of assets and asset information.

Asset Management

Planned actions and coordinated activities of an organization to optimally and sustainably manage its assets that will enable the assets to provide the desired level of service in a sustainable way, while managing their risk at the lowest life-cycle cost. It encompasses all asset types, tangible or intangible, individual components or complex systems, and all activities involved in the asset's lifecycle from acquisition/creation, through maintenance to renewal or disposal.

Asset Management Plan

A strategic document (long-term) that states how a group of assets is to be managed over a period of time. The plan describes the characteristics and performance of infrastructure assets, the levels of service expected from them, planned actions to ensure the assets are providing the expected level of service, and financial strategies to implement the planned actions. Specific criteria to be included is defined in Ontario Regulation 588/17.

Asset Management Policy

Mandated requirements, overall intentions/principles and framework for control of asset management. An Asset Management Policy guides the overall direction of the asset management system, providing direction to the appropriate focus and level of asset management practice expected. It shall establish key principles, overall vision for the program, and align other municipal plans.

Asset Management Strategy

Documents the intended approach by which the assets and other resources will be used to achieve the agreed upon objectives within the agreed Policy framework. It provides clear direction, intentions and rationale. It also identifies the organizational readiness, including identification of barriers and appropriate implementation plans to overcome the barriers.

Backlog

Backlog refers to the value of immediate work that is required (not including additional work that may occur over the forecast periods) based on asset needs. This work could include asset replacements that are required when an asset has passed the end of its life. It may also include rehabilitations that are required immediately. The City understands the term “backlog” to mean those assets that have been identified as having needs (either rehabilitation or replacement) but are also not identified in the City’s Lifecycle Reserve Study.

Backlog (Managed)

Managed backlog refers to the value of immediate work that is required (not including additional work that may occur over the forecast periods) based on asset needs that the City has identified and has planned to complete. These items include both rehabilitations and replacements (i.e. renewals), and they are identified in the City’s Lifecycle Reserve Study.

Building Together – Guide for Municipal Asset Management Plans

A document, released by the Government of Ontario, which explains the importance and the features of an AMP.

Community (Customer) Levels of Service

Community Levels of Service (also known as Customer Levels of Service) measures are typically expressed in non-technical terms and describe the general public’s understanding of services being provided by infrastructure systems. Community LOS measures are typically related to the service that is provided by the overall system supporting the service delivery, rather than the specific assets.

Core Asset

Includes any municipal infrastructure asset that is a:

- water asset that relates to the collection, production, treatment, storage, supply or distribution of drinking water,
- wastewater asset that relates to the collection, transmission, treatment or disposal of wastewater, including any wastewater asset that from time to time manages stormwater,
- stormwater management asset that relates to the collection, transmission, treatment, retention, infiltration, control or disposal of stormwater,
- road; or,
- bridge or culvert.

Current Replacement Value

The amount that an entity would have to pay to replace an asset of the same function and capacity at the present time, according to its current worth, including costs related to removal, installation, excavation, design, engineering, contingencies, disposal, material and labour.

Deterioration Curve

A mathematical representation used to model and predict the change in performance of an asset over time. These curves can be plotted on a graph, with the x-axis representing time (age), and the y-axis representing performance values (or ratings).

Estimated Service Life (ESL)

The estimated period of time (usually in years) that an asset is in use or is expected to be available for use, assuming perfect construction and general maintenance is carried out. ESLs may vary according to material type or functional component.

Infrastructure

The physical structures and associated facilities that form the foundation of development, and by or through which a public service is provided.

Infrastructure Deficit

A spending shortfall in comparison to an established need. This can include the accumulated deficit that results year over year due to financial shortfalls.

Key Performance Indicator (KPI)

A quantifiable measure used to evaluate the success of an organization, employee, asset, etc. in meeting objectives for performance.

Level of Service

The parameters or combination of parameters that reflect the social, political, economic, and environmental outcomes the organization delivers. Level of service statements describe the outputs or objectives of the organization's activities that are intended to be delivered to the community.

Lifecycle Activity

Activities undertaken with respect to an infrastructure asset over its service life, including constructing, maintaining, renewing, operating, and decommissioning, and all engineering and design work associated with those activities.

Lifecycle Cost

The total cost of ownership over the life of an asset. This may include but is not limited to capital costs, operating costs, maintenance costs, renewal costs, replacement costs, environmental costs, and user delay.

Lifecycle Management Strategy

The set of planned actions that will enable the assets to provide the desired levels of service in a sustainable way, while managing risk, at the lowest lifecycle cost.

Long-Term Financial Plan

A plan that projects a forecast of financial performance and position over a period of at least five years. The Long-Term Financial Plan should be consistent with actions required to implement strategies proposed in other plans/documents.

Maintenance

Activities that allow assets to meet their required performance objectives, including regularly scheduled inspection and activities associated with unexpected or unplanned events.

Missing Assets

Missing assets are assets that have been built and are currently in-service. These assets are not captured within the City's database system(s) or asset registry and are not captured in the City's Life Cycle Reserve Study.

Non-core Asset

All other municipally owned assets not included in the definition of a core asset (as per O. Reg 588/17).

Non-infrastructure Lifecycle Activities

Actions, studies, master plans or policies that are not capital in nature, which result in the lowering of costs and/or extend the useful life of an asset.

Ontario Regulation 588/17

Under the Infrastructure for Jobs and Prosperity Act, 2015, principles are set out by the provincial government to regulate asset management planning for municipalities. On December 27, 2017, O. Reg. 588/17 was released which regulates asset management planning for municipal infrastructure.

Operations

Regular, routine or regularly scheduled activities that are required or regularly anticipated as part of the assets service (for example, fueling a vehicle, completing an inspection or condition assessment, winter control, staffing/overhead).

Preventive Maintenance

Regular, routine or regularly scheduled maintenance activities that are intended to keep assets in good working order and prevent or minimize unplanned failures or downtime.

Rehabilitation

Significant repairs designed to extend the life of an asset. Rehabilitations are considered renewal lifecycle activities. They provide a significant improvement in an asset’s performance, as opposed to maintenance activities that could occur more frequently and are designed to maintain functionality and performance as opposed to improve or restore it. For example, the re-lining of a length of sewer pipe can be considered a rehabilitation activity, whereas a spot repair may be considered maintenance.

Renewal/Replacement

Major rehabilitation or replacement of an existing asset to an equivalent capacity, function and/or performance.

Risk

The effect of uncertainty on an organization’s objectives. It considers financial, socioeconomic and financial variables and is determined by assigning a numeric rating for the likelihood of an asset failing and the consequence if it does.

Risk Management Strategy

A Risk Management Strategy details the methodology and framework used to assess an asset portfolio. It details the methodology and results used to assign Likelihood of Failure, Consequence of Failure and Risk Ratings to assets, which assists in understanding asset criticality, and prioritizing assets for rehabilitation or replacement.

Technical Levels of Service (LOS)

Technical LOS are technical measures applied against assets and overall systems that define the performance requirements to support Community Levels of Service and are used to determine which criteria will be used to drive business decisions. Technical LOS are often expressed in quantitative or numerical terms.

Acronyms and Abbreviations

Acronym or Abbreviation	Meaning
AM	Asset Management
AMP	Asset Management Plan
BCI	Bridge Condition Index
ESA	Environmentally Sensitive Area
ESL	Estimated Service Life
FCI	Facility Condition Index
LOS	Levels of Service

O. Reg. 588/17	Ontario Regulation 588/17
PCI	Pavement Condition Index
SOTI	State of the Infrastructure

Assumptions and Limitations

The analysis, findings, and recommendations presented in this AMP contain certain assumptions and limitations. Throughout this AMP, where assumptions have been made or limitations exist (i.e., data availability, data granularity, etc.) it has been noted. The purpose of this section is to summarize these assumptions and limitations into a single, referenceable location. This section contains general and specific assumptions and limitations.

General Assumptions and Limitations

Asset Information – The detail, quantity, and quality of asset information varies across the City’s different asset classes. As the City’s asset management program continues to develop, asset data will also continue to improve over time. Where assumptions have been made due to the state of the available asset information, it has been noted.

Furthermore, it is noted that to complete the analyses that are reported in this AMP, the City utilized its asset inventory data that was current to year-end 2023. No dataset is without errors and/or gaps. Therefore, the findings in this AMP are based on the best information available, and as a result, output reports and modeling results are subject to change as this data improves.

Also noted is that any renewal work that the City has undertaken in 2024 is not reflected in the outputs of this AMP.

Decision Support System (DSS) – The DSS is a software model that generates a financial needs-based forecast over a forward-looking planning horizon. The DSS applies interventions (i.e., renewals, replacements, etc.) to assets at set trigger points (condition or age), and captures the cost of the intervention and post-intervention condition state of the asset. The interventions, their timing (i.e., trigger point), cost, and post-intervention condition state rely on input from subject matter experts. At the same time, the condition values used to trigger interventions is an estimated condition. Therefore, the financial forecast created by the DSS (any DSS) provides a best practice-based estimate of future costs and asset performance.

Having said this, forecasts are based upon a computational modeling exercise underpinned by assumptions and information that is subject to change and refinement as part of the annual resource and budget planning process.

Improvement and Monitoring Plan – It is assumed that the City will resource and action the elements of the improvement and monitoring plan. However, the rate at which the plan’s components can be actioned will limit the rate at which future AMPs and the City’s overall asset management program can mature.

Specific Assumptions and Limitations

Estimated Service Life (ESL) – is an asset management best practice that assigns a lifespan to an asset. It is a key datapoint that enables forecasting of asset performance and costs over time.

- Assumptions: as defined in the section Definitions (above), ESL assumes every asset is constructed perfectly and receives a regular maintenance regime over its entire service life. Many assets are not constructed perfectly. Furthermore, many assets exist in hostile environments (i.e., are exposed to salt water, corrosives, temperature extremes, etc.) or experience heavy utilization (i.e., heavy construction vehicle traffic on paved roads). As a result, actual service life can vary from estimated service life.
- Limitations: The ESL is typically assigned to an asset based on a combination of input from subject matter experts, direct experience with assets, and published service lives (City’s Tangible Capital Asset Policy, from manufacturers or industry standards and guidelines). Small changes in ESL can have compounding impacts on forecasts that contain large volumes of assets and/or span long time planning horizons.

Lifecycle Activity Costs – are defined in Section 9.2 and listed in table 9-3 and are annual operation costs related to non-infrastructure solutions, asset acquisitions, asset operation, and service improvements. These costs are incorporated into the financial forecasts within this AMP.

- Assumptions: all monetary values are presented in 2023 dollars. It is assumed that lifecycle activity costs will remain constant over future time periods, regardless of the City’s anticipated growth of its asset portfolio. No escalation to lifecycle activity costs have been applied.
- Limitations: because no year over year escalation is applied to the lifecycle activity costs portion of the forecasts, users of this AMP should limit their interpretation of the forecasts and related decision making with this in mind.

Likelihood of Failure (LOF) - Likelihood of Failure is defined in Section 7 – Risk Management Framework. The LOF of an asset is a key metric that guides its management approach.

- Assumptions: the LOF value assigned to assets is currently based on either observed condition or the asset's age (either known or estimated).
- Limitations: many assets do not fail based on condition or age (i.e., an asset can fail due to obsolescence, lack of capacity, poor efficiency, regulatory requirements, etc.). Further, when LOF is based on age, the rating is based upon the remaining Estimate Service Life, which is exactly that – an estimate. Therefore, users of this AMP should limit their interpretation of risk information presented in this AMP and any related decision making with this in mind.

1. Executive Summary

1.1. Introduction

The City of Markham's 2024 Asset Management Plan (AMP) provides an overview of the asset management practices and processes undertaken by the City in order to provide essential municipal services to its residents and businesses, as well as maintain the assets that support these services in a state of good repair.

The 2024 AMP was developed in alignment with the Ontario Regulation 588/17 (O.Reg.588/17) and key strategic documents, such as the City's Official Plan, Strategic Plan, Building Markham's Future Together (BMFT), the Greenprint, Markham's Community Sustainability Plan, and more.

This AMP formally documents the City's approach to performing sound asset management for the asset portfolio. The AMP contains the following content:

1. **Introduction:** provides a brief description of the City's asset management objectives, and the scope of the AMP.
2. **Alignment with Organization Goals:** documents the City's asset management journey and how the AMP is aligned with the City's strategic goals, objectives, and vision.
3. **Future Demand:** outlines internal and external factors that may influence future demand and how growth has been considered in this AMP.
4. **State of the Infrastructure:** provides an overview of the assets owned and maintained by the City, including asset valuation, quantities, average age and current performance.
5. **Levels of Service (LOS):** documents the established LOS measures and performance indicators used by the City to assess if adequate service is being provided to the community.
6. **Risk Management Strategy:** details the City's approach to evaluating risk, as well as the risks associated with the current state of assets.
7. **Lifecycle Management Strategy and Forecasting:** details the funding that is required based on asset needs and lifecycle management strategies to maintain current LOS and address backlogs.
8. **Financial Summary:** provides a summary of the City's finances, projected into the future, with the perspective of maintaining service levels.
9. **Improvement Plan:** provides recommendations and initiatives for the City to undertake to improve their AM program and future iterations of this AMP.

In addition to this information, this AMP is organized by providing more detailed analysis on major service areas. **Appendices A to K** contain chapters for each service area that include the following sections/information at a more granular level:

- a. State of the Infrastructure**
- b. Levels of Service**
- c. Risk Management Strategy**
- d. Lifecycle Management Strategy and Forecasting**

This AMP includes all infrastructure assets that are owned by the City and that the City is responsible for maintaining. The City's asset hierarchy, provided below, details these service areas and associated assets.

To complete the analyses that are reported in this AMP, the City utilized its asset inventory data that was current to year-end 2023. Therefore, the findings in this AMP are based on 2023 data, and as a result, any renewal work that the City has undertaken in 2024 is not reflected in the outputs of this AMP.



Figure ES - 1: Service Areas in Scope

1.2. State of the Infrastructure

The City's total asset portfolio is valued at \$17.5B. This value is based on the assets' current replacement cost, which represents the cost required to replace the assets like-for-like. To align with the data, which was provided at year-end 2023, this value is reported in 2023 dollars. The following table provides a summary of the asset portfolio, including replacement values and average asset performance by service.

Table ES - 1: Summary of Assets by Service

Service	Current Replacement Value	Overall Performance	Percentage of Replacement Value
Arts and Culture	\$94M	Very Good	0.5%
Fire & Emergency Service	\$83M	Very Good	0.5%
General Support Service	\$274M	Good	1.6%
Library	\$52M	Very Good	0.3%
Natural Assets	\$169M	Good	1.0%
Parks	\$106M	Good	0.6%
Potable Water	\$1,926M	Good	11.0%
Recreation	\$988M	Very Good	5.6%
Solid Waste Management	\$2M	Very Good	0.0%
Stormwater Management	\$3,229M	Good	18.5%
Transportation	\$7,903M	Good	45.2%
Wastewater	\$2,671M	Good	15.3%

Figure ES - 2 below, provides a visualization of the total asset replacement value by service.

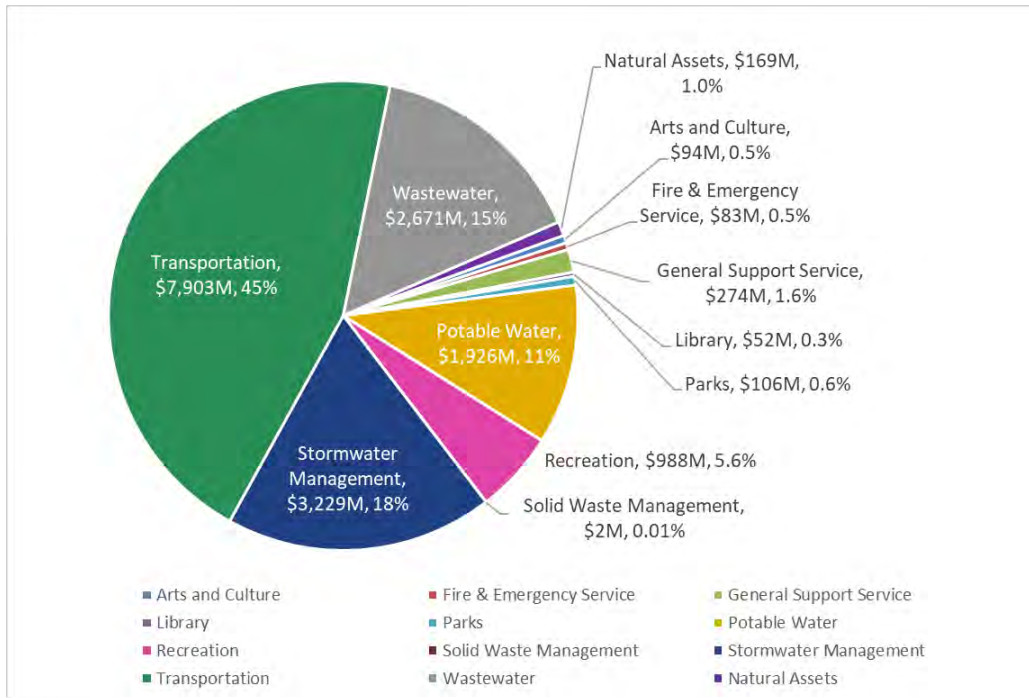


Figure ES - 2: Replacement Value Distribution by Service

Figure ES - 3 provides a visualization of the average asset age as a proportion of the average asset estimated service life (ESL), by service.¹

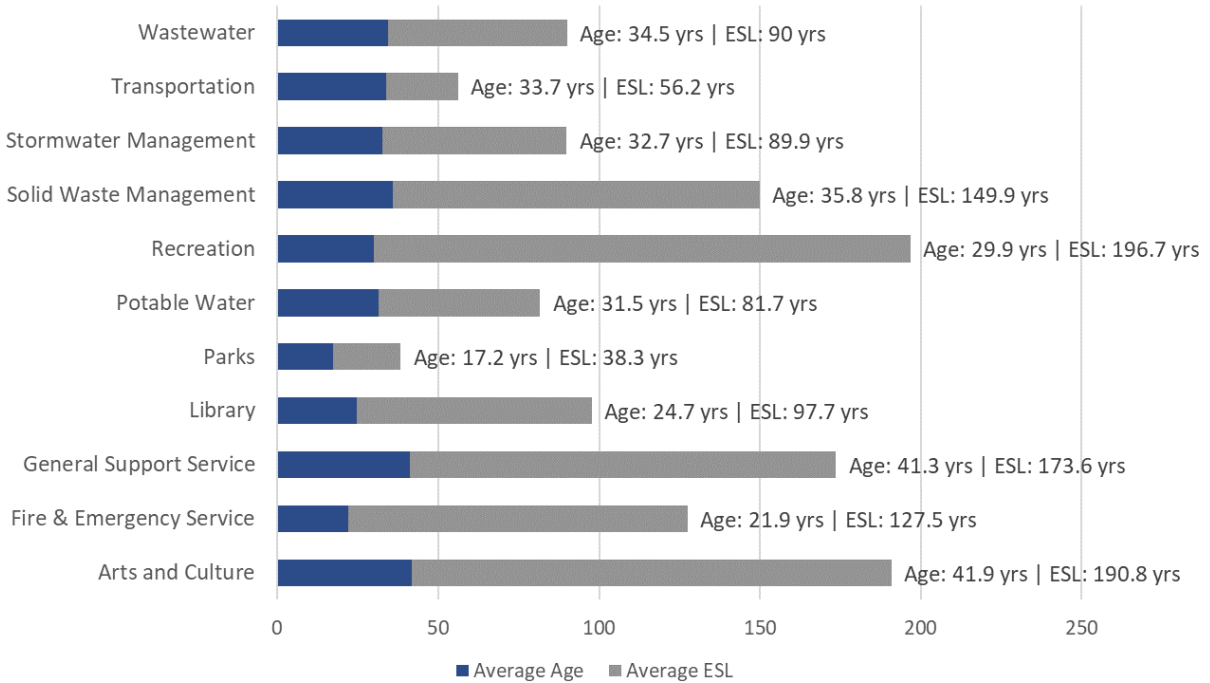


Figure ES - 3: Average Age as a Proportion of Average Estimated Service Life (ESL) by Service

¹ Natural assets are not included in this figure, as the City's Natural Assets Inventory and Evaluation Study did not provide installation dates, ages or service life for these assets.

Figure ES - 4 provides a visualization of the value of major asset construction or procurement, by decade, within each service².

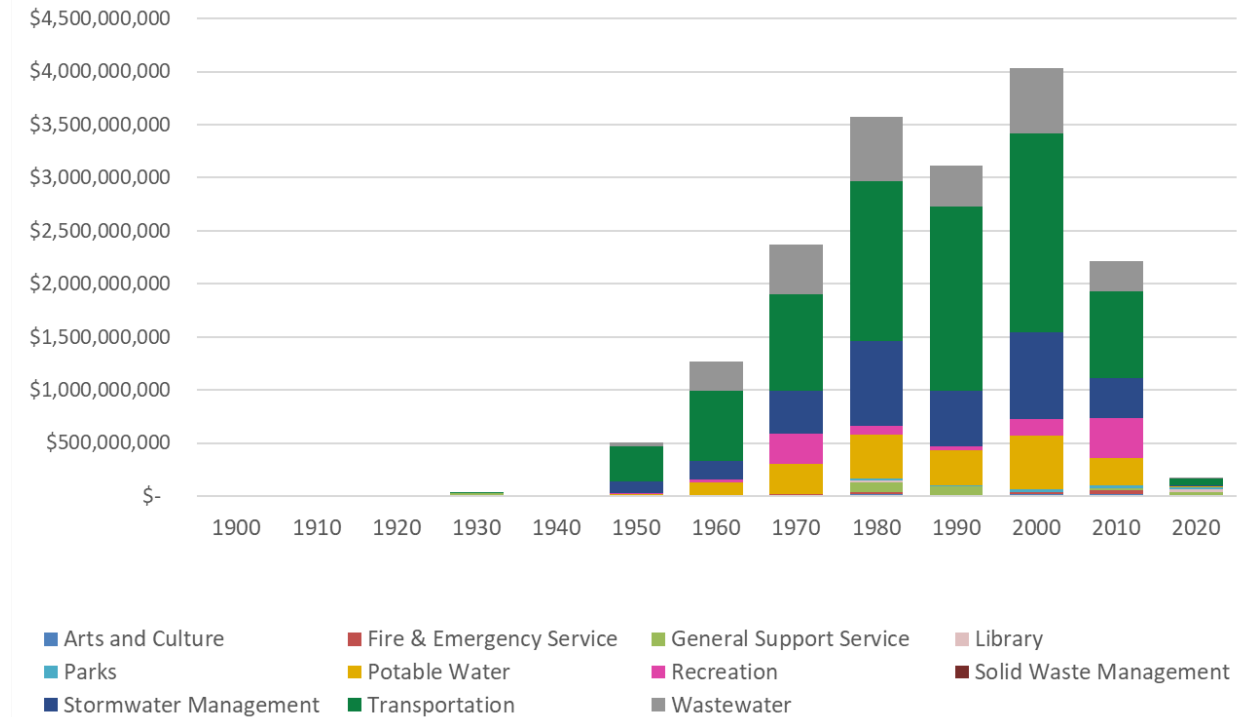


Figure ES - 4: Age Distribution by Installation Decade of All Assets

² Natural assets are not included in this figure, since the City's Natural Assets Inventory and Evaluation Study did not provide installation dates for these assets.

Figure ES - 5 and Figure ES - 6 below provide a visualization of the distribution of asset performance considering either asset age or rated physical condition over five (5) performance categories for the City as a whole, and then by service. Definitions of performance categories are provided in Section 5 in the AMP.

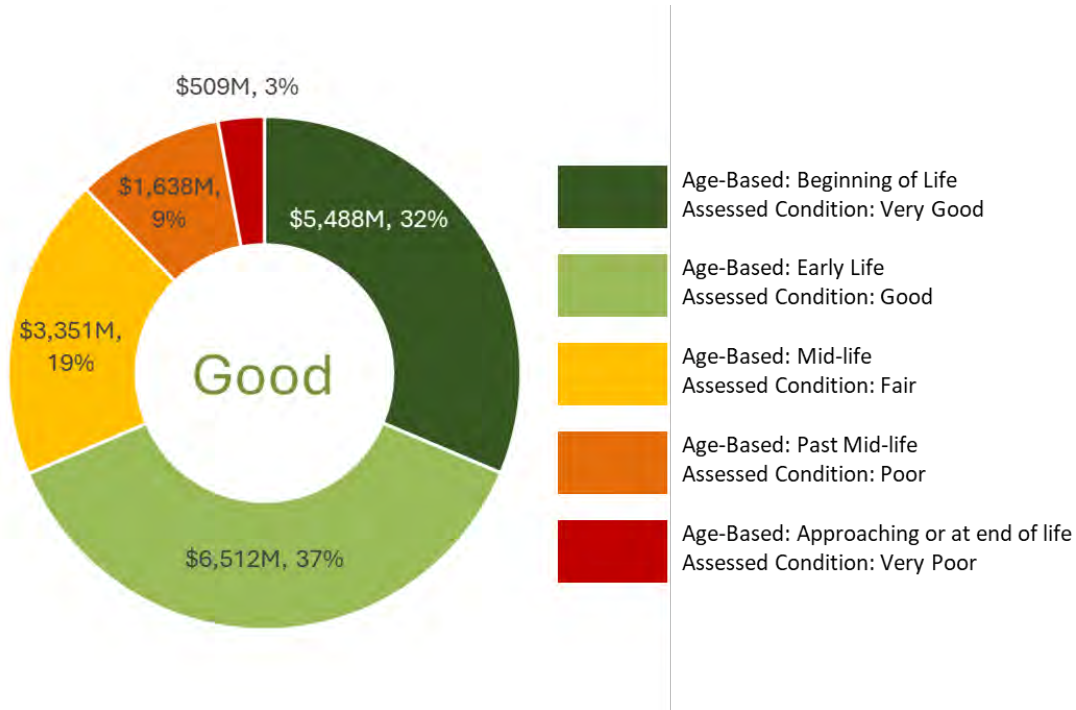


Figure ES - 5: Performance Distribution of All Assets

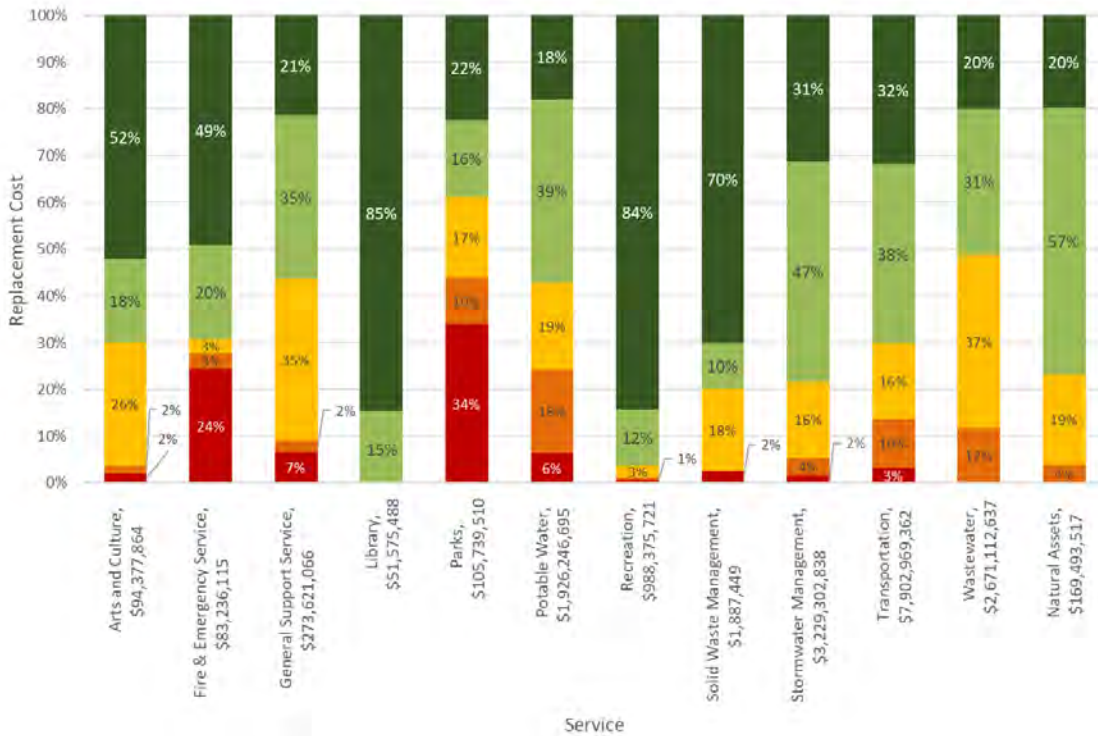


Figure ES - 6: Performance Distribution of All Assets by Service

1.3. Levels of Service

Levels of service (LOS) are a measure of the degree to which an asset meets functional or user requirements. Levels of service reflect documented approved or endorsed performance or service measures, which are articulated or reflected in a number of policy documents (i.e. plans or studies). The City has developed an LOS strategy, which documents the approach the City takes to monitor and report on these LOS. As part of that strategy, Levels of Service are regularly reviewed and updated to ensure that they reflect the current landscape at the City, which may take into account items such as Council directives, changes in policy or resource/funding constraints.

LOS measures were established for each service area to determine if service levels are being met. These measures were developed to be asset-focused and based on customer expectations and values, available asset data, and factors that support decision-making. Typically, LOS are measured in terms of parameters that reflect social, political, legislative, environmental, and economic outcomes that an organization delivers.

The full suite of LOS measures for each service area are presented in **Appendix A to Appendix K** of this AMP document. The current performance reported in these sections

take into account data for year ending 2023, unless otherwise stated. The LOS framework is presented as three tables within this AMP:

- Customer Values: summarizes the different customer expectations of each service
- Customer LOS: contains a suite of LOS measures that focus on customer experiences that use language that is familiar to the community.
- Technical LOS: details measures that the City uses to understand if it is managing assets to the level appropriate to meet community expectations. Note that technical LOS are linked to significant activities within the asset lifecycle and include the following: Acquisition, Operation, Maintenance, Renewal, Disposal, Service Improvement and Non-Infrastructure.

1.4. Risk Management Strategy

As part of the development of this AMP, a risk management strategy was developed to assess the risk of the City's asset portfolio to meet LOS goals. This was done by evaluating the likelihood of failure (LOF) and consequence of failure (COF) of each asset using a standardized framework. The risk management strategy was developed to provide the City with a formal and standardized methodology in assessing asset risk across all assets and service areas.

LOF represents the likelihood of an asset failing, relative to a specific failure event. For the purposes of this AMP, asset failure refers to failure due to poor performance, resulting in the asset no longer functioning as intended, and/or inability to provide its intended service. Therefore, the LOF of an asset is linked to its performance.

The COF framework defines the consequences that may occur should an asset fail or stop providing its intended service. The City's COF framework contains evaluation criteria, which were developed using a "triple bottom line" analysis, which evaluates the financial, social, and environmental consequences of asset failure.

Using the LOF and COF frameworks, LOF and COF scores can be assigned to each asset, on a 5-point rating scale. When the LOF and COF ratings are combined, an overall asset risk score ranging from 1 to 25 is determined. Detailed definitions of LOF, COF, risk, and the associated frameworks/rating scales are provided in Section 7. Table ES - 2 summarizes the risk scores for all assets within the scope of this AMP. It detailed the total replacement value of assets within each combination of LOF and COF ratings.

The City's Risk Management strategy has identified some assets that are considered "high" risk. Through regular business and operational planning processes, the City

ensures that attention is given to critical or high risk assets, and that initiatives are implemented to ensure that the needs of critical asset are addressed so as not to compromise the safety of the public, legislative compliance or other matters of concern.

Table ES - 2: Risk Score Distribution for All In-Scope Assets

		Consequence of Failure					Subtotal
		1	2	3	4	5	
Likelihood of Failure	1	\$84,310,092 (0.5%)	\$2,186,293,992 (12.5%)	\$3,034,001,361 (17.3%)	\$149,920,397 (0.9%)	\$0 (0.0%)	\$5,454,525,842 (31.2%)
	2	\$127,855,485 (0.7%)	\$2,734,860,216 (15.6%)	\$3,311,036,193 (18.9%)	\$255,067,034 (1.5%)	\$2,836,032 (0.0%)	\$6,431,654,960 (36.8%)
	3	\$105,103,028 (0.6%)	\$1,810,301,790 (10.3%)	\$1,416,588,023 (8.1%)	\$64,263,249 (0.4%)	\$10,272,917 (0.1%)	\$3,406,529,006 (19.5%)
	4	\$52,925,934 (0.3%)	\$779,715,138 (4.5%)	\$800,439,302 (4.6%)	\$55,494,129 (0.3%)	\$0 (0.0%)	\$1,688,574,503 (9.6%)
	5	\$45,771,739 (0.3%)	\$221,004,523 (1.3%)	\$238,252,867 (1.4%)	\$11,887,192 (0.1%)	\$0 (0.0%)	\$516,916,321 (3.0%)
Subtotal		\$415,966,277 (2.4%)	\$7,732,175,659 (44.2%)	\$8,800,317,745 (50.3%)	\$536,632,001 (3.1%)	\$13,108,949 (0.1%)	\$0

- Very Low Risk (1-5)
- Low Risk (6-10)
- Medium Risk (11-15)
- High Risk (16-20)
- Very High Risk (21-25)

1.5. Lifecycle Management Strategy and Forecasting

The City’s lifecycle strategy is a set of planned actions or activities performed on assets to provide LOS in a sustainable way, while managing risk, and at the lowest lifecycle cost. These activities include major asset renewals (such as rehabilitations and replacements), operations and maintenance, disposals, acquisitions and service improvements. These lifecycle activities work together to extend asset life, reduce overall lifecycle costs, minimize risk, and achieve other objectives such as environmental goals.

Lifecycle model forecasting uses logical assumptions about an asset’s expected or intended behaviours over time to predict future financial requirements for maintaining those assets in good working condition in order to provide services. These models incorporate the City’s lifecycle activities, such as repairs and replacements. As part of the City’s lifecycle strategy, a set of models has been developed to project future asset needs. These models are integrated with the City’s LOS and risk management strategies that inform decision-making into a decision support system (DSS) tool. This decision support tool combines the City’s asset inventories and current performance data with the lifecycle, risk, and LOS strategies to forecast future investment (i.e., renewals) required to meet asset performance goals (which in turn enables achievement of LOS goals).

For the purposes of this AMP, one (1) forecasting scenario was analyzed for the City's asset portfolio. This forecast provided insight on the City's current and forecasted renewal needs, as it relates to the LOS measures that the City has established. The following scenario was analyzed in this AMP.

- **Scenario: Cost to Maintain Current LOS** – This scenario identifies an estimate of costs that would be required to maintain the current performance of the City's assets relative to their established LOS over a 27-year forecast period (i.e. to 2051). The current technical LOS measure (i.e., asset level) that is used in this analysis is the percentage of assets that are beyond their service life or in a condition that is considered unfit to provide service. For example, if 90% of the asset portfolio is currently within its service life (or in acceptable condition), then the forecasts will identify the amount of funding required to maintain this ratio of 90% of assets within service life/in acceptable condition. Understanding the cost to maintain LOS at current levels is a requirement of the 2024, milestone of O. Reg. 588/17. Note that the assumptions used in the modelling reported herein were based on the best possible understanding of lifecycle behaviours and asset costing information at the time of writing of this AMP. As the City advances its asset management and data maturity, the outputs reported herein may be subject to change.

The forecasting model is primarily related to capital renewal needs, which includes major asset replacements and significant rehabilitations. The following figure illustrates the spending forecast for capital renewal and replacement needed to maintain current technical (i.e., asset) service levels to 2051. The figure illustrates each year's projected asset renewal needs. These needs are forecasted based on the City's lifecycle forecasting logic and anticipated renewal costs. The dashed line represents the average annual intervention cost, which is the total cost of all intervention activities over the entire period, divided by the number of years in the forecast. Note that this forecast does not include natural assets, since forecasting for these assets was completed separately in the City's Natural Assets AMP. Furthermore, as noted above, the outputs reported herein are subject to change as the City advances its asset management and data maturity.

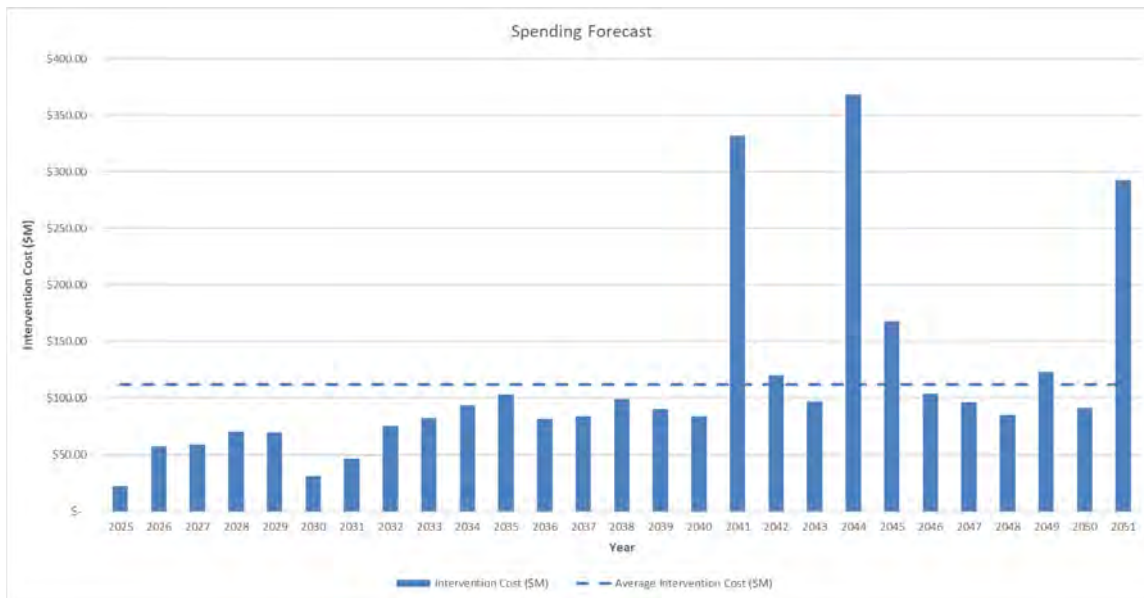


Figure ES - 7: Spending Forecast to Maintain Current Service Levels to 2051

The following figure illustrates the expected asset performance that is related to the spending forecast illustrated above. Each bar of this graph illustrates a performance distribution for a given year of the forecast. Note that natural assets are also not included in this figure, since they have been analyzed separately within the City’s Natural Assets AMP. Under this scenario, the City’s overall asset performance remains at an average rating of “Good” for each of the years of the forecast.

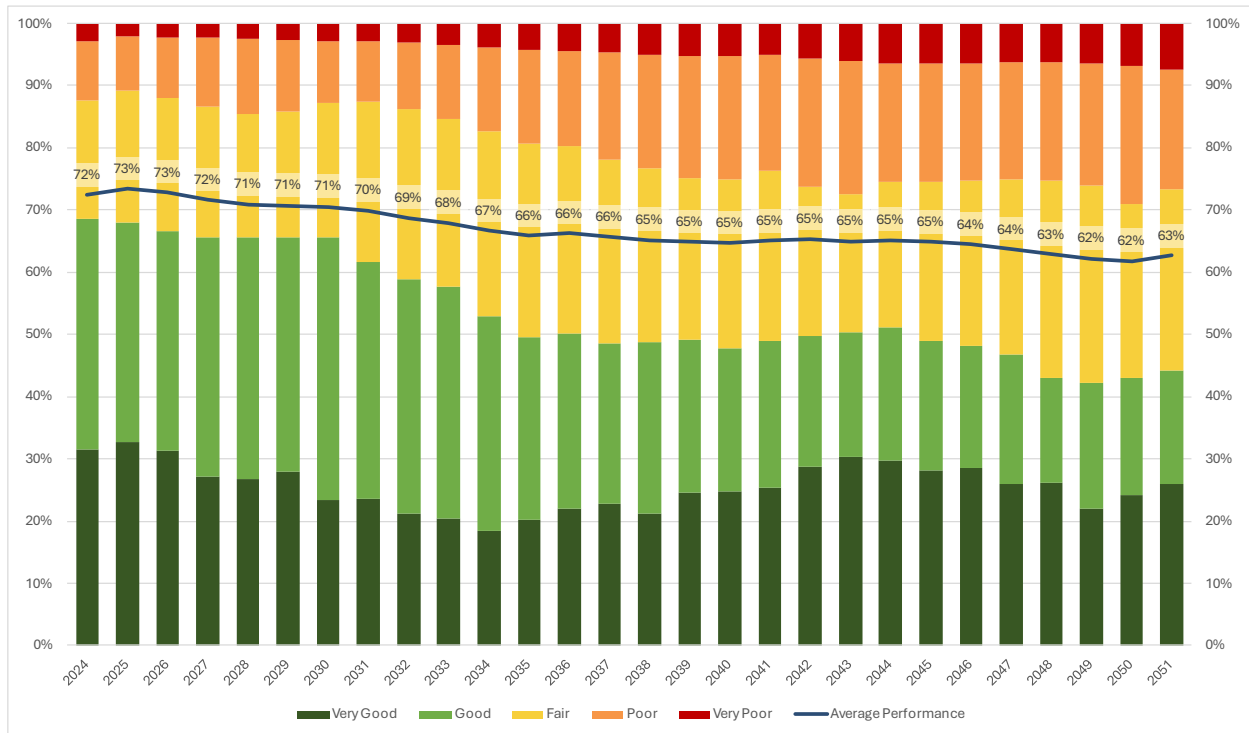


Figure ES - 8: Performance Forecast to Maintain Current Service Levels to 2051

1.6. Financial Strategy

The City’s financial summary identifies the funding levels required for the City to maintain current service levels across all lifecycle activities that it enacts to provide services to the community. The financial summary was developed through an analysis of the City’s historic budgets. Through this analysis, it was determined how much funding the City has been allocating towards each lifecycle activity type.

The City categorizes their budgets into the following:

- Operating budget:** Supports the day-to-day activities and functions conducted to provide City services. Samples of the expenditures funded from the operating budget include equipment maintenance, materials supply, and facilities services. These are expensed within the fiscal year. The total operating activities are the costs of the activities that can be tied directly with the repair and maintenance of

the City's assets. The City's operating budget also includes contributions to reserves.

- **Capital budget:** A comprehensive financial plan that addresses the financial requirements of growth, major rehabilitations, and replacements of existing infrastructure.

Using the past 10-years of budget data, a trend of operating and capital expenditures was identified. This trend was projected forward until 2051 to inform a financial forecast for the purpose of including it in this AMP. As noted earlier, these figures are part of a modelling exercise for illustrative purposes, with assumptions subject to change and refinement as part of annual resource / budget planning process. It was then compared with forecasted financial lifecycle needs, which were developed from asset lifecycle estimates provided by City staff. Note that the outputs were not derived from the City's Lifecycle Reserve Study outputs, but rather the forecasting models utilized as part of the Asset Management analysis in this AMP.

1.6.1. Historic Operating and Capital Budgets

The City's 2014 to 2024 operating, and capital budgets were analyzed to identify a spending trend. The following tables summarize the historic expenditures from these past operating and capital budgets.

Table ES - 3: Historic Operating and Capital Budgets

Year	Operating Expenditures	Capital Expenditures	Total
2014	\$306.7M	\$119.9M	\$426.6M
2015	\$324.4M	\$102.2M	\$426.52M
2016	\$345.7M	\$122.9M	\$468.6M
2017	\$358.8M	\$84.5M	\$443.3M
2018	\$378.5M	\$77.7M	\$456.17M
2019	\$395.1M	\$124.7M	\$519.78M
2020	\$410.5M	\$111.5M	\$522.0M
2021	\$415.7M	\$103.3M	\$519.0M
2022	\$423.4M	\$110.3M	\$533.7M
2023	\$444.8M	\$223.9M	\$668.7M
2024	\$469.4M	\$118.3M	\$587.7M

Using this information, the City has established a trend that illustrates an increase in spending. For illustrative purposes and as a modelling exercise, this can be projected forward to identify a potential spending profile the City may experience, if it continues to

increase budgets at current rates. Note that the operating budgets are projected to increase steadily based on inflation and growth. The capital budgets are underpinned by needs that have been identified through studies and plans, and therefore exhibit more peaks and valleys. Although the values fluctuate in the capital budget projections, the overall trend is positive, indicating that capital spending is anticipated to increase over time.

1.6.2. Forecasted Operating and Capital Budgets

In order to provide a forecast of required operating and capital needs, an analysis was used that incorporates the results of the City's lifecycle forecasts and other forecasts to understand future projections.

To forecast the operating budget, a high-level analysis was completed, which was developed using judgement from the City's finance subject matter experts. This analysis included a simple increase of 2.5% per year to the operating budget, which reflects an anticipated growth in this budget due to expected increased need for maintenance and increases in operating costs that are anticipated to occur over time. This was applied to the City's 2024 Operating budget of \$469.4M to complete this modelling exercise. Of note, operating expenditures shown in table ES-3 include annual contributions to the lifecycle reserve fund, which have been excluded from the 2.5% annual escalation.

To forecast the capital budget, renewals were obtained from the City's lifecycle forecasting exercise, as well as the results of the City's Natural Assets AMP. For other lifecycle activities (including non-infrastructure solutions, service improvements, etc.) forecasts were developed by looking at the City's line-item budget data to determine recent spending amounts. These amounts were projected forward using the assumption that spending will be the same in these categories if current service levels are maintained moving forward.

The following table summarizes the forecasted capital renewal expenditures, based on required asset replacements and rehabilitations for the City to continue meeting current service levels. 2024 expenditures are based on the 2024 capital budget. The 2025 to 2051 expenditures were forecasted using the lifecycle forecasting model, as indicated in the following table.

Table ES - 4: Forecasted Renewal Expenditures

Year	Capital Expenditures	Year	Capital Expenditures
2024	\$43.2M	2038	\$99.2M
2025	\$22.4M	2039	\$90.2M
2026	\$57.2M	2040	\$83.6M
2027	\$58.7M	2041	\$332.2M
2028	\$70.6M	2042	\$120.4M
2029	\$69.7M	2043	\$97.0M
2030	\$31.1M	2044	\$368.0M
2031	\$46.5M	2045	\$167.9M
2032	\$75.4M	2046	\$103.5M
2033	\$82.1M	2047	\$96.4M
2034	\$93.9M	2048	\$84.8M
2035	\$102.9M	2049	\$122.6M
2036	\$81.7M	2050	\$91.5M
2037	\$83.9M	2051	\$292.5M
		Total	\$3,068.8M

Note that the forecasts developed herein are based on a modelling exercise that is developed and supported by a series of assumptions. Therefore, these results are subject to change, as the information that supports the model is refined as part of the City's ongoing annual resource and budget planning process.

1.6.3. Total Summary

A summary of the trended historical operating and capital budgets was compared to the forecasted operating and capital needs. This provides an understanding of current spending projections as they relate to forecasts to maintain current levels of service moving forward. The following figure illustrates this comparison. The trend lines represent forecasted budgets, and the bars represent forecasted needs.

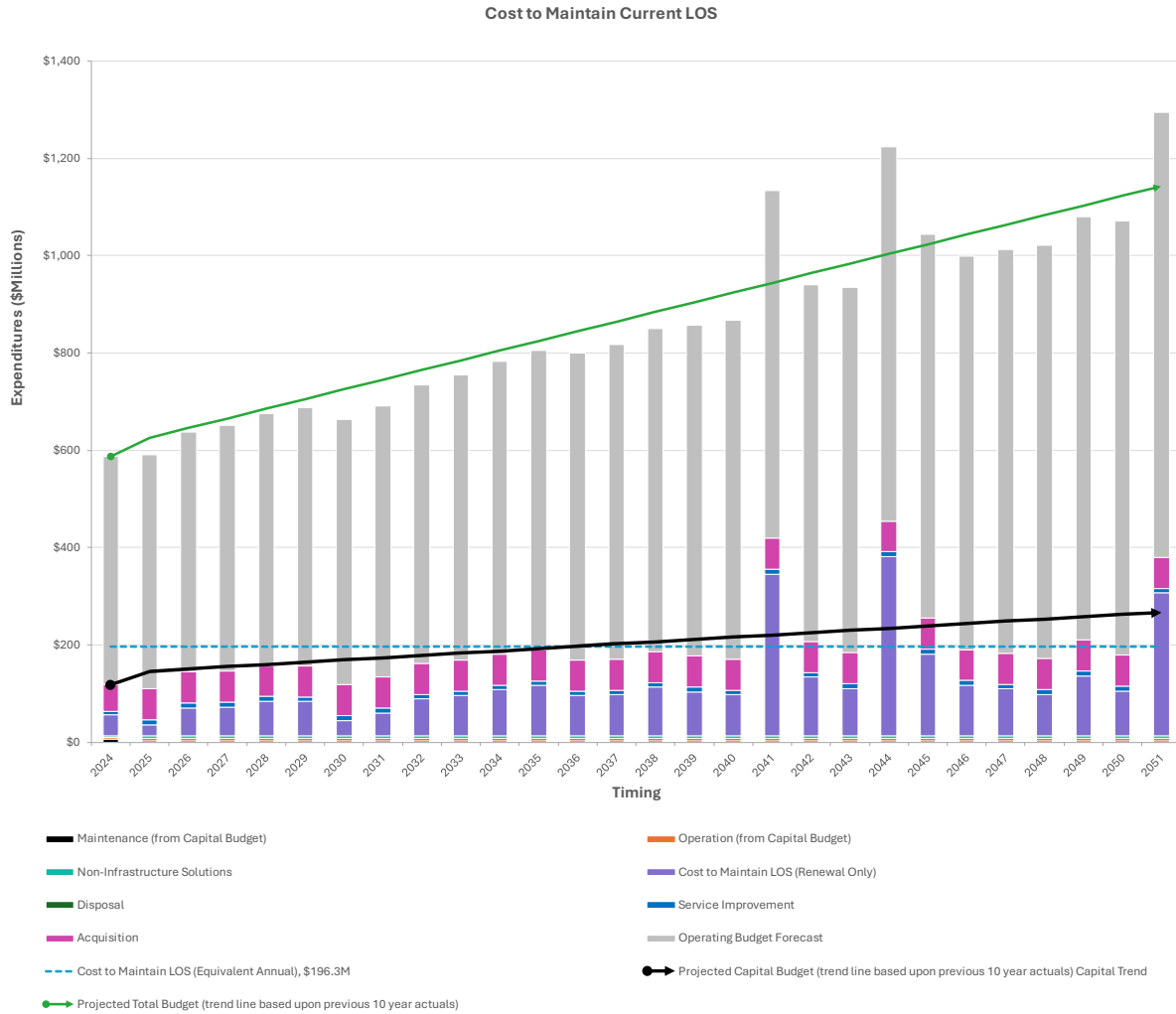


Figure ES - 9: Forecasted Expenditures –Maintain Current LOS

The total trended budgets equate to \$24,462M over 27 years (an average of \$873.7M per year). The total forecasted needs equate to \$24,208M over 27 years (an average of \$864.6M per year).

This comparison illustrates a potential funding variance between anticipated (trended) spending vs. forecasts. The variance between the trended and forecasted budgets is approximately 3.5% annually, which indicates that the City’s trended budgets should be adequate to maintain current service levels into the future.

As noted above, the forecasts developed herein are based on a modelling exercise that is developed and supported by a series of assumptions, and therefore is subject to change as the information that supports this modelling is refined as part of the City’s ongoing annual resource and budget planning process.

For this AMP, the analysis was focused on the financial needs related to maintaining current levels of service. The City's forthcoming 2025 AMP will complete an analysis to define proposed Levels of Service, and the costs associated with them. This forthcoming AMP will also provide the City with an opportunity to review and refine asset information and assumptions that supported the development of this AMP.

1.7. Improvement Plan

As part of its Asset Management program, the City has completed a detailed maturity assessment on their AM processes and practices. The maturity assessment was performed against the City's AM Framework, provided in Figure 2-1. The purpose of the maturity assessment was to identify areas to advance the City's AM System and program. The assessment framework was aligned to the Institute of Asset Management's Maturity Assessment Framework. This framework was used to assign ratings of 0 (Innocent) through to 5 (Excellent) to each major AM process. The full methodology of the maturity assessment will be detailed in the City's forthcoming *Asset Management Strategy* document which is currently being developed.

Overall, the City's current state of practice when analyzed using this framework was rated as "1 – Aware", to "2 – Developing". The City aspires to mature its asset management planning capabilities to a "3 – Core" rating.

The results of this assessment in conjunction with the development of this AMP were used to identify areas for improvement. The Improvement Plan of this AMP summarizes the key activities and initiatives for the City to undertake to continually improve the City's asset management system and future iterations of the AMP. The City has identified initiatives related to the following categories to increase the maturity of its AM system, and by extension, future iterations of this AMP. The following themes have emerged:

- Defining and evaluating asset management governance, roles and responsibilities
- Consistent and formalized standards, processes and procedures
- Improved data and information
- Formalized resource planning
- Improved demand/ growth analysis
- Stakeholder engagement

- Implement/develop supporting systems, tools and integrations (ex. decision support systems)

As the City undertakes and completes these initiatives, the overall maturity of the AM System will improve and the confidence of the AM analyses that support this AMP will increase.

Part of the City's AM program is to adopt a culture of continual improvement to ensure that AM planning processes are reviewed regularly to evolve as needed to suit the City's changing landscape, as well as improve the confidence in the AM analyses that support this AMP and future AMPs. The City's improvement plan is a significant step forward in adopting this culture.

1.8. Closing Remarks

The City of Markham is a relatively young municipality, evidenced by Figure ES-4 which illustrates that the majority of its assets have been constructed/acquired since the 1970s. As a young municipality, the majority of the City's asset portfolio on average is within the early stages of its service life (refer to Figure ES-3). On average, the City's infrastructure is in a "Good" performance state (Figure ES-2), which is a reflection not only of the fact that the City is relatively young, but also that the City has been successful in managing its assets to ensure that they are fit for service and providing appropriate services to the community.

The City has a robust, annual lifecycle planning process, which has been put in place to assist the City in taking a proactive approach to planning for and managing its state of infrastructure into the future. The City's overall asset performance is a reflection of this process.

Although the City has some assets in a poor and very poor performance state, it is important to note that this does not necessarily mean that assets are not fit for service. Through condition assessments and other asset monitoring exercises, the City identifies if any needs are required to ensure that these assets can remain in service. As assets near the end of their life, and enter poor or very poor performance states, the frequency of monitoring and maintenance may increase compared to assets that are near the beginning of their life or are in very good/good performance states. This is a normal practice that occurs in all municipalities.

The City always operates in a manner to ensure that services are provided safely by managing and maintaining its poor/very poor performance assets. City staff pay close attention to assets that have poor/very poor performance states and/or are high risk, to ensure that they implement appropriate initiatives to protect the safety of the public, meet legislative compliance and address any other matters of concern.

Note that within this AMP, assets have been included that are considered consumables, which have a short service life where information was available. The City's Asset Management program can assist the City in understanding how to manage these assets by developing processes and data to better-understand consumable asset risk and ensuring that the City's investments minimize risks and maximize levels of service.

The forecasting exercise completed in this AMP provides the City with an estimate of financial needs over the next 27-years. Note that the forecast is based on a modelling exercise that is underpinned by assumptions and asset information that is subject to change. As the City continues to refine the information that supports this AMP during annual resource and budget planning processes the fidelity of the models will improve.

As part of the closing remarks this AMP reiterates the following points:

- The City pays close attention to, and implement initiatives as part of, normal business to ensure assets are safe, meeting legislative compliance, etc.
- The forecasts are based on a modelling exercise underpinned by assumptions and information subject to change and refinement as part of the annual resource / budget planning process.
- As part of CAM 2025 and continuous improvement efforts, there will be an opportunity to review and refine assumptions, estimates, etc.

A key piece of this AMP is the City's Improvement Plan. It sets up a series of actions for the City's AM program to mature and provide better data/analyses to support better decision-making. Through continual improvement initiatives, including the development of the City's forthcoming 2025 Asset management Plan, the City has an opportunity to revise and refine the information and assumptions that underpin this AMP.

Furthermore, this AMP represents a significant step forward in the City's AM journey. It has introduced key asset management analyses that support better decision-making. Particularly, the City has enacted a framework to record and monitor levels of service, which is paired with an investment forecast and financial summary. The City will continue to monitor its levels of service against its spending, to better understand how services are being delivered, and how assets are being managed. Asset management is a journey, and the processes and data that it provides will ensure the City continues to keep a proactive approach to providing services to the community.

2. Introduction

The City of Markham (the City) is a municipality in the Region of York (the Region), adjacent to Toronto's northern boarder and part of the Greater Toronto Area (GTA). The City currently has a population of over 353,000 and a land area of 212 square kilometers. Markham is located in the south of the Region and shares borders with five (5) other municipalities: the City of Richmond Hill; the Town of Whitchurch-Stouffville; the City of Vaughan; the City of Pickering; and the City of Toronto.

Due to its proximity to Toronto, Markham has experienced significant development over the last several decades. As a result, Markham's population has grown substantially, particularly after the opening of Highway 404 in the mid-1970s. The City is projected to grow to approximately 610,500 residents and host 301,600 jobs by 2051.

As a result of this growth, and as part of its planning practices, the City has taken a proactive approach to asset management planning. Asset management planning assists the City in understanding the ways in which it should maintain its infrastructure, with the objective of delivering high quality services to the community.

The City first formally documented some of its asset management planning practices as part of its original Asset Management Plan (AMP) – developed in 2016. The development of this AMP was driven by the 2014 renewal of the Municipal Funding Agreement. As part of this renewal, municipalities were mandated to create an AMP by December 31, 2016 to be eligible for Canada Community Building Funds.

In January of 2018, Ontario Regulation 588/17 (O.Reg. 588/17): Asset Management Planning for Municipal Infrastructure came into effect. The regulation sets out requirements for municipal asset management planning to help municipalities better understand their infrastructure needs and inform infrastructure planning and investment decisions. This regulation offered the City another opportunity to continue developing its asset management practices through the advancement of its asset management program and further documentation of AM practices in a series of AMPs. In 2021, the City prepared an AMP in compliance with O. Reg. 588/17, which exceeded the minimum scope requirements of the regulation by including additional asset classes over and above what was mandated.

This AMP has been developed to meet the 2024 requirements of O.Reg. 588/17. It is an output of several AM processes as well as a guiding document for service delivery and continual improvement for the AM Program. Relevant documents that support the Asset Management Program include the following, which can be made available upon request.

- City of Markham Strategic Plan

- City of Markham Official Plan and Secondary Plans
- City of Markham Asset Management Policy
- City of Markham Asset Management Plan
- Integrated Leisure Master Plan
- Digital Markham Strategy
- Greenprint, Markham's Community Sustainability Plan
- Library Strategic Plan
- Active Transportation Master Plan
- Pathways and Trails Master Plan
- Corporate Energy Management Plan
- Municipal Energy Plan
- Region of York Transportation, Water and Wastewater Master Plans
- Region of York Official Plan

Figure 2-1 below is the City's asset management framework. It provides a visual representation of the various processes and activities within the City that make up all of its Asset Management practices. Note that it details the cyclical processes that form part of service delivery at the City, illustrating the feedback loop wherein the outputs of service delivery feed into the business drivers that drive further planning work.

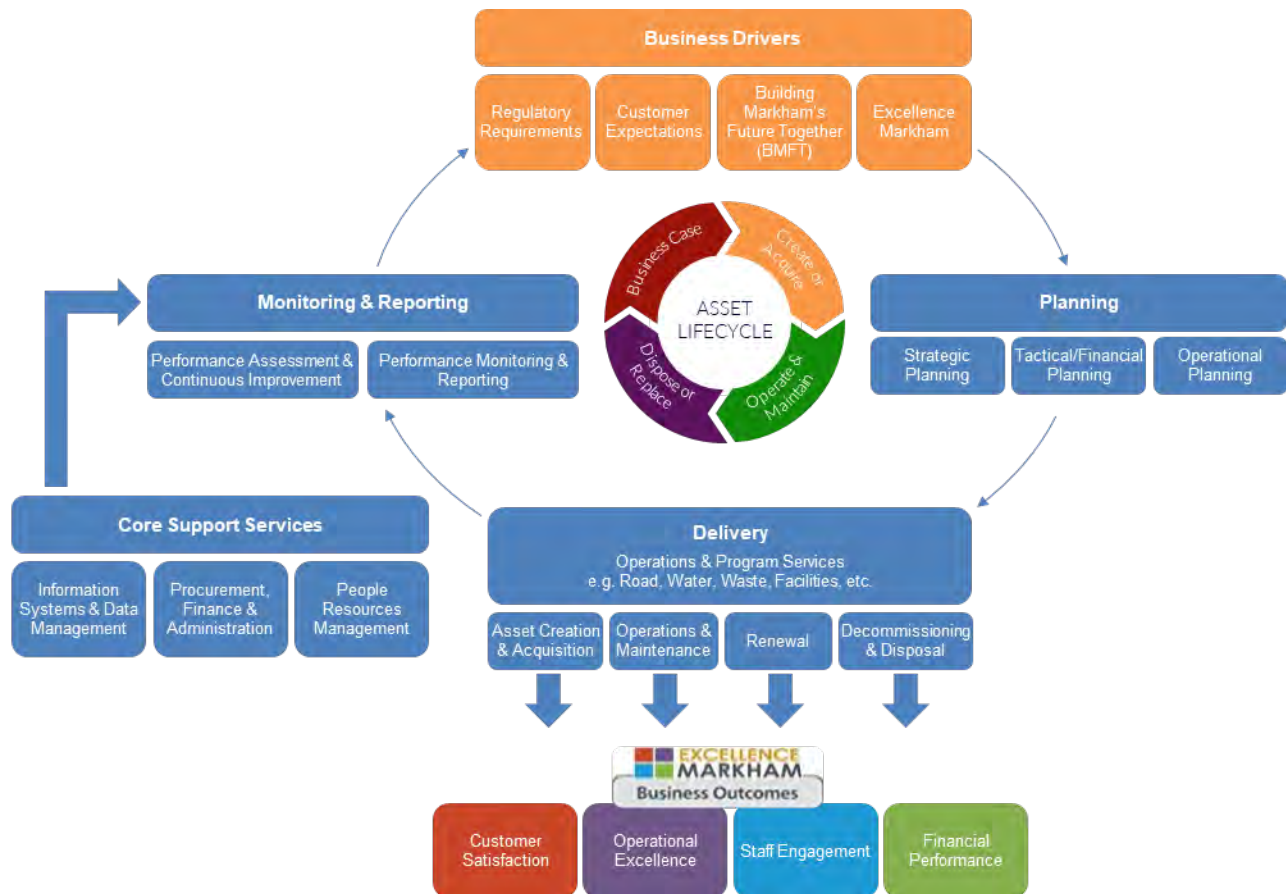


Figure 2-1. The City of Markham's Asset Management Framework

2.1. Objectives

The City of Markham is actively working to improve its Asset Management (AM) Program through various initiatives. By maturing the AM Program, the City will continue making data driven decisions in order to meet its strategic goals and deliver services in a responsible and sustainable manner which supports the livelihood of its residents, attracts businesses, and maintains the vibrancy of Markham.

One such initiative is this Asset Management Plan (AMP), which has been developed in compliance with O.Reg.588/17 and in alignment with the City's 2020-2026 Strategic Plan.

This AMP was developed in alignment with the organizational objectives outlined in the City's Strategic Plan, the current LOS being provided, and the asset management activities and processes currently performed to provide the intended LOS to the community.

2.2. Purpose

Asset management (AM) is the coordinated effort of the City of Markham to realize value from its assets in the form of the services they provide. It includes an integrated set of business processes that support decision making regarding acquiring, operating, maintaining, renewing, replacing, and disposing of infrastructure assets. It is an ongoing practice that is not limited to individual studies or reports. It is a way of doing business that provides the means through which the City's high-level strategic goals relate to the day-to-day activities of staff. The AMP helps guide the next step in the City's asset management journey to further develop and mature the City's AM program.

The purpose of this AMP is to:

- Meet the requirements of O. Reg. 588/17.
- Support the line of sight between the organization's strategic objectives, Council approved plans and initiatives, and asset investment needs.
- Report on and understand the current state of the City's assets.
- Document the City's current LOS and related performance measures.
- Document lifecycle management strategies that the City applies to assets to maintain service levels.
- Determine the funding required for the City to undertake lifecycle management strategies and sustain current levels of service.
- Determine any funding shortfalls between planned spending and required funding.
- Provide recommendations to meet future O. Reg. 588/17 requirements and to continually improve the City's asset management processes.

2.3. Scope

The assets included within the scope of the City's 2024 AMP are illustrated in Figure 2-2. The assets are organized into an asset hierarchy that details the relationship between the assets and the services that they support. The following figure details the services that the City provides and their associated assets. Detailed asset hierarchies are provided in **Appendices A to K**.



Figure 2-2: Asset Hierarchy of In-Scope Assets

To complete the analyses that are reported in this AMP, the City utilized its asset inventory data that was current to year-end 2023. Therefore, the findings in this AMP are based on 2023 data, and as a result, any renewal work that the City has undertaken in 2024 is not reflected in the outputs of this AMP.

2.4. Planning Horizon

This AMP covers a planning horizon of 27 years ending at 2051. This horizon aligns with the City's Official Plan. Note that the requirements of O. Reg. 588/17 require asset management plans to cover a 10-year time horizon. This AMP looks beyond the minimums specified by the regulation.

Note that due to the ongoing regulatory milestones of O. Reg. 588/17, a supplementary version of this AMP is required to be developed for July 1, 2025, that will outline proposed levels of service, identify what activities will be required to meet the proposed levels of service, and a financial strategy to fund these activities.

O. Reg 588/17 requires municipalities to prepare an AMP at least once every five (5) years following the completion of its 2025 AMP. As part of the City's asset management approach, the City endeavors to review its AM practices on a more regular basis to continually assess appropriate levels of service and integrate improved condition assessment strategies so the AMP can be used to support long-term planning.

2.5. AMP Overview

The AMP is structured to provide consistency and ease of understanding for readers. The structure and content within this AMP are influenced by several guidelines and best practices, including:

- Province of Ontario Guide: Building Together – Guide for Municipal Asset Management Plans
- Institute of Public Works Engineering Australia (IPWEA) guidelines and resources; and,
- Institute of Asset Management (IAM) guidelines.

All of these resources and guidelines are in alignment with the International Organization for Standardization (ISO) 55000 series of standards pertaining to asset management.

Sections 5 to 9 provide the overall State of the Infrastructure (SOTI) analysis, levels of service (LOS), risk management strategies, lifecycle management strategies, lifecycle forecasting, and financial summary for the City as a whole.

Appendices A to K provide the SOTI analysis, LOS, risk management strategies, lifecycle management strategies, and lifecycle forecasting for each individual service area, further broken down by specific asset classes.

3. Alignment with Organization Goals

3.1. Asset Management Policy

In 2019, the City established their AM Policy documenting their commitment to practice sound asset management principles and practices to meet strategic goals and objectives. The City aims to deliver services in a socially, economically and environmentally responsible manner. The City is in the process of updating the policy as part of its requirements to update the document every 5-years under O.Reg. 588/17.

By practicing asset management, the City hopes that customers are confident in how the City manages assets, that assets are considered across all related services, that asset risk is considered when prioritizing projects, that lifecycle costs and risks are reduced while providing services at appropriate levels of service, and that decisions made today will put the City in a position for assets to meet future challenges.

The City's AM Policy identifies the objectives and goals of the AM Program to guide AM at the City. These include:

- A. Align Asset Management practice** with the City of Markham's Strategic Plan, Building Markham's Future Together (BMFT), and other key strategic documents, including the Greenprint, Markham's Community Sustainability Plan, and the Official Plan.
- B. Ensure strong governance, accountability and transparency by:**
 - a. Demonstrating to owners, customers and stakeholders that services are delivered effectively and efficiently.
 - b. Providing a transparent and auditable basis for making service/risk/cost trade-off decisions.
 - c. Improving accountability for the use of resources through performance and financial metrics.
- C. Make effective and long-term sustainable decisions by:**
 - a. Having robust information/documentation to support evidence-based decisions.
 - b. Considering viable options and all aspects of decisions.
 - c. Ensuring total cost of ownership is the basis of decision-making processes so that emphasis is placed on sustainable long-term efficiencies rather than short term gains
- D. Provide customer service by:**

- a. Defining level of service in consultation with stakeholders.
 - b. Ensuring service delivery meets the defined level of service.
- E. Manage risk effectively by:**
- a. Understanding the risks related to asset management and service delivery and applying a framework to prioritize risk mitigation.
 - b. Developing and implementing risk management strategies.
 - c. Demonstrating compliance with legal and regulatory requirements.
- F. Demonstrate fiscal stewardship and financial efficiency through:**
- a. Balancing cost, risk and service performance to achieve the lowest total cost of ownership.
 - b. Updating the Life Cycle Reserve Study annually to determine if there are sufficient funds in the reserve to sustain the future replacement and rehabilitation requirements of the City's assets for the next 25 years based on known inflows and outflows.
- G. Provide excellent sustainable community planning and infrastructure management to accommodate growth**

3.2. 2020 – 2026 Strategic Plan

Building Markham's Future Together is the City of Markham's 2020-2026 Strategic Plan. The Strategic Plan was approved on May 1, 2024, following months of consultation with Members of Council, Markham staff, community and business stakeholders and the general public. The Strategic Plan is the blueprint for how City Council and Senior Staff will make thoughtful decisions about the City's future to ensure its success.

In 2019 and 2023, the City conducted community engagement with residents, businesses, and community stakeholders. There were over 2,000 survey responses which informed the strategic priorities established by the City. This resulted in the 2020-2023 Strategic Plan and the revised 2020-2026 Strategic Plan. The Strategic Plan focuses on four goals:

- **Goal 1 - Exceptional Services by Exceptional People:** We embrace a bold and innovative culture that empowers and inspires excellent services within a collaborative and healthy work environment.
- **Goal 2 - Engaged, Diverse, Thriving & Vibrant City:** We are an inclusive city, engaging everyone in building a livable, caring and culturally vibrant community while respecting our past. We enable a strong economy; we proactively work to attract investment in our community; and we effectively manage change to meet future needs.
- **Goal 3 - Safe, Sustainable & Complete Community:** We strive to achieve complete communities with an excellent quality of life. We ensure community

safety and enhance the natural environment and built form through sustainable integrated planning, infrastructure management, and services.

- **Goal 4 - Stewardship of Money & Resources:** We demonstrate exceptional leadership using sound, transparent and responsible fiscal & resource management, and policy development to mitigate risks while enabling efficient and effective service delivery.

The Strategic Plan outlines the actions the City will undertake to achieve each goal. These include holding more community events, implementing strategies and master plans, the implementation of new technology, and many more. The City has also documented a number of metrics to report against (e.g., overall customer satisfaction (internal and external services) taken from Department Surveys completed each year for each goal so the City can measure their success.

This AMP was developed using a service-centric approach, and by doing so it aligns asset management to service delivery, which in turn is connected to the City’s Strategic Plan. All the frameworks and strategies that have been put in place to support this AMP have been completed in alignment with the Strategic Plan.

3.3. Ontario Regulation 588/17

In January of 2018, Ontario Regulation 588/17: Asset Management Planning for Municipal Infrastructure came into effect. The regulation sets out requirements for municipal asset management planning to help municipalities better understand their infrastructure needs and inform infrastructure planning and investment decisions.

The regulation will be phased in over a total of six years and in 2025 will culminate in the development of an AMP that addresses the investment needs for all infrastructure assets owned by the City. Key legislative deadlines for all Ontario municipalities are provided in Table 3-1 below.

Table 3-1: O. Reg. 588/17 Milestones and Timelines

Date	Milestone	City Status
July 1, 2019	Prepare and publish a strategic asset management policy.	Complete
July 1, 2022	Develop an Asset Management Plan that details the cost to maintain current service levels for core infrastructure assets.	Complete
July 1, 2024	Develop an Asset Management Plan that details the cost to maintain current service levels for all other assets (i.e. non-core Assets).	Completed herein
July 1, 2025	Expand the City’s 2024 AMP to provide further details on all infrastructure assets, including proposed levels of	To be completed in 2025

Date	Milestone	City Status
	service and the revenue and expenditure plan to achieve them.	

This AMP has been developed in line with the requirements of O. Reg. 588/17 and meets the requirements for the July 1, 2024, milestone. This AMP addresses these requirements as follows:

- i. It applies to all assets (including those that are defined as “core assets” in O. Reg. 588/17).
- ii. It details the current performance for Community and Technical LOS specified in O. Reg. 588/17 (for core assets).
- iii. It details current performance for the Community and Technical LOS established by the City (for all assets).
- iv. It includes a summary of replacement costs, average age, and performance (age or physical condition based) of all assets.
- v. It includes a description of the City’s approach to assessing the condition of assets.
- vi. It includes a description of the lifecycle activities that need to be undertaken to maintain current LOS, as well as noting any risks in the delivery of services as appropriate.
- vii. It includes population and employment forecasts as set out in the Region of York’s 2022 Official Plan.
- viii. It includes the estimated capital expenditures and operating costs related to the lifecycle activities required to maintain current LOS and accommodate growth.
- ix. It applies a 27-year horizon to these activities and projections (the regulation requires a 10-year horizon).
- x. It is supported by the best available data at the City from within the last two calendar years (data has been collated as of year-end 2023).
- xi. It will be made available to the public via the City’s website.

3.4. Legislative Requirements

There are many legislative requirements related to the management of assets. Legislative requirements that impact the delivery of the services are outlined in Table 3-2.

Table 3-2: Legislative requirements

Legislation	Requirement
Municipal Act, 2001	Municipalities are created by the Province of Ontario to be responsible and accountable governments with respect to matters within their jurisdiction and each municipality is given powers and duties under this Act and many other Acts for the

Legislation	Requirement
	<p>purpose of providing good government with respect to those matters.</p> <p>The powers of a municipality under this or any other Act shall be interpreted broadly so as to confer broad authority on the municipality to enable the municipality to govern its affairs as it considers appropriate and to enhance the municipality's ability to respond to municipal issues.</p> <p>A lower-tier municipality and an upper-tier municipality may pass by-laws, subject to the rules set out in subsection (4), respecting the following matters:</p> <ol style="list-style-type: none"> 1. Governance structure of the municipality and its local boards. 2. Accountability and transparency of the municipality and its operations and of its local boards and their operations. 3. Financial management of the municipality and its local boards. 4. Public assets of the municipality acquired for the purpose of exercising its authority under this or any other Act. 5. Economic, social and environmental well-being of the municipality, including respecting climate change. 6. Health, safety and well-being of persons. 7. Services and things that the municipality is authorized to provide under subsection (1). 8. Protection of persons and property, including consumer protection. 2006, c.32, Sched. A, s.8; 2017, c.10, Sched.1, s.2.
<p>Planning Act, R.S.O. 1990, c. P.13</p>	<p>The purposes of this Act are:</p> <ol style="list-style-type: none"> (a) to promote sustainable economic development in a healthy natural environment within the policy and by the means provided under this Act: (b) to provide for a land use planning system led by provincial policy, (c) to integrate matters of provincial interest in provincial and municipal planning decisions, (d) to provide for planning processes that are fair by making them open, accessible, timely and efficient, (e) to encourage co-operation and co-ordination among various interests, (f) to recognize the decision-making authority and accountability of municipal councils in planning.
<p>Infrastructure for Jobs and Prosperity Act, 2015, and Ontario Regulation 588/17: Asset</p>	<p>The purpose of this Act is to establish mechanisms to encourage principled, evidence-based and strategic long-term infrastructure planning that supports job creation and training opportunities, economic growth and protection of the environment, and incorporate design excellence into</p>

Legislation	Requirement
Management Planning for Municipal Infrastructure	<p>infrastructure planning. Furthermore, to provide a framework for the development and implementation of the City's Corporate Asset Management Program. It is intended to guide the consistent use of asset management practices across the organization, to facilitate logical and evidence-based decision-making for the management of municipal infrastructure assets and to support the delivery of sustainable community services now and in the future.</p> <p>By using sound asset management practices, the City will work to ensure that all municipal infrastructure assets meet expected performance levels and continue to provide desired service levels in the most efficient and effective manner. Linking service outcomes to infrastructure investment decisions will assist the Town in focusing on service, rather than budget driven asset management approaches.</p>
Ontario Regulation 239/02: Minimum Maintenance Standards for Municipal Highways	<p>The purpose of this Regulation is to clarify the scope of the statutory defence available to a municipality under clause 44 (3) (c) of the Act by establishing maintenance standards which are non-prescriptive as to the methods or materials to be used in complying with the standards but instead describe a desired outcome by setting out the minimum standards of repair for highways under municipal jurisdiction.</p>
Development Charges Act, 1997, S.O. 1997, c. 27	<p>The council of a municipality may by by-law, impose development charges against land to pay for increased capital costs required because of increased needs for services arising from development of the area to which the by-law applies.</p>
Ontario Regulation 239/02: Minimum Maintenance Standards for Municipal Highways	<p>The purpose of this Regulation is to clarify the scope of the statutory defence available to a municipality under clause 44 (3) (c) of the Act by establishing maintenance standards which are non-prescriptive as to the methods or materials to be used in complying with the standards but instead describe a desired outcome by setting out the minimum standards of repair for highways under municipal jurisdiction.</p>
Ontario Regulations 104/97, 160/02 and 472/10: Standards for Bridges	<p>These regulations clarify the procedures and standards that must be adhered to when designing, inspecting and maintaining the integrity of municipal structures in Ontario. It specifies the requirements and standards for bridge designs, evaluation, construction and rehabilitations. It also mandates the structural integrity, safety and condition of every bridge must be determined by at least one inspection every second calendar year, under the direction of a professional engineer and in accordance with the Ontario Structure Inspection Manual (OSIM).</p>
Safe Drinking Water Act, 2002, S.O. 2002, c. 32, Ontario Regulation 163/03: Ontario Drinking	<p>The purposes of this Act are to recognize that the people of Ontario are entitled to expect their drinking water to be safe and to provide for the protection of human health and the prevention of drinking water health hazards through the control</p>

Legislation	Requirement
Water Quality Standards and Ontario Regulation 170/03: Drinking Water Systems	and regulation of drinking water systems and drinking water testing.
Ontario Water Resources Act, R.S.O. 1990, c. O.40	The purpose of this Act is to provide for the conservation, protection and management of Ontario's waters and for their efficient and sustainable use, in order to promote Ontario's long-term environmental, social and economic well-being.

Notably, Ontario Regulation 588/17 has mandated specific levels of service that apply to core assets. These are provided in Appendix A, Appendix B, Appendix C, and Appendix D.

3.5. Climate Change and Adaptation

O. Reg. 588/17 requires municipalities to state how they will consider climate change in their Asset Management Policy. The City's 2021 AMP recognized that future iterations of the AMP should consider climate change through the asset management strategies. The City currently undertakes climate change adaptation and mitigation initiatives, and it is important that these current initiatives are recognized and considered, and that the City continues to forecast initiatives that will be needed in the future to adapt its infrastructure to become more resilient to the effects climate change. Adapting infrastructure proactively will result in less funding required in overall operations and maintenance, rehabilitations, and renewals of assets.

3.5.1. Costing Climate Change Impacts to Public Infrastructure Report

In 2023, the Financial Accountability Officer (FAO) published a report analyzing the cost impacts of climate change on Ontario's provincial and municipal infrastructure. This report was developed through the FAO's Costing Climate Change Impacts to Public Infrastructure (CIPI) project. Through the CIPI project, \$708 billion of public infrastructure was analyzed. This included buildings and facilities, transportation infrastructure, and linear storm and wastewater infrastructure.

It is predicted that the province will experience more frequent and intense extreme rainfall and extreme heat, and fewer freeze-thaw cycles. These climate hazards will impact the infrastructure by accelerating asset deterioration, resulting in the need for higher capital investments, more frequent rehabilitations, earlier asset renewals, and more operations and maintenance activities.

Three strategies were explored in the CIPI project:

- No adaptation

- Reactive adaptation: assumes that assets are adapted when replaced at the end of their useful lives.
- Proactive Adaptation: assumes that asset stewards will adapt infrastructure either during an asset's next major rehabilitation or upcoming renewal.

The CIPI report concluded that the following additional funding would be required annually to maintain Ontario's public infrastructure:

- No Adaptation: \$4.1 billion per year on average
- Reactive Adaptation: \$3.5 billion per year on average
- Proactive Adaptation: \$3.0 billion per year on average

The proactive adaptation strategy results in the lowest **additional** required funding per year and adapts almost all public infrastructure by 2050. The reactive adaptation strategy leaves most of Ontario's public infrastructure vulnerable to climate risk through to the mid-2060s. Adapting infrastructure can reduce the risk of climate-related infrastructure service disruption.

3.5.2. The City's Climate Change Initiatives

The City has been undertaking a variety of climate change initiatives, such as policies and plans to support the mitigation and adaptation of climate change, achieving \$2M in utility savings and \$1.6M in revenue, and is recognized for its leadership in sustainability, energy, and climate action through receiving over a dozen rewards. On February 3, 2020, the City of Markham expressed its solidarity with the almost 500 local governments in Canada that have declared Climate Emergencies. The City recognizes the urgency of climate change and is committed to implementing and completing climate change mitigation and adaptation initiatives.

The City's current climate change initiatives include:

- Net Zero Facility Program
- Erosion site inspections
- Condition inspections of suspended watermains
- LEED Silver certification for new buildings
- Installing LED fixtures for streetlights
- The 30-year city-wide Flood Control Program to improve storm drainage and limit surface and basement flooding risks in urban areas
- Using solar and geo-thermal energy sources and building automation
- The development of a community-scale distributed geothermal energy system for heating, cooling and domestic hot water in the Berczy-Glen neighbourhood
- Planting new trees to reach a target of 30% tree canopy

The City's climate change mitigation goals are laid out in the following documents:

- The Greenprint: Markham's Community Sustainability Plan is a 50- to 100-year plan for the City to achieve an environmentally, economically, socially and culturally vibrant community. This plan documents a total of 12 sustainability priorities and 23 objectives that the community will work towards to meet its vision of sustainability. These objectives include creating a culture of walking, cycling, and transit usage, reaching 30% tree canopy and vegetation coverage city-wide, achieving net-zero energy, water, waste, and emissions by 2050, and more.
- Building Markham's Future Together (BMFT): ensure business continuity of our services and infrastructure, and enable community resilience and safety
- Municipal Energy Plan: targets to achieve net zero energy emissions by 2050
- Corporate Energy Management Plan: 5-year plan to improve energy management and reduce GHG emissions for the City's corporate operations

3.5.3. Partners for Climate Protection (PCP) Program

As of February 24, 2023, the PCP program has recognized the City of Markham with Milestone 5 for its corporate assets. This is the final milestone of the PCP framework demonstrating leadership on energy and greenhouse gas emissions management. Milestone 5 includes monitoring and reporting results to determine if the City's initiatives are working and if targets will be met. Since 2013, the City has implemented more than 200 initiatives that are saving energy, GHGs and utility costs. The PCP framework is provided below.



Figure 3-1: Partners for Climate Protection Program Framework

4. Future Demand

4.1. Demand Drivers

Drivers of demand include items such as population change, regulations, changes in demographics, seasonal factors, vehicle ownership rates, consumer preferences and expectations, technological changes, economic factors, agricultural practices and environmental awareness.

4.2. Demand Forecasts

The Region of York's 2022 Official Plan guides growth and development across the nine municipalities within the Region, including the City of Markham. The Plan provides the policies to be followed in partnership with the local municipalities to achieve the Region's vision of creating "Strong, Caring, Safe Communities". The Official Plan includes seven goals:

1. To provide an overview of the Purpose, Regional Vision, Goals, Objectives, and Key Guiding Principles of the Plan.
2. To enhance York Region's urban structure through a comprehensive integrated growth management process that provides for healthy, sustainable, complete communities with a strong economic base.
3. To protect and enhance the natural environment for current and future generations so that it will sustain life, maintain health and provide a high quality of life.
4. To enhance York Region's urban system through city building, intensification, and compact and complete communities including employment areas.
5. To protect the Agricultural, Rural and Holland Marsh Specialty Crop Areas and support the agricultural industry as essential components of the Regional fabric.
6. To provide the services required to support York Region's residents and businesses to 2051 and beyond, in a financially and environmentally sustainable manner.
7. To ensure resiliency and the ability to adapt to changing economic and environmental conditions and increasing social diversity.

The Region's Official Plan outlines the population and employment forecasts to 2051 in Table 4-1.

Table 4-1. Population and Employment Forecasts for the City of Markham (Region of York Official Plan)

Markham	2021	2031	2041	2051
Population	349,000	416,300	496,700	610,500
Employment	190,300	221,200	258,500	301,600

These forecasts represent a population growth of 75% over 30 years and an employment growth of 58% over the same period. Growth within Markham will primarily be accommodated through development within designated growth areas (typically green fields) and intensification within strategic growth areas (Yonge Street corridor, etc.).

To support asset management requirements and inform more granular financial planning, City staff developed growth projections that align the City’s land use policies with the population and employment projections noted above. Preliminary projections suggest possible asset growth needs averaging a 74% increase across all portfolios with resource needs averaging a 70% increase. Further granularity of growth projections is shown in Figure 4-1 and Table 4-2 below.

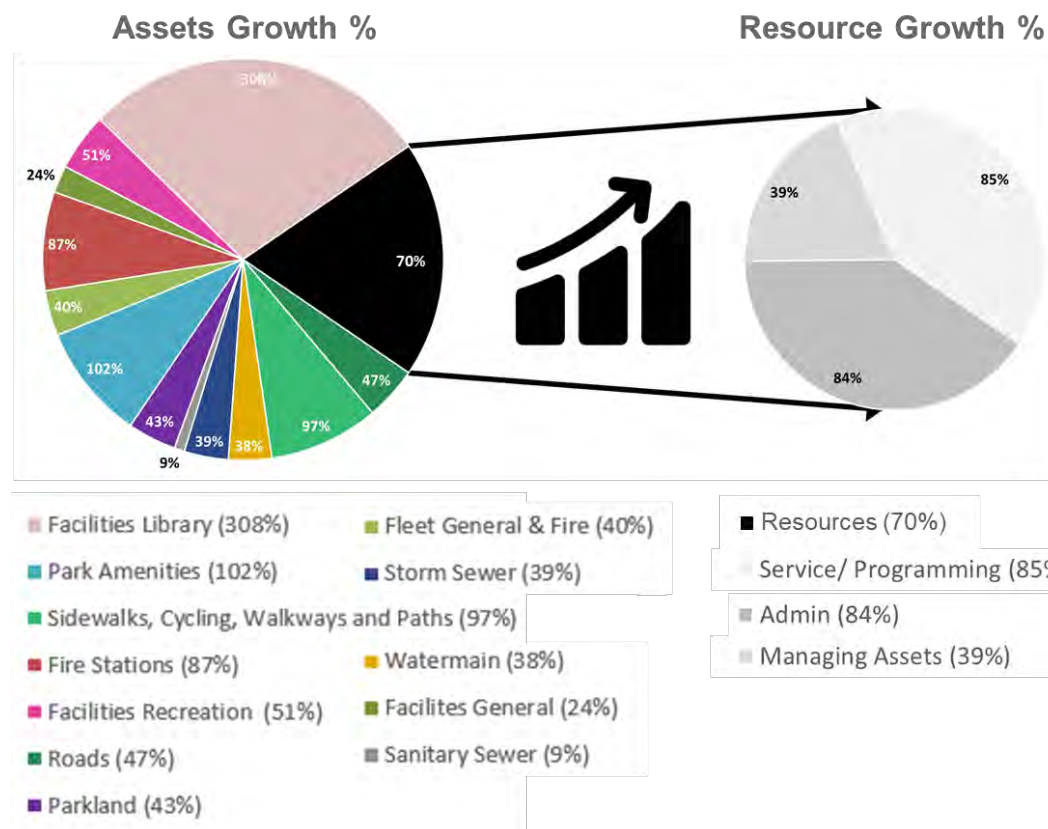


Figure 4-1. Growth and Resource Projections

Table 4-2: Growth Projections by Service/Subservice

Service	Subservice	Anticipated Growth %
All	-	Admin (84%)
All	-	Managing Assets (39%)
All	-	Service/ Programming (85%)
Transportation	Vehicular Transportation	Roads (47%)
Transportation	Active Transportation	Sidewalks, Cycling, Walkways and Paths (97%)
Potable Water	-	Watermain (38%)
Stormwater Management	-	Storm Sewer (39%)
Wastewater	-	Sanitary Sewer (9% under review)
Parks	-	Parkland (43%)
Parks	-	Park Amenities (102%)
General Support Service	Fleet	Fleet General & Fire (40%)
Fire & Emergency	-	Fire Stations (87%)
General Support Service	Facility	Facilities General (24%)
Recreation	Facility	Facilities Recreation (51%)
Library	Facility	Facilities Library (308%)

This growth in asset base will require additional funding and resourcing to adequately support acquisition, operations, maintenance and renewal pressures. The effects of growth using historical budgeting trends on capital and operating expenditures are detailed in the financial summary section of this report. Outputs from the previously noted growth projections will be further evaluated as part of the City's regulatory obligation to assess proposed levels of service for July 1, 2025.

4.3. Demand Impact and Demand Management Plan

Demand for new services will be managed through a combination of managing existing assets, upgrading of existing assets, and providing new assets to meet demand and demand management. Demand management practices can include non-infrastructure solutions, insuring against risks and managing failures.

Opportunities identified to date for demand management are provided in Table 4-3. Further opportunities will be developed in future revisions of this asset management plan.

Table 4-3: Demand Management Plan

Demand Driver	Current Position	Projected Position	Impact on Services	Demand Management Plan
Population Intensification in Existing Areas and Population Growth in New Areas	Ongoing implementation of projects to accommodate for new and existing growth	The City will continue to implement projects to accommodate for new and existing growth	Increase cost pressure for acquisition, operation, maintenance and renewal	Develop a program to ensure resources are available to acquire new infrastructure, maintain existing and new infrastructure, and provide levels of service.
Decreased Capacity	Population intensification and growth may result in services not being available to all users.	Projects to alleviate capacity and congestion issues are identified through the City's infrastructure master planning studies and growth projections.	Overall increase in usage due to growing customer base, need for projects to increase capacity	Implementing infrastructure and upgrading existing infrastructure as recommended through the City's infrastructure master planning studies and growth projections.

4.4. Asset Programs to Meet Demand

Asset acquisition is required to meet future demand from rising population and employment. These acquisitions will require the City to allocate more resources towards the operations, maintenance, and renewal of assets for the entirety of the asset's lifecycle. The costs associated with new assets in previous years were identified in the City's capital budgets and used to forecast costs associated with acquiring new assets for the 27-year forecasting period.

5. State of the Infrastructure

The State of Infrastructure section summarizes the assets included in each service area. This subsection illustrates the current performance of all assets, provides an asset inventory and valuation and provides a summary of asset age and useful life. The asset inventory was aligned to the City's asset hierarchy. The following figure illustrates the structure of the City's asset hierarchy. Granular versions of the hierarchy, aligned to specific services, are provided in **Appendix A to L**.

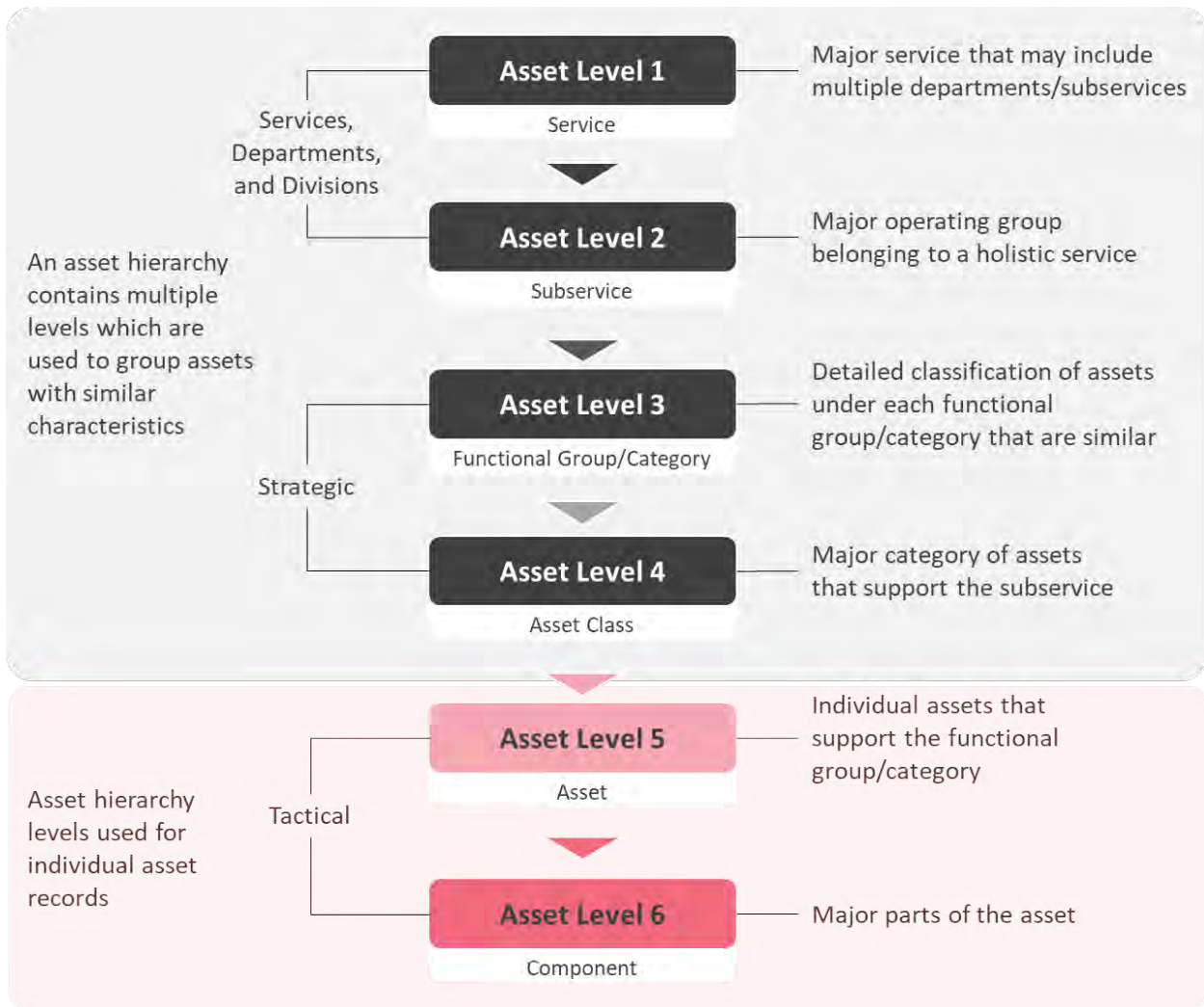


Figure 5-1: Asset Hierarchy Structure

5.1. Asset Inventory and Valuation

The first subsection within the State of Infrastructure section reports on the inventory and valuation of the in-scope assets. This is documented in a table with the following columns:

- Subservice: details the applicable subservice of each asset that is being reported, as per the City’s Asset Hierarchy (refer to Figure 2-2).
- Asset Category details the general category of assets that is being reported within each subservice, as per the City’s Asset Hierarchy (refer to Figure 2-2).
- Asset Class groups together similar types of assets that are organized within each asset category that is being reported, as per the City’s Asset Hierarchy (refer to Figure 2-2).

- Replacement Value details the total estimated replacement value (replacement cost) of the assets for the given asset class in 2023 dollars. This value represents the full project cost of replacing an asset on a like-for-like basis, including construction costs, material costs, design/engineering, project management and contingencies.
- Quantity details the total quantity of assets for the given asset class.
- Average Performance details the average age-based or physical condition of the assets for the given asset class. This condition is a weighted average that is weighted by replacement value (see Subsection 5.3 below for a description of performance categories).

As noted above, the analyses that are reported in this AMP utilized the City's asset inventory data that was current to year-end 2023. Therefore, the findings in this AMP are based on 2023 data, and as a result, any renewal work that the City has undertaken in 2024 is not reflected in the outputs of this AMP.

5.2. Age and Estimated Service Life

A summary of asset age and installation dates is reported through two figures. The first reports on average age and average estimated service life (ESL) by asset class, an example of which is provided below. The average age in this figure is represented by the horizontal blue bar, and the average ESL is by the horizontal grey bar. Average age and ESLs are weighted by replacement value for each asset class. This figure is useful to provide context to the reader regarding the average state of the network in terms of its age. While age is not always a predictor of an asset's performance, in general, most assets begin to deteriorate and require replacement or rehabilitations as they advance in age. As is illustrated in the following figure, nearly all of the City's assets are relatively young on average when compared to their estimated service lives.

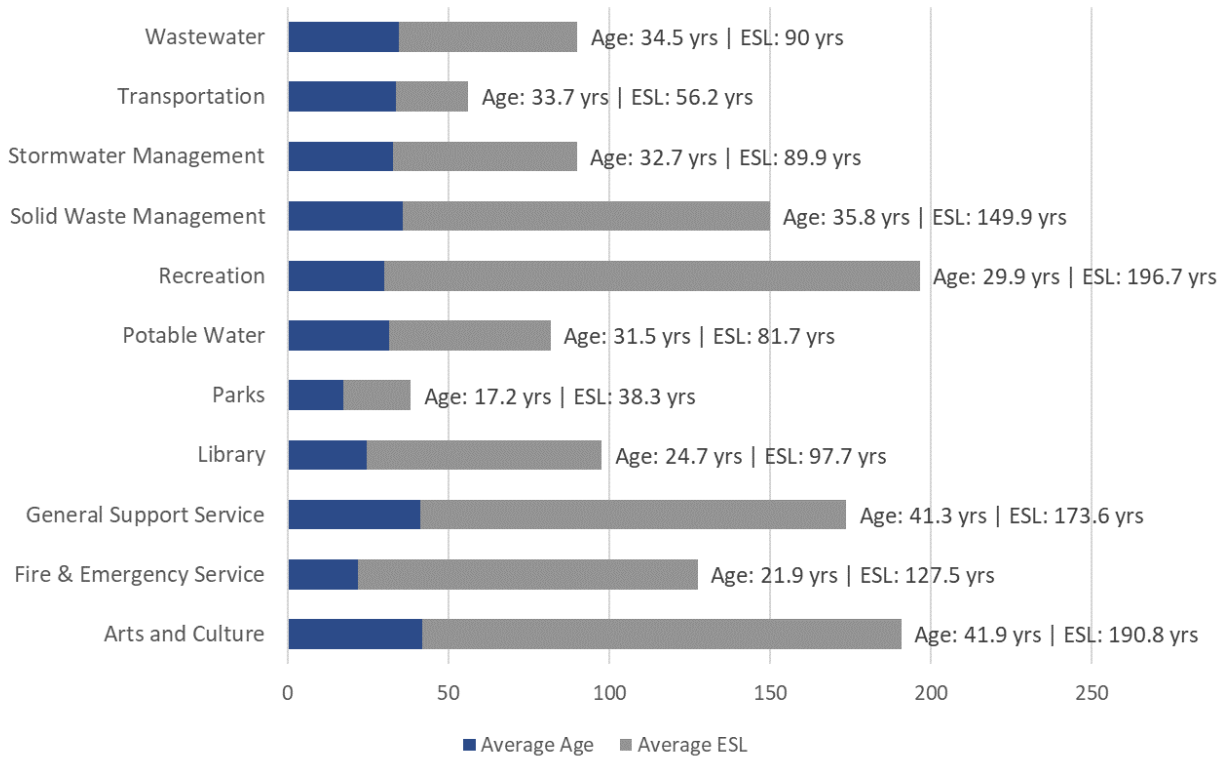


Figure 5-2. Average Age/Average Estimated Service Life for each Service Area

A figure reporting on installation dates follows, an example of which is provided below. The years are separated into installation decades, which helps to visualize the value of assets by the decade that they were constructed/installed or procured. Note that each decade of installation may have a corresponding decade in the future where the infrastructure could reach its end of life and will result in a large financial burden for replacement needs. In decades with significant construction, the City can expect significant renewal needs to occur in the future once these assets become aged and near the end of their service lives. For assets with long lifecycles, many of these needs are beyond the 27-year forecast included in this AMP. Note that asset performance will drive the need for major rehabilitation or replacement activities regardless of installation year (i.e., some long lived assets will experience short service lives for a variety of reasons).

The following figure illustrates that the City has seen its most significant asset acquisitions in the 1980s, 1990s and 2000s.

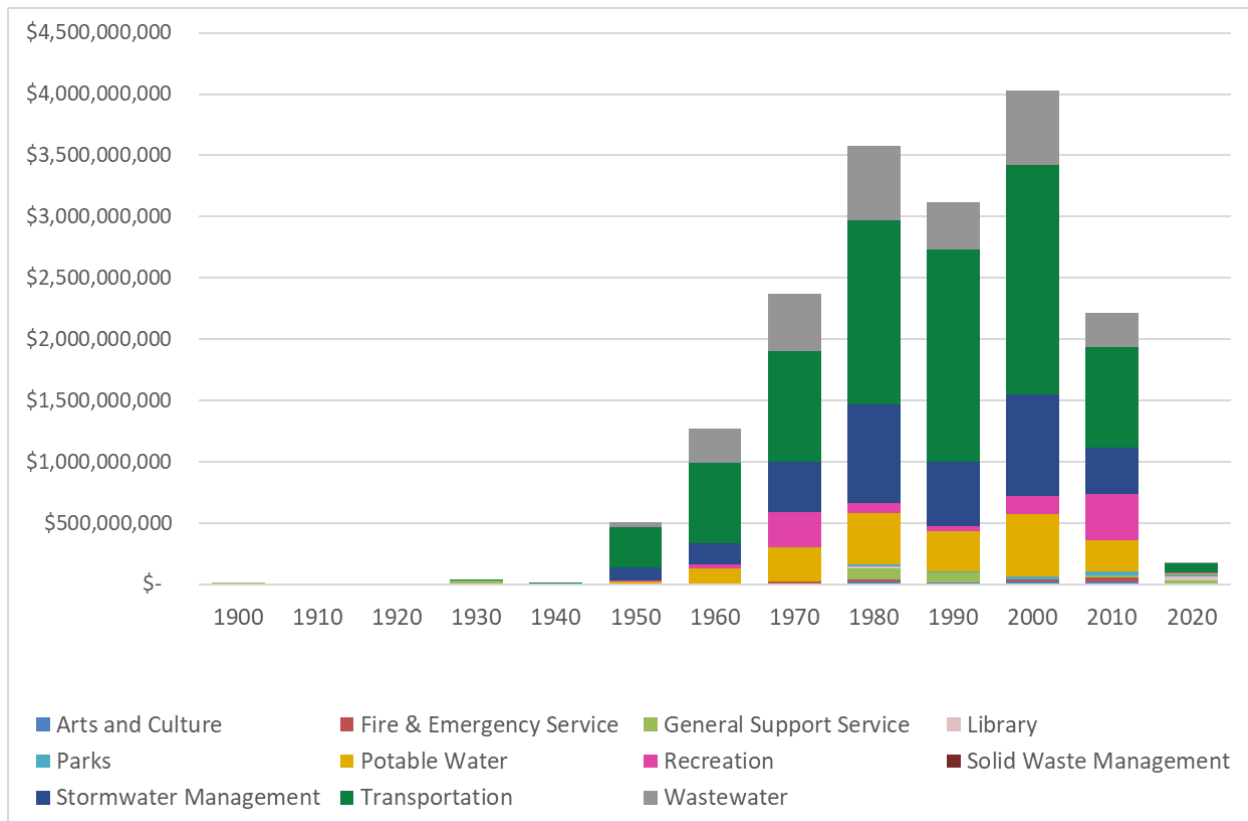


Figure 5-3. Age Distribution by Installation Year of all Service Areas

5.3. Asset Performance

Categories, describing asset physical condition or age state (i.e. performance), were assigned to all assets across each service area using a common 5-point categorical rating scale. This scale is aligned to the Canadian Infrastructure Report Card condition rating scale. Since methods for determining asset performance vary amongst different asset classes, all existing asset information, whether it be condition ratings or age-based assessments, were converted to the common 5-point categorical scale for a standardized and consistent basis to understand asset performance within the AMP.

Table 5-1 illustrates the definitions for each category, aligned to the age-based or assessed condition state of the assets. Using these categories, Figure 5-4 illustrates the performance distribution for all assets within the City and Figure 5-5 displays the same information, further subdivided by the City’s service areas.

Table 5-1. Overall Performance Rating Scale with Examples

Age-Based	Assessed Condition	Description	Useful Service Life Consumed	Example Condition Rating
Beginning of Life	Very Good	Asset is typically new or recently rehabilitated.	0% to 20%	1
Early Life	Good	Condition of assets is acceptable. Assets are generally in the early stages of their service life. Assets may show early signs of deterioration and may require attention or minor maintenance.	20% to 40%	2
Mid-Life	Fair	Assets are at the mid-point of their service life. Assets show some signs of deterioration that may require attention and maintenance.	40% to 60%	3
Past Mid-life	Poor	Assets show signs of deterioration and are beyond the mid-point of their service life. Ongoing monitoring and maintenance may be required.	60% to 80%	4
Approaching or at end of life	Very Poor	Assets are approaching the end or are beyond their useful service life and may show signs of advanced deterioration. Assets may exhibit signs of imminent failure that can affect service or increased risk. Extensive monitoring, rehabilitation and/or replacement likely required in the near future.	>80%	5

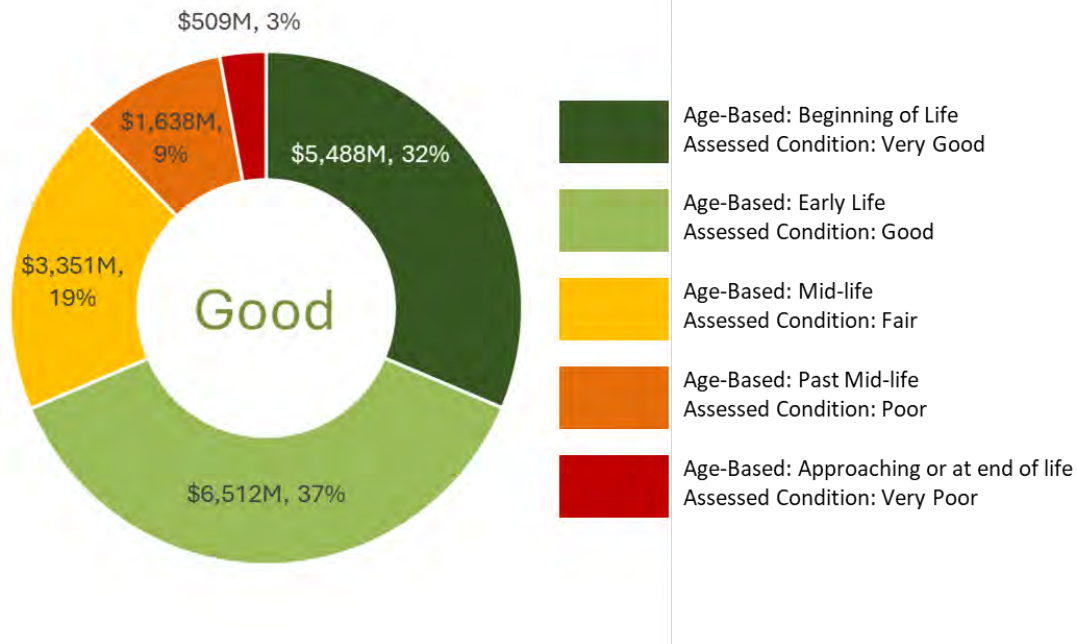


Figure 5-4 Performance Distribution of all Assets

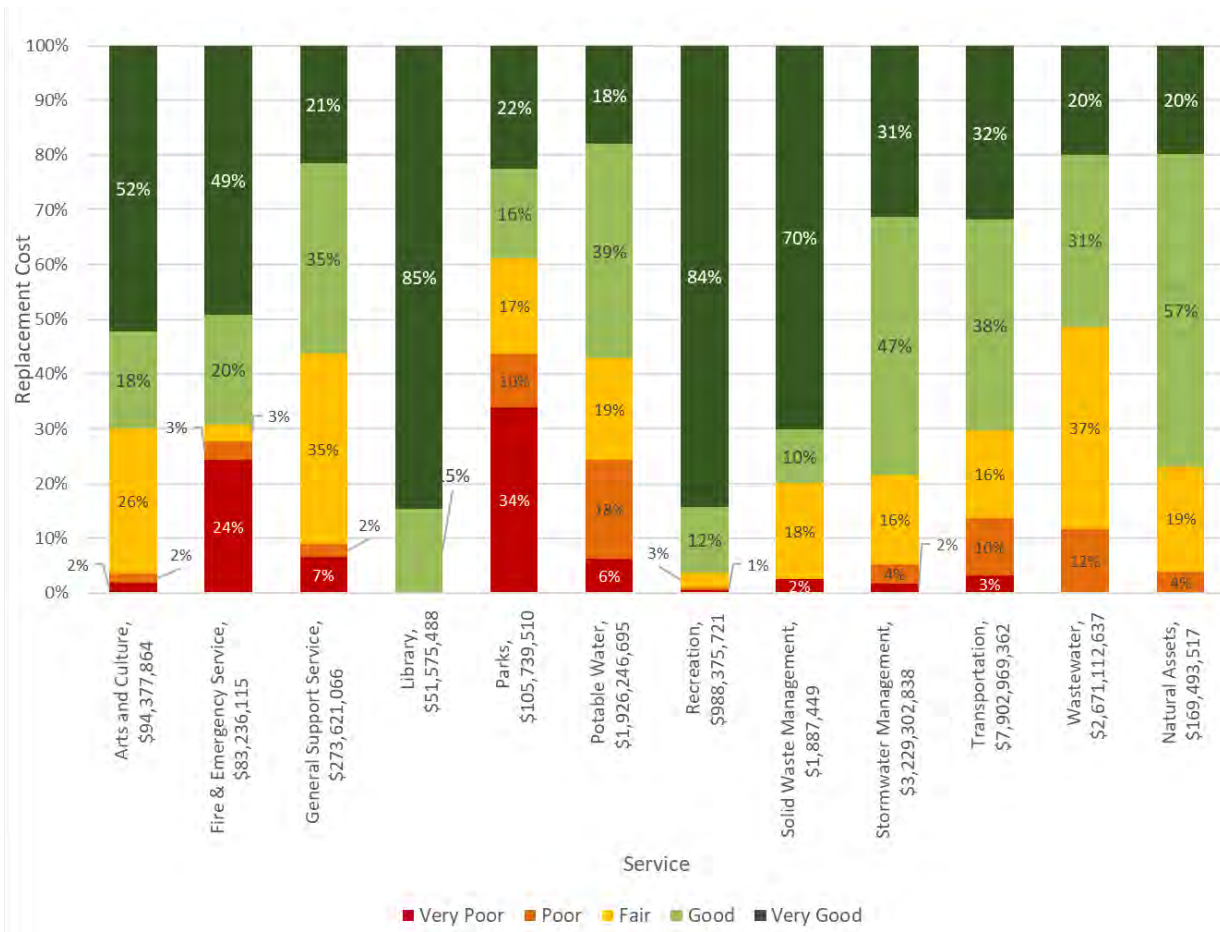


Figure 5-5 Performance Distribution for all Assets by Service Area

For each service area, the same performance information is reported at a more granular level in the appendices. The appendices also contain information on how performance is assessed for each major asset class, as well as the alignment between asset data and each of the 5 categories listed above.

As noted above, the analyses that are reported in this AMP utilized the City’s asset inventory data that was current to year-end 2023. Therefore, the findings in this AMP are based on 2023 data, and as a result, any renewal work that the City has undertaken in 2024 is not reflected in the outputs of this AMP.

6. Levels of Service

The following section describes the City's approach to monitoring and reporting on levels of service. The purpose of the LOS framework is to provide each service area with a set of performance measures that can be used to monitor asset performance and service delivery using measures that are relevant to each service area and will assist the City in determining if current LOS are adequate, and in the next iteration of the AMP, what proposed LOS should be. The City's initial work in developing LOS has resulted in the development of an LOS framework and a series of preliminary measures. A preliminary suite of measures has been reported in this AMP, however, the City expects to build these out and enhance them as it continues to move forward in its asset management journey.

Customer Research and Expectations

Subject matter experts and other stakeholders were engaged to introduce the concept of LOS and present a proposed framework, as well as a series of measures that will be used to monitor service delivery across asset classes. These experts provided context regarding customer needs relevant to the service areas. The initial suite of performance measures, as well as additional measures that are under consideration (but are not yet reported in the City's AMP) have been designed to align to customer expectations.

Strategic and Corporate Goals

The LOS framework and performance measures were developed in alignment with the City's strategic and corporate mission, vision, and goals. The City's 2020-2026 Strategic Plan focuses on four goals:

- Goal 1 – Exceptional Services by Exceptional People
- Goal 2 – Engaged, Diverse, Thriving & Vibrant City
- Goal 3 – Safe, Sustainable & Complete Community
- Goal 4 – Stewardship of Money & Resources

Mission Statement *Working with the community to provide high-quality municipal services that meet, if not exceed, the expectations of residents and businesses.*

Vision *Markham, the leading Canadian municipality - embracing technological innovation, celebrating diversity, characterized by vibrant and healthy communities - preserving the past and building for the future.*

Values

- *Cooperation and teamwork*
- *Focus on continuous improvement*
- *Respect for the individual*
- *Process-driven and prevention-based strategic planning*
- *Primary focus on the customer*
- *Responsibility to society*
- *Leadership through involvement*
- *Factual approach to decision-making*
- *People encouraged to make a contribution*

Customer Values

Service levels are defined in three ways, customer values, customer levels of service and technical levels of service. Customer Values indicate:

- What aspects of the service are important to the customer,
- Whether customers see value in what is currently provided,
- The likely trend over time based on the current budget provision.

The City’s customers refer to anybody who is using the service, including internal and external customers. Several common themes for Customer Values were identified across service areas and are documented in the table below.

Table 6-1: Common Themes for Customer Values and Applicable Services

Customer Values	
Customer Value Theme	Applicable Services
Service assets are safe and reliable to use	All service areas (including: Arts and Culture, Fire and Emergency Services, General Support Services, Library, Parks, Potable water, Recreation, Solid Waste Management, Stormwater Management, Transportation, Wastewater Collection)
Service assets are convenient to use	All service areas.

Customer Values	
Customer Value Theme	Applicable Services
Aesthetic Quality	<ul style="list-style-type: none"> • Arts and Culture • Fire and Emergency Services • General Support Services • Library • Parks • Recreation • Transportation
Environmentally sustainable	All service areas.

Customer/Community Levels of Service

Customer and community LOS have been developed to report on several key aspects of service delivery. These aspects include condition, function, capacity, and accessibility.

- Condition: How good is the service? What is the condition or quality of the service?
- Function: Is it suitable for its intended purpose? Is it the right service?
- Capacity/Use: Is the service over or under-utilized? Do we need more or less of the assets that make the service possible?
- Accessibility: Is the service convenient and/or available to use? Is the service easy to use?

Technical Levels of Service

Technical Levels of Service are required to deliver the customer values, and impact the achieved Customer Levels of Service, and are operational or technical measures of performance. These technical measures relate to the activities and allocation of resources to best achieve the desired customer outcomes and demonstrate effective performance.

Technical Levels of Service can also be referred to as dials or levers that when increased or decreased, should improve or reduce the state of overall asset performance documented within the Customer/ community Levels of Service section.

Technical service measures are linked to the activities carried out over the asset lifecycle and include the following:

- **Acquisition** – the activities to provide a higher level of service (e.g. widening a road, paving a gravel road, replacing a pipe with a larger size) or a new service that did not exist previously (e.g. a new library).
- **Operation** – the regular activities to provide services (e.g. opening hours, cleaning, mowing grass, energy, inspections, etc.).
- **Maintenance** – the activities necessary to retain an asset as near as practicable to an appropriate service condition. Maintenance activities enable an asset to provide service for its planned life (e.g. road patching, gravel road grading, building and structure repairs).
- **Renewal** – the activities that return the service capability of an asset up to that which it had originally provided (e.g. road resurfacing and reconstruction, pipe replacement and building component replacement).
- **Disposal** – the activities that are required when it is removed from service (e.g. decommissioning of a well, demolition of a building, ongoing testing and monitoring of a decommissioned waste landfill site, etc.).
- **Service Improvement** – activities to improve or upgrade services to meet changing business drivers, such as a change in community needs or regulatory requirements (ex. upgrading assets to meet AODA requirements, converting to green fleet, etc.)
- **Non-Infrastructure** – actions or policies that can lower costs, reduce risk of asset or service delivery failure, or extend asset life (ex. reducing water demand, reducing traffic on roads, etc.).

7. Risk Management Strategy

As part of the 2024 AMP development, the City developed a risk management strategy to assess the risk of each asset by evaluating its likelihood of failure (LOF) and consequence of failure (COF). The risk analysis will help the City assess and compare the risk assessment commonly across all services and can be incorporated into future operation, maintenance, and capital strategies.

LOF represents the probability (or likelihood) that an asset will fail, relative to a specific failure event. For the purposes of this AMP, LOF represents a failure of an asset due to its performance rating and therefore the LOF framework directly relates to the asset’s physical condition or age. Simply put, it is assumed that an asset with poorer performance rating is more likely to fail than an asset with a better performance rating. The LOF framework is defined in the following table.

Table 7-1: Likelihood of Failure Framework

Age-Based	Assessed Condition	Likelihood of Failure Rating	Description
Beginning of Life	Very Good	1	Failure Almost Impossible
Early Life	Good	2	Failure Unlikely
Mid-life	Fair	3	Failure Possible
Past Mid-life	Poor	4	Failure Likely
Approaching or at / beyond end of life	Very Poor	5	Failure Imminent/Failed

COF of an asset is assessed using a “triple bottom line” analysis to evaluate consequence of failure based on the three following characteristics of risk:

- Financial– the direct costs (such as costs associated with replacing failed assets) and indirect costs (such as loss of revenue) of the failure that are borne by the City.
- Socio-Economic– the impacts to the community.
- Environmental– the impacts to the natural environment or the environmental objectives of the City.

These consequence of failure categories are intended to capture the range of considerations that account for the consequence of an asset failing and in turn affecting the intended service level.

COF ratings were developed for each category on a 5-point scale with one (1) being minimal, and five (5) being extreme. This assessment was completed for individual

assets throughout the City and paired to the asset data. Table 7-2 illustrates the City's COF framework, which lists the definitions for assigning COF Ratings for each category.

Table 7-2. Consequence of Failure Framework

Rating	Direct Financial	Environmental	Socio-Economic
1 – Minimal	Cost to City: < \$5k	Trivial No remedial action required	No injuries Minimal impact to critical customers Routine claims Minimal negative impact on city reputation, minimal media coverage < 1 day disruption to local businesses or transportation routes Less than 10 people/businesses affected
2 – Minor	Cost to City: \$5k – \$50k	Minor non- permanent damage Minor clean-up effort required	Minor injuries Minor impact to critical customers Potential lawsuits Minor negative impact on city reputation, some media coverage 1 to 7 day disruption to local businesses or transportation routes 10 to 100 people/businesses affected
3 – Moderate	Cost to City: \$50k - \$500k	Important non- permanent damage Important clean- up efforts required	Moderate injuries Moderate impact to critical customers Continuous litigation Moderate negative impact on city reputation, important local media coverage 1 to 4 week disruption to local businesses or transportation routes 100 to 500 people/businesses affected
4 – Major	Cost to City: \$500k - \$5M	Some permanent damage Major and extensive clean- up efforts required	Serious injuries Major impact to critical customers Criminal charges or public trial Major negative impact on city reputation, national media coverage 1 to 3 month disruption to local businesses or transportation routes 500 to 2,000 people/businesses affected
5 – Extreme	Cost to City: > \$5M	Irreparable damage	Death Severe impact to critical customers Public inquiry/inquest Severe negative impact on city reputation, international media coverage > 3 month disruption to local businesses or transportation routes More than 2,000 people/businesses affected

For each major asset grouping, one or many criteria for assessing COF was used to determine the appropriate COF ratings to align with the definitions laid out in the COF framework in Table 7-2. At least one criterion was selected for each of the three major COF categories (Direct Financial, Socio-Economic, and Environmental). Figure 7-1 below demonstrates the procedure taken to calculate an asset grouping’s COF rating.

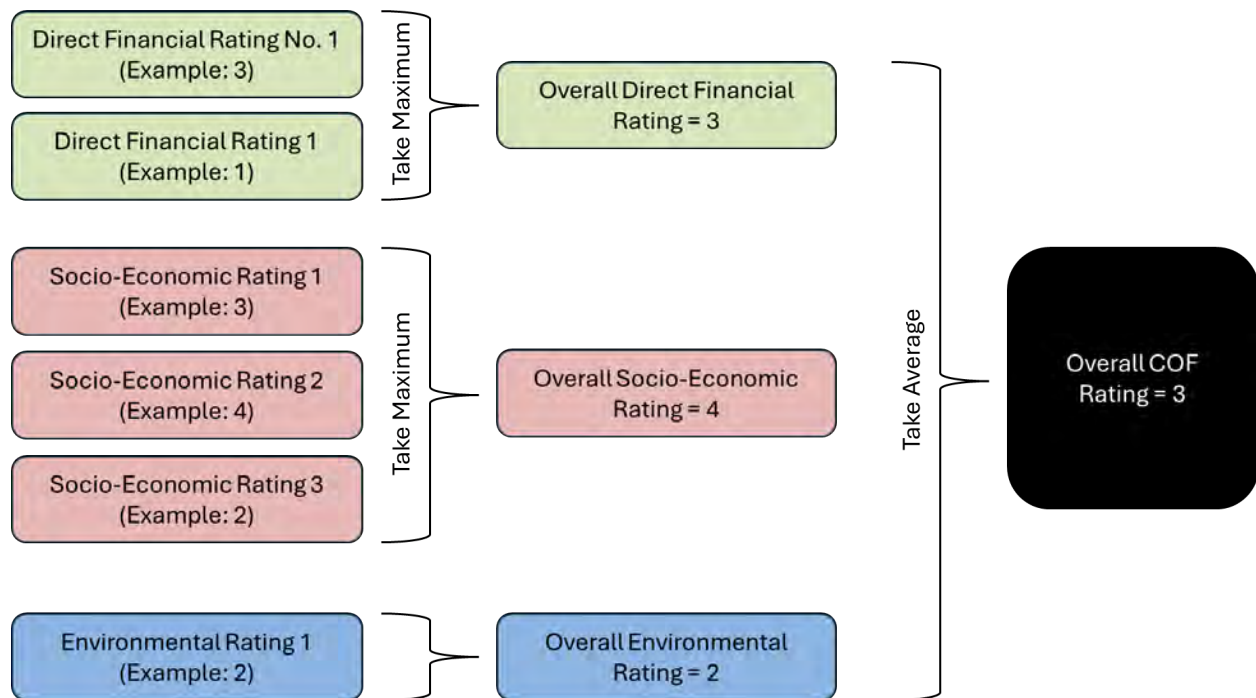


Figure 7-1 COF Rating Calculation Methodology

Individual COF models were developed for each in scope asset class. The criteria used to evaluate COF are summarized in tables for each asset class. Within each COF category of Direct Financial, Socio-Economic and Environmental, there are several different criteria that can be evaluated for an asset class.

For Direct Financial, the main criterion is Replacement cost. As asset failure will result in capital expenditures for emergency repairs and asset replacement, the rating for this criterion will increase as replacement cost is greater. Another criterion used in this category was also Revenue Loss. Assets that generate revenue and go offline will cost the city money in lost revenue, and therefore, add to the city’s COF. These criteria are applicable to all assets.

For Socio-Economic, the criteria used to evaluate COF are Land Use, Asset Type, Asset Size, and Road Class. Generally, these criteria pertain to the number of people they service, and the more users an asset has, the higher the COF rating will be. It is also important to note an asset and the land it is situated on or nearby. If an asset is

closer to open/unused land, the COF rating will be lower as opposed to it being closer to institutional land (e.g. a hospital) and or railway tracks, its failure will affect a greater and more at-risk population.

For Environmental, the criteria used to evaluate COF are Proximity to environmentally sensitive areas (ESA), Public Recreational Area, Watercourse, or Habitat.

Once LOF and COF were determined, the Risk Rating was calculated by using the following equation:

$$\text{Risk Rating} = \text{LOF Rating} \times \text{COF Rating}$$

Equation 1 Risk Rating Formula

Both LOF and COF ratings range from 1 to 5, yielding a Risk rating between 1 and 25. Five categories of Very Low, Low, Moderate High and Very High are associated with these scores and are illustrated in Table 7-3 and Table 7-4 below.

Table 7-3 Risk Matrix

		Consequence of Failure				
		1	2	3	4	5
Likelihood of Failure	1	\$84,338,977 (0.5%)	\$2,191,139,021 (12.6%)	\$3,031,655,144 (17.5%)	\$149,005,119 (0.9%)	\$0 (0.0%)
	2	\$125,720,158 (0.7%)	\$2,735,467,083 (15.8%)	\$3,303,393,951 (19.1%)	\$251,321,555 (1.5%)	\$0 (0.0%)
	3	\$97,332,486 (0.6%)	\$1,773,467,965 (10.2%)	\$1,406,978,642 (8.1%)	\$39,835,170 (0.2%)	\$0 (0.0%)
	4	\$52,026,489 (0.3%)	\$771,828,537 (4.5%)	\$789,304,613 (4.6%)	\$16,809,139 (0.1%)	\$0 (0.0%)
	5	\$45,462,813 (0.3%)	\$218,979,547 (1.3%)	\$237,462,427 (1.4%)	\$6,915,908 (0.0%)	\$0 (0.0%)

Table 7-4 Risk score mapping legend

Legend		
Very Low	1 – 5	Fit for the Future
Low	6 – 10	Adequate for Now
Medium	11 – 15	Requires Attention
High	16 – 20	At Risk
Very High	21 – 25	Unfit for Sustained Service

The risk matrix illustrated above indicates the following:

- 48.8% or \$8.5B of all assets assessed as Very Low risk or fit for future use.
- 44.4% or \$7.8B of all assets assessed as Low risk or adequate for now.
- 6.4% or \$1.1B of all assets assessed as Moderate risk or may require attention.

- 0.4% or \$67.5M of all assets assessed as High risk or at risk or requires attention.
- No assets are assessed as Very High risk or unfit for sustained service.

COF and Risk Ratings can provide additional functions when completing evaluations at the asset level. They can be used to assign different Technical Levels of Service thresholds, by managing assets with higher COF scores at higher target performance states. For instance, a critical asset may be replaced at an earlier time than a non-critical asset of the same type, due to a higher consequence of failure. On the other hand, assets with lower COF and Risk Ratings may be allowed to reach lower target performance states.

Another important use for these ratings is to assist the city with its selection of capital projects. When completing an annual capital planning exercise, Markham can incorporate risk ratings developed through these strategies to understand how much risk will be reduced for each planned project. Therefore, utilizing these strategies as a tool to help prioritize projects or determine tiebreakers when analyzing capital projects for inclusion of the forthcoming capital plan.

It should be noted that since likelihood of failure is tied to asset performance, it is expected to change as asset performance changes over time. As a result, risks may vary. Assets that are renewed or maintained may experience a reduction in risk, whereas those that age may experience an increase in risk. The City responds to these changes through regular activities that they employ to manage assets such as operation, maintenance and renewal programs.

8. Lifecycle Management Strategies and Forecasting

The City's lifecycle management strategy is a set of planned actions and activities performed on its assets over their service lives to provide LOS in a sustainable way, manage the risk of failures and manage lifecycle costs. These lifecycle activities work together to extend asset life, reduce overall lifecycle costs, minimize risk, and can help achieve environmental goals. Documentation on the planned lifecycle activities for each asset is provided as part of the City's technical levels of service framework. These Technical Levels of service detail the activities that the City undertakes to ensure that its assets are providing services at target levels. In addition to this documentation, a series of lifecycle modelling logic was also developed as part of a computational forecasting tool that projected asset needs forward into the future.

Lifecycle modelling applies logic to assets based on their intended and expected behaviours over the course of their service lives. Using these models, forecasting can be completed to understand the financial impacts of maintaining assets in a state of good repair. As a part of the city's lifecycle strategy, a series of models were developed to forecast assets needs over a 27-year period. The lifecycle models in conjunction with the City's LOS and risk management strategies were implemented in the decision support system (DSS) tool. The DSS tool pairs the city's asset inventory and current performance of respective assets to the lifecycle, LOS and risk management strategies logic to analyze the relationship between capital investment and asset performance under various scenarios.

For this AMP, one scenario was analyzed for the City's asset portfolio, that being, to Maintain Current LOS. This scenario demonstrates the performance of assets, and the intervention costs required if The City were to maintain the levels of service it already provides. It is important to note that understanding the cost to maintain LOS at current levels is a requirement of the 2024 milestone of O. Reg. 588/17.

The forecasting model is primarily related to capital renewal needs. The City employs two primary renewal strategies: asset replacements, which consider the removal of an existing asset and its replacement with a like asset; and, prominent rehabilitations, which include major retrofits and other significant works that extend asset life. Figure 8-1 and Figure 8-2 display the annual intervention costs and performance distribution over a 27-year period to maintain Markham's current LOS. Note that this forecast does not include natural assets, since these assets were included in the City's Natural Assets AMP.

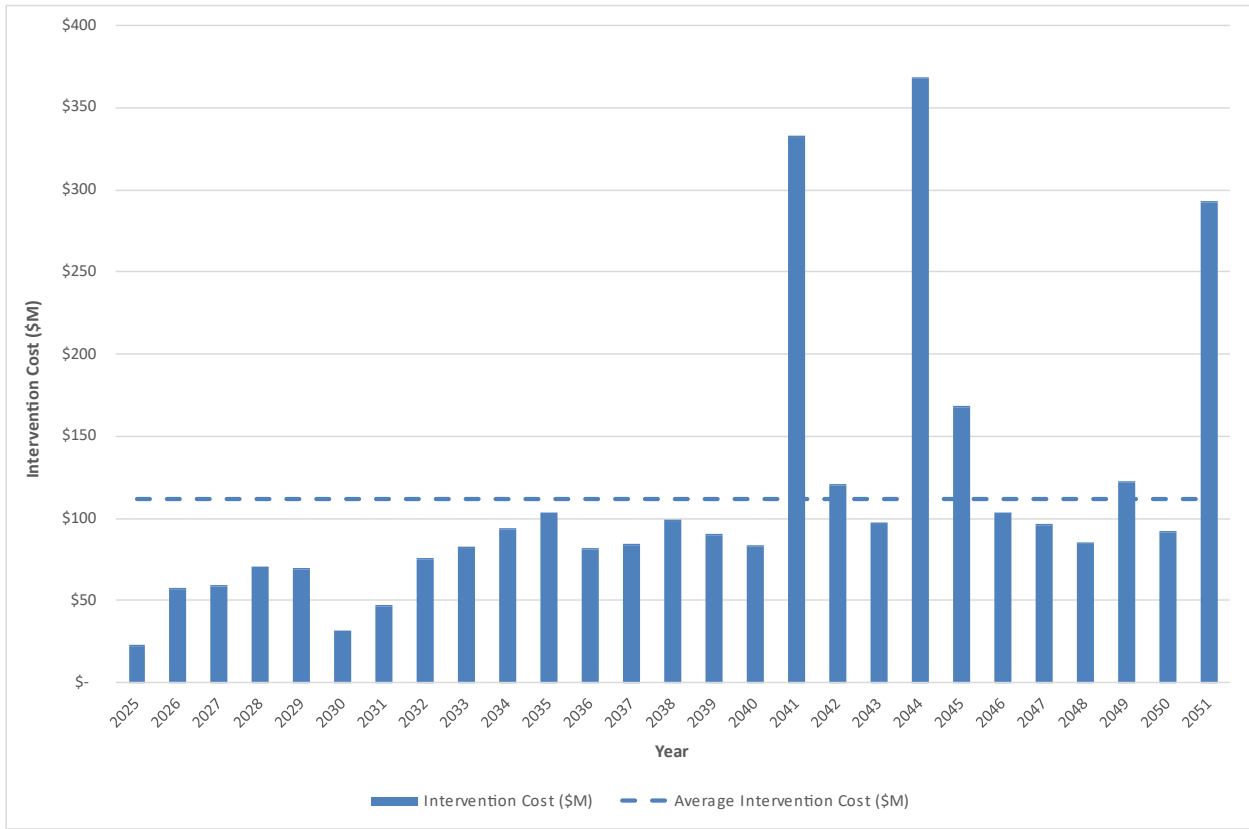


Figure 8-1: Maintain Current LOS Intervention Costs for The City's Assets

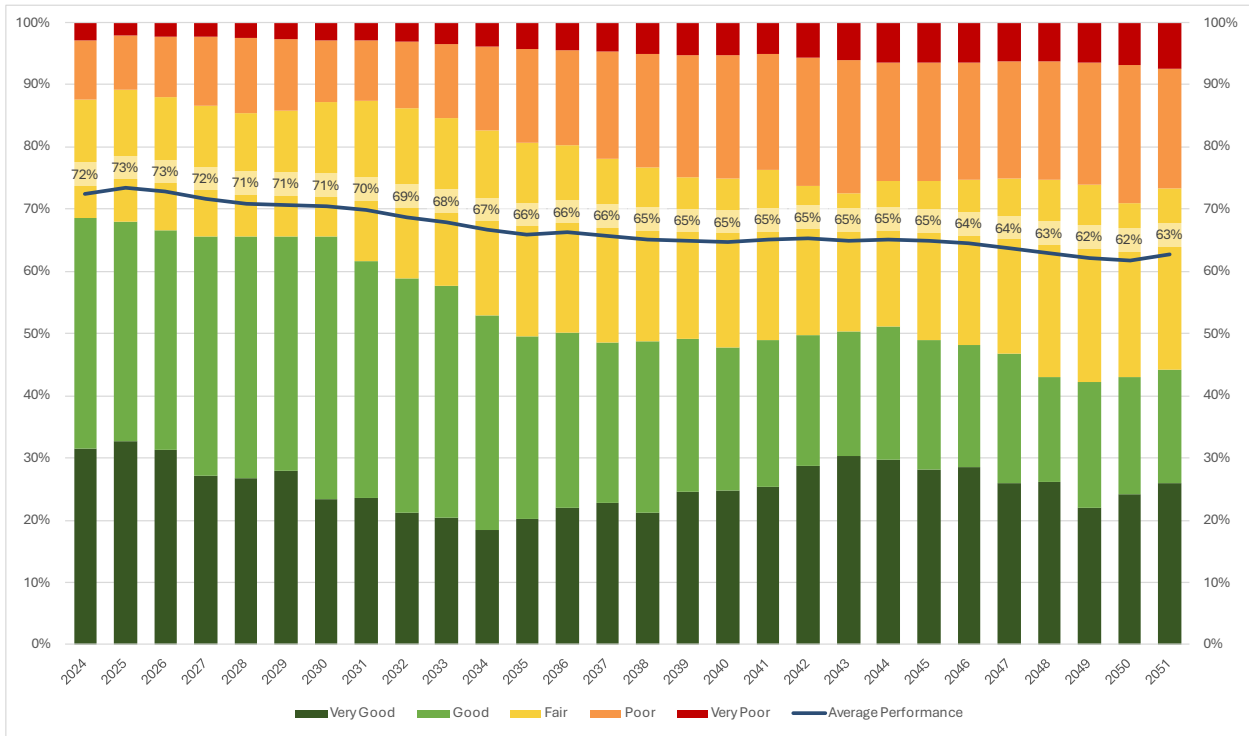


Figure 8-2: Maintain Current LOS Performance Distribution for The City's Assets

9. Financial Summary

This section outlines the funding levels required for the City to maintain current service levels by applying the lifecycle activities it uses against assets. Determining funding levels for each service area will allow the City to maintain healthy reserve fund levels, acquire the required people resources to continue maintaining assets in a state of good repair as well as construct/implement new assets and support the annual capital budgeting process.

Analyzing the City’s historic budgets, the financial summary was established. Using this analysis, it was determined how much funding the City has been allocating towards each respective lifecycle activity and service area.

The City categorizes their budget into the following groups:

- **Operating budget:** This supports the day-to-day activities and functions to provide City Services. Operating expenses include equipment maintenance, materials supply, facilities services, and contributions to reserves; all of which are expensed in the current fiscal year.
- **Capital budget:** This includes a comprehensive financial plan that addresses the financial requirements needed for growth, major rehabilitations, and major replacements of existing infrastructure.

Using the past 10 years of budget data, a trend of operating and capital expenditures was identified. This was then projected forward and compared with forecasted financial lifecycle needs which were developed from the City’s lifecycle models. The forecasts cover projections until 2051, in alignment with the City’s Official Plan.

9.1. Historic Operating and Capital Budgets

The City’s 2014 to 2024 operating and capital budgets were analyzed to identify a spending trend. The following tables summarize the historic expenditures from these past operating and capital budgets.

Table 9-1: Historic Operating and Capital Budgets

Year	Operating Expenditures	Capital Expenditures	Total
2014	\$306.7M	\$119.9M	\$426.6M
2015	\$324.4M	\$102.2M	\$426.52M
2016	\$345.7M	\$122.9M	\$468.6M
2017	\$358.8M	\$84.5M	\$443.3M
2018	\$378.5M	\$77.7M	\$456.17M

Year	Operating Expenditures	Capital Expenditures	Total
2019	\$395.1M	\$124.7M	\$519.78M
2020	\$410.5M	\$111.5M	\$522.0M
2021	\$415.7M	\$103.3M	\$519.0M
2022	\$423.4M	\$110.3M	\$533.7M
2023	\$444.8M	\$223.9M	\$668.7M
2024	\$469.4M	\$118.3M	\$587.7M

Using this information, the City has established a trend that illustrates an increase in spending. This can be projected forward to identify the amount of spending that the City may exercise if it continues to increase budgets at current rates.

9.2. Forecasted Operating and Capital Budgets

In order to provide a forecast of required operating and capital needs, an analysis was used that incorporates the results of the City’s lifecycle forecasts and other forecasts to understand future projections.

To forecast the operating budget, a high-level analysis was completed, which was developed using judgement from the City’s finance subject matter experts. This analysis included a simple increase of 2.5% per year to the operating budget, which reflects anticipated growth. This was applied to the City’s 2024 Operating budget of \$469.4M.

To forecast the capital budget, renewals were obtained from the City’s lifecycle forecasting exercise, as well as the results of the City’s Natural Assets AMP. For other lifecycle activities (including non-infrastructure solutions, service improvements, etc.) forecasts were developed by looking at the City’s line-item budget data to determine recent spending amounts. These amounts were projected forwards using the assumption that spending will be the same in these categories if service levels are maintained at their current level moving forward.

The following table summarizes the forecasted capital renewal expenditures, based on required asset replacements and rehabilitations for the City to continue meeting current service levels. The 2024 expenditures are based on the 2024 capital budget. The 2025 to 2051 expenditures were forecasted using the lifecycle forecasting model, as indicated in the following table.

Table 9-2: Forecasted Renewal Expenditures

Year	Capital Expenditures	Year	Capital Expenditures
2024	\$43.2M	2038	\$99.2M
2025	\$22.4M	2039	\$90.2M
2026	\$57.2M	2040	\$83.6M
2027	\$58.7M	2041	\$332.2M
2028	\$70.6M	2042	\$120.4M
2029	\$69.7M	2043	\$97.0M
2030	\$31.1M	2044	\$368.0M
2031	\$46.5M	2045	\$167.9M
2032	\$75.4M	2046	\$103.5M
2033	\$82.1M	2047	\$96.4M
2034	\$93.9M	2048	\$84.8M
2035	\$102.9M	2049	\$122.6M
2036	\$81.7M	2050	\$91.5M
2037	\$83.9M	2051	\$292.5M
		Total	\$3,068.8M

Table 9-3 below shows the 3-year average (from 2022 to 2024) by lifecycle activity. The 3-year average was used to forecast the non-renewal expenditures from 2025 to 2051.

Table 9-3: Forecasted Expenditures (Non-Renewal)

Lifecycle Activity Type	3-Year Average
Non-Infrastructure Solutions	\$5.3M
Operation	\$6.0M
Maintenance	\$2.7M
Acquisition	\$63.8M
Service Improvement	\$9.4M

9.3. Total Summary

A summary of the trended historical operating and capital budgets (trend lines in Figure 9-1) was compared to the forecasted operating and capital needs (bars in Figure 9-1). This provides an understanding of current spending projections as they relate to forecasts to maintain current levels of service moving forwards. The following figure illustrates this comparison. The trend lines represent forecasted budgets, and the bars represent forecasted needs.

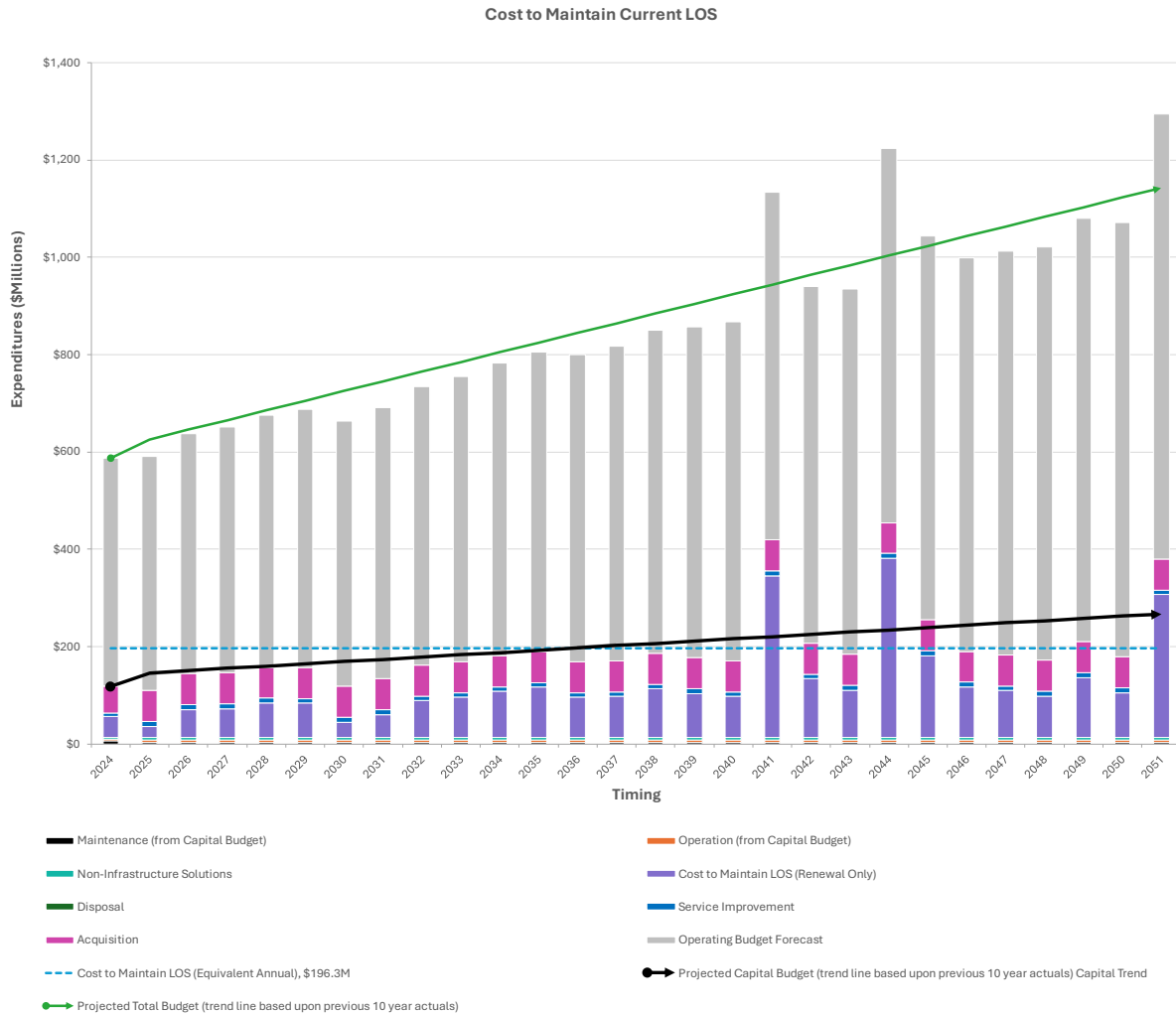


Figure 9-1: Forecasted Expenditures – Maintain Current LOS

The total trended budgets equate to \$24,462M over 27 years (an average of \$873.7M per year). The total forecasted needs equate to \$24,208M over 27 years (an average of \$864.6M per year).

This comparison illustrates a potential funding variance between anticipated (trended) spending compared with the DSS modeled forecasts combined with lifecycle activities (table 9-3). The variance between the trended and forecasted budgets is approximately 3.5% annually, which indicates that the City’s trended budgets should be adequate to maintain current service levels into the future.

Note that this value represents the average variance over the entire period. The forecast depicts fluctuations in annual funding needs, with the largest peaks occurring in 2041, 2044 and 2045. As the City plans for and executes work, peaks will be smoothed, either by a balancing of needs that occurs during regular capital planning activities, or naturally, since predictions that are further away are indicative of orders of magnitude or system-level behavior and may not represent year-to-year predictions.

Note that the forecasts developed herein are based on a modelling exercise that is developed and supported by a series of assumptions. Therefore, these results are subject to change, as the information that supports this modelling is refined as part of the City’s ongoing annual resource and budget planning process.

9.4. Backlog Summary

For the 2024 AMP, the analysis was focused on the financial needs related to maintaining current levels of service. This is defined as maintaining the City’s current level of backlog (including managed backlog) of asset needs to the same magnitude as it exists today.

Backlog refers to the value of immediate work that is required based on asset data and applied lifecycle strategies. The City employs two definitions of backlog: “backlog” and “managed backlog” (refer to the definition section of this document for details). Backlog/managed backlog is an indicator of the current needs of the asset portfolio at the time that the analysis was completed and may include both replacements and significant rehabilitations. Note that it does not include any additional asset needs that are projected to occur into the future.

The following table summarizes the backlog/managed backlog findings for each service area.

Table 9-4: Infrastructure Backlog Summary

Service Area	Current Infrastructure Backlog	% of Replacement Cost	% of Total Backlog
Arts & Culture	\$7.0M	7.4%	0.8%
Fire & Emergency Services	\$19.6M	23.6%	2.3%
General Support Service	\$30.8M	11.2%	3.5%
Libraries	\$3.9M	7.5%	0.4%
Parks	\$29.0M	27.4%	3.3%
Potable Water	\$30.9M	1.6%	3.6%

Service Area	Current Infrastructure Backlog	% of Replacement Cost	% of Total Backlog
Recreation	\$7.5M	0.8%	0.9%
Solid Waste Management	\$74.0k	3.9%	<0.1%
Stormwater Management	\$17.9M	0.6%	2.1%
Transportation	\$721.3M	9.1%	83.1%
Wastewater	\$507.5k	<0.1%	0.1%
Total	\$868.4M	5.0%	-

The City’s total backlog and managed backlog is \$868.4M, which is approximately 5% of the replacement cost of the City’s entire asset portfolio. The backlog and managed backlog of transportation services assets accounts for 83.1% of the total backlog/managed backlog value, which is made up of mostly roads rehabilitation or replacement works. However, transportation assets have the highest valuation and almost account for half of the City’s asset portfolio by value, therefore a higher backlog/managed backlog value is expected for this service area. It is important to note that the backlog/managed backlog of transportation services only accounts for 9.1% of the service’s replacement cost. Parks and Fire & Emergency services have the highest backlog/managed backlog with respect to the services’ total replacement costs.

The City is currently reviewing the backlog/managed backlog identified from the analysis completed herein in order to determine whether any of these needs are not accounted for within the City’s Lifecycle Reserve Study in order to establish a funding source. The results from this review will be incorporated into and reported in the City’s 2025 Asset Management Plan and Financial Strategy. The City expects to identify that the majority of these needs are considered to be “managed backlog”.

In 2021 the Financial Accountability Office of Ontario (FAO) [reported](#) on Ontario’s Municipal Infrastructure with respect to its state of good repair. The FAO reported a total infrastructure backlog of \$52.1B relative to a total replacement value of \$484B. This represents a backlog of over 10% of the infrastructure’s replacement value. The City of Markham’s backlog/managed backlog measured by percentage of replacement cost sits at 5%, which is less than the average for Ontario.

The City’s forthcoming 2025 AMP and financial strategy will consider an analysis to:

- Define proposed Levels of Service and the costs associated with them

- Determine whether backlog assets are “true gaps” in the City’s Lifecycle Reserve Study or are considered “managed backlog”
- Determine if any High Risk assets require additional management strategies
- Consider the proposed Natural Asset management strategies as outlined in the [May 21, 2024 Council Report, Incorporating Natural Assets into Markham’s Asset Management Plan](#)

This will give the City an opportunity to further the discussion related to backlog, and to propose a strategy to address critical backlogs, while still operating with a healthy level of backlog/managed backlog that ensures that services can continue to be provided to the community while optimizing the financial impacts to the City.

This approach aligns with the City’s objectives as stated in its Asset Management policy, by utilizing risk to understand how to effectively manage backlog. This approach also allows the City to effectively manage backlog to a healthy level, which ensures that the City can maximize service levels to the community in the most financially responsible and sustainable manner.

10. Improvement and Monitoring Plan

As part of the City’s Corporate Asset Management program, a detailed maturity assessment was completed on their AM processes and practices.

The purpose of the maturity assessment was to identify and compare processes and practices with industry benchmarks in order to determine improvement strategies to advance the City’s AM System and program. The assessment framework was aligned to the Institute of Asset Management’s Maturity Assessment Framework and scoring system, illustrated in Figure 10-1. This framework was used to assign ratings of 0 (Innocent) to 5 (Excellent) to each major AM process. The full methodology of the maturity assessment will be detailed in the City’s forthcoming *2024 Asset Management Strategy*.

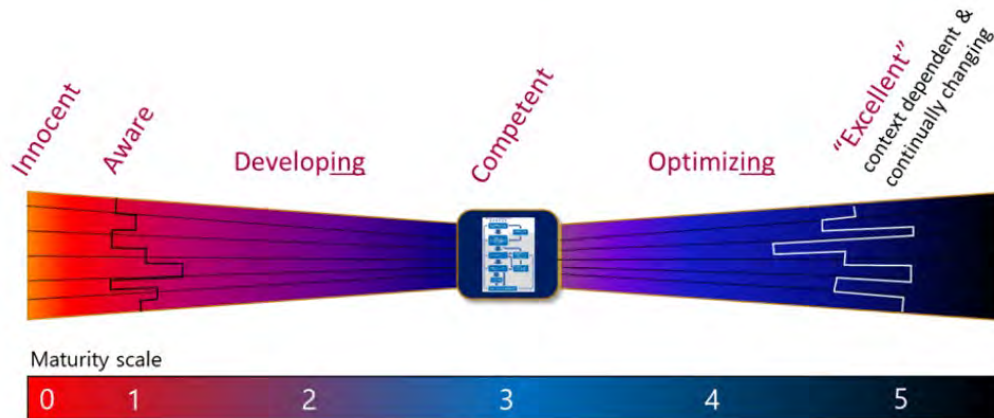


Figure 10-1: Institute of Asset Management Maturity Assessment Framework

The asset management categories that were assessed in this maturity assessment were aligned to the City’s AM Framework.

The maturity assessment was conducted on four (4) of the components in the AM Framework: Planning, Delivery, Monitoring & Reporting, and Core Support Services. The maturity of each process was assessed through a series of workshops held with City stakeholders.

The results from the assessment, aligned to the City’s AM framework are illustrated in Figure 10-2.

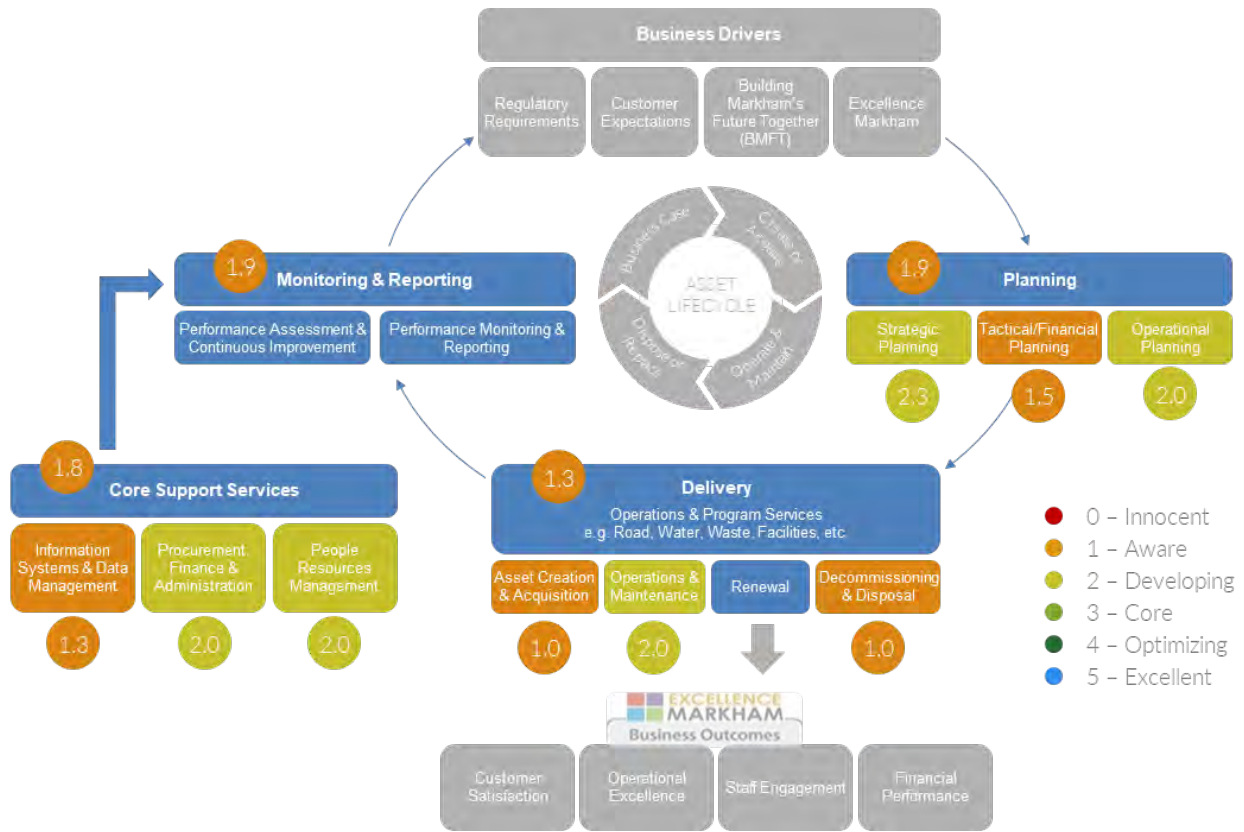


Figure 10-2: Maturity Assessment Results

Overall, the City’s current state of practice when analyzed using this framework was rated as “1 – Aware”, to “2 – Developing”, as shown in Table 10-1. The City aspires to mature its asset management planning capabilities to a “3 – Core” rating.

Table 10-1: Maturity Assessment Results by AM Framework Category

Category	Sub-Category	Maturity Score
Planning	Asset Management Planning	Developing
	Strategic Planning	Aware to Developing
	Tactical/Operational Planning	Developing
Delivery	Operations & Program Services	Aware to Developing
Monitoring & Reporting	Performance Assessment & Continuous Improvement and Performance Monitoring and Reporting	Aware to Developing
Core Support Services	Information Systems & Data Management	Aware to Developing
	Finance & Administration	Developing
	People Resources Management	Developing

The results of this assessment in conjunction with the development of this AMP were used to identify areas for improvement. The Improvement Plan of this AMP summarizes the key activities and initiatives for the City to undertake to continually improve the City’s asset management system and future iterations of the AMP. The City has identified initiatives related to the following categories to increase the maturity of its AM system, and by extension, future iterations of this AMP. These initiatives have been formally endorsed along with the City’s 2024 Asset Management Plan. A high-level summary of them includes the following initiatives:

- Defining and evaluating asset management governance, roles and responsibilities
 1. Asset Management Strategic Documents Regulatory Reporting (Strategic Upkeep)
 2. Financial Planning Support and Regulatory Reporting Plan
- Consistent and formalized standards, processes and procedures
 3. Emergency/Continuity Plans
 4. Asset Management Lifecycle Strategy/SOPs
 5. Asset Condition and Performance Assessment Procedures
 6. Asset Management Strategies Maintenance
- Improved data and information
 7. Asset Data and Information Strategy
- Formalized resource planning
 8. Resourcing Strategy
- Improved demand/growth analysis
 9. Demand Analysis (i.e. Growth) planning process
- Stakeholder engagement
 10. Stakeholder Engagement Plan
- Implement/develop supporting systems, tools and integrations (ex. decision support systems)
 11. Decision-Support System and Integrate it with the Lifecycle Planning Process
 12. Enterprise Asset Management (EAM) System Implementation & Integration:

The following table summarizes the initiatives and how completing each initiative will increase the maturity of the City’s AM System to a “3 – Core” rating.

Table 10-2: Asset Management System Improvement Initiatives

Initiative		AM Framework Category	Description	Timeline
1	Asset Management Strategic Documents Regulatory Reporting (Strategic Upkeep)	Planning	<ul style="list-style-type: none"> • Establish guidelines and enact a process to continually update the Asset Management System: <ul style="list-style-type: none"> ○ Update the AM Policy every 5 years ○ Update the AM strategy (including governance framework) every 5 years ○ Update the AMP every 5 years ○ Perform a maturity assessment every 5 years • Identify the means for rolling out these procedures to the organization (i.e. cross-disciplinary collaboration) 	Ongoing
2	Financial Planning Support and Regulatory Reporting Plan	Core Support Services	<ul style="list-style-type: none"> • Establish roles and responsibilities from applicable service areas for various types of regulatory reporting. • Standardize frameworks to determine if regulatory reporting can be completed in-house or through consulting services. • Integrate regulatory reporting with AM program. • Provide a clear definition of Finance department's responsibilities to support AM processes. • Establish roles and responsibility to support finance in the lifecycle process. 	Longer-Term
3	Develop Emergency/Continuity Plans	Planning	<ul style="list-style-type: none"> • Develop Business Continuity Plans, Emergency Management Plans, etc. for each service area, including: <ul style="list-style-type: none"> ○ Procedures, roles and responsibilities ○ Outlining highly critical assets 	Medium- to long-term

Initiative		AM Framework Category	Description	Timeline
4	Develop an Asset Management Lifecycle Strategy/SOPs	Planning and Core Support Services	<ul style="list-style-type: none"> Formally document the lifecycle procedures for each asset group. Formally document processes for updating asset inventories with new assets including roles and responsibilities, i.e., when asset replacements or renewals take place, decommissioning, etc. <ul style="list-style-type: none"> Tie processes to the City's lifecycle management strategy/activities Address implementation and training of new procedures related to AM data management. Implement a formal communication process to notify appropriate departments of changes to asset data that affect them (ex. onboarding new assets). 	Medium-term
5	Develop Asset Condition and Performance Assessment Procedures	Monitoring & Reporting	<ul style="list-style-type: none"> Formally develop condition assessment procedures and integrate across all service areas. Develop a formal process for integrating condition data into AM data, processes and ensure it aligns with AM objectives. Develop definitions for asset performance across all service areas. 	Medium-term
6	Asset Management Strategies Maintenance	Monitoring & Reporting	<ul style="list-style-type: none"> Implement the asset management strategies (LOS, lifecycle management, and risk management strategies) Integrate a regular process of reporting on performance and levels of service to align with O.Reg. 588/17. Asset data should be formatted in a way that is easy for staff to pull the required data for reporting. Integrate the asset management strategies with each other. Commit to continually updating the strategies (5-years). Update the strategies to include climate change considerations. 	Ongoing

	Initiative	AM Framework Category	Description	Timeline
7	Develop an Asset Data and Information Strategy:	All	<ul style="list-style-type: none"> Define and establish the asset information systems that will be used, the data they will store, and how each system will link to one another to produce one single “source of truth”. Develop data standards indicating what information is required to support asset management analyses, reporting, and AM/organizational objectives. Establish definitions for data quality and accuracy. Establish QA/QC procedures to ensure that data is correct and in a consistent format. Ensure the appropriate groups of people have access to the data and that data is in a usable format that supports other AM processes. Define governance for various datasets. 	Short-term
8	Develop a Resourcing Strategy	Core Support Services	<ul style="list-style-type: none"> Implement the current growth model outputs as part of identifying people resources to support this strategy. Develop a formal process and resourcing strategy that identifies required staffing levels for the City to be able to meet its AM objectives. 	Short- to medium-term
9	Implement a Formalized Demand Analysis (i.e. Growth) planning process	Planning	<ul style="list-style-type: none"> Identify the types of demand analysis that need to be performed for each service area and their frequency (e.g., master plans, vs. others) Adopt a regular cycle of updates to this process. Integrate the demand analysis with future resource planning for growth (ex. impact of growth model). Formally document processes, roles, and responsibilities across all service areas with respect to demand analysis. Integrate this process with Asset Management objectives. 	Short-term

			<ul style="list-style-type: none"> Perform the studies more frequently to understand how they are sequenced along with other related initiatives. 	
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Initiative		AM Framework Category	Description	Timeline
10	Develop a Stakeholder Engagement Plan:	Monitoring & Reporting and Core Support Services	<ul style="list-style-type: none"> Staff are educated on asset management, the asset management system, and are engaged in a combined effort to achieve the City's AM objectives. Develop and implement a formal framework to engage both stakeholders and community members. Develop a framework to implement stakeholder and community member feedback into current and future AM planning. Hold community engagement events and incorporate feedback into decision-making processes and LOS. 	Longer-term
11	Implement a Decision-Support System and Integrate it with the Lifecycle Planning Process	Planning, Delivery, and Core Support Services	<ul style="list-style-type: none"> Formally document processes, roles, and responsibilities across all service areas for the lifecycle planning process. Define and centralize the sub-processes of the lifecycle process. Establish ownership of the lifecycle planning process via the AM group (or another neutral party). Coordinate the processes, policies and decision points. Perform the AM analyses annually to support capital planning and budgeting. Integrate the standardized risk framework into decision-making. Integrate the lifecycle planning process with Asset Management objectives. 	Short- to medium-term

	Initiative	AM Framework Category	Description	Timeline
12	Enterprise Asset Management (EAM) System Implementation & Integration:	All	<ul style="list-style-type: none"> Continue to implement the EAM system and integrate it into day-to-day operations. Incorporate the standardized risk framework to be incorporated into operations and maintenance strategies. Develop a process or role to operationalize the EAM platform across all service areas. Integrate the EAM system with a DSS system or AM planning activities. 	Ongoing

These initiatives were prioritized based on:

- If the initiative targets lower maturity scores resulting a more significant impact/improvement to the overall maturity
- Appropriate sequencing: The downstream effect the project may have on other processes and projects (i.e., projects that are required to be completed first. For example, data is used for all AM analyses. Developing a data strategy for consistent data collection and understanding what data is available should be completed before developing a risk management strategy.
- The resources required for each initiative, including both internal and external resources.

As the City undertakes and completes these initiatives, the overall maturity of the AM System will improve and the confidence of the AM analyses that support this AMP will increase.

Part of the City's AM program is to adopt a culture of continual improvement to ensure that AM planning processes are reviewed regularly to evolve as needed to suit the City's changing landscape, as well as improve the confidence in the AM analyses that support this AMP and future AMPs. The City's improvement plan is a significant step forward in adopting this culture.

11. Closing Remarks

The City of Markham is a relatively young municipality – the average age of its asset portfolio is approximately 33 years. As a young municipality, the majority of the City’s asset portfolio on average is within the early stages of its service life. On average, the City’s infrastructure is in “Good” performance, which is a reflection not only of the fact that the City is relatively young, but also of the fact that the City has been successful in managing its assets to ensure that they are fit for service and providing appropriate services to the community.

The City has a robust, annual lifecycle planning process, which has been put in place to assist the City in taking a proactive approach to planning for and managing its state of infrastructure into the future. The City’s overall asset performance is a reflection of this process.

Although the City has some assets in poor and very poor performance, it is important to note that this does not necessarily mean that assets are not fit for service. Assets in poor or very poor performance may require additional monitoring and maintenance to ensure that they remain in service. This is a normal practice that occurs in all municipalities in their efforts to maximize the useful service life of an asset. The City always operates in a manner to ensure that services are provided safely by managing and maintaining its poor/very poor performance assets.

The City’s Asset Management program can assist it in understanding how to manage these assets, by developing processes and data to better-understand asset risk and ensuring that the City’s investments minimize risks and maximize levels of service.

A key piece of this AMP is the City’s Improvement Plan. It sets up a series of actions for the City’s AM program to mature and provide better data/analyses to support better decision-making. Furthermore, this AMP represents a significant step forward in the City’s AM journey. It has introduced key asset management frameworks and analyses that support better decision-making. Particularly, the City has enacted a framework to record and monitor levels of service, which is paired with an investment forecast and financial summary. The City will keep monitoring its levels of service against its spending, to better understand how services are being delivered and assets are being managed. Asset management is a journey, and the processes and data that it provides will ensure the City continues to keep a proactive approach to providing services to the community.



**Sustainability and
Asset Management**

2024 Asset Management Plan Appendix A: Potable Water City of Markham

Appendix A Potable Water

Service Summary



Replacement Value
\$1.9 Billion

Fair

Overall Performance



Quantity

1,098 km of watermains
11,320 valves
13 suspended watermain insulation assets
5 auto flushing stations
2 bulk water sales stations
106 sampling stations

The City's potable water services contain assets that support the distribution of clean and safe drinking water to residents and businesses.

The City of Markham's water comes from Lake Ontario which is treated by the City of Toronto's and Region of Peel's water treatment facilities. The City is responsible for water distribution assets such as watermains, valves, service connections, and fire hydrants as well as water management assets like sampling stations and bulk water sales stations, as shown in Figure A - 1.

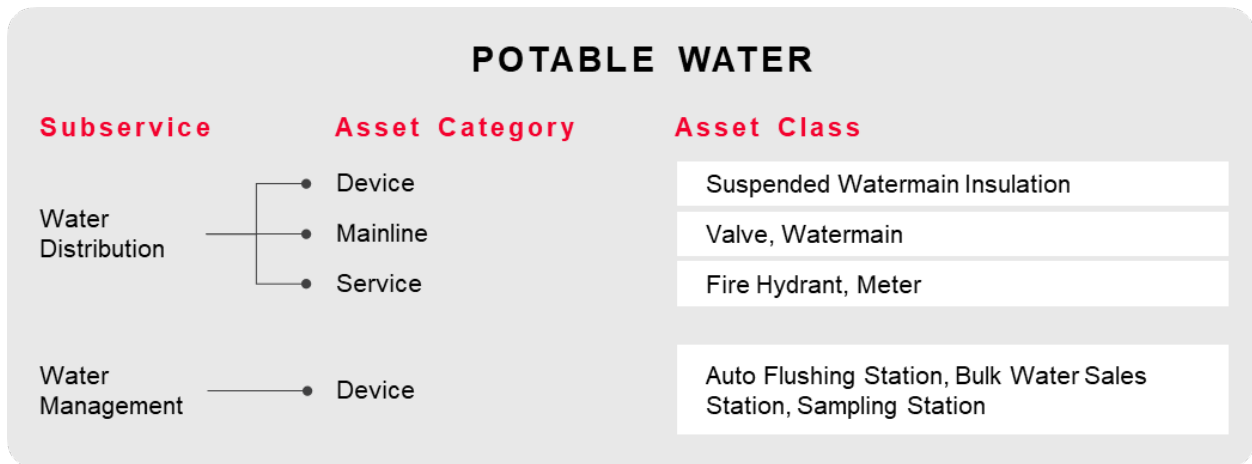


Figure A - 1: Potable Water Asset Hierarchy

More information on potable water such as state of infrastructure, levels of service, risk management strategies, lifecycle management strategies, and investment forecasting can be found in the following sections.

A.1 State of the Infrastructure

Figure A - 2 provides the replacement value for all potable water assets, while Figure A - 3 and Figure A - 4 illustrate replacement values for water distribution assets and water management assets, respectively.

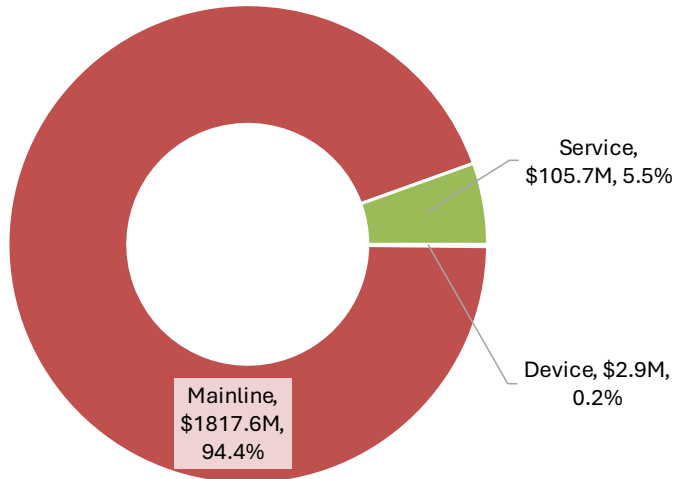


Figure A - 2: Replacement Value Distribution of Potable Water Assets

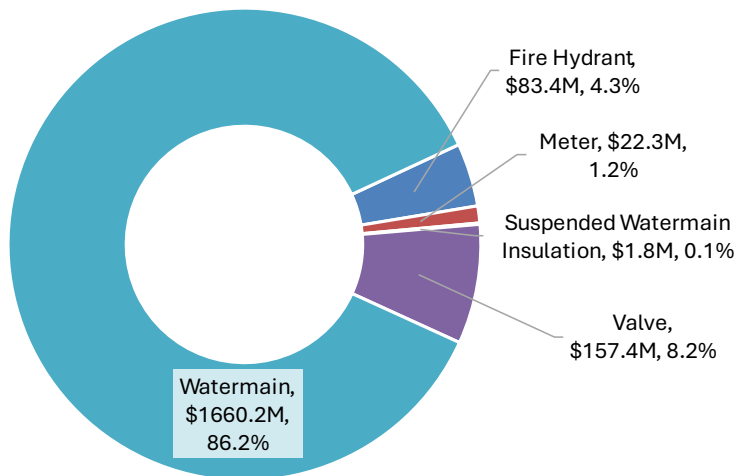


Figure A - 3: Replacement Value of Water Distribution Assets

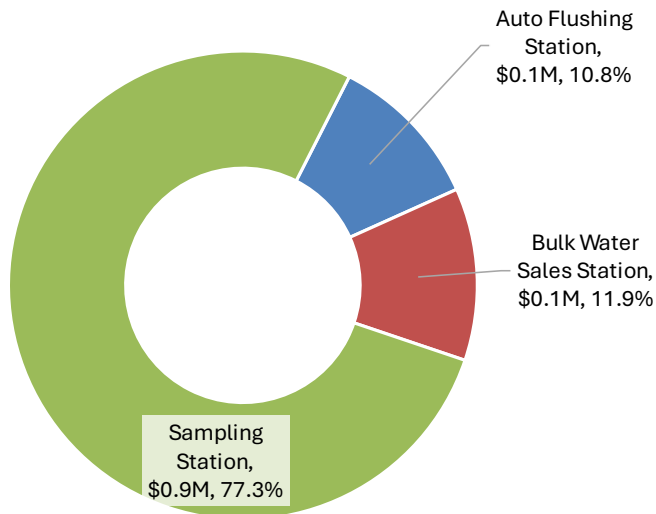


Figure A - 4: Replacement Value Distribution of Water Management Assets

A.1.1 Asset Inventory and Valuation

Table A - 1 below summarizes the asset valuation, quantities, and performance for each asset category of potable water asset class.

Table A - 1: Inventory and Valuation of Potable Water Assets

Subservice	Asset Category	Asset Class	Replacement Cost	Inventory	Average Performance
Water Distribution	Device	Suspended Watermain Insulation	\$1,806,319	13 Assets	Good
	Mainline	Valve	\$157,368,602	11,320 Assets	Good
		Watermain	\$1,660,224,176	1,097,996 m	Good
	Service	Fire Hydrant	\$83,369,243	8,894 Assets	Good
		Meter	\$22,343,109	85,240 Assets	Good

Table A - 2 (Continues): Inventory and Valuation of Potable Water Assets

Subservice	Asset Category	Asset Class	Replacement Cost	Inventory	Average Performance
Water Management	Device	Auto Flushing Station	\$122,364	5 Assets	Good
		Bulk Water Sales Station	\$135,138	2 Assets	Good
		Sampling Station	\$877,744	106 Assets	Good

A.1.2 Age and Estimated Service Life

Figure A - 5 illustrates the age of potable drinking water assets as a proportion of their estimated service life. Figure A - 6 illustrates the value of potable water assets acquired by decade. Generally, all asset types except for sampling stations are on average between a third and halfway through their estimate service life. Sampling stations are approaching the end of their ESL on average. No asset classes have an average age that exceeds the average ESL.

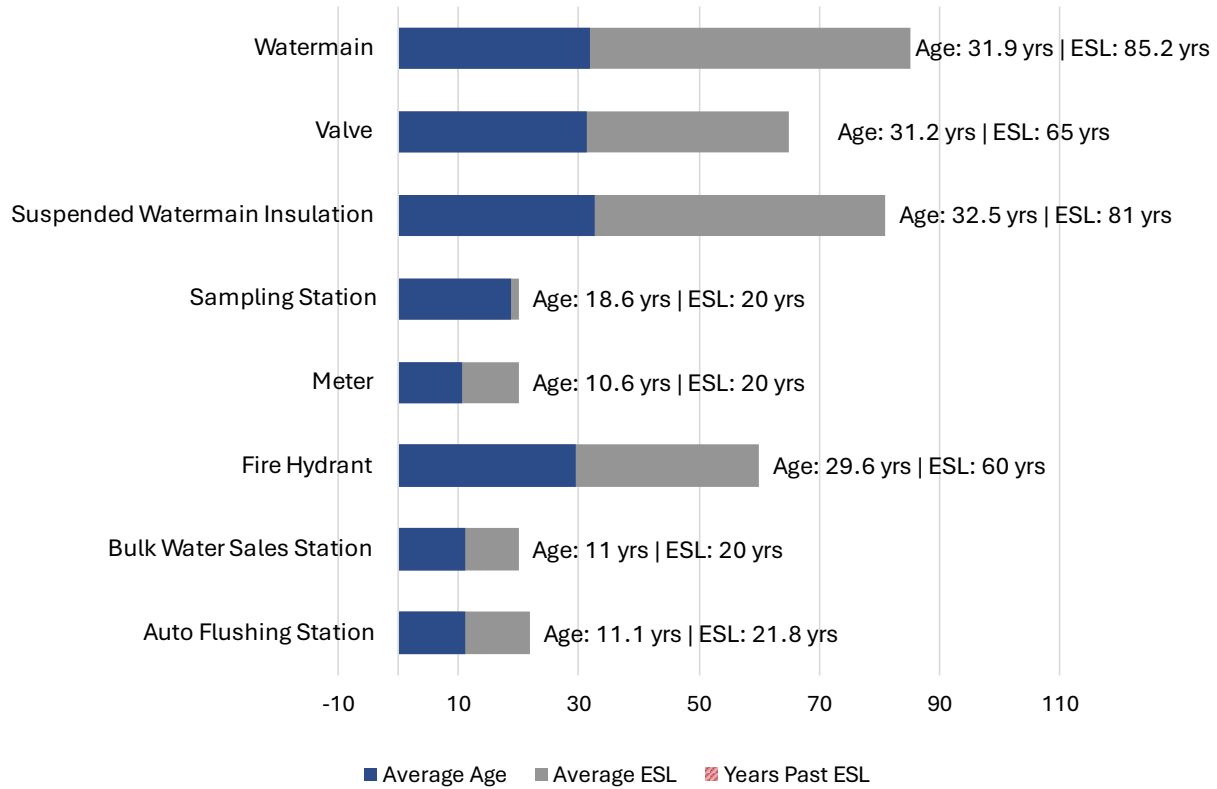


Figure A - 5: Age as a Proportion of Estimated Service Life (ESL) of Potable Water Assets

The installation profile of potable water assets illustrates that the majority of watermains were installed from the 1980s to 2000s, which is in line with decades that experienced significant growth and corresponding development in the City.

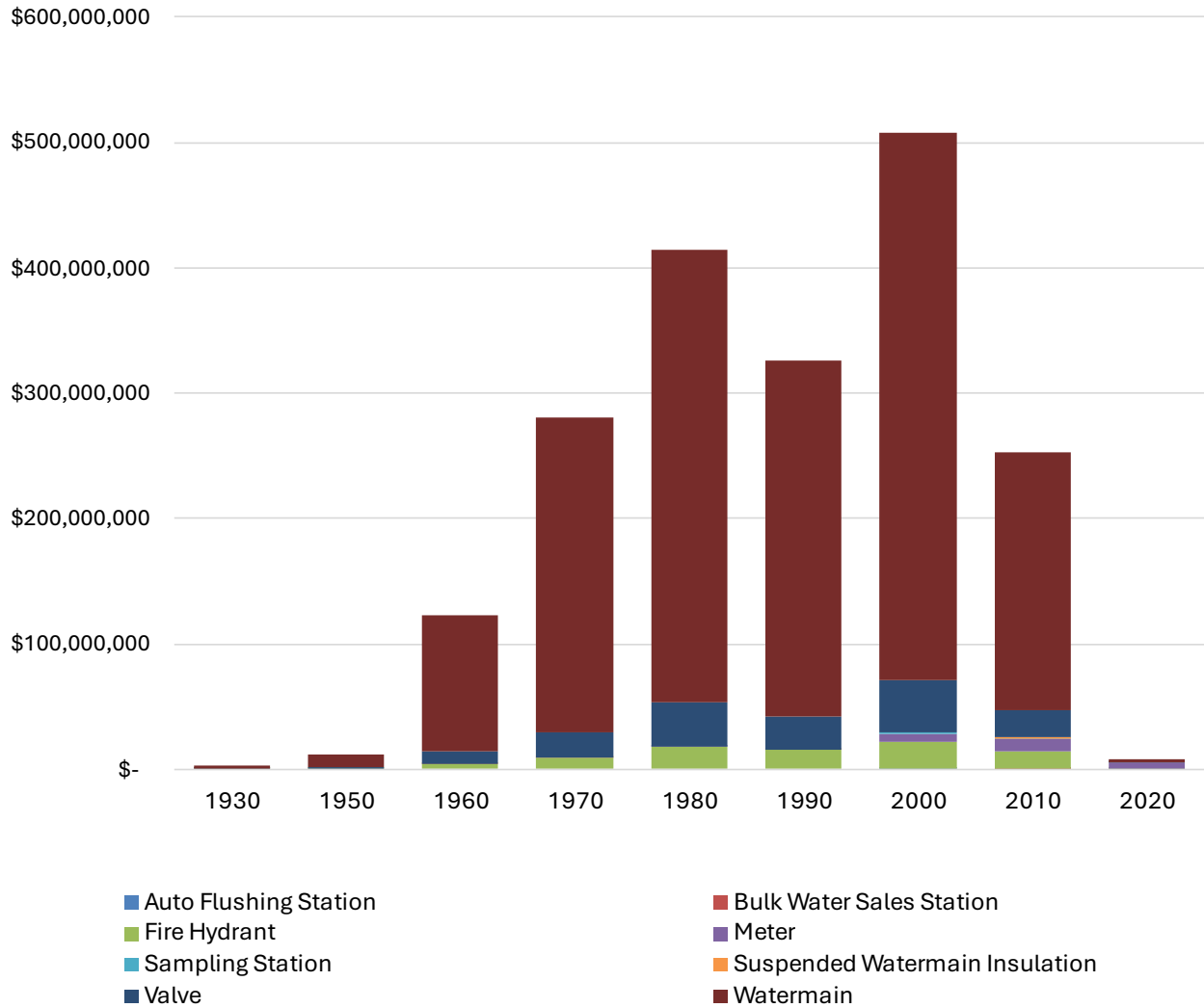


Figure A - 6: Age Distribution by Installation Decade of Potable Water Assets

A.1.3 Asset Performance

Table A - 2 details the approaches that the City utilizes to assess asset performance for of each asset class in potable water services.

Table A - 3: Performance assessment approaches to Potable Water Assets

Asset Class	Performance Reporting Metric	Description
Suspended Watermain Insulation	Age/ESL	The City understands the performance of these assets based on asset age and estimated service life.
Watermain	Remaining Life/ESL (Derived from a combination of asset age and watermain break data)	The City records watermain breaks as maintenance records against each watermain asset in their digital inventory. The City uses a combination of breaks and watermain age as a metric to understand performance (with a 60% to 40% ratio of age to breaks). This ratio is translated to a remaining life, which is used in the asset management plan for forecasting purposes.
Meter	Remaining Life/ESL	The City understand the performance of these assets based on asset age and estimated service life.
Fire Hydrant		
Valve		
Sampling Station		
Auto Flushing Station		
Bulk Water Sales Station		

Figure A - 7 and Figure A - 8 illustrate the performance distribution of all drinking water distribution assets. Table A - 3 summarizes the relationship between the performance categories and how performance ratings are determined.

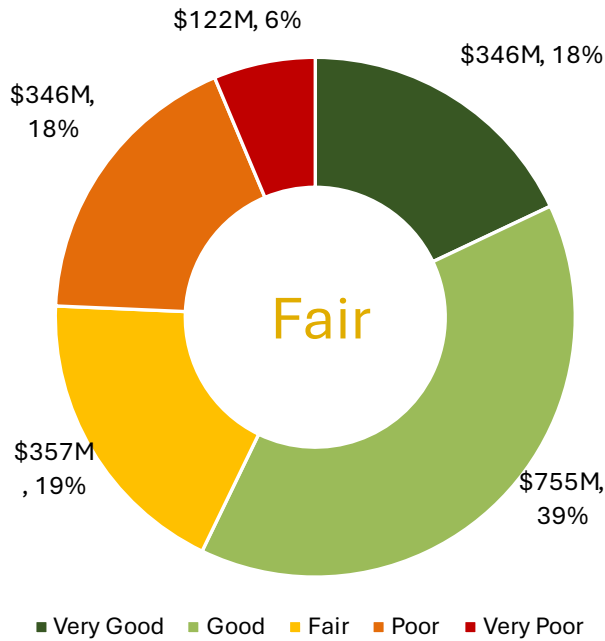


Figure A - 7: Performance Distribution of Potable Water Assets

Table A - 4: Performance Rating of Potable Water Assets

Performance Category	Remaining Life/ESL	Age/ESL
Very Good	100% - 80%	0% - 20%
Good	80% - 60%	20% - 40%
Fair	60% - 40%	40% - 60%
Poor	40% - 20%	60% - 80%
Very Poor	< 20%	> 80%

*Note: for watermains, remaining life is derived from a combination of breaks and age

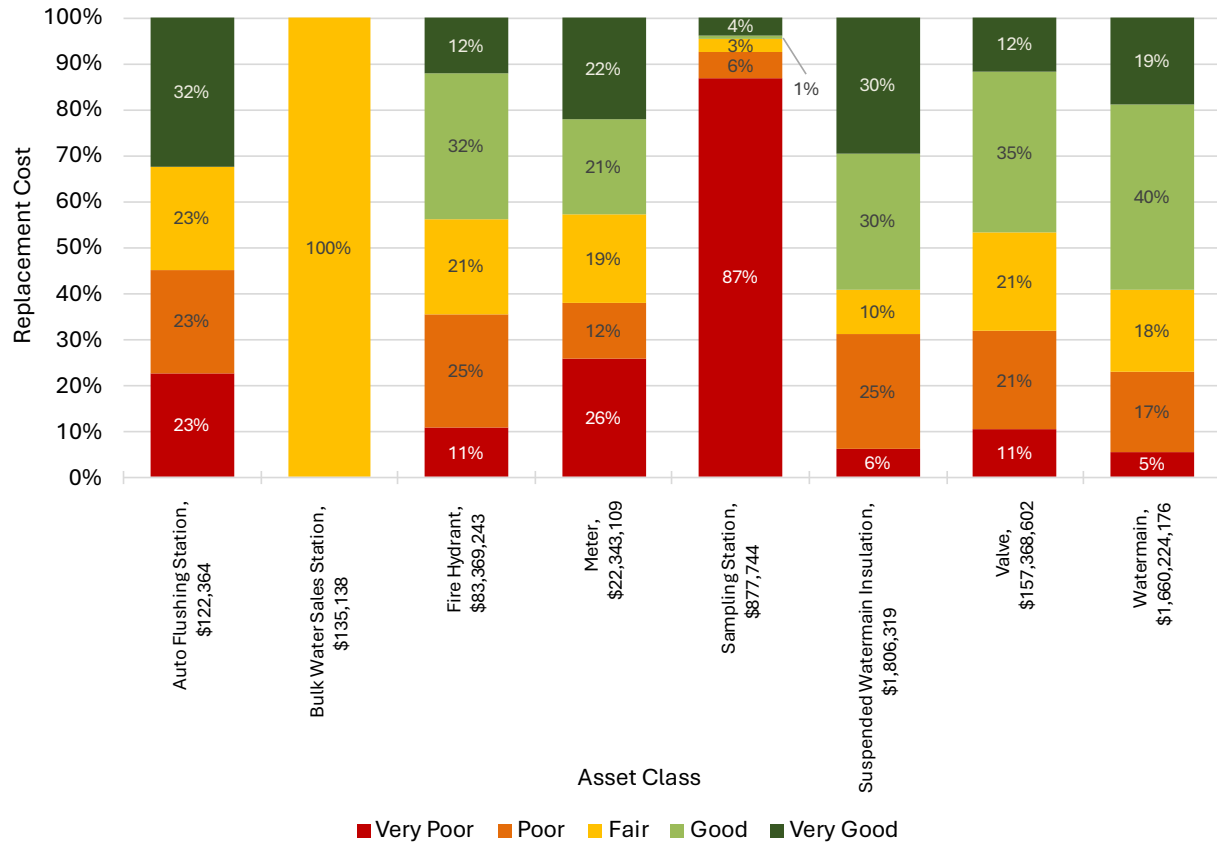


Figure A - 8: Performance Distribution of Potable Water Assets by Asset Class

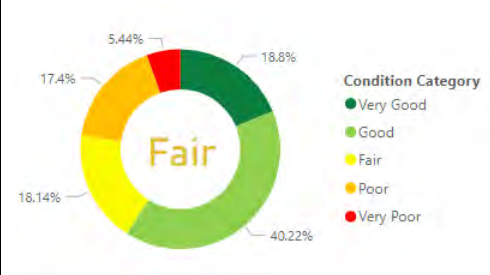
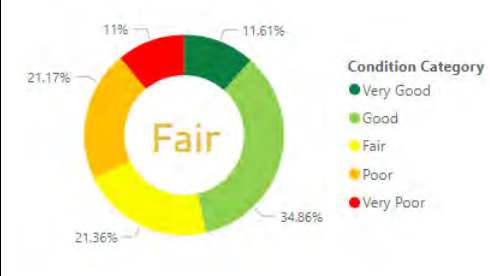
A.2 Levels of Service

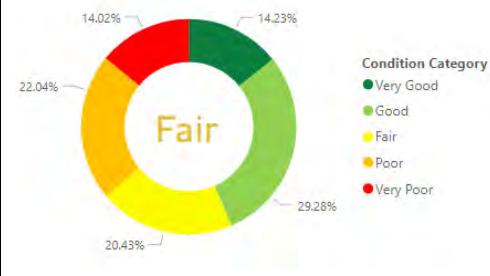
Customer values, customer levels of service, and technical levels of service for Potable Water can be found in Table A - 4, Table A - 5, and Table A - 6, respectively. Furthermore, mandated O.Reg. 588/17 LOS for Potable Water can be found in Table A - 7.

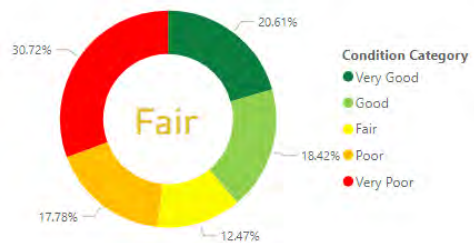
Table A - 5: Potable Water Customer Values

Customer Values		
Customer Values	Customer Satisfaction Measure	Current Feedback & Expected Trend Based on Planned Budget
Potable water distribution and management services assets are safe and reliable to use	Assets are structurally adequate for use and in overall good working condition.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.
	Assets can support customer water demand, including peak demand hours.	
	Water distribution system has adequate pressure and flow.	
	Potable water has acceptable taste, odour and colour.	
	Quality controls and devices have been installed to increase water quality consumption safety and reduce overall number of watermain breaks and property related damages.	
Potable water distribution and management services assets are convenient to use	The quality of assets does not negatively affect water usage.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.
	Potable water distribution and management services assets are accessible and easy to access.	
Environmentally sustainable	Environmental impacts are minimized.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.

Table A - 6: Potable Water Customer LOS

Customer Level of Service Measures			
Type of Measure	Level of Service	Performance Measure	Current Performance
Mainline			
Condition	Condition of Watermains	Weighted Index (60% age & 40% watermain breaks) – expressed as a remaining life and aggregated into 5-point rating scales	
		Confidence Levels: High – watermain break data is used in conjunction with age/estimated service life to evaluate watermain condition	
	Condition of Valves	Condition or Age/Remaining Useful Life - Aggregated into 5-point rating scale	
	Condition of Valve Chamber	Confidence Levels: Moderate – age and ESL are used to evaluate asset condition in place of condition data. Condition data is not typically collected for this asset type.	
	Individual element/element group condition.	Percentage of all elements/ element groups in very poor to poor condition	24%
		Confidence Levels: Moderate to High – age and ESL are used to evaluate asset condition where condition data is not available	
Function	Measure of whether the service is appropriate for its intended use	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	

Customer Level of Service Measures			
Type of Measure	Level of Service	Performance Measure	Current Performance
Capacity	Measure of whether the service is adequate to meet water demand needs	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Accessibility	Service interruptions	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Service			
Condition	Condition of Fire Hydrants	Condition or Age/Remaining Useful Life - Aggregated into 5-point rating scale	
	Condition of Meters		
	Individual element/element group condition.	Percentage of all elements/element groups in very poor to poor condition	36%
Function	Measure of whether the service is appropriate for its intended use	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	

Customer Level of Service Measures			
Type of Measure	Level of Service	Performance Measure	Current Performance
Capacity	Measure of whether the service is adequate to meet water demand needs	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Accessibility	Service interruptions	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Device			
Condition	Condition of Suspended Watermain Insulation	Condition or Age/Remaining Useful Life - Aggregated into 5-point rating scale	
	Condition of Sampling Station		
	Condition of Auto Flushing Station		
	Condition of Bulk Water Sales Station		
	Individual element/element group condition.	Percentage of all elements/element groups in very poor to poor condition	49%
Function	Measure of whether the service is	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	

Customer Level of Service Measures			
Type of Measure	Level of Service	Performance Measure	Current Performance
	appropriate for its intended use		
Capacity	Measure of whether the service is adequate to meet water demand needs		The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.
Accessibility	Service interruptions		The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.

Table A - 7: Potable Water Technical LOS

Technical Level of Service Measures				
Lifecycle Activity	Purpose of Activity	Activity Measure	Current Performance (\$, 2023 Budget)	Recommended Performance
Water Distribution (Suspended Watermain Insulation, Valves, Watermains, Fire Hydrants, and Meters)				
Acquisition	Growth Expansion Development	Projects developed in Future Urban Area Conceptual Master Plan - Transportation, Water and Wastewater Master Plan Class Environmental Assessment Study	\$222,600	Recommended performance will be considered and included for the City's 2025 Asset Management Plan and Financial Strategy
		Operation	Inspections	
	Regular Operations	As required		
Maintenance	Minor repairs	As required	The City is in the process of documenting maintenance costs by service	
	Regular Maintenance	Annual programs		
	Major maintenance (holding strategies)	As required		
Renewal	Major rehabilitation or replacement	As required	\$2,127,600	
Disposal	Disposal of replaced assets	As required	Included with renewal costs	

Table A - 8 (Continued): Potable Water Technical LOS

Technical Level of Service Measures				
Lifecycle Activity	Purpose of Activity	Activity Measure	Current Performance (\$, 2023 Budget)	Recommended Performance
Service Improvement	Upgrades to improve LOS to benefit existing serviced areas	As required	\$10,806,500	Recommended performance will be considered and included for the City's 2025 Asset Management Plan and Financial Strategy
Water Management (Stations: Auto Flushing, Bulk Water Sales, Sampling)				
Acquisition	Growth Expansion Development	Projects developed in Future Urban Area Conceptual Master Plan - Transportation, Water and Wastewater Master Plan Class Environmental Assessment Study	\$0	Recommended performance will be considered and included for the City's 2025 Asset Management Plan and Financial Strategy
Operation	Inspections	Annual programs	\$0	
	Regular Operations	As required	\$0	
Maintenance	Minor repairs	As required	\$0	
	Regular Maintenance	Annual programs	\$0	
	Major maintenance (holding strategies)	As required	\$0	

Table A - 9 (Continued): Potable Water Technical LOS

Technical Level of Service Measures				
Lifecycle Activity	Purpose of Activity	Activity Measure	Current Performance (\$, 2023 Budget)	Recommended Performance
Renewal	Major rehabilitation or replacement	As required	\$1,140,500	Recommended performance will be considered and included for the City's 2025 Asset Management Plan and Financial Strategy
Disposal	Disposal of replaced assets	As required	Included with renewal costs	
Service Improvement	Upgrades to improve LOS to benefit existing serviced areas	As required	\$88,200	
<i>Other (not asset specific expenditures)</i>				
Acquisition	Growth Expansion Development	Projects developed in Future Urban Area Conceptual Master Plan - Transportation, Water and Wastewater Master Plan Class Environmental Assessment Study	\$79,400	Recommended performance will be considered and included for the City's 2025 Asset Management Plan and Financial Strategy

Table A - 10: Potable Water O.Reg. LOS

Customer Levels of Service		
Service attribute	Community levels of service (qualitative descriptions)	Metric
Scope	1. Description, which may include maps, of the user groups or areas of the municipality that are connected to the municipal water system.	Refer to Figure A - 9 – Map showing properties connected to Municipal Water System and Fire Flow Availability
	2. Description, which may include maps, of the user groups or areas of the municipality that have fire flow.	Refer to Figure A - 9 – Map showing properties connected to Municipal Water System and Fire Flow Availability
Reliability	Description of boil water advisories and service interruptions.	No boil water advisories during 2023 calendar year. Service interruptions typically occur due to watermain breaks.
Technical Levels of Service		
Service attribute	Technical levels of service (technical metrics)	Metric Value
Scope	1. Percentage of properties connected to the municipal water system.	99%
	2. Percentage of properties where fire flow is available.	99%
Reliability	1. The number of connection-days per year where a boil water advisory notice is in place compared to the total number of properties connected to the municipal water system.	
	2. The number of connection-days per year due to water main breaks compared to the total number of properties connected to the municipal water system.	

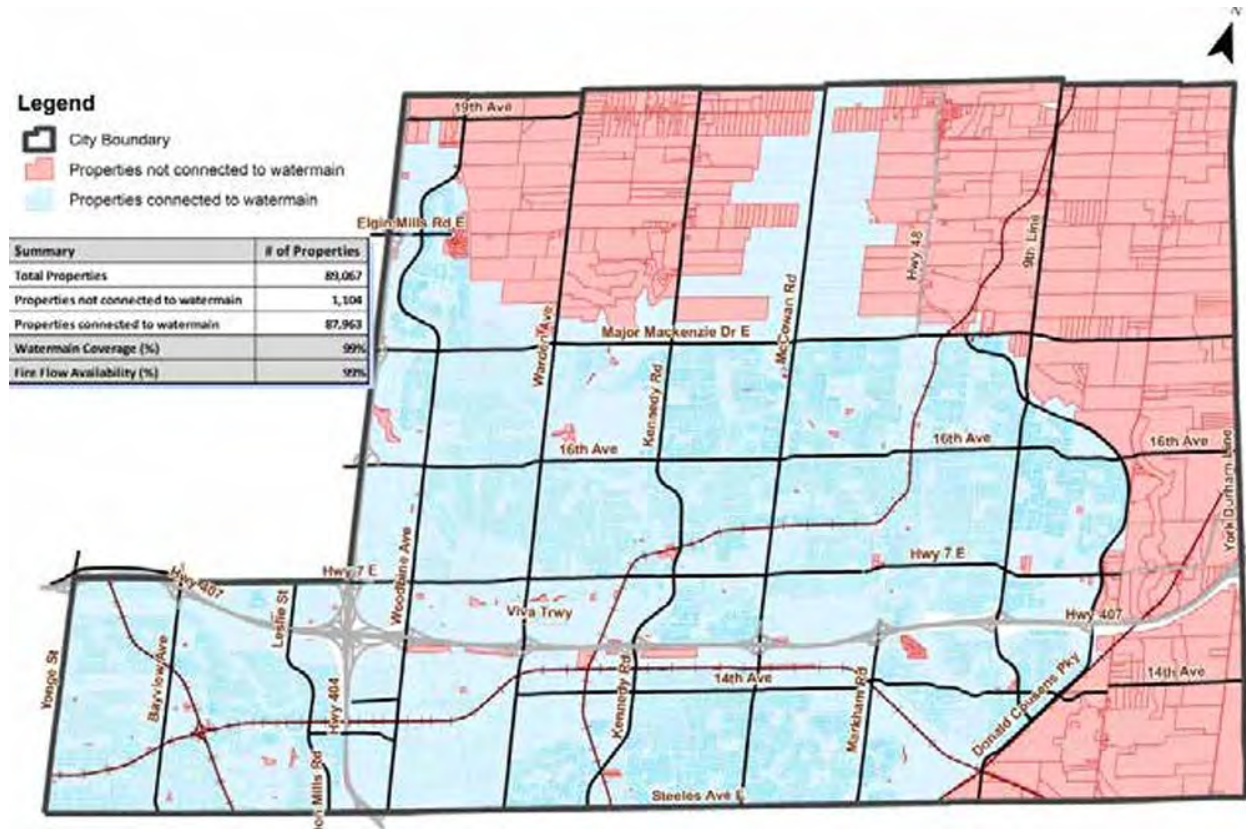


Figure A - 9: Properties connected to Municipal Water System and Fire Flow Availability

A.3 Risk Management Strategy

The criteria used to determine the consequence of failure for Potable Water Assets can be found in Table A - 8 below.

Table A - 11: COF Criteria used for Potable Water Assets

Direct Financial	Socio-Economic	Environmental
<ul style="list-style-type: none"> Replacement cost Revenue loss 	<ul style="list-style-type: none"> Land use Diameter Asset type 	<ul style="list-style-type: none"> Proximity to ESA, Public recreational areas, watercourse or habitat

Table A - 9 displays the risk score for Potable Water assets along with the proportion of assets within each risk score, likelihood of failure and consequence of failure.

Table A - 12: Risk Score Distribution of Potable Water Assets

		Consequence of Failure				
		1	2	3	4	5
Likelihood of Failure	1	\$4,905,052 (0.3%)	\$291,018,654 (15.1%)	\$47,349,015 (2.5%)	\$3,017,476 (0.2%)	\$0 (0.0%)
	2	\$4,653,154 (0.2%)	\$627,640,697 (32.6%)	\$115,361,259 (6.0%)	\$7,251,015 (0.4%)	\$0 (0.0%)
	3	\$4,449,633 (0.2%)	\$290,467,180 (15.1%)	\$60,923,307 (3.2%)	\$961,304 (0.0%)	\$0 (0.0%)
	4	\$2,694,331 (0.1%)	\$271,208,954 (14.1%)	\$68,041,110 (3.5%)	\$4,421,519 (0.2%)	\$0 (0.0%)
	5	\$5,776,076 (0.3%)	\$99,064,118 (5.1%)	\$16,824,296 (0.9%)	\$218,542 (0.0%)	\$0 (0.0%)

A.4 Lifecycle Management Strategies and Forecasting

The following section outlines the funding required for the entire lifecycle of potable water assets. The expenditures were determined using the lifecycle activities outlined in Table A - 6 and the LOS established.

Required funding was determined using the following forecasting analysis scenario:

- **Maintain Current Levels of Service** – this scenario provides the funding required to maintain a similar asset performance over a 27-year period. It focuses on maintaining the percentage of assets in backlog in a similar state. Backlog is defined as assets that are in need of renewal work (either significant rehabilitation or replacement). For example, if 20% of assets are past their service life, or are in need of renewal work, then the forecast model will determine the funding to maintain 20% of assets in this state over the forecast period.

The forecast analysis identified a total of \$433.7M (annual average of \$16.1M) that is anticipated to be spent over the next 27 years. In 2023, approximately 1.6% of the asset portfolio (by replacement value) is in backlog. The average annual spending identified attempts to maintain this percentage over the next 27 years. The performance and financial forecasts for this state are illustrated in Figure A - 10 and Figure A - 11. Note that there is a significant expenditure forecasted in 2048, which represents a significant amount of asset needs that are forecasted to occur in that year.

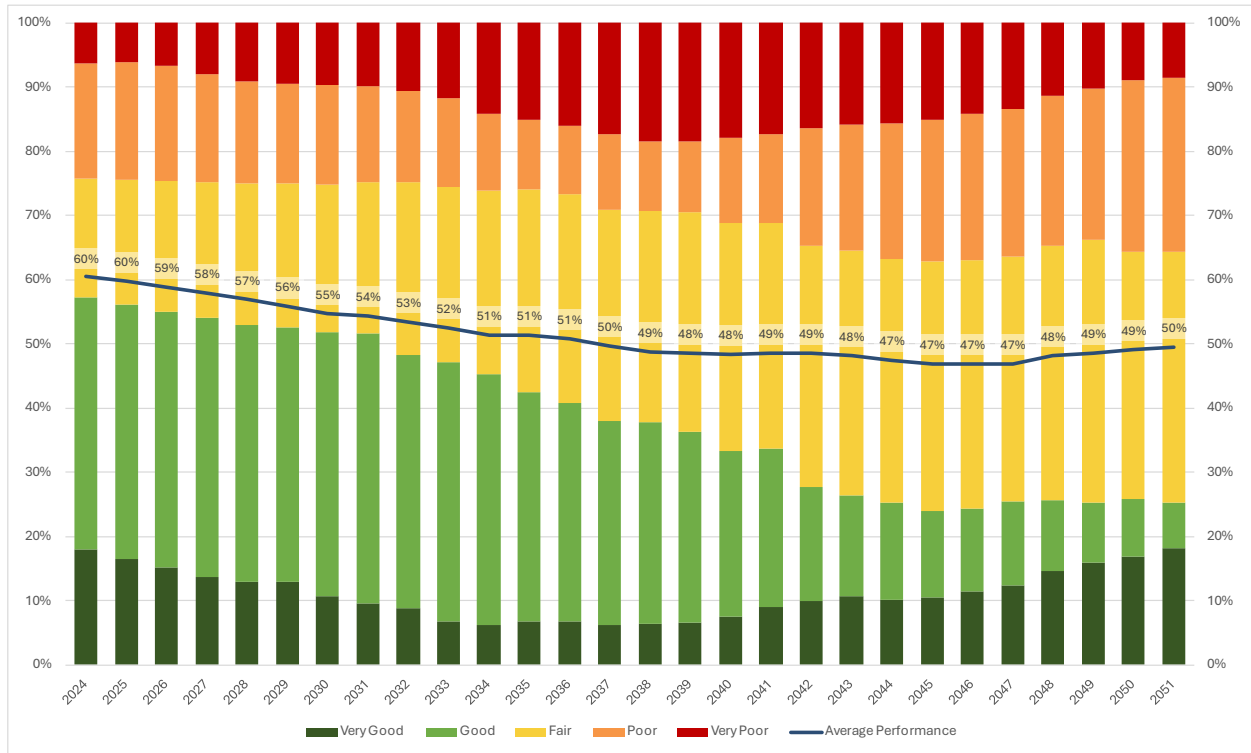


Figure A - 10: Scenario 2 – Maintain Current LOS Performance Distribution for Potable Water Assets

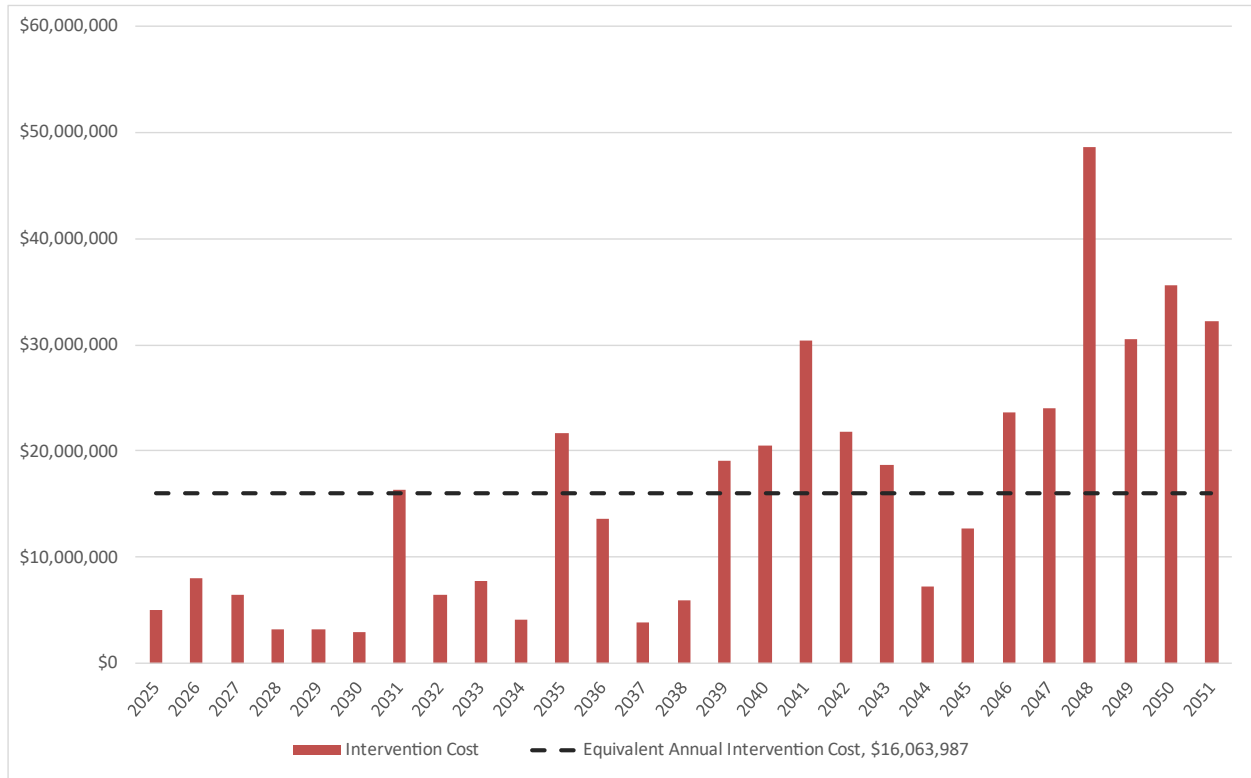


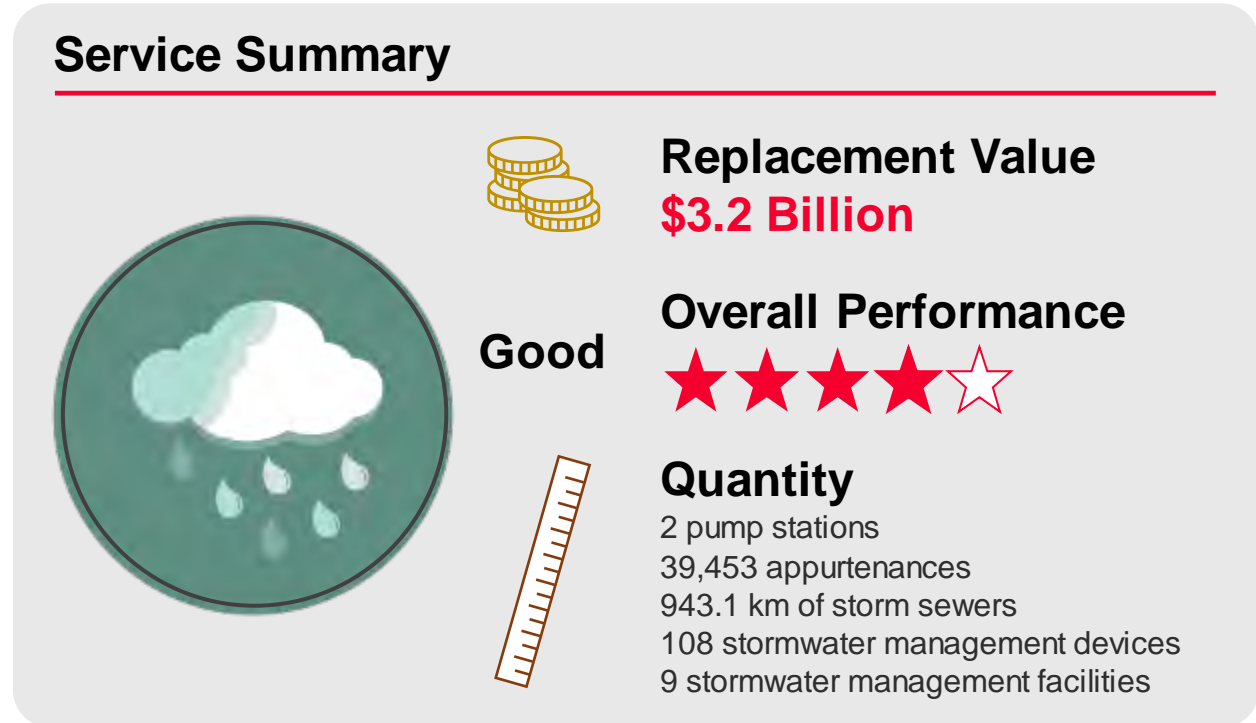
Figure A - 111: Scenario 2 – Maintain Current LOS Intervention Costs for Potable Water Assets



**Sustainability and
Asset Management**

**2024 Asset Management
Plan Appendix B
Stormwater Management
City of Markham**

Appendix B Stormwater Management



The City’s stormwater management services contain assets that support the collection, diversion and treatment of stormwater.

The City is responsible for stormwater collection assets including pump stations and storm sewers as well as stormwater management assets including rain gauges, hickenbottoms, orifice controls, and Stormwater Management (SWM) Facilities, as detailed in Figure B - 1.

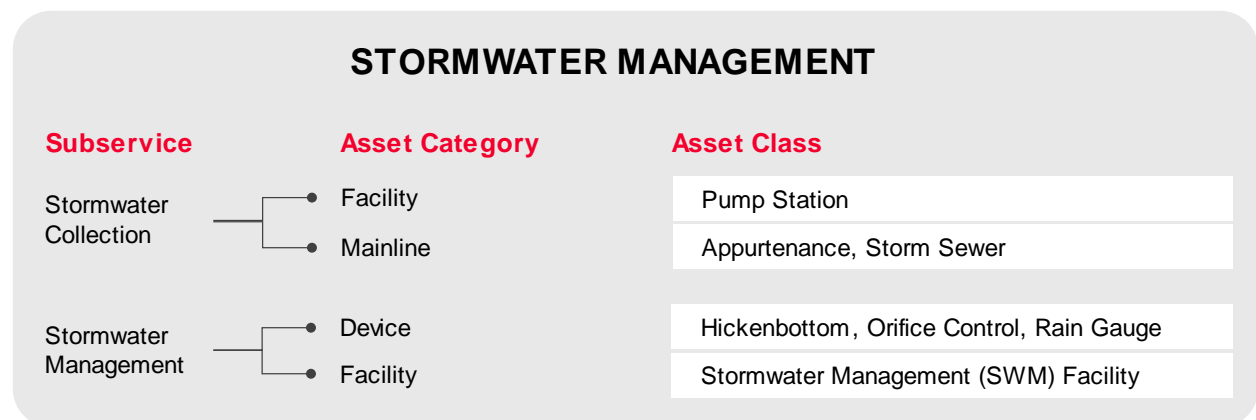


Figure B - 1: Stormwater Management Asset Hierarchy

More information on stormwater management such as state of infrastructure, levels of service, risk management strategies and lifecycle management strategies and forecasting can be found in the following sections.

B.1 State of the Infrastructure

Figure B - 2 shows the replacement value of stormwater assets, while Figure B - 3 and Figure B - 4 illustrate replacement value of stormwater collection assets and stormwater management assets respectively.

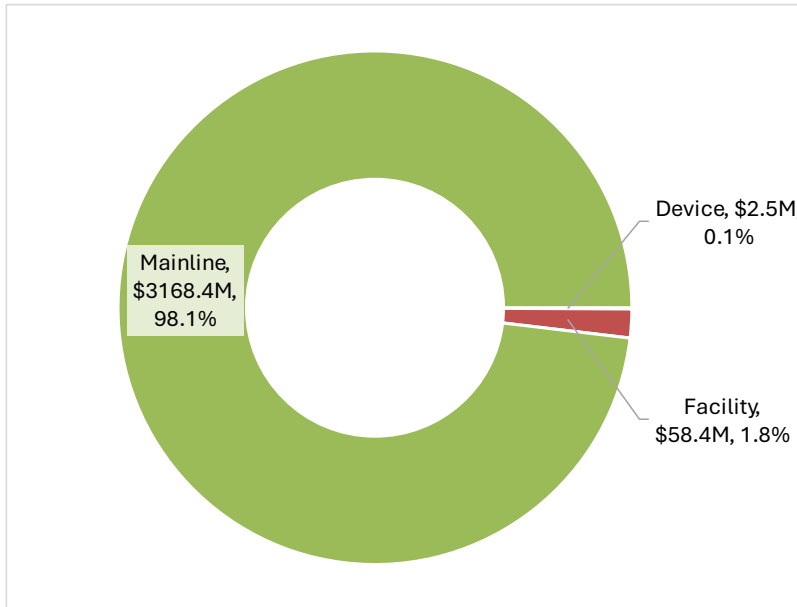


Figure B - 2: Replacement Value Distribution of Stormwater Assets

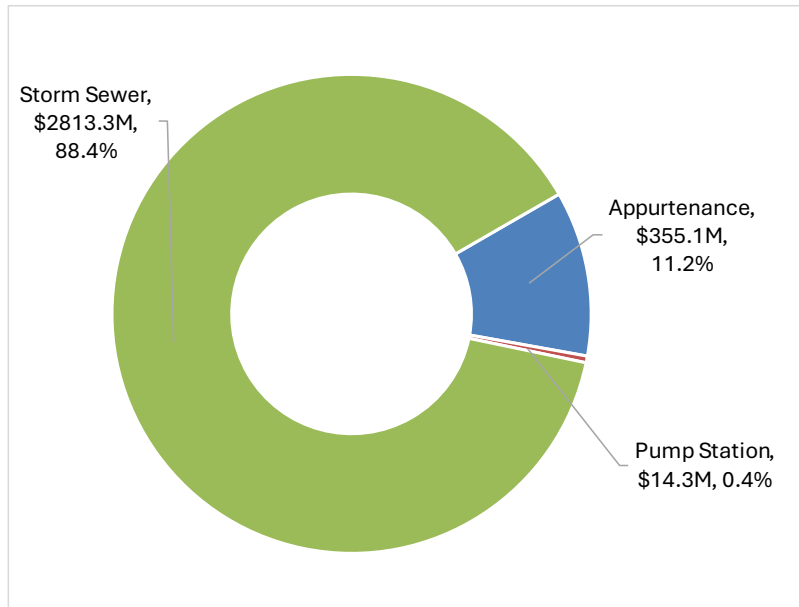


Figure B - 3: Replacement Value of Stormwater Collection Assets

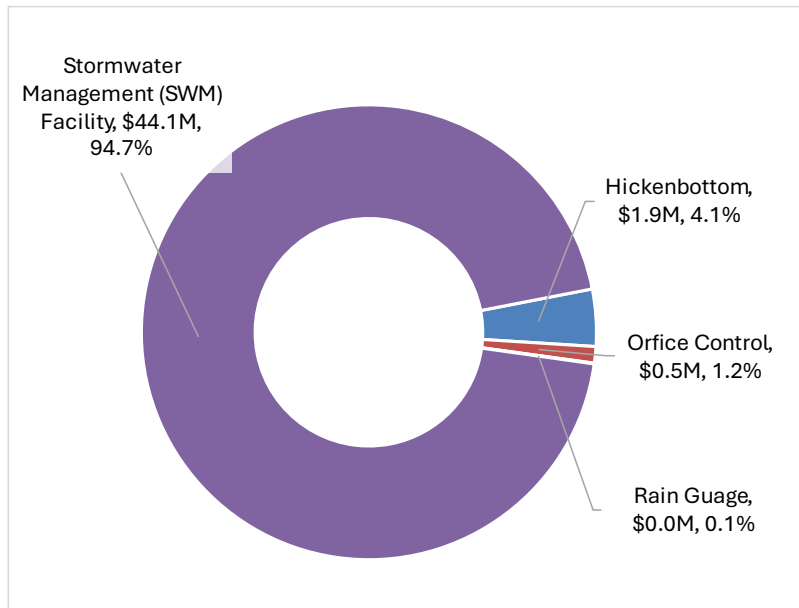


Figure B - 4: Replacement Value of Stormwater Management Assets

B.1.1 Asset Inventory and Valuation

Table B - 1 below summarizes the asset valuation, quantities, and performance for each asset category.

Table B - 1: Inventory and Valuation of Stormwater Assets

Subservice	Asset Category	Asset Class	Replacement Cost	Inventory	Average Performance
Stormwater Collection	Facility	Pump Station	\$14,302,263	2 Assets	Very Good
	Mainline	Appurtenance	\$355,096,665	39,453 Assets	Good
		Storm Sewer	\$2,813,312,472	943,114 m	Good
Stormwater Management	Device	Hickenbottom	\$1,891,229	41 Assets	Good
		Orifice Control	\$544,400	54 Assets	Good
		Rain Guage	\$24,239	13 Assets	Good
	Facility	Stormwater Management (SWM) Facility	\$44,131,570	9 Asset	Very Good

B.1.2 Age and Estimated Service Life

Figure B - 5 illustrates the age of stormwater management assets as a proportion of their estimated service life. Figure B - 6 illustrates the value of stormwater management assets acquired by decade. Generally, all assets except for rain gauges are on average less than half through their estimated service life, which indicates that they are relatively young. Rain gauges are about 60% through their estimated service life. No asset classes have an average age that exceeds the average ESL.

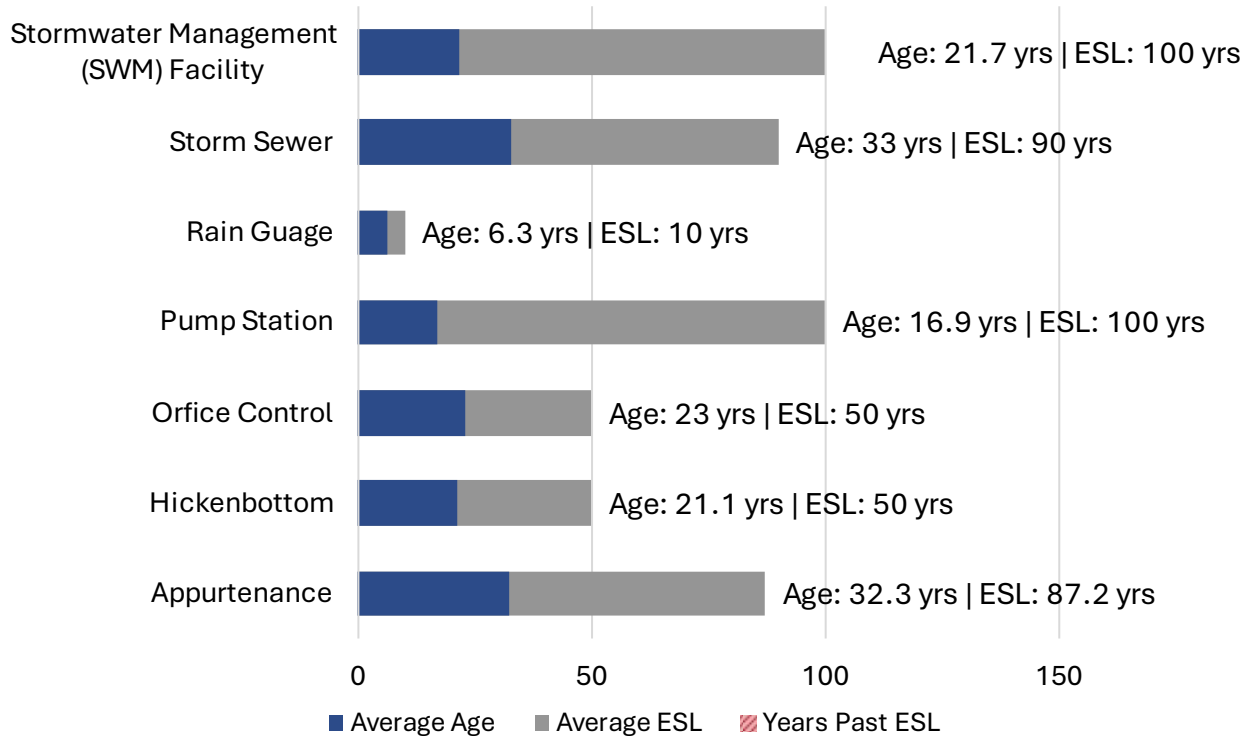


Figure B - 5: Age as a Proportion of Estimated Service Life (ESL) of Stormwater Assets

The installation of stormwater management assets illustrates that the majority of storm sewers were installed in the 1980s to 2000s, in line with decades that experienced significant growth and corresponding development in the City.

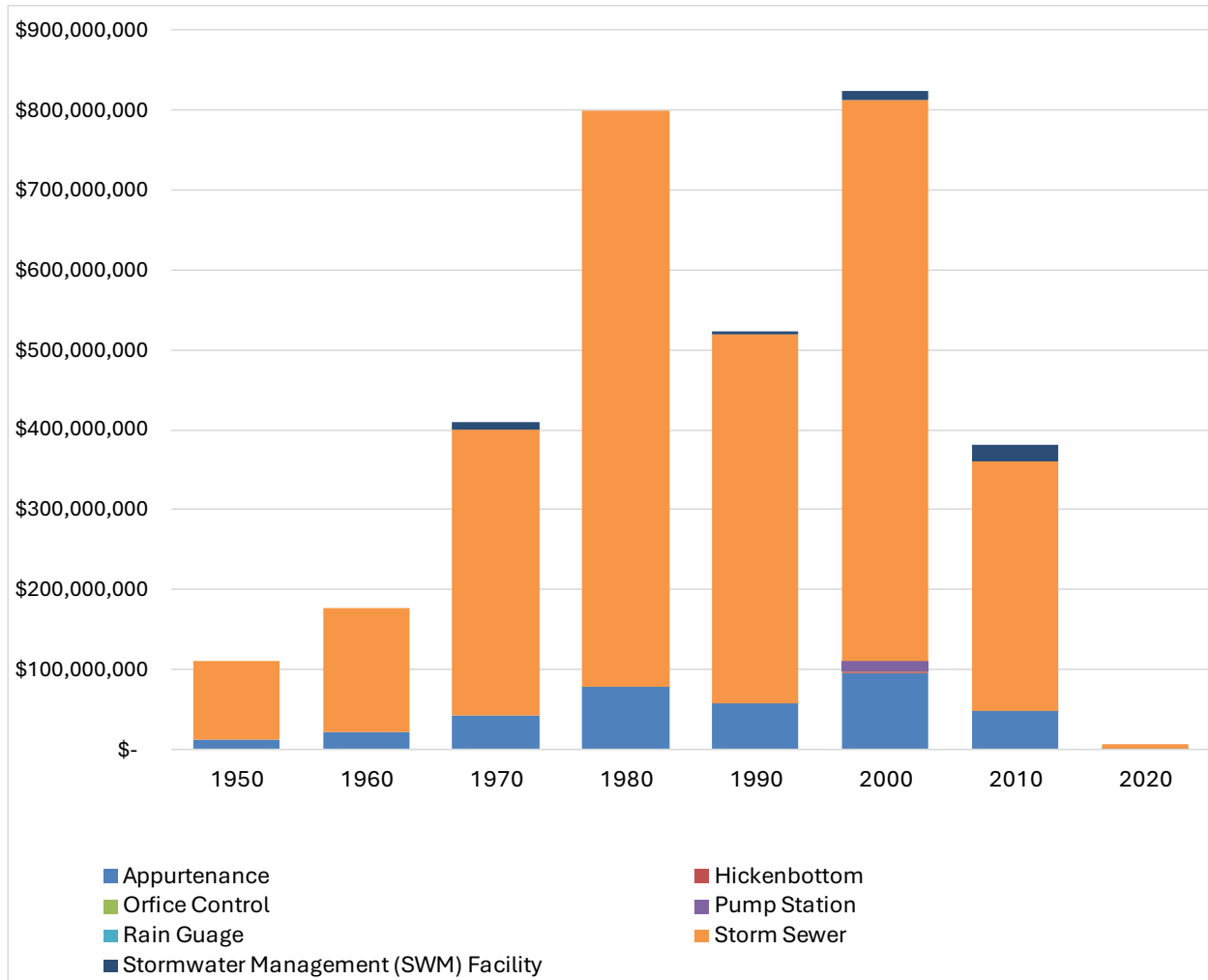


Figure B - 6: Age Distribution by Installation Decade of Stormwater Assets

B.1.3 Asset Performance

Table B - 2 details the approaches that the City utilizes to assess the performance of each asset class in stormwater management services.

Table B - 2: Performance assessment approaches to Stormwater Assets

Asset Class	Performance Metric	Approach to Assessing Performance
Orifice Control	Remaining Life/ESL	The City understands the performance of these assets based on asset age and estimated service life
Storm Sewer	CCTV Inspection, Remaining Life/ESL	Inspections are performed based on CCTV inspections under NASSCO-PACP standards on a 10-year cycle, remaining life and estimated service life
Pump Station	Facility Condition Index (FCI), Remaining Life/ESL	The City performs inspections of the condition of the pump stations and uses the results from the inspections to understand performance.
Stormwater Management Facility (SWMF)		The City performs inspections of the condition of the SWMF and uses the results from the inspections to understand performance.
Appurtenance	Remaining Life/ESL	The City understands the performance of these assets based on asset age and estimated service life
Hickenbottom		
Rain Gauge		

Figure B - 7 and Figure B - 8 illustrate the performance distribution of stormwater management assets. Table B - 3 summarizes the relationship between the performance categories and how performance ratings are determined.

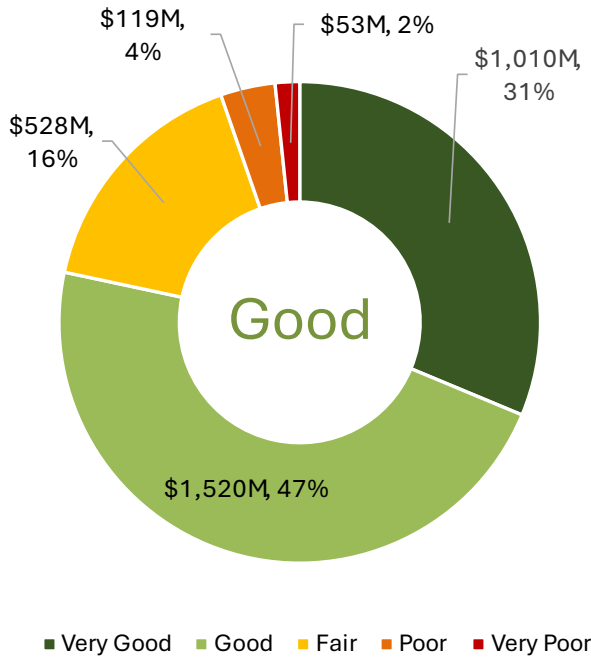


Figure B - 7: Performance Distribution of Stormwater Management Assets

Table B - 3: Performance Ratings of Stormwater Management Assets

Performance Category	Remaining Life/ESL	Facility Condition Index (FCI)
Very Good	100% - 80%	0% - 20%
Good	80% - 60%	20% - 40%
Fair	60% - 40%	40% - 60%
Poor	40% - 20%	60% - 80%
Very Poor	20% - 0%	80% - 100%



Figure B - 8: Performance Distribution of Stormwater Assets by Asset Class

B.2 Levels of Service

Customer values, customer levels of service and technical levels of service for Stormwater Management can be found in Table B - 4, Table B - 5, and Table B - 6, respectively. Furthermore, mandated O.Reg. LOS for Stormwater Management can be found in Table B - 7.

Table B - 4: Stormwater Management Customer Values

Customer Values

Customer Values	Customer Satisfaction Measure	Current Feedback & Expected Trend Based on Planned Budget
Stormwater management assets are safe and reliable to use	Assets are structurally adequate for use and in overall good working condition.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.
	Assets are resilient to 5-year and 100-year storms.	
	Transportation impacts from flooding are minimized.	
	Quality controls and devices have been installed to reduce overall number of incidents (e.g. property impacts from flooding).	
Stormwater management assets offer convenience to the customer	The quality of assets does not negatively affect the customer.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.
	Stormwater management assets are accessible.	
Environmentally sustainable	Environmental impacts from flooding are minimized.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.

Table B - 5: Stormwater Management Customer LOS

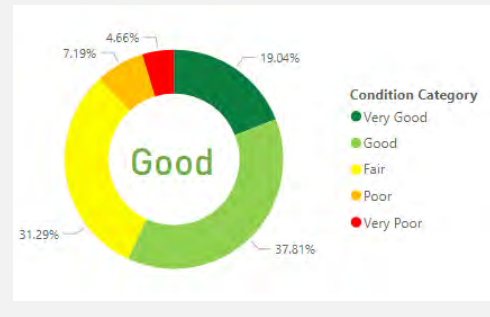
Customer Level of Service Measures				
Type of Measure	Level of Service	Performance Measure	Current Performance	
Mainline				
Condition	Condition of Storm Sewers	CCTV Condition Index	1.92	
		Confidence Levels: High – CCTV data is used to determine storm sewer condition		
	Condition of Appurtenance	Condition or Age/Remaining Useful Life - Aggregated into 5-point rating scale		
			Confidence Levels: Low – age and ESL are used to evaluate asset condition in place of condition data	
		Individual element/element group condition.	Percentage of all elements/element groups in poor condition	2%
	Confidence Levels: Low – age and ESL are used to evaluate asset condition where condition data is not available			
Function	Measure of whether the service is appropriate for its intended use	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.		
Capacity	Measure of whether the service is adequate to meet consumer stormwater needs	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.		

Table B - 6 (Continued): Stormwater Management Customer LOS


Customer Level of Service Measures			
Type of Measure	Level of Service	Performance Measure	Current Performance
Accessibility	Service interruptions	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Stormwater Collection Facilities (Pump Stations)			
Condition	Condition of Pump Stations	Condition or Age/Remaining Useful Life - Aggregated into 5-point rating scale	 <p>Condition Category ● Very Good</p>
		Confidence Levels: Low – age and ESL are used to evaluate asset condition in place of condition data	
	Individual element/element group condition.	Percentage of all elements/element groups in poor condition	0%
Function	Measure of whether the service is appropriate for its intended use	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Capacity	Measure of whether the service is adequate to meet consumer stormwater needs	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	

Table B - 7 (Continued): Stormwater Management Customer LOS

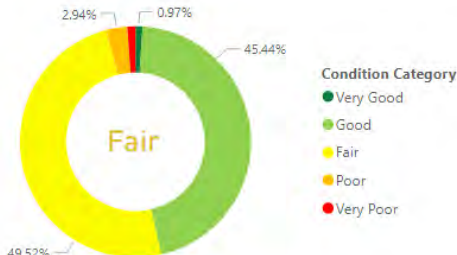
Customer Level of Service Measures			
Type of Measure	Type of Measure	Type of Measure	Type of Measure
Accessibility	Service interruptions	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Stormwater Management Devices			
Condition	Condition of Hickenbottoms	Condition or Age/Remaining Useful Life - Aggregated into 5-point rating scale	
	Condition of Orifice Control		
	Condition of Rain Gauge	Confidence Levels: Low – age and ESL are used to evaluate asset condition in place of condition data	
	Individual element/element group condition.	Percentage of all elements/element groups in very poor to poor condition	4%
Function	Measure of whether the service is appropriate for its intended use	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	

Table B - 8 (Continued): Stormwater Management Customer LOS

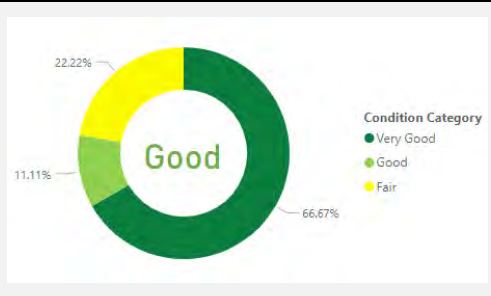
Customer Level of Service Measures			
Type of Measure	Type of Measure	Type of Measure	Type of Measure
Capacity	Measure of whether the service is adequate to meet consumer stormwater needs	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Accessibility	Service interruptions	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Stormwater Management Facilities			
Condition	Condition of SWMF	Condition or Age/Remaining Useful Life - Aggregated into 5-point rating scale	
		Confidence Levels: Low – age and ESL are used to evaluate asset condition in place of condition data	
	Individual element/element group condition.	Percentage of all elements/element groups in very poor to poor condition	0%

Table B - 9 (Continued): Stormwater Management Customer LOS

Customer Level of Service Measures			
Type of Measure	Type of Measure	Type of Measure	Type of Measure
Function	Measure of whether the service is appropriate for its intended use	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Capacity	Measure of whether the service is adequate to meet consumer stormwater needs	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Accessibility	Service interruptions	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	

Table B - 10: Stormwater Management Services Technical LOS

Technical Level of Service Measures				
Lifecycle Activity	Purpose of Activity	Activity Measure	Current Performance (\$, 2023 Budget)	Recommended Performance
Stormwater Collection (Pump Stations, Appurtenances, Storm Sewers)				
Acquisition	Growth Expansion Development	Projects developed in Future Urban Area Conceptual Master Plan - Transportation, Water and Wastewater Master Plan Class Environmental Assessment Study	\$2,773,400	Recommended performance will be considered and included for the City's 2025 Asset Management Plan and Financial Strategy
Operation	Inspections	Annual Programs	The City is in the process of documenting maintenance costs by service	
	Regular Operations	As required		
Maintenance	Minor repairs	As needed	The City is in the process of documenting maintenance costs by service	
	Regular Maintenance	Annual Programs		
	Major maintenance (holding strategies)	As needed		
Renewal	Major rehabilitation or replacement	As needed	The City is in the process of documenting maintenance costs by service	
Disposal	Disposal of replaced assets	As required	Included with renewal costs	
Service Improvement	Upgrades to improve LOS to benefit existing serviced areas	As required	\$10,806,500	

Table B - 11 (Continued): Stormwater Management Services Technical LOS

Technical Level of Service Measures				
Lifecycle Activity	Purpose of Activity	Activity Measure	Current Performance (\$, 2023 Budget)	Recommended Performance
Stormwater Management (Devices, SWM Facilities)				
Acquisition	Growth Expansion Development	Projects developed in Future Urban Area Conceptual Master Plan - Transportation, Water and Wastewater Master Plan Class Environmental Assessment Study	\$15,979,900	Recommended performance will be considered and included for the City's 2025 Asset Management Plan and Financial Strategy
Operation	Inspections	Annual Programs	\$366,400	
	Regular Operations	As required		
Maintenance	Minor repairs	As needed	\$56,200	
	Regular Maintenance	Annual Programs		
	Major maintenance (holding strategies)	As needed		
Renewal	Major rehabilitation or replacement	As needed	\$4,526,000	
Disposal	Disposal of replaced assets	As required	Included with renewal costs	
Service Improvement	Upgrades to improve LOS to benefit existing serviced areas	As required	\$1,830,700	

Table B - 12 (Continued): Stormwater Management Services Technical LOS

Technical Level of Service Measures				
Lifecycle Activity	Purpose of Activity	Activity Measure	Current Performance (\$, 2023 Budget)	Recommended Performance
<i>Other (not asset specific expenditures)</i>				
Acquisition	Growth Expansion Development	Projects developed in Future Urban Area Conceptual Master Plan - Transportation, Water and Wastewater Master Plan Class Environmental Assessment Study	\$23,721,300	Recommended performance will be considered and included for the City's 2025 Asset Management Plan and Financial Strategy

Table B - 13: Stormwater Management O.Reg. LOS

Customer Levels of Service		
Service attribute	Community levels of service (qualitative descriptions)	Metric
Scope	Description, which may include maps, of the user groups or areas of the municipality that are protected from flooding, including the extent of the protection provided by the municipal stormwater management system.	Refer to Figure B - 9 – Map of properties resilient to five-year and 100-year storms
Technical Levels of Service		
Service Attribute	Technical levels of service (technical metrics)	Metric
Scope	1. Percentage of properties in municipality resilient to a 100-year storm.	73%
	2. Percentage of the municipal stormwater management system resilient to a 5-year storm.	82%

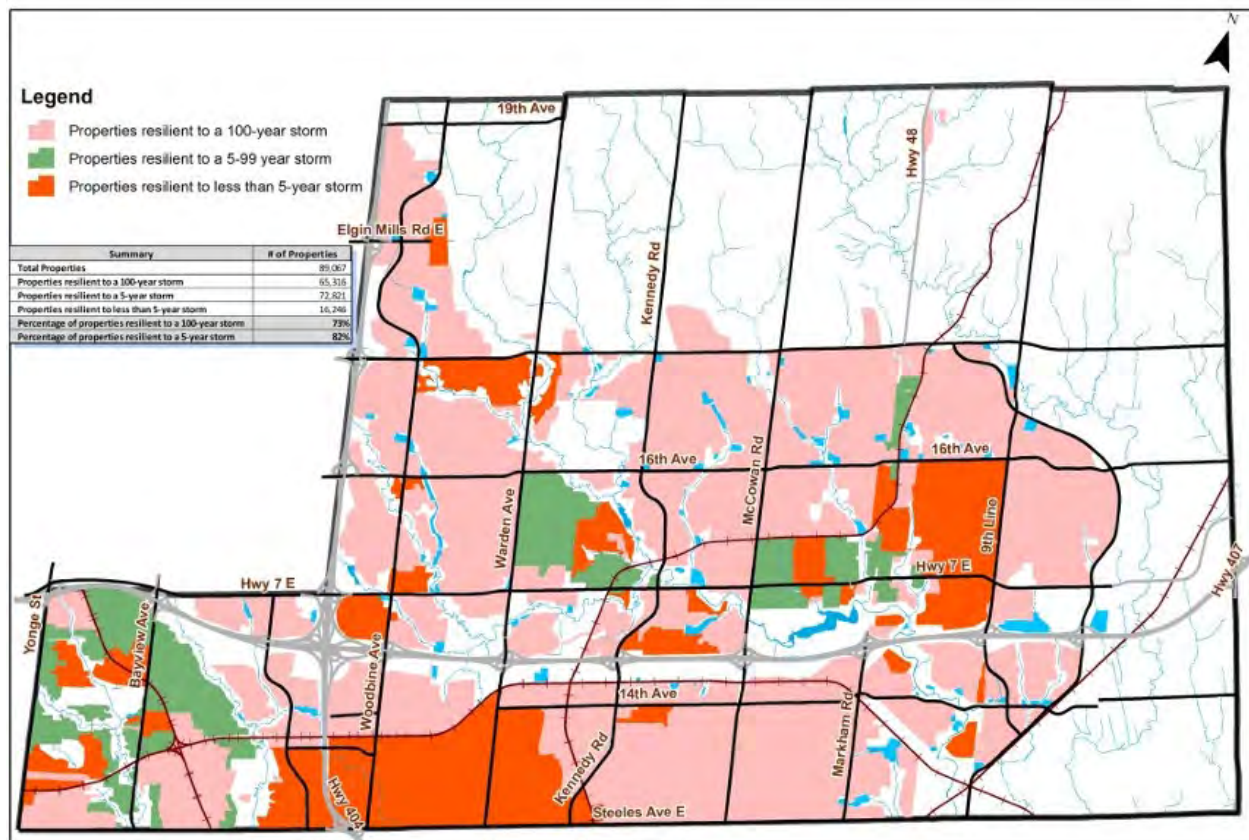


Figure B - 9: Properties Resilient to 5-year and 100-year storms

B.3 Risk Management Strategy

The criteria used to determine consequence of failure (COF) for Stormwater Assets can be found in Table B - 8:

Table B - 14: COF Criteria used for Stormwater Assets

Direct Financial	Socio-Economic	Environmental
<ul style="list-style-type: none"> • Replacement cost • Revenue loss 	<ul style="list-style-type: none"> • Land use • Diameter • Adjacent land use 	<ul style="list-style-type: none"> • Proximity to ESA, Public recreational areas, watercourse or habitat

Table B - 9 displays the risk score for Stormwater assets along with the proportion of assets within each risk score, likelihood of failure (LOF) and COF.

Table B - 15: Risk Score Distribution of Stormwater Assets

		Consequence of Failure				
		1	2	3	4	5
Likelihood of Failure	1	\$555,769 (0.0%)	\$406,408,831 (12.6%)	\$555,624,016 (17.2%)	\$47,560,510 (1.5%)	\$0 (0.0%)
	2	\$876,770 (0.0%)	\$725,260,206 (22.5%)	\$719,921,242 (22.3%)	\$73,835,242 (2.3%)	\$0 (0.0%)
	3	\$97,419 (0.0%)	\$229,609,853 (7.1%)	\$273,079,239 (8.5%)	\$24,870,519 (0.8%)	\$0 (0.0%)
	4	\$1,865 (0.0%)	\$40,585,974 (1.3%)	\$69,705,229 (2.2%)	\$8,309,679 (0.3%)	\$0 (0.0%)
	5	\$3,729 (0.0%)	\$29,433,520 (0.9%)	\$21,447,709 (0.7%)	\$2,115,516 (0.1%)	\$0 (0.0%)

B.4 Lifecycle Management Strategies and Forecasting

The following section outlines the funding required for the entire lifecycle of stormwater management assets. The expenditures were determined using the lifecycle activities outlined in Table B - 6 and the LOS established. Required funding was determined for the following scenarios using the following forecasting analysis:

- **Maintain Current Levels of Service** – this scenario provides the funding required to maintain a similar asset performance over a 27-year period. It focuses on maintaining the percentage of assets in backlog in a similar state. Backlog is defined as assets that are in need of renewal work (either significant rehabilitation or replacement). For example, if 20% of assets are past their service life, or are in need of renewal work, then the forecast model will

determine the funding to maintain 20% of assets in this state over the forecast period.

The forecast analysis identified a total of \$106.4M (annual average of \$3.9M) that is anticipated to be spent over the next 27 years. In 2023, approximately 0.6% of the asset portfolio (by replacement value) is in backlog. The average annual spending identified attempts to maintain this percentage over the next 27 years. The performance and financial forecasts for this state are illustrated in Figure B - 10 and Figure B - 11. Note that there is a significant expenditure forecasted in 2041 and 2044, which represents a significant amount of asset needs that are forecasted to occur in that year.

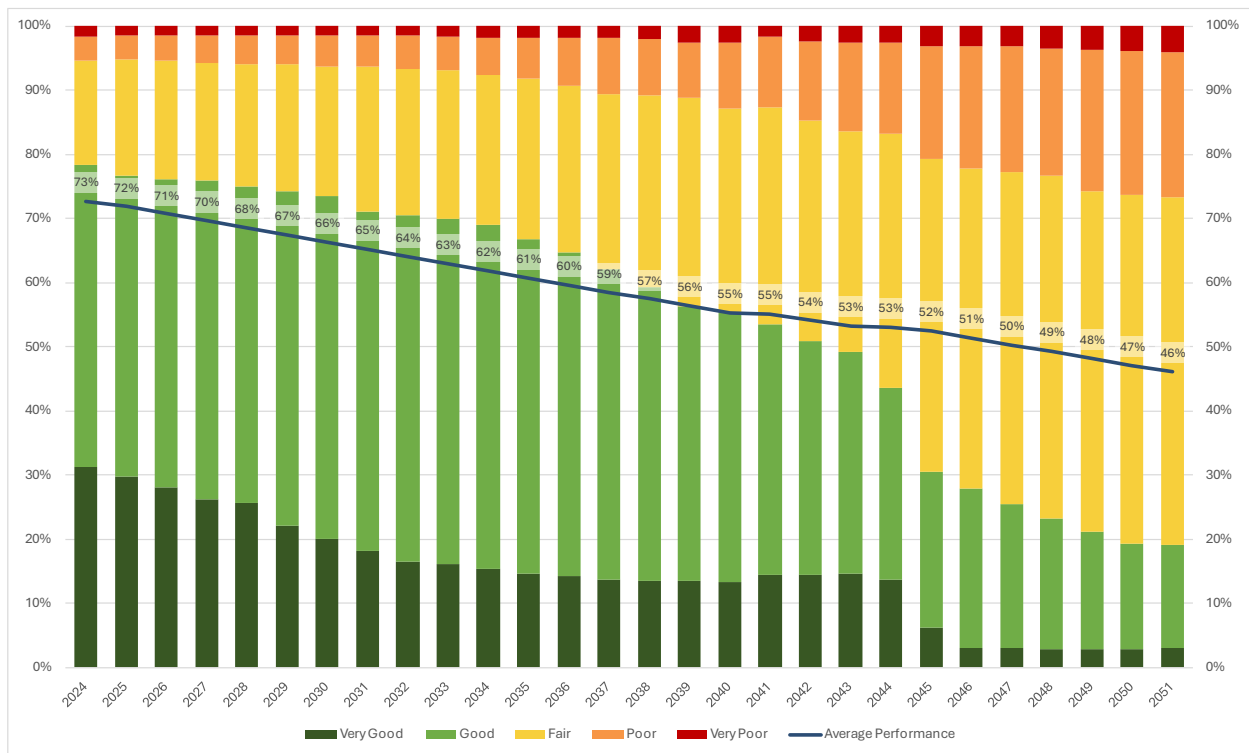


Figure B - 10: Maintain Current LOS Performance Distribution for Stormwater Assets

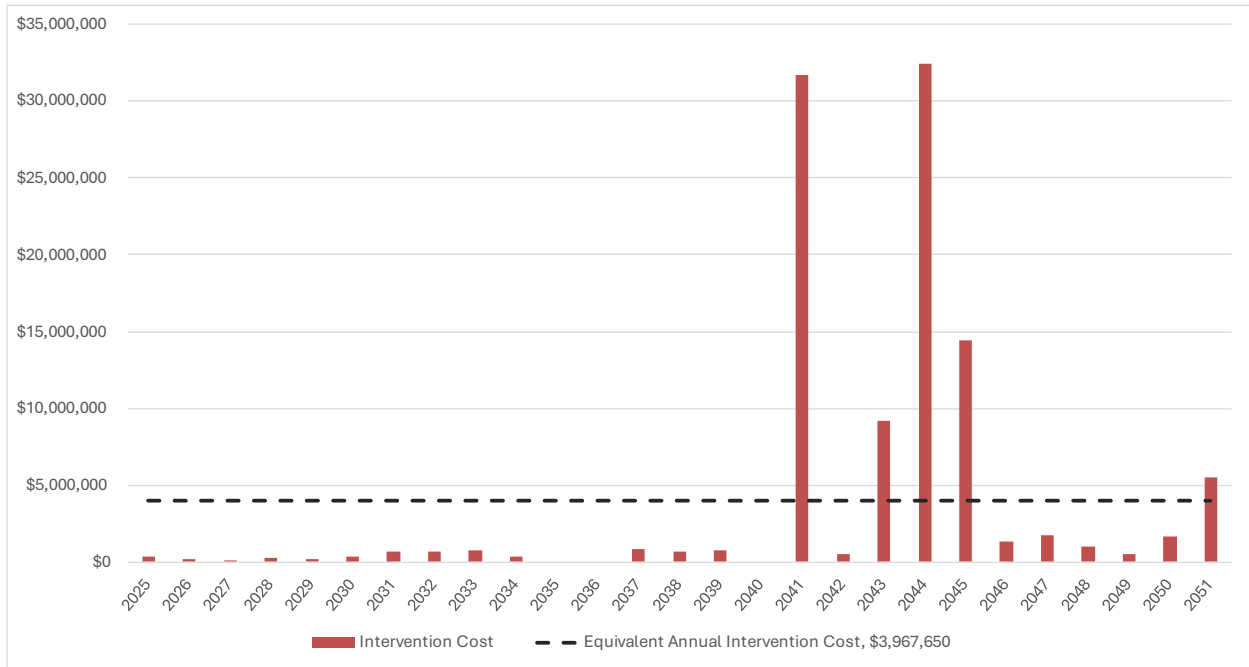
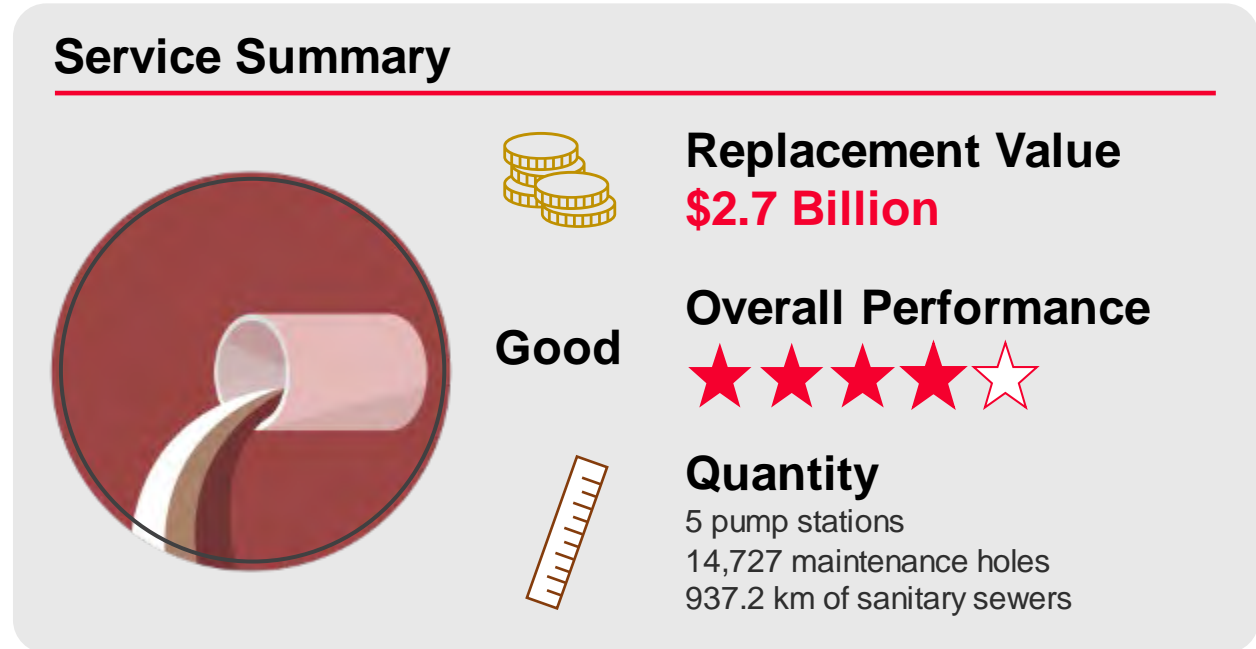


Figure B - 11: Maintain Current LOS Intervention Costs for Stormwater Assets



**2024 Asset Management
Plan Appendix C
Wastewater
City of Markham**

Appendix C Wastewater



The City’s wastewater management services contain assets that support the collection and conveyance of wastewater to York Region’s wastewater transmission system. The City’s wastewater is treated at the Duffin Creek Wastewater Pollution Control Plant located in Pickering, Ontario. The treated water is released into Lake Ontario.

The City is responsible for wastewater collection assets, such as pump stations, sanitary sewers, service connections, and maintenance holes, as detailed in Figure C - 1.

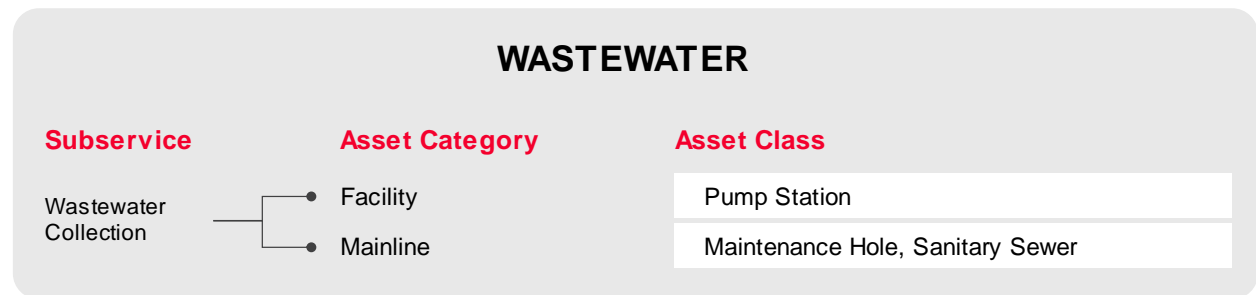


Figure C - 1: Wastewater Asset Hierarchy

More information on wastewater collection such as state of infrastructure, levels of service, risk management strategies and lifecycle management strategies and forecasting can be found in the following sections.

C.1 State of the Infrastructure

Figure C - 2 illustrates the replacement value for the wastewater asset portfolio and Figure C - 3 illustrates the replacement value of wastewater collection assets.

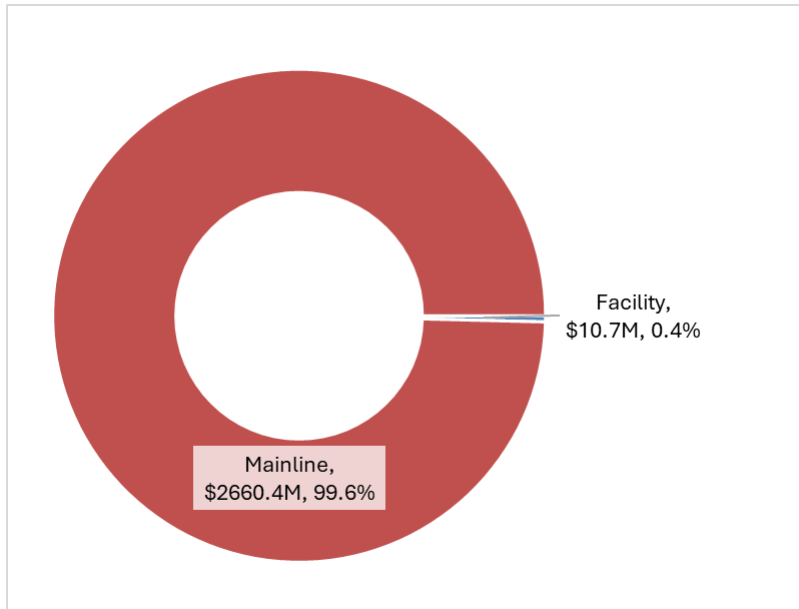


Figure C - 2: Replacement Value Distribution of Wastewater Assets

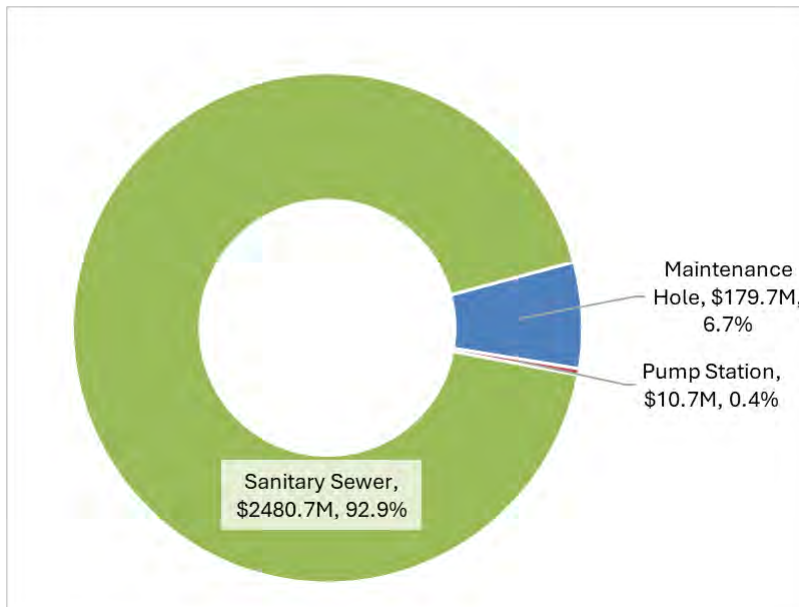


Figure C - 3: Replacement Value of Wastewater Collection Assets

C.1.1 Asset Inventory and Valuation

Table C - 1 below summarizes the asset valuation, quantities, and performance for each asset category of wastewater assets

Table C - 1: Inventory and Valuation of Wastewater Assets

Subservice	Asset Category	Asset Class	Replacement Cost	Inventory	Average Performance
Wastewater Collection	Facility	Pump Station	\$10,667,629	5 Assets	Good
	Mainline	Maintenance Hole	\$179,726,688	14,727 Assets	Good
		Sanitary Sewer	\$2,922,567	3 Assets	Very Good
		Sanitary Sewer	\$2,477,795,753	937,154 m	Good

C.1.2 Age and Estimated Service Life

Figure C - 4 illustrates the age of wastewater assets as a proportion of their estimated service life. Figure C - 5 illustrates the value of wastewater assets acquired by decade. Generally, wastewater assets are on average a third through their estimate service life, which indicates that they are relatively young. No asset classes have an average age that exceeds the average ESL.

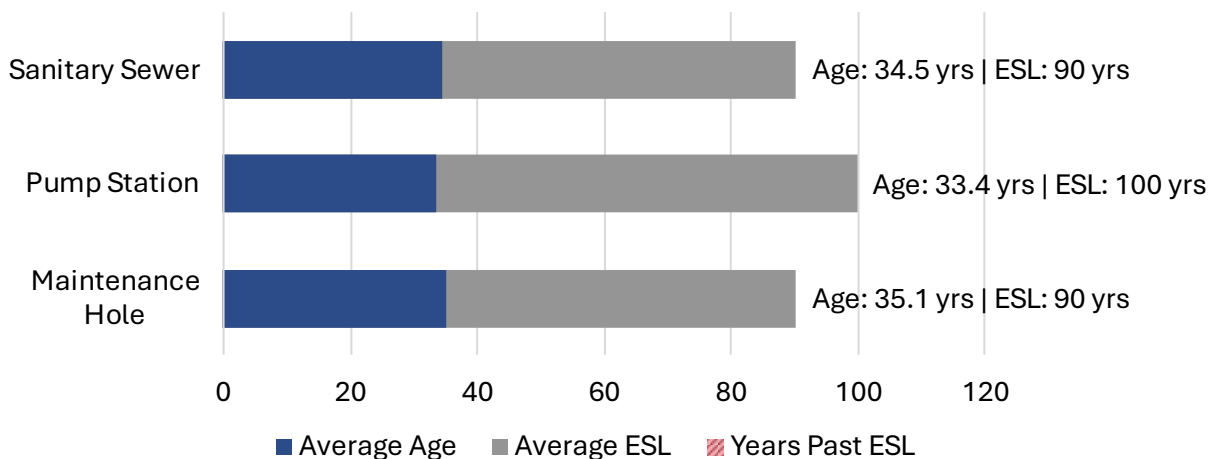


Figure C - 4: Age as a Proportion of Estimated Service Life (ESL) of Wastewater Assets

The installation profile of wastewater assets illustrates that the majority of sanitary sewers were installed from the 1980s to 2000s, in line with decades that experienced significant growth and corresponding development in the City.

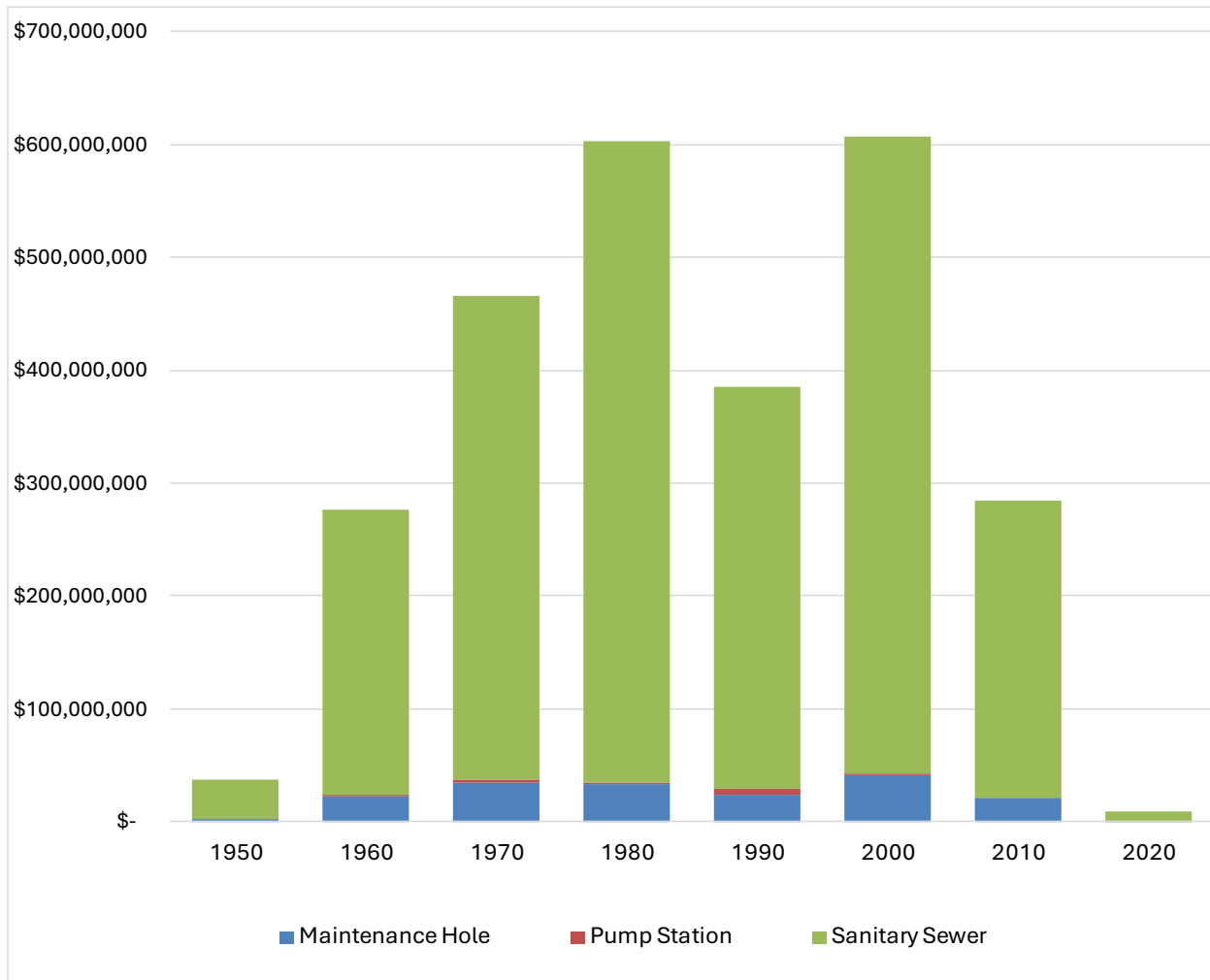


Figure C - 5: Age Distribution by Installation Decade of Wastewater Assets

C.1.3 Asset Performance

Table C - 2 details the approaches the City utilizes to assess the performance of each asset class in wastewater services.

Table C - 2: Performance assessment approaches to Wastewater Assets

Asset Class	Performance Rating Metric	Description
Maintenance Hole	Age/ESL	The City understands the performance of these assets based on asset age and estimated service life.
Pump Station	FCI, Remaining Life/ESL	Inspections are performed on pump stations and the results from the inspections are used to understand performance.
Sanitary Sewer	CCTV Condition Index, Remaining Life/ESL	Inspections are performed based on CCTV inspections under NASSCO-PACP standards on a 10-year cycle, remaining life and estimated service life.

Figure C - 6 and Figure C - 7 illustrate the performance distribution of stormwater management assets. Table C - 3 summarizes the relationship between the performance categories and how performance ratings are determined.

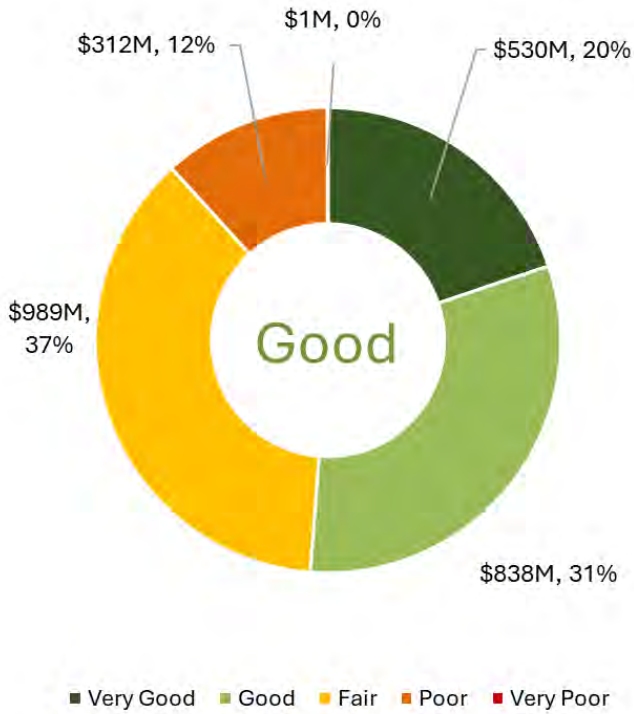


Figure C - 6: Performance Distribution of Wastewater Assets

Table C - 3: Performance Ratings of Wastewater Assets

Performance Category	Remaining Life/ESL	Facility Condition Index (FCI)	CCTV Condition Index (CCTVCI)
Very Good	100% - 80%	0% - 20%	1.0 - 2.0
Good	80% - 60%	20% - 40%	2.0 - 3.0
Fair	60% - 40%	40% - 60%	3.0 - 4.0
Poor	40% - 20%	60% - 80%	4.0 - 5.0
Very Poor	20% - 0%	80% - 100%	5.0 - 6.0

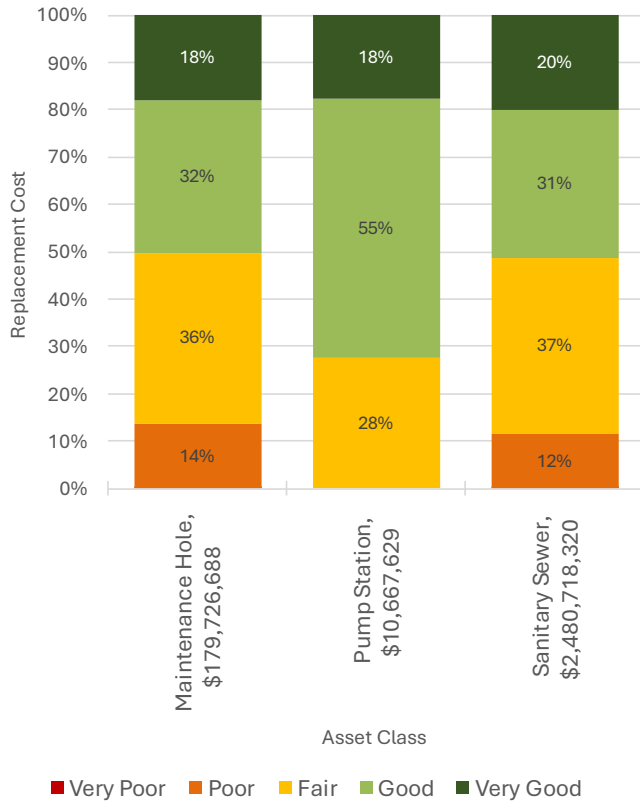


Figure C - 7: Performance Distribution of Wastewater Assets by Asset Class

C.2 Levels of Service

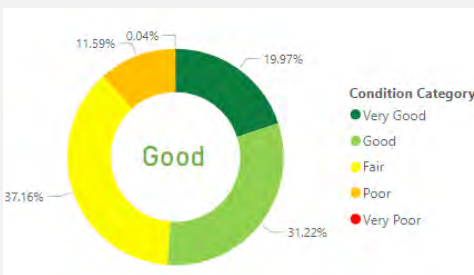
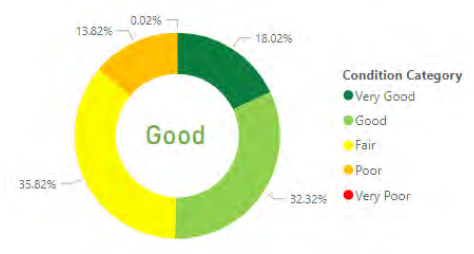
Customer values, customer levels of service and technical levels of service for Wastewater can be found in Table C - 4, Table C - 5, and Table C - 6, respectively. Furthermore, mandated O.Reg. LOS for Wastewater can be found in Table C - 7.

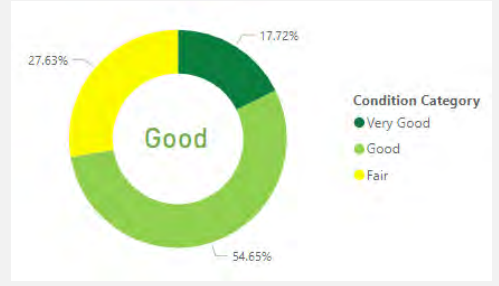
Table C - 4: Wastewater Customer Values

Customer Values		
Customer Values	Customer Satisfaction Measure	Current Feedback & Expected Trend Based on Planned Budget
Wastewater collection assets are safe and reliable to use	Assets are structurally adequate for use and in overall good working condition.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.
	Assets reliably collect and remove wastewater from properties.	
	Adverse wastewater odours are minimized.	
	Quality controls and devices have been installed to reduce overall number of incidents (e.g. sewer backups and flooding are minimized).	
Wastewater collection services are accessible and do not inconvenience customers	The quality of assets do not negatively affect the customer.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.
Aesthetic Quality	Wastewater collection assets meet aesthetic expectations.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.
Environmentally sustainable	Wastewater does not harm the environment.	The City is currently reviewing the data that

	Environmental impacts are minimized.	supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.
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Table C - 5: Wastewater Customer LOS

Customer Level of Service Measures			
Type of Measure	Level of Service	Performance Measure	Current Performance
Mainline			
Condition	Condition of Sanitary Sewers	CCTV Condition Index or Condition Based on Remaining Life - Aggregated into 5-point rating scales	
	Condition of Maintenance Holes	Condition or Age/Remaining Useful Life - Aggregated into 5-point rating scale	
	Confidence Levels: High – CCTV data is used in to evaluate sanitary sewer and maintenance hole condition		
	Individual element/element group condition.	Percentage of all elements/element groups in very poor to poor condition	12%
Confidence Levels: High – CCTV data is used in to evaluate sanitary sewer and maintenance hole condition			

Function	Measure of whether the service is appropriate for its intended use	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Capacity	Measure of whether the service is adequate to meet consumer wastewater needs	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Accessibility	Service interruptions	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Facilities			
Condition	Condition of Pump Station	Condition or Age/Remaining Useful Life - Aggregated into 5-point rating scale	
		Confidence Levels: Medium – Condition assessments are performed to determine pump station condition. Age and ESL are used to evaluate asset condition where condition assessment data is unavailable.	
	Individual element/element group condition.	Percentage of all elements/element groups in poor condition	0%
Function	Measure of whether the service is	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	

	appropriate for its intended use	
Capacity	Measure of whether the service is adequate to meet consumer wastewater needs	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.
Accessibility	Service interruptions	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.

Table C - 6: Wastewater Technical LOS

Technical Level of Service Measures				
Lifecycle Activity	Purpose of Activity	Activity Measure	Current Performance (\$, 2023 Budget)	Recommended Performance
Wastewater Collection - Facilities				
Acquisition	Growth Expansion Development	Projects developed in Future Urban Area Conceptual Master Plan - Transportation, Water and Wastewater Master Plan Class Environmental Assessment Study	The City is in the process of documenting acquisition costs by service	Recommended performance will be considered and included for the City's 2025 Asset Management Plan and Financial Strategy
		Inspections		
Operation	Regular Operations	As required	The City is in the process of documenting operations costs by service	
	Minor repairs	As needed		
Maintenance	Regular Maintenance	Annual programs	The City is in the process of documenting	

	Major maintenance (holding strategies)	As needed	maintenance costs by service	
Renewal	Major rehabilitation or replacement	As needed	\$391,600	
Disposal	Disposal of replaced assets	As required	Included in renewal costs	
Service Improvement	Upgrades to improve LOS to benefit existing serviced areas	As required	\$211,700	
Wastewater Collection – Mainline				
Acquisition	Growth Expansion Development	Projects developed in Future Urban Area Conceptual Master Plan - Transportation, Water and Wastewater Master Plan Class Environmental Assessment Study	The City is in the process of documenting acquisition costs by service	Recommended performance will be considered and included for the City's 2025 Asset Management Plan and Financial Strategy
Operation	Inspections	Annual programs	\$261,800	
	Regular Operations	As required		
Maintenance	Minor repairs	As needed	The City is in the process of documenting maintenance costs by service	
	Regular Maintenance	Annual programs		
	Major maintenance (holding strategies)	As needed		
Renewal	Major rehabilitation or replacement	As needed	\$846,600	
Disposal	Disposal of replaced assets	As required	Included in renewal costs	

Service Improvement	Upgrades to improve LOS to benefit existing serviced areas	As required	-	
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Table C - 7: Wastewater O.Reg. LOS

Customer Levels of Service		
Service attribute	Community levels of service (qualitative descriptions)	Metric
Scope	Description, which may include maps, of the user groups or areas of the municipality that are connected to the municipal wastewater system.	Refer to Figure C - 8: Properties connected to the Municipal Wastewater System
Reliability	1. Description of how combined sewers in the municipal wastewater system are designed with overflow structures in place which allow overflow during storm events to prevent backups into homes.	City does not have any combined sewers
	2. Description of the frequency and volume of overflows in combined sewers in the municipal wastewater system that occur in habitable areas or beaches.	City does not have any combined sewers
	3. Description of how stormwater can get into sanitary sewers in the municipal wastewater system, causing sewage to overflow into streets or backup into homes.	Infiltration and inflow into sanitary sewers in both groundwater and stormwater which are not intended to be in the sanitary system. Infiltration can enter through a variety of sources – cracks in pipes, cross connections such as downspout connections, through maintenance hole covers, etc. The City has implemented an annual Infiltration and Inflow (I&I) monitoring program to monitor the I&I impact and provide incentives to homeowners to remove the downspouts from sanitary sewers.
	4. Description of how sanitary sewers in the municipal wastewater system are designed to be resilient to avoid events described in paragraph 3.	To minimize sewage overflow into streets and backups into homes, the City has established design standards with 0.26 l/s/ha and other measures to reduce infiltration and inflow such as:

		<ul style="list-style-type: none"> Place manholes outside of surface ponding areas and Regional flood plains; Install seal tape around rings on the manholes; and Implement water-tight measures when sewers are installed in high groundwater areas.
	5. Description of the effluent that is discharged from sewage treatment plants in the municipal wastewater system.	City does not have sewage treatment plants

Technical Levels of Service		
Service Attribute	Technical levels of service (technical metrics)	Metric
Scope	Percentage of properties connected to the municipal wastewater system.	97%
Reliability	1. The number of events per year where combined sewer flow in the municipal wastewater system exceeds system capacity compared to the total number of properties connected to the municipal wastewater system.	City does not have any combined sewers
	2. The number of connection-days per year due to wastewater backups compared to the total number of properties connected to the municipal wastewater system.	X reported instances of basement flooding/issues compared to X connected properties
	3. The number of effluent violations per year due to wastewater discharge compared to the total number of properties connected to the municipal wastewater system.	X violations compared to X connected properties

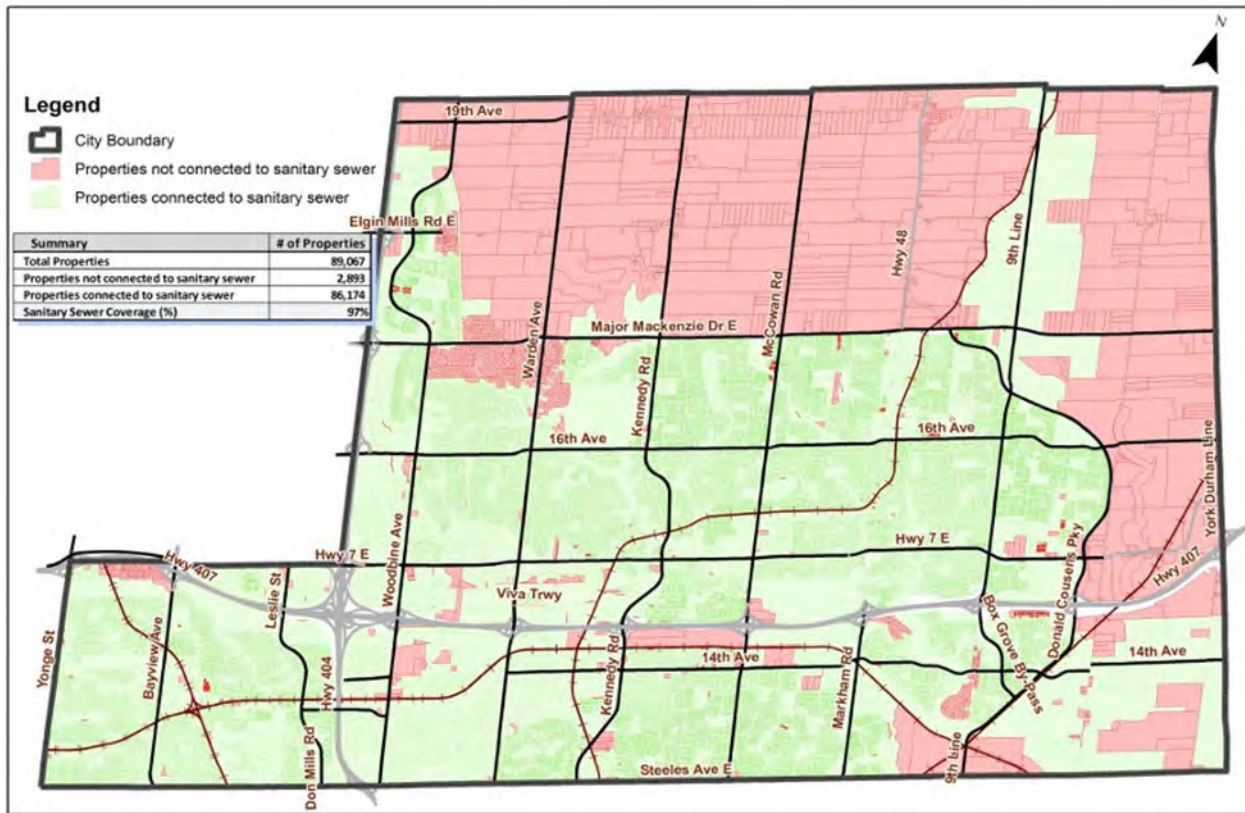


Figure C - 8: Properties connected to the Municipal Wastewater System

C.3 Risk Management Strategy

The criteria used to determine COF of Wastewater Assets can be found in Table C - 8:

Table C - 8: COF Criteria used for Wastewater Assets

Direct Financial	Socio-Economic	Environmental
<ul style="list-style-type: none"> Replacement cost Revenue loss 	<ul style="list-style-type: none"> Land use Diameter Adjacent land use 	<ul style="list-style-type: none"> Proximity to ESA, Public recreational areas, watercourse or habitat

Table C - 9 displays the risk score for wastewater assets along with the proportion of assets within each risk score, LOF and COF.

Table C - 9: Risk Score Distribution of Wastewater Assets

		Consequence of Failure				
		1	2	3	4	5
Likelihood of Failure	1	\$2,922,567 (0.1%)	\$457,580,186 (17.1%)	\$67,367,649 (2.5%)	\$1,921,033 (0.1%)	\$0 (0.0%)
	2	\$0 (0.0%)	\$728,278,119 (27.3%)	\$97,877,593 (3.7%)	\$12,342,260 (0.5%)	\$0 (0.0%)
	3	\$0 (0.0%)	\$828,474,569 (31.0%)	\$150,887,905 (5.6%)	\$9,885,624 (0.4%)	\$0 (0.0%)
	4	\$0 (0.0%)	\$270,645,953 (10.1%)	\$39,364,815 (1.5%)	\$2,454,942 (0.1%)	\$0 (0.0%)
	5	\$0 (0.0%)	\$891,683 (0.0%)	\$217,739 (0.0%)	\$0 (0.0%)	\$0 (0.0%)

C.4 Lifecycle Management Strategies and Forecasting

The following section outlines the funding required for the entire lifecycle of potable water assets. The expenditures were determined using the lifecycle activities outlined in Table C - 6 and the LOS established. Required funding was determined using the following forecasting analysis scenario:

- Maintain Current Levels of Service – this scenario provides the funding required to maintain a similar asset performance over a 27-year period. It focuses on maintaining the percentage of assets in backlog in a similar state. Backlog is defined as assets that are in need of renewal work (either significant rehabilitation or replacement). For example, if 20% of assets are past their service life, or are in need of renewal work, then the forecast model will

determine the funding to maintain 20% of assets in this state over the forecast period.

The forecast analysis identified a total of \$80.5M (annual average of \$3.0M) that is anticipated to be spent over the next 27 years. In 2023, approximately <0.1% of the asset portfolio (by replacement value) is in backlog. The average annual spending identified attempts to maintains this percentage over the next 27 years. The performance and financial forecasts for this state are illustrated in Figure C - 10 and Figure C - 11. There are significant expenditures forecasted in 2047 and 2051, which represent a significant amount of asset needs that are forecasted to occur in those years.

Note that over the 27-year forecast period, the portfolio’s performance experiences a decline on average. This is evidenced by the larger share of assets with very poor and poor performance ratings and smaller share of assets with good and very good performance ratings that arise in the later years of the forecast. This indicates that beyond the 27-year forecast the City is anticipated to experience significant renewal needs for these assets.

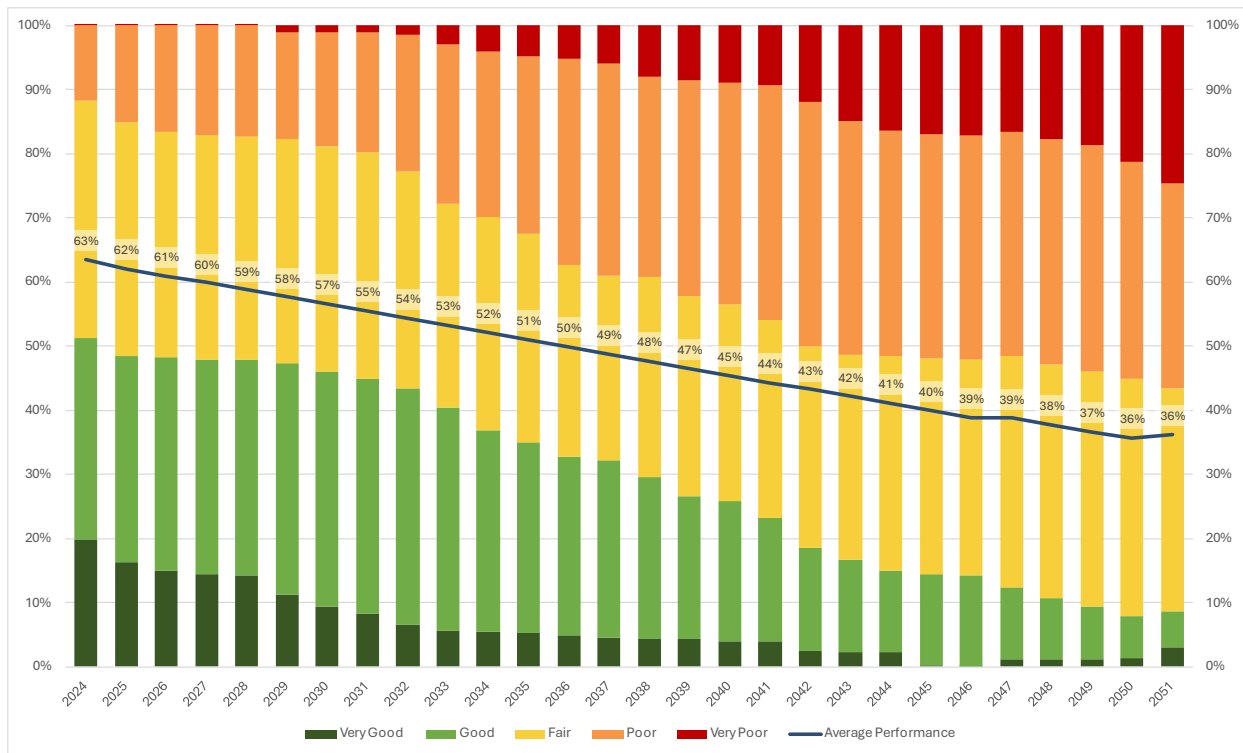


Figure C - 9: Maintain Current LOS Performance Distribution for Wastewater Assets

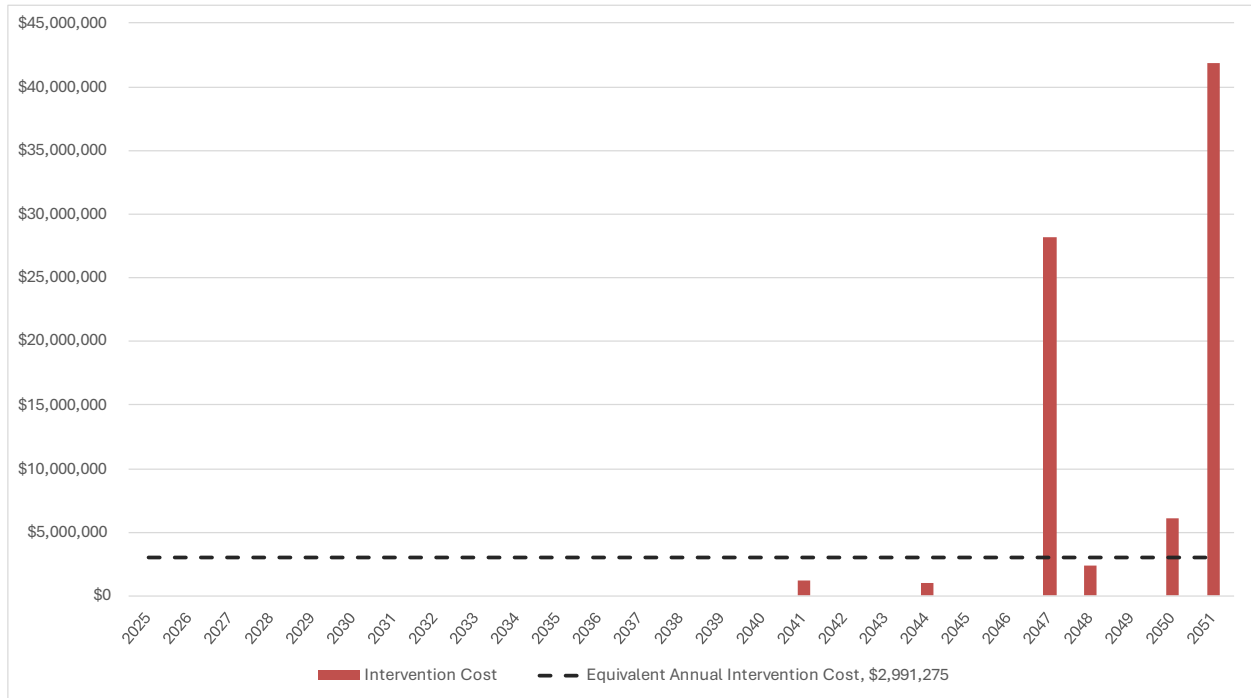
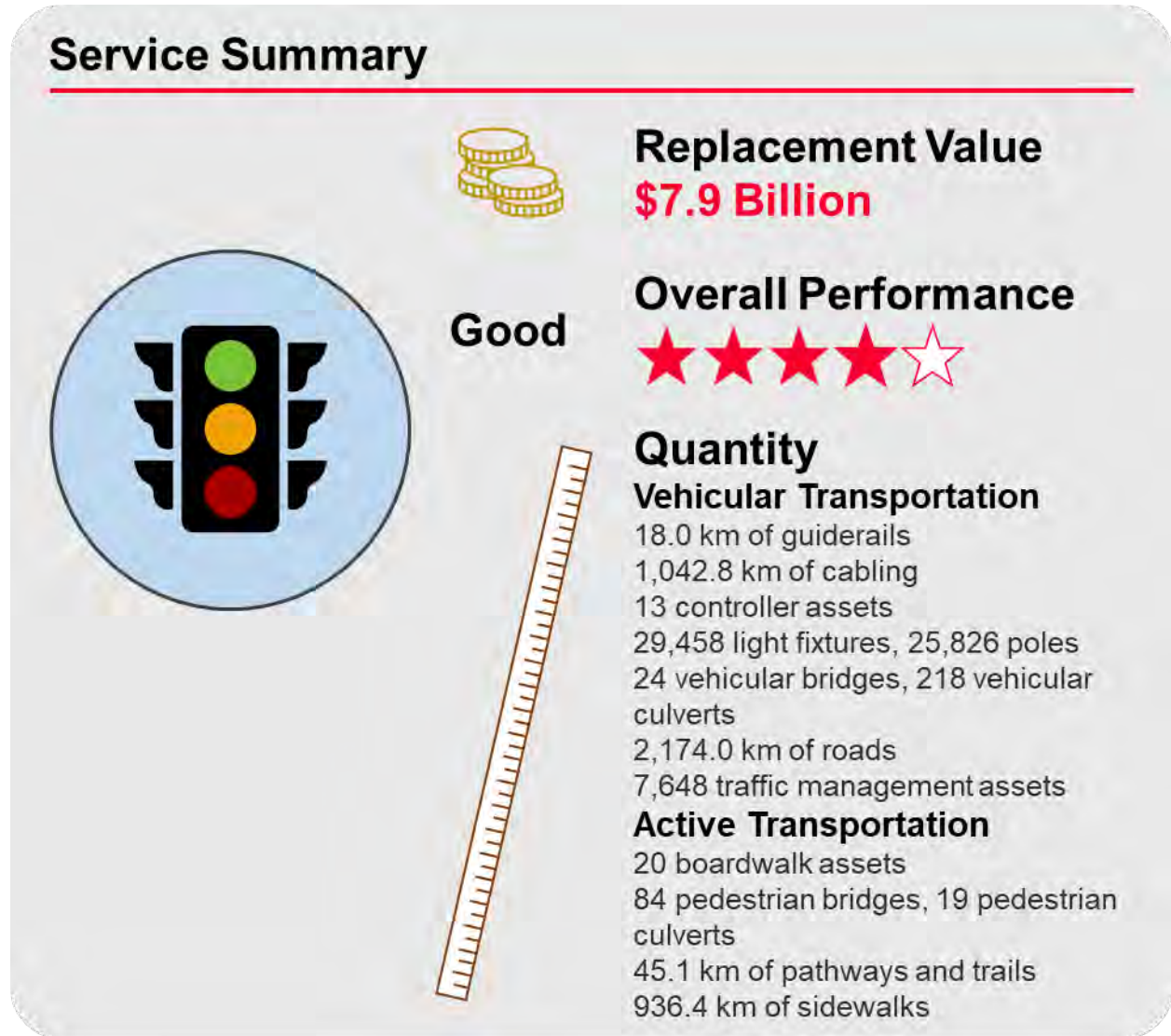


Figure C - 10: Maintain Current LOS Intervention Costs for Wastewater Assets



**2024 Asset Management
Plan Appendix D
Transportation
City of Markham**

Appendix D Transportation



The City’s transportation services contain assets that provide routes of movement for drivers, cyclists and pedestrians, while playing a critical role supporting the connectivity, and economic growth for residents and businesses of Markham.

The City is responsible for assets such as various roads, bridges, sidewalks, bicycle lanes, trails, traffic signs and equipment, and many more detailed in Figure D - 1.

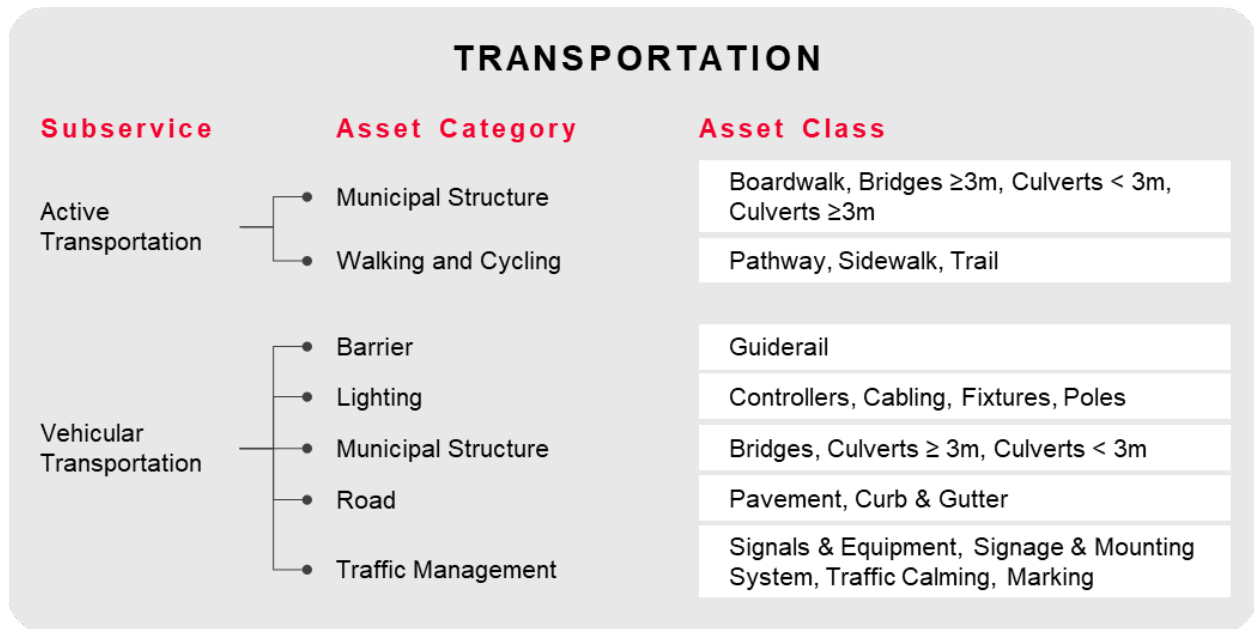


Figure D - 1: Transportation Asset Hierarchy

More information on transportation such as state of infrastructure, levels of service, risk management strategies, lifecycle management strategies and forecasting can be found in the following sections. The sections are split by the major subservices: Vehicular Transportation and Active Transportation

D.1 State of the Infrastructure – Vehicular Transportation

Figure D - 2 shows the replacement value of vehicular transportation assets while Figure D - 3 illustrates the replacement value of vehicular transportation assets by asset class.

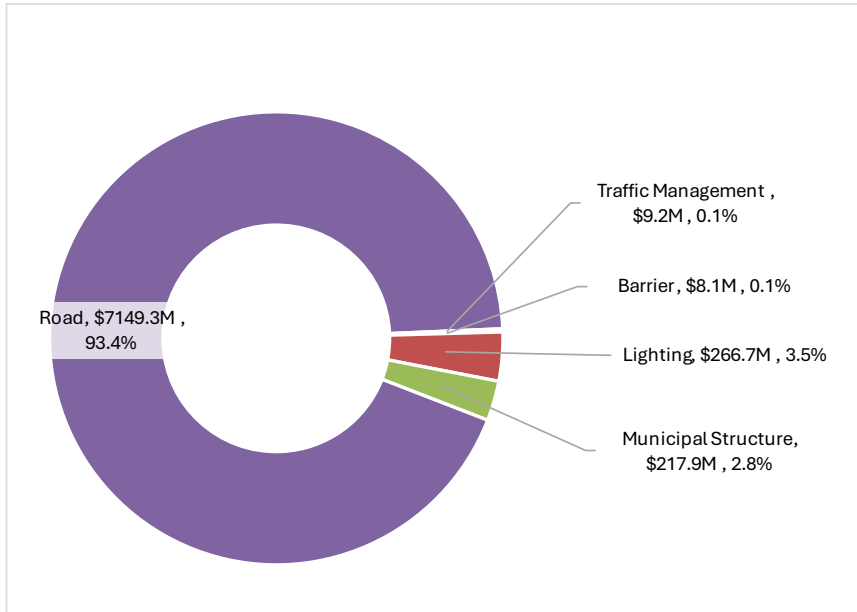


Figure D - 2: Replacement Value Distribution of Vehicular Transportation Assets

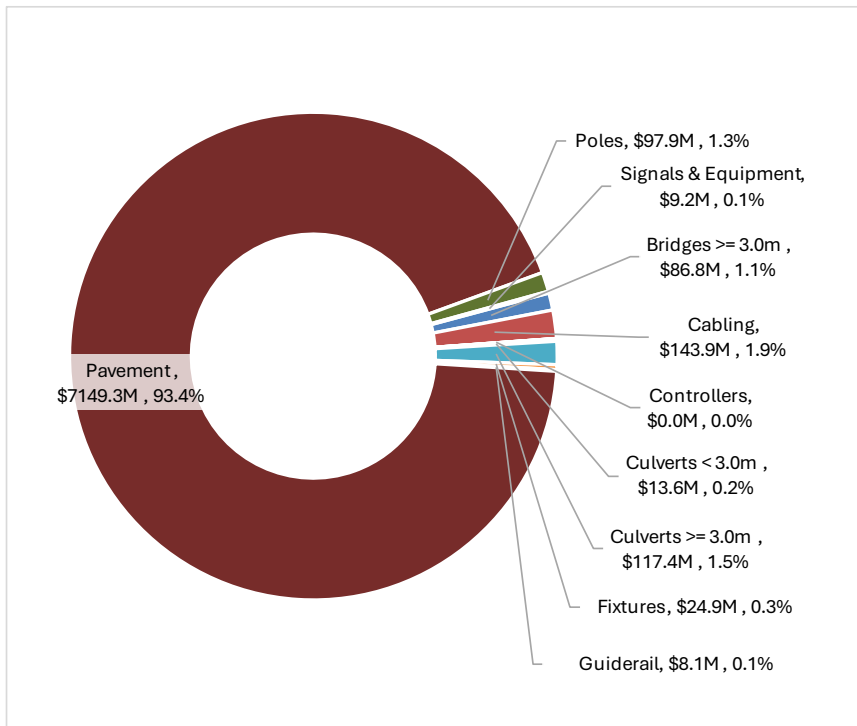


Figure D - 3: Replacement Value of Vehicular Transportation Assets by Asset Class

D.1.1 Asset Inventory and Valuation

Table D - 1 below summarizes the asset valuation, quantities, and performance for each asset category of vehicular transportation assets.

Table D - 1: Inventory and Valuation of Vehicular Transportation Assets

Subservice	Asset Category	Asset Class	Replacement Cost	Inventory	Average Performance
Vehicular Transportation	Barrier	Guiderail	\$8,117,224	17,959 m	Good
	Lighting	Cabling	\$143,868,095	1,042,825 m	Good
		Controllers	\$21,245	13 Assets	Good
		Fixtures	\$24,890,094	29,548 Assets	Good
		Poles	\$97,896,810	25,826 Assets	Good
	Municipal Structure	Bridges ≥ 3m	\$86,832,955	26 Assets	Very Good
		Culverts < 3m	\$13,625,122	155 Assets	Good
		Culverts ≥ 3m	\$117,439,623	63 Assets	Good
	Road	Pavement	\$7,149,268,886	2,174 km	Good
	Traffic Management	Signals & Equipment	\$9,212,989	7,648 Assets	Good

D.1.2 Age and Estimated Service Life

Figure D - 5 illustrates the age of vehicular transportation assets as a proportion of their estimated service life. Figure D - 6 illustrates the value of vehicular transportation assets acquired by decade. Controllers are the only asset group on average that are approaching end of ESL.

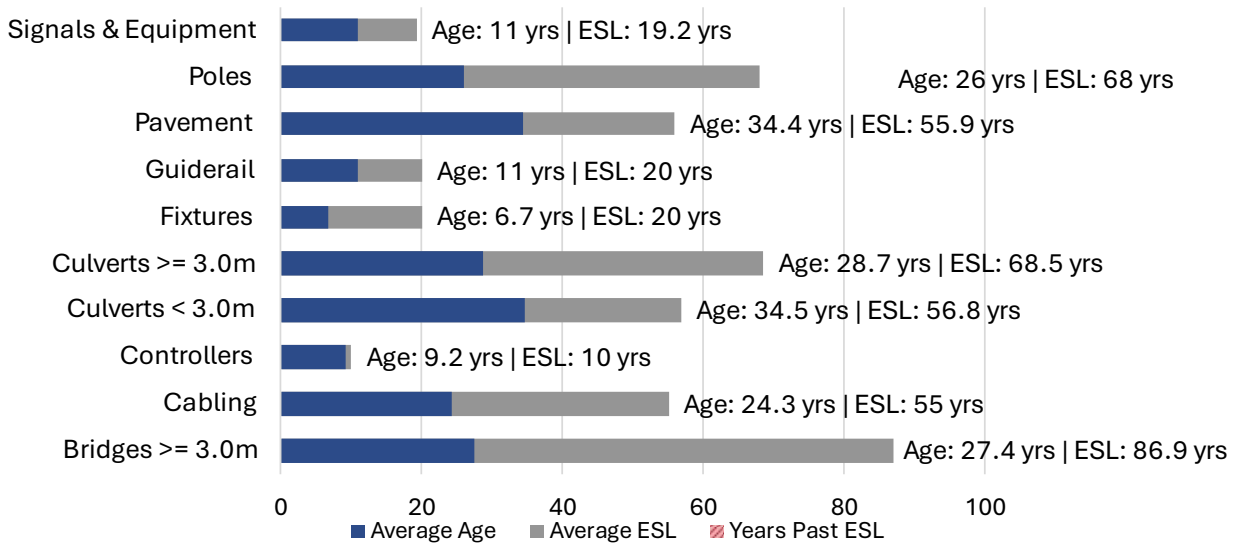


Figure D - 4: Age as a Proportion of Estimated Service Life (ESL) of Vehicular Transportation Assets

The installation profile of transportation assets illustrates that the majority of roads (pavement) were installed from the 1980s to 2000s, in line with decades that experienced significant growth and corresponding development in the City.

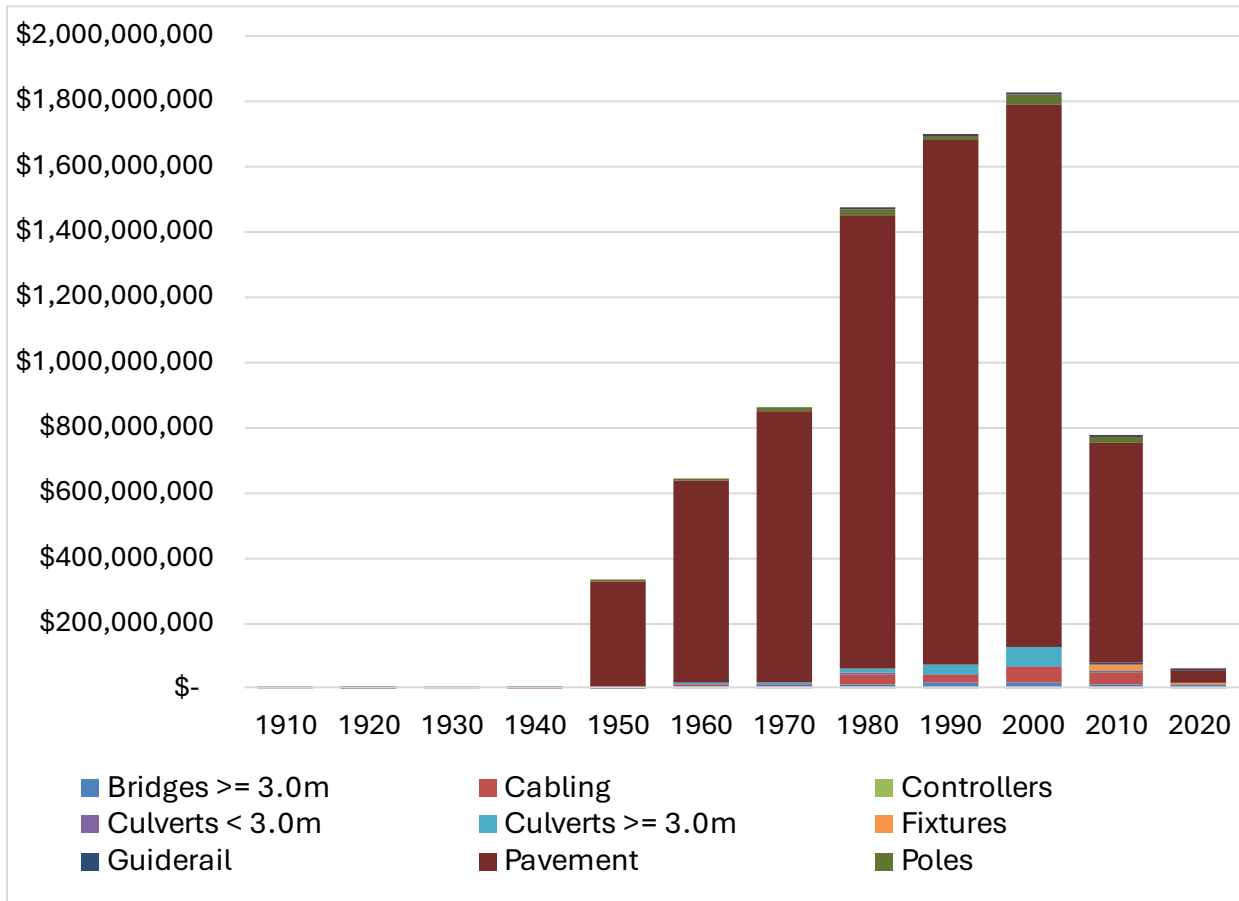


Figure D - 5: Age Distribution by Installation Decade of Vehicular Transportation Assets

D.1.3 Asset Performance

Table D - 2 below details the approaches that the City utilizes to understand the performance of vehicular transportation asset class.

Table D - 2: Performance assessment approaches to Vehicular Transportation Assets

Asset Class	Performance Rating Metric	Approach to Assessing Performance
Fixtures	Age/ESL	The City understands the performance of these assets based on asset age and estimated service life.
Guiderail		
Signals & Equipment		
Bridges < 3m, Bridges ≥ 3m	BCI (Bridge Condition Index)	OSIM inspections and BCI recorded into city's database per MTO standards. BCI is used to understand asset performance.
Culverts < 3m, Culverts ≥ 3m	BCI, CCTV Condition Index	OSIM inspections and BCI recorded into City's database per MTO standards, CCTV inspections are all recorded into city's database. CCTV and BCI ratings are used to understand asset performance.
Pavement	PCI (Pavement Condition Index)	Inspected annually using laser technology to obtain a PCI score which is recorded in City's database and used to understand performance. PCI is used to understand asset performance.
Cabling	Remaining Life/ESL	The City understands the performance of these assets based on asset age and estimated service life.
Poles	Remaining Life/ESL	
Controllers	Remaining Life/ESL	

Figure D - 7 illustrates the performance distribution of the vehicular transportation services asset portfolio, while Figure D - 8 shows the performance distribution of vehicular transportation assets by asset class. Table D - 3 summarizes the relationship between the performance categories and how performance ratings are determined.

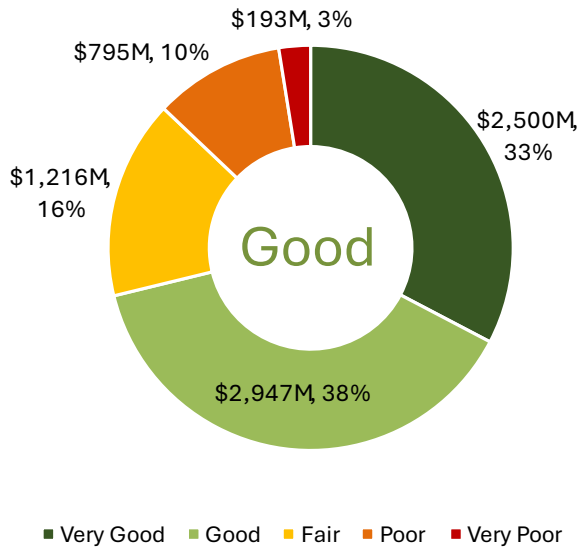


Figure D - 6: Performance Distribution of Vehicular Transportation Assets

Table D - 3: Performance Ratings of Vehicular Transportation Assets

Performance Category	Remaining Life/ESL	Age/ESL	Bridge Condition Index (BCI)	CCTV Condition Index (CCTVCI)
Very Good	100% - 80%	0% - 20%	100% - 85%	1.0 - 2.0
Good	80% - 60%	20% - 40%	85% - 70%	2.0 - 3.0
Fair	60% - 40%	40% - 60%	70% - 60%	3.0 - 4.0
Poor	40% - 20%	60% - 80%	60% - 50%	4.0 - 5.0
Very Poor	20% - 0%	80% - 100%	50% - 0%	5.0 - 6.0

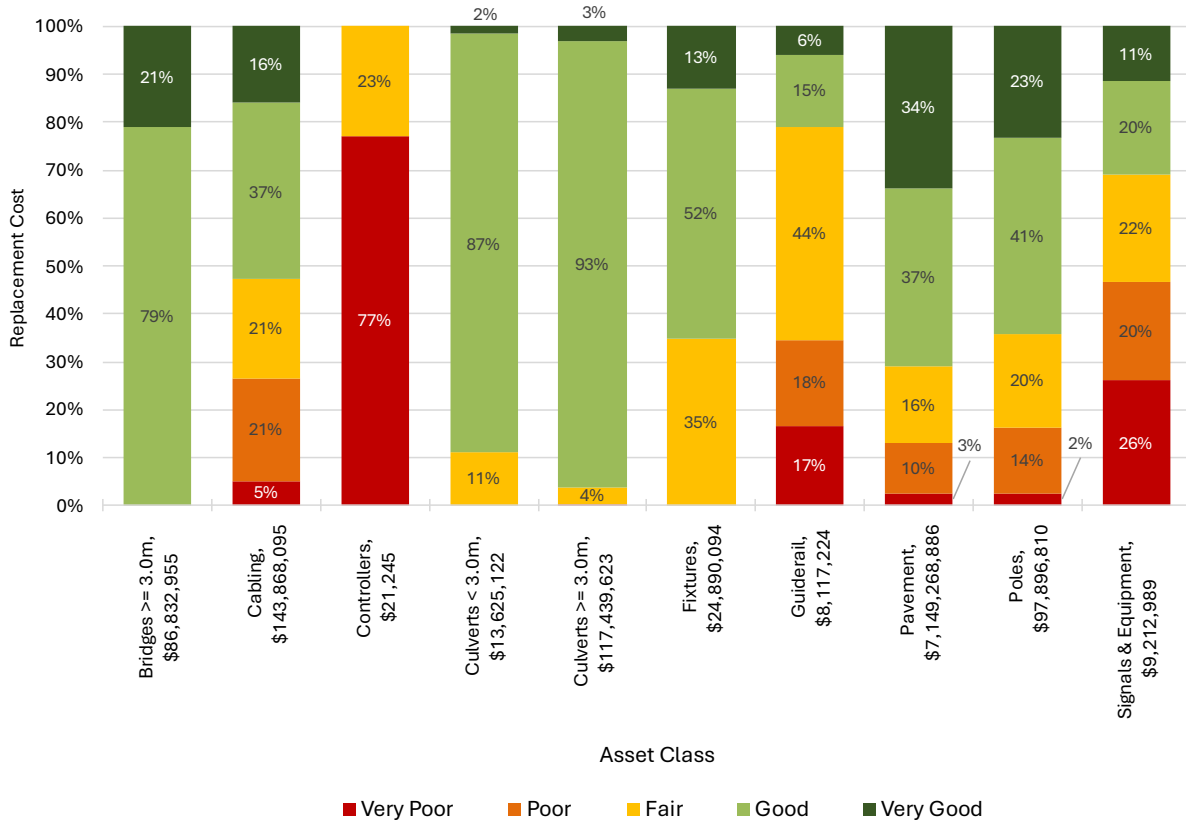


Figure D - 7: Performance Distribution of Vehicular Transportation Assets by Asset Class

D.2 State of the Infrastructure – Active Transportation

Figure D - 2 shows the replacement value of active transportation assets while Figure D - 3 illustrates the replacement value of active transportation assets by asset class.

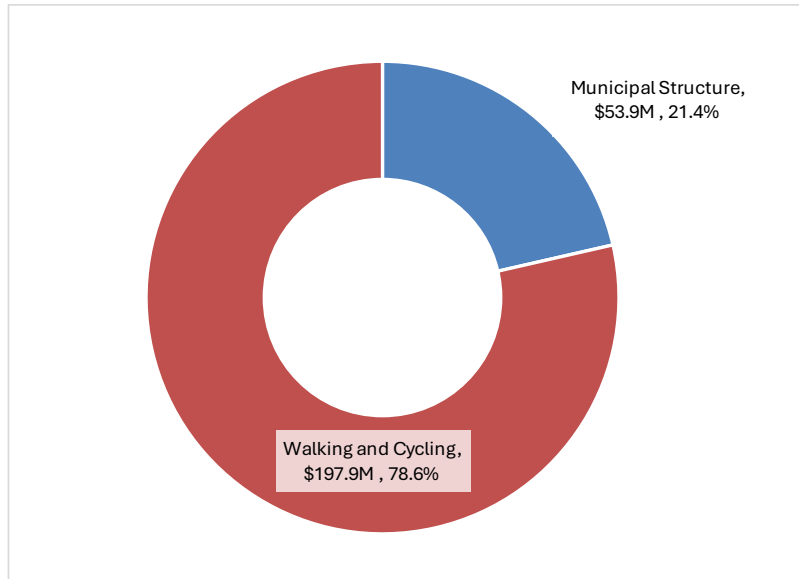


Figure D - 8: Replacement Value Distribution of Active Transportation Assets

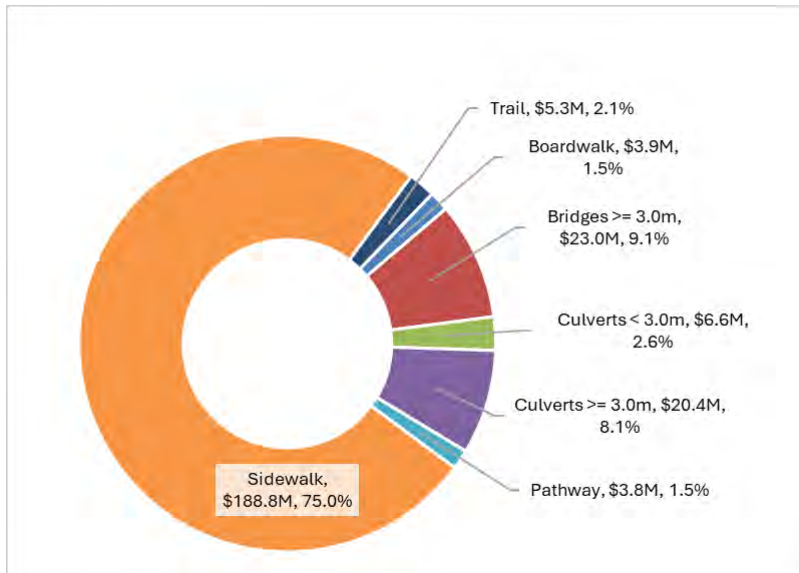


Figure D - 9: Replacement Value of Active Transportation Assets by Asset Class

D.2.1 Asset Inventory and Valuation

Table D - 1 below summarizes the asset valuation, quantities, and performance for each asset category of transportation assets.

Table D - 4: Inventory and Valuation of Transportation Assets

Subservice	Asset Category	Asset Class	Replacement Cost	Inventory	Average Performance
Active Transportation	Municipal Structure	Boardwalk	\$3,893,914	20 Assets	Good
		Bridges ≥ 3m	\$23,034,164	84 Assets	Good
		Culverts < 3m	\$6,570,356	7.0 Assets	Fair
		Culverts ≥ 3m	\$20,441,835	12 Assets	Fair
	Walking and Cycling	Pathway	\$3,833,608	19,018 m	Very Poor
		Sidewalk	\$188,758,324	936,394 m	Fair
		Trail	\$5,264,118	26,114 m	Very Good

D.2.2 Age and Estimated Service Life

Figure D - 5 illustrates the age of active transportation assets as a proportion of their estimated service life. Figure D - 6 illustrates the value of active transportation assets acquired by decade. Pathways are the only asset group with an average age past the average ESL.

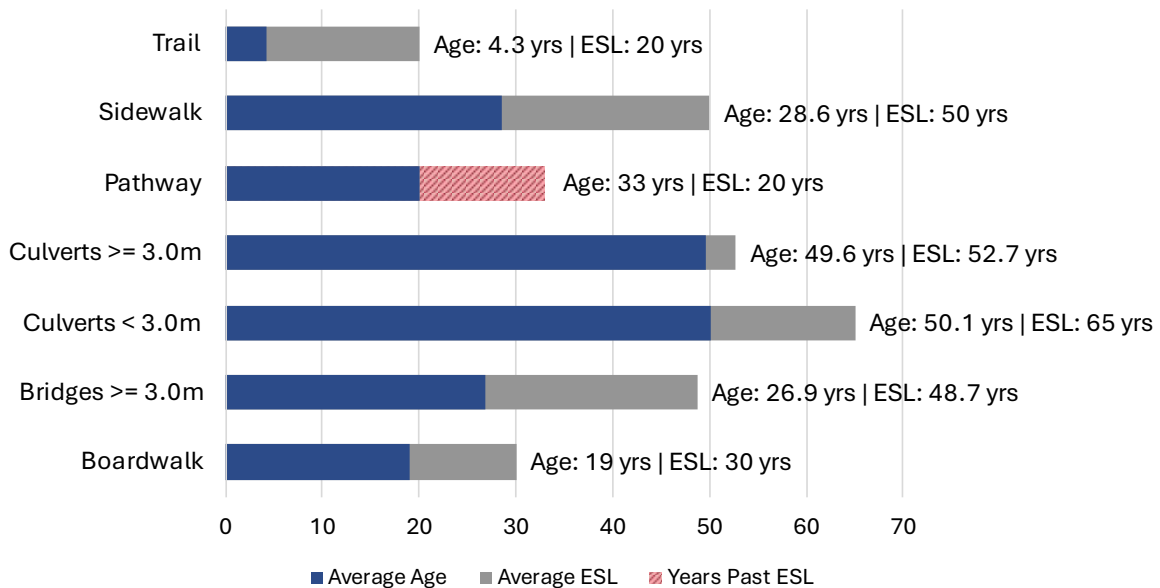


Figure D - 10: Age as a Proportion of Estimated Service Life (ESL) of Active Transportation Assets

The installation profile of transportation assets illustrates that the majority of sidewalks were installed from the 1970s to 2000s, in line with decades that experienced significant growth and corresponding development in the City.

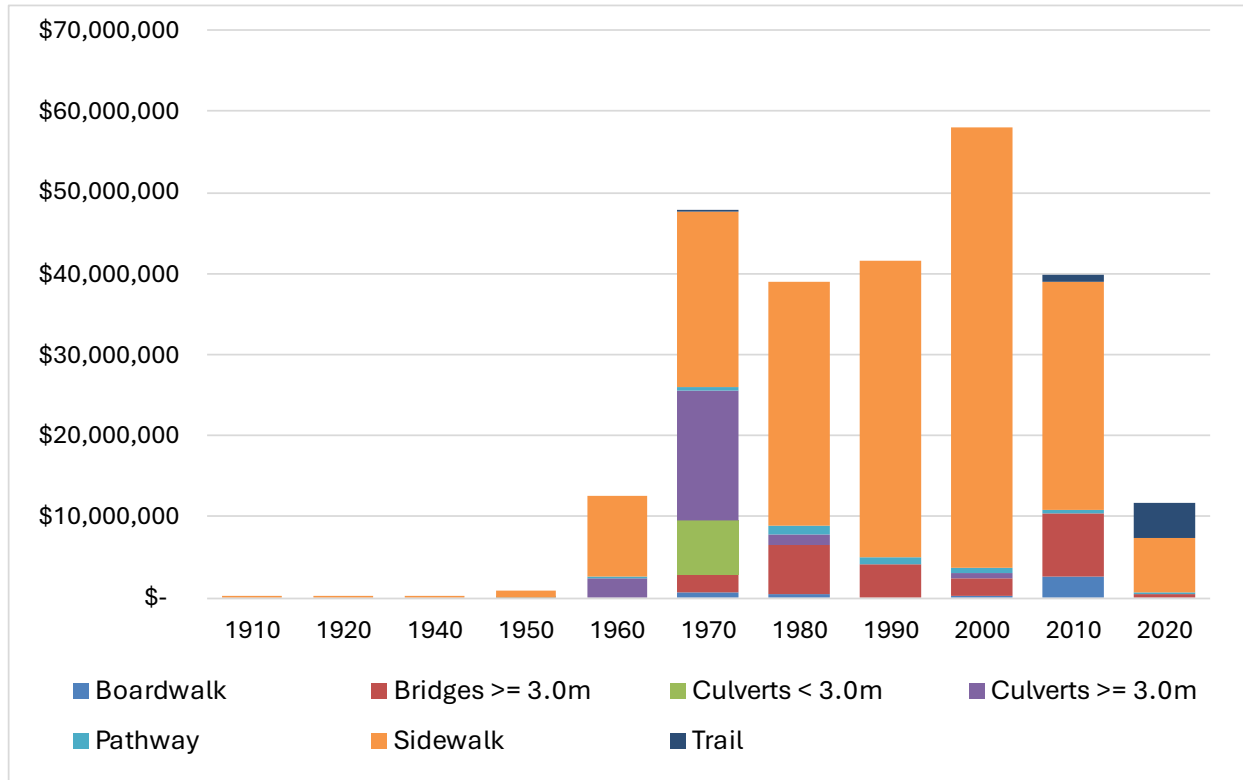


Figure D - 11: Age Distribution by Installation Decade of Active Transportation Assets

D.2.3 Asset Performance

Table D - 2 below details the approaches that the City utilizes to understand the performance of active transportation asset class.

Table D - 5: Performance assessment approaches to Active Transportation Assets

Asset Class	Performance Rating Metric	Approach to Assessing Performance
Sidewalk	Age/ESL	The City understands the performance of these assets based on asset age and estimated service life.
Trail		
Pathway		
Bridges \geq 3m	BCI (Bridge Condition Index)	OSIM inspections and BCI recorded into city's database per MTO standards. BCI is used to understand asset performance.
Boardwalk	BCI	OSIM inspections and BCI recorded into city's database per MTO standards. BCI is used to understand asset performance.
Culverts < 3m, Culverts \geq 3m	BCI, CCTV Condition Index	OSIM inspections and BCI recorded into City's database per MTO standards, CCTV inspections are all recorded into city's database. CCTV and BCI ratings are used to understand asset performance.

Figure D - 7 illustrates the performance distribution of the active transportation services asset portfolio, while Figure D - 8 shows the performance distribution of active transportation assets by asset class. Table D - 3 summarizes the relationship between the performance categories and how performance ratings are determined.

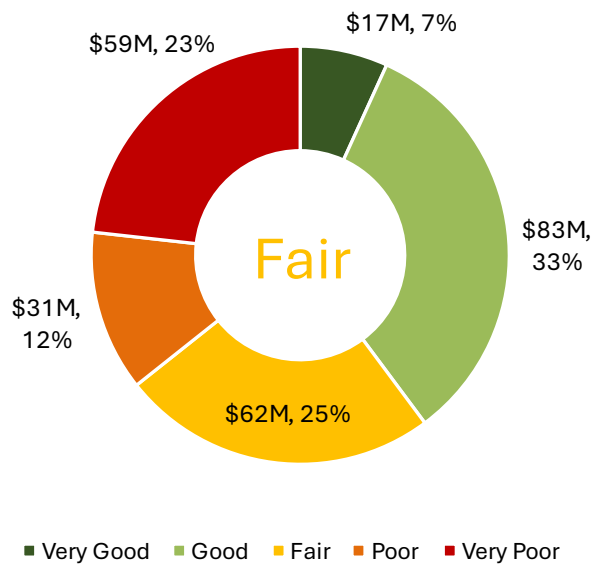


Figure D - 12: Performance Distribution of Active Transportation Assets

Table D - 6: Performance Ratings of Active Transportation Assets

Performance Category	Remaining Life/ESL	Age/ESL	Bridge Condition Index (BCI)	CCTV Condition Index (CCTVCI)
Very Good	100% - 80%	0% - 20%	100% - 85%	1.0 - 2.0
Good	80% - 60%	20% - 40%	85% - 70%	2.0 - 3.0
Fair	60% - 40%	40% - 60%	70% - 60%	3.0 - 4.0
Poor	40% - 20%	60% - 80%	60% - 50%	4.0 - 5.0
Very Poor	20% - 0%	80% - 100%	50% - 0%	5.0 - 6.0

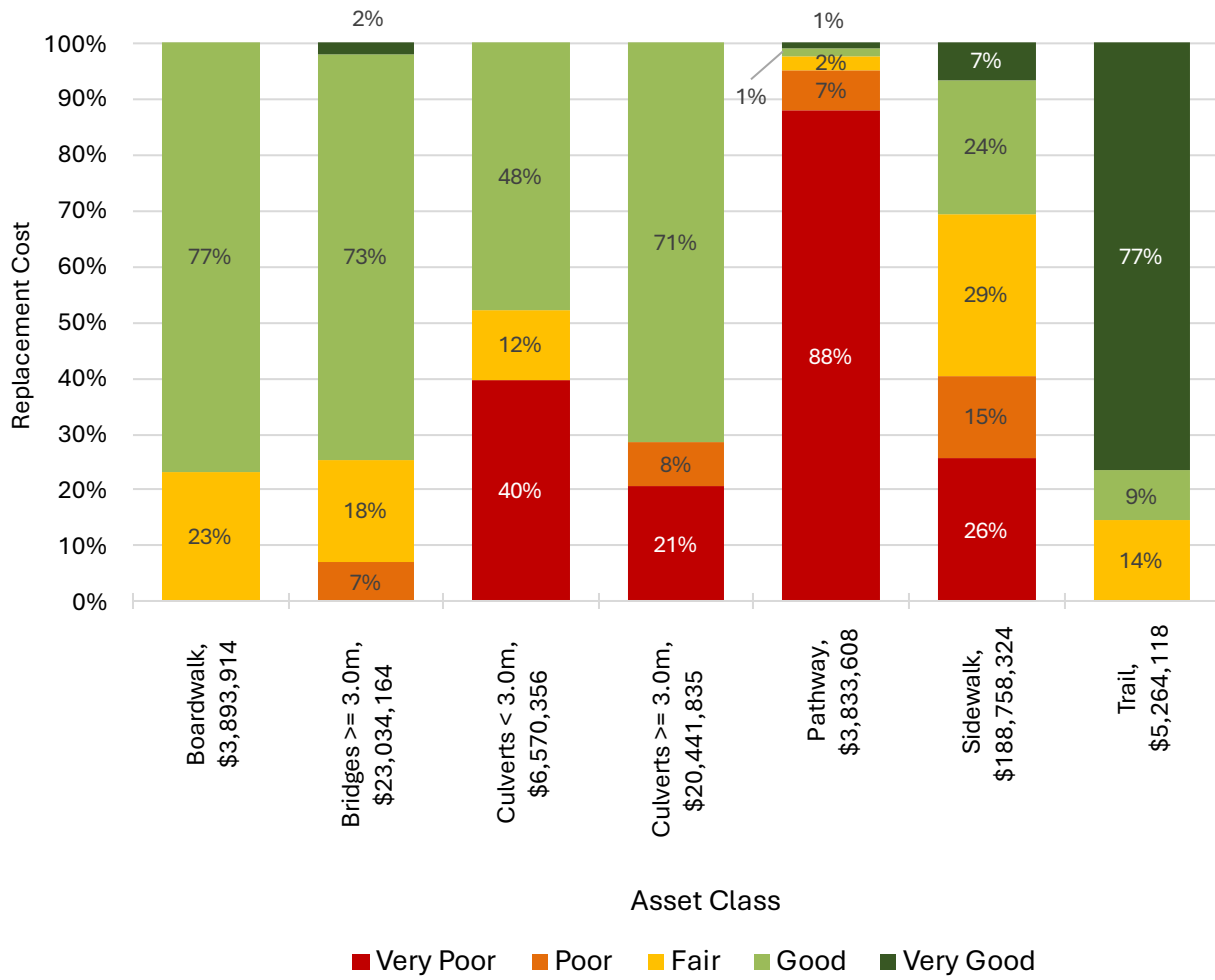


Figure D - 13: Performance Distribution of Transportation Assets by Asset Class

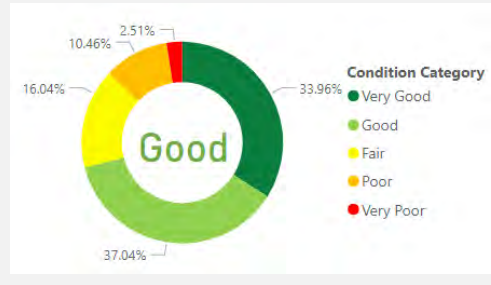
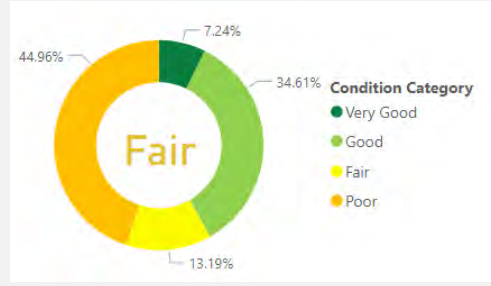
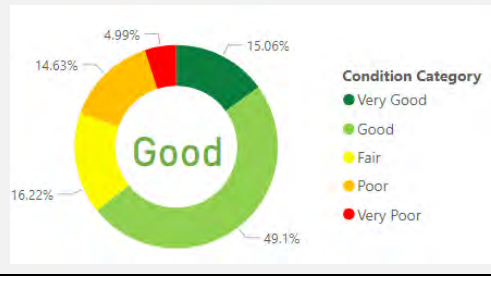
D.3 Levels of Service – Vehicular Transportation

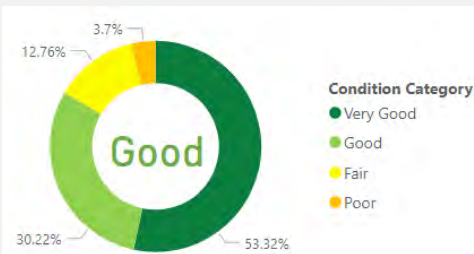
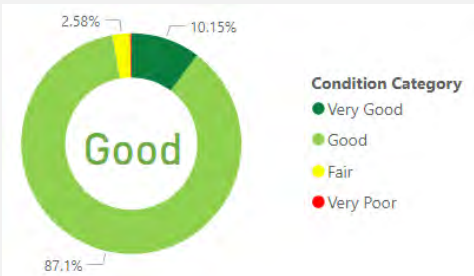
Customer values, customer levels of service and technical levels of service for Vehicular Transportation can be found in Table D - 7, Table D - 5, and Table D - 6, respectively. Furthermore, mandated O.Reg. LOS for roads and bridges can be found in Table D - 13 and Table D - 14.

Table D - 7: Vehicular Transportation Customer Values

Customer Values		
Customer Values	Customer Satisfaction Measure	Current Feedback & Expected Trend Based on Planned Budget
Transportation services assets are safe and reliable to use	Assets are structurally adequate for use and in overall good working condition.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.
	Assets can support all types of traffic.	
	Traffic controls have been installed to increase commuter safety, reduce injury and overall number of incidents.	
Transportation services assets are convenient to use	The quality of assets does not negatively affect the travelling experience	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.
	Transportation services assets are accessible and easy to access.	
Aesthetic Quality	Transportation services assets meet aesthetic expectations.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.
Environmentally sustainable	Environmental impacts are minimized.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.

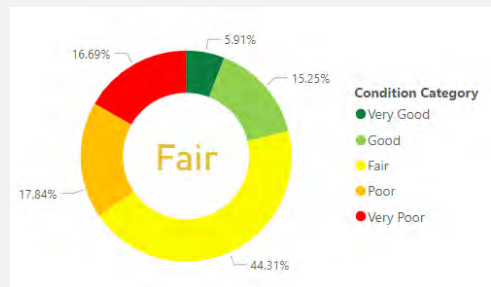
Table D - 8: Vehicular Transportation Customer LOS

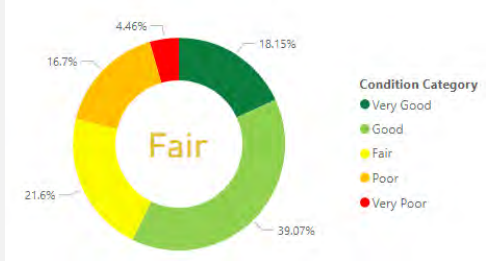
Customer Level of Service Measures			
Type of Measure	Level of Service	Performance Measure	Current Performance
Vehicular Transportation – Roads			
Condition	Condition of Local roads	Pavement Condition Index (PCI) - Aggregated into 5-point rating scales	
		Confidence Levels: High – condition assessments are performed to determine PCI scores	
	Condition of Arterial roads	Pavement Condition Index (PCI) - Aggregated into 5-point rating scales	
		Confidence Levels: High – condition assessments are performed to determine PCI scores	
	Condition of Collectors roads	Pavement Condition Index (PCI) - Aggregated into 5-point rating scales	
		Confidence Levels: High – condition assessments are performed to determine PCI scores	

	Condition of Laneways	Pavement Condition Index (PCI) - Aggregated into 5-point rating scales	
		Confidence Levels: High – condition assessments are performed to determine PCI scores	
	Individual element/element group condition.	Percentage of all elements/element groups in very poor to poor condition	13%
		Confidence Levels: High – condition assessments are performed to determine PCI scores	
Function	Measure of whether the service is appropriate for its intended use	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Capacity	Measure of whether the service is adequate to meet traffic needs		
Accessibility	Service interruptions		
<i>Vehicular Transportation – Municipal Structures</i>			
Condition	Condition of Vehicular Bridges	Bridge Condition Index (BCI) - Aggregated into 5-point rating scale	
	Condition of Culverts		

		Confidence Levels: High – condition assessments are performed to determine BCI scores	
	Individual element/element group condition.	Percentage of all elements/element groups in very poor to poor condition	0%
		Confidence Levels: High – condition assessments are performed to determine BCI scores	
Function	Measure of whether the service is appropriate for its intended use	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Capacity	Measure of whether the service is adequate to meet traffic needs	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Accessibility	Service interruptions	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	

Vehicular Transportation – Barriers

Condition	Condition of Guardrails	Condition or Age/Remaining Useful Life	 <p>Condition Category</p> <ul style="list-style-type: none"> Very Good Good Fair Poor Very Poor
------------------	-------------------------	--	---

		Confidence Levels: Low – age and remaining service life are used to determine condition in place of condition data	
	Individual element/element group condition.	Percentage of all elements/element groups in very poor to poor condition	35%
		Confidence Levels: Low – age and remaining service life are used to determine condition in place of condition data	
Function	Measure of whether the service is appropriate for its intended use	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Capacity	Measure of whether the service is adequate to meet traffic needs	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Accessibility	Service interruptions	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
<i>Vehicle Transportation – Lighting & Traffic Management</i>			
Condition	Condition of Cabling	Condition - Aggregated into 5-point rating scales	
	Condition of Controllers		
	Condition of Fixtures		
	Condition of Streetlights		
	Condition of Traffic Signals		
	Condition of Equipment		

	Individual element/element group condition.	Percentage of all elements/element groups in very poor to poor condition	21%
		Confidence Levels: Low – age and remaining service life are used to determine condition in place of condition data	
Function	Measure of whether the service is appropriate for its intended use	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Capacity	Measure of whether the service is adequate to meet traffic needs	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Accessibility	Service interruptions	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	

Table D - 9: Vehicular Transportation Technical LOS

Technical Level of Service Measures				
Lifecycle Activity	Purpose of Activity	Frequency	Current Performance (\$, 2023 Budget)	Recommended Performance
Vehicular Transportation				
Acquisition	Growth Expansion Development	Projects developed in transportation master plans and DC study	\$54,075,400	Recommended performance will be considered and included for the City's 2025 Asset Management Plan and Financial Strategy
	Operation	Inspections	Annual programs	
Regular Operations		As required		
Maintenance	Minor repairs	As needed	\$27,400	
	Regular Maintenance	Annual programs		
	Major maintenance (holding strategies)	As needed		
Renewal	Major rehabilitation or replacement	As needed	\$13,358,900	
Disposal	Disposal of replaced assets	As required	Included in renewal costs	
Service Improvement	Upgrades to improve LOS to benefit existing serviced areas	As required	\$319,700	
Other (not asset specific expenditures)				
Acquisition	Growth Expansion Development	Projects developed in transportation master plans and DC study	\$22,759,800	Recommended performance will be considered and included for the City's 2025 Asset Management
Operation	Inspections	Annual programs	\$157,000	

	Development of Transportation Master Plan (TMP)	Frequency		Plan and Financial Strategy
	Regular Operations	As required		
Maintenance	Minor repairs	As needed		
	Regular Maintenance	Annual programs		
	Major maintenance (holding strategies)	As needed	-	
Renewal	Major rehabilitation or replacement	As needed	\$118,600	
Disposal	Disposal of replaced assets	As required	Included in renewal costs	
Service Improvement	Upgrades to improve LOS to benefit existing serviced areas	As required	\$76,300	

D.4 Levels of Service – Active Transportation

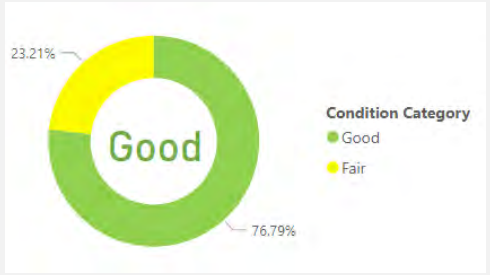
Customer values, customer levels of service and technical levels of service for Active Transportation can be found in Table D - 10, Table D - 11, and Table D - 12, respectively.

Table D - 10: Active Transportation Customer Values

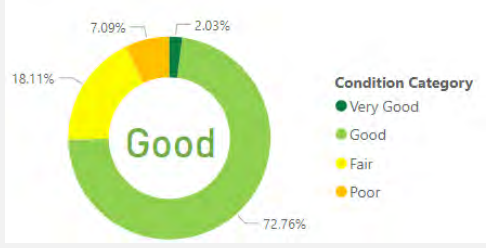
Customer Values		
Customer Values	Customer Satisfaction Measure	Current Feedback & Expected Trend Based on Planned Budget
Transportation services assets are safe and reliable to use	Assets are structurally adequate for use and in overall good working condition.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.
	Assets can support all types of traffic.	

	Traffic controls have been installed to increase commuter safety, reduce injury and overall number of incidents.	
Transportation services assets are convenient to use	The quality of assets does not negatively affect the travelling experience	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.
	Transportation services assets are accessible and easy to access.	
Aesthetic Quality	Transportation services assets meet aesthetic expectations.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.
Environmentally sustainable	Environmental impacts are minimized.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.

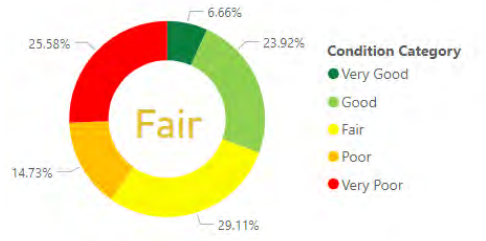
Table D - 11: Active Transportation Customer LOS

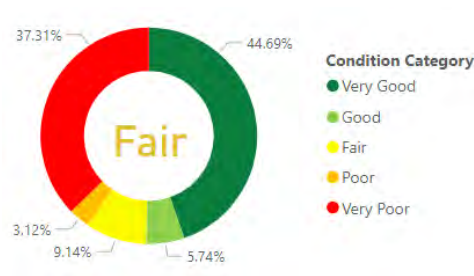
Customer Level of Service Measures			
Type of Measure	Level of Service	Performance Measure	Current Performance
Active Transportation – Municipal Structures (Boardwalks)			
Condition	Condition of Boardwalks	Bridge Condition Index (BCI) - Aggregated into 5-point rating scale	
		Confidence Levels: High – condition assessments are performed to determine BCI scores	
	Individual element/element group condition.	Percentage of all elements/element groups in very poor to poor condition	0%
Function	Measure of whether the service is appropriate for its intended use	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Capacity	Measure of whether the service is adequate to meet traffic needs		
Accessibility	Service interruptions		

Active Transportation – Municipal Structures (Pedestrian Bridges)

Condition	Condition of Pedestrian Bridges	Bridge Condition Index (BCI) - Aggregated into 5-point rating scale		
		Confidence Levels:		
	Individual element/element group condition.	Percentage of all elements/element groups in poor condition	7%	
		Confidence Levels: High – condition assessments are performed to determine BCI scores		
Function	Measure of whether the service is appropriate for its intended use	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.		
Capacity	Measure of whether the service is adequate to meet traffic needs	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.		
Accessibility	Service interruptions	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.		

Active Transportation – Walking and Cycling (Sidewalks)

Condition	Condition of Sidewalks	Condition - Aggregated into 5-point rating scales	
------------------	------------------------	---	--

		Confidence Levels:													
	Individual element/element group condition.	Percentage of all elements/element groups in very poor to poor condition	41%												
		Confidence Levels: Low – age and remaining service life are used to determine condition in place of condition data													
Function	Measure of whether the service is appropriate for its intended use	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.													
Capacity	Measure of whether the service is adequate to meet traffic needs	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.													
Accessibility	Service interruptions	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.													
Active Transportation – Walking and Cycling (Trails & Pathways)															
Condition	Condition of Trails	Condition - Aggregated into 5-point rating scales	 <table border="1"> <caption>Condition Category Data</caption> <thead> <tr> <th>Condition Category</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>Very Good</td> <td>44.69%</td> </tr> <tr> <td>Good</td> <td>5.74%</td> </tr> <tr> <td>Fair</td> <td>9.14%</td> </tr> <tr> <td>Poor</td> <td>3.12%</td> </tr> <tr> <td>Very Poor</td> <td>37.31%</td> </tr> </tbody> </table>	Condition Category	Percentage	Very Good	44.69%	Good	5.74%	Fair	9.14%	Poor	3.12%	Very Poor	37.31%
	Condition Category			Percentage											
	Very Good	44.69%													
Good	5.74%														
Fair	9.14%														
Poor	3.12%														
Very Poor	37.31%														
	Condition of Pathways	Confidence Levels: Low – age and remaining service life are used to determine condition in place of condition data													
	Individual element/element group condition.	Percentage of all elements/element groups in very poor to poor condition	40%												
		Confidence Levels: Low – age and remaining service life are used to determine condition in place of condition data													

Function	Measure of whether the service is appropriate for its intended use	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.
Capacity	Measure of whether the service is adequate to meet traffic needs	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.
Accessibility	Service interruptions	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.

Table D - 12: Active Transportation Technical LOS

Technical Level of Service Measures				
Lifecycle Activity	Purpose of Activity	Frequency	Current Performance (\$, 2023 Budget)	Recommended Performance
Active Transportation				
Acquisition	Growth Expansion Development	Projects developed in transportation master plans and DC study	\$2,191,520	Recommended performance will be considered and included for the City's 2025 Asset Management Plan and Financial Strategy
	Operation	Inspections	Annual programs	
Regular Operations		As required		
Maintenance	Minor repairs	As needed	The City is in the process of documenting maintenance costs by service	
	Regular Maintenance	Annual programs		
	Major maintenance (holding strategies)	As needed		
Renewal	Major rehabilitation or replacement	As needed	\$151,300	
Disposal	Disposal of replaced assets	As required	Included in renewal costs	
Service Improvement	Upgrades to improve LOS to benefit existing serviced areas	As required	\$502,300	

D.5 Levels of Service – O.Reg. 588/17

Levels of service that are prescribed by O.Reg. 588/17 apply to roads, bridges and culverts. Bridges and Culverts can be found both in the Active Transportation and Vehicular Transportation subservices. The following tables detail the O.Reg. 588/17 prescribed levels of service for the Transportation group.

Table D - 13: Roads O.Reg. 588/17 Customer LOS

Customer Levels of Service		
Service attribute	Community levels of service (qualitative descriptions)	Metric
Scope	Description, which may include maps, of the road network in the municipality and its level of connectivity.	Refer to Figure D - 9: City of Markham Road Network and Connectivity. The City of Markham's road network with a total 2,174 lane-kilometers is categorized to three different classification as arterial roads, major/ minor collector roads and local/laneway roads
Quality	Description or images that illustrate the different levels of road class pavement condition.	Refer to Figure D - 10: Pavement Condition Index of Arterial Roads, Figure D - 11: Pavement Condition Index of Major/Minor Roads, Figure D - 12: Pavement Condition Index of Local/Laneway Roads

Table D - 14: Roads O. Reg. 588/17 Technical LOS

Technical Levels of Service			
Service attribute	Technical levels of service (technical metrics)	By Asset	By Replacement Value
Scope	Number of lane-kilometres of each of arterial roads, collector roads and local roads as a proportion of square kilometres of land area of the municipality.		
Quality	1. For paved roads in the municipality, the average pavement condition index value.	77 average PCI	77 average PCI
	2. For unpaved roads in the municipality, the average surface condition (e.g. excellent, good, fair or poor).	The City of Markham does not have unpaved roads.	

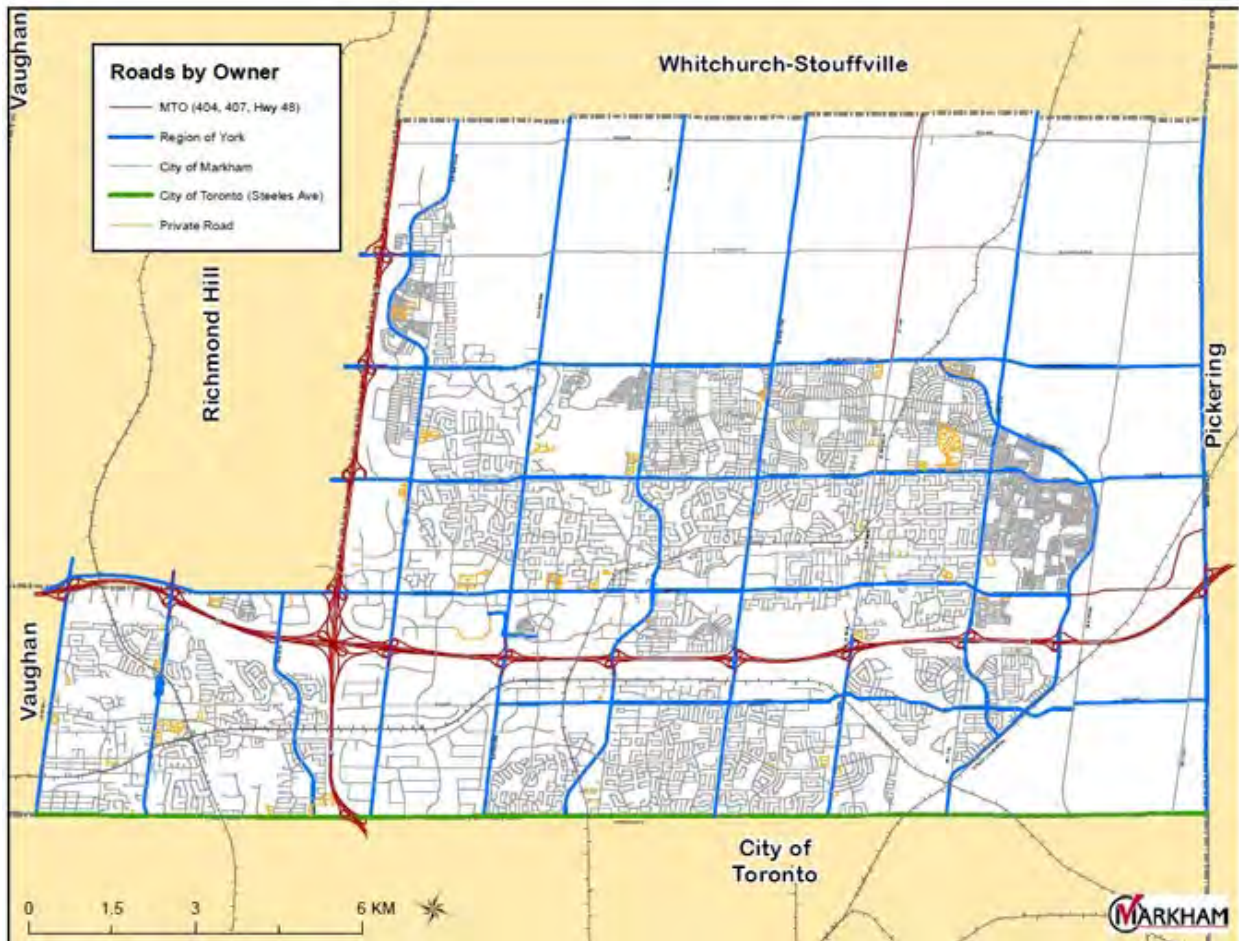


Figure D - 14: City of Markham Road Network and Connectivity

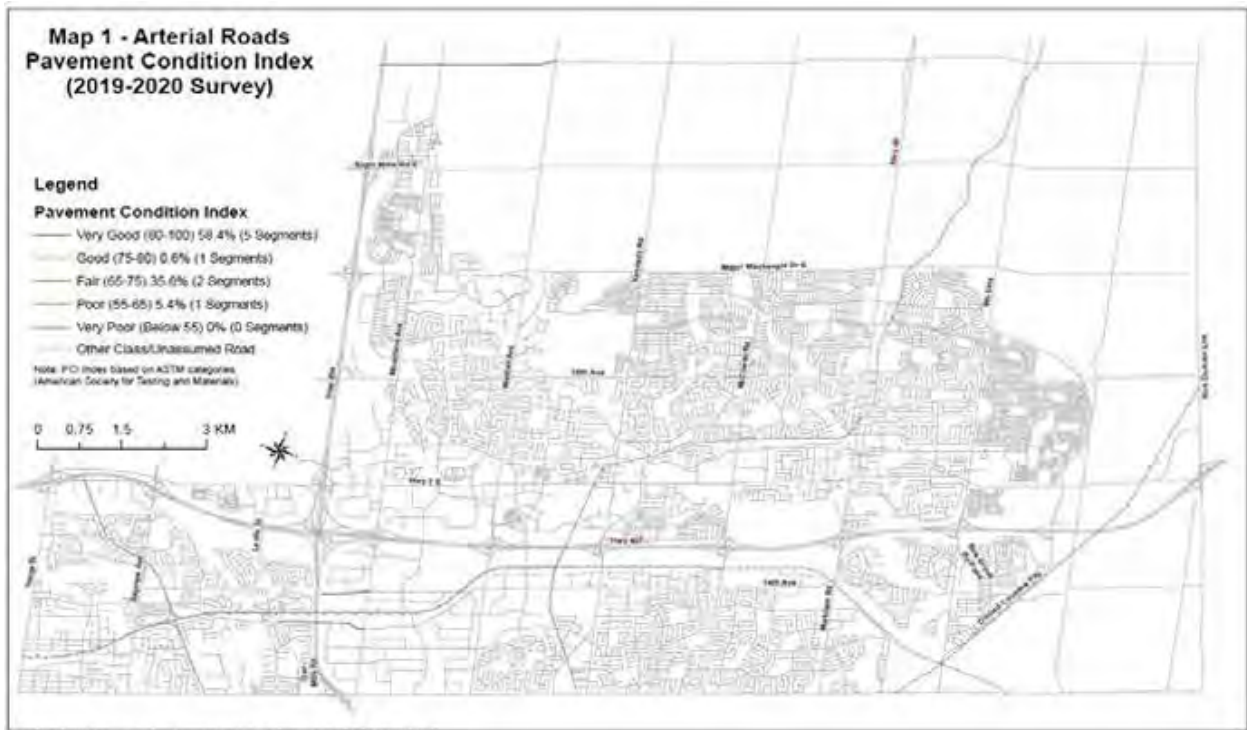


Figure D - 15: Pavement Condition Index of Arterial Roads

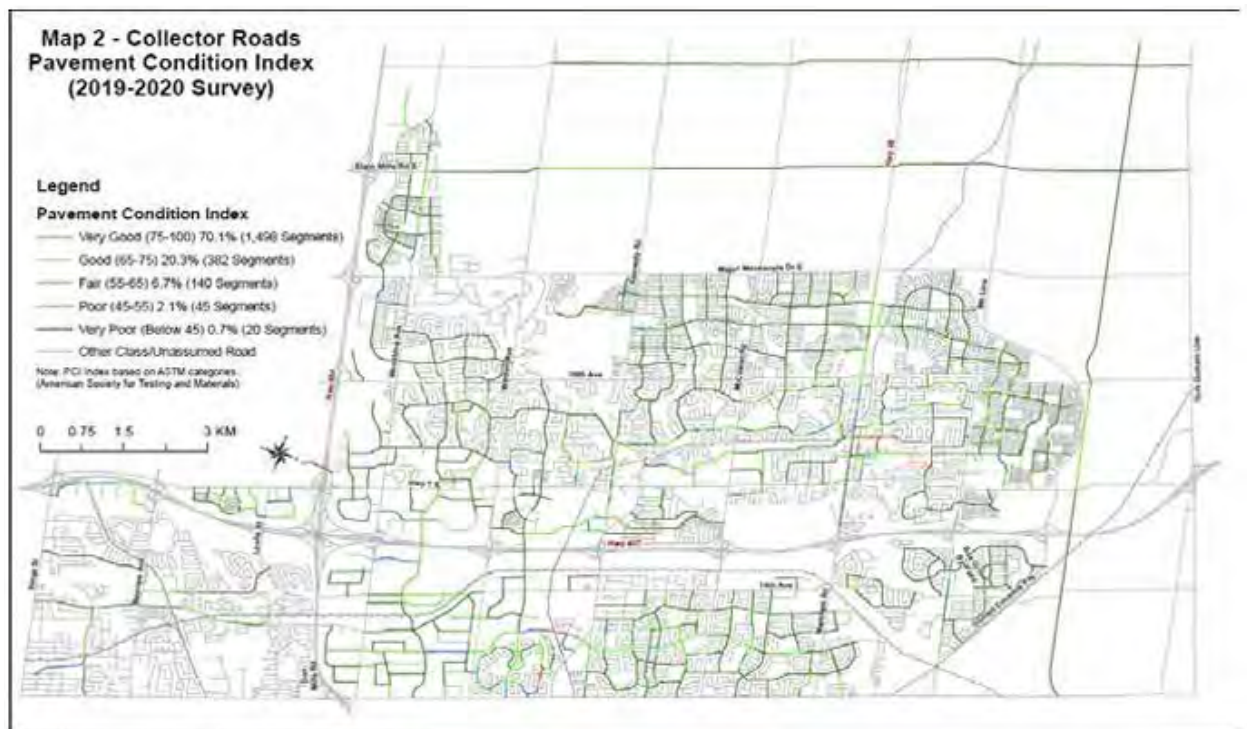


Figure D - 16: Pavement Condition Index of Major/Minor Roads

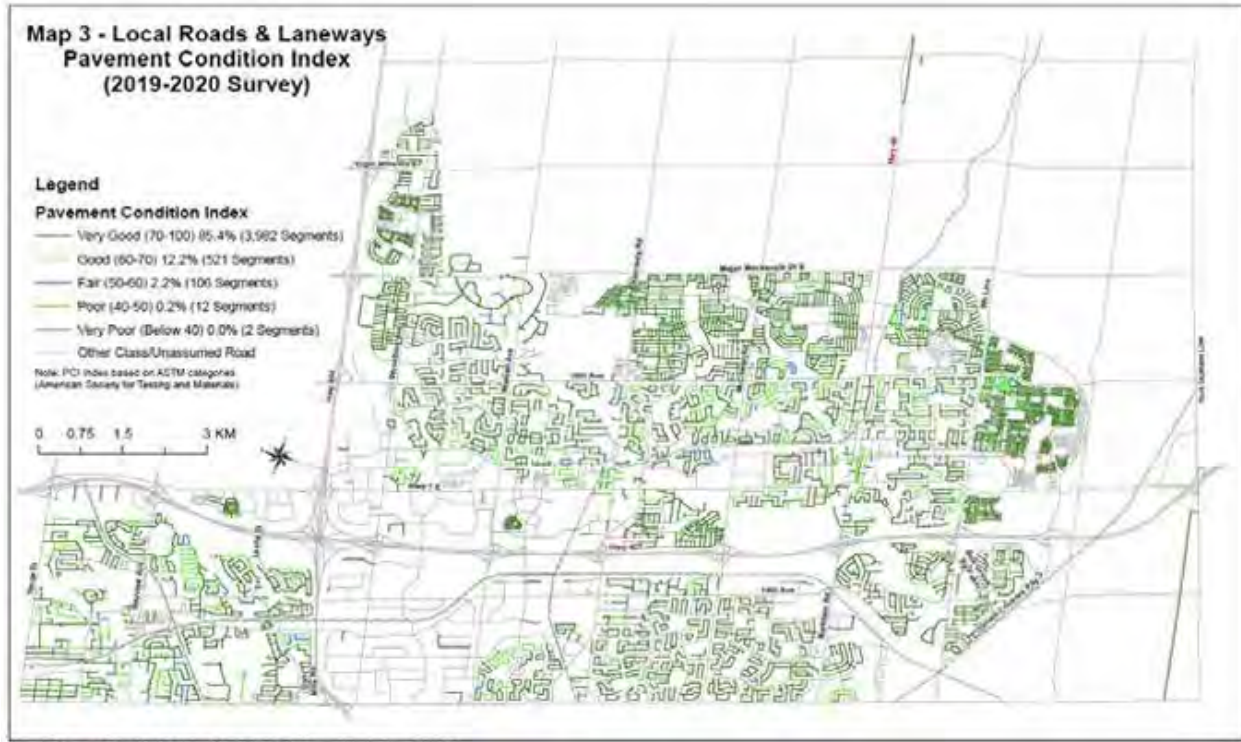


Figure D - 17: Pavement Condition Index of Local/Laneway Roads

Table D - 15: Bridges and Culverts O. Reg. 588/17 LOS

Customer Levels of Service		
Service attribute	Community levels of service (qualitative descriptions)	Metric
Scope	Description of the traffic that is supported by municipal bridges (e.g., heavy transport vehicles, motor vehicles, emergency vehicles, pedestrians, cyclists).	The City of Markham bridges have been designed in accordance with the municipality standard and requirements of the Canadian Highway Bridge Design Code (CHBDC) at the time of construction. The bridges have been designed to carry heavy transport vehicles, motor vehicles, emergency vehicles, pedestrians, and cyclists.
Quality	1. Description or images of the condition of bridges and how this would affect use of the bridges.	Refer to Figure D - 13 showing images of the condition of bridges. The condition of the bridge has no effect on the use of

		the bridges as the City undertakes rehabilitation/replacement works if BCI is less than 60.
	2. Description or images of the condition of culverts and how this would affect use of the culverts.	Refer to Figure D - 13 showing images of the condition of culverts. The condition of the culvert has no effect on the use of the culverts as the City undertakes rehabilitation/replacement works if BCI is less than 60.

Technical Levels of Service			
Service attribute	Technical levels of service (technical metrics)	By Structure	By Replacement Value
Scope	Percentage of bridges in the municipality with loading or dimensional restrictions.		
Quality	1. For bridges in the municipality, the average bridge condition index value.	76 average BCI for 26 vehicular bridges	79 average BCI for 26 vehicular bridges
	2. For structural culverts in the municipality, the average bridge condition index value.	72 average BCI for culverts over 3m width	75 average BCI for culverts over 3m width







	Vehicular Bridges	Culverts
Condition Ratings	Image of the condition of bridge and how this would affect use of bridges	Image of the condition of culvert and how this would affect use of culverts
<p>Good Condition 1 BCI Ratings (70 – 100)</p>	<p>Bridge Condition Index (BCI) - 75 Good Condition</p> 	<p>Bridge Condition Index (BCI) - 81 Good Condition</p> 
<p>Fair Condition 2 BCI Ratings (60-70)</p>	<p>Bridge Condition Index (BCI) - 63 Hairline pattern and vertical cracks</p> 	<p>Bridge Condition Index (BCI) - 67 Light corrosion inside the barrel below the waterline</p> 
<p>Poor Condition 3 BCI Ratings (<60)</p>	<p>Bridge Condition Index (BCI) - 42 Severe deterioration of concrete girders and slab</p> 	<p>Bridge Condition Index (BCI) - 41 Heavy corrosion of the steel plate</p> 

Figure D - 18: Images of Condition of Bridges and Culverts

D.6 Risk Management Strategy – Vehicular Transportation

Risk ratings are calculated by the product of Likelihood of Failure Ratings and Consequence of Failure Ratings. The City’s Risk framework aligns the Likelihood of Failure rating (a 1 to 5 score) with the performance categories assessed against each asset class. The criteria used to determine the consequence of failure of Transportation Assets can be found in Table D - 10:

Table D - 16: COF Criteria used for Vehicular Transportation Assets

Direct Financial	Socio-Economic	Environmental
<ul style="list-style-type: none"> Replacement cost 	<ul style="list-style-type: none"> Road Class Land Use and Zone Description Land Use Accessible pedestrian signal assets Associated road class Asset type 	<ul style="list-style-type: none"> Asset class

Table D - 11 displays the risk score for transportation assets along with the proportion of assets within each risk score, LOF and COF.

Table D - 17: Risk Score Distribution of Vehicular Transportation Assets

		Consequence of Failure				
		1	2	3	4	5
Likelihood of Failure	1	\$47,105,960 (0.6%)	\$988,864,459 (12.5%)	\$1,459,717,849 (18.5%)	\$21,900,451 (0.3%)	\$0 (0.0%)
	2	\$118,013,512 (1.5%)	\$585,880,353 (7.4%)	\$2,168,051,776 (27.4%)	\$157,880,834 (2.0%)	\$0 (0.0%)
	3	\$90,798,012 (1.1%)	\$386,260,833 (4.9%)	\$796,010,297 (10.1%)	\$4,117,722 (0.1%)	\$0 (0.0%)
	4	\$47,930,894 (0.6%)	\$172,637,785 (2.2%)	\$604,409,191 (7.6%)	\$1,622,999 (0.0%)	\$0 (0.0%)
	5	\$36,824,909 (0.5%)	\$39,660,394 (0.5%)	\$170,699,282 (2.2%)	\$4,581,850 (0.1%)	\$0 (0.0%)

D.7 Risk Management Strategy – Active Transportation

Risk ratings are calculated by the product of Likelihood of Failure Ratings and Consequence of Failure Ratings. The City’s Risk framework aligns the Likelihood of Failure rating (a 1 to 5 score) with the performance categories assessed against each asset class. The criteria used to determine the consequence of failure of Transportation Assets can be found in Table D - 18:

Table D - 18: COF Criteria used for Active Transportation Assets

Direct Financial	Socio-Economic	Environmental
<ul style="list-style-type: none"> Replacement cost 	<ul style="list-style-type: none"> Road Class Asset type Land use Associated facility type 	<ul style="list-style-type: none"> Asset class

Table D - 11 displays the risk score for transportation assets along with the proportion of assets within each risk score, LOF and COF.

Table D - 19: Risk Score Distribution of Vehicular Transportation Assets

		Consequence of Failure				
		1	2	3	4	5
Likelihood of Failure	1	\$47,105,960 (0.6%)	\$988,864,459 (12.5%)	\$1,459,717,849 (18.5%)	\$21,900,451 (0.3%)	\$0 (0.0%)
	2	\$118,013,512 (1.5%)	\$585,880,353 (7.4%)	\$2,168,051,776 (27.4%)	\$157,880,834 (2.0%)	\$0 (0.0%)
	3	\$90,798,012 (1.1%)	\$386,260,833 (4.9%)	\$796,010,297 (10.1%)	\$4,117,722 (0.1%)	\$0 (0.0%)
	4	\$47,930,894 (0.6%)	\$172,637,785 (2.2%)	\$604,409,191 (7.6%)	\$1,622,999 (0.0%)	\$0 (0.0%)
	5	\$36,824,909 (0.5%)	\$39,660,394 (0.5%)	\$170,699,282 (2.2%)	\$4,581,850 (0.1%)	\$0 (0.0%)

D.8 Lifecycle Management Strategies and Forecasting

The following section outlines the funding required for the entire lifecycle of transportation assets. The expenditures were determined using the lifecycle activities outlined in Table D - 8 and the Level of Service established. Required funding was determined using the following forecasting analysis scenario:

- Maintain Current Levels of Service** – this scenario provides the funding required to maintain a similar asset performance over a 27-year period. It focuses on maintaining the percentage of assets in backlog in a similar state. Backlog is defined as assets that are in need of renewal work (either significant rehabilitation or replacement). For example, if 20% of assets are past their service life, or are in need of renewal work, then the forecast model will determine the funding to maintain 20% of assets in this state over the forecast period.

The forecast analysis identified a total of \$9.7B (annual average of \$358.0M) that is anticipated to be spent over the next 27 years. In 2023, approximately 9.1% of the asset portfolio (by replacement value) is in backlog. The average annual spending identified attempts to maintain this percentage over the next 27 years. The performance and financial forecasts for this state are illustrated in Figure D - 14 and Figure D - 15.

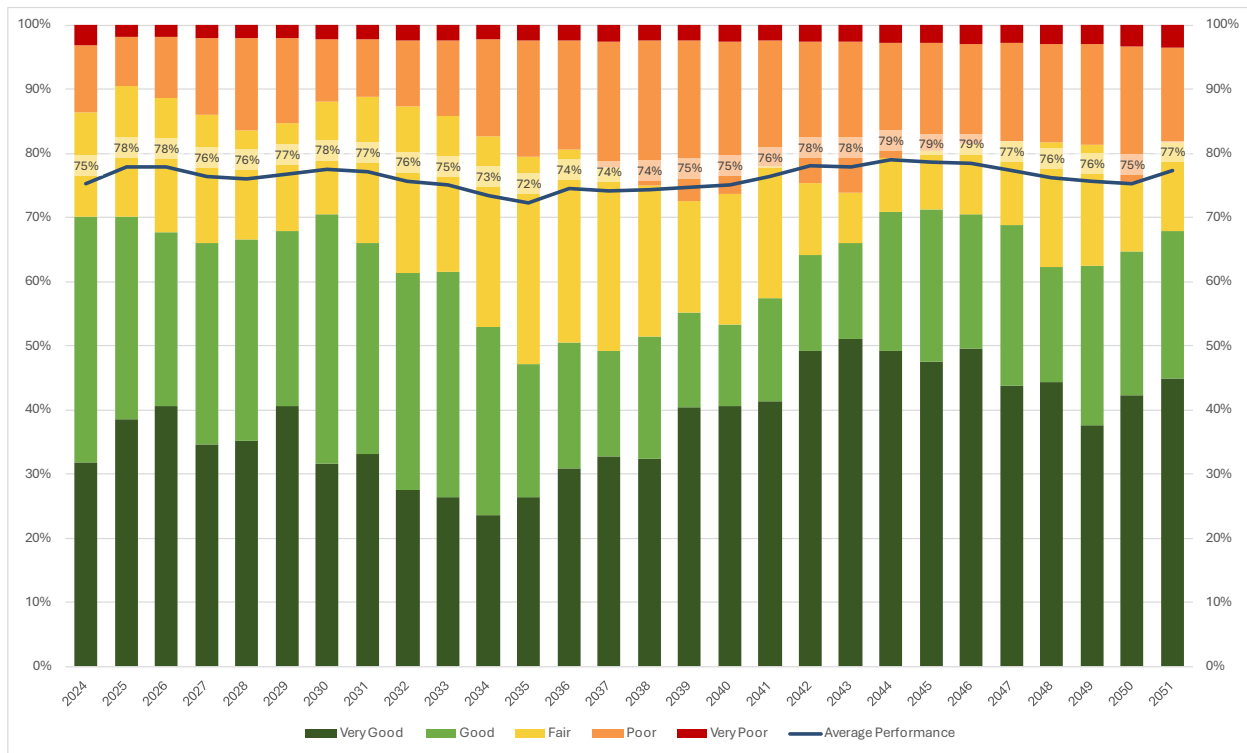


Figure D - 19: Maintain Current LOS Performance Distribution for Transportation Assets

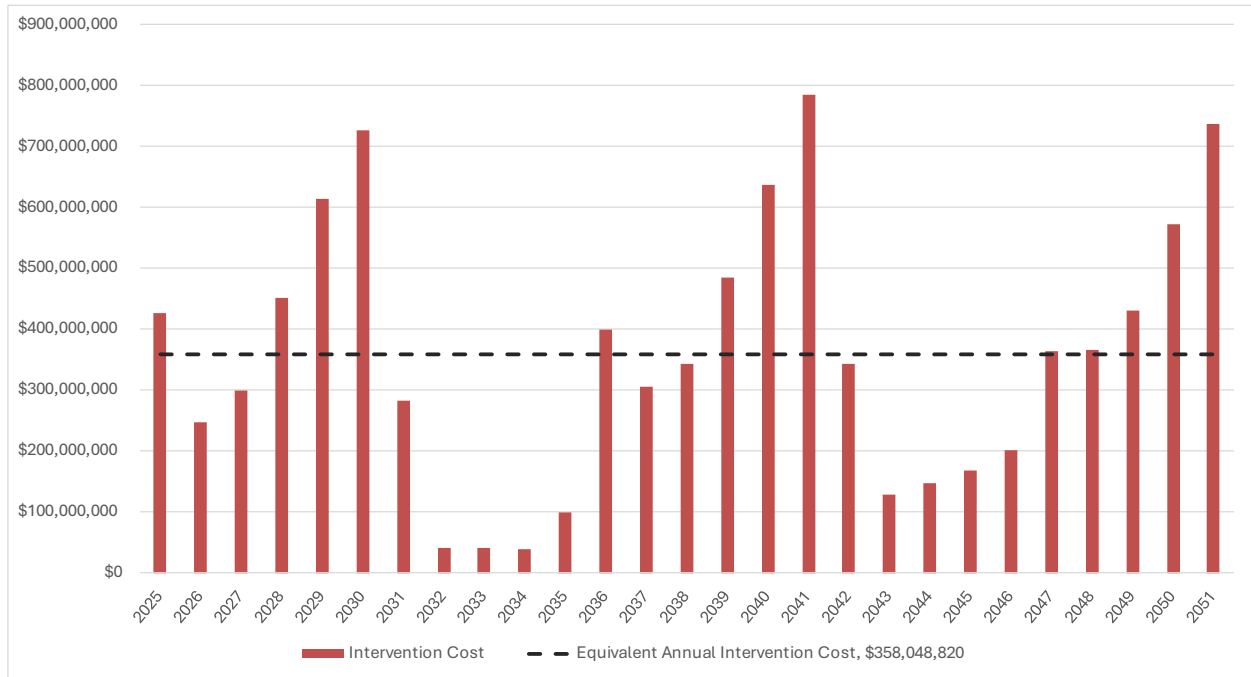


Figure D - 20: Scenario 2 – Maintain Current LOS Intervention Costs for Transportation Assets



**2024 Asset Management
Plan Appendix E:
Recreation
City of Markham**

Appendix E Recreation

Service Summary



Replacement Value

\$988.4 Million

**Very
Good**

Overall Performance



Quantity

33,017 ft² of aquatics facilities
 885,001 ft² of major community centres
 259,295 ft² of minor community centres
 7,250 ft² of residential facilities
 255,231 ft² sports facilities
 1,605 ft² of warehouses
 740 furnishings, fixtures & equipment
 assets

The City's Recreation services contain assets that provide affordable, accessible, safe and reliable community programs for the residents of Markham. By doing so, The City promotes healthy and active lifestyles to citizens.

The City is responsible for assets such as various facilities, furnishings, fixtures and equipment, as detailed in Figure E - 1.

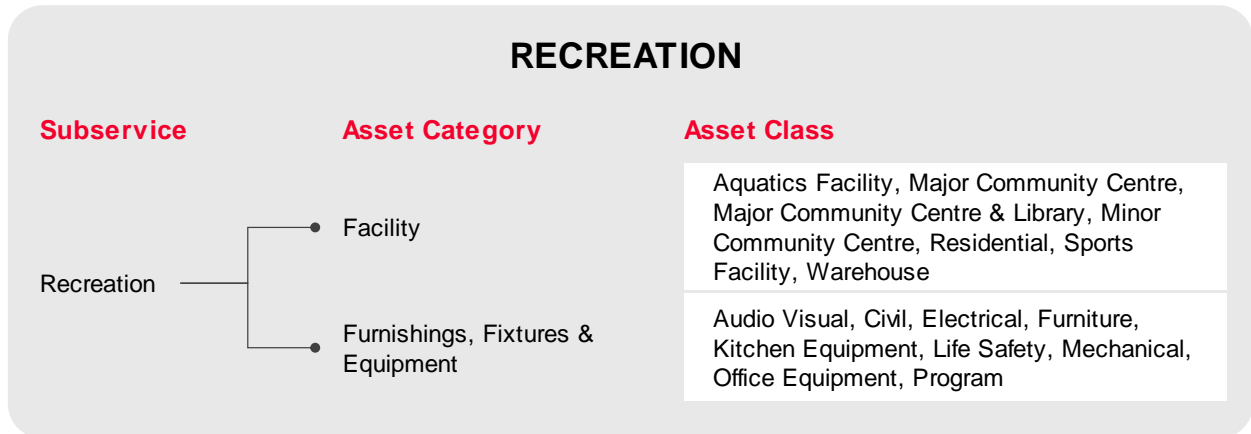


Figure E - 1: Recreation Asset Hierarchy

More information on recreation such as state of infrastructure, levels of service, risk management strategies and lifecycle management strategies and forecasting can be found in the following sections.

E.1 State of the Infrastructure

Figure E - 2 illustrates the replacement value distribution of the recreation service asset portfolio, while Figure E - 3 shows the replacement value distribution of recreation facilities and Figure E - 4 captures the replacement value of recreation equipment, furnishings and fixtures.

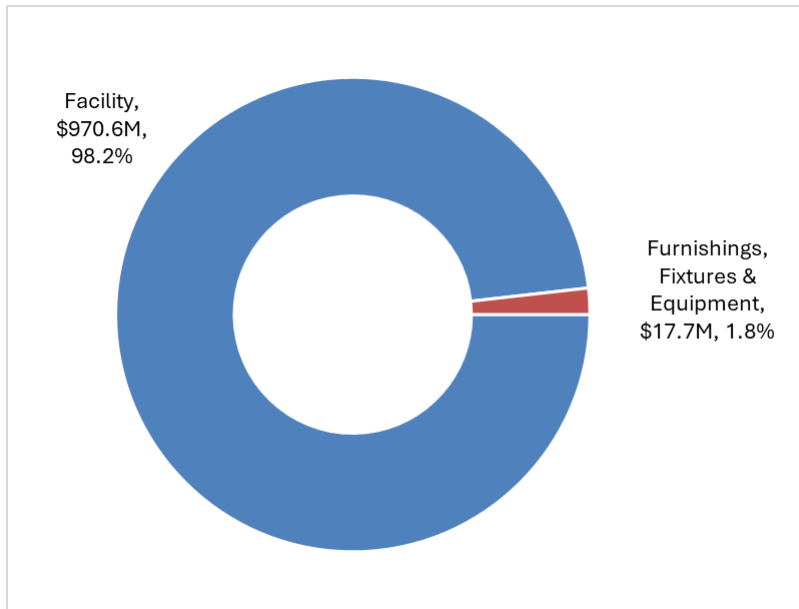


Figure E - 2: Replacement Value Distribution of Recreation Assets

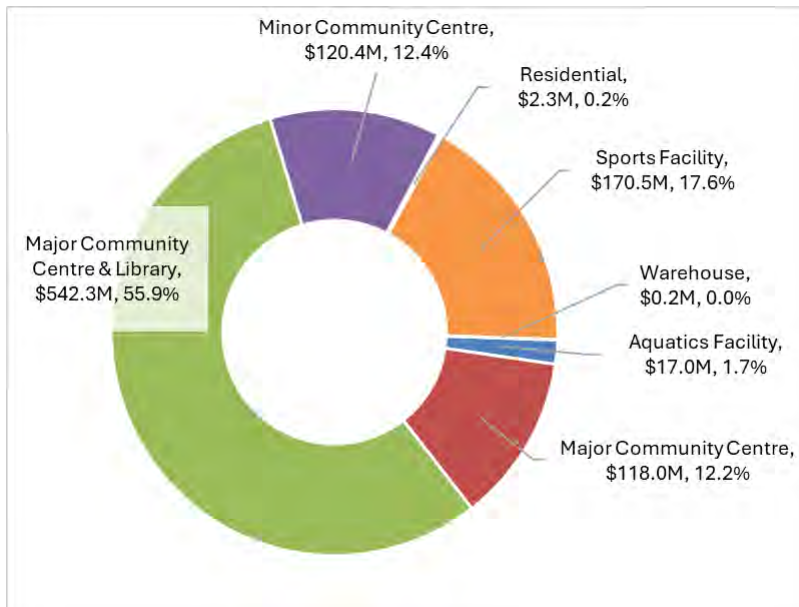


Figure E - 3: Replacement Value Distribution of Recreation Facilities

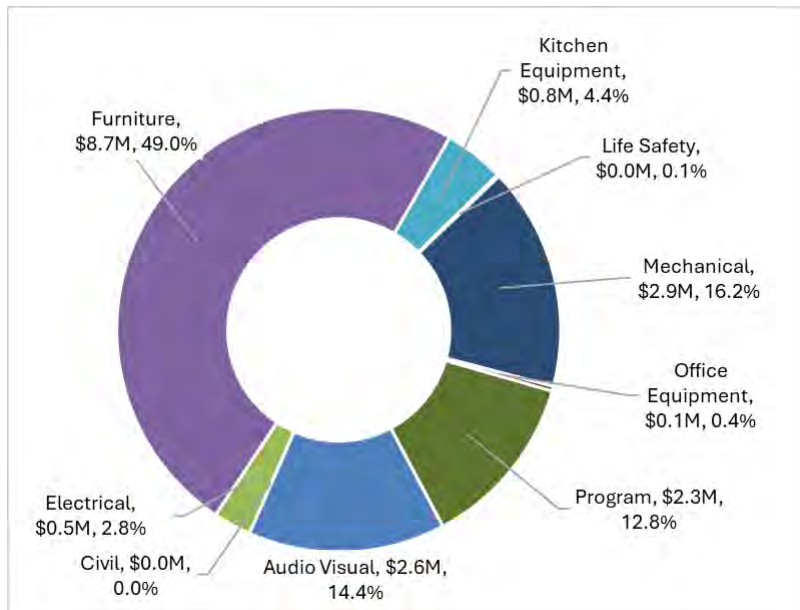


Figure E - 4: Replacement Value Distribution of Recreation Equipment, Furnishings and Fixtures

E.1.1 Asset Inventory and Valuation

Table E - 1 below summarizes the asset valuation, quantities, and performance for each asset category of recreation assets.

Table E - 1: Inventory and Valuation of Recreation Assets

Subservice	Asset Category	Asset Class	Replacement Cost	Inventory	Average Performance
Recreation	Facility	Aquatics Facility	\$16,958,235	33,017 sq ft	Good
		Major Community Centre	\$118,029,215	142,000 sq ft	Very Good
		Major Community Centre & Library	\$542,284,301	743,001 sq ft	Very Good
		Minor Community Centre	\$120,417,923	259,295 sq ft	Very Good
		Residential	\$2,258,801	7,250 sq ft	Good
		Sports Facility	\$170,472,490	255,231 sq ft	Very Good
		Warehouse	\$218,310	1,605 sq ft	Good
		Audio Visual	\$2,550,502	235 Assets	Good
		Civil	\$1,341	1 Asset	Good

	Furnishing, Fixtures & Equipment	Electrical	\$490,401	18 Assets	Good
		Furniture	\$8,685,167	218 Assets	Good
		Kitchen Equipment	\$774,555	97 Assets	Good
		Life Safety	\$23,982	6 Assets	Good
		Mechanical	\$2,881,921	76 Assets	Good
		Office Equipment	\$62,827	6 Assets	Good
		Program	\$2,265,749	83 Assets	Good

E.1.2 Age and Estimated Service Life

Figure E - 5 illustrates the age of recreation assets as a proportion of their estimated service life. Figure E - 6 illustrates the value of recreation assets acquired by decade. Generally, recreation assets are on average between a quarter to halfway through their estimate service life.

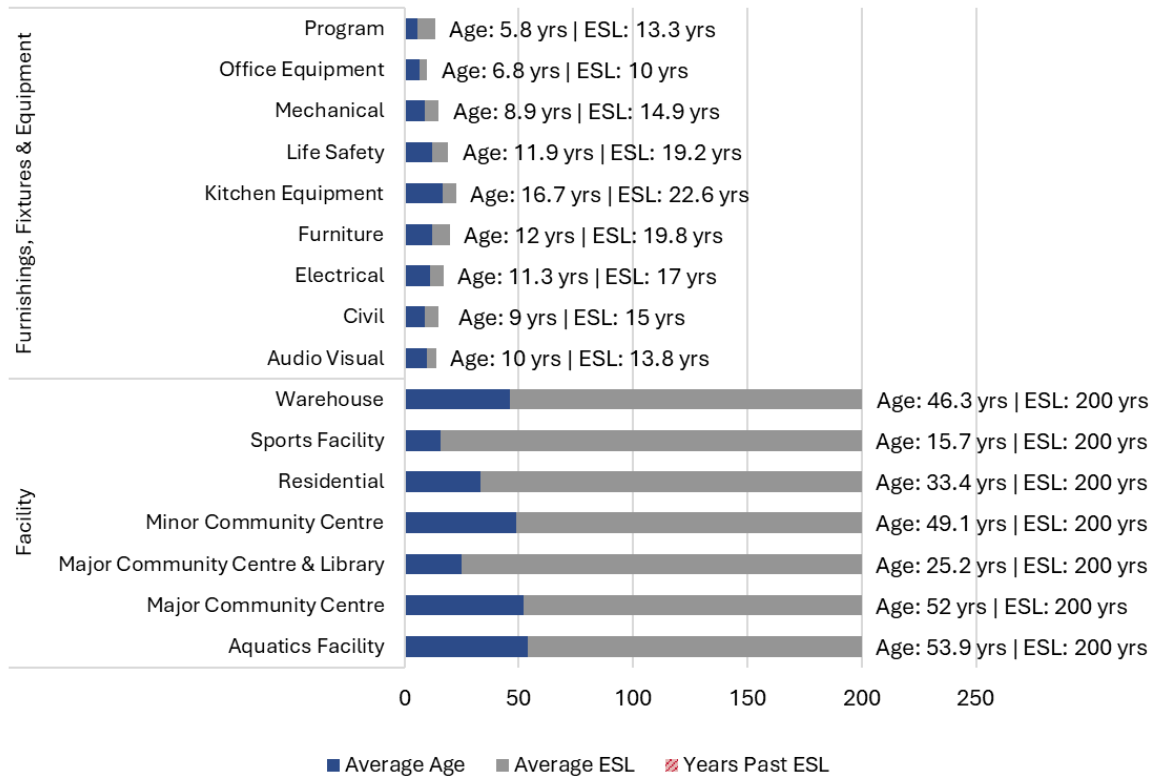


Figure E - 5: Age as a Proportion of Estimated Service Life (ESL) of Recreation Assets

The installation profile of recreation assets illustrates that the majority of major community centres and libraries were constructed in the 1970s, 2000s, and 2010s, in line with some of the decades where the City experienced significant growth and development.

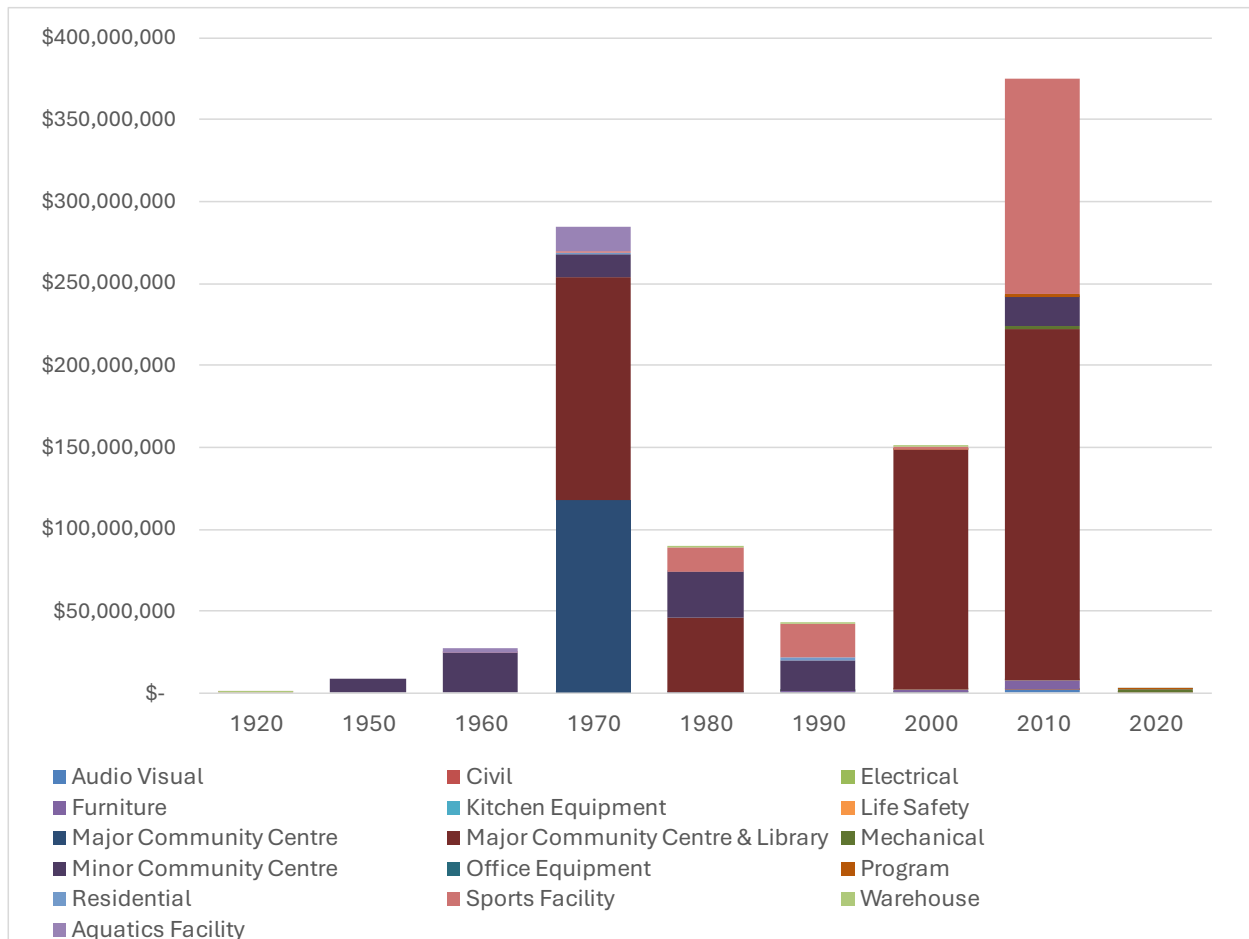


Figure E - 6: Age Distribution by Installation Decade of Recreation Assets

E.1.3 Asset Performance

Table E - 2 below details the approaches that the City utilizes to understand the performance of each asset class in recreation services and the approaches used to assess performance.

Table E - 2 Performance assessment approaches to Recreation Assets

Asset Class	Performance Rating Metric	Approach to Assessing Performance
Major Community Centre & Library	FCI	Facilities are inspected on a 3-year cycle to understand facility renewal needs. The results from inspections are recorded in
Minor Community Centre		
Major Community Centre		

Aquatics Facility		City's database and an FCI rating is calculated.
Sports Facility		
Residential		
Warehouse		
Furniture	Age/ESL	The City understands the performance of these assets based on asset age and estimated service life.
Program		
Mechanical		
Office Equipment		
Audio Visual		
Electrical		
Kitchen Equipment		
Life Safety		
Civil		

Figure E - 7 illustrates the performance distribution of all recreation assets, while Figure E - 8 shows the performance distribution of recreation assets by asset class. Table E - 3 summarizes the relationship between the performance categories and how performance ratings are determined.

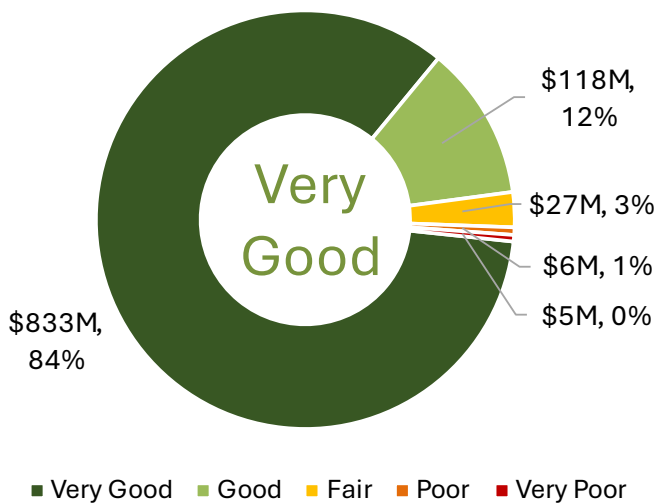


Figure E - 7: Performance Distribution of Recreation Assets

Table E - 3: Performance Ratings of Recreation Assets

Performance Category	Age/ESL	Facility Condition Index (FCI)
Very Good	0% - 20%	0% - 5%
Good	20% - 40%	5% - 10%
Fair	40% - 60%	10% - 30%
Poor	60% - 80%	30% - 60%
Very Poor	80% - 100%	60 - 100%

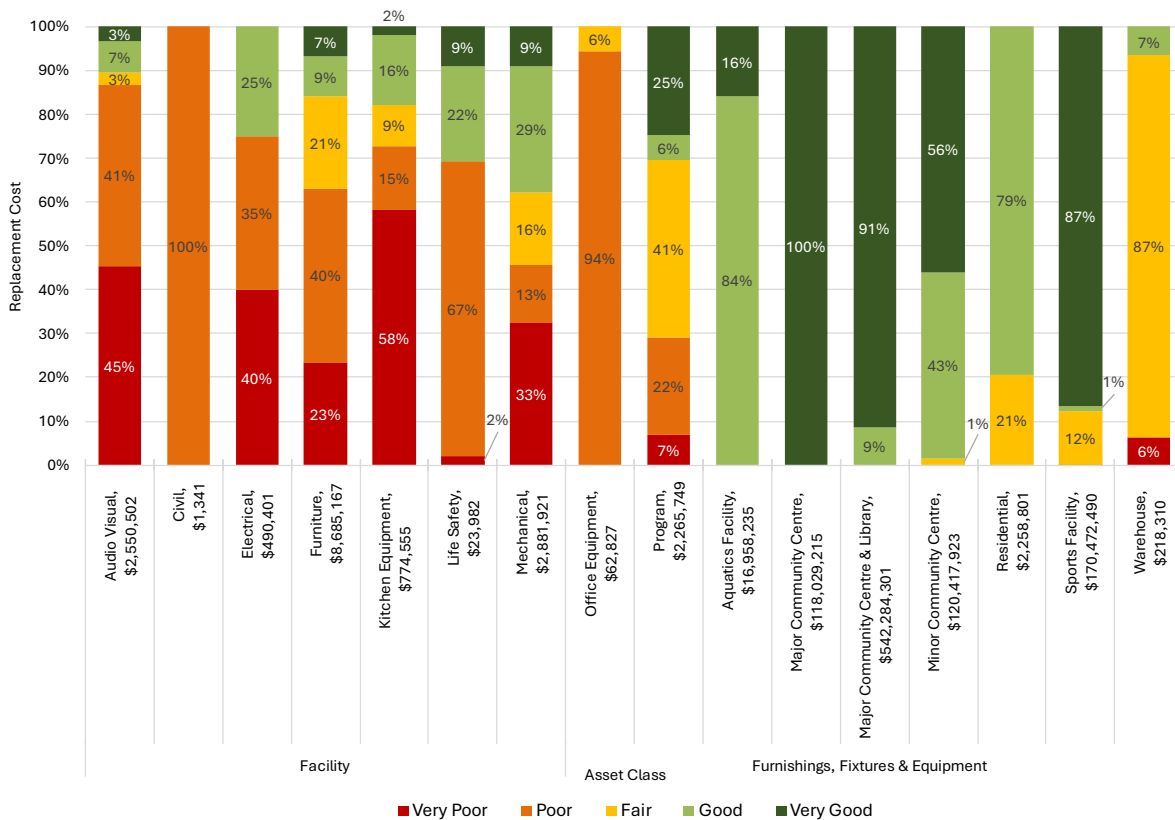


Figure E - 8: Performance Distribution of Recreation Assets by Asset Class

E.2 Levels of Service

Customer values, customer levels of service and technical levels of service for Recreation can be found in Table E - 4, Table E - 5, and Table E - 6, respectively.

Table E - 4: Recreation Customer Values

Customer Values		
Customer Values	Customer Satisfaction Measure	Current Feedback & Expected Trend Based on Planned Budget
Recreation assets are safe and reliable to use	Assets are structurally adequate for use and in overall good working condition.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.
Recreation services are convenient to use	The quality of assets does not negatively affect the customer.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.
	There are sufficient and appropriate amenities available for all customers.	
	Recreation services are accessible.	
Environmentally sustainable	Environmental impacts are minimized.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.

Table E - 5: Recreation Customer LOS

Customer Level of Service Measures			
Type of Measure	Level of Service	Performance Measure	Current Performance
Facilities			
Condition	Condition of Facilities	Average FCI rating of facilities.	0.03

Customer Level of Service Measures			
Type of Measure	Level of Service	Performance Measure	Current Performance
		Confidence Levels: High – condition assessments are performed on facilities to determine condition	
	Individual element/element group condition.	Percentage of all elements/element groups in very poor to poor condition.	1%
		Percentage of assets that have not exceeded their ESL.	99%
		Confidence Levels: High – condition assessments are performed on facilities to determine condition	
Function	Measure of whether the service is appropriate for its intended use	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Capacity	Measure of whether the service is adequate to meet customer needs	<p>The City's targets for community centres are as follows:</p> <ul style="list-style-type: none"> 1 major community centre per 60,000 population 1 minor community centre per 25,000 population 	<ul style="list-style-type: none"> Major community centres per 60,000 population: 1.06 (or 56,417 population per community centre)* Minor community centres per 25,000 population: 1.03 (24,179 population per community centre)* <p>*Based on a 2021 census population of 338,503.</p>
Accessibility	Service interruptions	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
<i>Furnishings, Fixtures & Equipment</i>			
Condition	Condition of assets	Percentage of assets that have not exceeded their ESL.	99%

Customer Level of Service Measures			
Type of Measure	Level of Service	Performance Measure	Current Performance
		Confidence Levels: Low – age and remaining service life are used to determine condition in place of condition data	
	Individual element/element group condition.	Percentage of all elements/element groups in very poor to poor condition.	60%
		Confidence Levels: Low – age and remaining service life are used to determine condition in place of condition data	
Function	Measure of whether the service is appropriate for its intended use	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Capacity	Measure of whether the service is adequate to meet customer needs	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Accessibility	Service interruptions	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	

Table E - 6: Recreation Technical LOS

Technical Level of Service Measures				
Lifecycle Activity	Purpose of Activity	Activity Measure	Current Feedback (2023 Budget)	Recommended Performance
Facilities				
Acquisition	Growth Expansion Development	Projects developed in Integrated Leisure Master Plan	The City is in the process of documenting acquisition costs by service	Recommended performance will be considered and included for the City's 2025 Asset Management
Operation	Inspections	Annual programs	\$244,100	

	Regular Operations	As required		Plan and Financial Strategy
Maintenance	Minor repairs	As needed	\$649,000	
	Regular Maintenance	Annual programs		
	Major maintenance (holding strategies)	As required		
Renewal	Major rehabilitation or replacement	As required	\$7,147,000	
Disposal	Disposal of replaced assets	As required	Included in renewal costs	
Service Improvement	Upgrades to improve LOS to benefit existing serviced areas	As required	\$1,623,300	
<i>Furnishings, Machinery & Equipment</i>				
Acquisition	Growth Expansion Development	Projects developed in Integrated Leisure Master Plan	The City is in the process of documenting acquisition costs by service	Recommended performance will be considered and included for the City's 2025 Asset Management Plan and Financial Strategy
Operation	Inspections	Annual programs	The City is in the process of documenting operation costs by service	
	Regular Operations	As required		
Maintenance	Minor repairs	As required	The City is in the process of documenting maintenance costs by service	
	Regular Maintenance	Annual programs		
	Major maintenance (holding strategies)	As needed		
Renewal	Major rehabilitation or replacement	As needed	\$343,700	

Disposal	Disposal of replaced assets	As required	Included in renewal costs	
Service Improvement	Upgrades to improve LOS to benefit existing serviced areas	As required	-	
Other (not asset specific expenditures)				
Operation	Inspections	Annual programs	\$97,100	Recommended performance will be considered and included for the City's 2025 Asset Management Plan and Financial Strategy
	Regular Operations	As required		

E.3 Risk Management Strategy

The criteria used to determine COF of Recreation Assets can be found in Table E - 7 below:

Table E - 7: COF Criteria used for Recreation Assets

Direct Financial	Socio-Economic	Environmental
<ul style="list-style-type: none"> Replacement cost 	<ul style="list-style-type: none"> Asset Class Asset Detail 	<ul style="list-style-type: none"> Not expected to have significant consequences on environment

Table E - 8 displays the risk score for recreation assets along with the proportion of assets within each risk score, LOF and COF.

Table E - 8: Risk Score Distribution of Recreation Assets

		Consequence of Failure				
		1	2	3	4	5
Likelihood of Failure	1	\$33,526 (0.0%)	\$2,225,442 (0.2%)	\$830,960,970 (84.1%)	\$0 (0.0%)	\$0 (0.0%)
	2	\$37,324 (0.0%)	\$1,246,290 (0.1%)	\$116,445,620 (11.8%)	\$0 (0.0%)	\$0 (0.0%)
	3	\$215,499 (0.0%)	\$2,826,664 (0.3%)	\$23,687,672 (2.4%)	\$0 (0.0%)	\$0 (0.0%)
	4	\$255,586 (0.0%)	\$4,264,056 (0.4%)	\$1,234,517 (0.1%)	\$0 (0.0%)	\$0 (0.0%)

5	\$191,495 (0.0%)	\$2,961,618 (0.3%)	\$1,789,441 (0.2%)	\$0 (0.0%)	\$0 (0.0%)
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E.4 Lifecycle Management Strategies and Forecasting

The following section outlines the funding required for the entire lifecycle of recreation assets. The expenditures were determined using the lifecycle activities outlined in Table E - 6 and the LOS established. Required funding was determined using the following forecasting analysis scenario:

- **Maintain Current Levels of Service** – this scenario provides the funding required to maintain a similar asset performance over a 27-year period. It focuses on maintaining the percentage of assets in backlog in a similar state. Backlog is defined as assets that are in need of renewal work (either significant rehabilitation or replacement). For example, if 20% of assets are past their service life, or are in need of renewal work, then the forecast model will determine the funding to maintain 20% of assets in this state over the forecast period.

The forecast analysis identified a total of \$181.5M (annual average of \$1.5M) that is anticipated to be spent over the next 27 years. In 2024, approximately 0.8% of the asset portfolio (by replacement value) is in backlog. The average annual spending identified attempts to maintain this percentage over the next 27 years. The performance and financial forecasts for this state are illustrated in Figure E - 11 and Figure E - 12.

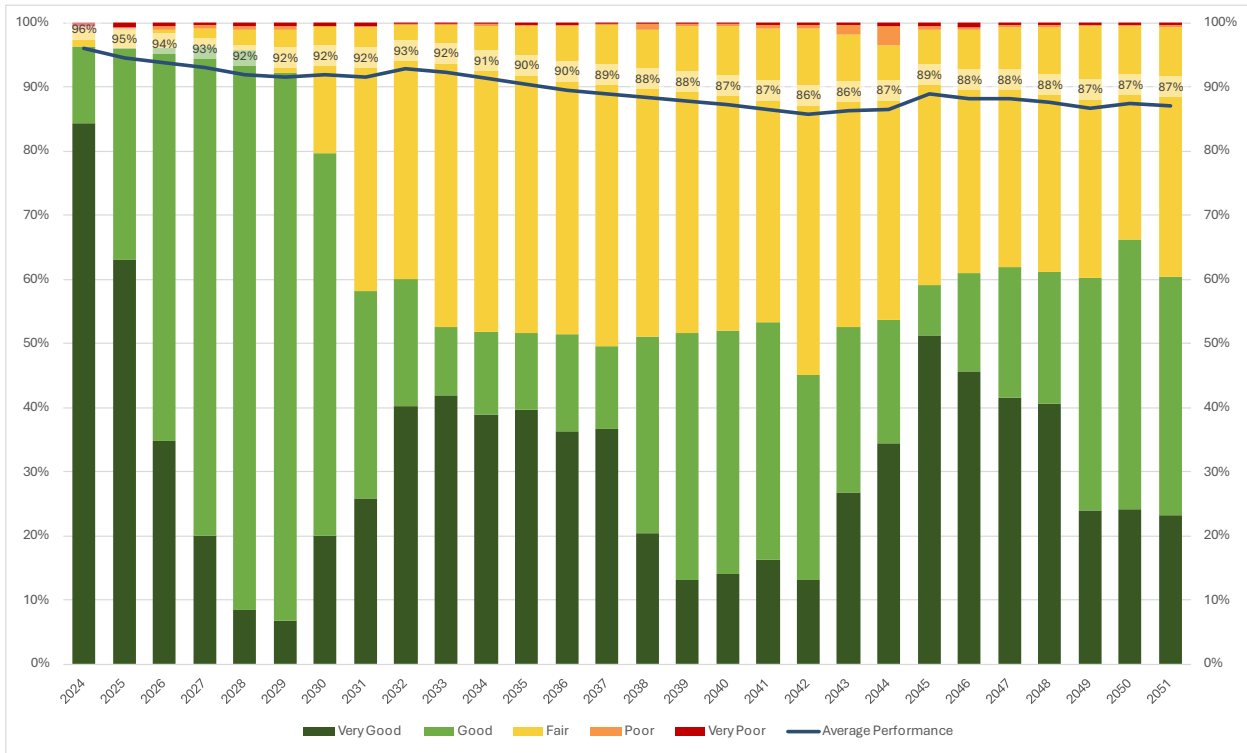


Figure E - 9: Maintain Current LOS Performance Distribution for Recreation Assets

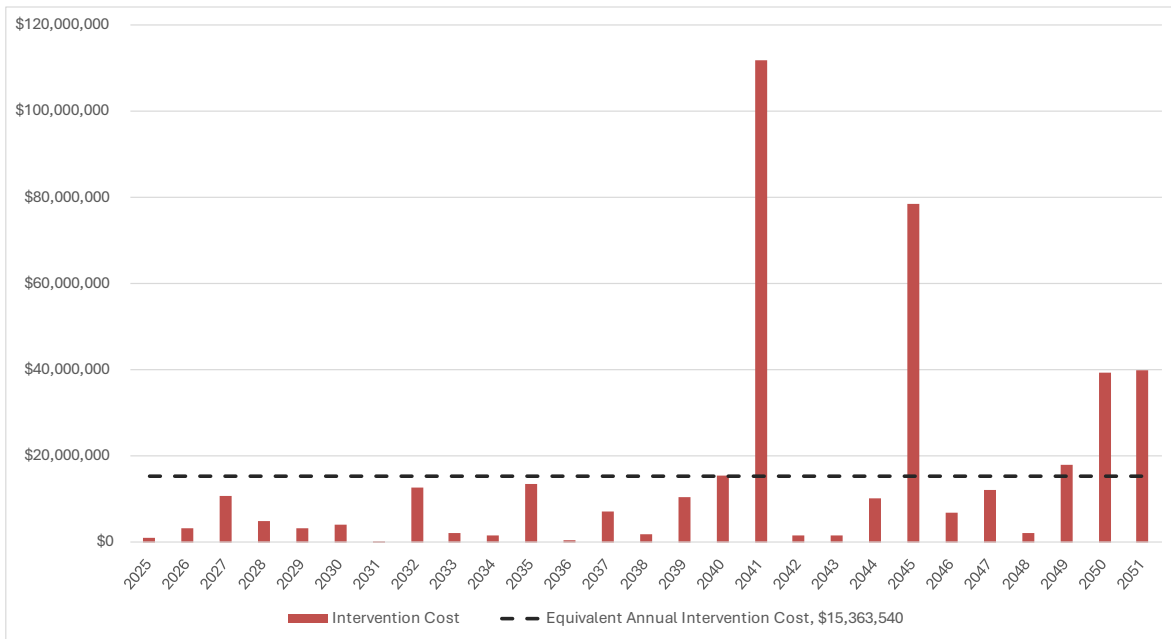


Figure E - 10: Maintain Current LOS Intervention Costs for Recreation Assets



2024 Asset Management Plan Appendix F: Solid Waste Management City of Markham

Appendix F Solid Waste Management

Service Summary



Replacement Value
\$1.9 Million

Good

Overall Performance



Quantity

6,229 ft² of solid waste collection facilities
11 fleet and furnishings, fixtures & equipment assets

The City's Solid Waste Management services lead in waste diversion and environmental strategies like clear garbage bags, e-waste drop-offs, and textile recycling. They promote public awareness and participation in waste reduction, aiming to create a sustainable community and protect natural resources for future generations.

The City's Solid Waste Management Services are responsible for assets such as various facilities, fleet, furnishings, fixtures and equipment detailed in Figure F - 1.



Figure F - 1: Solid Waste Management Asset Hierarchy

More information on Solid Waste Management such as state of infrastructure, levels of service, risk management strategies and lifecycle management strategies and forecasting can be found in the following sections.

F.1 State of the Infrastructure

Figure F - 2 illustrates the replacement value distribution of solid waste service assets by asset category while Figure F - 3 shows the replacement value distribution of solid waste assets by asset class, respectively.

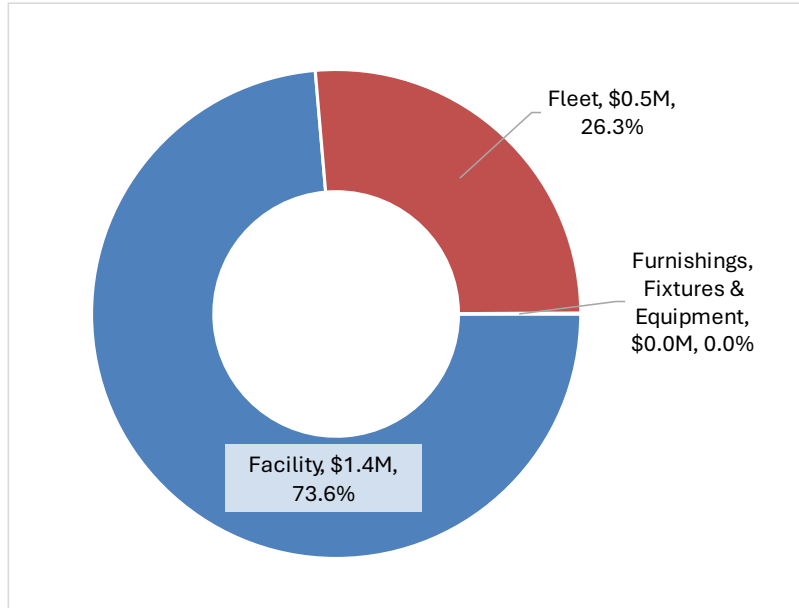


Figure F - 2: Replacement Value Distribution of Solid Waste Assets

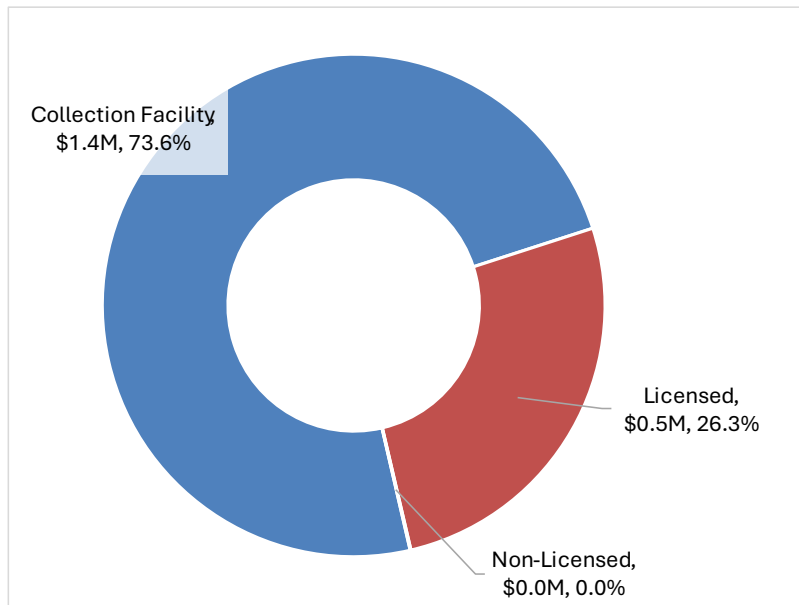


Figure F - 3: Replacement Value Distribution of Solid Waste Assets by Asset Class

F.1.1 Asset Inventory and Valuation

Table F - 1 below summarizes the asset valuation, quantities, and condition for each asset category in solid waste management.

Table F - 1: Inventory and Valuation of Solid Waste Assets

Subservice	Asset Category	Asset Class	Replacement Cost	Inventory	Average Condition
Solid Waste Collection	Facility	Collection Facility	\$1,389,826	6,229 sq ft	Very Good
	Fleet	Licensed	\$496,703	5 Assets	Good
	Furnishings, Fixtures & Equipment	Non-Licensed	\$920	1 Asset	Good

F.1.2 Age and Estimated Service Life

Figure F - 4 illustrates the age of solid waste assets as a proportion of their estimated service life and Figure F - 5 illustrates the value of solid waste management assets acquired by decade.

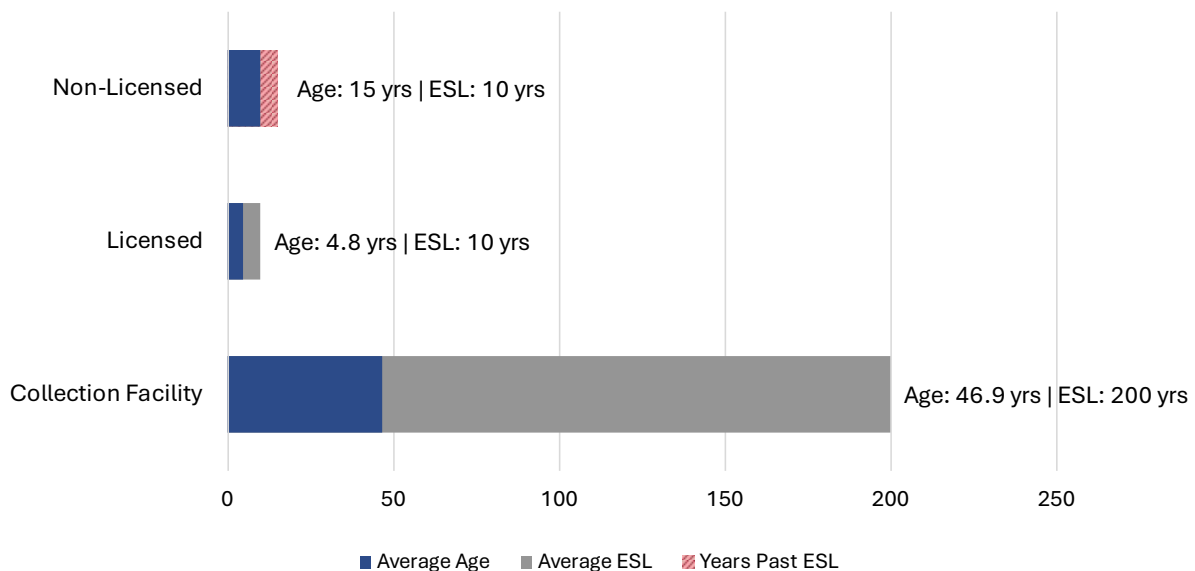


Figure F - 4: Age as a Proportion of Estimated Service Life (ESL) of Solid Waste Assets

The installation profile illustrates that the majority of solid waste management facilities were constructed in the 1980s and 1990s, in line with decades that experienced significant growth and corresponding development in the City.

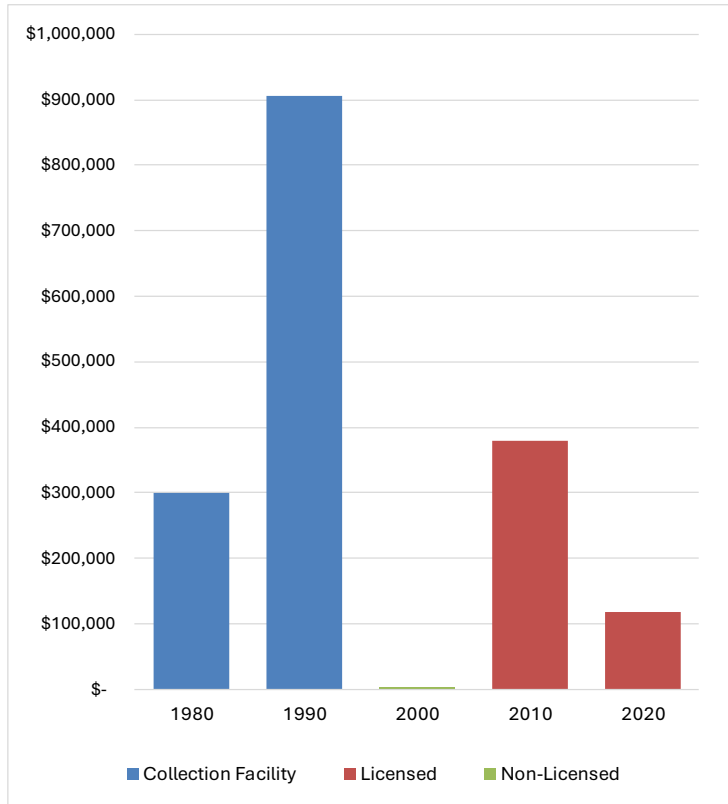


Figure F - 5: Age Distribution by Installation Decade of Solid Waste Management Assets

F.1.3 Asset Condition

Table F - 2 details the approaches used by the City to understand and assess the condition of each asset class in solid waste management services.

Table F - 2: Condition assessment approaches to Solid Waste Management Assets

Asset Class	Condition Rating Metric	Approach to Assessing Condition
Collection Facility	FCI	Facilities are inspected on a 3-year cycle. The inspection results are recorded in City's database annually and used to understand facility renewal needs and calculate the FCI.
Fleet	Age/ESL	Reviewed upon arrival of new asset, inspected monthly and upon completion of maintenance then recorded into City's database
Furnishings, Fixtures & Equipment		

Figure F - 6 and Figure F - 7 illustrate the condition distribution of all solid waste management assets. Table F - 3 summarizes the relationship between the condition categories and how condition ratings are determined.

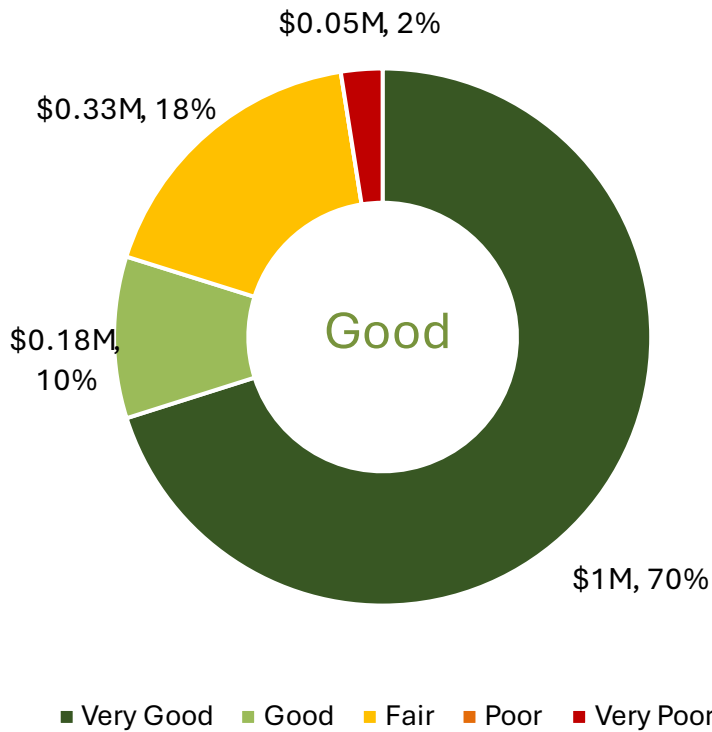


Figure F - 6: Condition Distribution of Solid Waste Management Assets

Table F - 3: Condition Ratings of Solid Waste Assets

Condition Category	Age/ESL	Facility Condition Index (FCI)
Very Good	0% - 20%	0% - 5%
Good	20% - 40%	5% - 10%
Fair	40% - 60%	10% - 30%
Poor	60% - 80%	30% - 60%
Very Poor	80% - 100%	60 - 100%

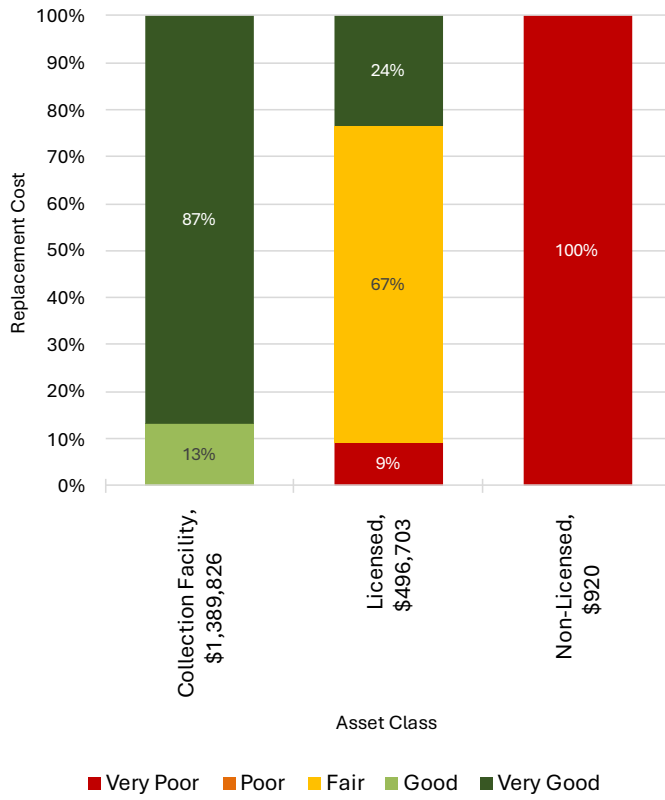


Figure F - 7: Condition Distribution of Solid Waste Assets by Asset Class

F.2 Levels of Service

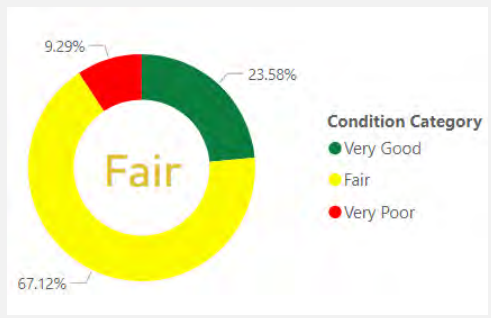
Customer values, customer levels of service and technical levels of service for Solid Waste Management can be found in Table F - 4, Table F - 5, and Table F - 6, respectively.

Table F - 4: Solid Waste Management Customer Values

Customer Values		
Customer Values	Customer Satisfaction Measure	Current Feedback & Expected Trend Based on Planned Budget
Solid waste management services are safe and reliable to use	Assets are structurally adequate for use and in overall good working condition.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.
Solid waste management services are convenient to use	The quality of assets does not negatively affect the customer.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.
	There are sufficient and appropriate facilities and services available for all customers.	
	Solid waste management services are accessible.	
Environmentally sustainable	Environmental impacts are minimized.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.

Table F - 5: Solid Waste Management Customer LOS

Customer Level of Service Measures			
Type of Measure	Level of Service	Performance Measure	Current Performance
Facilities			
Condition	Condition of Facilities	Average FCI rating of facilities.	0.025
		Confidence Levels: Medium – building condition assessments are performed on facilities to determine investment needs but data requires refinement.	
	Individual element/element group condition.	Percentage of all elements/element groups in poor or very poor condition.	0%
		Percentage of assets that have not exceeded their ESL.	100%
		Confidence Levels: Medium – building condition assessments are performed on facilities to determine investment needs but data requires refinement.	
Function	Measure of whether the service is appropriate for its intended use	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Capacity	Measure of whether the service is adequate to meet customer needs	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Accessibility	Service interruptions	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	

Customer Level of Service Measures			
Type of Measure	Level of Service	Performance Measure	Current Performance
Fleet			
Condition	Condition of assets	Condition or Age/Remaining Useful Life - Aggregated into 5-point rating scale	
		Percentage of assets that have not exceeded their ESL.	91%
		Confidence Levels: Moderate – age and ESL are used to assess for condition. Condition data is not typically collected for this asset type.	
Function	Measure of whether the service is appropriate for its intended use	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Capacity	Measure of whether the service is adequate to meet customer needs		
Accessibility	Service interruptions		
Furnishings, Fixtures & Equipment			
Condition	Condition of assets	Percentage of assets that have not exceeded their ESL.	0%

Customer Level of Service Measures			
Type of Measure	Level of Service	Performance Measure	Current Performance
			Confidence Levels: Low to medium – age and ESL are used to assess for condition. Condition data is unavailable.
Function	Measure of whether the service is appropriate for its intended use		The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.
Capacity	Measure of whether the service is adequate to meet customer needs		The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.
Accessibility	Service interruptions		The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.

Table F - 6: Solid Waste Management Technical LOS

Technical Level of Service Measures				
Lifecycle Activity	Purpose of Activity	Activity Measure	Current Performance (\$, 2023 Budget)	Recommended Performance
Facilities				
Acquisition	Growth Expansion Development	Projects developed in solid waste management related growth studies	-	Recommended performance will be considered and included for the City's 2025 Asset Management Plan and Financial Strategy
	Operation	Inspections	Annual programs	
Regular Operations		As required		
Maintenance	Minor repairs	As required	-	
	Regular Maintenance	Annual programs		
	Major maintenance (holding strategies)	As required		
Renewal	Major rehabilitation or replacement	As required	\$13,000	
Disposal	Disposal of replaced assets	As required	Included in renewal costs	
Service Improvement	Upgrades to improve LOS to benefit existing serviced areas	As required	-	
Fleet				
Acquisition	Growth Expansion Development	Projects developed in solid waste management related growth studies	\$106,100	Recommended performance will be considered and included for the City's 2025 Asset Management
Operation	Inspections	Annual programs	-	

Technical Level of Service Measures				
Lifecycle Activity	Purpose of Activity	Activity Measure	Current Performance (\$, 2023 Budget)	Recommended Performance
	Regular Operations	As required		Plan and Financial Strategy
Maintenance	Minor repairs	As required	-	
	Regular Maintenance	Annual programs		
	Major maintenance (holding strategies)	As required		
Renewal	Major rehabilitation or replacement	As required	-	
Disposal	Disposal of replaced assets	As required	-	
Service Improvement	Upgrades to improve LOS to benefit existing serviced areas	As required	-	

F.3 Risk Management Strategy

The criteria used to determine COF of Solid Waste Management Assets can be found in Table F - 7 below:

Table F - 7: COF Criteria used for Solid Waste Management Assets

Direct Financial	Socio-Economic	Environmental
• Replacement cost	• Asset Class	• Asset Class

Table F - 8 displays the risk score for Solid Waste Management assets along with the proportion of assets within each risk score, LOF and COF.

Table F - 8: Risk Score Distribution for Solid Waste Management Assets

		Consequence of Failure				
		1	2	3	4	5
Likelihood of Failure	1	\$0 (0.0%)	\$117,138 (6.2%)	\$1,206,201 (63.9%)	\$0 (0.0%)	\$0 (0.0%)
	2	\$0 (0.0%)	\$0 (0.0%)	\$183,625 (9.7%)	\$0 (0.0%)	\$0 (0.0%)
	3	\$0 (0.0%)	\$333,402 (17.7%)	\$0 (0.0%)	\$0 (0.0%)	\$0 (0.0%)
	4	\$0 (0.0%)	\$0 (0.0%)	\$0 (0.0%)	\$0 (0.0%)	\$0 (0.0%)
	5	\$920 (0.0%)	\$46,163 (2.4%)	\$0 (0.0%)	\$0 (0.0%)	\$0 (0.0%)

F.4 Lifecycle Management Strategies and Forecasting

The following section outlines the funding required for the entire lifecycle of solid waste management assets. The expenditures were determined using the lifecycle activities outlined in Table F - 6 and the LOS established. Required funding was determined using the following forecasting analysis scenario:

- **Maintain Current Levels of Service** – this scenario provides the funding required to maintain a similar asset performance over a 27-year period. It focuses on maintaining the percentage of assets in backlog in a similar state. Backlog is defined as assets that are in need of renewal work (either significant rehabilitation or replacement). For example, if 20% of assets are past their service life, or are in need of renewal work, then the forecast model will determine the funding to maintain 20% of assets in this state over the forecast period.

The forecast analysis identified a total of \$1.9M (annual average of \$105.2k) that is anticipated to be spent over the next 27 years. In 2023, approximately 3.9% of the asset portfolio (by replacement value) is in backlog. The average annual spending identified attempts to maintain this percentage over the next 27 years. The performance and financial forecasts for this state are illustrated in Figure F - 8 and Figure F - 9. Note that there are significant expenditures forecasted in 2029, 2039, 2041, and 2049, which represent significant amounts of asset needs that are forecasted to occur in those years.

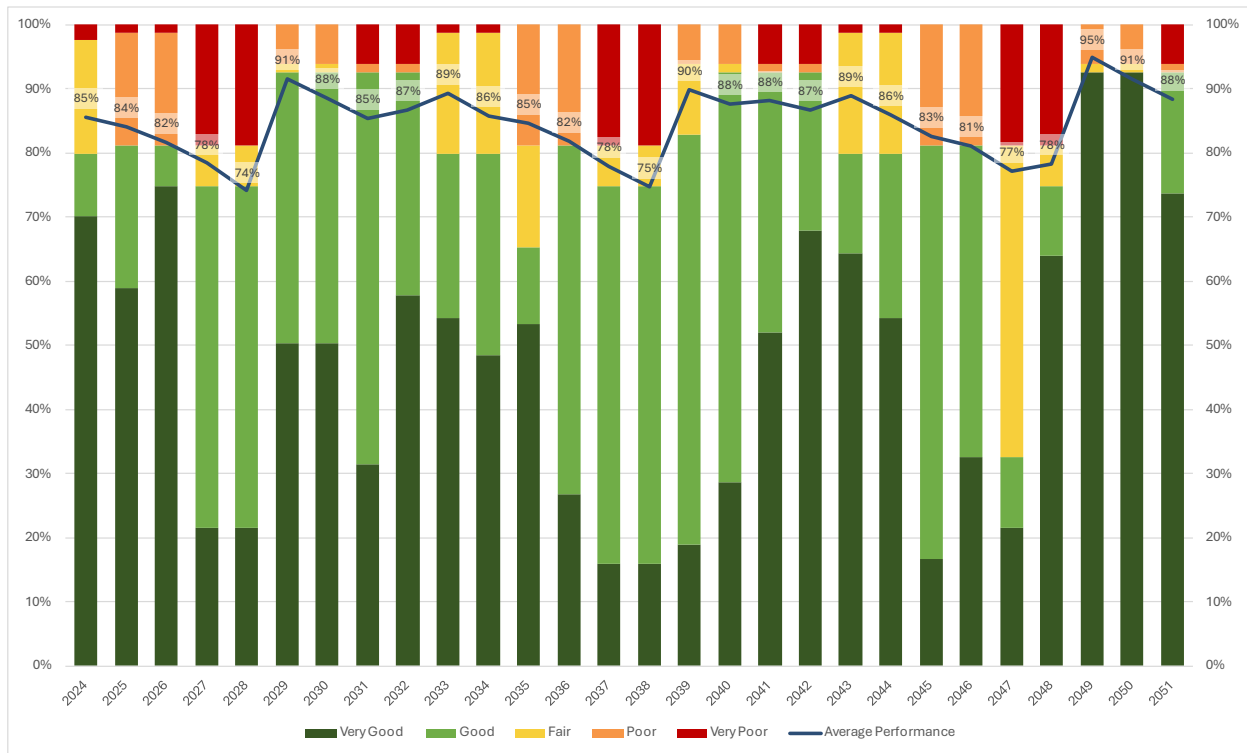


Figure F - 8: Scenario 2 – Maintain Current LOS Performance Distribution for Solid Waste Management Assets

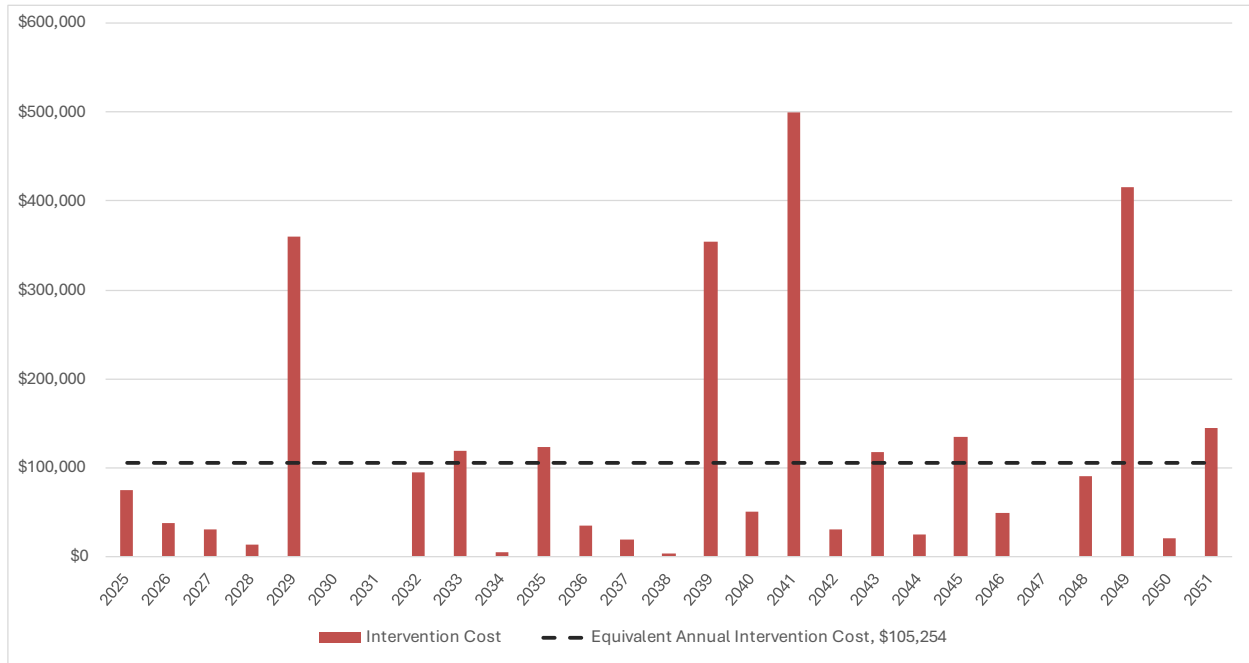


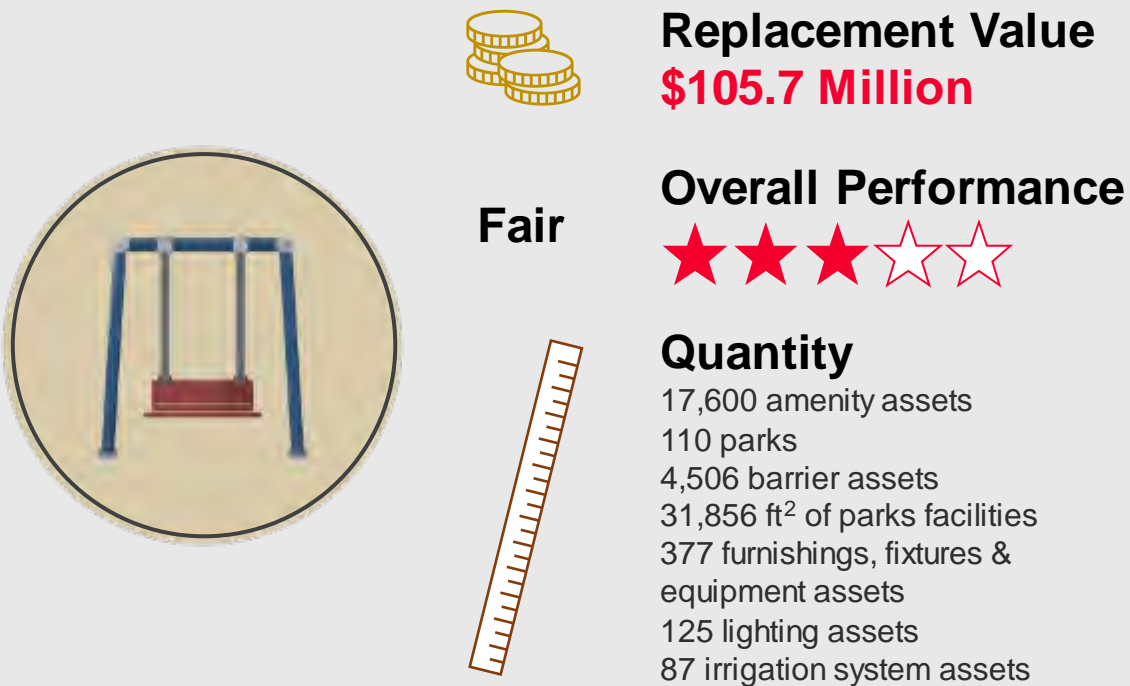
Figure F - 9: Scenario 2 – Maintain Current LOS Intervention Costs for Solid Waste Management Assets



2024 Asset Management Plan Appendix G: Parks City of Markham

Appendix G Parks

Service Summary



The City of Markham’s Parks Services promote a safe, active and healthy outdoor experience for residents and visitors. The City and its residents take pride in keeping their parks beautiful and encourage all users of outdoor spaces to do their part.

Markham is responsible for assets such as various amenities, facilities, lighting, barriers, site servicing, furnishings, fixtures and equipment, as detailed in Figure G - 1.

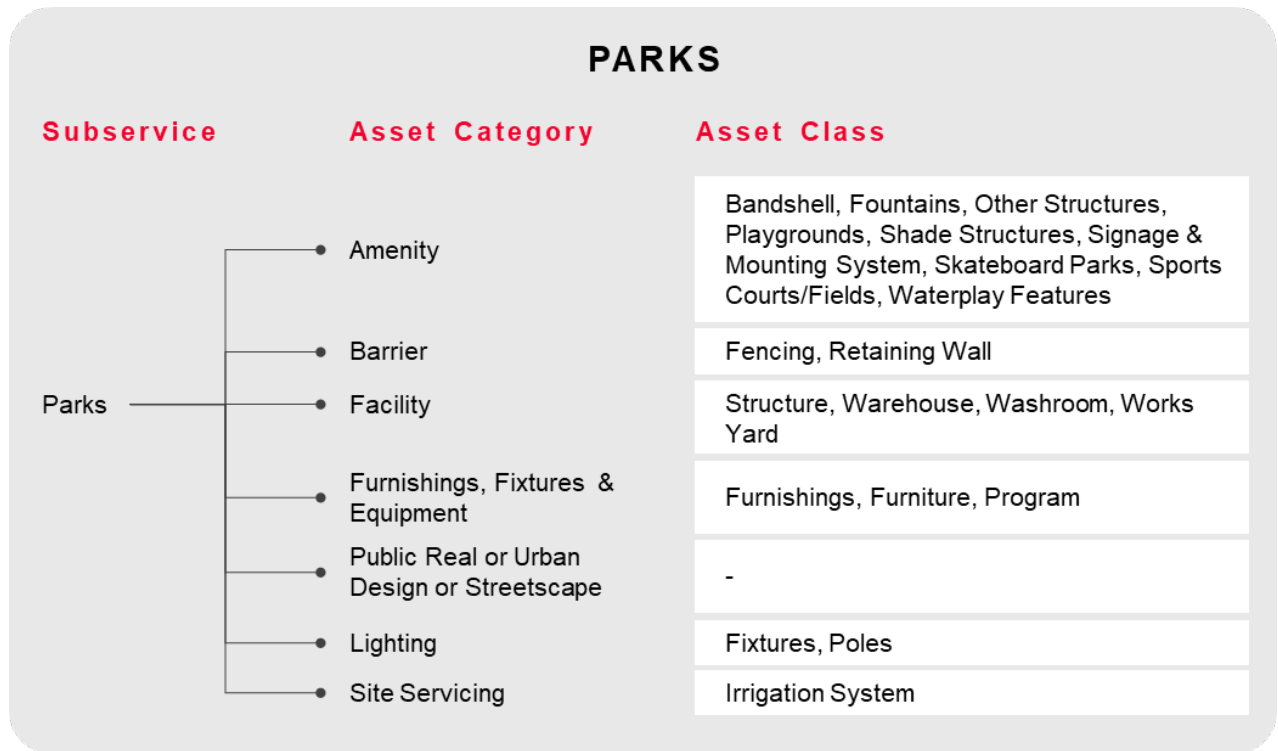


Figure G - 1: Parks Asset Hierarchy

More information on Parks such as state of infrastructure, levels of service, risk management strategies and lifecycle management strategies and forecasting can be found in the following sections.

G.1 State of the Infrastructure

Figure G - 2 provides the replacement value for all parks assets, while Figure G - 3 illustrates the replacement value distribution of amenities and Figure G - 4 shows the replacement value distribution of facilities, furnishings, fixtures and equipment.

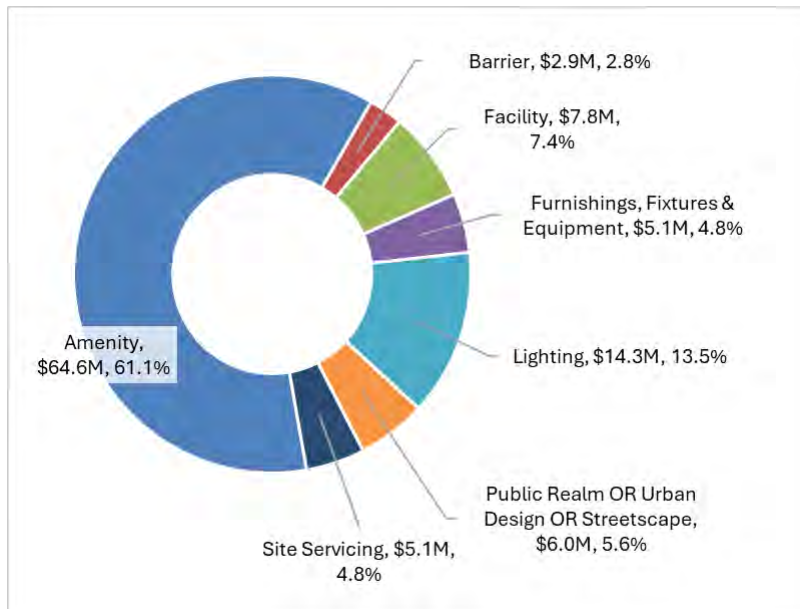


Figure G - 2: Replacement Value Distribution of Parks Assets

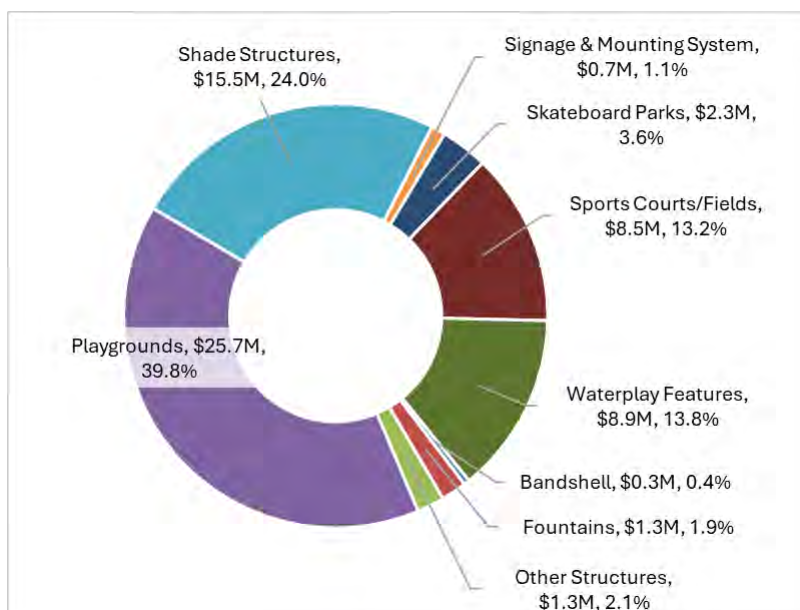


Figure G - 3: Replacement Value Distribution of Park Amenity Assets

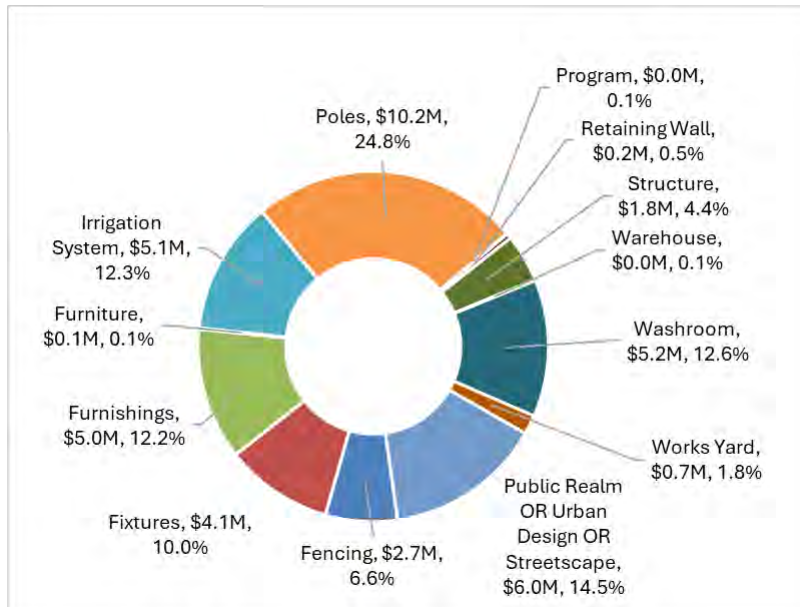


Figure G - 4: Replacement Value Distribution of Park Facilities, Equipment, Furnishing & Fixture Assets

G.1.1 Asset Inventory and Valuation

Table G - 1 below summarizes the asset valuation, quantities, and performance for each asset category of parks assets.

Table G - 1: Inventory and Valuation of Parks Assets

Subservice	Asset Category	Asset Class	Replacement Cost	Inventory	Average Performance
Parks	Amenity	Bandshell	\$289,959	11 Assets	Good
		Fountains	\$1,253,352	7 Assets	Fair
		Other Structures	\$1,348,156	6 Assets	Fair
		Playgrounds	\$25,730,790	16,641 Assets	Fair
		Shade Structures	\$15,534,973	155 Assets	Good
		Signage & Mounting System	\$699,626	495 Assets	Fair
		Skateboard Parks	\$2,321,694	8 Assets	Fair
		Sports Courts/Fields	\$8,513,713	246 Assets	Poor

Subservice	Asset Category	Asset Class	Replacement Cost	Inventory	Average Performance
		Waterplay Features	\$8,915,984	31 Assets	Poor
	Barrier	Fencing	\$2,730,198	4,502 Assets	Fair
		Retaining Wall	\$195,632	4 Assets	Good
	Facility	Structure	\$1,805,794	13,147 sq ft	Good
		Warehouse	\$40,806	300 sq ft	Fair
		Washroom	\$5,197,735	16,683 sq ft	Very Good
		Works Yard	\$734,217	1,726 sq ft	Very Good
	Furnishings, Fixtures & Equipment	Furnishings	\$5,010,625	362 Assets	Poor
		Furniture	\$53,346	11 Assets	Good
		Program	\$21,000	4 Assets	Very Poor
	Lighting	Fixtures	\$4,102,844	75 Assets	Fair
		Poles	\$10,206,982	50 Assets	Poor
	Public Realm OR Urban Design OR Streetscape	Public Realm OR Urban Design OR Streetscape	\$5,963,162	158 Assets	Good
	Site Servicing	Irrigation System	\$5,068,921	87 Assets	Fair

G.1.2 Age and Estimated Service Life

Figure G - 5 illustrates the age of parks assets as a proportion of their estimated service life and Figure G - 6 shows the value of assets acquired by decade. Generally, parks assets are on average a quarter through their estimate service life. Sports courts/fields and program assets have average ages that exceed their average ESLs.

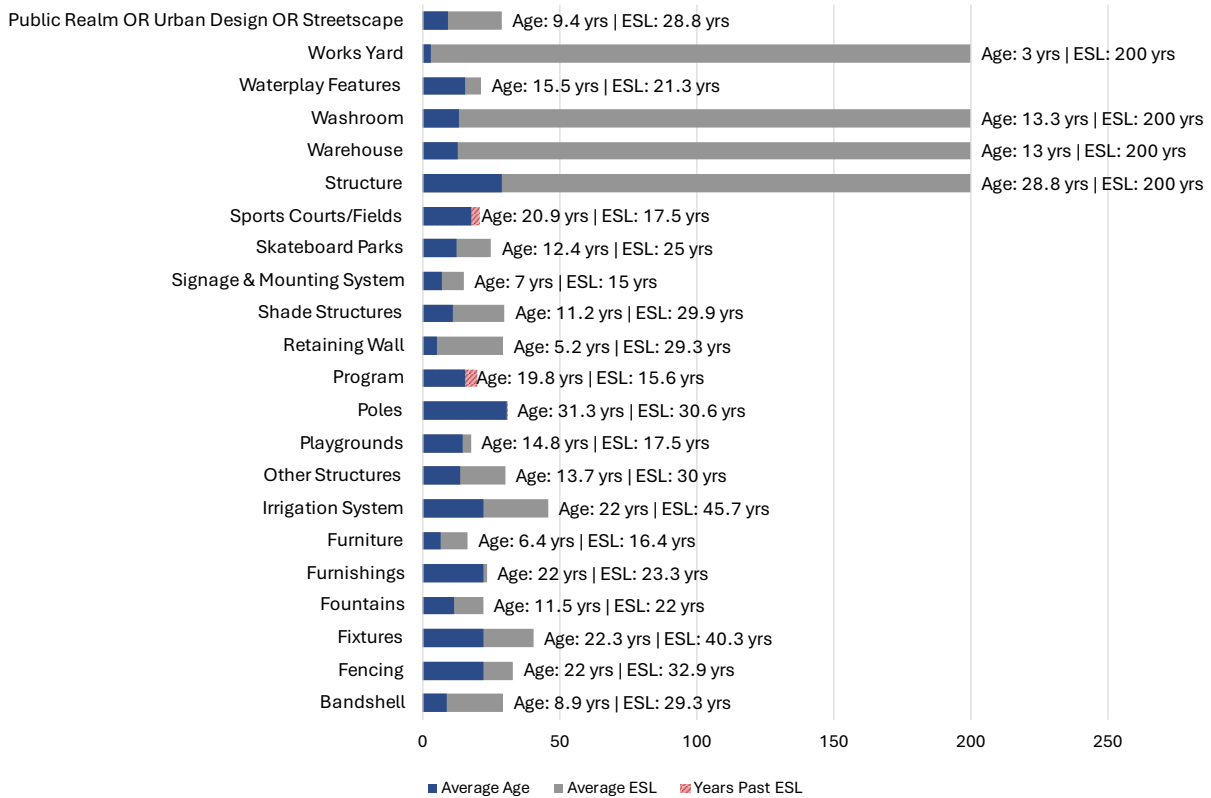


Figure G - 5: Age as a Proportion of Estimated Service Life (ESL) of Parks Assets

The installation profile of parks assets illustrates that the majority of assets were installed from the 2000s, due to the significant growth and development in the City.

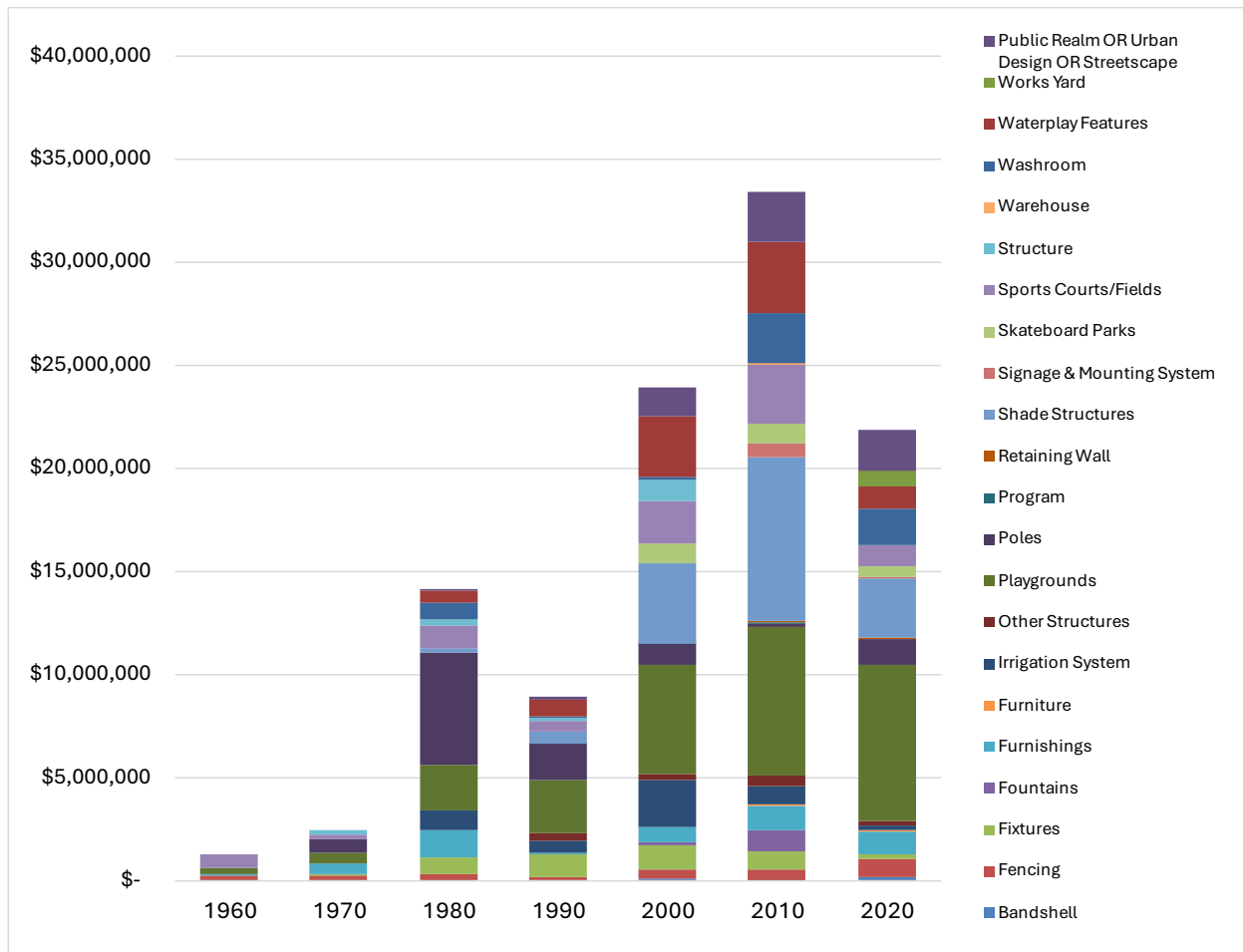


Figure G - 6: Age Distribution by Installation Decade of Parks Assets

G.1.3 Asset Performance

Table G - 2 summarizes the approaches used by the City to understand the performance of each asset class and the approaches to assess performance.

Table G - 2: Performance assessment approaches to Park Assets

Asset Class	Performance Rating Metric	Approach to Assessing Performance
Structure	FCI	Facilities are inspected on a 3-year cycle and performance is recorded in city's database. The inspection results are used to understand facility renewal needs and to calculate the FCI rating.
Warehouse		
Washroom		
Works Yard		
Fencing	Age/ESL	

Asset Class	Performance Rating Metric	Approach to Assessing Performance
Fixtures		The City understands the performance of these assets based on asset age and estimated service life
Shade Structures		
Other Structures		
Waterplay Features		
Sports Courts/Fields		
Furnishings		
Public Realm /Urban Design /Streetscape		
Retaining Wall		
Poles		
Irrigation System		
Signage & Mounting System		
Playgrounds		
Skateboard Parks		
Fountains		
Bandshell		
Furniture		
Program		

Figure G - 7 captures the performance of all park assets and Figure G - 8 shows the performance distribution of park assets by asset class. Table G - 3 summarizes the relationship between the performance categories and how performance ratings are determined.

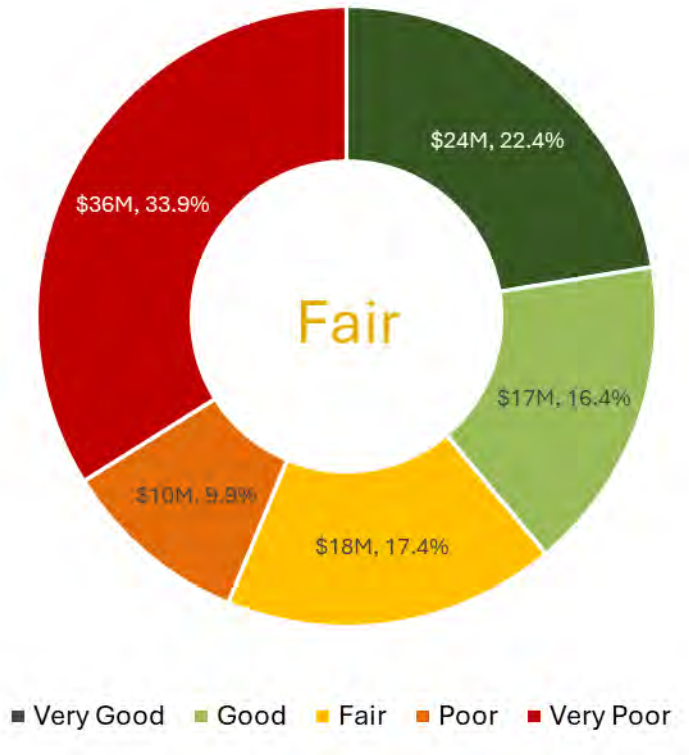


Figure G - 7: Performance Distribution of Parks Assets

Table G - 3: Performance Ratings of Parks Assets

Performance Category	Age/ESL	Facility Condition Index (FCI)
Very Good	0% - 20%	0% - 5%
Good	20% - 40%	5% - 10%
Fair	40% - 60%	10% - 30%
Poor	60% - 80%	30% - 60%
Very Poor	80% - 100%	60 - 100%

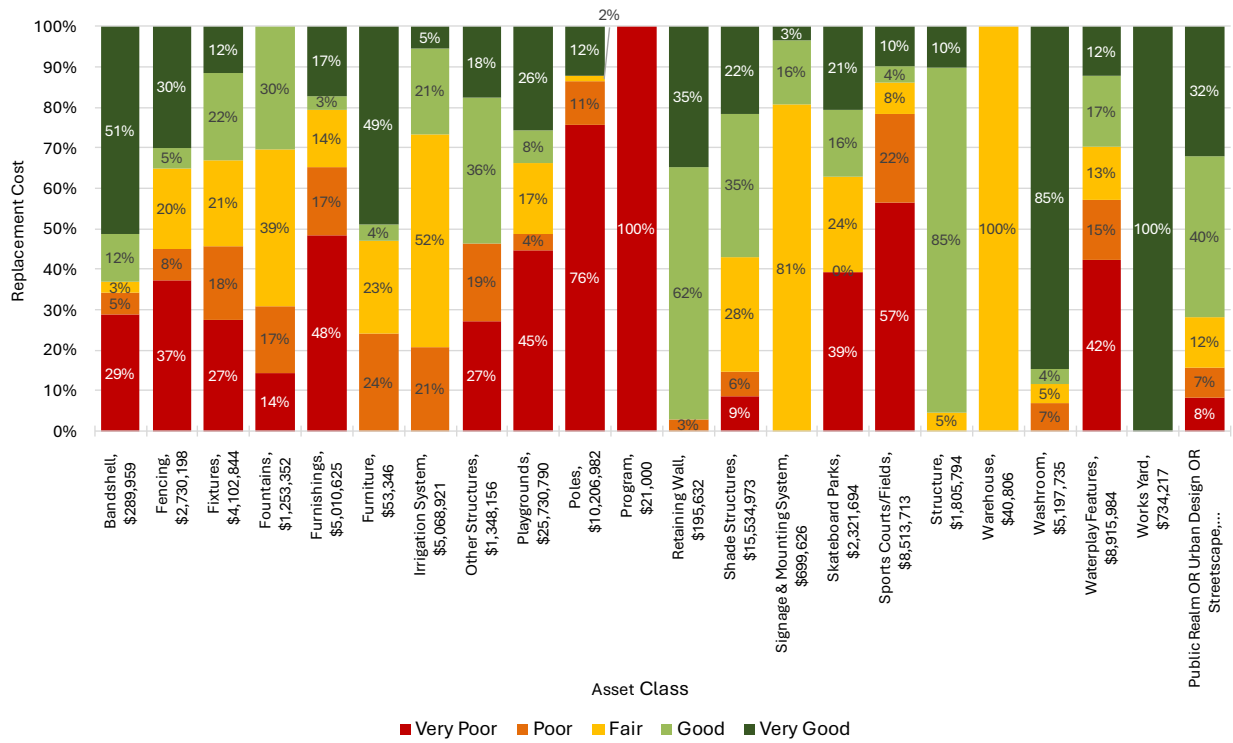


Figure G - 8: Performance Distribution of Parks Assets by Asset Class

G.2 Levels of Service

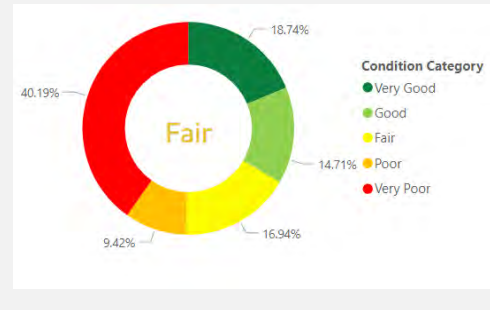
Customer values, customer levels of service and technical levels of service for Parks can be found in Table G - 4, Table G - 5, and Table G - 6, respectively.

Table G - 4: Parks Customer Values

Customer Values		
Customer Values	Customer Satisfaction Measure	Current Feedback & Expected Trend Based on Planned Budget
Park assets are safe and reliable to use	Assets are structurally adequate for use and in overall good working condition.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.
Park assets offer convenience to the customer	The quality of assets do not negatively affect the customer.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.
	Park assets are accessible.	
Aesthetic Quality	Park assets meet aesthetic expectations.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.

Table G - 5: Parks Customer LOS

Customer Level of Service Measures			
Type of Measure	Level of Service	Performance Measure	Current Performance
<i>Amenities, Barriers, and Lighting</i>			

Condition	Condition of Amenities/Park Components	Condition or Age/Remaining Useful Life - Aggregated into 5-point rating scale		
		Confidence Levels: Low to medium – age and ESL are used to assess for condition. Condition data is unavailable.		
	Individual element/element group condition.	Percentage of all elements/element groups in very poor to poor condition	46%	
		Confidence Levels: Low to medium – age and ESL are used to assess for condition. Condition data is unavailable.		
Function	Measure of whether the service is appropriate for its intended use	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.		
Capacity	Measure of whether the service is adequate to meet customer needs	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.		
Accessibility	Service interruptions	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.		
Facilities				
Condition	Condition of Facilities	Average FCI rating of facilities.	0.042	
		Confidence Levels: Medium – building condition assessments are performed on facilities to determine investment needs but data requires refinement.		
		Percentage of all elements/element	5%	

		groups in poor condition.	
	Individual element/element group condition.	Percentage of assets that have not exceeded their ESL.	100%
		Confidence Levels: Medium – building condition assessments are performed on facilities to determine investment needs but data requires refinement.	
Function	Measure of whether the service is appropriate for its intended use	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Capacity	Measure of whether the service is adequate to meet customer needs	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Accessibility	Service interruptions	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
	Comfort/AODA		
<i>Furnishings, Fixtures & Equipment</i>			
Condition	Condition of assets	Percentage of assets that have not exceeded their ESL.	52%
	Individual element/element group condition.	Percentage of all elements/element groups in poor or very poor condition	65%
Function	Measure of whether the service is appropriate for its intended use	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	

Capacity	Measure of whether the service is adequate to meet customer needs	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Accessibility	Service interruptions	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
	Comfort/AODA		
<i>Public Realm or Urban Design or Streetscape & Site Servicing</i>			
Condition	Condition of assets	Percentage of assets that have not exceeded their ESL.	95%
	Individual element/element group condition.	Percentage of all elements/element groups in poor or very poor condition	19%
Function	Measure of whether the service is appropriate for its intended use	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Capacity	Measure of whether the service is adequate to meet customer needs	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Accessibility	Service interruptions	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
	Comfort/AODA		

Table G - 6: Parks Technical LOS

Technical Level of Service Measures				
Lifecycle Activity	Purpose of Activity	Activity Measure	Current Performance (\$, 2023 Budget)	Recommended Performance
Acquisition	Growth Expansion Development	Projects developed in Integrated Leisure MP	\$9,486,900	Recommended performance will be considered and included for the City's 2025 Asset Management Plan and Financial Strategy
Operation	Inspections	Frequency	\$727,100	
	Regular Operations	Frequency		
Maintenance	Minor repairs	As needed	\$45,800	
	Regular Maintenance	Frequency		
	Major maintenance (holding strategies)	As needed		
Renewal	Major rehabilitation or replacement	As needed	\$2,301,571	
Disposal	Disposal of replaced assets	Each	Included in renewal costs	
Service Improvement	Upgrades to improve LOS to benefit existing serviced areas	As required	\$111,940	

G.3 Risk Management Strategy

The criteria used to determine the consequence of failure of Parks Assets can be found in Table G - 7 below:

Table G - 7: COF Criteria used for Parks Assets

Direct Financial	Socio-Economic	Environmental
<ul style="list-style-type: none"> Replacement cost 	<ul style="list-style-type: none"> Asset Class 	<ul style="list-style-type: none"> Not expected to have significant consequences on the environment

Table G - 8 displays the risk score for Parks assets along with the proportion of assets within each risk score, likelihood of failure and consequence of failure.

Table G - 8: Risk Score Distribution for Parks Assets

		Consequence of Failure				
		1	2	3	4	5
Likelihood of Failure	1	\$137,973 (0.1%)	\$14,737,076 (13.9%)	\$8,859,771 (8.4%)	\$0 (0.0%)	\$0 (0.0%)
	2	\$972,303 (0.9%)	\$8,683,308 (8.2%)	\$7,716,669 (7.3%)	\$0 (0.0%)	\$0 (0.0%)
	3	\$1,343,158 (1.3%)	\$12,204,303 (11.5%)	\$4,819,342 (4.6%)	\$0 (0.0%)	\$0 (0.0%)
	4	\$130,663 (0.1%)	\$7,821,764 (7.4%)	\$2,471,156 (2.3%)	\$0 (0.0%)	\$0 (0.0%)
	5	\$28,529 (0.0%)	\$31,538,203 (29.8%)	\$4,275,290 (4.0%)	\$0 (0.0%)	\$0 (0.0%)

G.4 Lifecycle Management Strategies and Forecasting

The following section outlines the funding required for the entire lifecycle of park assets. The expenditures were determined using the lifecycle activities outlined in Table G - 6 and the LOS established. Required funding was determined using the following forecasting analysis scenario:

- **Maintain Current Levels of Service** – this scenario provides the funding required to maintain a similar asset performance over a 27-year period. It focuses on maintaining the percentage of assets in backlog in a similar state. Backlog is defined as assets that are in need of renewal work (either significant rehabilitation or replacement). For example, if 20% of assets are past their service life, or are in need of renewal work, then the forecast model will determine the funding to maintain 20% of assets in this state over the forecast period.

The forecast analysis identified a total of \$94.5M (annual average of \$3.8M) that is anticipated to be spent over the next 27 years. In 2023, approximately 27.4% of the asset portfolio (by replacement value) is in backlog. The average annual spending identified attempts to maintain this percentage over the next 27 years. The performance and financial forecasts for this state are illustrated in Figure G - 9 and Figure G - 10. Note that there are significant expenditures forecasted in 2032, 2046, 2047, and 2050, which represent significant amounts of asset needs that are forecasted to occur in those years.

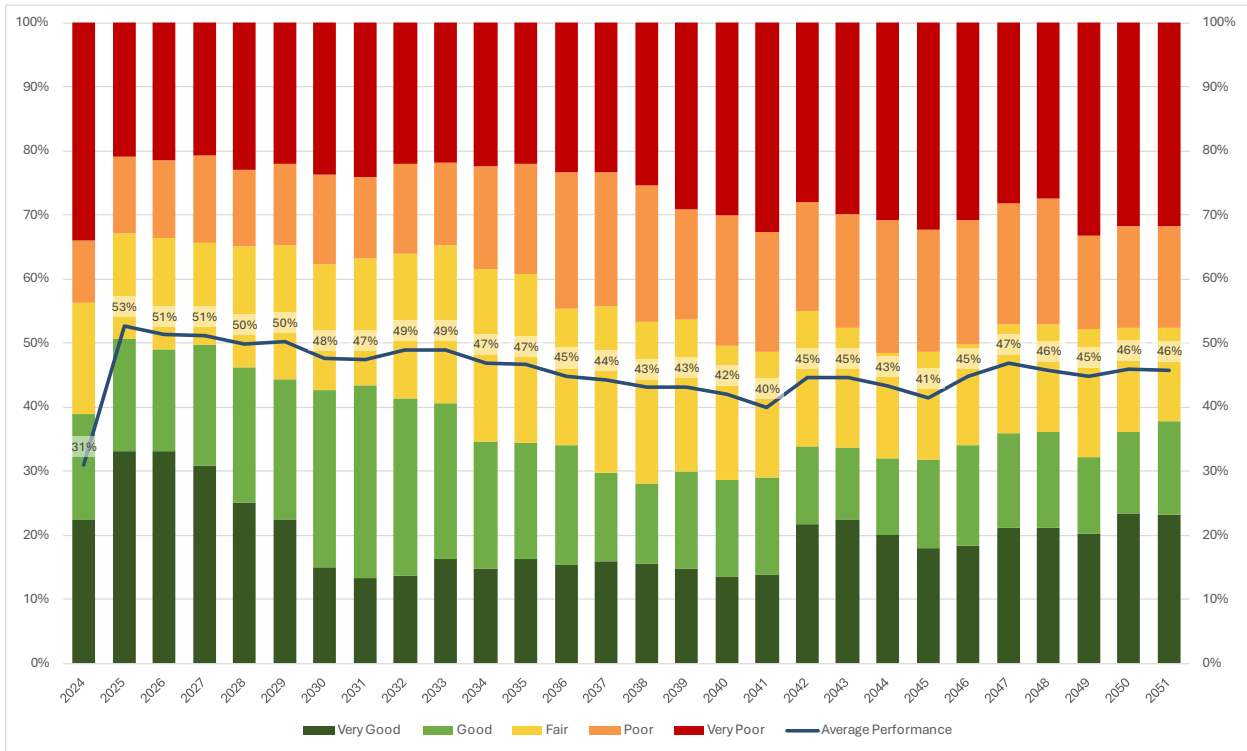


Figure G - 9: Scenario 2 – Maintain Current LOS Performance Distribution for Parks Assets

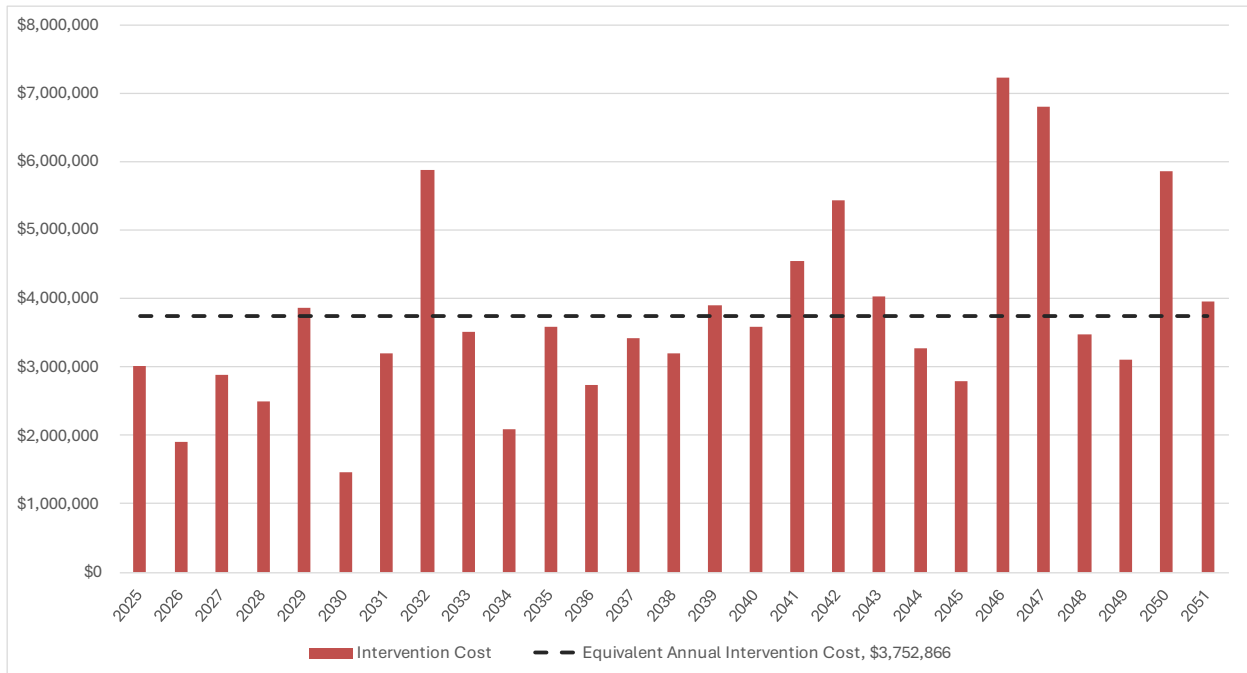


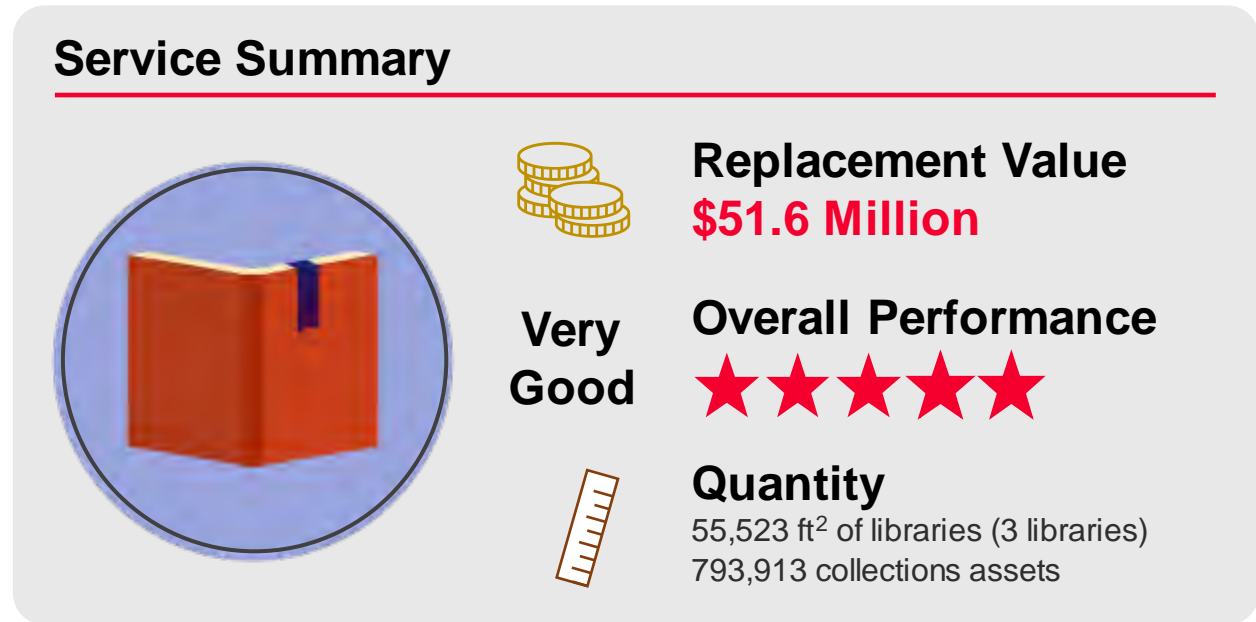
Figure G - 10: Scenario 2 – Maintain Current LOS Intervention Costs for Parks Assets



**Sustainability and
Asset Management**

2024 Asset Management Plan Appendix H: Library City of Markham

Appendix H Library



The City of Markham’s Library promotes to enrich, inspire, empower and link the community through the many resources and services. It proudly works to promote literacy, a lifelong love of learning, and a culture of reading.

Markham is responsible for assets such as various facilities, furnishings, fixtures and equipment, as detailed in Figure H - 1.



Figure H - 1: Library Asset Hierarchy

More information on Library such as state of infrastructure, levels of service, risk management strategies and lifecycle management strategies and forecasting can be found in the following sections.

H.1 State of the Infrastructure

Figure H - 2 illustrates the replacement value distribution of all Library service assets and Figure H - 3 illustrates the replacement value distribution of library furnishings, fixtures, and equipment.

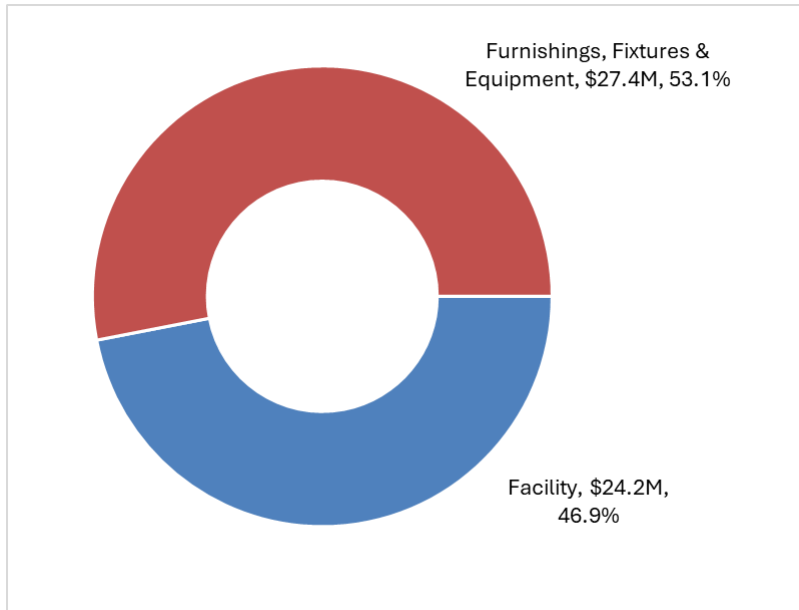


Figure H - 2: Replacement Value Distribution of Library Assets

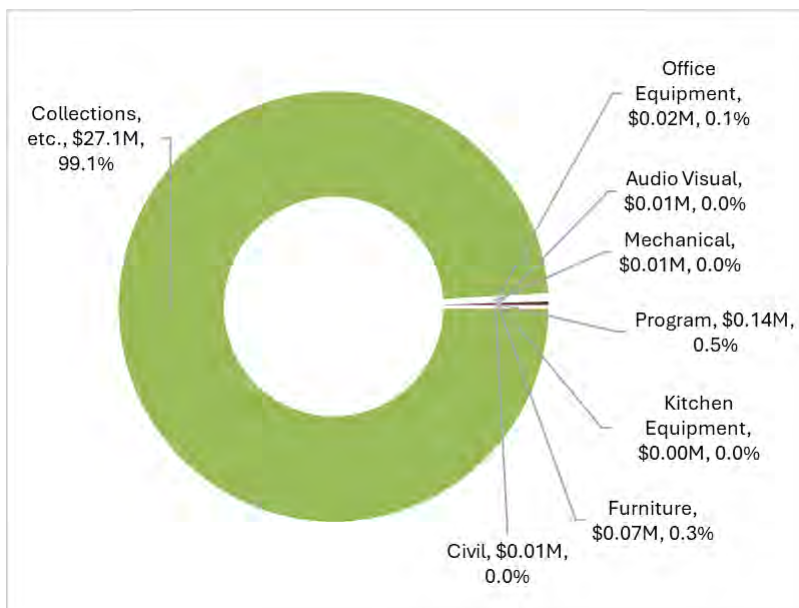


Figure H - 3: Replacement Value Distribution of Library Furnishings, Fixtures & Equipment

H.1.1 Asset Inventory and Valuation

Table H - 1 below summarizes the asset valuation, quantities, and performance for each library asset category.

Table H - 1: Inventory and Valuation of Library Assets

Subservice	Asset Category	Asset Class	Replacement Cost	Inventory	Average Performance
Library	Facility	Library Facility	\$24,214,323	55,523 sq ft	Very Good
	Furnishing, Fixtures & Equipment	Audio Visual	\$5,500	1 Asset	Good
		Civil	\$6,000	1 Asset	Good
		Collections, etc.	\$27,111,813	793913 Assets	Very Good
		Furniture	\$71,393	11 Assets	Good
		Kitchen Equipment	\$4,035	5 Assets	Good
		Mechanical	\$10,000	1 Asset	Good
		Office Equipment	\$17,196	1 Asset	Very Good
Program	\$135,227	11 Assets	Good		

H.1.2 Age and Estimated Service Life

Figure H - 4 illustrates the age of library assets as a proportion of their estimated service life. Figure H - 5 illustrates the value of assets acquired by decade. Mechanical assets, kitchen equipment, and civil assets on average are approaching the end of their ESLs.

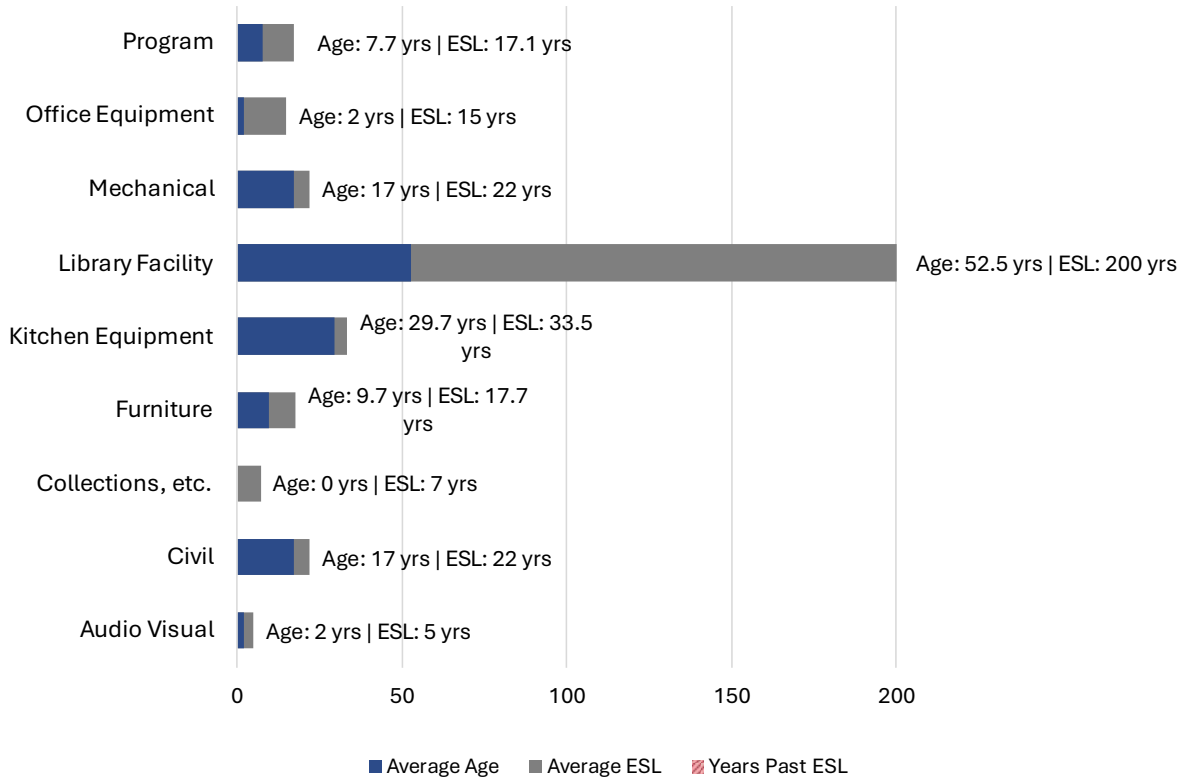


Figure H - 4: Age as a Proportion of Estimated Service Life (ESL) of Library Assets

The installation profile of library assets illustrates that the majority of library facilities were constructed in the 1980s, and the majority of collections were acquired in the 2020s.

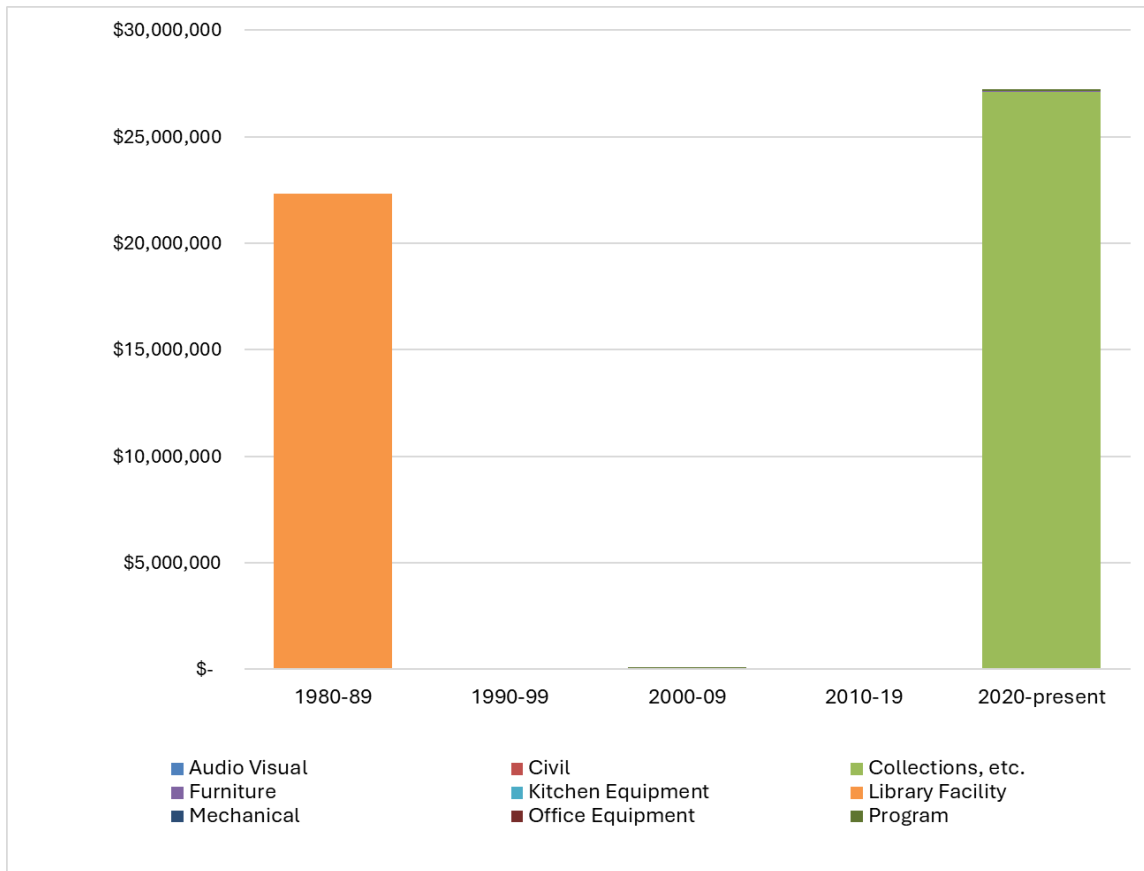


Figure H - 5: Age Distribution by Installation Decade of Library Assets

H.1.3 Asset Performance

Table H - 2 details the approaches used by the City to assess asset performance.

Table H - 2: Condition assessment approaches for Library Assets

Asset Class	Performance Metric	Description
Library Facility	FCI	Facilities are inspected on a 3-year cycle and condition is recorded in city's database. The inspection results are used to understand facility renewal needs and to calculate the FCI rating.
Collections, etc.	Age/ESL	Material being returned is assessed constantly to ensure it is fit to re enter circulation, collection is maintenance is ongoing for currency and accuracy.
Furniture	Age/ESL	

Audio Visual		The City understands the condition of these assets based on asset age and estimated service life
Mechanical		
Program		
Civil		
Office Equipment		
Kitchen Equipment		

Figure H - 6 and Figure H - 7 illustrate the performance distribution of all library assets by asset class. Table H - 3 summarizes the relationship between the performance categories and how performance ratings are determined.

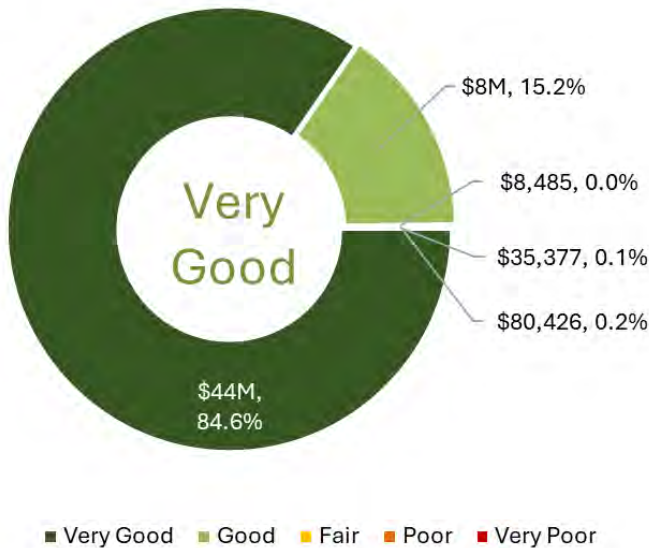


Figure H - 6: Performance Distribution of Library Assets

Table H - 3: Performance Ratings of Library Assets

Performance Category	Age/ESL	Facility Condition Index (FCI)
Very Good	0% - 20%	0% - 5%
Good	20% - 40%	5% - 10%
Fair	40% - 60%	10% - 30%
Poor	60% - 80%	30% - 60%
Very Poor	80% - 100%	60 - 100%



Figure H - 7: Performance Distribution of Library Assets by Asset Class

H.2 Levels of Service

Customer values, customer levels of service and technical levels of service for Libraries can be found in Table H - 4, Table H - 5, and Table H - 6, respectively.

Table H - 4: Library Customer Values

Customer Values		
Type of Measure	Customer Satisfaction Measure	Current Feedback & Expected Trend Based on Planned Budget
Library assets are safe and reliable to use	Assets are structurally adequate for use and in overall good working condition.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP.

Customer Values		
Type of Measure	Customer Satisfaction Measure	Current Feedback & Expected Trend Based on Planned Budget
		These metrics are subject to change as data is reviewed and incorporated into future AMPs.
Library services are convenient to use	The quality of assets do not negatively affect the customer.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.
	There are sufficient and appropriate amenities available for all customers.	
	Library services are accessible.	
Aesthetic Quality	Recreation assets meet aesthetic expectations.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.
Environmentally sustainable	Environmental impacts are minimized.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.

Table H - 5: Library Customer LOS

Customer Level of Service Measures			
Type of Measure	Level of Service	Performance Measure	Current Performance
Facilities			
Condition	Condition of Facilities	Average FCI rating of facilities.	0.04
		Confidence Levels: Medium – building condition assessments are performed on facilities to determine investment needs but data requires refinement.	

	Individual element/element group condition.	Percentage of all elements/element groups in poor condition.	0%
		Percentage of assets that have not exceeded their ESL.	100%
		Confidence Levels: Medium – building condition assessments are performed on facilities to determine investment needs but data requires refinement.	
Function	Measure of whether the service is appropriate for its intended use	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Capacity	Measure of whether the service is adequate to meet customer needs	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Accessibility	Service interruptions	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
<i>Furnishings, Fixtures & Equipment</i>			
Condition	Condition of assets	Percentage of assets that have not exceeded their ESL.	99.9%
		Confidence Levels: High – condition assessments are performed regularly on furnishings, machinery and equipment to determine if assets are still fit for service	
	Individual element/element group condition.	Percentage of all elements/element groups in poor or very poor condition	0.4%
		Confidence Levels: High – condition assessments are performed regularly on furnishings, machinery and equipment to determine if assets are still fit for service	
Function	Measure of whether the service is appropriate for its intended use	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	

Capacity	Measure of whether the service is adequate to meet customer needs	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.
Accessibility	Service interruptions	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.

Table H - 6: Library Technical LOS

Technical Level of Service Measures				
Lifecycle Activity	Purpose of Activity	Activity Measure	Current Performance (\$, 2023 Budget)	Recommended Performance
Facilities				
Acquisition	Growth Expansion Development	Projects developed in Integrated Leisure Master Plan and Library Strategic Plan	The City is in the process of documenting acquisition costs by service	Recommended performance will be considered and included for the City's 2025 Asset Management Plan and Financial Strategy
	Operation	Inspections	Annual programs	
Regular Operations		As required		
Maintenance	Minor repairs	As required	The City is in the process of documenting maintenance costs by service	
	Regular Maintenance	Annual programs		
	Major maintenance (holding strategies)	As required		
Renewal	Major rehabilitation or replacement	As needed	\$6,238,600	
Disposal	Disposal of replaced assets	As required	Included in renewal costs	
Service Improvement	Upgrades to improve LOS to benefit existing serviced areas	As required	The City is in the process of documenting service improvement costs by service	

Furnishings, Fixtures & Equipment				
Acquisition	Growth Expansion Development	Projects developed in Integrated Leisure Master Plan and Library Strategic Plan	The City is in the process of documenting service acquisition by service	Recommended performance will be considered and included for the City's 2025 Asset Management Plan and Financial Strategy
Operation	Inspections	Annual programs	The City is in the process of documenting operation costs by service	
	Regular Operations	As required		
Maintenance	Minor repairs	As needed	The City is in the process of documenting maintenance costs by service	
	Regular Maintenance	Annual programs		
	Major maintenance (holding strategies)	As needed		
Renewal	Major rehabilitation or replacement	As needed	\$84,400	
Disposal	Disposal of replaced assets	As required	Included in renewal costs	
Service Improvement	Upgrades to improve LOS to benefit existing serviced areas	As required	The City is in the process of documenting service improvement costs by service	

H.3 Risk Management Strategy

The criteria used to determine COF of Library Assets can be found in Table H - 7 below:

Table H - 7: COF Criteria used for Library Assets

Direct Financial	Socio-Economic	Environmental
<ul style="list-style-type: none"> Replacement cost 	<ul style="list-style-type: none"> Asset Class 	<ul style="list-style-type: none"> Not expected to have significant consequences on the environment

Table H - 6 displays the risk score for Library Assets along with the proportion of assets within each risk score, LOF and COF.

Table H - 8: Risk Score Distribution of Library Assets

		Consequence of Failure				
		1	2	3	4	5
Likelihood of Failure	1	\$27,180,599 (52.7%)	\$51,589 (0.1%)	\$16,397,863 (31.8%)	\$0 (0.0%)	\$0 (0.0%)
	2	\$4,689 (0.0%)	\$1,867,874 (3.6%)	\$5,948,587 (11.5%)	\$0 (0.0%)	\$0 (0.0%)
	3	\$2,985 (0.0%)	\$5,500 (0.0%)	\$0 (0.0%)	\$0 (0.0%)	\$0 (0.0%)
	4	\$54,426 (0.1%)	\$26,000 (0.1%)	\$0 (0.0%)	\$0 (0.0%)	\$0 (0.0%)
	5	\$8,377 (0.0%)	\$27,000 (0.1%)	\$0 (0.0%)	\$0 (0.0%)	\$0 (0.0%)

H.4 Lifecycle Management Strategies and Forecasting

The following section outlines the funding required for the entire lifecycle of potable water assets. The expenditures were determined using the lifecycle activities outlined in Table H - 6 and the LOS established. Required funding was determined using the following forecasting analysis scenario:

- Maintain Current Levels of Service** – this scenario provides the funding required to maintain a similar asset performance over a 27-year period. It focuses on maintaining the percentage of assets in backlog in a similar state. Backlog is defined as assets that are in need of renewal work (either significant rehabilitation or replacement). For example, if 20% of assets are past their service life, or are in need of renewal work, then the forecast model will determine the funding to maintain 20% of assets in this state over the forecast period.

The forecast analysis identified a total of \$114.6M (annual average of \$4.8M) that is anticipated to be spent over the next 27 years. In 2023, approximately 7.5% of the asset portfolio (by replacement value) is in backlog. The average annual spending identified attempts to maintain this percentage over the next 27 years. The performance and financial forecasts for this state are illustrated in Figure H - 8 and Figure H - 9. Note that there is a significant expenditure forecasted in 2041, which represents a significant amount of asset needs that are forecasted to occur in that year.

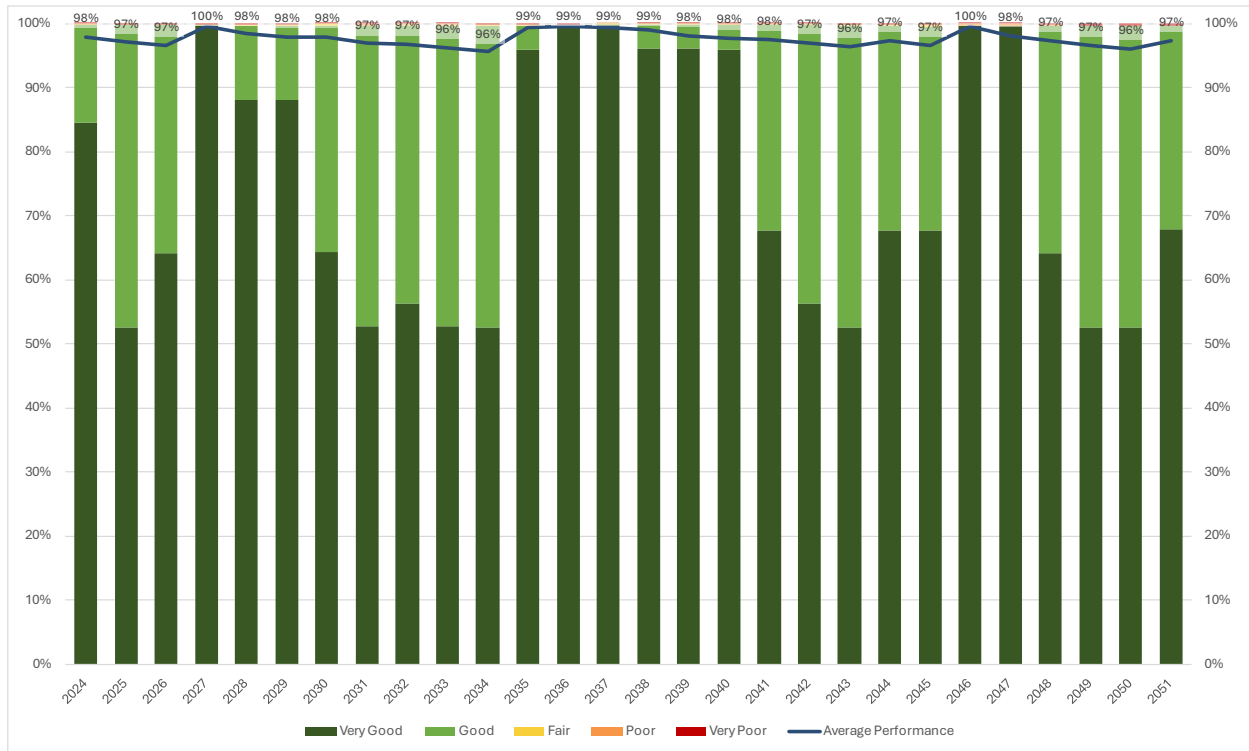


Figure H - 8: Maintain Current LOS Performance Distribution for Library Assets

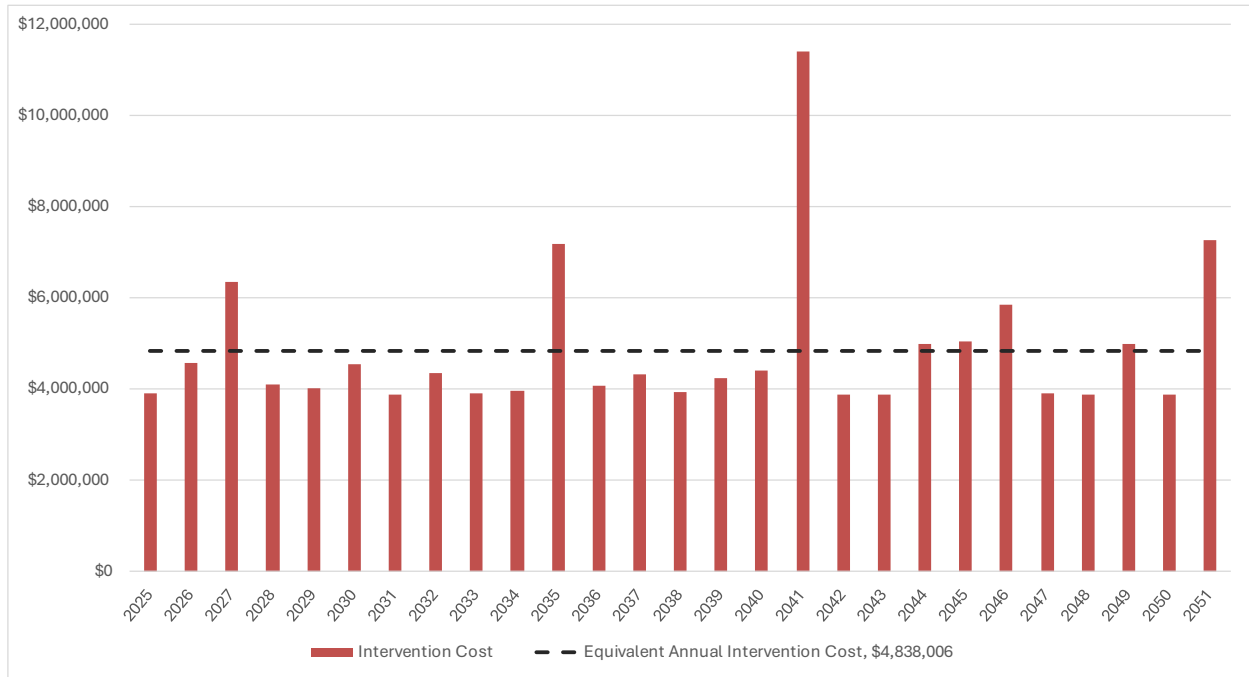


Figure H - 9: Maintain Current LOS Intervention Costs for Library Assets



**2024 Asset Management
Plan Appendix I General
Support Service
City of Markham**

Appendix I General Support Service

Service Summary



The City of Markham’s General Support Service provides support to the municipal government’s function while also providing the tools and resources necessary to maintain the City’s various assets. Markham is responsible for assets such as various facilities, fleet, furnishings, fixtures and equipment, as detailed in Figure I - 1.

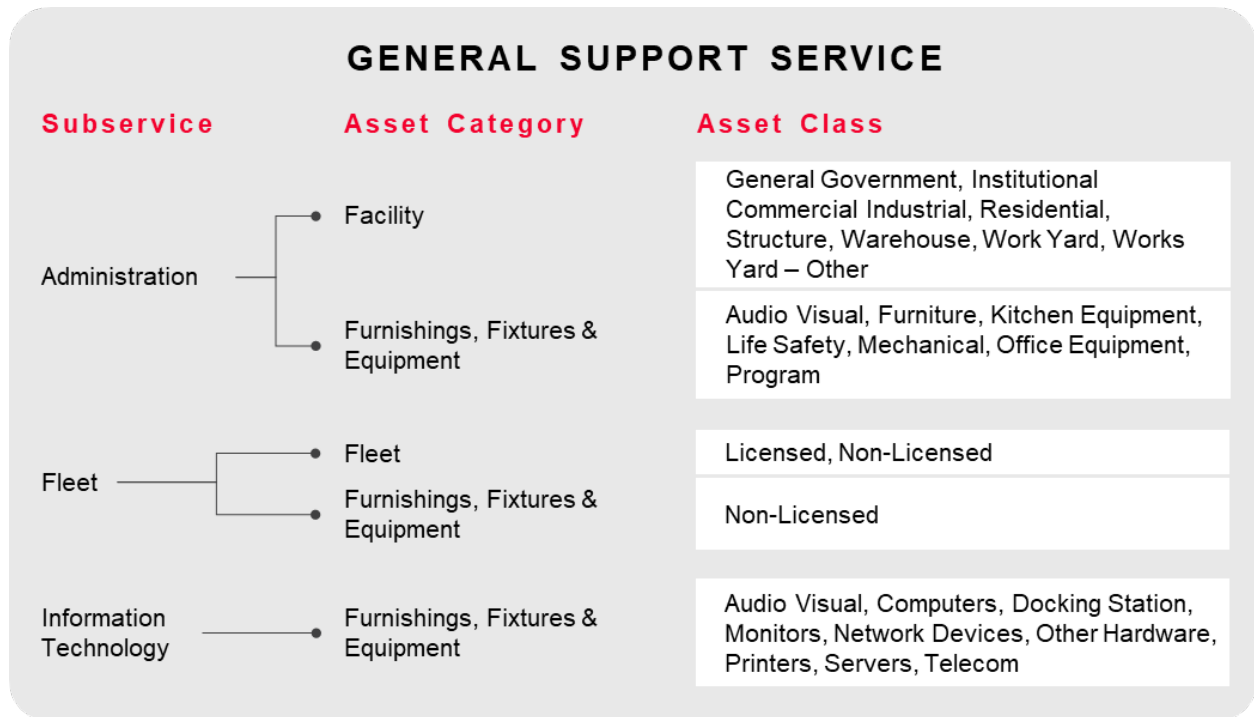


Figure I - 1: General Support Service Asset Hierarchy

More information on General Support Service such as state of infrastructure, levels of service, risk management strategies and lifecycle management strategies and forecasting can be found in the following sections.

I.1 State of the Infrastructure – Administration

Figure I - 2 illustrates the replacement value distribution of administration assets, while Figure I - 3 and Figure I - 4 display the replacement value distribution by asset class.

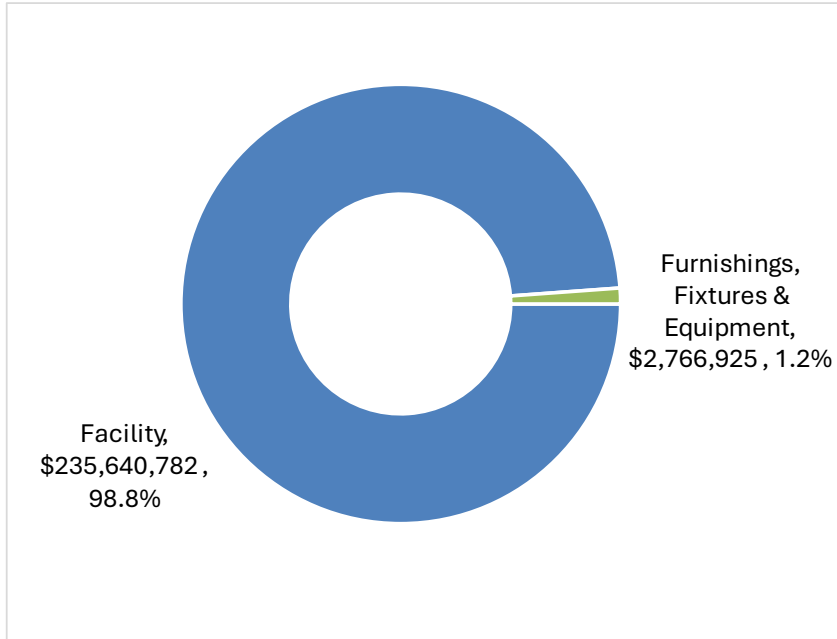


Figure I - 2: Replacement Value Distribution of Administration Assets

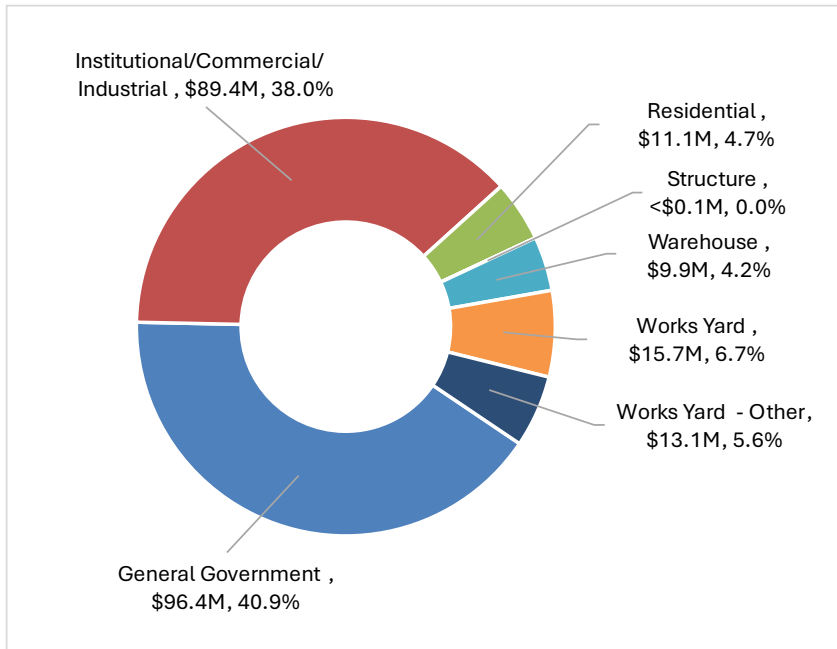


Figure I - 3: Replacement Value Distribution of Administration Assets (Facilities)

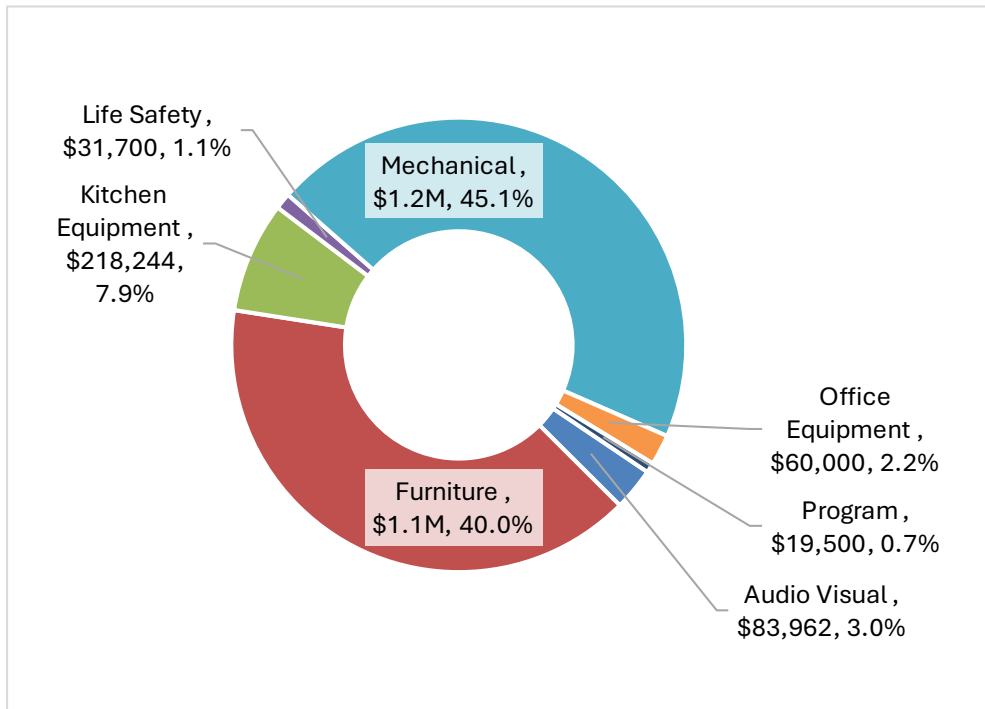


Figure I - 4: Replacement Value Distribution of Administration Assets (Furnishings, Fixtures & Equipment)

I.1.1 Asset Inventory and Valuation

Table I - 1 below summarizes the asset valuation, quantities, and performance for each asset category of administration assets.

Table I - 1: Inventory and Valuation of General Support Service Assets

Subservice	Asset Category	Asset Class	Replacement Cost	Inventory	Average Performance
Administration	Facility	General Government	\$96,358,714	227,515 sq ft	Fair
		Institutional Commercial Industrial	\$89,443,865	249,005 sq ft	Good
		Residential	\$11,136,358	35,744 sq ft	Fair
		Structure	\$13,602	100 sq ft	Poor
		Warehouse	\$9,870,344	72,566 sq ft	Very Good
		Works Yard	\$15,712,507	36,937 sq ft	Very Good
		Works Yard - Other	\$13,105,393	65,187 sq ft	Good

	Furnishings, Fixtures & Equipment	Audio Visual	\$83,962	34 Assets	Good
		Furniture	\$1,105,950	70 Assets	Very Poor
		Kitchen Equipment	\$218,244	43 Assets	Very Poor
		Life Safety	\$31,700	7 Assets	Good
		Mechanical	\$1,247,570	56 Assets	Fair
		Office Equipment	\$60,000	1 Assets	Good
		Program	\$19,500	5 Assets	Very Poor

I.1.2 Age and Estimated Service Life

Figure I - 5 illustrates the age of administration assets as a proportion of their estimated service life and Figure I - 6 illustrates the value of assets acquired by decade. Furniture, kitchen equipment, and program assets on average are approaching the end of their ESLs.

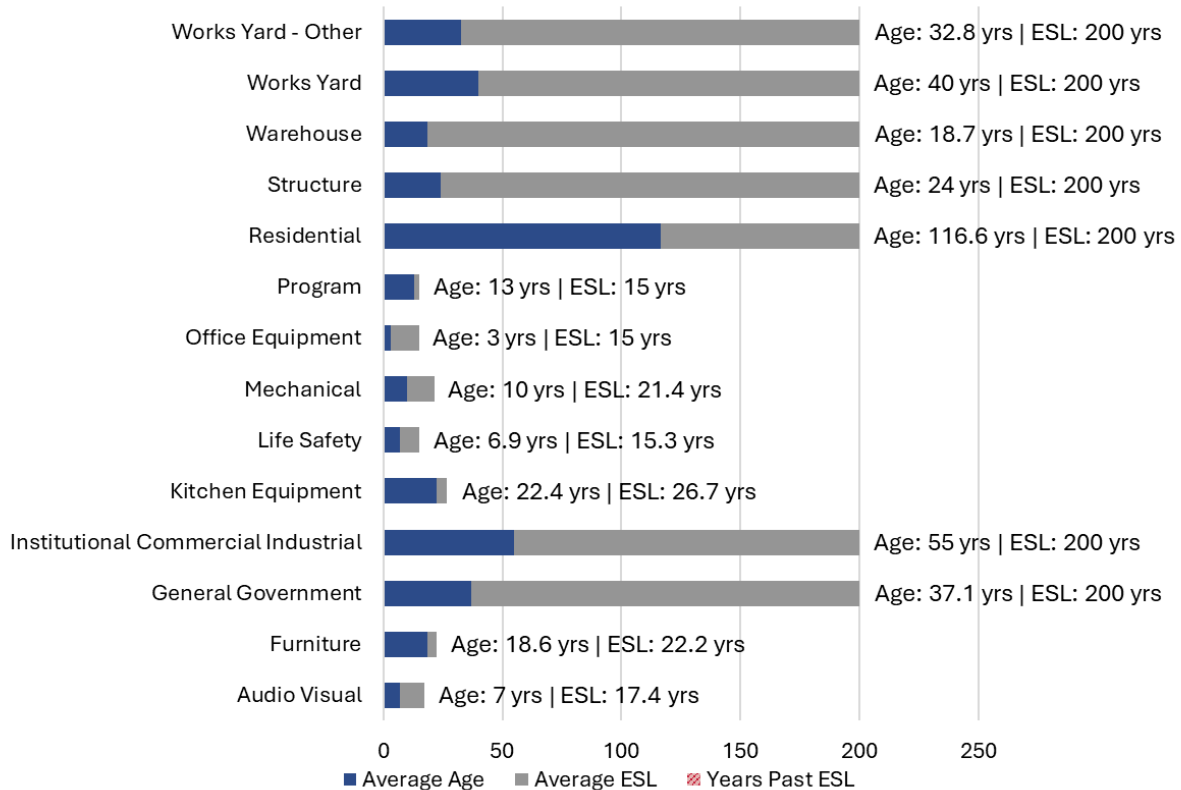


Figure I - 5: Age as a Proportion of Estimated Service Life (ESL) of Administration Assets

The installation profile of administration assets illustrates that the majority of general government and institutional commercial industrial assets were installed in the 1980s and 1990s, in line with decades that experienced significant growth and corresponding development in the City.

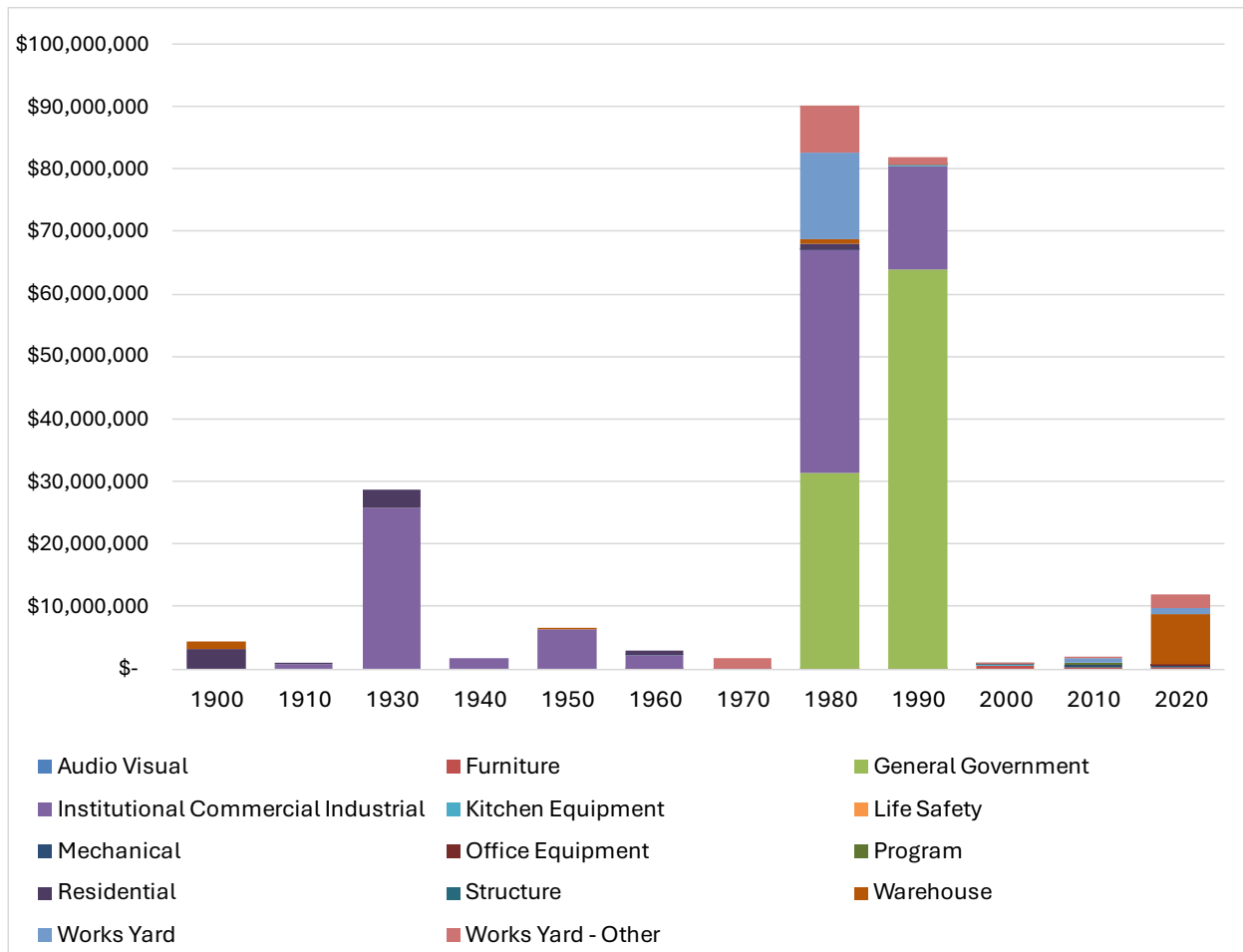


Figure I - 6: Age Distribution by Installation Decade of Administration Assets

I.1.3 Asset Performance

Table I - 2 details the approaches used by the City to understand and assess the performance of each class of administration assets.

Table I - 2: Performance assessment approaches for Administration Assets

Asset Class	Performance Metric	Description
General Government	FCI	Facilities are inspected on a 3-year cycle and performance is recorded in City’s database. The inspection results are used to understand facility renewal needs and to calculate the FCI rating.
Institutional Commercial Industrial		
Residential		
Structure		
Warehouse		

Works Yard	Age/ESL	The City understands the performance of these assets based on asset age and estimated service life
Works Yard - Other		
Mechanical		
Furniture		
Life Safety		
Program		
Kitchen Equipment		
Audio Visual		
Office Equipment		

Figure I - 7 and Figure I - 8 illustrate the performance of all administration assets. Table I - 3 summarizes the relationship between the performance categories and how performance ratings are determined.

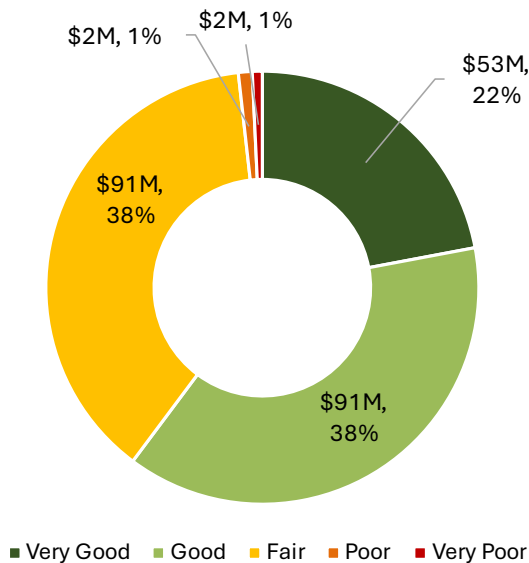


Figure I - 7: Performance Distribution of Administration Assets

Table I - 3: Performance Ratings of Administration Assets

Performance Category	Facility Condition Index (FCI)	Age/ESL
Very Good	0% - 5%	0% - 20%
Good	5% - 10%	20% - 40%

Fair	10% - 30%	40% - 60%
Poor	30% - 60%	60% - 80%
Very Poor	60 - 100%	80% - 100%

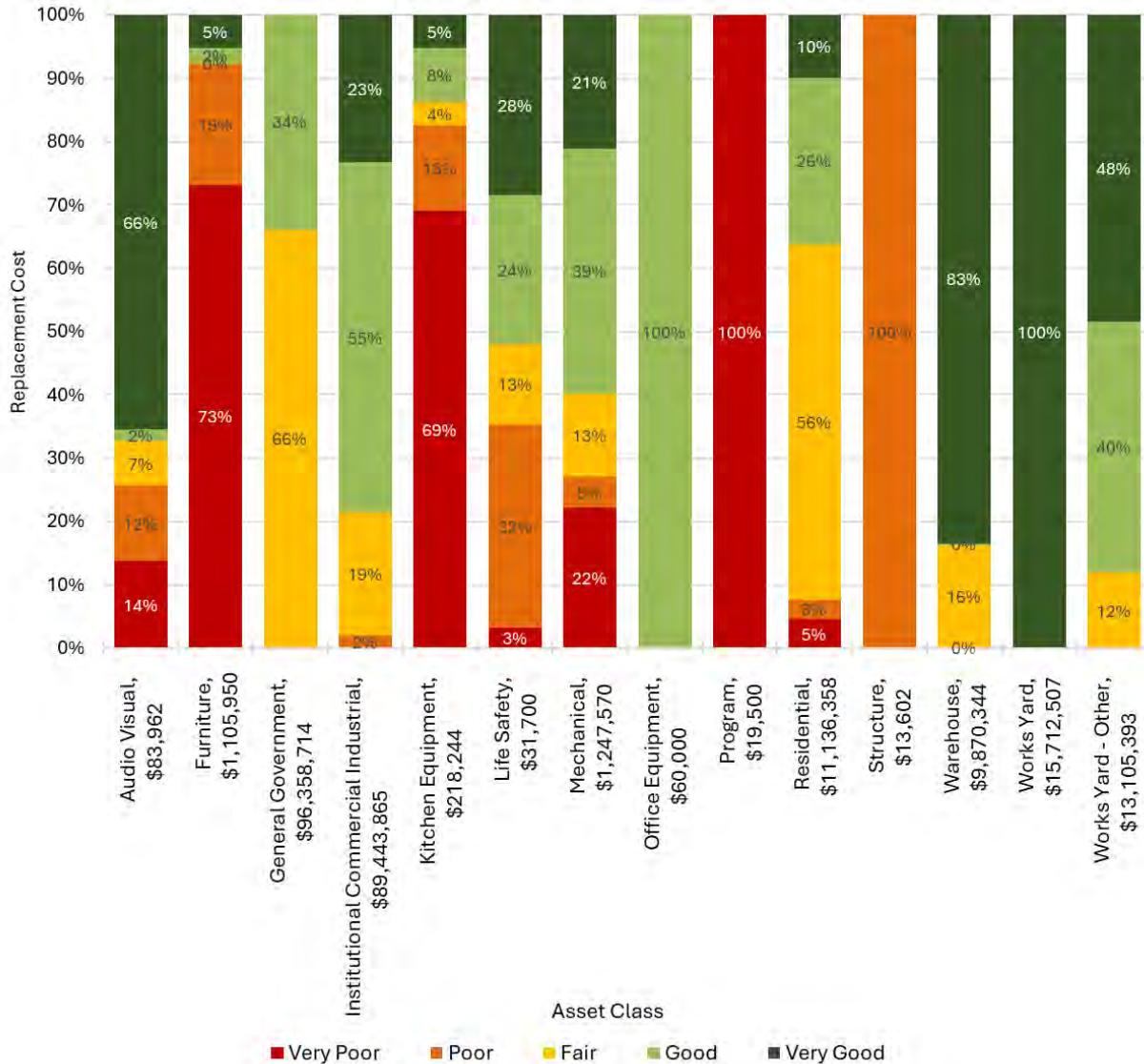


Figure I - 8: Performance Distribution of Administration Assets by Asset Class

I.2 State of the Infrastructure – Fleet

Figure I - 2 illustrates the replacement value distribution of Fleet assets.

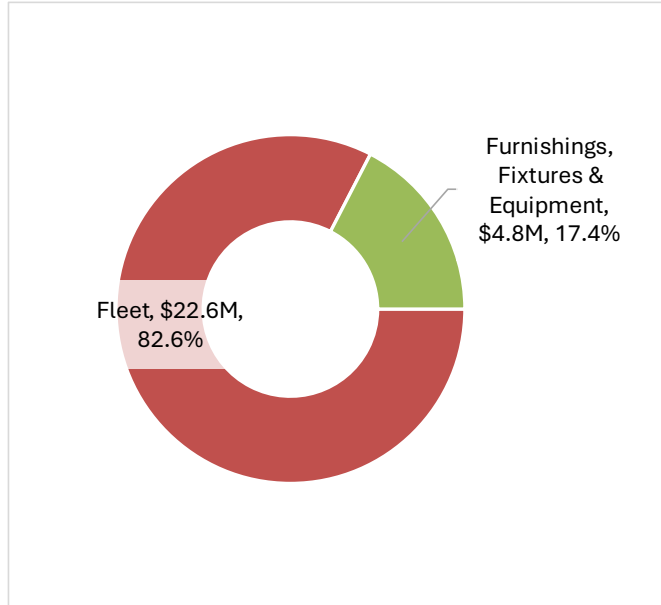


Figure I - 9: Replacement Value Distribution of Fleet Assets

I.2.1 Asset Inventory and Valuation

Table I - 4 below summarizes the asset valuation, quantities, and performance for each asset category of fleet assets.

Table I - 4: Inventory and Valuation of General Support Service Assets

Subservice	Asset Category	Asset Class	Replacement Cost	Inventory	Average Performance
Fleet	Fleet	Licensed	\$17,427,177	219 Assets	Poor
		Non-Licensed	\$5,159,718	64 Assets	Poor
	Furnishings, Fixtures & Equipment	Non-Licensed	\$4,761,653	525 Assets	Poor

I.2.2 Age and Estimated Service Life

Figure I - 5 illustrates the age of general support service assets as a proportion of their estimated service life and Figure I - 6 illustrates the value of assets acquired by decade. Telecom, servers, program, non-licensed, monitors, kitchen equipment, furniture, and audio visual assets on average are approaching the end of their ESLs. Other hardware and network devices have average ages that exceed their average ESLs.

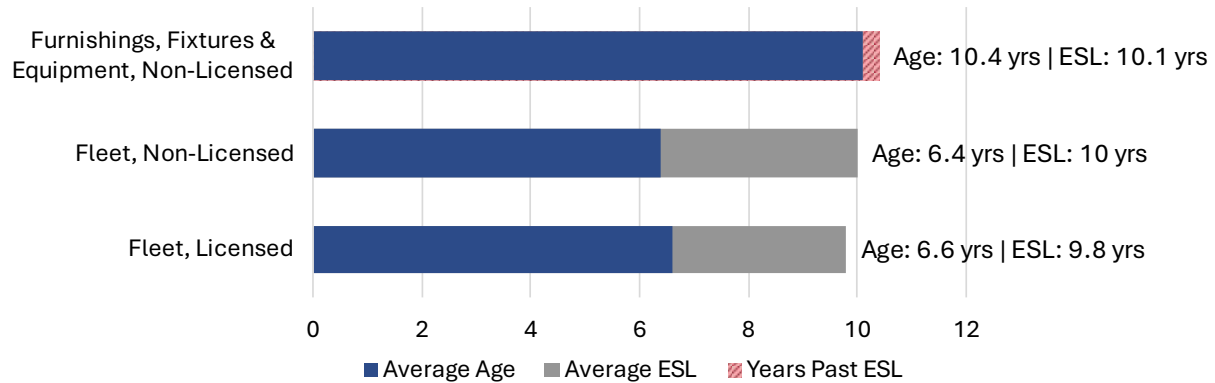


Figure I - 10: Age as a Proportion of Estimated Service Life (ESL) of Fleet Assets

The installation profile of fleet assets illustrates that the majority of assets were installed in the 2010s to present, in line with decades that experienced significant growth and corresponding development in the City.

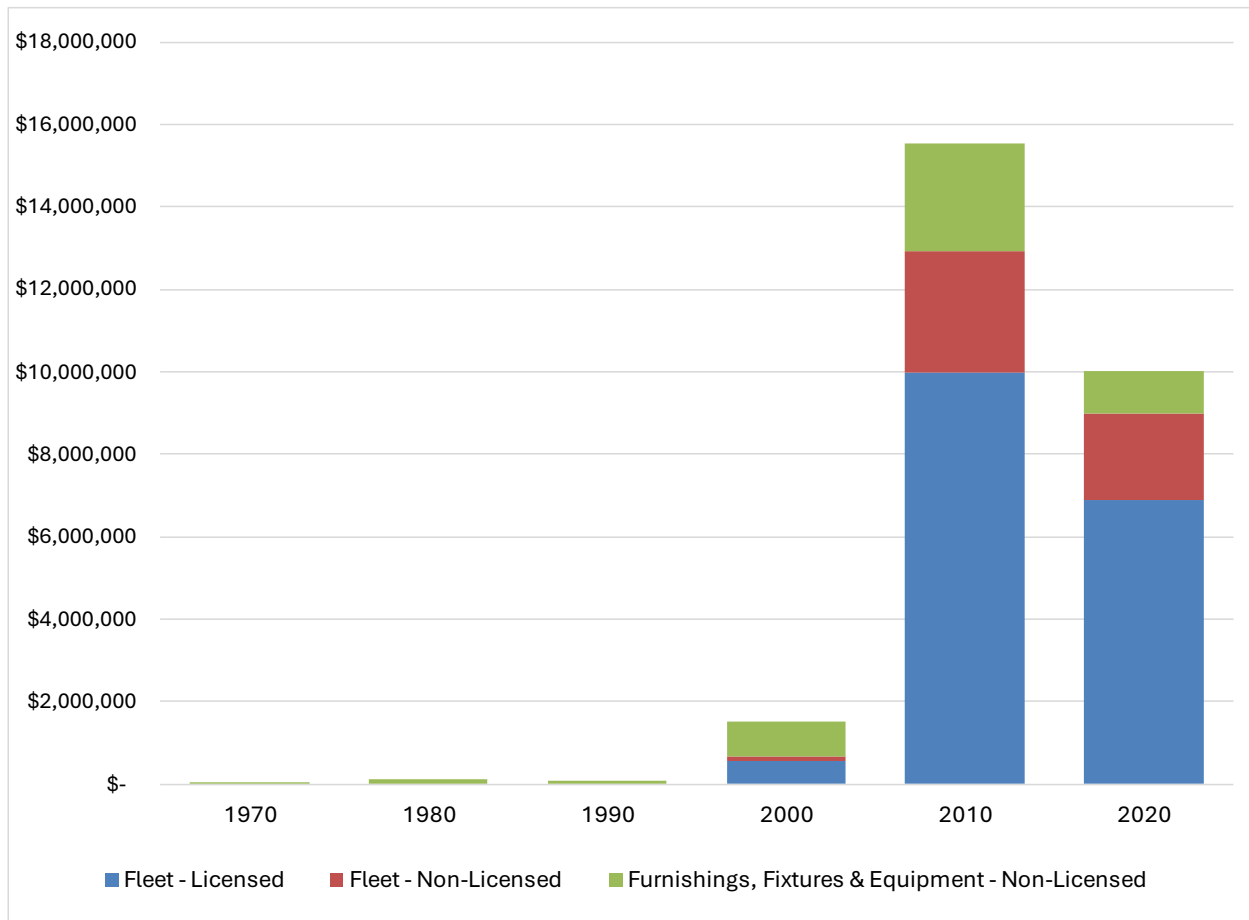


Figure I - 11: Age Distribution by Installation Decade of Fleet Assets

I.2.3 Asset Performance

Table I - 5 details the approaches used by the City to understand and assess the performance of each class of fleet assets.

Table I - 5: Performance assessment approaches for General Support Service Assets

Asset Category	Asset Class	Performance Metric	Description
Fleet	Non-Licensed	Age/ESL	The City understands the performance of these assets based on asset age and estimated service life
	Licensed		
Furnishings, Fixtures & Equipment	Non-Licensed		

Figure I - 7 and Figure I - 8 illustrate the performance of all fleet assets. Table I - 6 summarizes the relationship between the performance categories and how performance ratings are determined.

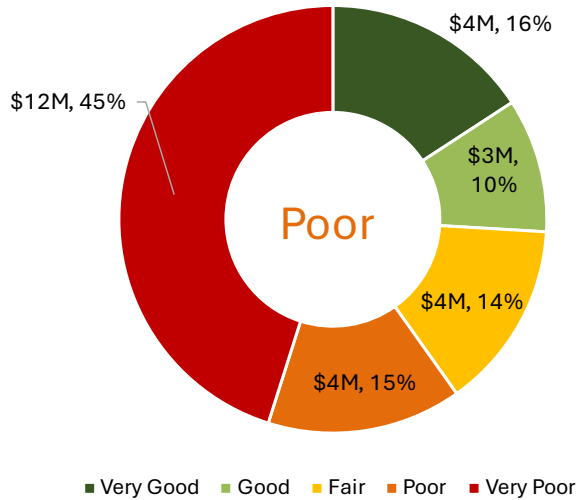


Figure I - 12: Performance Distribution of Fleet Assets

Table I - 6: Performance Ratings of General Support Service Assets

Performance Category	Facility Condition Index (FCI)	Age/ESL
Very Good	0% - 5%	0% - 20%
Good	5% - 10%	20% - 40%
Fair	10% - 30%	40% - 60%
Poor	30% - 60%	60% - 80%
Very Poor	60 - 100%	80% - 100%

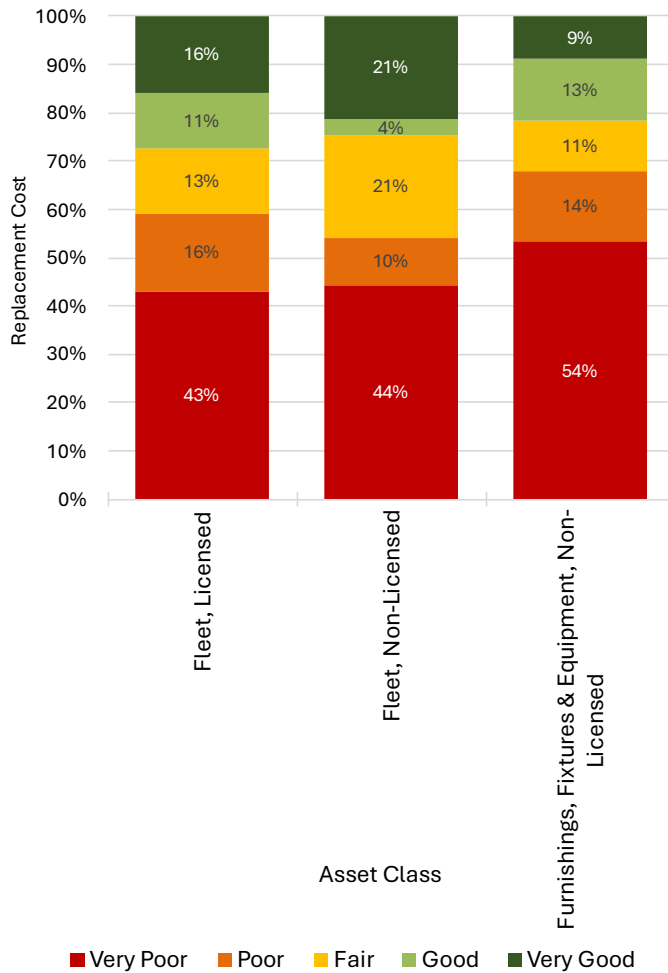


Figure I - 13: Performance Distribution of General Support Service Assets by Asset Class

I.3 State of the Infrastructure – Information Technology

Figure I - 14 illustrates the replacement value distribution of information technology assets by asset class.

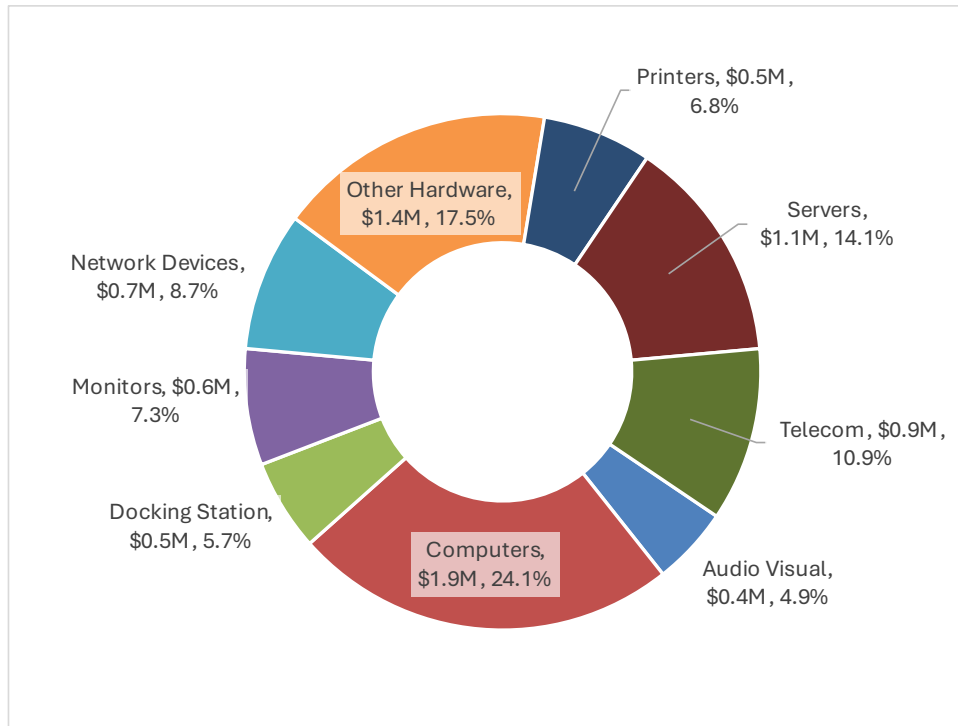


Figure I - 14: Replacement Value Distribution of Information Technology Assets

I.3.1 Asset Inventory and Valuation

Table I - 7 below summarizes the asset valuation, quantities, and performance for each asset category of general support service assets.

Table I - 7: Inventory and Valuation of General Support Service Assets

Subservice	Asset Category	Asset Class	Replacement Cost	Inventory	Average Performance
Information Technology	Furnishings, Fixtures & Equipment	Audio Visual	\$384,417	337 Asset	Very Poor
		Computers	\$1,894,699	2,268 Assets	Good
		Docking Station	\$450,831	1,665 Assets	Fair
		Monitors	\$573,360	2,057 Assets	Fair
		Network Devices	\$683,521	525 Assets	Poor
		Other Hardware	\$1,374,008	433 Assets	Very Poor
		Printers	\$538,491	318 Assets	Good



City of Markham
Appendix I: General Support Service

		Servers	\$1,109,709	415 Assets	Fair
		Telecom	\$855,774	3,377 Assets	Fair

I.3.2 Age and Estimated Service Life

Figure I - 5 illustrates the age of general support service assets as a proportion of their estimated service life and Figure I - 6 illustrates the value of assets acquired by decade. Telecom, servers, and monitors on average are approaching the end of their ESLs. Audio visual assets, other hardware and network devices have average ages that exceed their average ESLs.

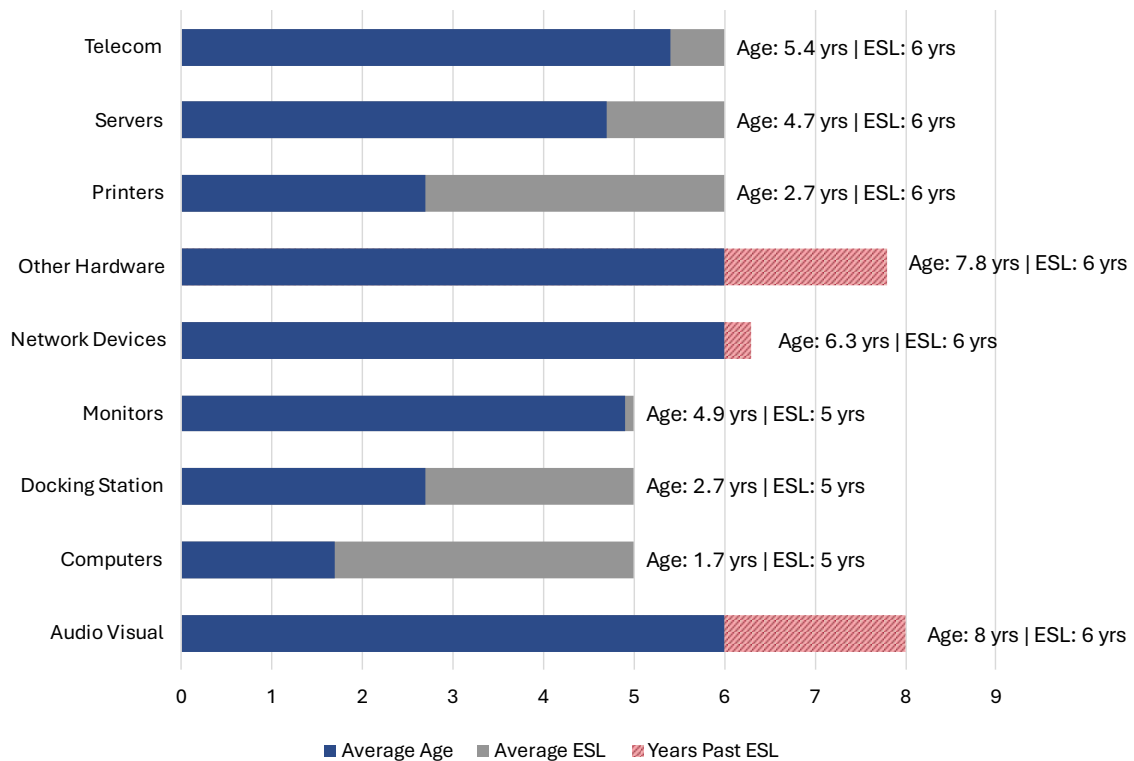


Figure I - 15: Age as a Proportion of Estimated Service Life (ESL) of General Support Service Assets

The installation profile of general support service assets illustrates that the majority of general government and institutional commercial industrial assets were installed in the 1980s and 1990s, in line with decades that experienced significant growth and corresponding development in the City.

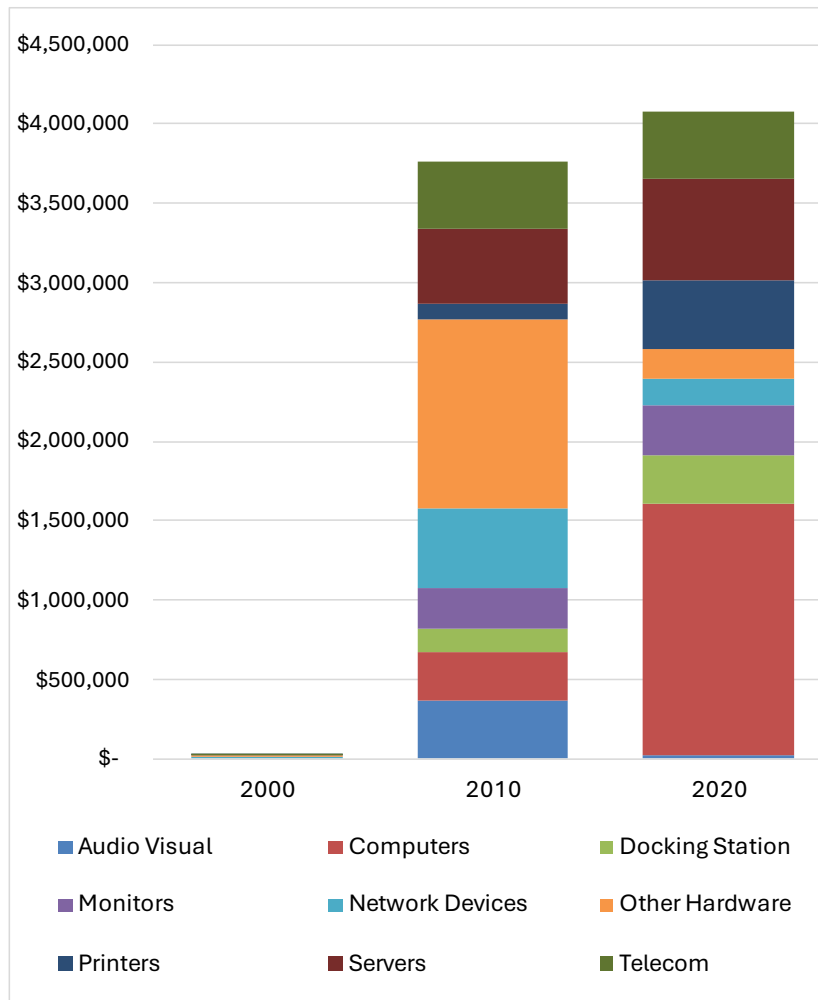


Figure I - 16: Age Distribution by Installation Decade of Information Technology Assets

I.3.3 Asset Performance

Table I - 8 details the approaches used by the City to understand and assess the performance of each class of information technology assets.

Table I - 8: Performance assessment approaches for Information Technology Assets

Asset Class	Performance Metric	Description
Office Equipment	Age/ESL	The City understands the performance of these assets based on asset age and estimated service life
Computers		
Docking Station		
Servers		
Telecom		

Monitors		
Printers		
Other Hardware		
Network Devices		
Audio Visual		

Figure I - 7 and Figure I - 8 illustrate the performance of all library assets. Table I - 9 summarizes the relationship between the performance categories and how performance ratings are determined.

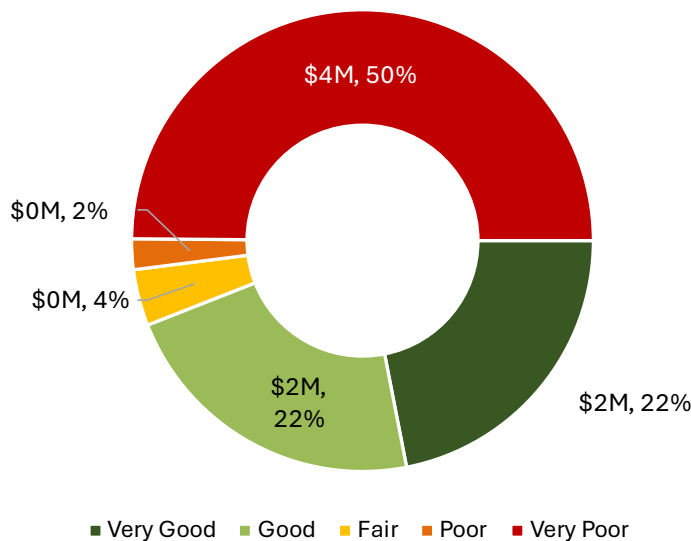


Figure I - 17: Performance Distribution of General Support Service Assets

Table I - 9: Performance Ratings of General Support Service Assets

Performance Category	Facility Condition Index (FCI)	Age/ESL
Very Good	0% - 5%	0% - 20%
Good	5% - 10%	20% - 40%
Fair	10% - 30%	40% - 60%
Poor	30% - 60%	60% - 80%

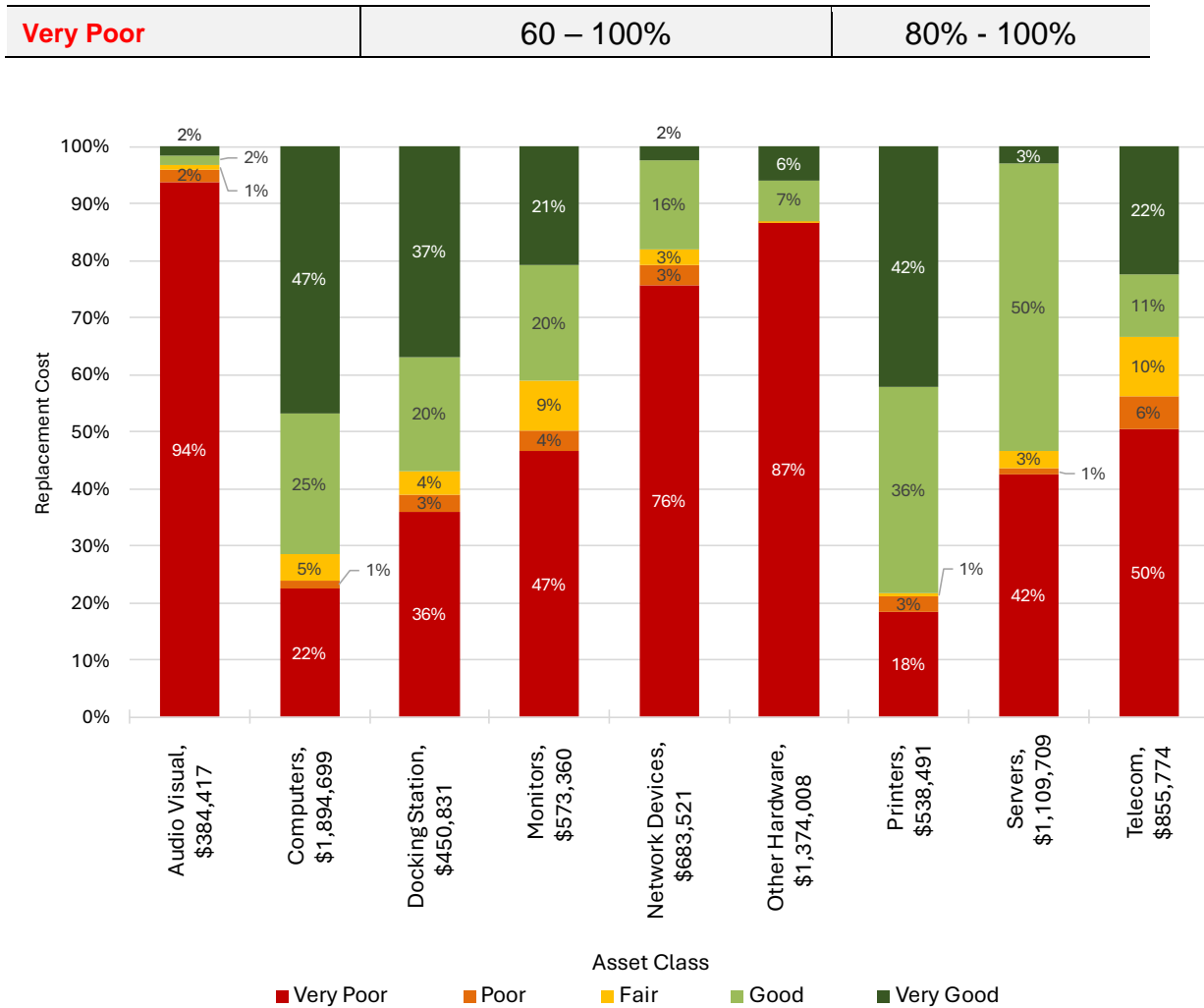


Figure I - 18: Performance Distribution of General Support Service Assets by Asset Class

I.4 Levels of Service – Administration

Customer values, customer levels of service and technical levels of service for administration assets can be found in Table I - 10, Table I - 11, and Table I - 12, respectively.

Table I - 10: Administration Assets Customer Values

Customer Levels of Service		
Type of Measure	Customer Satisfaction Measure	Current Feedback

General Support Service assets are safe and reliable to use	Assets are structurally adequate for use and in overall good working condition.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.
General Support Service are convenient to use	The quality of assets do not negatively affect the customer.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.
	General Support Service is accessible.	
Environmentally sustainable	Environmental impacts are minimized.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.

Table I - 11: Administration Assets Customer LOS

Technical Level of Service Measures			
Type of Measure	Level of Service	Performance Measure	Current Performance
Administration Facilities			
Condition	Condition of Facilities	Average FCI rating of facilities.	0.09
		Confidence Levels: Medium – building condition assessments are performed on facilities to determine investment needs but data requires refinement.	
	Individual element/element group condition.	Percentage of all elements/element groups in poor or very poor condition.	1%
		Percentage of assets that have not exceeded their ESL.	100%

		Confidence Levels: Medium – building condition assessments are performed on facilities to determine investment needs but data requires refinement.	
Function	Measure of whether the service is appropriate for its intended use	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Capacity	Measure of whether the service is adequate to meet customer needs	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Accessibility	Service interruptions	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Administration - Furnishings, Fixtures & Equipment			
Condition	Condition of assets	Percentage of assets that have not exceeded their ESL.	54%
		Confidence Levels: Low to medium – age and ESL are used to assess for condition. Condition data is unavailable.	
Function	Measure of whether the service is appropriate for its intended use	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Capacity	Measure of whether the service is adequate to meet customer needs	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Accessibility	Service interruptions	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	

Table I - 12: Administration Assets Technical LOS

Technical Level of Service Measures				
Lifecycle Activity	Purpose of Activity	Activity Measure	Current Performance (\$, 2023 Budget)	Recommended Performance
Administration				
Acquisition	Growth Expansion Development	Projects developed in Corporate Energy Management Plan, Digital Markham Strategy, and additional growth studies	-	Recommended performance will be considered and included for the City's 2025 Asset Management Plan and Financial Strategy
Operation	Inspections	Annual programs	The City is in the process of documenting operation costs by service	
	Regular Operations	As required		
Maintenance	Minor repairs	As needed	The City is in the process of documenting maintenance costs by service	
	Regular Maintenance	Annual programs		
	Major maintenance (holding strategies)	As needed		
Renewal	Major rehabilitation or replacement	As needed	\$1,157,900	
Disposal	Disposal of replaced assets	As required	Included in renewal costs	
Service Improvement	Upgrades to improve LOS to benefit existing serviced areas	As required	-	

I.5 Levels of Service – Fleet

Customer values, customer levels of service and technical levels of service for General Support Service can be found in Table I - 13, Table I - 14, and Table I - 15, respectively.

Table I - 13: Fleet Assets Customer Values

Customer Levels of Service		
Type of Measure	Customer Satisfaction Measure	Current Feedback
General Support Service assets are safe and reliable to use	Assets are structurally adequate for use and in overall good working condition.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.
General Support Service are convenient to use	The quality of assets do not negatively affect the customer.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.
	General Support Service is accessible.	
Environmentally sustainable	Environmental impacts are minimized.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.

Table I - 14: Fleet Assets Customer LOS

Technical Level of Service Measures			
Type of Measure	Level of Service	Performance Measure	Current Performance
Fleet			

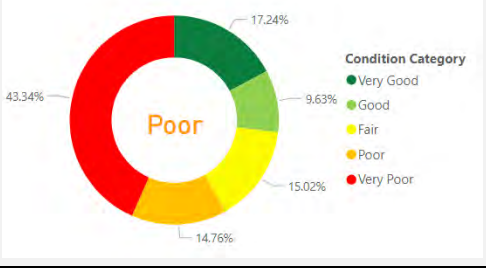
Condition	Condition of assets	Condition or Age/Remaining Useful Life - Aggregated into 5-point rating scale		
		Confidence Levels: Low to medium – age and ESL are used to assess for condition. Condition data is unavailable.		
	Individual element/element group condition.	Percentage of assets that have not exceeded their ESL.	87%	
		Confidence Levels: Low to medium – age and ESL are used to assess for condition. Condition data is unavailable.		
Function	Measure of whether the service is appropriate for its intended use	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.		
Capacity	Measure of whether the service is adequate to meet customer needs	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.		
Accessibility	Service interruptions	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.		

Table I - 15: Fleet Assets Technical LOS

Technical Level of Service Measures				
Lifecycle Activity	Purpose of Activity	Activity Measure	Current Performance (\$, 2023 Budget)	Recommended Performance
Fleet				

Technical Level of Service Measures				
Lifecycle Activity	Purpose of Activity	Activity Measure	Current Performance (\$, 2023 Budget)	Recommended Performance
Acquisition	Growth Expansion Development	Projects developed in Corporate Energy Management Plan, Digital Markham Strategy, and additional growth studies	\$966,800	Recommended performance will be considered and included for the City's 2025 Asset Management Plan and Financial Strategy
		Inspections	Annual programs	
Operation	Regular Operations	As required	\$107,400	
		Minor repairs	As needed	
Maintenance	Regular Maintenance	Annual programs	The City is in the process of documenting maintenance costs by service	
		Major maintenance (holding strategies)		
Renewal	Major rehabilitation or replacement	As needed	\$8,429,900	
Disposal	Disposal of replaced assets	As required	Included in renewal costs	
Service Improvement	Upgrades to improve LOS to benefit existing serviced areas	As required	-	

I.6 Levels of Service – Information Technology

Customer values, customer levels of service and technical levels of service for General Support Service can be found in Table I - 16, Table I - 17, and Table I - 18, respectively.

Table I - 16: Information Technology Assets Service Customer Values

Customer Levels of Service		
Type of Measure	Customer Satisfaction Measure	Current Feedback
General Support Service assets are safe and reliable to use	Assets are structurally adequate for use and in overall good working condition.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.
General Support Service are convenient to use	The quality of assets do not negatively affect the customer.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.
	General Support Service is accessible.	
Environmentally sustainable	Environmental impacts are minimized.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.

Table I - 17: Information Technology Assets Customer LOS

Technical Level of Service Measures			
Type of Measure	Level of Service	Performance Measure	Current Performance
<i>IT - Furnishings, Fixtures & Equipment</i>			
Condition	Condition of assets	Percentage of assets that have not exceeded their ESL.	63%
		Confidence Levels: Low to medium – age and ESL are used to assess for condition. Condition data is unavailable.	
Function	Measure of whether the service is	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	

	appropriate for its intended use	
Capacity	Measure of whether the service is adequate to meet customer needs	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.
Accessibility	Service interruptions	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.

Table I - 18: Information Technology Assets Technical LOS

Technical Level of Service Measures				
Lifecycle Activity	Purpose of Activity	Activity Measure	Current Performance (\$, 2023 Budget)	Recommended Performance
Information Technology				
Acquisition	Growth Expansion Development	Projects developed in Corporate Energy Management Plan, Digital Markham Strategy, and additional growth studies	\$114,000	Recommended performance will be considered and included for the City's 2025 Asset Management Plan and Financial Strategy
Operation	Inspections	Annual programs	\$107,400	
	Regular Operations	As required		
Maintenance	Minor repairs	As needed	The City is in the process of documenting maintenance costs by service	
	Regular Maintenance	Annual programs		
	Major maintenance (holding strategies)	As needed		

Technical Level of Service Measures				
Lifecycle Activity	Purpose of Activity	Activity Measure	Current Performance (\$, 2023 Budget)	Recommended Performance
Renewal	Major rehabilitation or replacement	As needed	\$7,953,300	
Disposal	Disposal of replaced assets	As required	Included in renewal costs	
Service Improvement	Upgrades to improve LOS to benefit existing serviced areas	As required	\$1,866,800	

I.7 System Technical Levels of Service

Table I - 19 outlines the technical LOS related to expenditures that are not specific to an asset class. These include acquisition and renewal projects that affect the service as a whole and/or all asset classes.

Table I - 19: System Technical LOS

Technical Level of Service Measures				
Lifecycle Activity	Purpose of Activity	Activity Measure	Current Performance (\$, 2023 Budget)	Recommended Performance
Other (not asset specific expenditures)				
Acquisition	Growth Expansion Development	Projects developed in Corporate Energy Management Plan, Digital Markham Strategy, and additional growth studies	\$1,129,400	Recommended performance will be considered and included for the City's 2025 Asset Management Plan and Financial Strategy
Renewal	Major rehabilitation or replacement	As needed	\$1,157,900	

Technical Level of Service Measures				
Lifecycle Activity	Purpose of Activity	Activity Measure	Current Performance (\$, 2023 Budget)	Recommended Performance
Disposal	Disposal of replaced assets	As required	Included in renewal costs	

I.8 Risk Management Strategy

The criteria used to determine COF of General Support Service Assets can be found in Table I - 20 below:

Table I - 20: COF Criteria used for General Support Service Assets

Direct Financial	Socio-Economic	Environmental
<ul style="list-style-type: none"> Replacement cost 	<ul style="list-style-type: none"> Asset Category Asset Class Asset Type 	<ul style="list-style-type: none"> Not expected to have significant consequences on the environment

Table I - 21 displays the risk score for General Support Service Assets along with the proportion of assets within each risk score, LOF and COF.

Table I - 21: Risk Score Distribution for General Support Service Assets

		Consequence of Failure				
		1	2	3	4	5
Likelihood of Failure	1	\$1,386,092 (0.5%)	\$26,376,965 (9.6%)	\$30,827,230 (11.3%)	\$0 (0.0%)	\$0 (0.0%)
	2	\$941,335 (0.3%)	\$54,768,077 (20.0%)	\$39,806,234 (14.5%)	\$0 (0.0%)	\$0 (0.0%)
	3	\$254,909 (0.1%)	\$23,305,894 (8.5%)	\$71,268,038 (26.0%)	\$0 (0.0%)	\$0 (0.0%)
	4	\$350,527 (0.1%)	\$5,324,046 (1.9%)	\$976,427 (0.4%)	\$0 (0.0%)	\$0 (0.0%)
	5	\$2,185,880 (0.8%)	\$14,148,797 (5.2%)	\$1,700,615 (0.6%)	\$0 (0.0%)	\$0 (0.0%)

I.9 Lifecycle Management Strategies and Forecasting

The following section outlines the funding required for the entire lifecycle of general support service assets. The expenditures were determined using the lifecycle activities outlined in Table I - 12, Table I - 15, Table I - 18, and Table I - 19 and the LOS established. Required funding was determined using the following forecasting analysis scenario:

- **Maintain Current Levels of Service** – this scenario provides the funding required to maintain a similar asset performance over a 27-year period. It focuses on maintaining the percentage of assets in backlog in a similar state. Backlog is defined as assets that are in need of renewal work (either significant rehabilitation or replacement). For example, if 20% of assets are past their service life, or are in need of renewal work, then the forecast model will determine the funding to maintain 20% of assets in this state over the forecast period.

The forecast analysis identified a total of \$153.5M (annual average of \$10.3M) that is anticipated to be spent over the next 27 years. In 2023, approximately 11.2% of the asset portfolio (by replacement value) is in backlog. The average annual spending identified attempts to maintain this percentage over the next 27 years. The performance and financial forecasts for this state are illustrated in Figure I - 19 and Figure I - 20.

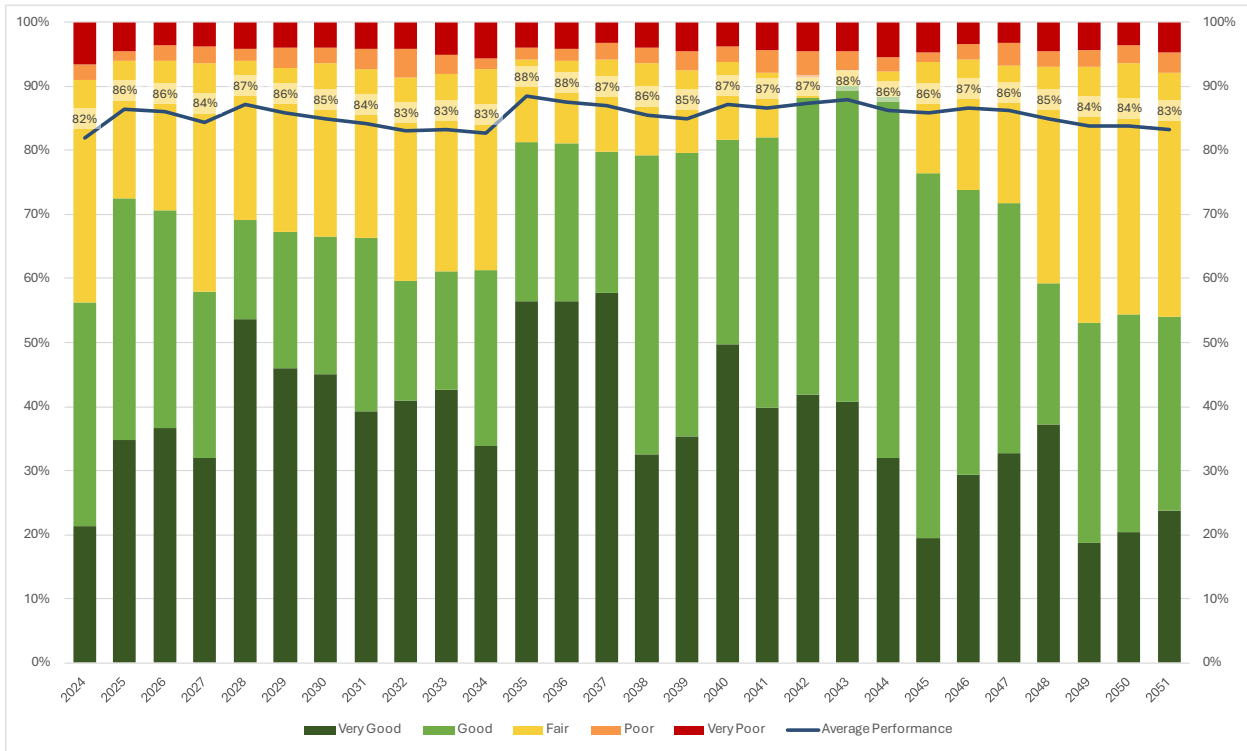


Figure I - 19: Scenario 2 – Maintain Current LOS Performance Distribution for General Support Service Assets

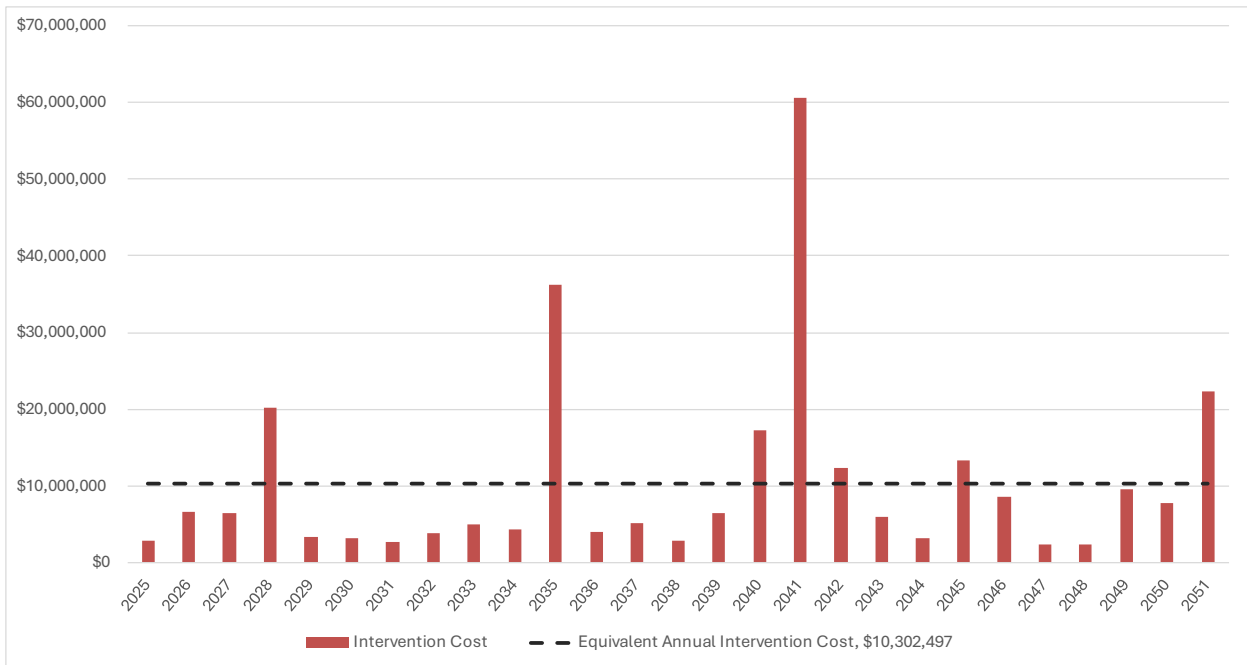


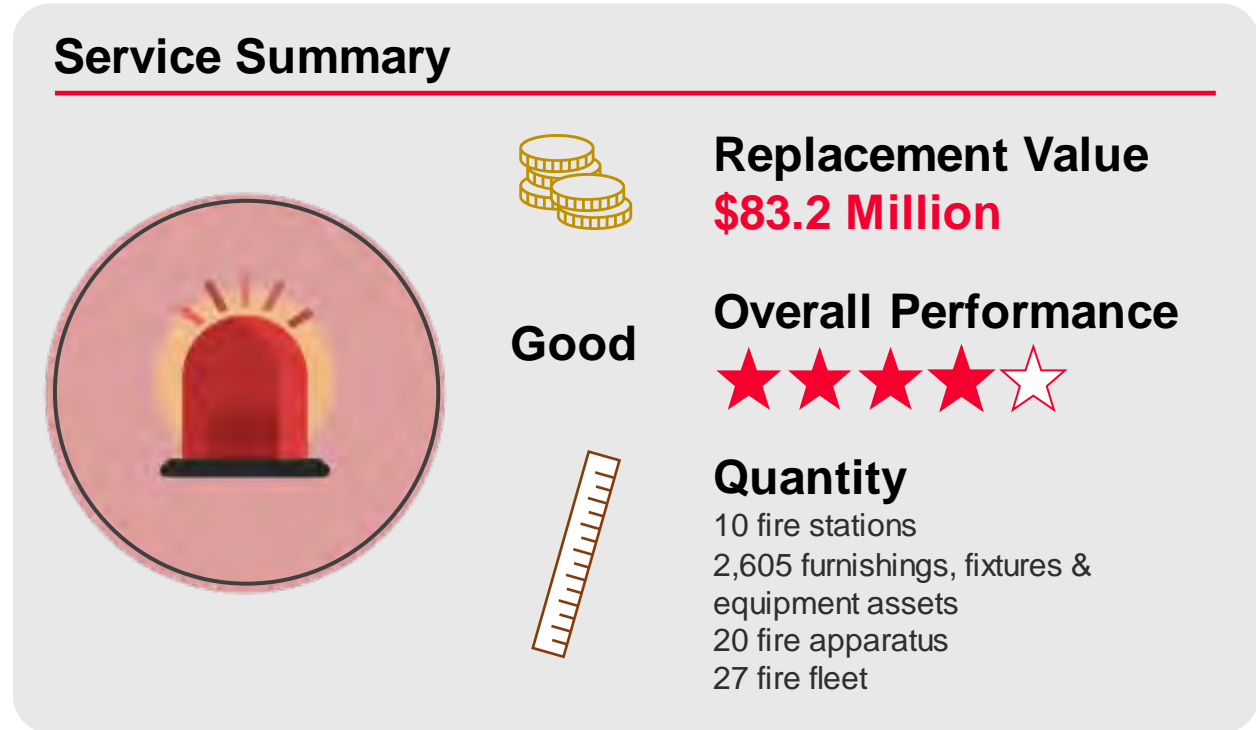
Figure I - 20: Scenario 2 – Maintain Current LOS Intervention Costs for General Support Service Assets



**Sustainability and
Asset Management**

2024 Asset Management Plan Appendix J: Fire and Emergency Services City of Markham

Appendix J Fire and Emergency Services



The City of Markham’s Fire and Emergency Service provides protection to the community, learning and education resources in order to keep residents informed all while responding to local needs and circumstances.

Markham is responsible for assets such as various fire station facilities, fleet, furnishings, fixtures and equipment, as detailed in Figure J - 1.



Figure J - 1: Fire and Emergency Services Asset Hierarchy

More information on Fire and Emergency Services such as state of infrastructure, levels of service, risk management strategies and lifecycle management strategies and forecasting can be found in the following sections.

J.1 State of the Infrastructure

Figure J - 2 provides the replacement value distribution of all fire and emergency service assets, while Figure J - 3 illustrates the replacement value distribution of fire and emergency furnishings, fixtures, and equipment.

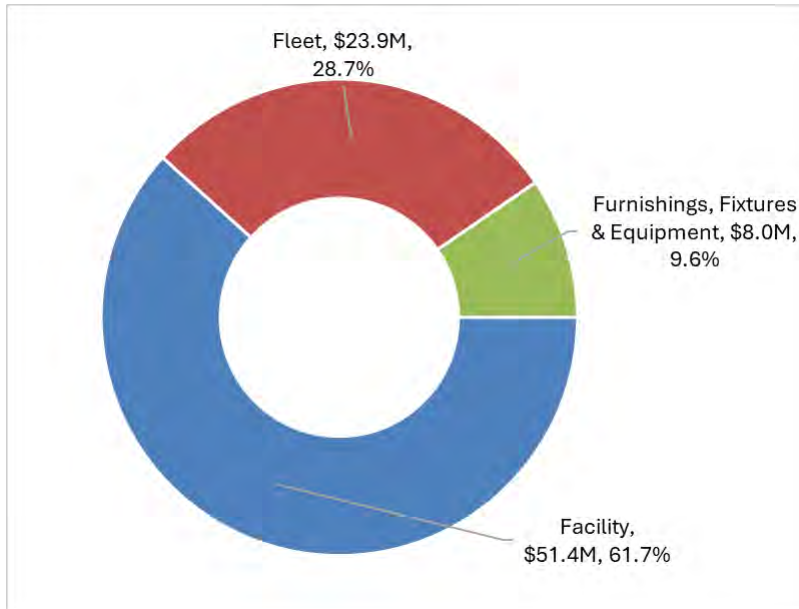


Figure J - 2: Replacement Value Distribution of Fire and Emergency Services Assets

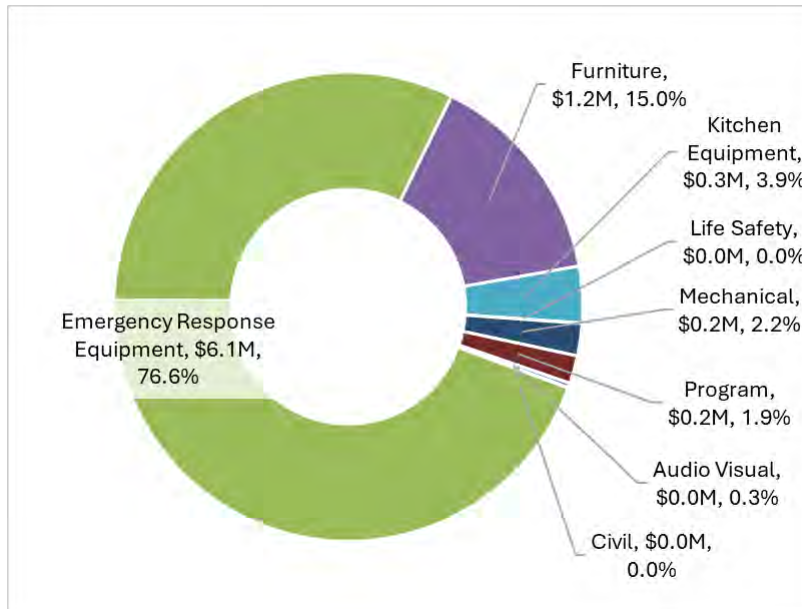


Figure J - 3: Replacement Value Distribution of Fire and Emergency Services Furnishings, Fixtures and Equipment

J.1.1 Asset Inventory and Valuation

Table J - 1 below summarizes the asset valuation, quantities, and performance for each asset category of fire and emergency services.

Table J - 1: Inventory and Valuation of Fire and Emergency Services Assets

Subservice	Asset Category	Asset Class	Replacement Cost	Quantity	Average Performance
Fire & Emergency Service	Facility	Fire Station	\$51,355,598	103,865 sq ft	Very Good
	Furnishings, Fixtures & Equipment	Audio Visual	\$25,696	6 Assets	Good
		Civil	\$3,000	2 Assets	Good
		Emergency Response Equipment	\$6,111,901	2,445 Assets	Good
		Furniture	\$1,192,760	70 Assets	Good
		Kitchen Equipment	\$309,536	18 Assets	Good
		Life Safety	\$3,000	3 Assets	Good
		Mechanical	\$177,376	27 Assets	Good
		Program	\$152,127	34 Assets	Good

Fleet	Fleet	Fire Apparatus	\$22,495,960	20 Assets	Good
		Fire Fleet	\$1,409,159	27 Assets	Good

J.1.2 Age and Estimated Service Life

Figure J - 4 illustrates the age of Fire and Emergency Services assets as a proportion of their estimated service life. Figure J - 5 illustrates the value of assets acquired by decade. All fire and emergency service assets, with the exception of fire stations and fire apparatus, are on average more than halfway through their ESL. Fire apparatus assets on average have exceeded their ESL and fire stations on average are only 15% through their ESL.

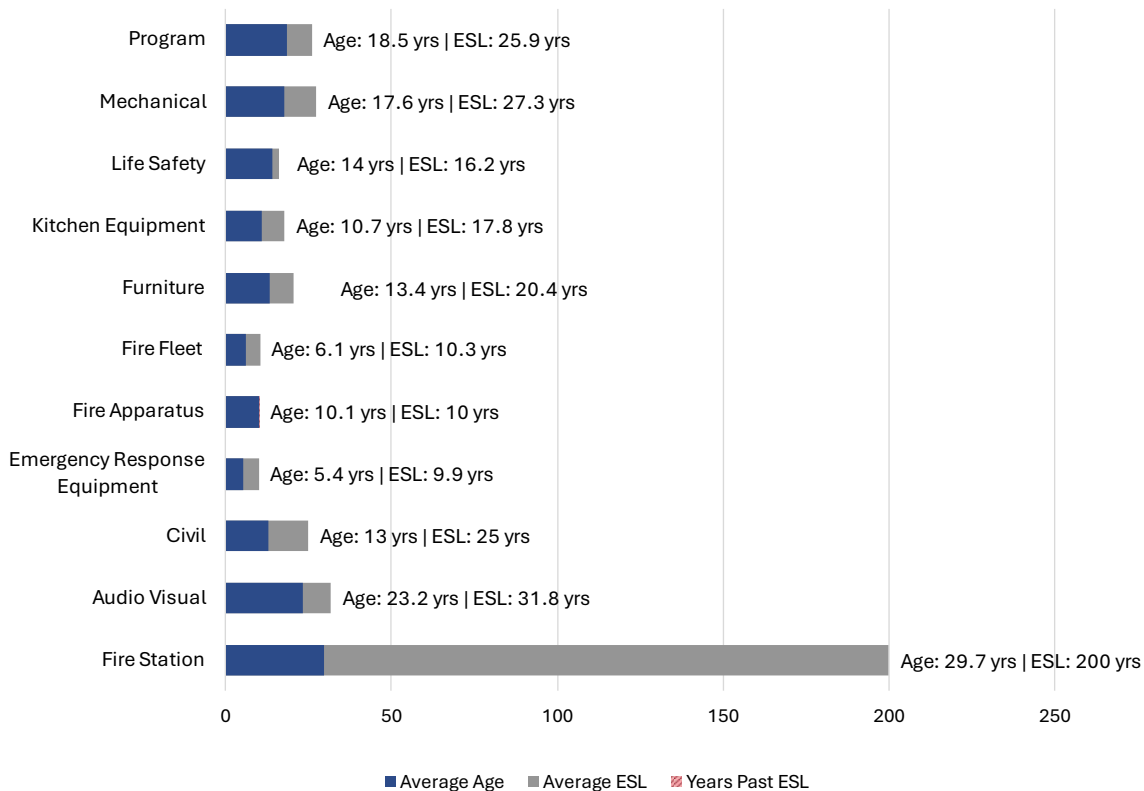


Figure J - 4: Age as a Proportion of Estimated Service Life (ESL) of Fire and Emergency Services Assets

The installation profile of fire and emergency service assets illustrates that the majority of fire stations were constructed from the 1970s to 2010s, and the majority of fire apparatus were acquired in the 2010s, in line with decades that experienced significant growth and corresponding development in the City.

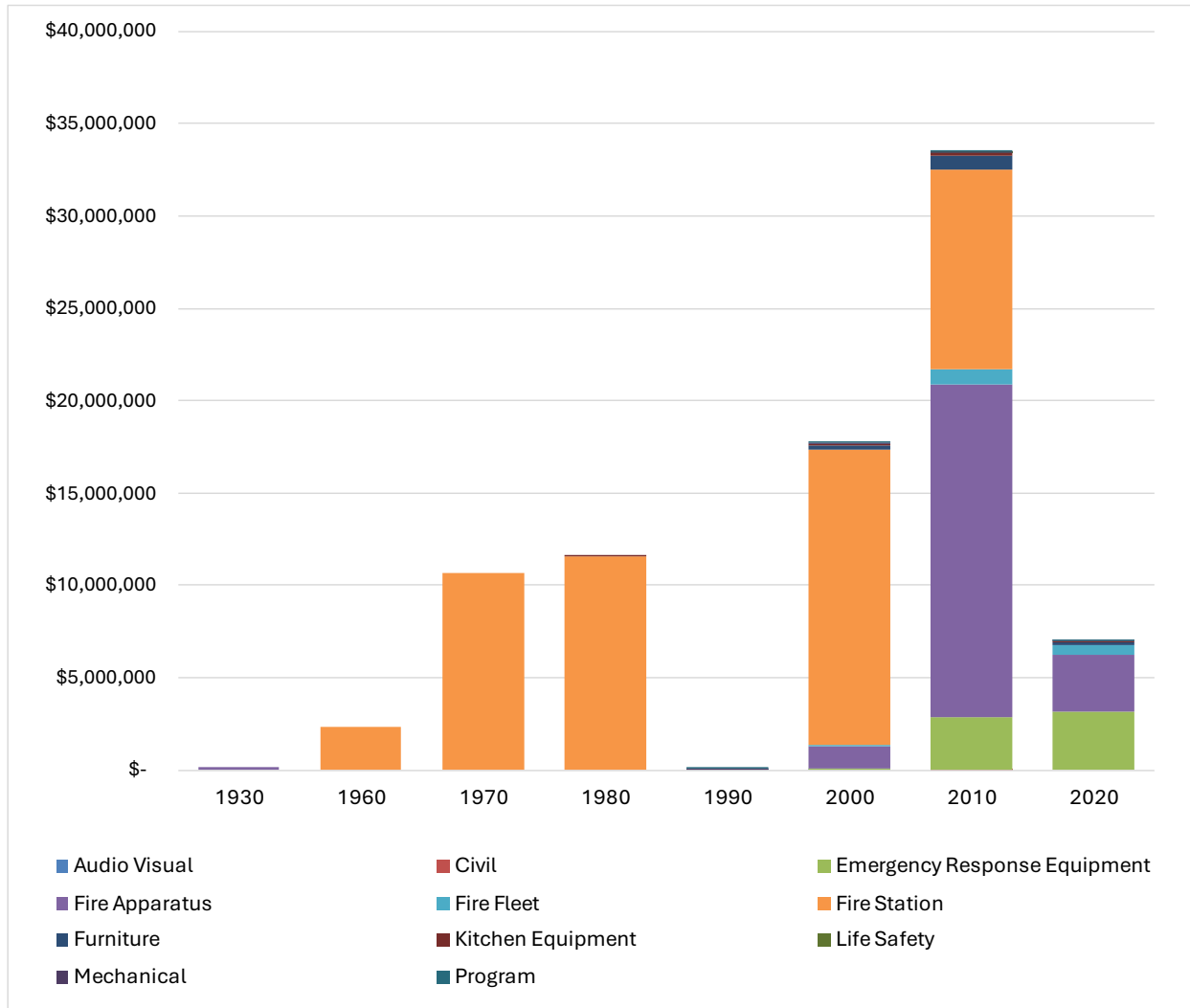


Figure J - 5: Age Distribution by Installation Decade of Fire and Emergency Services Assets

J.1.3 Asset Performance

Table J - 2 details the approaches used by the City to assess asset performance.

Table J - 2: Condition assessment approaches for Fire and Emergency Services Assets

Asset Class	Performance Metric	Description
Fire Station	FCI	Facilities are inspected on a 3-year cycle and the results from the inspections are recorded in City's database annually and used to understand facility renewal needs and to calculate FCI.
Fire Fleet	Age/ESL	The City understands the condition of these assets based on asset age and estimated service life
Fire Apparatus		
Emergency Response Equipment		
Furniture		
Mechanical		
Program		
Audio Visual		
Life Safety		
Civil		
Kitchen Equipment		

Figure J - 6 and Figure J - 7 illustrate the performance of all fire and emergency services assets. Table J - 3 summarizes the relationship between the performance categories and how performance ratings are determined.

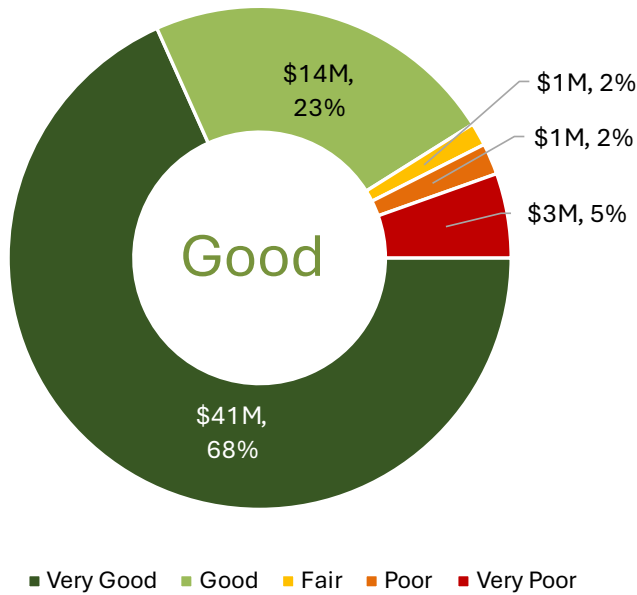


Figure J - 6: Performance Distribution of Fire and Emergency Services Assets

Table J - 3: Performance Ratings of Fire and Emergency Services Assets

Performance Category	Facility Condition Index (FCI)	Age/ESL
Very Good	0% - 5%	0% - 20%
Good	5% - 10%	20% - 40%
Fair	10% - 30%	40% - 60%
Poor	30% - 60%	60% - 80%
Very Poor	60 - 100%	80% - 100%



Figure J - 7: Performance Distribution of Fire and Emergency Services Assets by Asset Class

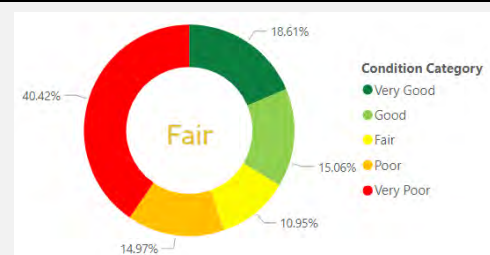
J.2 Levels of Service

Customer values, customer levels of service and technical levels of service for Fire and Emergency Services Assets can be found in Table J - 4, Table J - 5, and Table J - 6, respectively.

Table J - 4: Fire and Emergency Services Customer Values

Customer Values		
Customer Values	Customer Satisfaction Measure	Current Feedback & Expected Trend Based on Planned Budget
Fire & Emergency services assets are safe and reliable to use	Assets are structurally adequate for use and in overall good working condition.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.
	Fire & emergency services responds to incidents in a timely manner.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.
Fire & Emergency services assets are available to the customer	Fire & emergency services are actively working towards preventing fires.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.
	Fire & emergency services are actively educating the public.	
	Fire services surpass the minimum requirement for rural communities.	
Environmentally sustainable	Environmental impacts are minimized.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.

Table J - 5: Fire and Emergency Services Customer LOS

Customer Level of Service Measures			
Type of Measure	Level of Service	Performance Measure	Current Performance
Facilities			
Condition	Condition of Fire Station	Average FCI rating of facilities.	0.04
		Confidence Levels: High – building condition assessments are performed on facilities to determine investment needs.	
	Individual element/element group condition.	Percentage of all elements/element groups in poor condition.	0%
		Percentage of assets that have not exceeded their ESL.	100%
		Confidence Levels: High – building condition assessments are performed on facilities to determine investment needs.	
Function	Measure of whether the service is appropriate for its intended use	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Capacity	Measure of whether the service is adequate to meet customer needs	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Accessibility	Service interruptions	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Furnishings, Fixtures & Equipment and Fleet			
Condition	Condition of Emergency Response Equipment and Non-Emergency Equipment	Condition or Age/Remaining Useful Life - Aggregated into 5-point rating scale	 <p>Condition Category</p> <ul style="list-style-type: none"> Very Good Good Fair Poor Very Poor

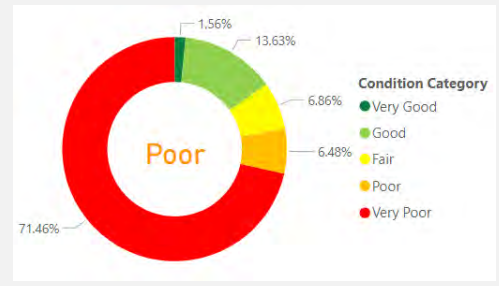
Customer Level of Service Measures			
Type of Measure	Level of Service	Performance Measure	Current Performance
		Confidence Levels: Low to medium – age and ESL are used to assess for condition. Condition data is unavailable.	
	Condition of Fire Fleet and Apparatus	Condition or Age/Remaining Useful Life - Aggregated into 5-point rating scale	
		Confidence Levels: Low to medium – age and ESL are used to assess for condition. Condition data is unavailable.	
	Individual element/element group condition.	Percentage of all elements/element groups in poor or very poor condition.	72%
		Percentage of assets that have not exceeded their ESL.	28%
		Confidence Levels: Low to medium – age and ESL are used to assess for condition. Condition data is unavailable.	
Function	Measure of whether the service is appropriate for its intended use	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Capacity	Measure of whether the service is adequate to meet customer needs	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Accessibility	Service interruptions	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	



Table J - 6: Fire and Emergency Services Technical LOS

Technical Level of Service Measures				
Lifecycle Activity	Purpose of Activity	Activity Measure	Current Performance (\$, 2023 Budget)	Recommended Performance
Acquisition	Growth Expansion Development	Projects developed in City of Markham Emergency Response Plan, Master Fire Plan and the Council Endorsed Deployment Plan	\$208,700	Recommended performance will be considered and included for the City's 2025 Asset Management Plan and Financial Strategy
		Inspections	Annual programs	
Operation	Regular Operations	As required	\$139,300	
		Minor repairs	As required	
Maintenance	Regular Maintenance	Annual programs	The City is in the process of documenting maintenance costs by service	
		Major maintenance (holding strategies)		
Renewal	Major rehabilitation or replacement	As required	\$1,972,600	
Disposal	Disposal of replaced assets	As required	Included in renewal costs	
Service Improvement	Upgrades to improve LOS to benefit existing serviced areas	As required	\$751,900	

J.3 Risk Management Strategy

The criteria used to determine COF of Fire and Emergency Service Assets can be found in Table J - 7 below:

Table J - 7: COF Criteria used for Fire and Emergency Service Assets

Direct Financial	Socio-Economic	Environmental
<ul style="list-style-type: none"> Replacement cost 	<ul style="list-style-type: none"> Facility Size Equipment Type Division Type 	<ul style="list-style-type: none"> Not expected to have significant consequences on the environment

Table J - 8 displays the risk score for Fire and Emergency Service Assets along with the proportion of assets within each risk score, LOF and COF.

Table J - 8: Risk Score Distribution for Fire and Emergency Service Assets

		Consequence of Failure				
		1	2	3	4	5
Likelihood of Failure	1	\$39,593 (0.0%)	\$44,573 (0.1%)	\$7,963,032 (9.6%)	\$32,852,905 (39.5%)	\$0 (0.0%)
	2	\$130,570 (0.2%)	\$367,565 (0.4%)	\$16,275,258 (19.6%)	\$0 (0.0%)	\$0 (0.0%)
	3	\$126,079 (0.2%)	\$109,091 (0.1%)	\$2,278,378 (2.7%)	\$0 (0.0%)	\$0 (0.0%)
	4	\$626,466 (0.8%)	\$120,515 (0.1%)	\$1,996,790 (2.4%)	\$0 (0.0%)	\$0 (0.0%)
	5	\$376,023 (0.5%)	\$1,008,283 (1.2%)	\$18,920,993 (22.7%)	\$0 (0.0%)	\$0 (0.0%)

J.4 Lifecycle Management Strategies and Forecasting

The following section outlines the funding required for the entire lifecycle of fire and emergency service assets. The expenditures were determined using the lifecycle activities outlined in Table J - 6 and the LOS established. Required funding was determined using the following forecasting analysis scenario:

- **Maintain Current Levels of Service** – this scenario provides the funding required to maintain a similar asset performance over a 27-year period. It focuses on maintaining the percentage of assets in backlog in a similar state. Backlog is defined as assets that are in need of renewal work (either significant rehabilitation or replacement). For example, if 20% of assets are past their service life, or are in need of renewal work, then the forecast model will determine the funding to maintain 20% of assets in this state over the forecast period.

The forecast analysis identified a total of \$67.0M (annual average of \$3.6M) that is anticipated to be spent over the next 27 years. In 2023, approximately 23.6% of the asset portfolio (by replacement value) is in backlog. The average annual spending identified attempts to maintains this percentage over the next 27 years. The performance and financial forecasts for this state are illustrated in Figure J - 8 and Figure J - 9.

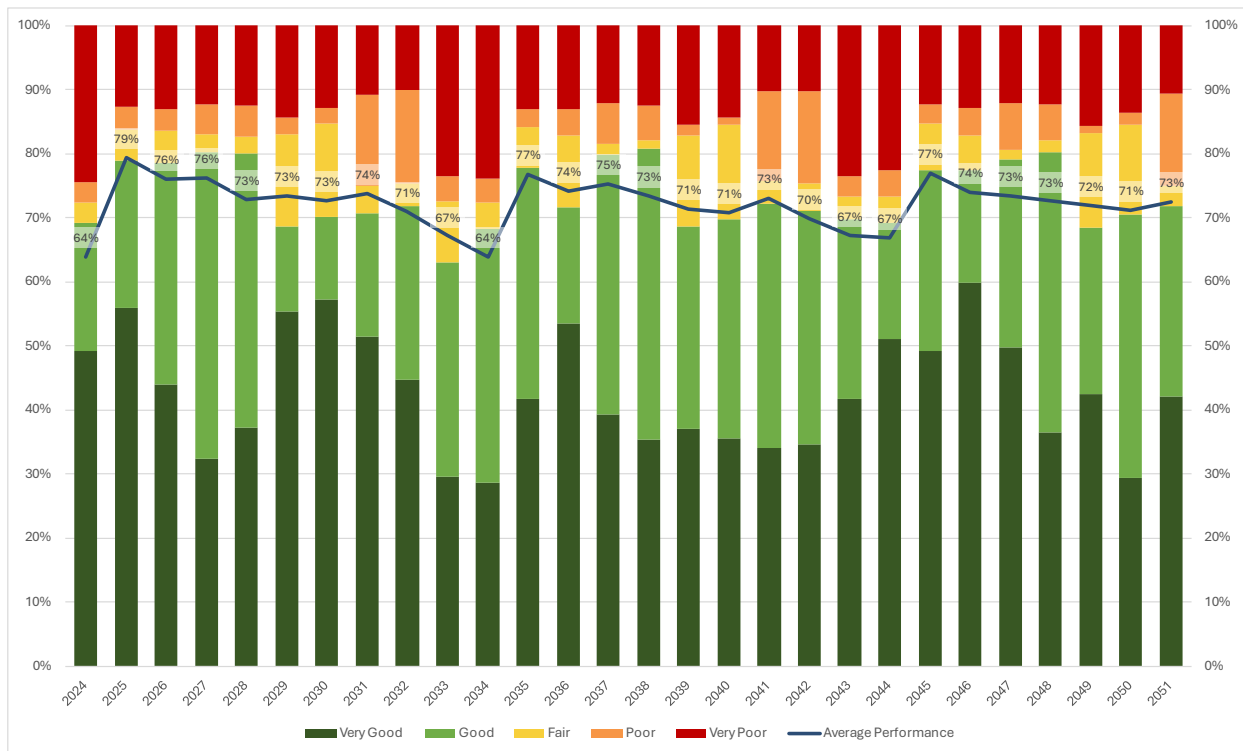


Figure J - 8: Maintain Current LOS Performance Distribution for Fire and Emergency Service Assets

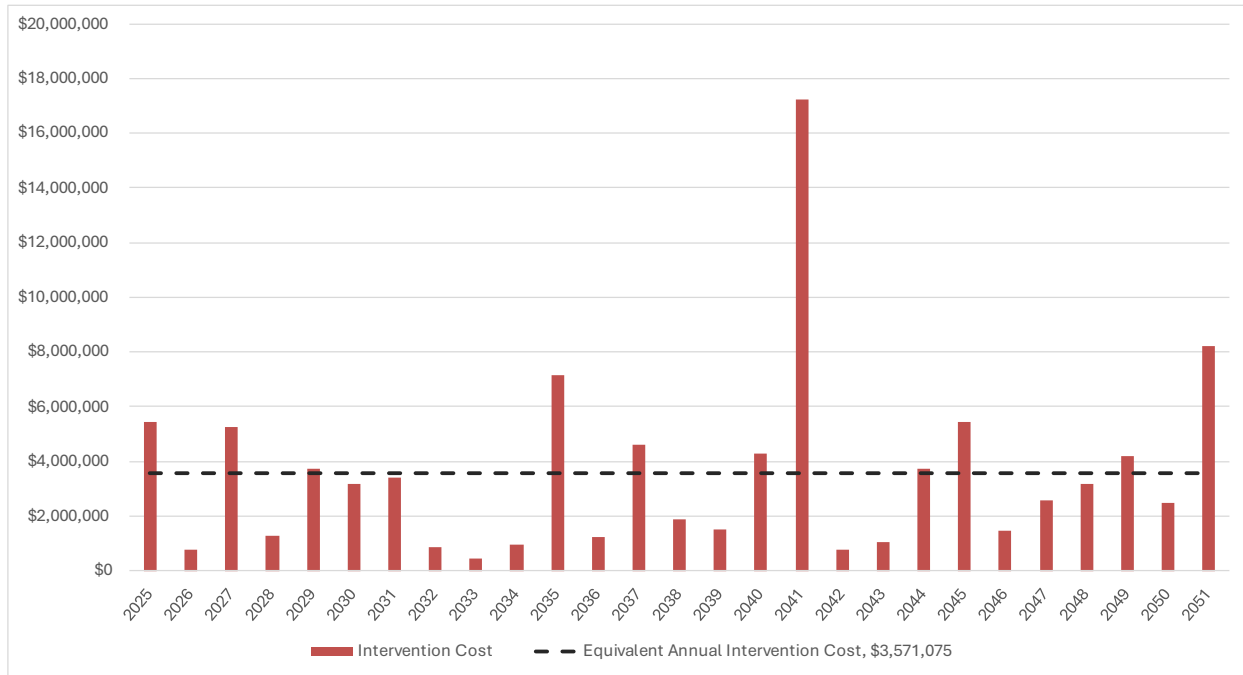


Figure J - 9: Maintain Current LOS Intervention Costs for Fire and Emergency Service Assets



**2024 Asset Management
Plan Appendix K: Arts and
Culture
City of Markham**

Appendix K Arts and Culture



The City of Markham’s Arts and Culture Services provide residents with exposure to various arts forms and culture via facilities such as art galleries, theatres, museums and historical artifacts.

Markham is responsible for assets such as various facilities, furnishings, fixtures and equipment, as detailed in Figure K - 1.



Figure K - 1: Arts and Culture Asset Hierarchy

More information on Arts and Culture such as state of infrastructure, levels of service, risk management strategies and lifecycle management strategies and forecasting can be found in the following sections.

K.1 State of the Infrastructure

Figure K - 2 illustrates the replacement value distribution of all arts and cultural assets, while Figure K - 3 and Figure K - 4 display the replacement value distribution of arts and cultural facilities and furnishings, fixtures and equipment, respectively.

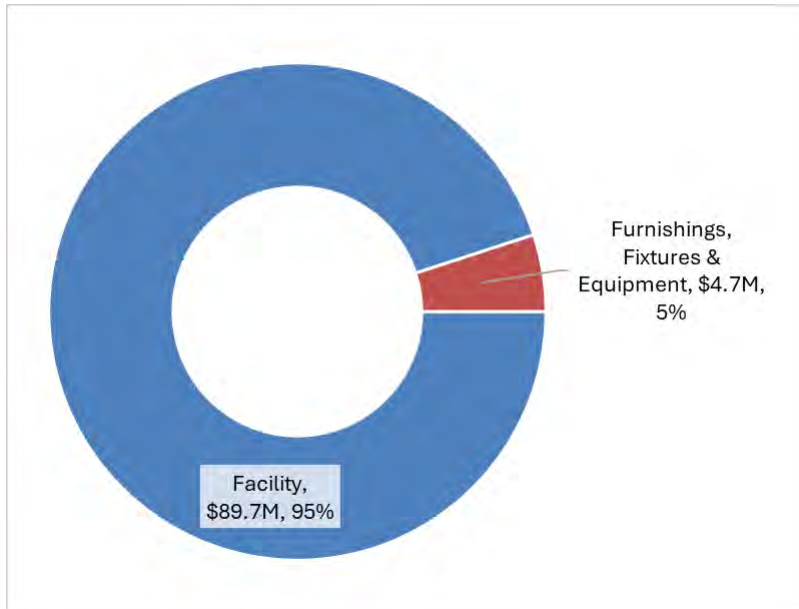


Figure K - 2: Replacement Value Distribution of Arts and Culture Assets

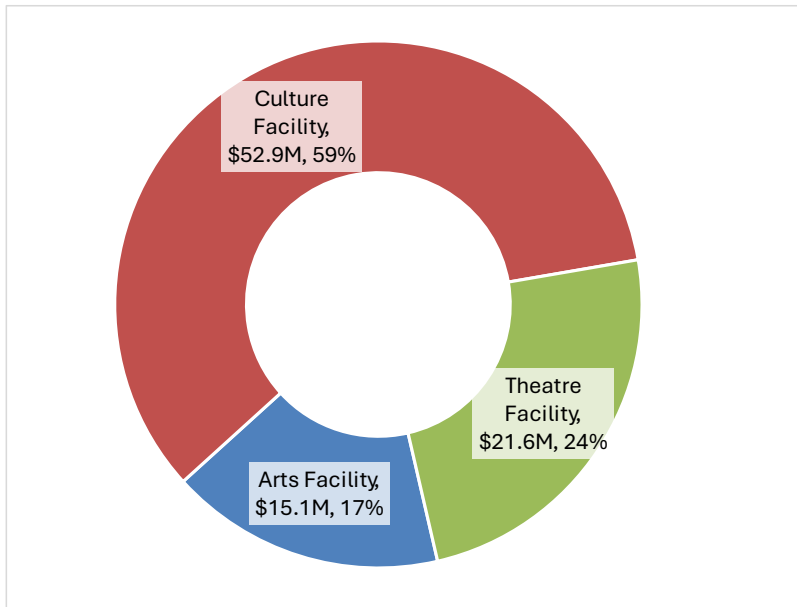


Figure K - 3: Replacement Value Distribution of Arts and Culture Facilities

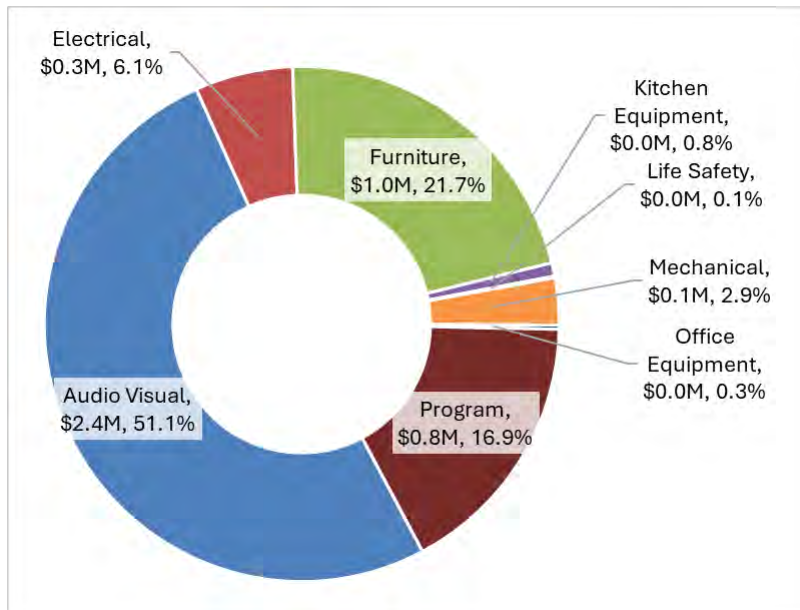


Figure K - 4: Replacement Value Distribution of Arts and Culture Furnishings, Fixtures & Equipment

K.1.1 Asset Inventory and Valuation

Table K - 1 below summarizes the asset valuation, quantities, and performance for each arts and cultural services asset category.

Table K - 1: Inventory and Valuation of Arts and Culture Assets

Subservice	Asset Category	Asset Class	Replacement Cost	Quantity	Average Performance
Arts and Culture	Facility	Arts Facility	\$15,139,060	22,918 sq ft	Good
		Culture Facility	\$52,905,342	111,187 sq ft	Very Good
		Theatre Facility	\$21,612,855	30,200 sq ft	Good
	Furnishings, Fixtures & Equipment	Audio Visual	\$2,410,825	111 Assets	Good
		Electrical	\$290,000	3 Assets	Good
		Furniture	\$1,026,537	118 Assets	Good
		Kitchen Equipment	\$39,440	13 Assets	Good
		Life Safety	\$5,000	1 Asset	Good
		Mechanical	\$138,781	15 Assets	Good
		Office Equipment	\$12,460	5 Assets	Good
		Program	\$797,565	49 Assets	Good

K.1.2 Age and Estimated Service Life

Figure K - 5 illustrate the age of arts and culture assets as a proportion of their estimated service life and Figure K - 6 illustrates the value of assets acquired by decade. The facilities on average are less than a third between their ESL. All other assets, with the exception of life safety assets are between halfway and approaching the end of their ESL. Life safety assets on average have exceeded their ESL.

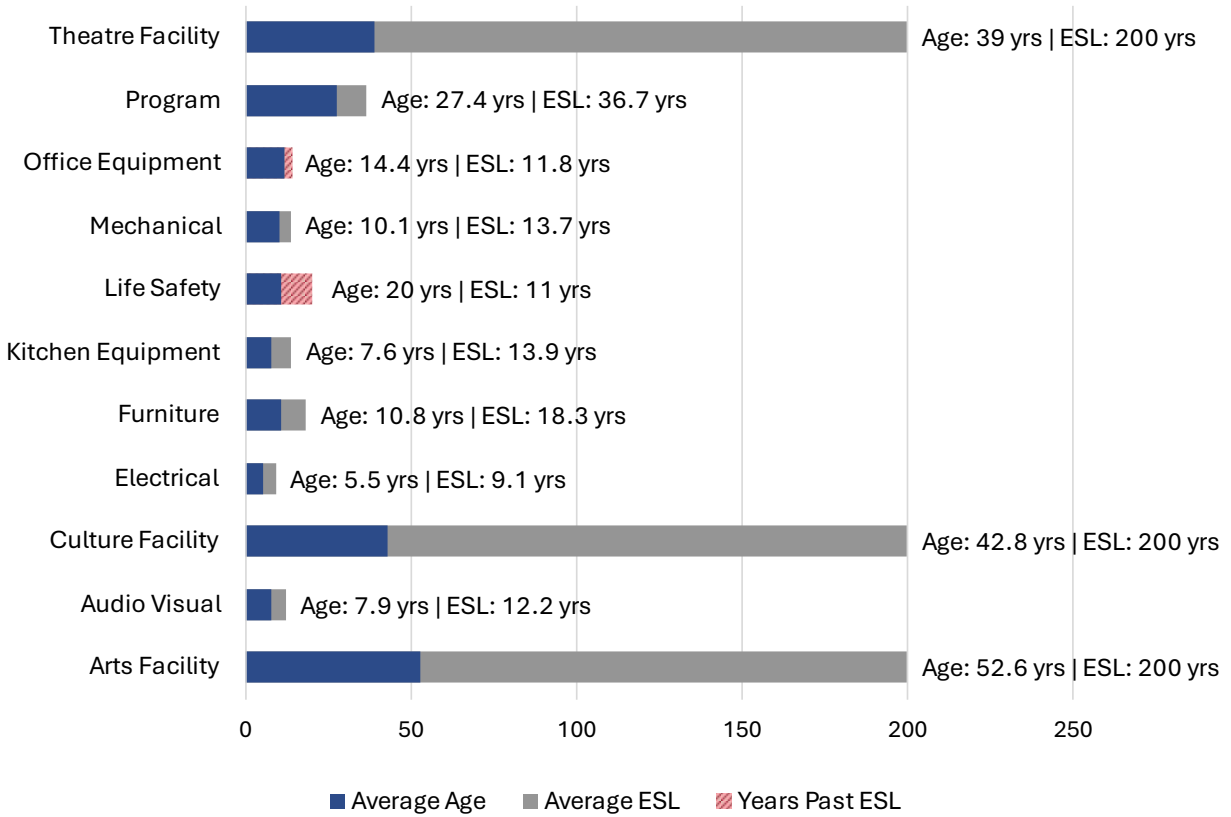


Figure K - 5: Age as a Proportion of Estimated Service Life (ESL) of Arts and Culture Assets

The installation profile of arts and culture assets illustrates that the majority of facilities were installed from the 1980s to 2010s, in line with decades that experienced significant growth and corresponding development in the City.

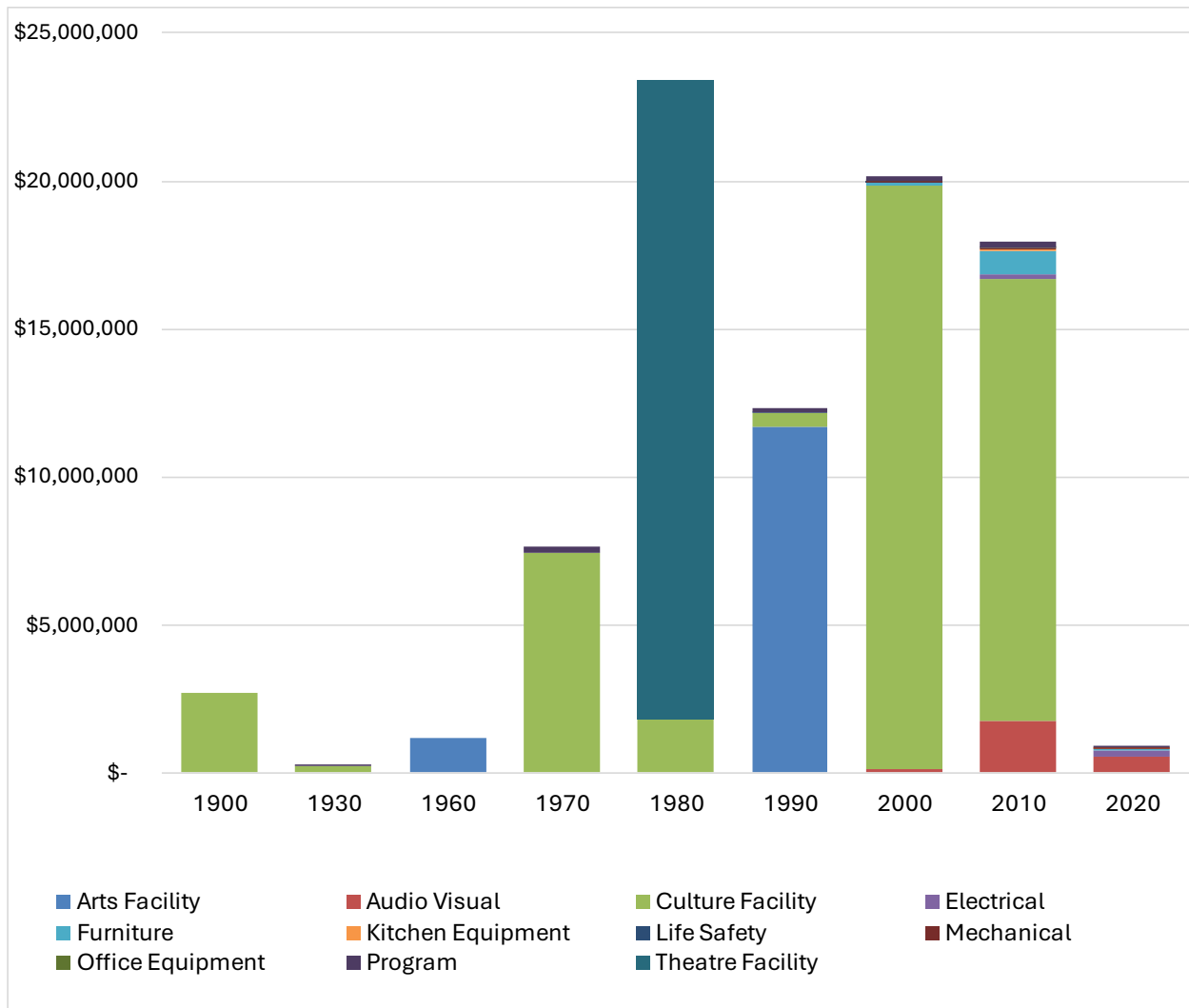


Figure K - 6: Age Distribution by Installation Decade of Arts and Culture Assets

K.1.3 Asset Performance

Table K - 2 details the approaches used by the City to assess asset performance.

Table K - 2: Performance assessment approaches for Arts and Cultural Assets

Asset Class	Performance Metric	Description
Arts Facility	FCI	Facilities are inspected on a 3-year cycle and the inspection results are recorded in City's database annually and used to understand facility renewal needs and calculate the FCI.
Culture Facility		
Theatre Facility		
Furniture	Age/ESL	The City understand the performance of these assets based on asset age and estimated service life
Program		
Mechanical		
Audio Visual		
Electrical		
Kitchen Equipment		
Office Equipment		
Life Safety		

Figure K - 7 and Figure K - 8 illustrate the performance of all library assets. Table K - 3 summarizes the relationship between the performance categories and how performance ratings are determined.

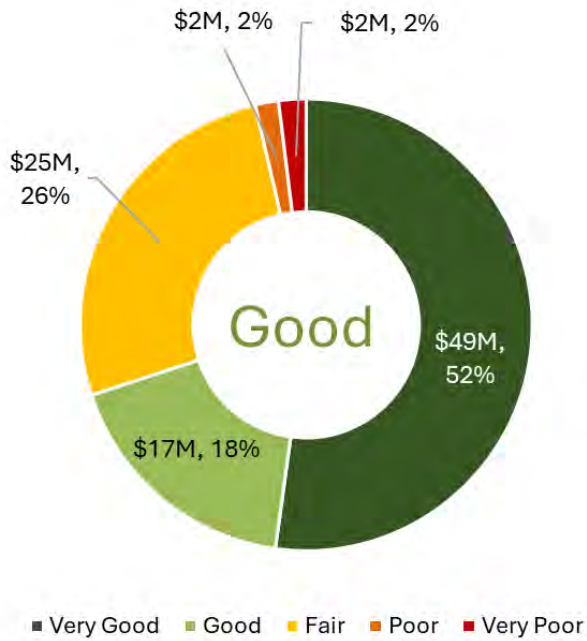


Figure K - 7: Performance Distribution of Arts and Culture Assets

Table K - 3: Performance Ratings of Arts and Culture Assets

Performance Category	Facility Condition Index (FCI)	Age/ESL
Very Good	0% - 5%	0% - 20%
Good	5% - 10%	20% - 40%
Fair	10% - 30%	40% - 60%
Poor	30% - 60%	60% - 80%
Very Poor	60 - 100%	80% - 100%

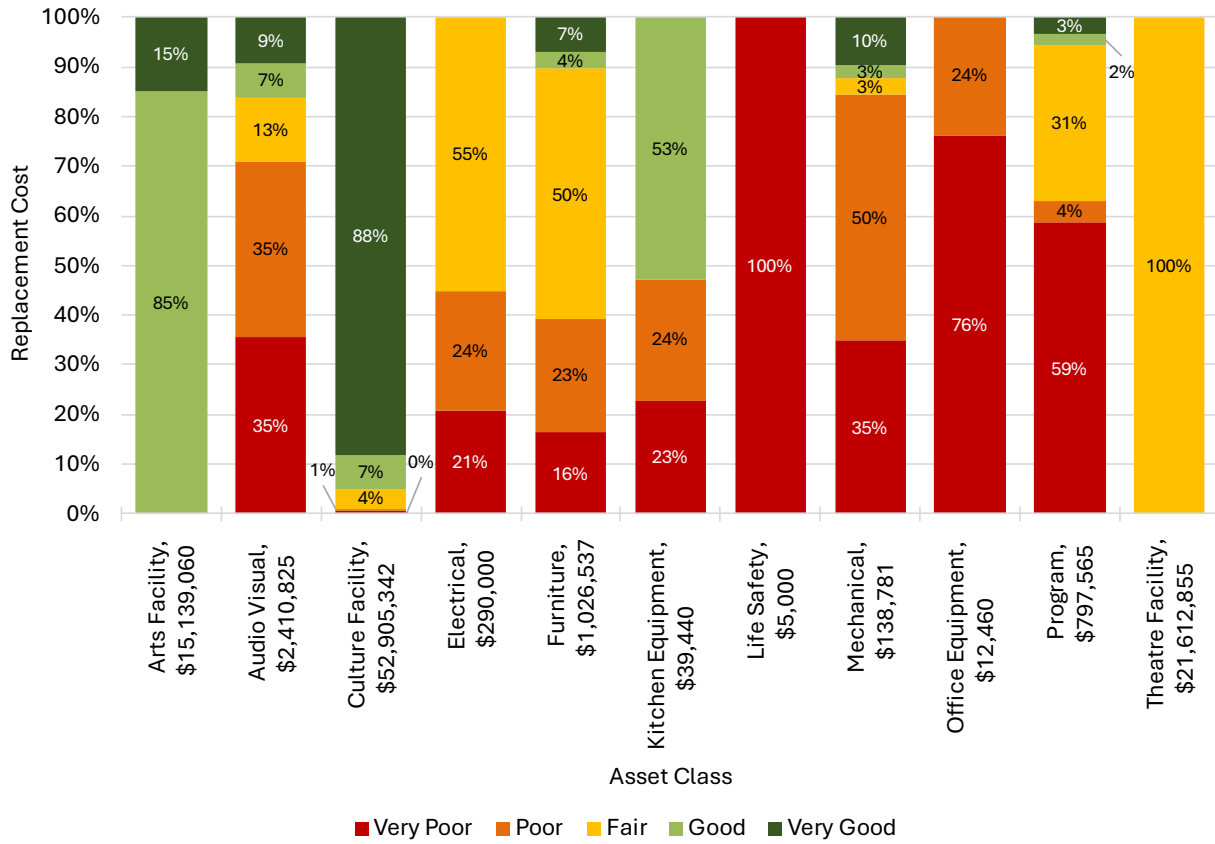


Figure K - 8: Performance Distribution of Arts and Culture Assets by Asset Class

K.2 Levels of Service

Customer values, customer levels of service and technical levels of service for Arts and Culture can be found in Table K - 4, Table K - 5, and Table K - 6, respectively.

Table K - 4: Arts and Culture Customer Values

Customer Values		
Customer Values	Customer Satisfaction Measure	Current Feedback & Expected Trend Based on Planned Budget
Arts & Culture Services		
Arts & Culture assets are safe and reliable to use	Assets are structurally adequate for use and in overall good working condition.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.
Arts & Culture services are convenient to use	The quality of assets do not negatively affect the customer.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.
	There are sufficient and appropriate amenities available for all customers.	
	Arts & Culture services are accessible.	
Aesthetic Quality	Arts & Culture assets meet aesthetic expectations.	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.
Arts & Culture Services (Theatre Specific)		

Customer Values		
Customer Values	Customer Satisfaction Measure	Current Feedback & Expected Trend Based on Planned Budget
Shine (Modern, appeal, engaging, state of the art)	Clients and patrons of theatres expect an experience working with and attending theatres that is at the leading edge of technological advancements	The City is currently reviewing the data that supports this metric, which will be reported in future iterations of the City's AMP. These metrics are subject to change as data is reviewed and incorporated into future AMPs.

Table K - 5: Arts and Culture Customer LOS

Customer Levels of Service			
Type of Measure	Level of Service	Performance Measure	Current Performance
Facilities			
Condition	Condition of Facilities	Average FCI rating of facilities.	0.08
		Confidence Levels: Medium – building condition assessments are performed on facilities to determine investment needs but data requires refinement.	
	Individual element/element group condition.	Percentage of all elements/element groups in poor or very poor condition.	0.6%
		Percentage of assets that have not exceeded their ESL.	100%
		Confidence Levels: Medium – building condition assessments are performed on facilities to determine investment needs but data requires refinement.	

Function	Measure of whether the service is appropriate for its intended use	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Capacity	Measure of whether the service is adequate to meet customer needs	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Accessibility	Service interruptions	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
<i>Furnishings, Fixtures & Equipment</i>			
Condition	Condition of assets	Percentage of assets that have not exceeded their ESL.	94%
		Confidence Levels: Low to medium – age and ESL are used to assess for condition. Condition data is unavailable.	
	Individual element/element group condition.	Percentage of all elements/element groups in poor or very poor condition	61%
		Confidence Levels: Low to medium – age and ESL are used to assess for condition. Condition data is unavailable.	
Function	Measure of whether the service is appropriate for its intended use	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Capacity	Measure of whether the service is adequate to meet customer needs	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
Accessibility	Service interruptions	The City is currently reviewing and selecting measures for this category, which will be developed and integrated into future iterations of the City's AMP.	
	The theatre meets accessibility needs		

Table K - 6: Arts and Culture Technical LOS

Technical Level of Service Measures				
Lifecycle Activity	Purpose of Activity	Activity Measure	Current Performance (\$, 2023 Budget)	Recommended Performance
Facilities				
Acquisition	Growth Expansion Development	Projects developed in Integrated Leisure Master Plan	The City is in the process of documenting acquisition costs by service	Recommended performance will be considered and included for the City's 2025 Asset Management Plan and Financial Strategy
	Operation	Inspections	Annual programs	
Regular Operations		As required		
Maintenance	Minor repairs	As needed	\$350,100	
	Regular Maintenance	Annual programs		
	Major maintenance (holding strategies)	As needed		
Renewal	Major rehabilitation or replacement	As needed	\$857,900	
Disposal	Disposal of replaced assets	As required	Included in renewal costs	
Service Improvement	Upgrades to improve LOS to benefit existing serviced areas	As required	-	
Furnishings, Machinery & Equipment				
Acquisition	Growth Expansion Development	Projects developed in Integrated Leisure Master Plan	The City is in the process of documenting acquisition costs	Recommended performance will be considered and included for the City's 2025 Asset Management
Operation	Inspections	Annual programs	The City is in the process of	

Technical Level of Service Measures				
Lifecycle Activity	Purpose of Activity	Activity Measure	Current Performance (\$, 2023 Budget)	Recommended Performance
	Regular Operations	As required	documenting operation costs	Plan and Financial Strategy
Maintenance	Minor repairs	As needed	\$89,900	
	Regular Maintenance	Annual programs		
	Major maintenance (holding strategies)	As needed		
Renewal	Major rehabilitation or replacement	As needed	\$67,200	
Disposal	Disposal of replaced assets	As required	Included in renewal costs	
Service Improvement	Upgrades to improve LOS to benefit existing serviced areas	As required	-	
Other (not asset specific expenditures)				
Acquisition	Growth Expansion Development	Projects developed in Integrated Leisure Master Plan	\$248,000	Recommended performance will be considered and included for the City's 2025 Asset Management Plan and Financial Strategy

K.3 Risk Management Strategy

The criteria used to determine COF of Arts and Culture Assets can be found in Table K - 7 below:

Table K - 7: COF Criteria used for Arts and Culture Assets

Direct Financial	Socio-Economic	Environmental
<ul style="list-style-type: none"> Replacement cost Revenue lost 	<ul style="list-style-type: none"> Asset class 	<ul style="list-style-type: none"> Not expected to have significant consequences on the environment

Table K - 8 displays the risk score for Arts and Culture Assets along with the proportion of assets within each risk score, LOF and COF.

Table K - 8: Risk Score Distribution for Arts and Culture Assets

		Consequence of Failure				
		1	2	3	4	5
Likelihood of Failure	1	\$42,962 (0.0%)	\$2,311,232 (2.4%)	\$5,146,575 (5.5%)	\$41,752,744 (44.2%)	\$0 (0.0%)
	2	\$18,775 (0.0%)	\$1,211,307 (1.3%)	\$15,544,774 (16.5%)	\$0 (0.0%)	\$0 (0.0%)
	3	\$15,419 (0.0%)	\$540,086 (0.6%)	\$24,364,304 (25.8%)	\$0 (0.0%)	\$0 (0.0%)
	4	\$18,350 (0.0%)	\$295,810 (0.3%)	\$1,261,823 (1.3%)	\$0 (0.0%)	\$0 (0.0%)
	5	\$75,431 (0.1%)	\$191,211 (0.2%)	\$1,587,062 (1.7%)	\$0 (0.0%)	\$0 (0.0%)

K.4 Lifecycle Management Strategies and Forecasting

The following section outlines the funding required for the entire lifecycle of arts and culture assets. The expenditures were determined using the lifecycle activities outlined in Table K - 6 and the LOS established. Required funding was determined using the following forecasting analysis scenario:

- **Maintain Current Levels of Service** – this scenario provides the funding required to maintain a similar asset performance over a 27-year period. It focuses on maintaining the percentage of assets in backlog in a similar state. Backlog is defined as assets that are in need of renewal work (either significant rehabilitation or replacement). For example, if 20% of assets are past their service life, or are in need of renewal work, then the forecast model will determine the funding to maintain 20% of assets in this state over the forecast period.

The forecast analysis identified a total of \$55.8M (annual average of \$2.8M) that is anticipated to be spent over the next 27 years. In 2023, approximately 7.4% of the asset portfolio (by replacement value) is in backlog. The average annual spending identified attempts to maintain this percentage over the next 27 years. The performance and financial forecasts for this state are illustrated in Figure K - 11 and Figure K - 12. Note that there is a significant expenditure forecasted in 2041, which represents a significant amount of asset needs that are forecasted to occur in that year.

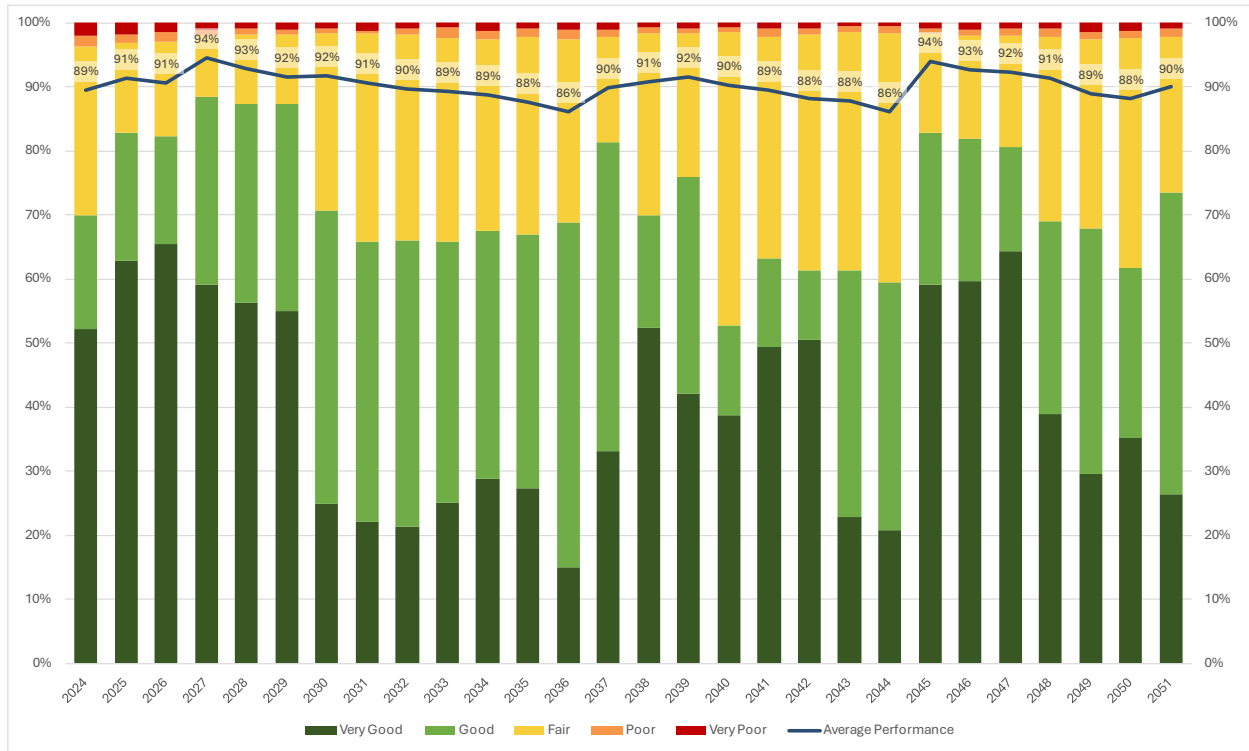


Figure K - 9: Scenario 2 – Maintain Current LOS Performance Distribution for Arts and Culture Assets

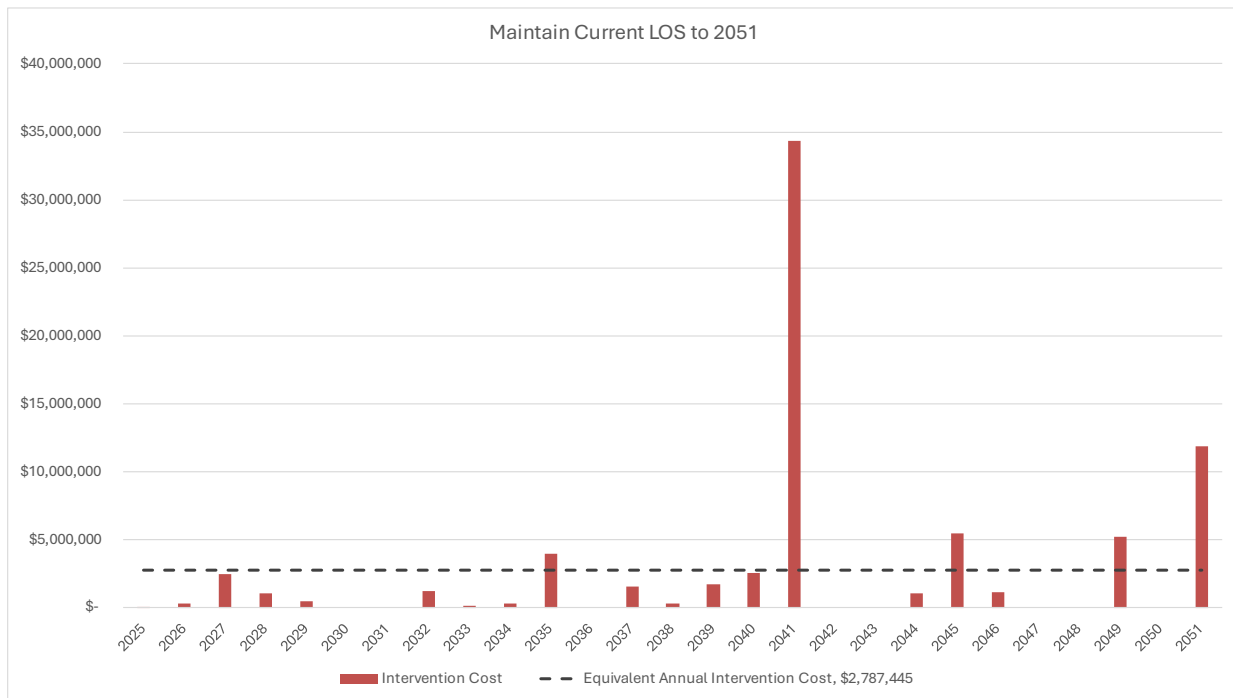


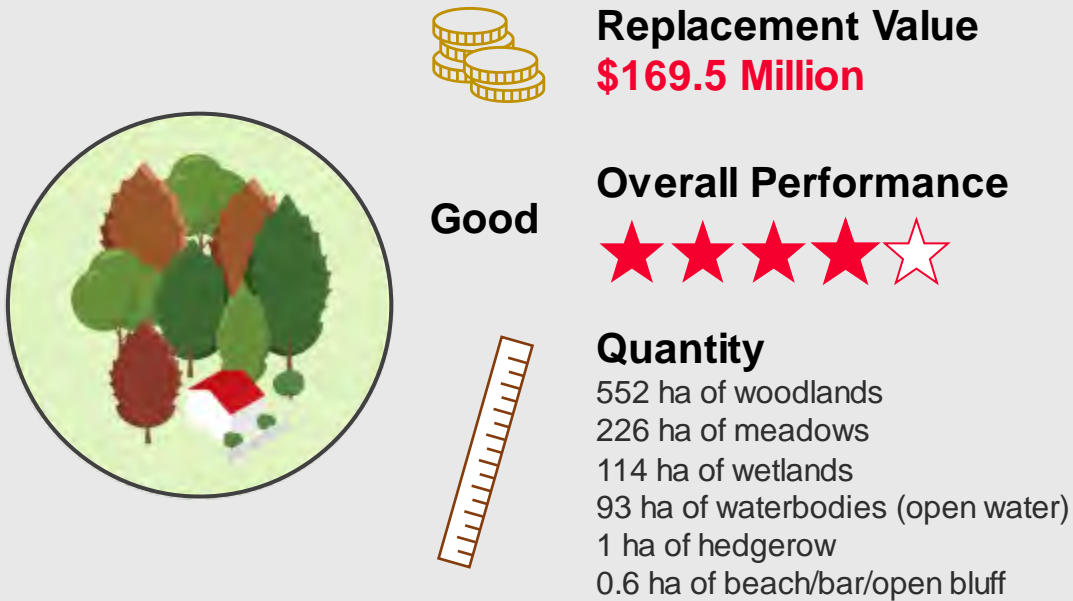
Figure K - 10: Scenario 2 – Maintain Current LOS Intervention Costs for Arts and Culture Assets



2024 Asset Management Plan Appendix L: Natural Assets City of Markham

Appendix L Natural Assets

Service Summary



The City of Markham's natural assets support a diversity of natural habitats and ecosystems, help mitigate climate change and build resilience to climate change impacts and provide public natural areas and other greenspaces for passive recreation and cultural activities.

The City's natural assets include woodlands, meadows, wetlands, waterbodies, hedgerows, and beaches/bars/open bluffs, as detailed in Figure L - 1.

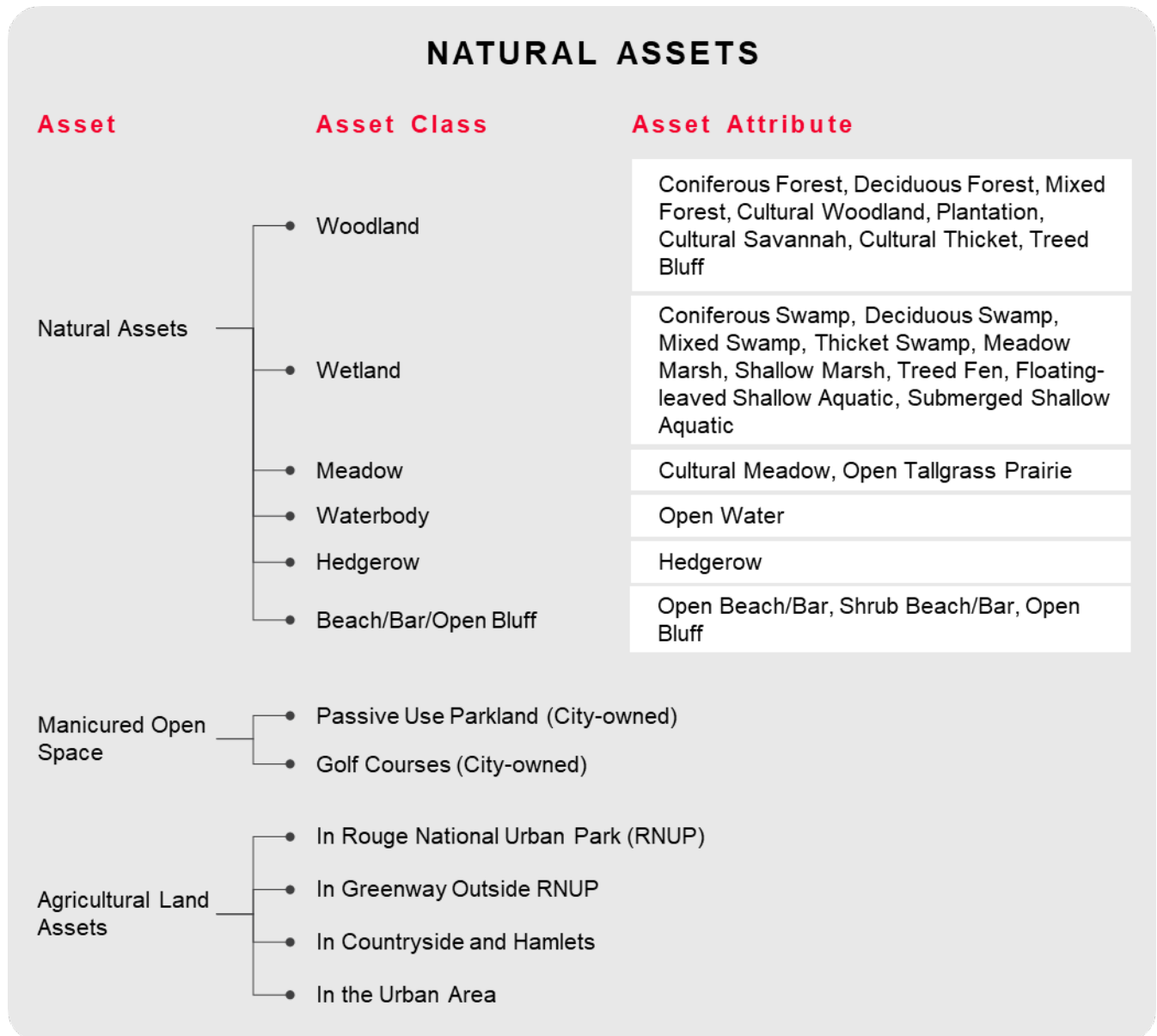


Figure L - 1: Green Space & Agricultural Land Asset Hierarchy

In 2022, the City completed their first comprehensive natural assets inventory and evaluation which is detailed in the City’s Natural Assets Inventory and Evaluation Study report. This study included developing an inventory, assessing the performance of each natural asset, completing a risk assessment, establishing levels of service and management activities, and determining required funding based on various management scenarios. The information presented in this subsection was derived from the City’s Natural Assets Inventory and Evaluation Study report.

L.1 State of the Infrastructure

Figure L - 2 provides the replacement value distribution for all natural assets, by asset attribute.

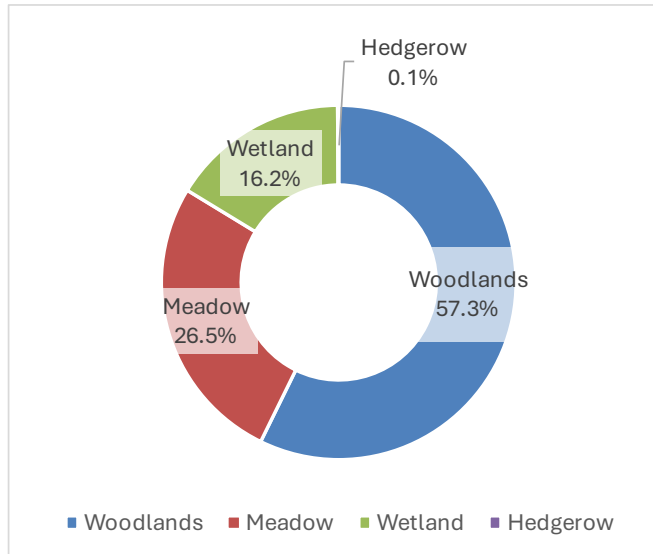


Figure L - 2: Replacement Value Distribution of Natural Assets by Asset Attribute

L.1.1 Asset Inventory and Valuation

Table L - 1 summarizes the asset valuation and quantities for each asset attribute.

Table L - 1: Inventory and Valuation of Natural Assets

Asset Attribute	Area owned by Markham (ha)	Unit Replacement Costs (\$/ha)	Total replacement costs for City-owned Assets
Woodlands	552.26		\$97,039,909
Coniferous Forest	11.61	\$173,847	
Deciduous Forest	277.07	\$173,847	
Mixed Forest	74.01	\$173,847	
Cultural Woodland	90.12	\$173,847	
Plantation	24.94	\$173,847	
Cultural Savannah	41.93	\$188,546	
Cultural Thicket	32.24	\$188,546	
Treed Bluff	0.34		
Meadow	226.29		\$44,838,837
Cultural Meadow	226.13	\$198,144	
Open Tallgrass Prairie	0.16	\$198,144	
Wetland	113.71		\$27,440,924
Coniferous Swamp	1.55	\$268,404	

Deciduous Swamp	29.4	\$268,404	
Mixed Swamp	9.2	\$268,404	
Thicket Swamp	9.49	\$245,945	
Meadow Marsh	42.46	\$224,816	
Shallow Marsh	21.27	\$224,816	
Treed Fen	0	\$268,404	
Floating-leaved Shallow Aquatic	0	-	
Submerged Shallow Aquatic	0.33	-	
Waterbody: Open Water	92.82	-	-
Hedgerow	1	\$173,847	\$173,847
Beach/Bar/Open Bluff	0.6	-	-
Open Beach/Bar	0.6	-	
Shrub Beach/Bar	0	-	
Open Bluff	0	-	
TOTAL REPLACEMENT COSTS FOR MARKHAM OWNED NATURAL ASSETS			\$169,493,517

L.1.2 Asset Performance

Figure L - 3 and Figure L - 4 illustrate the asset performance distribution of all natural assets. Figure L - 4 shows the performance distribution of natural assets by asset attribute. For more information on how the performance of natural assets were determined, refer to the City's Natural Assets Inventory and Evaluation Study report.

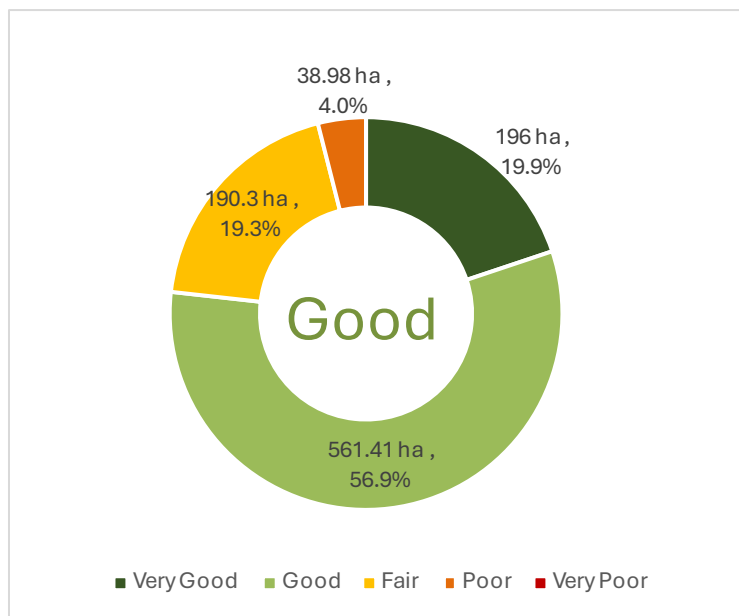


Figure L - 3: Performance Distribution of Natural Assets

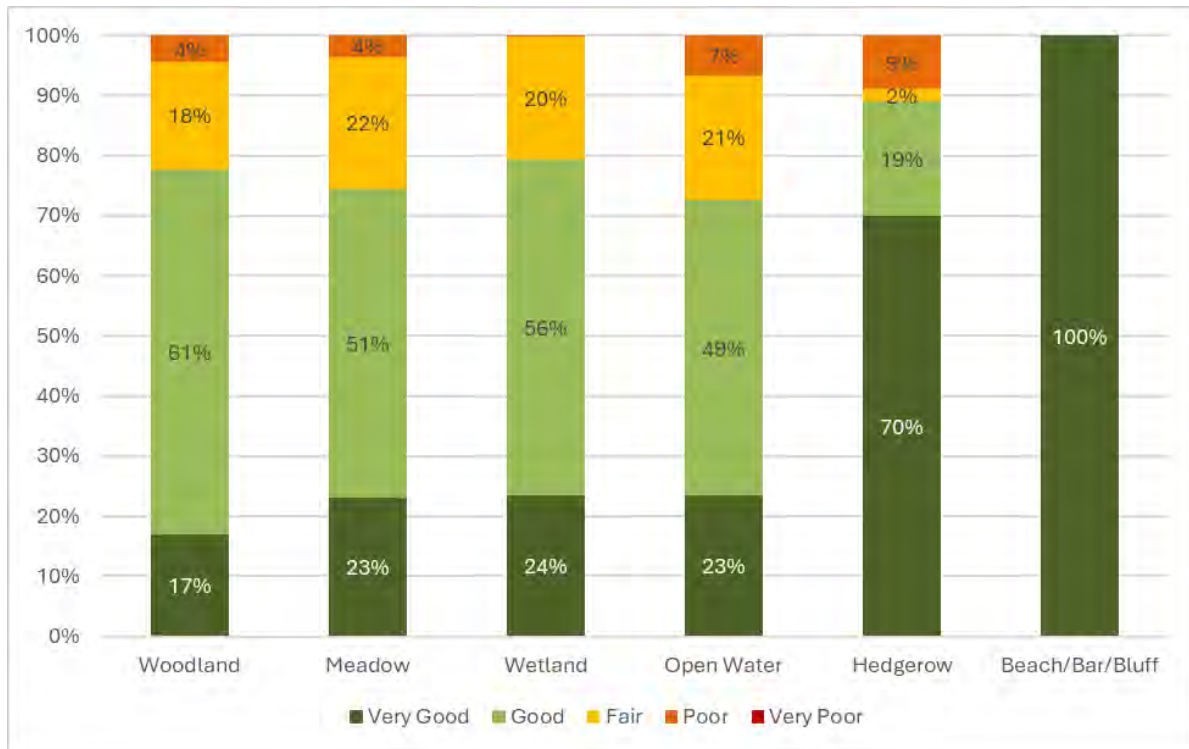


Figure L - 4: Performance Distribution of Natural Assets by Asset Class

L.2 Lifecycle Management Strategies and Forecasting

The City’s Natural Assets Inventory and Evaluation Study report provides an analysis on the funding required to support the various lifecycle activities that continue to provide services to the community through natural assets. The assessment completed a financial forecast for the following three (3) scenarios,

- Current Management: the baseline scenario based on performing current ongoing management activities to 2051
- Enhanced Management: includes current management activities and additional activities to adapt to climate change risks
- Target Management: includes current activities, enhanced activities and additional anticipated activities to meet the City’s target LOS by 2051

The City’s 2024 AMP has focused on a forecasting analysis that understands the costs associated with maintaining current service levels. From the scenarios completed for the Natural Assets Inventory and Evaluation Study report, the most similar to the analysis completed in this AMP is the “Current Management” scenario. The results of this scenario were incorporated into the financial forecast within the 2024 AMP.

The following table outlines the funding required for the various lifecycle activities for the “Current Management” Scenario.

Table L - 2: Average annual estimate capital and staff cost of management scenarios

Lifecycle Activity	Supporting Level of Service	Scenario 1: Current		
		Capital	Staff	Total
Acquisition/ Expansion	Land Acquisition	\$0	\$35,128	\$35,128
	Land Securement	\$0	\$0	\$0
Maintenance	Natural Areas Monitoring	\$53,571	\$21,108	\$74,679
	Stewardship Activities	\$62,500	\$23,072	\$85,572
	Invasive Plant management	\$35,000	\$30,932	\$65,932
	Meadow (Invasive/Woody Plant) Management	\$0	\$1,972	\$1,972
	Basic Natural Areas Maintenance	\$0	\$78,579	\$78,579
	High Risk Tree Management	\$0	\$37,822	\$37,822
Rehabilitation and Renewal	Forest Restoration	\$462,500	\$41,510	\$504,010
	Wetland/Riparian Restoration	\$20,000	\$9,219	\$29,219
Total		\$633,571	\$279,342	\$912,913