ASSET MANAGEMENT PLAN 2025

Toronto Transit Commission

Contents

Appendices

LIST OF TABLES

LIST OF FIGURES

Glossary

Term	Abbreviation	Definition
Accessibility for Ontarians with Disabilities Act	**AODA**	An Ontario act governing the development, implementation and enforcement of accessibility standards, including for transit services.
Active Transportation		Modes of transportation that involve physical activity, such as walking, cycling, scootering, or using a wheelchair or mobility aid.
Artificial Intelligence	AI	The ability of a computer to perform tasks commonly associated with human intelligence.
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. For the purposes of this document, the term refers to physical vehicles, systems, and infrastructure assets that support the delivery of transportation services.
Asset Data and Information		Information on the condition, performance, maintenance history, and lifecycle of assets such as vehicles, facilities, infrastructure, and equipment.
Asset Hierarchy		A classification system that is used to group assets with similar characteristics or functions. In this AMP, it is used to organize asset data/information using a common framework (or "language") to assist in understanding, communicating and visualizing groups of assets. The TTC's asset hierarchy featured in this AMP is further defined in section 2.3.
Asset Management	AM	The coordinated activity of an organization to realize value from assets. This involves the balancing of costs, opportunities, and risks against the desired performance of assets to achieve organizational objectives.
Asset Management Objectives		High level objectives that reflect our business responsibilities and are aligned with our strategic objectives and priorities.
Asset Management Policy	AM Policy	Document demonstrating commitment to asset management and summarizing the principles adopted in applying asset management to achieve strategic objectives.
Asset Management Plan	AMP	Document specifying activities and resources for implementing the Asset Management Strategy and delivering the Asset Management Objectives.
Asset Management Strategy	AM Strategy	Document setting out the long-term approach to management of the assets, derived from, and consistent with, the asset management policy.
Automatic Train Control	ATC	A train protection system which controls speed in response to external inputs.

Term	Abbreviation	Definition
Capital Expenditure	Capex	the funds used by the TTC to acquire, upgrade, and maintain its physical assets, including investments in new vehicles, infrastructure projects, facility upgrades, and major repairs.
Closed Circuit Television	CCTV	A video surveillance system that can monitor and record particular areas.
Deterioration		A mathematical representation of the change in condition of an asset over time. Deterioration models are used to understand future asset needs to assist in forecasting.
Enterprise Asset Management	EAM	The management and maintenance of an organization's physical assets throughout their entire lifecycle, including activities such as capital planning, procurement, installation, performance monitoring, maintenance, compliance, risk management, and eventual disposal.
Enterprise Risk Management	ERM	Approach to identify, assess, manage, and monitor risks that could potentially affect our ability to achieve our objectives. Encompasses a wide range of risks, including financial, operational, strategic, and compliance-related risks.
Estimated Service Life	ESL	This is the estimated amount of time (usually in years) that an asset is expected to remain in service from the installation/implementation date and continuing to meet performance targets, before requiring replacement or a major life-extending renewal activity.
Facilities		Garages and maintenance facilities, subway stations, administrative and operational buildings, bus and streetcar stops, and shelters.
Fixed block signalling		A signalling system that divides the track into small sections, creating artificial separation between trains
Fleet		Revenue vehicles (buses, streetcars, and subway trains), non-revenue vehicles and the industrial equipment used to service those vehicles.
Headway		The time interval between vehicles moving in the same direction on a particular route. Headway is crucial for ensuring regular and reliable service, minimizing wait times for passengers, and optimizing the flow of transit vehicles
Heating, Ventilation and Air Conditioning	HVAC	System to control heating, ventilation, cooling and air movement in an enclosed space
Infrastructure		The physical structures and associated facilities that form the foundation of development, and by or through which a public service is provided.
Innovation		Innovation at the TTC is the pursuit of customer-centric solutions, powered by agile lean methodologies, strategic ecosystem partnerships, an unwavering commitment to achieving net zero emissions by 2040, data driven decision making and considering

Term	Abbreviation	Definition
		accessibility, equity across communities, and diversity in every initiative we undertake.
International Standards Organization	ISO	An independent, non-governmental international organization that develops and publishes standards across a wide range of industries.
Internet of Things	IoT	A network of physical devices embedded with sensors, software and network capability, enabling them to collect and share data.
Key Performance Indicator	KPI	A measurable value that is used to monitor and evaluate performance in specific areas or across multiple area.
Levels of Service	LOS	The parameters that reflect the social, political, economic, and environmental outcomes an organization delivers to its stakeholders. The TTC's level of service framework incorporates statements describing the outputs of its activities, and metrics to evaluate and measure their quality.
Lifecycle		The useful life of an asset from acquisition to disposal, typically expressed in years.
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.
Light Rail Transit	LRT	A transportation system based on electrically powered light rail vehicles that operates on a track in a dedicated right-of-way.
Linear Infrastructure		Subway track, Streetcar Way and overhead power.
Maintenance		Activities that allow assets to meet their required performance objectives, including regularly scheduled inspection and maintenance activities associated with unexpected or unplanned events.
Maximo		Enterprise asset management software adopted by the TTC
Mean Distance Between Failures	MDBF	A measure of reliability that expresses the average distance travelled by a vehicle before corrective maintenance is required.
Metrolinx		An agency of the Government of Ontario with the responsibility for coordinating and integrating transit in the Greater Toronto and Hamilton Area.
Ontario Regulation 588/17	O. Reg. 588/17	An Ontario regulation governing asset management planning for municipal infrastructure, including the TTC.
Operating Expenditure		The ongoing costs required to run the day-to-day operations of the transit system. This includes expenses such as salaries and wages, fuel, utilities, maintenance, and other operational costs necessary to provide transit services.
Original Equipment Manufacturer	OEM	The manufacturer of equipment used by TTC to provide its services.

Term	Abbreviation	Definition
Preventive Maintenance	PM	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.
Rapid Transit Line		A high-capacity public transportation system, typically electric, designed for fast and frequent service within urban areas.
Replacement Value		The anticipated amount that an entity would have to pay to replace an asset with a modern equivalent at the present time.
Scarborough Subway Extension	SSE	A 7.8km extension to Line 2 being built by Metrolinx, extending the line from Kennedy station through Scarborough city centre to a terminal at Sheppard Avenue and McCowan Road.
Service Standards		The TTC Service Standards are a systematic and objective means of planning, monitoring, adjusting, and evaluating transit services throughout Toronto. The standards provide a mechanism for measuring the trade-offs between the benefits achieved by providing more service in one location, the inconvenience caused by removing it from another, and the costs of providing those services.
Stakeholder		Any individual, group, or organization that has an interest in or is affected by the TTC's operations, decisions, and policies.
State of Good Repair	SOGR	A condition in which an asset is functioning as designed within its estimated service life, individually and as part of a system. The asset can deliver agreed service levels and is sustained through regular maintenance and replacement programs.
Structures		Box structures, bored tunnels, station structures, bridges, Prince Edward Viaduct (track beams and sidewalks), culverts, retaining walls, and miscellaneous structures.
Supervisory Control and Data Acquisition	SCADA	A control system for processes and equipment which uses real-time data.
Systems		Communications systems, signals, electrical systems, and mechanical systems.
Sustainability		Sustainability at the TTC is the pursuit of impactful action to reduce GHG emissions, increase operational resiliency, responsibly consume limited resources and improve community health and wellbeing, while maximizing service reliability for our customers.
Sustainable City of Toronto Fleets Plan		Part of the TransformTO strategy, the Fleets Plan sets goal and objectives in addressing climate mitigation and adaptation with strategies for transitioning City Fleets to sustainable, climate resilient, net zero operations.
T1 Trains	T1	Trains operated on Line 2, built between 1995 and 2001 and first delivered to TTC in 1995.
Toronto Rocket Trains	TR	Trains operated on Lines 1 and 4, built between 2009 and 2015 and first delivered to TTC in 2010.

Term	Abbreviation	Definition
TransformTO		The strategy adopted by the City of Toronto to reduce greenhouse gas emissions to net zero by 2040.
TTC Corporate Plan		Document outlining the organization's key priorities and strategic directions for a five-year period. It supports the achievement of the TTC's mandate, vision, and mission statements.
TTC Capital Investment Plan	CIP	A comprehensive strategic document that outlines the Toronto Transit Commission's capital needs and priorities. Provides a clear overview of the investments required for state-of-good-repair, capacity building, and service improvements.
TTC Innovation and Sustainability Strategy 2024-2028	ISS	A five-year strategic roadmap to embed corporate innovation and environmental sustainability at the TTC constructing a more innovative and sustainable public transit system.
TTC Service & Customer Experience Action Plan	SCE Plan	A five-year plan which lays out anticipated growth and sets a vision to accommodate it, focusing on improvements that enhance the TTC's core-competency: mass transit
TTC Real Estate Investment Plan 2022 -2036 (On Solid Ground)		Closely linked with the CIP, this plan provides a comprehensive strategic view of the TTC's property portfolio and expected real estate activity through to 2036.
Wheel-Trans		Paratransit service provided by the TTC.
Whole-life Cost	WLC	The total expense of owning an asset over its entire lifespan, from purchase to disposal.
Yonge North Subway Extension	YNSE	An 8km extension to Line 1 being built by Metrolinx, extending the line from Finch station through Vaughan and Markham to a terminal in Richmond Hill Centre.

Document Control

This document and its contents have been prepared and are intended solely as information for the Toronto Transit Commission and use in relation to the Enterprise Asset Management Project.

AtkinsRéalis assumes no responsibility to any other party in respect of or arising out of or in connection with this document and/or its contents.

This document has 268 pages including the cover, not including the appendices.

Document History

Document title: Asset Management Plan 2025

Revision	Purpose description	Originated	Checked	Reviewed	Authorised	Date
0.1 - 0.2	Initial drafts	EG, RVB	RVB			
0.3	Draft for SS review	EG, RVB	RVB			2025-02-11
0.4	Draft for Chiefs' review	EG, RVB	RVB			2025-03-19
0.5	Appendices Compiled	EG, RVB	RVB			2025-03-19

1. Executive Summary

1.1 Introduction

This Asset Management Plan (AMP) builds on the TTC's 2024 AMP, and incorporates additional information aligned with Ontario Regulation (O.Reg.) 588/17: Asset Management (AM) Planning for Municipal Infrastructure. It details key information regarding the State of TTC's infrastructure assets and how they are being managed to allow TTC to meet the service delivery expectations of our customers. This document presents the current total replacement value of TTC assets, average age and condition, asset performance against customer and stakeholder Level of Service (LOS) expectations, and the investments required to maintain State of Good Repair (SOGR) and deliver on future level of service expectations.

This document is informed by our operational strategies identified in the Corporate Plan's integrated planning and performance framework, including the TTC AM Policy and Strategy. The following figure sets out the relationship between key asset management documents within this framework:

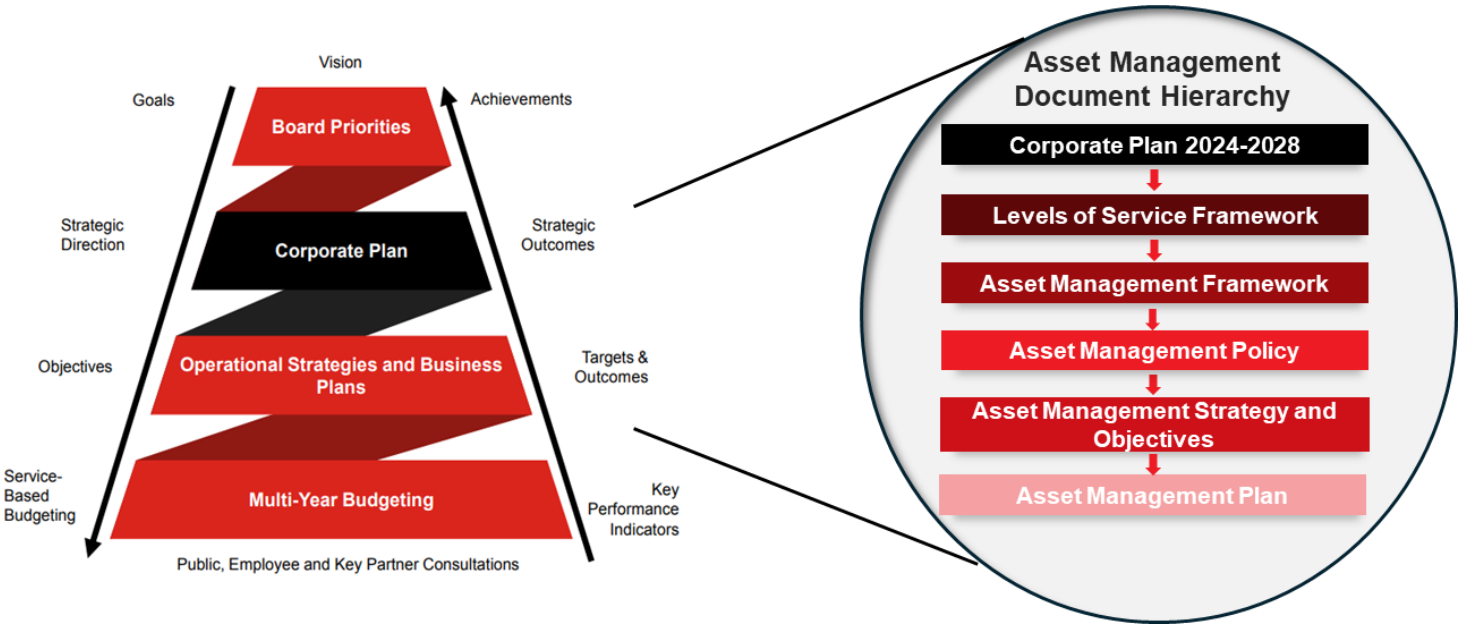


Figure 1-1: TTC's Integrated Planning and Performance Framework (left) and Asset Management Document Hierarchy (right)

TTC's infrastructure assets are grouped into the following categories within this document:

- **Fleet:** Revenue vehicles (buses, streetcars, subway), non-revenue vehicles and the industrial equipment used to service those vehicles.
- **Linear Infrastructure:** Subway track, streetcar way, and overhead power.
- **Facilities:** Garages and maintenance facilities, subway stations, administrative and operational buildings, bus and streetcar stops, and shelters.
- **Systems:** Communications systems, signals, electrical systems, and mechanical systems.
- **Structures:** Box structures, bored tunnels, station structures, bridges, Prince Edward Viaduct (track beams and sidewalks), culverts, retaining walls, and miscellaneous structures.

This AMP aggregates the combined information across all asset categories within this base document. Additional asset category specific details are included in the individual asset category plans included in the appendices.

The 2025 AMP includes significant improvements and refinements compared to the 2024 AMP along four key themes:

Theme	Key Enhancements
Data	- Revised systemwide asset hierarchy. - New asset information framework. - Updated asset-level condition and replacement cost data.
Asset Performance	- New Level of Service and performance framework developed for 2025. - Maps service expectations/requirement to individual asset performance.
Lifecycle Activity Analysis	- Reassessed at the asset subclass level (bottom-up analyses on lifecycle needs) - Aligned to LOS targets - Enables annualized SOGR investment analysis
Document Format	- Updated to present new data frameworks. - Aligned to City of Toronto Corporate AMP.

Table 1-A – Key enhancements – AMP 2025

these efforts have resulted in marked improvements in the 2025 AMP:

Theme	AMP 2024		AMP 2025
Data	- Fit to document - Gathered ad-hoc	→	- Mapped to a defined asset hierarchy - Retained in asset registers - Quality assessed
Asset Performance	- Anecdotal	→	- Service-based performance framework - Asset-focused Level of Service metrics
Asset Valuation	- Based on escalated initial costs (Insurance Report)	→	- Bottom-up asset replacement valuation - Benchmarked contemporary cost analyses
Lifecycle Activity Analysis	- Generalized, representative	→	- Network-wide, asset-specific, costed activities - SOGR needs-based assessment
Investment Requirements	- Capital funding only (CIP) - Project request-based (triaged)	→	- Top-down needs assessment for lifecycle activities & maintenance operations - Needs-based
Overall	- Aggregated Report	→	- Plan, supported by Strategy & Policy, Framework for future data & process refinement - Aligned to City of Toronto Corporate AMP Framework

Table 1-B – AMP 2024 vs AMP 2025 – Marked Improvement

As a result of the changes in methodology, much of the data presented herein does not directly compare to that presented in the 2024 AMP, which used substantively different reporting frameworks. Overall, TTC's 2025 AMP is more comprehensive and data-driven, with a clear strategy and policy framework to support future data and

process refinement. The improvements in data mapping, asset hierarchy, and performance metrics demonstrate a significant advancement in the organization's asset management maturity.

1.2 State of Infrastructure

The condition of TTC's assets varies significantly across the system depending on the age and renewal activities that have been undertaken to date. The TTC has been investing in infrastructure to maintain the state of good repair (SOGR) of the assets, improving on the services delivered to the travelling public, and to accommodate growth, both in terms of ridership growth and network expansion.

The following figures outlines a high-level overview of the state of TTC infrastructure across the entire asset base:

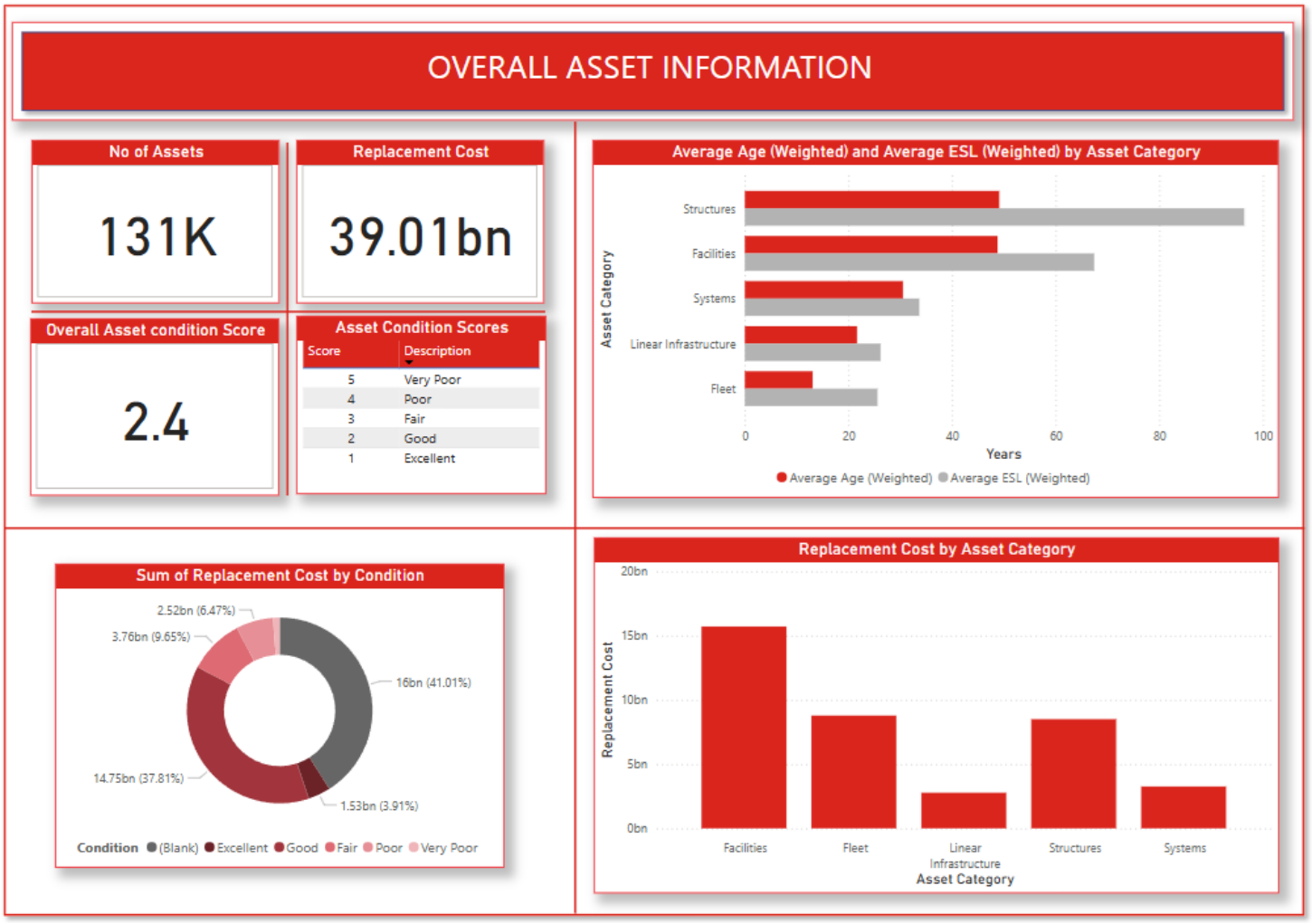


Figure 1-2: State of TTC Infrastructure Summary Dashboard

Overall condition is based on an aggregation of the assessed conditions of individual assets, weighted against asset replacement value. The overall condition of TTC assets is Good to Fair, which suggests that the majority or assets which have available condition ratings are within their reasonable useful lifespans. Roughly 7% of assets (by value) have been assessed to be in poor or very poor condition, or beyond their effective service life. More than 40% of assets (by value) have not been assessed.

The methodology used to determine asset condition varies between asset categories and classes. Where available measurable wear and condition parameters are used. In other cases, age or qualitative assessment is used as a proxy.

The current assessed replacement value of TTC infrastructure assets is approximately $39B, which is a significant uplift from the $25B reported in the 2024 AMP. This increase reflects the difference in methodologies used, with the current assessment using individual asset component replacement costs aggregated within the asset register. The TTC believes these values to be more representative of the true costs to replace the asset base, although the current low level of data maturity limits the ultimate accuracy.

The current state of data quality/maturity among TTC assets is outlined in the following figure:

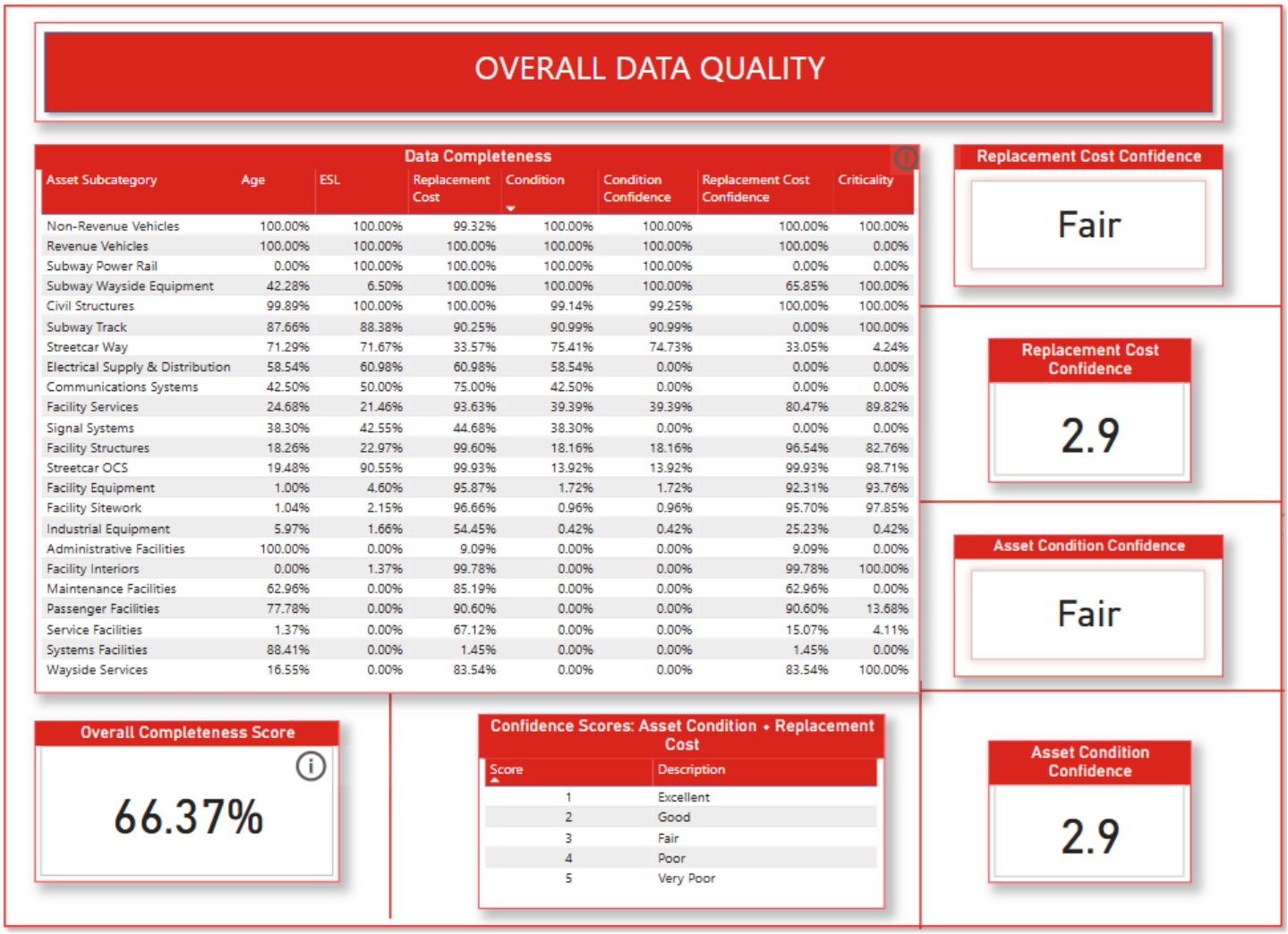


Figure 1-3: State of TTC Asset Data Summary Dashboard

The data presented in this AMP and the associated Appendices represents the best available at the time of publishing. Asset data was primarily collected in Q4 of 2024. Some data values represent a snapshot at the time of collection. Where data represents an average over a time period (e.g. LOS performance metrics), the time period is the 2024 calendar year.

Within the new asset data framework, we have assessed the maturity of TTC asset data with respect to completeness and confidence (quality). Current data completeness against all critical asset data fields is 66%, although this is not equally represented across asset categories. Facilities and Systems have low levels of data maturity, whereas Fleet data maturity is relatively high. It is important to note that low levels of reported data maturity do not necessarily reflect a lack of data or a lack of understanding of the factors that the data represents. In many cases, similar or complimentary data exists, but has not yet been translated into a format that can be presented in this document.

As this is an entirely new data framework, quantifiable comparison to 2024 data maturity is not practical. Nevertheless, the current state represents a significant improvement over the previous year.

1.3 Levels of Service and Performance

The TTC has developed a level of service (LOS) framework aligned to overall corporate objectives and goals, and underpinned by TTC's Mission:

> ***"To serve the needs of transit riders by providing a safe, reliable, efficient and accessible mass public transit service through a seamless integrated network to create access to opportunity for everyone."***

The following seven key service expectations have been developed with asset specific performance measures identified and evaluated as follows:

TTC 's Transportation Services…	Performance Measure	Performance	Previous Year Performance	Year over Year
…**meet the route and ridership demands** of the travelling public.	Service Availability	Good	Good	Slight Increase
…**are reliable and on-time**, per the posted schedule/service plan.	Percentage of TTC assets in Fair or better condition	Fair	Unknown	Unknown
	On-time Performance	Fair	Fair	Slight Increase
	Mean Distance Between Failures (MDBF)	Good	Good	Maintain
…**are safe** to use and operate.	Customer Perception of Safety	Fair	Fair	Slight Increase
…**accommodate accessibility needs** of all customers.	AODA compliance	Fair	Fair	Slight Increase
	Customer Perception of Accessibility	Fair	Fair	Unknown
…meet customer expectations for **cleanliness, comfort, and convenience**.	Customer Perception of Cleanliness	Fair	Fair	Slight Decrease
	Asset Related convenience/comfort issues	Fair	Unknown	Unknown
…are designed in such a way as to **mitigate the environmental impact and build climate resilience** of transportation in the GTA.	Performance against Green Fleet Plan	Fair	Unknown	Unknown
…are undertaken in a **cost-efficient** manner, minimizing the cost to the city for the service provided.	No current asset specific KPIs			

Table 1-C – TTC Current Levels of Service - Summary

Overall, TTC's performance against LOS targets and expectations is **Fair** (TTC assets are approaching level of service targets and expectations).

While service availability and reliability remain high, the impacts of an aging asset base and degrading asset condition is noticeable.

1.4 Lifecycle Management Strategies

Lifecycle activities are those carried out across the life of an asset, such as construction or acquisition, maintenance, operation, and decommissioning. Activities are required across the lifecycle to maintain levels of service and manage the risks associated with assets failing to meet defined levels of service. This AMP presents the lifecycle activities required across asset categories to maintain SOGR, and to deliver on growth and service enhancement expectations in line with the current and proposed future LOS.

Lifecycle activities themselves and the point at which they occur vary between assets according to their inherent nature, the required level of service, their operating context, use and condition. For example, for vehicles many of the maintenance lifecycle activities to maintain SOGR are at defined frequencies based on age and/or mileage aligned to the original equipment manufacturer's recommendations. As assets approach the end of their serviceable life, life extension programs may also be implemented to prolong service life ahead of replacement or renewal.

Details of the lifecycle activities applicable to each asset category and the associated sub-categories are contained in the relevant appendices.

1.5 State of Good Repair and Investment Forecasts

The following figures and table illustrate the full lifecycle investment forecasts for all TTC assets, showing the year-by-year budgeted funding by activity type compared to the total overall funding required to maintain SOGR and deliver on selected service enhancement and growth projects, and to address the condition gap. Figure 1-4 shows the investment to maintain SOGR only (maintenance and renewals). Figure 1-5 shows the totals, including non-infrastructure costs (operations and administrative costs and projects) as well as service improvement and growth costs. In these charts, the investment gap is indicated by the discrepancy between the bar height (budgeted funding levels) and the lines (required funding levels).

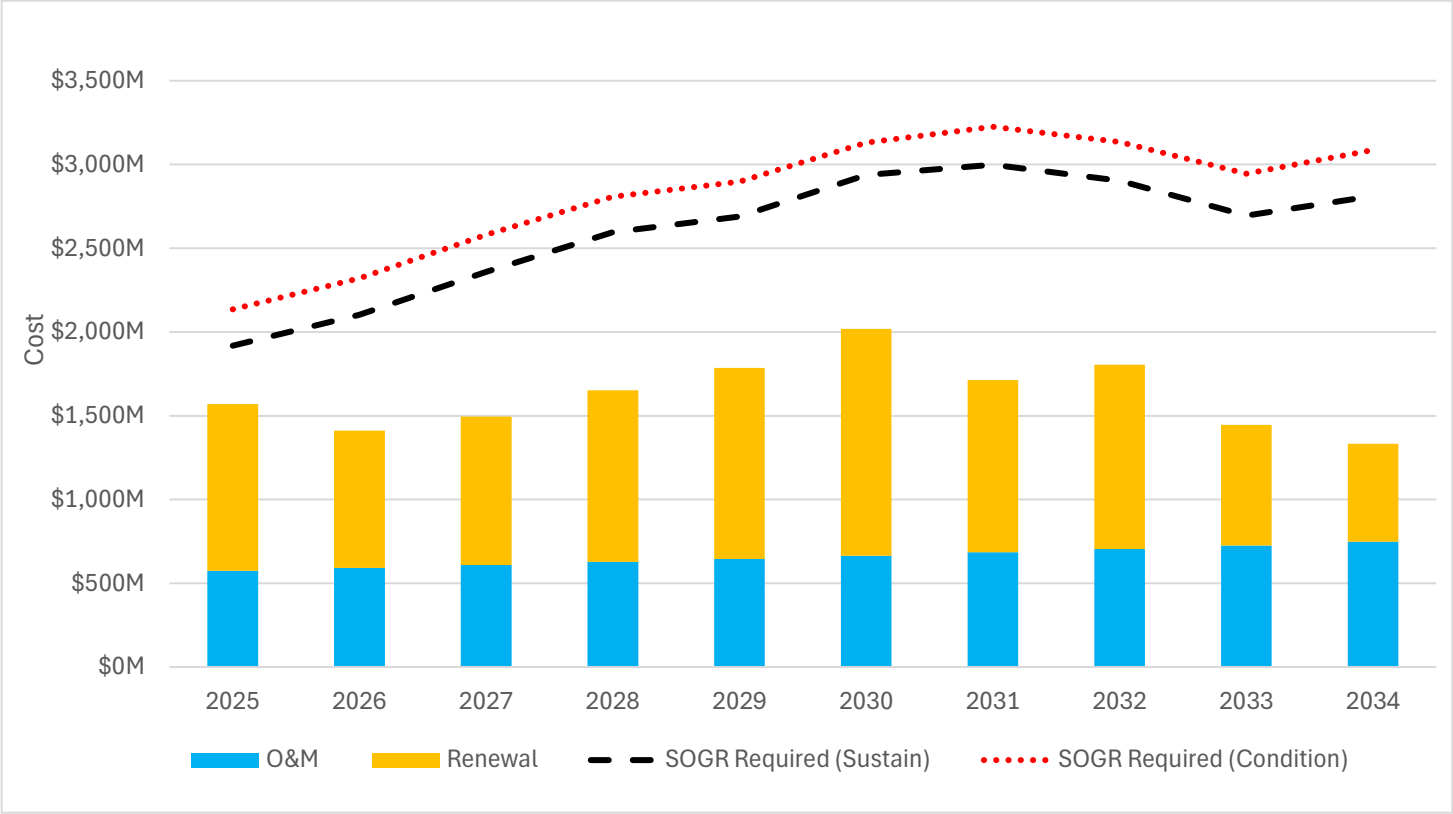


Figure 1-4: Funding vs Assessed Program Requirements – All TTC Assets (SOGR only)

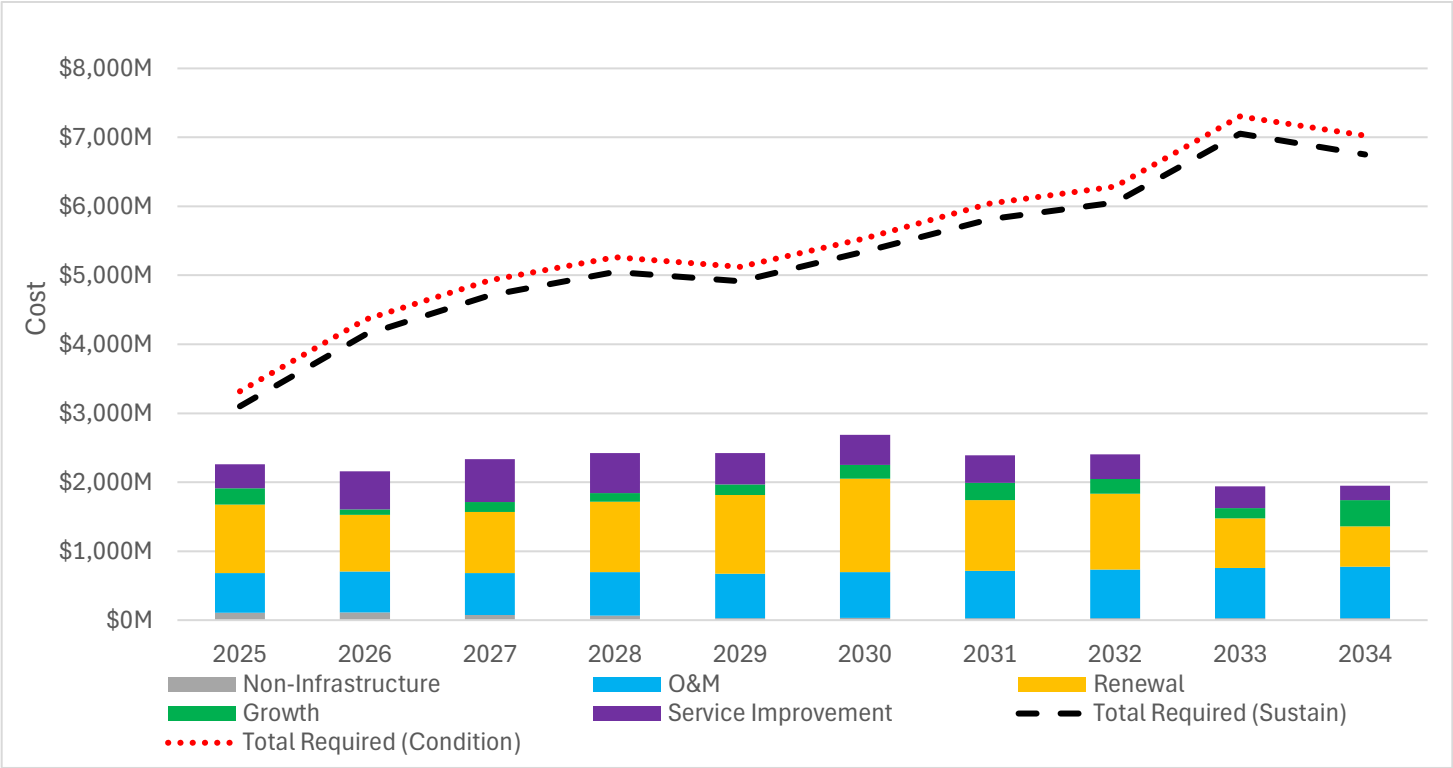


Figure 1-5: Funding vs Assessed Program Requirements – All TTC Assets

The following table summarizes the average annualized values from the figures above.

Lifecyle Activity	Planned Budget ($K)	Investment Needed to Sustain LoS ($K)	Investment Needed to Address Condition Gap ($K)
Non-Infrastructure	$53,181	$72,818	$72,818
Maintenance	$657,954	$763,416	$763,416
Renewals	$965,350	$1,837,879	$2,062,894
Growth	$192,767	$1,210,239	$1,210,239
Service Improvement	$427,342	$1,408,522	$1,408,522
Total Expenditure	$2,296,595	$5,292,874	$5,517,889
Average annual SOGR Gap		$977,991	$1,203,006
Average annual Infrastructure Gap		$2,996,279	$3,221,294

Table 1-D – Annualized Funding vs Assessed Program Requirements – All TTC Assets

As outlined above, a significant gap exists between current funding levels and those required to sustain asset SOGR, address degrading asset conditions, and to deliver on expected growth and service improvement expectations. The implications of these gaps on specific asset categories are discussed in the appendices. Overall, it is expected that, without a substantial uplift in funding, the condition and performance of TTC's assets will continue to degrade, negatively impacting reliability and availability of service.

1.6 Risks

As part of the development of this AMP, the TTC has identified the following key risks relating to the delivery of this plan:

Data Maturity

The accuracy and reliability of the forecasting analyses and resulting plans are heavily dependent on the quality and completeness of the asset information and data. Forecasts for asset subcategories with low data maturity will be subject to a greater level of uncertainty.

Aging Infrastructure / Condition Gap

Many key TTC assets are in poor to very poor condition and are beyond their useful service life. At the current funding levels, overall average asset condition is expected to decrease. This will lead to an increased likelihood of asset failure, which could result in significant service disruptions and increased maintenance requirements. TTC strategies to mitigate these risks across the asset categories are outlined further in the AM Strategy document.

Delivery Capacity

The TTC faces significant constraints in delivering the necessary infrastructure lifecycle activities. These constraints include limited access windows for performing maintenance and upgrades, which are often restricted to non-operational hours to minimize service disruptions. Additionally, the onboarding and training of new staff required to execute these activities can be time-consuming, further delaying project timelines.

1.7 Improvement Plan

The TTC has implemented an Enterprise Asset Management (EAM) program to improve its asset management maturity. This will deliver the requirements of O.Reg 588/17 for 2025 and go beyond regulatory compliance to fully align with transit asset management best practice. This AMP is built upon an enhanced framework that supports better understanding of asset condition, valuations, and performance. The TTC's EAM program continued, focus will be placed on enhancing data maturity to provide more accurate forecasts and support better data-driven decision making.

In 2025 the TTC will move beyond the foundational work undertaken to date and embed and build upon the processes to ensure a sustaining asset management program.

2. Introduction

2.1 Purpose of the Asset Management Plan

As a public transit provider, TTC manages an extensive network of physical assets, including fleet, linear infrastructure, facilities, structures and systems. Implementing a holistic approach to managing our assets means that our teams and supply chain will be able to deliver in an aligned, co-ordinated way, providing a seamless, integrated network and allowing TTC to meet the service delivery expectations of our customers.

This AMP is intended to document, communicate, and report on the TTC's plan to ensure that all TTC transit network assets are appropriately managed to optimize value realization from transportation investments. The AMP supports this by providing an understanding of the current state and condition of these assets, the current and expected future levels of service being provided through the assets, and the required funding to achieve those published levels of service over a 10-year forecast horizon.

This provides the TTC and key stakeholders with the information to make better-informed, evidence based asset management decisions to provide the best possible service to the travelling public, while minimizing risk.

This AMP builds on the information presented in the 2024 AMP ensuring compliance with the additional requirements for 2025 as outlined in O.Reg 588/17 and aligning with the City of Toronto's overarching Corporate Asset Management Plan (CAMP).

The key goals of this AMP are to:

- Ensure that the TTC responds to and complies with current asset management regulatory requirements of O. Reg. 588/17.
- Support the line-of-sight between the TTC Board approved plans and initiatives and asset investment needs, via the AM Strategy.
- Report on the current state of the TTC's assets, including their replacement costs, condition and other pertinent information.
- Articulate the current and expected future levels of service (LOS) being provided to the travelling public, as well as the lifecycle activities required to achieve those LOS.
- Forecast expenditures required to achieve LOS over the next 10-years.
- Detail the TTC's financial outlook to sustain service levels through the management of its assets over the next 10-years.
- Quantify the gap (if any) between planned spending and forecasted expenditures.
- Provide recommendations to continually improve the TTC's AM practices, and the development of future AMPs.

2.2 About the TTC

The TTC is the public transit agency responsible for serving Toronto's 630 square kilometres geography. Vital to the mobility of the region, pre-pandemic, the TTC moved more than 525 million customers annually enabling access to employment, education, services, and social connection through an integrated mass transit network.

The TTC is the largest public transit system in Canada and the third largest in North America. It is also integrated with neighbouring transit systems, such as Durham Region Transit, York Regional Transit, MiWay in Mississauga, and Ontario's inter-regional GO Transit system. The TTC functions as one of the agencies of the City of Toronto and is dependent upon the City for both operating and capital subsidies.

Currently, the TTC operates more than 160 bus routes, 11 streetcar routes, and three subway lines. In 2025 service will be expanded with two additional light rail transit lines (Lines 5 and 6), with TTC operating 113

subway and light rail stations. Through its Wheel-Trans paratransit service, TTC provides over 900,000 trips annually across its Family of Services model.

The TTC is critical to Toronto's success as the economic powerhouse of Canada and to the health and wellbeing of the 6.7 million residents of the Greater Toronto Area. Research by the University of Toronto shows that every dollar invested in transit delivers $1.08 in economic and regional benefits and $6.06 in quality-of-life benefits, through reduced congestion, enabling people to get around quickly and reliably, mitigating the impact of climate change and improving air quality. There are also significant social benefits from TTC's services. 34% of TTC riders are unemployed, 24% make less than $40,000 a year and 32% do not own a car. Public transit is vital to enabling mobility for all members of our society.

Figure 2-1: TTC's Subway and Streetcar Map

2.3 About our assets

The TTC is an asset-intensive organization with a portfolio value of approximately $39 billion. TTC assets are subdivided into the following types:

- **Revenue fleet:** subway trains, streetcars and buses;
- **Non-revenue fleet:** vehicles which deliver operational and maintenance activities;
- **Linear infrastructure**: track, power rail and wayside equipment;
- **Facilities:** Administrative buildings, maintenance facilities and passenger facilities and their equipment; (such as elevators);
- **Structures:** Tunnels, bridges, viaducts and retaining walls;
- **Systems:** Communications, signalling, IT, mechanical and electrical.

Summary information about these assets can be found in Figure 2-2 and the sections which follow it. Detailed information about these assets, their life cycle plans, risks and costs can be found in the appendices of this document. High-level strategies for their management can be found in the AM Strategy.

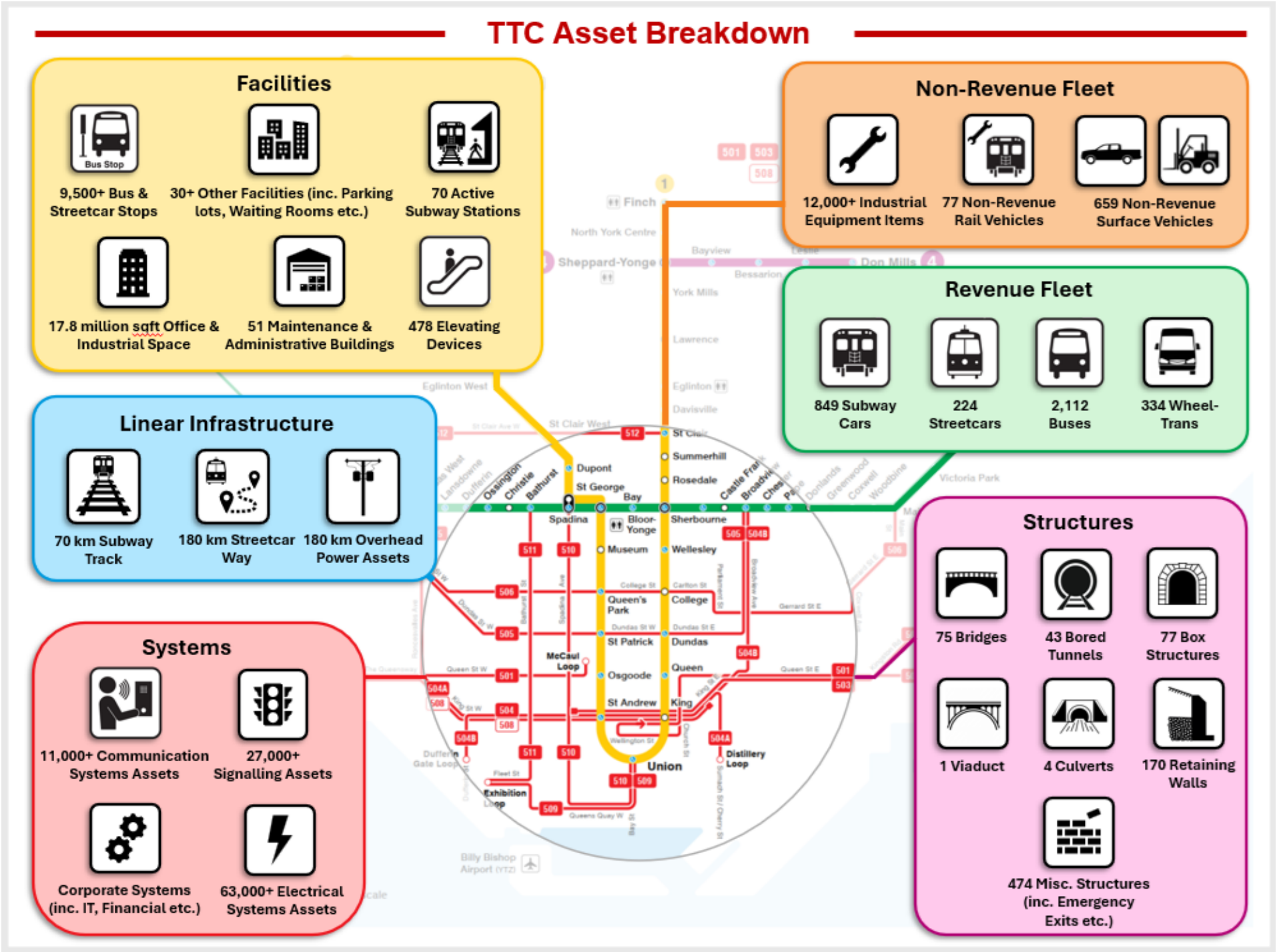


Figure 2-2: TTC Asset Breakdown

2.4 Scope of this Plan

This AMP covers all assets owned and operated by the TTC to deliver bus, streetcar, subway and Wheel-Trans services in Toronto, with the following exceptions:

- Assets currently under construction/commissioning (Line 4, 5)
- IT systems and assets
- Hand tools, uniforms, and other minor assets
- Intangible (non-physical) assets

2.5 Timeframes

This AMP covers a planning forecast period of 10-years. For the purposes of this AMP, the planning period is 2025 to 2034. Depending on the publishing cycle, data in this AMP may be drawn from 2024 documents, and may not reflect latest figures published in other 2025 plans.

The 2025 AMP has been produced to meet the ongoing regulatory milestones and requirements of O.Reg 588/17 (as detailed in Section 3.5), and to provide the information required for inclusion in the City of Toronto Corporate AMP to be developed for July 1, 2025.

This AMP will be reviewed annually and fully updated at least once every 5 years.

2.6 Limitations

The details reported in this AMP are subject to the availability of data at the time of publishing. Where estimates have been made to accommodate data gaps, this has been reflected in data confidence or maturity scores. As the TTC continues along its EAM maturity transformation project, these gaps will be addressed, with priority given to low-confidence, high consequence (or value) data.

2.7 Changes from Previous Version

The 2025 AMP shows significant improvements and refinements compared to the 2024 AMP along four key themes:

Theme	Key Enhancements
Data	- Revised systemwide asset hierarchy. - New asset information framework. - Updated asset-level condition and replacement cost data.
Asset Performance	- New Level of Service and performance framework developed for 2025. - Maps service expectations/requirement to individual asset performance.
Lifecycle Activity Analysis	- Reassessed at the asset subclass level (bottom-up analyses on lifecycle needs) - Aligned to LOS targets - Enables annualized SOGR investment analysis
Document Format	- Updated to present new data frameworks. - Aligned to City of Toronto Corporate AMP.

Table 2-A – Key enhancements – AMP 2025

Data has been improved with an updated asset hierarchy and new data governance models which specify critical asset information and identify key data gaps for further population. Significant effort has been undertaken in the past year to close data gaps around asset condition and asset replacement value. This has resulted in a significant adjustment to the overall reported replacement value of TTC assets. The TTC is confident that these new replacement values are more reflective of the actual costs to replace the assets, and reflect total design, construction, and implementation costs. However, due to the changes in methodology, much of the data presented herein does not directly compare to that presented in the 2024 AMP, which used significantly different reporting frameworks.

The new LOS framework presented in section 7 has been developed to map overall TTC service requirements and expectations to individual asset service performance, providing a much more complete and data driven picture of asset performance.

The lifecycle activities required to sustain SOGR have been reassessed at the asset subclass level. The tables presented in this AMP have been updated to present a clear picture of the total annualized investments required to achieve SOGR for all asset categories, as well as asset-specific projects targeted towards service improvement and growth.

Finally, the document structure and format have been adjusted to align more closely with the City of Toronto's corporate AMP, and to present the new information and analyses outlined above.

Overall, TTC's 2025 AMP is more comprehensive and data-driven, with a clear strategy and policy framework to support future data and process refinement. The improvements in data mapping, asset hierarchy, and performance metrics demonstrate a significant advancement in the organization's asset management maturity.

Theme	AMP 2024		AMP 2025
Data	- Fit to document - Gathered ad-hoc	→	- Mapped to a defined asset hierarchy - Retained in asset registers - Quality assessed
Asset Performance	- Anecdotal	→	- Service-based performance framework - Asset-focused Level of Service metrics
Asset Valuation	- Based on escalated initial costs (Insurance Report)	→	- Bottom-up asset replacement valuation - Benchmarked contemporary cost analyses
Lifecycle Activity Analysis	- Generalized, representative	→	- Network-wide, asset-specific, costed activities - SOGR needs-based assessment
Investment Requirements	- Capital funding only (CIP) - Project request-based (triaged)	→	- Top-down needs assessment for lifecycle activities & maintenance operations - Needs-based
Overall	- Aggregated Report	→	- Plan, supported by Strategy & Policy, Framework for future data & process refinement - Aligned to City of Toronto Corporate AMP Framework

Table 2-B – AMP 2024 vs AMP 2025 – Marked Improvement

3. Alignment to TTC Organizational Context

The TTC's Vision, Mission, and Values are documented in the '2024-2028 TTC Corporate Plan'.

TTC Vision

> *"Moving Toronto towards a more equitable, sustainable and prosperous future."*

TTC Mission

> *"To serve the needs of transit riders by providing a safe, reliable, efficient and accessible mass public transit service through a seamless integrated network to create access to opportunity for everyone."*

TTC Values

> ***"Safety, Service and Courtesy"***

As an agency of the City of Toronto, the TTC is guided by the public service values codified in the Toronto Public Service By-Law, Chapter 192 of Toronto's Municipal Code:

- Serve the public well.
- Serve the TTC Board well.
- Act with integrity.
- Maintain political neutrality.
- Uphold Toronto's motto- Diversity Our Strength.
- Use TTC property, services and resources responsibly.
- Apply judgement and discretion.
- Serve the Public Service well.

This AMP is informed by the operational strategies identified in the Corporate Plan's integrated planning and performance framework, including the TTC AM Policy and Strategy. The following figure sets out the relationship between key asset management documents within this framework:

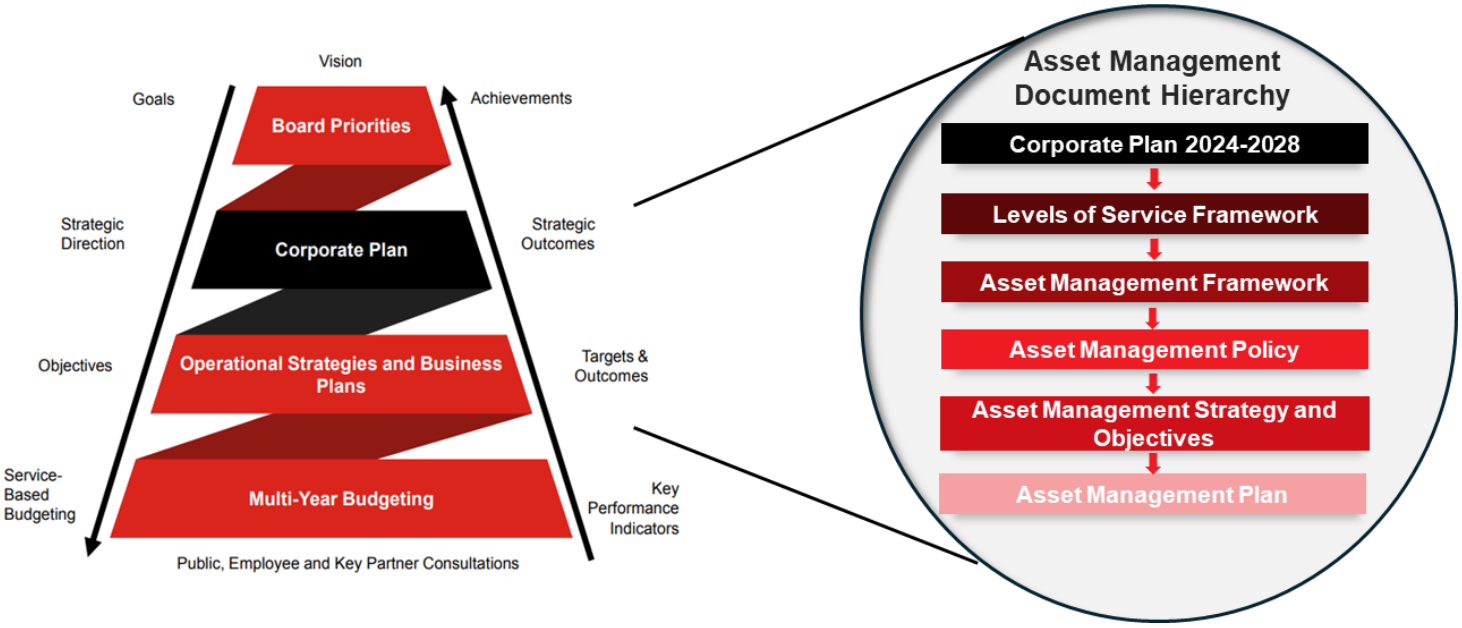


Figure 3-1: TTC's Integrated Planning and Performance Framework (left) and Asset Management Document Hierarchy (right)

3.1 TTC's Asset Management Framework

Asset management is an enterprise-wide discipline. The framework below shows how the different components which contribute to asset management at the TTC fit together to deliver on TTC's overarching goals.

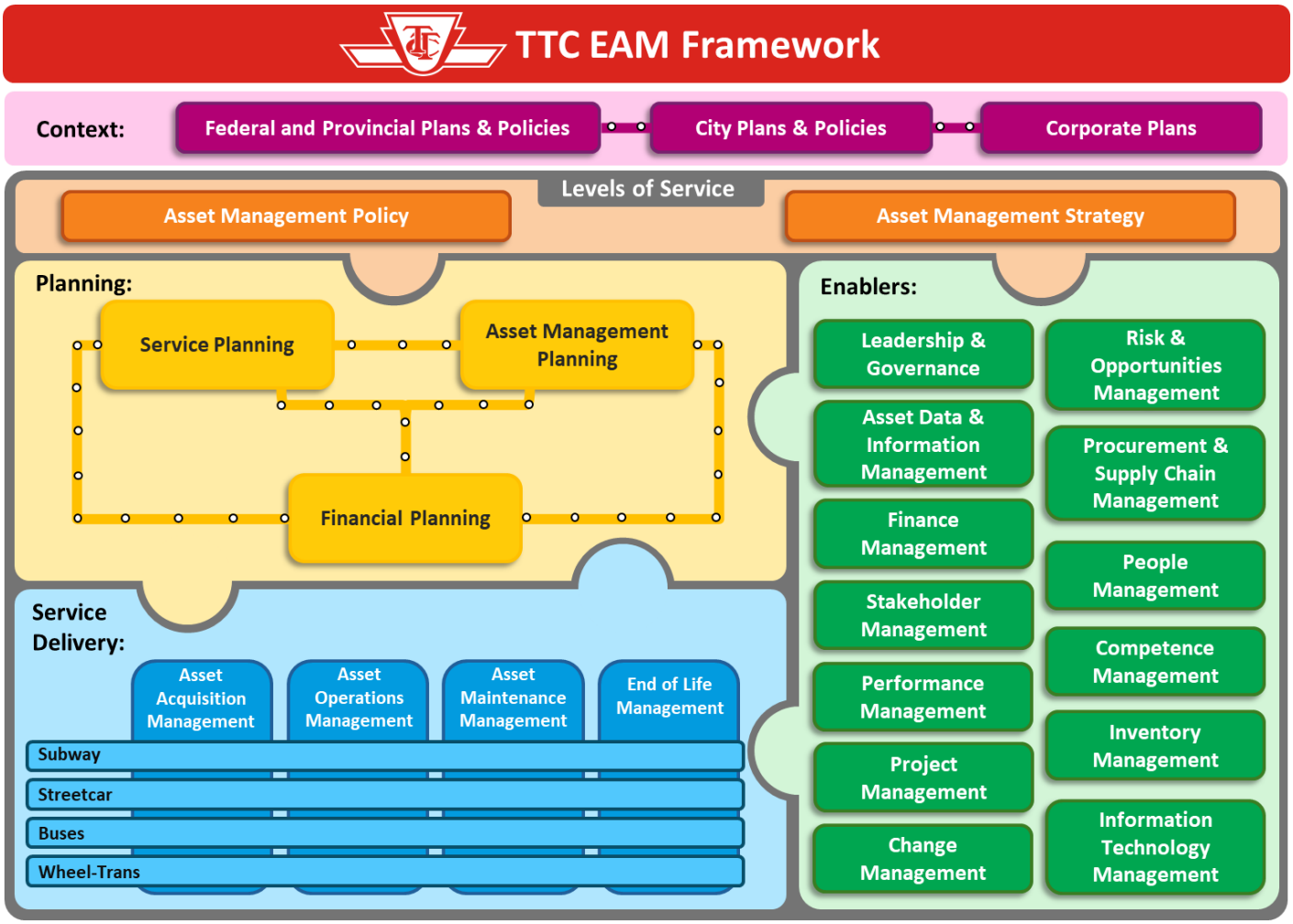


Figure 3-2: TTC's Asset Management Framework

The **Context** for asset management comes from the organization's corporate plans, along with plans and policies which are published by the municipal and provincial governments. These set out the desired outcomes from the TTC's services.

Levels of Service summarise the combined needs and expectations of the travelling public into statements of required service. Delivering our Corporate Plan and LOS through improved asset management is the purpose of the AM Framework.

The **AM Policy** and **AM Strategy** guide the approach to AM at the TTC. The AM Policy outlines the principles for asset management, and senior commitment to implementing it, ensuring alignment with the organization's corporate plans and government policies. The AM Strategy details the asset management objectives, approaches and high-level actions required to achieve the objectives and levels of service. Both documents facilitate the translation of strategic directions into actionable plans.

Asset management plans set out how assets will be managed across their life cycles, detailing activities required, costs, and risks to delivery. These are directly aligned to service planning to ensure that agreed levels of service can be met, and feeds into financial planning, to support the development of capital and operating budgets. When budgets have been set, AM plans are updated to reflect which activities are prioritised for delivery against constrained funds.

Asset management plans direct **Service Delivery** through all stages of the asset lifecycle (acquisition, operations, maintenance and decommissioning).

The ability to perform planning and delivery activities is supported by a series of **Enablers** which provide the capabilities needed for successful asset management. These include financial management, information management and people management functions.

3.2 Alignment to Corporate Plan & Context

The TTC's Corporate Plan establishes four key principles with a commitment to plan, deliver and evaluate services by applying these to everything that they do:

Safety and Security as a Cornerstone

Equity, Diversity, Inclusion and Accessibility (EDIA)

Environmental Sustainability

Innovation

Figure 3-3: "Moving Toronto, Connecting Communities" TTC Corporate Plan (2024-2028 & Beyond)

These key principles support the TTC's five strategic directions and set the TTC on a path to be successful in moving Toronto, connecting communities, and achieving the benefits of public transit investment.

Figure 3-4: TTC's 5 Strategic Directions

The AMP will assist the TTC in managing its various infrastructure assets that support service delivery, strengthen and build resilience into its operations, and enable the organization to focus on the key priorities and initiatives necessary to accomplish its long-term goals.

This AMP will align with the five strategic directions and the associated objectives, by establishing line of sight between these objectives, associated Levels of Service, and asset performance and condition. Furthermore, this AMP will speak to specific asset-related initiatives that are underway in response to these objectives, including initiatives to adapt to and mitigate the impacts of climate change.

Beyond the corporate plan, the AM Strategy and Plan are informed by and aligned to a variety of policies, overarching plans, regulations, and constraints. These are collectively referred to as the TTC's EAM Context and are outlined in the Figure 3-5.

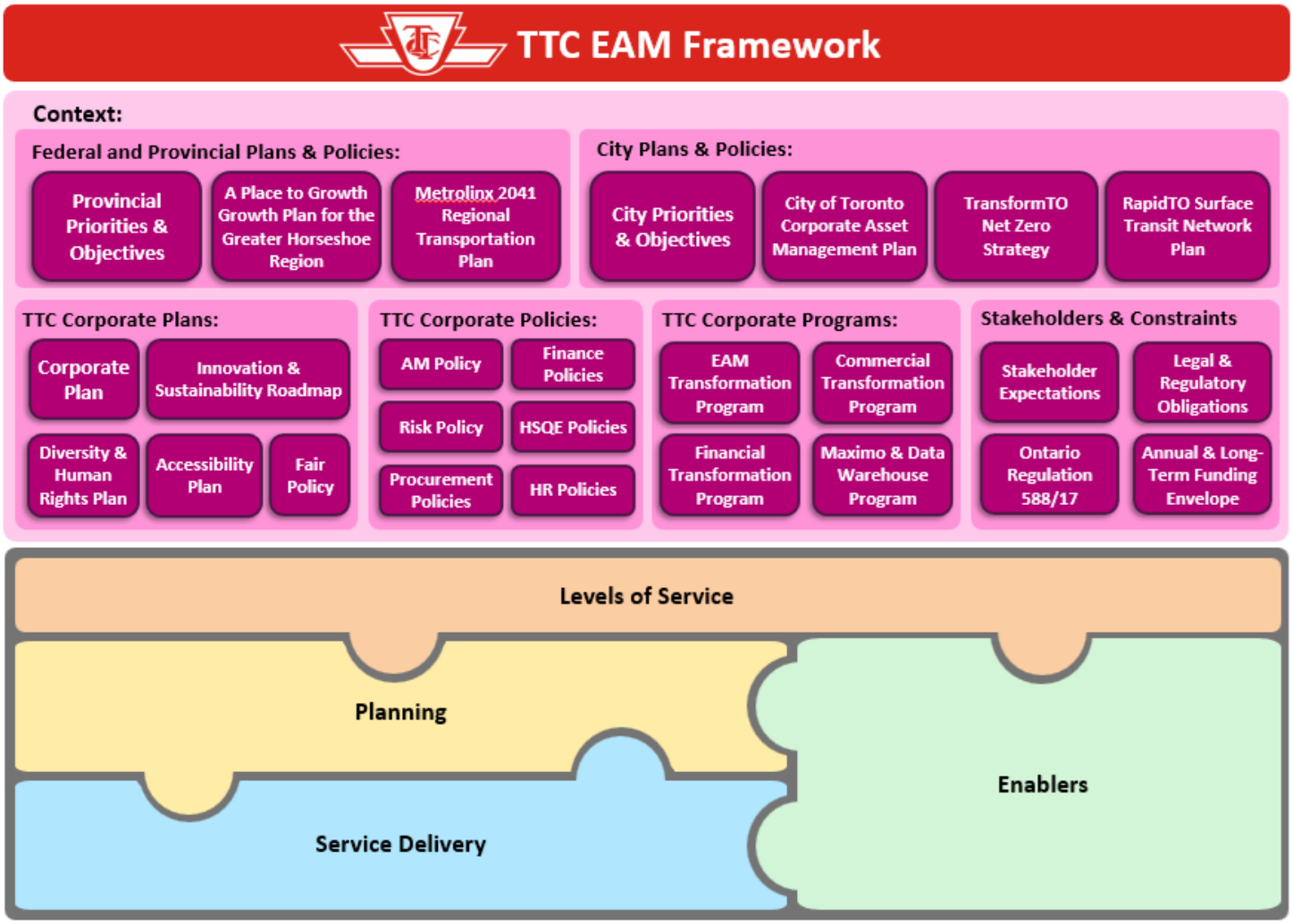


Figure 3-5: TTC's Expanded Internal and External Organizational Context

3.3 Alignment to TTC Asset Management Policy & Strategy

As outlined above, this AMP is guided and informed by the AM Policy and Strategy documents.

The AM Policy outlines the principles for asset management, and the commitment of senior leadership to implement it, ensuring that:

- Asset management decisions are evidence-based and reflect a holistic understanding of the value that the assets provide to the City of Toronto
- Risks are identified and mitigated
- TTC's asset management program and AM capabilities are effectively implemented and continuously improved

The AM Strategy sets out the asset management objectives as well as the strategies that the TTC's uses to make asset management decisions, set level of service targets, and develop lifecycle activities. The strategy also includes asset class specific strategies that the TTC has adopted to address key risks to asset management delivery.

3.4 Alignment to Business Planning Landscape

Since 2018, the TTC has introduced key business planning documents, which serve as supporting second level plans to the Corporate Plan, and which further elaborate how key strategic directions will be followed.

The following figure demonstrates the alignment between the Corporate Plan and the following business functions:

- **Financial Planning –** the creation of multi-year capital and operating budgets and plans, including a 15-Year Capital Investment Plan (CIP) to provide the funding to implement service and capital priorities.
- **Service Planning –** planning the service to be provided to TTC customers.
- **Asset Management Planning –** planning the activities required to achieve the TTC's long-term objectives.

Long-term planning is an iterative process that seeks to balance levels of service, funding, and risk. Levels of service include many factors, such as frequency of transit service, environmental targets, customer satisfaction, and SOGR.

As the TTC continues to mature its EAM practices, it is expected that TTC's longer-term business planning capabilities will also continue to evolve.

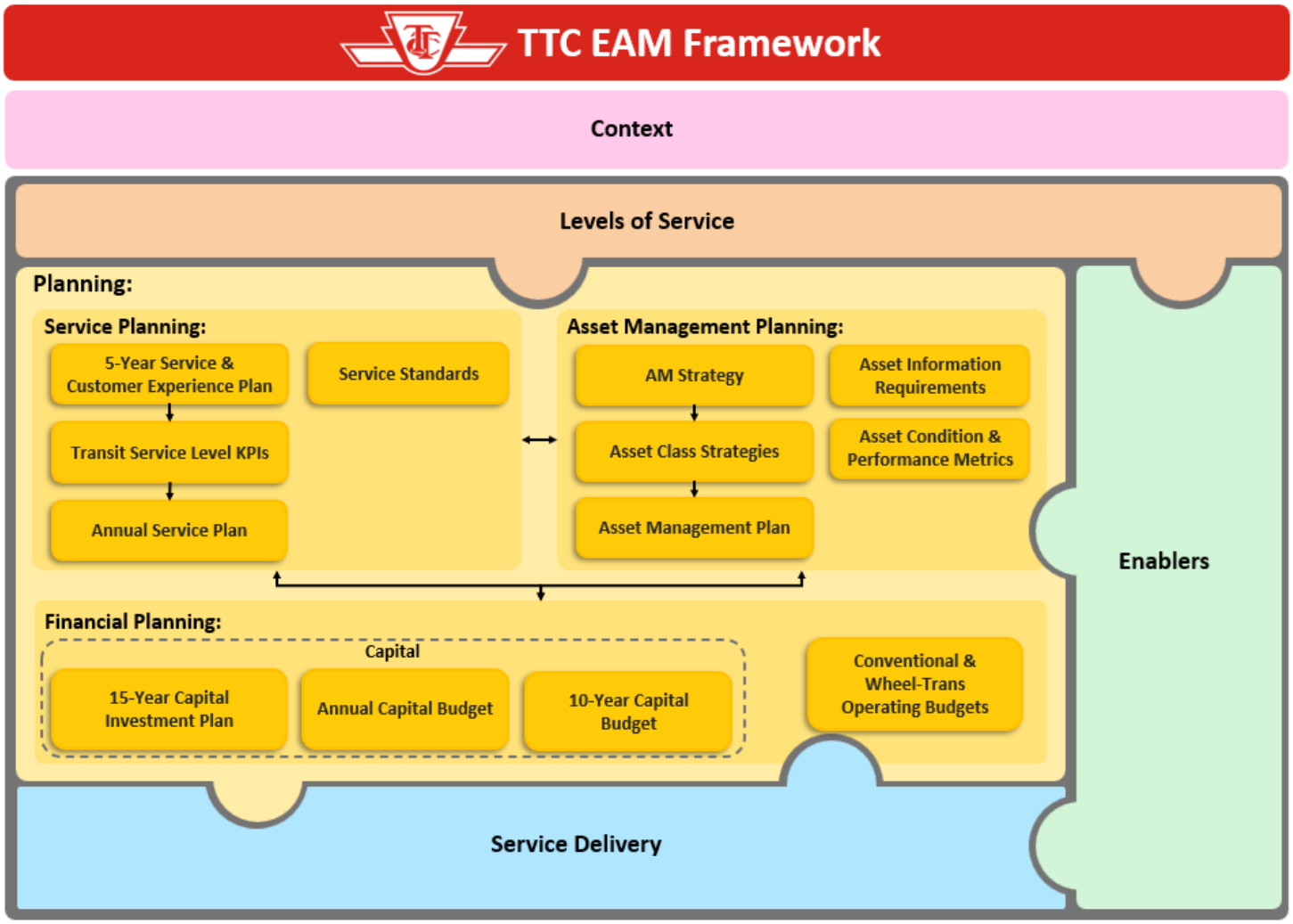


Figure 3-6: TTC's Expanded Business Planning Landscape

3.4.1 Financial Planning

Longer-term financial planning documents provide a view of the multi-year capital programs and projects necessary to maintain and build the assets. These include:

- **15-Year Capital Investment Plan**, first introduced in 2019 and updated annually thereafter, provides a comprehensive overview of capital needs, interdependencies and what is funded and not funded, as well as the key investment priorities and risks of not funding.
- **15-Year Real Estate Investment Plan**, a comprehensive set of principles, strategies and an implementation plan to achieve the TTC's strategic real estate goals and objectives.
- **10-Year Capital Budget & Plan**, guided by the CIP and REIP, outlines the funding and timing of acquisition, renewal and improvement of the TTC's assets that enable the TTC's delivery of a safe, reliable, and resilient integrated transit service.
- The annual **Staff Recommended Operating Budget and two-year outlook** to fund the TTC's current services, increase service to meet demand, operate transit expansion and conversion initiatives, and invest in safety, security and well-being initiatives.

Figure 3-7: Making Headway" Update to the TTC Capital Investment Plan 2025-2039

As the TTC's asset management program continues to evolve, TTC will work towards greater integration of AMP lifecycle activity requirement costing and financial planning documents. Going forward, this AMP will be used to inform the activities within the CIP and Operating Budgets.

The financial lifecycle activity costing requirements developed to sustain and deliver on proposed future LOS are presented below and contrasted with current funding to identify and highlight any infrastructure spending gap risks.

3.4.2 Service Planning

TTC service planning is undertaken at various levels and forecast horizons. The Corporate Plan takes into consideration the service expectations of TTC customers from a long-term perspective (through 2051, in the current planning horizon). Medium and near-term plans are outlined in the **5-Year Service & Customer Experience Action Plan** and the **Annual Service Plan**.

5-Year Service & Customer Experience Action Plan

The first 5-Year Service Plan and 10-Year Outlook (2020-2024) identified service-related improvements to public transit services in the city of Toronto. An updated version, the 5-Year Service and Customer Experience Action Plan (2024-2028), referred hereafter as the SCE Plan, was published in 2024.

The SCE Plan is informed by the following supporting documents:

- Innovation and Sustainability Strategy.
- 5-Year Accessibility Plan.
- 5-Year Fare Policy.
- 5-Year Diversity and Human Rights Plan.

The SCE Plan lays out anticipated growth and sets a vision to accommodate it, focusing on improvements that enhance the TTC's core-competency: mass transit – moving large volumes of customers safely, reliably and swiftly across Toronto.

The SCE Plan is supported by five pillars of opportunity. Each pillar addresses a key step in a customer's journey using the transit system. The pillars are designed to:

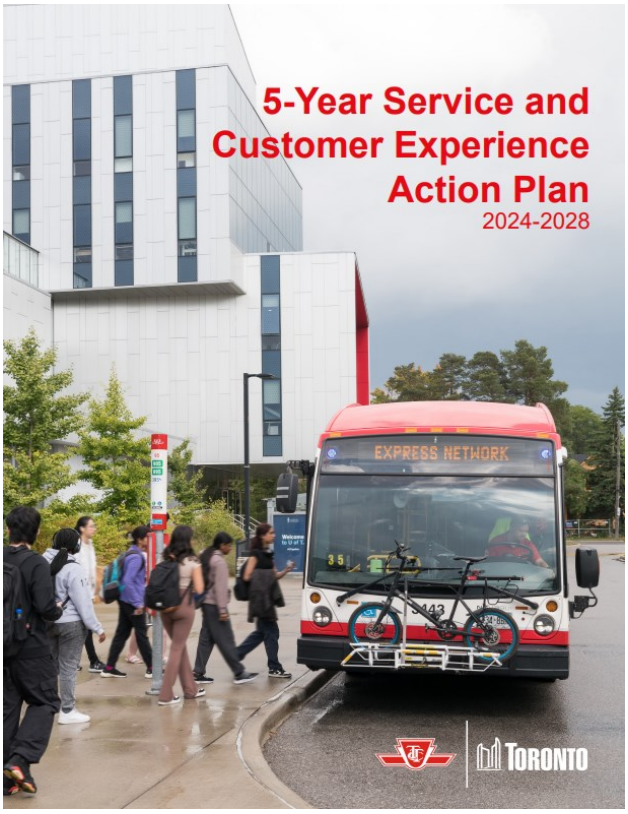


Figure 3-8: The 5-Year Service and Customer Experience Action Plan

1. Enhance the transit network.
2. Enhance customer experience at key surface stop areas.
3. Improve service reliability.
4. Prioritize surface transit.
5. Accelerate integration with regional transit partners and complementary modes of transport.

Each of these five pillars are accompanied with specific actions outlined in a multi-year 20-point action plan. The action plan is a blueprint that identifies major service-related initiatives to be implemented every year, and the associated resources required.

The SCE Plan also outlines the methodology for measuring service performance at the System level, at Route level, and at Plan level. Measuring performance is critical to ensuring investments in TTC services result in the benefits envisioned for customers.

This AMP takes the System and Route level service performance metrics and targets, as well as the TTC Service Standards into consideration when developing the asset-specific LOS, outlined further in Section 7. Asset-specific priorities and identified actions to improve service are also detailed in the appropriate lifecycle activity plans in the Asset Category Plans in the appendices.

Annual Service Plan

The Annual Service Plan measures past performance and present actions for the upcoming year and identify resource requirements that will serve as the basis for the TTC's annual Operating Budget and 10-Year Capital Budget submission.

The TTC reviews and monitors customers' emerging travel patterns to learn about how to better serve them and provides a roadmap for service changes for the coming year – including recommendations for new and revised routes based on input and engagement with TTC customers, employees, and the community. It applies valuable lessons learned from recent years to enhance transit in Toronto, ensuring a more efficient and reliable system for all riders.

The 2025 Annual Service Plan focuses on three key themes:

- Enhancing connections to meet customer needs – Service improvements that address customer demand and travel patterns of TTC's three key priority groups (women, shift workers and people with low income), including routing changes to optimize the network, improving first and last trip times and creating new connections.
- Improving the Community Bus service – Route improvements on the Community Bus Network in addition to customer communication and wayfinding changes to raise awareness about the service and make it more attractive to customers.
- Planning for construction: from principles to practice – Continuing to apply principles from the 2024 ASP to plan for construction, minimize disruptions and maintain service reliability. The TTC will also continue to identify ways to move transit better by mitigating the impacts of congestion

As above, this AMP aligns with this plan in determining the future LOS requirements of the assets and outlines the asset specific actions required to deliver on the proposed action plans.

3.5 Alignment to Ontario Regulation (O.Reg.) 588/17

On January 1, 2018, 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.

The regulation has been phased in over six years with the final requirements coming into effect in July of 2025. This AMP has been developed in accordance with these requirements to support the City of Toronto in achieving the final milestone.

This AMP addresses these requirements as follows:

- It applies to all assets as defined in O. Reg. 588/17.
- It includes a summary, replacement costs, average age, and condition (see section 6.2).
- It includes a description of the TTC's approach to assessing the condition of assets (see section 6.1).
- It includes assessments of current and proposed future Levels of Service (see section 7).
- It includes a description of the lifecycle activities that need to be undertaken achieve LOS targets, as well as risks associated with those activities (see section 8.2).
- It includes the estimated capital expenditures and operating costs related to the lifecycle activities required to achieve LOS targets and accommodate growth (see section 11.3).
- It applies a 10-year horizon to these activities and projections.
- It is supported by the best available and most current data that is available at the TTC.

A key objective of this AMP, which is also prescribed by O. Reg. 588/17, is to ensure that the document is publicly available to residents and other key stakeholders of the TTC. This AMP is accessible to the community through the TTC's website. The City of Toronto Corporate AMP, which summarises data from this document, can be accessed via the City of Toronto's website.

3.6 Climate Change

One of TTC's four key principles highlighted in the 2024-2028 Corporate Plan is 'Environmental Sustainability'. Through adoption of this principle, the TTC is dedicated to reducing their impact on the environment by implementing leading sustainability practices and embedding climate action into TTC's culture, assets, and business practices. This begins with targeted activities aimed at reducing greenhouse gas emissions from its facilities and operations.

The TTC plays a critical role in climate change mitigation through the delivery of low to zero-emissions mass transit services that contribute to reduce community-wide emissions. To address the global climate emergency, the TTC will continue to work with the City of Toronto to support the City's TransformTO net-zero target by 2040.

The TTC also recognizes its responsibility to ensure that its transit operations are resilient to the effects of gradual shifts in climate, as well as the increasing rate of severe weather incidents brought about by climate change. The impacts of climate change are expected to result in an increase in the investment and effort required to maintain SOGR, and to achieve LOS. Asset degradation may accelerate, and costs of renewal, refurbishment, and replacement activities may increase as renewed assets will need to be designed to accommodate a changing environment.

Figure 3-9: TTC's Innovation and Sustainability Strategy (2024-2028)

While there is significant cost to adapting to and mitigating the effects of climate change, the costs and risks in not doing so would be much higher. As such, the TTC incorporates the lifecycle cost and LOS impacts associated with the effects of climate change into the AMP as part of the proposed future-state, based on the best available knowledge and predictions. As such, where possible, the asset replacement and renewal activities presented in this document represent upgrades to modern, zero or low-emissions assets, rather than simple like-for-like replacements.

Section 9 presents specific strategies and initiatives related to climate change. Additional details can be found in TTC's Innovation and Sustainability Strategy.

4. Approach to Incorporating Growth

In 2024, the TTC provided 422 million rides, an increase of 6% over 2023 and over 100% from the lowest period of the pandemic, when ridership dropped to 198 million rides in 2021. Although the TTC's ridership remains below the 525 million rides recorded in 2019, there has been growth in off-peak travel periods, weekends, and discretionary trips. However, hybrid work arrangements that emerged during the COVID pandemic may be here to stay in some form. The TTC is actively monitoring trends in downtown office occupancy and factoring these considerations into service plans and revenue forecasts. As customer demand patterns change, and customer expectations evolve, so must our service.

Significant growth in Toronto's population and job market are expected to put the TTC on a path to approaching 2019 levels of ridership again by 2030. The LOS targets included in this AMP are assessed accordingly.

The 2025 5-Year Service and Customer Experience (SCE) Plan provides the framework for the development of the Annual Service Plan and outlines a range of service initiatives that respond to increases in ridership due to population and employment growth, and options to enhance service to incentivize new riders to take transit. The planning process will continue to be informed by the latest information in customer demand patterns, operational environment changes, and customer research and engagement.

The 2025 SCE Plan, anchored on the TTC Service Standards, provides the foundation for further exploration of ridership reacquisition and long-term growth. Depending on the LOS investment and key policy changes, such as implementation of the RapidTO: Surface Transit Network Plan, there is an opportunity to reach up to 480 million rides annually by 2028.

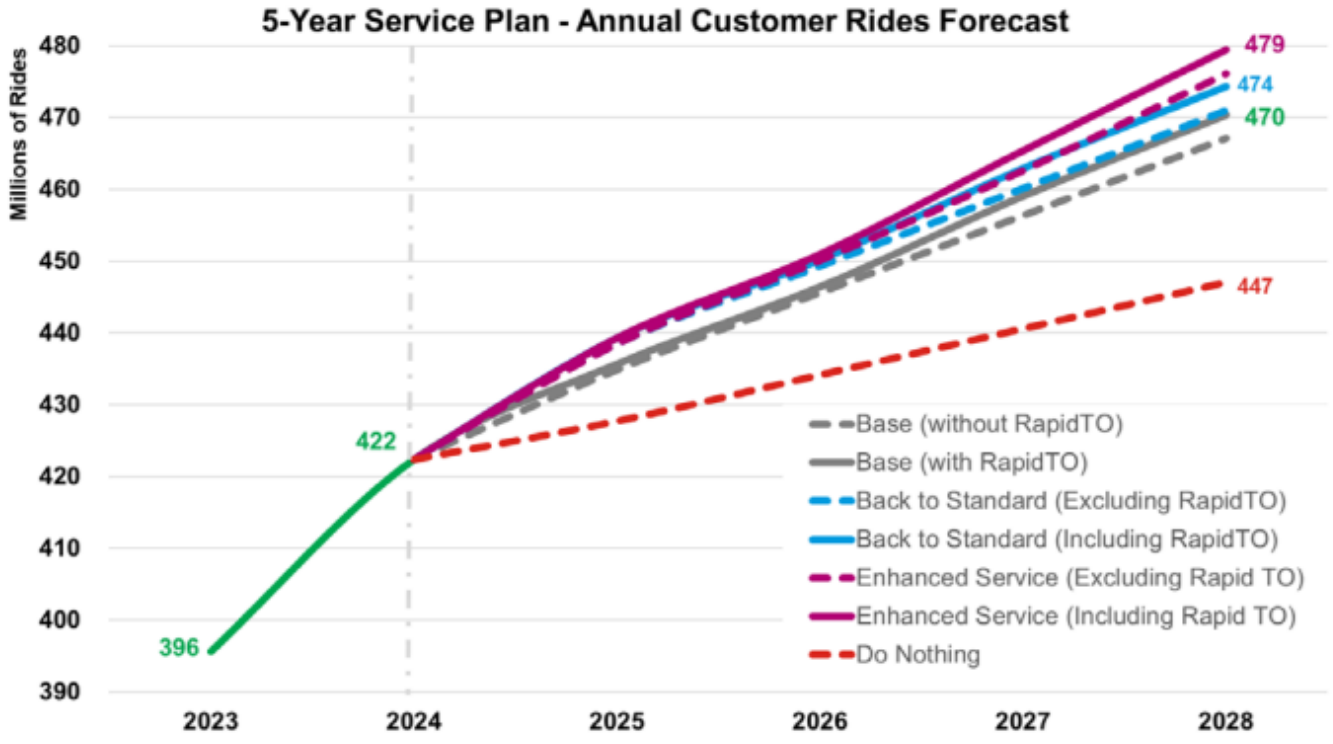


Figure 4-1: Annual Customer Rides Forecast

4.1 Development of Forward Plan

In 2023, the TTC published a Board report titled, 'Sustaining a Reliable Transit System: Outlook 2024 and Beyond' to highlight the challenges faced in realizing the benefits of public transportation to the City of Toronto and its three million residents by enabling access to employment, education, services, and social connection through an integrated mass transit network.

When developing the TTC's forward plan for 2025 and beyond, the following factors were taken into consideration:

- Ridership is currently averaging at 74% of the pre-pandemic level, due in large part to the continuation of hybrid work averaging 2.3 days per week in the office (18% of the gap, with the other 12% of the gap due to mode shift).
- Recovery of ridership continues to be strongest on bus compared to other modes (boardings at 84% pre-pandemic levels) and serves many of Toronto's equity-seeking communities, compared to streetcar and subway use at 57% and 63% pre-pandemic levels, respectively.
- Recent data shows traffic congestion in Toronto is near pre-pandemic levels despite 50% of office worker trips not taking place. Major construction is also planned and underway over the next seven-to-eight years with further potential impacts on surface transit reliability.
- Customer experience and satisfaction are important to attracting and retaining riders. However, concerns regarding streetcar service and community safety, among other factors, have resulted in a decline in customer satisfaction scores.
- The heavy reliance on the farebox has demonstrated the vulnerability of the system and poses a risk to service (approximately 70% of operating costs pre-pandemic were funded by fares); the TTC continues to face significant ridership revenue impacts from COVID.
- New rapid transit services are being built that will transform the network but also introduce new operating cost pressures to a challenging fiscal framework once entered into revenue service (e.g. Line 5, Line 6 and future subway expansion).
- Population growth in Toronto and the region is expected, with Toronto's population expected to grow to 3.56 million by 2051. With a current transit mode share of 23% (compared to 27% pre-pandemic), and the City's TransformTO goals to increase share of trips taking sustainable transportation modes – ensuring the competitiveness of public transit will be key in a climate-changed environment.

4.2 Service Improvement and Growth

The TTC has established a long-term planning horizon to 2051, based on an assumed annual growth rate of 1.5% to address forecasted population and ridership growth. This information is used to determine long-term service and fleet plan requirements, which are inputs to the capital asset plans. Along with an assessment of SOGR requirements based on asset management practices, the TTC utilizes this information to determine capital investment needs for the system. The City's TransformTO policy will also have an outsized impact on the TTC's capital and operating growth across all vehicles.

The following figure shows the distribution of spend across project portfolios and by project category between 2025 and 2034, with 26% of the total allocated to service improvement and growth.

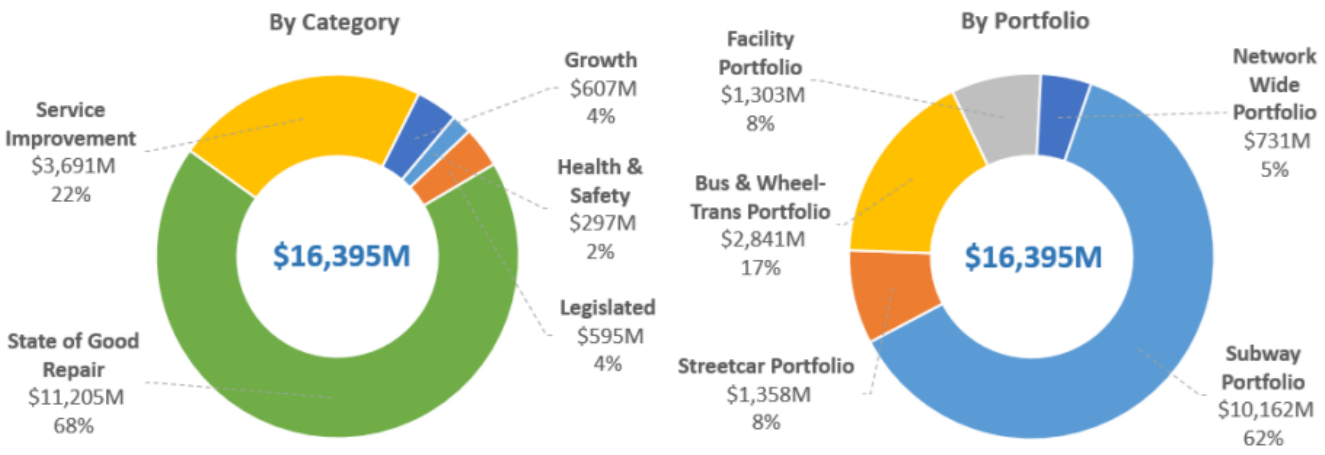


Figure 4-2: 2025-2034 Base Capital Plan Distribution by Category & Portfolio

4.3 Expansion Plans

The TTC is committed, with its partners, to growing the Toronto transit network through a series of expansion projects. Figure 4-3 reflects the existing and future transit network around the city of Toronto and its neighbouring regions. With the exception of the ECWE, all of the listed projects will be Provincial assets upon completion and will be owned and managed by the province.

Line 1 – Yonge North Subway Extension (YNSE)

This Metrolinx-led subway development will extend Line 1 from Finch Station to Richmond Hill Centre Station. Spanning eight kilometres and serving five stations, the extension is proposed to connect to the existing bus and train services from the TTC, GO, Viva, and York Region Transit.

Line 2 – Scarborough Subway Extension (SSE)

Led by Metrolinx, this extension will replace the now-decommissioned Line 3 Scarborough RT by expanding Line 2 from Kennedy Station to Sheppard Avenue East and McCowan Road, through Scarborough Centre. The extension will add 7.8 kilometres to Line 2 and serve an additional three stations, connecting the downtown core to further transit links from the TTC, GO and Durham Region services.

Line 5 – Eglinton Crosstown Light Rail Transit (ECLRT)

A new light rail transit line being built by Metrolinx will run across Eglinton Avenue, from the future Mount Dennis Station to Kennedy Station, spanning 19 kilometres in total, including a 10-kilometre underground section through the middle of the city. Featuring 15 stations and 10 stops along Eglinton Avenue, the service will connect to TTC bus routes, subway stations and GO lines. The TTC and the City of Toronto are exploring the option of advancing the ECLRT further east, extending the line from Kennedy Station to pass through the University of Toronto Scarborough Campus and terminate at the future Line 2 terminal at Sheppard Avenue and McCowan Road.

Eglinton Crosstown West Extension (ECWE)

Led by Metrolinx, this extension will add 9.2 kilometres to the Eglinton West Crosstown LRT and will connect the future Mount Dennis Station to Renforth Drive. Serving seven stations, the extended route will operate mainly underground and connect to local and regional transit options from the TTC, MiWay and GO. Additional plans are being explored to extend the line further west by 4.7 kilometres to Pearson International Airport.

Line 6 – Finch West Light Rail Transit (FWLRT)

Metrolinx is building a new light rail transit line along Finch Avenue West, from Keele Street to Humber College. This 11-kilometre line will include 18 stops and connect to Line 1's Finch West Station.

Ontario Line

The Ontario Line will be a 15.6-kilometre subway line running from Exhibition Place, through downtown Toronto and out to the current Ontario Science Centre location. Planned by Metrolinx, the line will introduce 15 new stations to the city and connect to transit options, including Line 1, Line 2, the ECLRT, many TTC streetcar and bus routes, and the GO network.

In addition to the above provincial driven expansion projects, the TTC and City of Toronto conducted a comprehensive assessment of needs and options for transit improvements for the waterfront area.

Waterfront Transit Network Expansion

With significant development along Toronto's waterfront, a Waterfront Transit "Reset" Study articulated the opportunities that exist and proposed an approach to advance waterfront transit.. Focusing on the waterfront from Long Branch in the west through to the TTC's Leslie Barns streetcar facility in the east, a series of individual projects were identified to strengthen transit links, and they are now in various stages of the planning, design and approval processes.

Figure 4-3: Existing and Future Rapid Transit Network

5. AMP Overview

The TTC AMP is structured to align with the City of Toronto Corporate AMP and is organized via this main document and five supporting Asset Category Plan documents, which are provided in the appendices. The main document provides a high-level summary of all information, as well as overarching principles, strategies and methodologies. The asset category summaries provide additional details specific to those asset groups.

The TTC asset hierarchy has been developed to organize its asset base for reporting purposes in this AMP. At each level of the hierarchy, a dashboard is used to provide a visual summary of key information aggregated to that level. This summary figure includes the total replacement value of all assets within the hierarchy level, the overall average asset condition (a weighted average, by replacement cost, of individual asset conditions within the category), the condition distribution across the asset portfolio over the five applicable condition states, and a summary of the average age of assets against Estimated Service Life (ESL).

A subsequent dashboard figure is also included, which visualises the maturity of the data within that asset portfolio. This figure lists data completeness for each of the key asset data fields, by asset subcategory. It also includes an overall completeness score, as well as average confidence assessments for asset replacement cost and condition rating data. Whereas the analyses for asset areas with high data maturity grades are well supported given the best available information, the analysis results for areas with low maturity grades may be less accurate and subject to change as better data becomes available.

A more detailed description of all parameters presented in the dashboard can be found in Section 6.1.

Within the Asset Category Plan documents included in the appendices these summary figures are followed by a visual description of the hierarchy for the asset category, which illustrates all subcategories, and asset classes. Following this initial summary, each service area summary document is broken down further by subcategory.

6. State of Infrastructure

6.1 Understanding the State of Infrastructure

The state of infrastructure section in this AMP describes key information related to the current state of the TTC's assets. It summarizes the following information:

Replacement Value:

An asset's Replacement Value is the estimated cost in present dollars to replace the asset (or system of assets/asset base, if applied to a higher-level group), either like-for-like or with a modern equivalent asset as appropriate. The TTC will use a variety of methodologies in determining replacement value, depending on data availability and asset type.

For assets which are routinely replaced, the TTC will utilize existing data, exploring the following data sources:

- TTC procurement departments for costs associated with recent procurement exercises
- Historic acquisition costs from TTC accounts, indexed to present dollars
- Valuation records from the TTC insurance report

For assets which are not routinely replaced, the TTC will develop estimates for replacement or new builds based on the following data sources:

- Any available data from similar TTC procurements or constructions that can be adapted or customized to apply.
- Any applicable data that is available from partners or other projects that can be adapted or customized to apply.
- Valuation records form the TTC insurance report
- Generic industry rates and/or estimates from qualified subject matter experts

In all cases, a Replacement Value Confidence score will be applied to the value estimate based on the estimate methodology applied. The TTC has defined five confidence categories which align to other qualitative assessment frameworks used in this AMP (condition, performance, etc). These are defined below:

Code	Confidence	Method of assessment	Expected Variance
1	Excellent	Value is based on recent replacement quotes or historic costs of identical assets.	+/- 5%
2	Good	Value is based on a parameterized assessment of similar quotes or replacement costs.	+ 15% -5%
3	Fair	Value is based on expert opinion or benchmarked data from other systems	+30% -15%
4	Poor	Value is based on insurance data or similar aggregated assessments	+50% -25%
5	Very Poor	Value is estimated	+100% -50%

Table 6-A – Replacement Value Confidence Rating Framework

As the TTC continues along its asset management maturity journey, replacement value estimates will be refined to improve confidence prioritizing high value, low confidence assets.

Age:

A summary of the average age of the assets is provided. This average is calculated by averaging the age of each individual asset, weighted by replacement value.

Estimated Service Life:

A summary of the average estimated service life (ESL) of the assets is provided. This average is calculated by averaging the ESL of each individual asset, weighted by replacement value. Asset estimated service life is the total expected service life of the asset, from its in-service date (as opposed to remaining service life). This is a semi-static parameter for each asset type, which may be reassessed as more information is made available

Condition:

A summary of the average performance of the assets is also provided. This is calculated by averaging the performance ratings of each individual asset, weighted by replacement value.

The asset condition reflects the measured or assessed physical condition of the asset. Asset age relative to ESL can be used as a proxy for asset condition where assessment of physical condition is not practical or useful (e.g.: software & systems).

The TTC has defined five condition categories which align to other qualitative assessment frameworks used in this AMP. These are defined below:

Code	Condition	Description	Details
1	Excellent	Fit for Future	No noticeable degradation. New or like new (>75% life remaining).
2	Good	Acceptable for now	Normal wear and tear. Any defects have been addressed (repaired, planned, or mitigated). Asset is generally in the mid stage of expected service life (75%-25% life remaining).
3	Fair	Requires attention	Measured asset condition is below action thresholds, but within acceptable limits. Defects do not significantly degrade performance. Maintenance/rehabilitation is required. Asset is approaching end of service life (<25% life remaining).
4	Poor	Increasing potential of affecting service	Measured asset condition is below action thresholds and approaching condemnable limits. Asset is considered unfit for service without risk assessment/mitigation. Significant maintenance/rehabilitation is required. Asset is at or beyond end of service life.
5	Very Poor	Unfit for sustained service	Measured asset condition is at or beyond condemnable limits. Asset is unfit for service without major risk mitigation activities. Replacement/rehabilitation is required. Asset is well beyond service life.

Table 6-B – Asset Condition Rating Framework - General

Specific examples of the condition ratings as applied to asset subcategories will be generated where more applicable qualitative or quantitative metrics are available. These are outlined in the associated Asset Category Plan.

For most assets, one of three approaches to assessing condition is utilized.

1. **Asset-specific Condition Rating –** For many asset types, an asset-specific condition rating metric that adheres to industry best practices or a standardized system of assessing condition for a particular asset type or group. Some examples of this are a facility condition index (FCI) rating for buildings or a bridge condition index (BCI) rating for bridges/municipal structures.
2. **Remaining Life –** For many other asset types, condition is understood and expressed in terms of remaining life as a percentage of its estimated service life. Note that this metric is not necessarily a reflection of the asset's age – it is a condition or performance metric. For example, some assets may have aged beyond their ESL but are still fit for purpose and may still have remaining life. Conversely, relatively new assets may be in poor condition, which can be reflected in a lower than anticipated remaining life.
3. **Life Consumed –** Life consumed is simply the asset age divided by its estimated service life. It is a function of asset age and is often used when condition information (including remaining life) is not available or known. It can also be used in cases where it is not feasible to complete condition assessments of assets for financial, practical or other reasons (these assets are sometimes referred to as "run to failure" assets).

Condition data will be of varying quality, depending on the timeliness and method of assessment. This is represented by an asset condition confidence rating. The TTC has defined five confidence categories which align to other qualitative assessment frameworks used in this AMP (condition, performance, etc). These are defined below:

Code	Confidence[1]	Method of assessment	Sampling[2]	Timeliness[3]
1	Excellent	Score is based on quantified wear or degradation parameters or qualified SME assessment.	All assets	<6 months
2	Good	Score is based on qualitative assessment by a competent assessor.	All or most (>75%) assets	<12 months
3	Fair	Score is based on qualitative assessment by a competent assessor.	Statistically significant (>25%) random sample of the asset base	<2 years
4	Poor	Score is based on statistical assessment of layperson (operator or public) accounts, or is purely based on known asset age vs assumed life	Small batch (<25%) random sample	<3 years
5	Very Poor	Score is assumed based on anecdotal accounts, age estimates, or similar.	Anecdotal or estimation only	>3 years

Table 6-C – Asset Condition Confidence Rating Framework - General

[1] Overall confidence should be based on the lowest of method, sampling, and timeliness ratings
[2] Samples should not knowingly exclude any assets with known condition concerns, or whose operating environment is known or suspected to result in differing degradation rates.
[3] Representative values only. Actual timeliness rating values may change for particularly stable or unstable asset types, or if using validated condition degradation models or other prediction tools

Performance:

A summary of the average performance of the assets is also provided. This is calculated by averaging the performance ratings of each individual asset, weighted by replacement value.

The performance of an asset is the ability of that asset to meet the specific LOS expectations for that asset, independent of its age. The performance scale is meant to capture the degree to which expected LOS are met, as well as the perceived risk to future performance based on current performance history and RAMS data.

The TTC is utilizing five performance categories which are broadly aligned to those established by the City of Toronto to understand asset performance. The following framework defines these performance categories:

Code	Performance	Details
1	Excellent	Asset meets or exceeds all level of service targets. Disruptions are negligible.
2	Good	Asset meets level of service targets. Minor disruptions are addressed through routine processes.
3	Fair	Asset approaches level of service targets. Regular maintenance and minor interventions allow acceptable operations.
4	Poor	Asset does not substantively meet level of service targets. Significant regular interventions are required to sustain service.
5	Very Poor	Asset is consistently below level of service targets. Acceptable service is not achievable through regular interventions.

Table 6-D – Asset Performance Rating Framework

Additional information on the state of infrastructure can be found in each of the Asset Category Plans in the appendices of this AMP. Each of these documents provides the following information organized at the asset subcategory level (or otherwise within the specified asset portfolio):

- The quantity of assets
- The total combined replacement value assets
- The average condition of the assets (weighted by replacement value).
- The average age of the assets (weighted by replacement value).
- The average estimated service life (ESL) of the assets (weighted by replacement value).

Following this tabular summary section, details explaining how asset condition ratings were assessed are provided.

6.2 State of Infrastructure Summary

The TTC operates one of the largest and most complex public transit systems in North America. Toronto's transit infrastructure is a mix of both modern and aging legacy assets, reflecting the long history of the transit network. Some of the oldest assets include subway stations and tracks that date back to the mid-20th century, while newer assets include recently upgraded buses and streetcars. The varying ages of these assets present unique challenges in terms of maintenance and modernization. Older infrastructure often requires more frequent repairs and upgrades to meet current safety and efficiency standards, while newer assets are designed to be more resilient and technologically advanced but bring increasingly complex maintenance requirements

The condition of TTC's assets varies significantly across the system. Some of the Linear Infrastructure and Facilities on the older subway lines, such as the Yonge-University line, have seen extensive use over the decades and are in need of ongoing maintenance and renewal to ensure reliability. In contrast, newer lines and vehicles are generally in better condition but still require regular upkeep and investment to maintain optimal performance. The TTC has been investing in infrastructure to maintain the SOGR of the assets, improve services delivered to the travelling public, and accommodate growth in both ridership and network expansion. These efforts are aimed to enhance the overall quality of service and ensure the transit system can meet the changing and growing demands of the city's population.

The following figure outlines a high-level overview of the state of TTC infrastructure across the entire asset base.

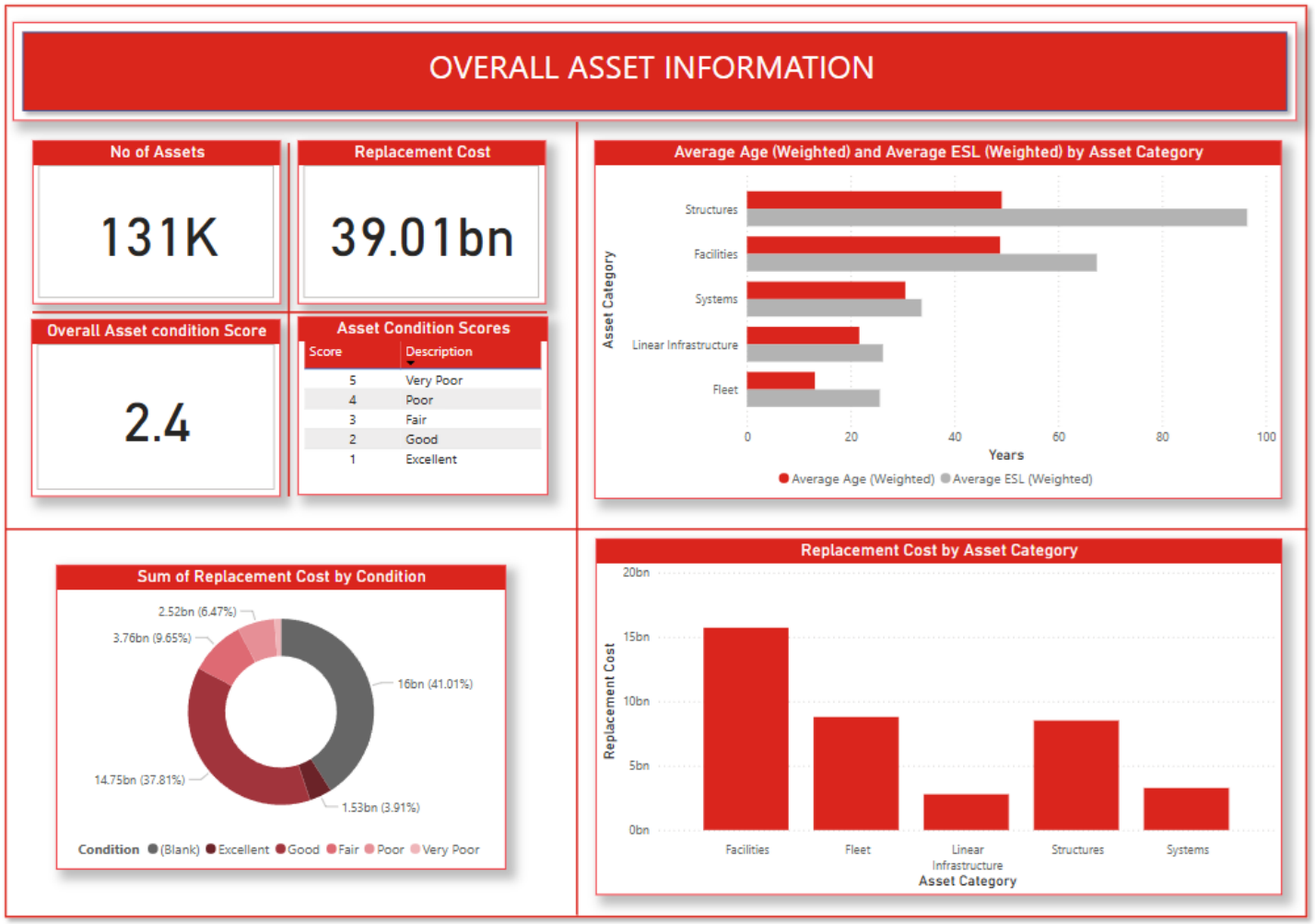


Figure 6-1: State of Infrastructure Summary Dashboard – All TTC Assets

The replacement values shown in this section are based on an aggregated assessment of the replacement costs of all assets within the category. Where individual asset cost data is not available, an estimate is established based on similar asset procurement cost, industrial average cost of the same type of asset, or market price whichever is more appropriate in the situation. Yearly inflation indexation is considered while establishing the replacement cost estimate.

The replacement costs below include the material cost as well as the associated costs for the replacement of the asset, to the best effort of estimation, such as design costs, access costs, labour costs and disposal costs.

It is projected that the costs that comprise these values will continue to trend upwards with the implementation of new construction standards, inflationary pressures, and increased function and use of these assets.

A further breakdown of the asset replacement cost by asset category can be seen in Table 6-E below:

Asset Class	Total Replacement Cost ($ Billions)	Notes
Fleet	$8.78	This figure does not include any decommissioned or to-be-decommissioned subway cars and buses) (Line 3 Subway cars, retired buses), but is inclusive of the planned new vehicles that will be in service shortly as well as spare non-revenue road vehicles
Facilities	$15.71	This figure includes contents of the facilities as well as the associate equipment that serve the good state of the facilities (E&M services, furnishings, etc)
Linear Infrastructure	$2.77	This figure includes all Subway, and streetcar tracks underground and above ground, and the assets associated to them as well as the OCS and wayside power supply and distribution for the streetcar system
Systems	$3.26	This figure includes the Electrical Supply and Distribution systems, Signal systems and Communications systems.
Structures	$8.50	This figure includes underground and above ground civil structures (not including linear infrastructure or building facilities)
Total Replacement Cost	**$39.01**	

Table 6-E – Summary of Asset Replacement Costs by Asset Category

The costs presented herein represent an uplift of 55% over those from the 2024 AMP ($39.01B vs $25.18B) and the insurance valuation report. It is important to note that the current costs have been developed through a bottom-up exercise, with individual asset component replacement costs aggregated within the asset register. The TTC believes these values to be more representative of the true costs to replace the asset base, although the current low level of data maturity limits the ultimate accuracy. It is anticipated that these figures will change as data maturity is improved and more accurate financial information can be aligned to the asset subclasses within each category.

Key changes in this year's report are:

- **Systems ($3.26B vs $1.06B) –** The values presented in the 2024 AMP did not include communications assets, and significantly undervalued signals assets.
- **Facilities ($15.71B vs $5.04B) –** Subways station valuations were determined not to be reflective of modern construction costs, which were benchmarked against the ECLRT.

In all cases, the values presented herein are based on available asset data. Within the new asset data framework, we have assessed the maturity of TTC asset data with respect to completeness and confidence (quality). Current data completeness against all critical asset data fields is 66%, although this is not equally represented across asset categories. Facilities and Systems have low levels of data maturity, whereas Fleet data maturity is relatively high. It is important to note that low levels of reported data maturity do not necessarily reflect a lack of data or a lack of understanding of the factors that the data represents. In many cases, similar or complimentary data exists, but has not yet been translated into a format that can be presented in this document.

In reviewing Figure 6-1, it is important to consider the following in how the data gaps are represented:

- Number of assets is a count of all line items in the asset register. Grouped assets (e.g.: track sections) are included as a single asset.
- Overall asset condition score is a value weighted average for all assets for which a condition rating and value is available.
- The average age vs ESL chart includes only assets for which an age, ESL, and value are available.

As the TTC's EAM transformation project continues efforts will be taken to improve data quality and address gaps, while simultaneously developing and embedding the processes to keep data up to date.

The following figure outlines a high-level overview of the current state of TTC asset data.

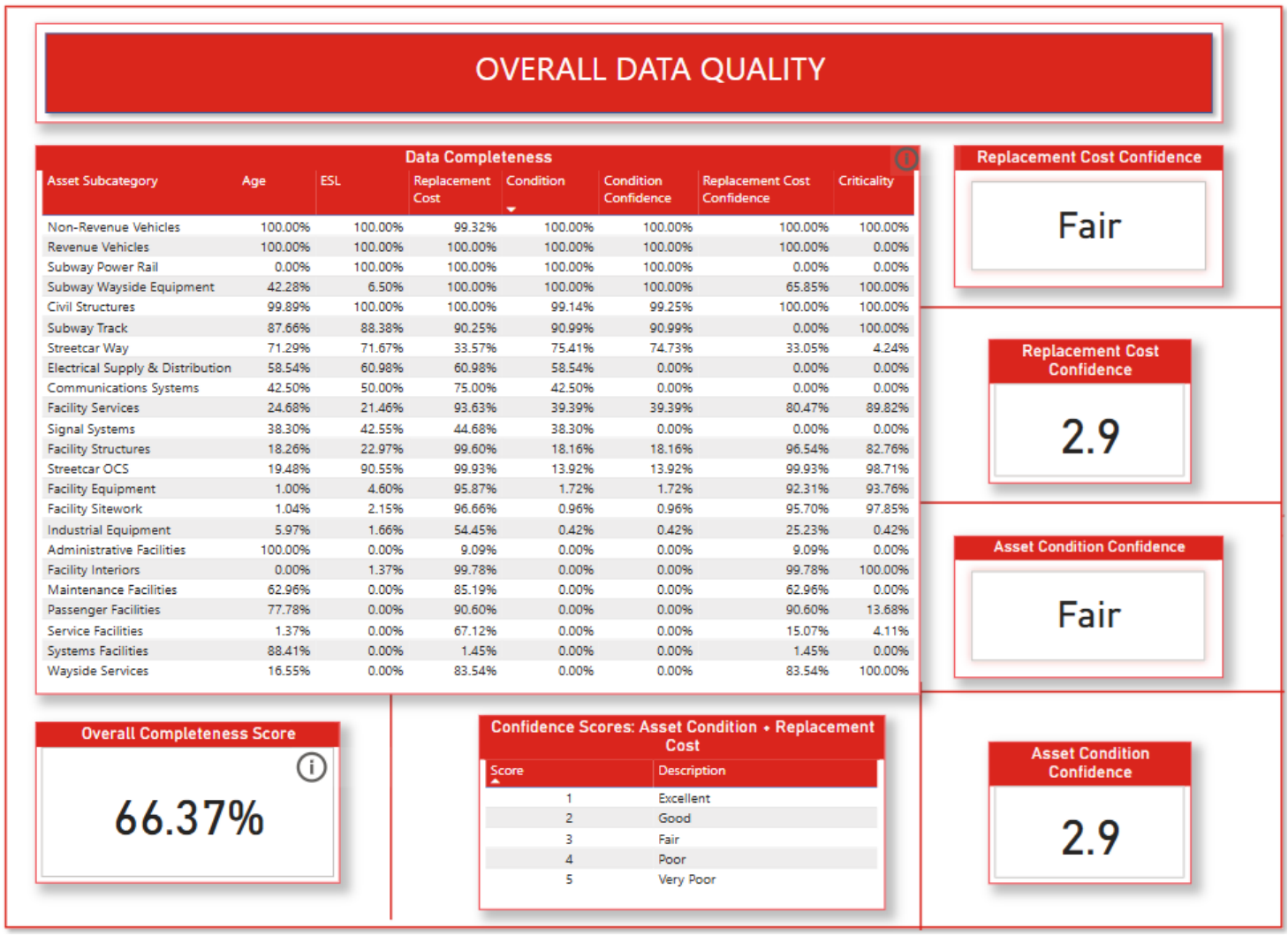


Figure 6-2: Asset Data Quality Summary Dashboard – All TTC Assets

Within the new asset data framework, we have assessed the maturity of TTC asset data with respect to completeness and confidence (quality). Current data completeness against all critical asset data fields is 66%, although this is not equally represented across asset categories. Facilities and Systems have low levels of data maturity, whereas Fleet data maturity is relatively high. It is important to note that low levels of reported data maturity do not necessarily reflect a lack of data or a lack of understanding of the factors that the data represents. In many cases, similar or complimentary data exists, but has not yet been translated into a format that can be presented in this AMP.

7. Levels of Service

7.1 Understanding Levels of Service

TTC's Levels of Service (LOS) represent the combined needs and expectations of the travelling public, with respect to the transportation services that the TTC provides. Table 7-A below outlines a breakdown of TTC's core services, as well as service statements that outline the high-level goal or objective of the service or sub-service. Each of these sub-services has a suite of key activities, which are aligned to the LOS.

Toronto Transit Commission								
To serve the needs of transit riders by providing a safe, reliable, efficient and accessible mass public transit service through a seamless integrated network to create access to opportunity for everyone.								
	Conventional Transit					**Wheel-Trans Transit**		
	To meet the public transportation needs of all residents of and visitors to the City of Toronto					*To provide safe, reliable, courteous, and efficient specialized door-to-door transportation service for persons with the greatest need for accessible transportation*		
Subservice	**Conventional Transit Operations**	**Conventional Transit Fleet Management**	**Conventional Transit Infrastructure Management**	**Conventional Transit Fuel & Energy Management**	**Conventional Transit Management & Administration**	**Wheel-Trans Transit Operations**	**Wheel-Trans Transit Fleet Management**	**Wheel-Trans Transit Fuel & Energy Management**	**Wheel-Trans Transit Management & Administration**
Service Statement	*To operate TTC conventional transit systems and vehicles to meet the needs of Toronto's travelling public*	*To provide repair and preventive maintenance services for vehicles and equipment to support Conventional Transit operations and comply with legislative requirements*	*To provide infrastructure custodial, maintenance, and security services to support Conventional Transit Operations*	*To provide Fuel and energy to support Conventional Transit Operations*	*To provide comprehensive and integrated management, administration, and support services to Conventional Transit*	*To operate TTC wheel-Trans Vehicles to provide safe, reliable, courteous, and efficient specialized door-to-door transportation service for persons with the greatest need for accessible transportation*	*To provide repair and preventive maintenance services for vehicles and equipment to support Wheel-Trans Transit operations and comply with legislative requirements*	*To provide Fuel and energy to support Wheel-Trans Transit operations*	*To provide comprehensive and integrated management, administration, and support services to Wheel-Trans Transit*

Table 7-A – TTC Service Inventory

At the fundamental level, the LOS represent TTC's capacity to meet the expected ridership, as well as customer expectations with respect to safety, accessibility, reliability, predictability, and comfort.

In evaluating LOS expectations for customers and other stakeholders, as well as the metrics and Key Performance Indicators (KPIs) used to evaluate performance against the LOS, various other plans, strategies and other documents are considered.

The **SCE Plan** outlines the methodology for measuring service performance at the System level, Route level, and Plan level. Measuring performance is critical to ensure investments in TTC services result in the benefits envisioned for customers. For the purposes of determining LOS, the System and Route level metrics are most appropriate:

System Level

- Customer Satisfaction - Measured by overall customer satisfaction.
- Ridership - Measured by boardings.
- Service Reliability - Measured by on-time departures.
- Journey Time - Measured by travel time.

Route Level

- Productivity - Measured by boardings per revenue hour.
- Service Reliability - Measured by on-time departures.
- Crowding - Measured at the busiest stop on the route.
- Efficiency - Measured by net cost per passenger.

The TTC's **Service Standards** provide a systematic and objective means of planning, monitoring, adjusting, and evaluating conventional transit services throughout the City of Toronto.

They include network design standards and performance targets. The standards provide a mechanism for measuring the trade-offs between the benefits achieved by providing more service in one location, the inconvenience caused by removing it from another, and the costs of providing those services.

The Service Standards cover:

- Service Coverage and Access
- Surface Stop Spacing
- Span of Service and Service Levels
- Vehicle Crowding
- Service Reliability – Surface Transit
- Service Reliability – Rapid Transit
- Service Productivity
- Economic Performance
- Annual Performance Review

Levels of Service are also aligned to TTC's **Corporate Plan** and associated Corporate Strategic Directions and their associated objectives, which have been developed based on TTC's, vision, values, principles, and stakeholder expectations.

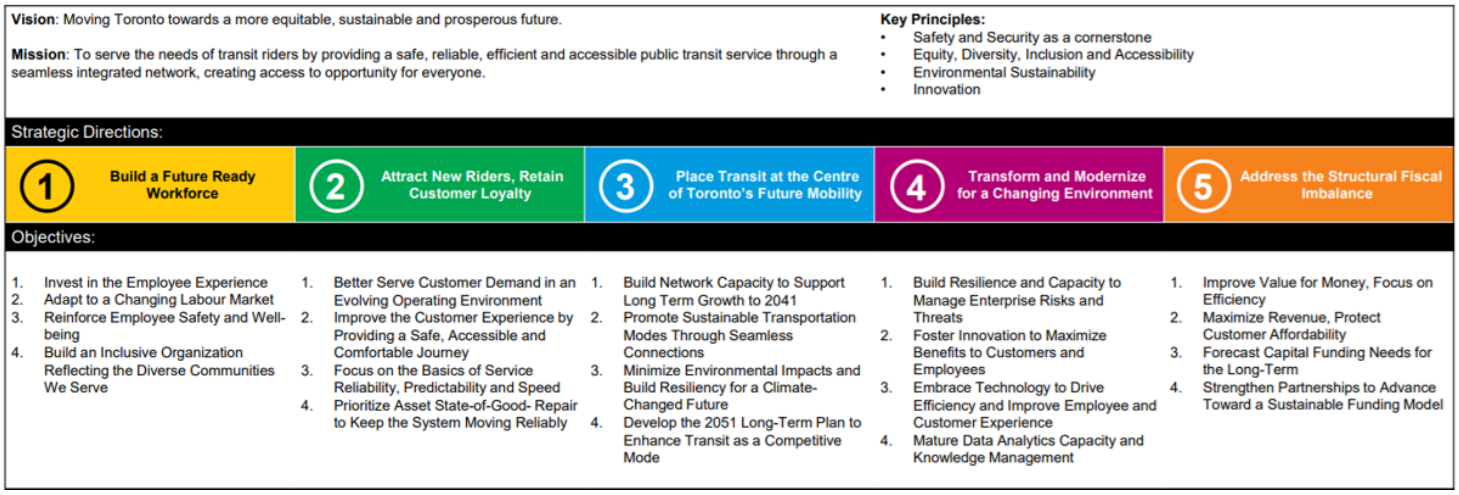


Figure 7-1: TTC's 5 Strategic Directions & Objectives

In general, most of the current asset-specific LOS are related to the second strategic direction “Attract New Riders, Retain Customer Loyalty”. This and the associated objectives speak to customer demand, the customer experience, and asset performance and condition. Additional LOS for environmental and financial stewardship are aligned with strategic directions 3 and 5, respectively.

Taking into consideration all the various inputs outlined above, the TTC has developed the following Transit LOS, from which subservice specific LOS are aligned. Future LOS are derived based on anticipated changes to these LOS, including ridership growth projections, as well as the TTC’s future development goals as outlined in the appropriate plans.

	TTC’s Transportation Services…	Example Future LOS
Transit Levels of Service	…**meet the route and ridership demands** of the travelling public.	Adjustments for expected ridership growth, new routes/services
	…**are reliable and on-time**, per the posted schedule/service plan.	Enhanced reliability targets
	…**are safe** to use and operate.	New regulations, new expected safety standards
	…**accommodate accessibility needs** of all customers.	Expectations for improved accessibility
	…meet customer expectations for **cleanliness, comfort, and convenience**.	Technology enhancements
	…are designed in such a way as to **mitigate the environmental impact and build climate resilience** of transportation in the GTA.	Electrification, green initiatives
	…are undertaken in a **cost-efficient** manner, minimizing the cost to the city for the service provided.	Efficiency improvements

Table 7-B – TTC Transit Levels of Service

Current and future customer LOS are summarized at a high-level below, with more detailed asset category and subcategory specific breakdowns in the Appendices.

For each asset category a service statement is included, which outlines the specific services that subcategory delivers in support of the TTC’s Mission. Additionally, an Asset LOS table is included, listing each of the transit LOS and aligning them with associated asset specific LOS. This table outlines how each asset category supports the overarching Transit LOS and, by extension, the strategic objectives.

At the subcategory level (or other asset portfolio level as specified), the LOS are broken down further and presented in two tables: the Current LOS table, and the Future LOS table. The Current and Future LOS tables outline more specific Levels of Service associated with the asset subcategories or classes. These tables may include both Customer and Technical LOS.

As outlined further below, current LOS being delivered by TTC assets are demonstrated through the current performance metrics and statements in the Performance column of the various Current LOS tables and summarized in the dashboards.

Proposed future LOS are demonstrated in two ways: through the targets defined in the Current LOS tables, and through the Future LOS tables.

The Current LOS tables outline the snapshot of customer and stakeholder expectations that the asset category or class is committed to meeting. It includes the following data:

Asset Category LOS: The asset focused customer LOS that aligns to the specific higher-level service focused Transit LOS (presented above). These represent how the asset category supports the achievement of the Transit LOS.

Technical LOS: A statement that identifies the technical measures that are linked to the customer's expectations from the service, related to the specific asset group. These technical LOS are typically quantitative, and express numerical measures of performance that can be evaluated and compared from year-to-year.

Performance Measure: The metric by which the performance against the LOS is measured. If appropriate a target is also included. Where specific KPIs relating to the LOS are not currently tracked, this will be listed as Not Available (N/A).

Performance: A numerical value that indicates the current performance for each performance measure during the previous calendar year. Where specific KPIs relating to the LOS are not currently tracked, a statement is included that outlines the TTC's qualitative assessment of performance against the associated LOS.

Target: As appropriate, either the numerical value that indicates the proposed LOS that TTC is taking efforts to reach, or a statement that reflects this. See Section 7.3 for additional details on LOS Target setting methodologies.

The Future LOS tables outline how the customer and stakeholder expectations for the asset category are anticipated to change over time. It includes the following data:

Asset Category LOS: The asset focused customer LOS that aligns to the specific higher-level service focused Transit LOS (presented above). These represent how the asset category supports the achievement of the Transit LOS.

Future LOS: A statement that expresses how the LOS is expected to change, based on customer feedback, growth projections, or other factors.

Action: How the TTC intends to address the changing LOS expectations. These actions are linked to lifecycle activities outlined in further sections.

Target Date: The date at which point the TTC expects to deliver on the proposed action and meet the Future LOS.

Initiative: Where applicable, this is the specific initiative within the TTC's associated planning framework that speaks further to the planned actions.

7.2 Levels of Service & Performance Summary

The following summarizes the current LOS measures established for the TTC as a whole and the associated KPIs and metrics. The Asset Category Plan documents in the appendices also contains the selected performance measures and current performances for their respective asset portfolios.

To align with the Service Summary overview in the City of Toronto's Corporate AMP, the following high-level service overview is included, underpinned by TTC's Mission, which serves as service statement. This is followed by overarching Current and Future LOS, which include aggregated data from the individual asset categories.

TTC Transit Services

"To serve the needs of transit riders by providing a safe, reliable, efficient and accessible mass public transit service through a seamless integrated network to create access to opportunity for everyone."

Customer and Technical Service Attribute Focus

"Safe, Reliable, Efficient, and Accessible"

Overall Performance

FAIR

Overall, TTC's performance against LOS targets and expectations is **Fair** (TTC assets are approaching LOS targets and expectations).

While service availability and reliability remain high, the impacts of an aging asset base and degrading asset condition is noticeable.

TTC's Transportation Services…	Performance Measure	Performance	Target
…**meet the route and ridership demands** of the travelling public.	Service Availability - Bus	114.4%	100%
	Service Availability - Subway	103.2%	100%
	Service Availability - Streetcar	101%	100%
…**are reliable and on-time**, per the posted schedule/service plan.	Percentage of TTC assets in Fair or better condition	87%	90%
	Achieve 90% On-time Performance - Bus	84%	90%
	Achieve 90% On-time Performance – Subway	92%	90%
	Achieve 90% On-time Performance - Streetcar	73%	90%
	MDBF – Bus (eBus)	21,142 km	12,000 km
	MDBF – Bus (Hybrid)	30,000 km[4]	24,000 km
	MDBF – Bus (Diesel)	20,000 km[4]	12,000 km
	MDBF – Wheel-Trans	38,662 km	20,000 km
	MDBF – Subway (TR)	640,300 km	600,000 km
	MDBF – Subway (T1)	442,000 km	330,000 km
	MDBF – Streetcar	37,518 km	35,000 km

[4] Performance metrics are capped at these values. Actual performance exceeds this cap.

TTC's Transportation Services…	Performance Measure	Performance	Target
…**are safe** to use and operate.	Customer Perception of Safety	60%	80%
…**accommodate accessibility needs** of all customers.	AODA compliance	TTC vehicles and facilities substantively meet AODA accessibility standards	100% compliance
	Elevator availability	97.8%	98%
	Customer Service Communications – Accessibility (Asset Related)	262	N/A
…meet customer expectations for **cleanliness, comfort, and convenience**.	Customer Perception of Vehicle Cleanliness	60%	80%
	Customer Perception of Stop/Station Cleanliness	60%	80%
	Escalator Availability	94%	97%
	Customer Service Communications – Information (Asset Related)	186	N/A
…are designed in such a way as to **mitigate the environmental impact and build climate resilience** of transportation in the GTA.	eBus quantity as a percentage of total fleet size (on procurement)	19.6%[5]	20% (2025 TransformTO target)
	Commissioned eBuses in service	59%[6]	80%
…are undertaken in a **cost-efficient** manner, minimizing the cost to the city for the service provided.	No current asset specific KPIs		

Table 7-C – TTC Current Level of Service Performance

7.3 Proposed Future Levels of Service & Level of Service Targets

As stated above, proposed future LOS are demonstrated through the targets defined in the Current LOS tables, as well as through the Future LOS tables. Specific projects and initiatives underway to address future levels of service are outlined in the Asset Category Plans in the Appendices, as well as in Sections 4.3 and 9 of this document.

LOS targets represent proposed LOS that are deemed reasonably achievable and represent stakeholder expectations. Targets are determined through a variety of methods, depending on the metric. In many cases the TTC strives for year-over-year improvement, and targets are set accordingly. Other targets may be set by external regulators, stakeholder requirements, or based on reasonable expectations as determined by appropriate subject matter experts. More details on the service expectations of the travelling public can be found in the **SCE Plan**.

[5] 2025 projection based on current active procurements and fleet size
[6] Takes into consideration availability due to corrective maintenance, warranty issues and part availability only.

Future LOS are also addressed through strategic action plans. Where action plans reflect changes to asset LOS, these are presented in the Asset Category Plans in the appendices. These action items are typically drawn from the **TTC Corporate Plan,** and the **SCE Plan.** More details regarding expectations and justification can be found in these documents.

7.4 Performance Framework Alignment

As the TTC matures its asset management program, it will continue to develop the performance management framework to provide a clear line of sight from the Corporate Plan through to daily activities undertaken on the network. This framework will extend beyond the asset level focus outlined above, and will support, accompany, and align with the service level performance KPIs used currently to track and monitor the service provided by the TTC as outlined in the 5-Year Service and Customer Experience Plan and Innovation and Sustainability Strategy.

This framework will enable the alignment of Corporate Objectives with:

- Asset Management Objectives.
- Wider Provincial and City Objectives.
- Climate-related objectives from the TTC's Innovation & Sustainability Strategy and from the City's TransformTO Net Zero Strategy.
- 5-Year Service and Customer Experience Plan (and the supporting documents).
- Service Level KPIs & PIs.
- Asset Level KPIs & PIs.
- 15-Year CIP.
- 10-Year Capital Budget & Plan.
- Annual Capital Budget; and
- Annual Conventional & Wheel-Trans Operating Budgets.

In developing the framework, a review of all current performance measures will be undertaken.

As per O.Reg. 588/17, current service and performance levels are based on the previous two years of data available at the time of the AMP publication.

8. Lifecycle Management Strategy

8.1 Understanding Lifecycle Management Strategies

The TTC's Lifecycle Strategy is the set of planned actions performed on assets to provide levels of service in a sustainable way, while managing risk, at the lowest lifecycle cost. Lifecycle activities detail the actions that are executed as part of the strategy and include actions to sustain current LOS and meet future LOS expectations.

The TTC plans its asset specific lifecycle management strategies to ensure that the assets are maintained in SOGR, are scaled to support growth, and are modified, enhanced, and/or upgraded to support improved service delivery, meeting the changing needs of the travelling public and other stakeholders. These activities are aligned to ensure that current and future LOS are met.

Within the Asset Category Plans in the Appendices, the following Lifecycle Management activities are considered:

Acquisition: The procurement and implementation of new assets. This could be the purchase of new transit vehicles, construction of new structures or facilities, or implementation of new systems.

Maintenance: Activities to ensure and maintain the condition of assets including inspections, replacement of wear components, and minor interventions.

Overhaul: Significant asset interventions, designed to extend life, improve performance, or add capabilities.

Decommissioning: Removal from service and/or disposal of assets that are no longer fit for service or are being phased out for other reasons. This typically occurs when the asset has reached the end of its maintainable life and/or is no longer able to meet customer expectations (LOS).

In evaluating and planning lifecycle activities, the TTC takes into consideration asset performance against all technical LOS, including asset condition, and the level of effort required to maintain SOGR. Where available, lifecycle degradation models are evaluated to predict future asset performance against current and anticipated LOS over the 10-year planning period.

The TTC will engage in non-asset related initiatives such as service and financial planning, customer research, need/requirements evaluation, and program enhancement in addition to the asset specific activities. These are captured in the lifecycle activities and are classified as non-infrastructure activities.

Within the Asset Category Plans, the lifecycle activities are presented in two tables; one representing the activities to maintain asset SOGR, and the other representing activities required to address growth and improve on the service offered.

8.2 Lifecycle Management Strategies Summary

The following tables present a generalized summary of the lifecycle activities that apply to the various asset categories and classes and outlines the format for which these tables are presented. Further details, including specific activities, expected timelines and quantities/scopes are included in the Asset Category Plans in the Appendices.

The following table provides examples of the type of lifecycle activities that are undertaken to ensure that the system SOGR is maintained.

Activity	Typical Frequency	Annualized Cost ($M)
Non-Infrastructure		
Operations, Administration, Support	As required	939.8
Maintenance		
Regular inspection, functionality testing, and servicing	Annual	551.6
Scheduled replacement of wear components	As required	
Corrections and replace-on-failure of minor components	As required	
Capitalized Acquisitions, Overhauls, & Renewals		
End of life replacements: Major systems	10-50 Years	891.1
End of life replacements: Capitalized key subcomponents	3-20 Years	
Mid-Life Overhauls	5-25 Years	
Life Extension Overhauls	10-50 Years	
Data source: Various		

Table 8-A – Lifecycle Activities Required to Maintain SOGR

The following table provides examples of lifecycle activities that are undertaken to provide improvements to service and address ridership growth and system network expansion (meet proposed future LOS).

Activity	Timeline	Program Cost ($M, current planning period)
Non-Infrastructure		
Asset-specific capitalized studies, investigations, and process improvement activities.	2025-2034	68.7
System Improvement		
Capitalized activities to improve the capabilities of TTC assets or to meet new service expectations, and which are not tied to SOGR programs.	2025-2034	1,046
Growth		
Capitalized procurements to address growth in ridership or services, and which are not tied to SOGR programs.	2025-2034	838
Data source: Various		

Table 8-B – Lifecycle Activities Required to Improve Service and Address Growth

9. Climate Change

The TTC is engaged in many projects and initiatives that are designed to adapt to or mitigate the effects of climate change. The following table provides a summary of some of these initiatives. More details can be found in the **Innovation and Sustainability Strategy**, as well as in the **TTC Corporate Plan**.

Strategy/Plan/Initiative	Description	Reference
Assess the Resiliency of TTC Assets	A key component of the TTC's Innovation and Sustainability Strategy is to undertake a comprehensive assessment of our existing assets to assess vulnerabilities, risks, and potential adaptations needed. This information will be critical to update and refine the TTC's 15-Year Capital Investment Plan.	Corporate Plan Action 3.2.2
Integrate the Toronto Green Standard (TGS) into New Asset Planning and Design	The TGS establishes sustainable design requirements for new private and City-owned developments, which includes the TTC as a City agency. The TTC has been integrating the new TGS into the planning, design and construction of new facilities and asset renewal projects. Supported by technical expertise and the TTC's Innovation and Sustainability team, the adoption of the TGS supports the TTC's efforts to build resiliency, embed sustainability approaches into our assets and mitigate environmental impacts	Corporate Plan Action 3.3.3
Launch the TTC's Innovation and Sustainability Strategy	In September 2024, the TTC Board adopted the TTC's first Innovation and Sustainability Strategy, 2024-2028 (ISS). Innovation initiatives in the ISS will enable the TTC to be more intentional in advancing innovation opportunities to mitigate existing and emerging risks and foster a culture where the TTC seeks out opportunities to improve our business. Sustainability initiatives in the ISS outline how the TTC will help drive the City of Toronto toward its TransformTO target to achieve net zero by 2040, mitigate direct and indirect emissions, and make the TTC more resilient to extreme weather events.	Corporate Plan Action 4.2.1
Maximize Avoided Green House Gas (GHG) Emissions by Ensuring Transit Ridership Grows Faster than Toronto's Population	Public transit plays a critical role in reducing city-wide GHG emissions by providing a low-emission mode of transportation compared to a personal automobile. The TTC has initiatives underway to make public transit an attractive mode of choice by ensuring our service is efficient, reliable, frequent, fast, accessible and seamless from one end of the journey to the other.	ISS Work Stream 2.1.1
Eliminate Direct GHG Emissions by Decarbonizing Our Fleets	The TTC's city bus fleet generates almost 80% of our Scope 1 and 2 GHG emissions. The TTC is committed to procuring only fossil fuel free zero-emission buses and working towards transitioning all buses, wheel-trans vehicles, and non-revenue vehicles to 100% zero-emissions by 2040.	ISS Work Stream 2.1.2

Strategy/Plan/Initiative	Description	Reference
Minimize Direct and Indirect GHG Emissions by Decarbonizing Our Facilities	In 2019, the TTC's facilities contributed to 16% of their Scope 1 GHG emissions, primarily due to natural gas used for heating. To address this, they plan to create zero-carbon transition plans for each facility by 2027, as mandated by Toronto's Municipal By-law. These plans will include: ▪ Energy efficiency programs to reduce consumption. ▪ Fuel switching for heating of buildings. ▪ Integrated design processes and deep retrofits for better efficiency and performance. ▪ A refrigerant inventory and processes for leak management and responsible disposal.	ISS Work Stream 2.1.3
Reduce Indirect GHG Emissions from Our Value Chain	The total scale of the TTC's Scope 3 emissions is currently unknown. However, there are steps being taken to better understand and reduce these emissions. Understanding Value Chain Emissions: Scope 3 Assessment: TTC will expand its GHG Inventory by conducting a Scope 3 assessment to identify and quantify value chain emissions. This will include a prioritized plan to systematically reduce these emissions. Addressing Known Sources of Value Chain Emissions: Embodied Carbon Emissions: These are significant and come from materials used in construction and repair of vehicles and facilities. TTC will require suppliers to provide environmental product declarations to quantify carbon impacts from material sourcing and production. Vendors will need to show that emissions from significant materials, like concrete, are below industry norms or comply with specified thresholds. Commuting Emissions: Scope 3 also includes emissions from customers and employees commuting to TTC locations. TTC will incentivize lower carbon transportation methods, such as active transportation, eMobility, and electric vehicles, supported by infrastructure like EV charging stations. These efforts aim to improve the understanding and reduction of TTC's Scope 3 emissions.	ISS Work Stream 2.1.4

Strategy/Plan/Initiative	Description	Reference
Use Sustainable Materials	By prioritizing sustainable materials procurement, TTC aims to drive positive change in supply chains across the industry. As a major consumer of materials for construction and maintenance, TTC will leverage its purchasing power to enhance transparency and accountability among suppliers. This involves transitioning to materials that are mined, manufactured, and transported in environmentally conscious and ethical ways. To support this, TTC will develop best practices for sustainable material selection and integrate them into procurement processes and design criteria.	ISS Work Stream 2.2.1
Improve Waste Management Practices	The City of Toronto aims to achieve zero waste by 2030 as part of its circular economy initiative. To contribute to this goal, TTC will assess and benchmark waste generation and diversion rates through audits to understand waste habits and identify reduction opportunities.	ISS Work Stream 2.2.2
Reduce Water Consumption	With fresh water becoming increasingly scarce globally, TTC is proactively managing water use by conducting a portfolio water assessment to map and benchmark consumption against industry averages. This will help understand baseline water usage and drive continuous improvement. TTC plans to implement best practices and prioritize efficiency to reduce water consumption and explore reuse opportunities.	ISS Work Stream 2.2.3
Restore Ecological Performance	The TTC aims to mitigate environmental damage by enhancing the urban forest, increasing biodiversity, and minimizing urban heat islands. This involves assessing current landscaping and integrating sustainable best practices to restore ecological performance. Measures include increasing the tree canopy, supporting biodiversity with native and pollinator-friendly species, using bird-friendly glazing, reducing light pollution, and minimizing impacts on the water cycle. TTC will review and update construction procedures to align with green construction best practices.	ISS Work Stream 2.3.1
Identify Climate Crisis Risks, Vulnerabilities, and Implement Adaptive Measures	The TTC is committed to ensuring the resilience of its transit assets against the climate crisis. This involves conducting comprehensive assessments to identify vulnerabilities and risks, starting with high-level portfolio assessments followed by asset-specific evaluations. Based on these results, TTC will develop and implement climate resilience measures in design standards and operational plans, prioritizing adaptations that enhance safety and operational resiliency during extreme weather events. These plans will be integrated into the TTC's 15-Year CIP to systematically address climate risks and safeguard the public, customers, employees, operations, and assets.	ISS Work Stream 2.4.1

Strategy/Plan/Initiative	Description	Reference
Increase Energy Resiliency	Electrical grid resilience is crucial for the safety and resilience of TTC customers, employees and stakeholders, especially with increasingly intense weather events. As TTC and the City of Toronto transition away from fossil fuels, electricity demand will rise. To address this, TTC will deploy emergency back-up generation, on-site renewable energy sources, and battery energy storage systems to reduce peak demand and increase redundancy. This approach will enhance energy resiliency during peak usage and provide backup power to essential assets, ensuring the safety and comfort of employees and customers	ISS Work Stream 2.4.2
Maximize Economic Returns	The TTC plans to actively seek 'green' grant funding from all government levels. Over the coming years, they will mature their estimates for the new capital funding needed to implement climate and resiliency actions. They will also identify projects within the existing TTC's CIP that support sustainability goals and collaborate with government partners to secure funding. If full funding isn't sourced, they will temporarily use savings and revenue from green initiatives to self-fund their Innovation and Sustainability Strategy. The goal is to maximize permanent operating budget savings post-2040 when the TTC and the City of Toronto aim to be net zero.	ISS Work Stream 2.5.1
Make Every TTC Job a Sustainable Job	Recognizing the climate crisis as a significant challenge, the TTC aims to engage its workforce, leveraging their unique perspectives and subject matter knowledge. The goal is to implement tangible, collaborative strategies that empower employees to identify sustainable solutions and integrate climate considerations into their roles, thereby harnessing the collective knowledge and capabilities to address climate crisis effectively.	ISS Work Stream 3.2.1

Table 9-A – Lifecycle Activities Required to Improve Service and Address Growth

10. State of Good Repair Performance & Investment Needs

10.1 Understanding State of Good Repair Needs & Forecasting

To understand the costs associated with maintaining SOGR and meeting the current and future LOS, a forecasting analysis of asset lifecycle needs was undertaken. Where available, lifecycle degradation models are evaluated to predict future asset performance against current and anticipated LOS over the 10-year planning period. These models are driven by the identified asset LOS.

For the purposes of this document, lifecycle SOGR activity cost models are presented as an annualized average evergreen cost to sustain the asset. Growth, system improvement and capitalized non-infrastructure activities within the planning period are presented in term of total project value within the 10-year planning period. Further details on these can be found in the CIP.

Where lifecycle models are not yet in place, the TTC will estimate annual lifecycle SOGR investment needs based on a percentage of total replacement value.

In determining the investments required to address the condition gap, the annualized evergreen renewal costs were updated to include an estimation of the investment required to bring the average condition of assets to fair or better across the asset base, through partial asset replacements. This methodology assumes, where it is practical and applicable, that partial assets rehabilitation is possible.

The results of these forecasts are included in the financial analysis below. As the TTC's EAM program continues to mature, these analyses will be expanded to include more robust asset lifecycle models to present a more fulsome picture of asset lifecycle investment needs.

11. Financial Summary

11.1 Introduction

The TTC is one of the most visible and vital public service organizations in North America. It has a large, complex, and diverse range of infrastructure assets that the City of Toronto relies on to ensure that the transportation needs of the travelling public are met safely, reliably, efficiently, and sustainably.

To date, the TTC has also suffered from the same challenges as other infrastructure operators, as costs increase exponentially and supply chains dwindle, particularly in response to the recent pandemic. As such infrastructure investment have not kept up with the SOGR requirements, resulting in a deteriorating asset base and decreased LOS, despite a steady increase in demand (notwithstanding the disruption caused by COVID-19).

This AMP, along with the TTC EAM program in general, seeks to improve the visibility of the impacts of capital funding on LOS, supporting better asset lifecycle decision making and optimizing the return on investment. The investment required to achieve the proposed LOS are presented and compare with existing approved funding to highlight the gap, and any risks associated with underfunding.

11.2 Disclaimer

Note that there are several factors that can contribute to uncertainty or misalignment in the financial data presented herein, particularly when comparing the SOGR and investment needs forecast with the current CIP and Operating budgets.

- The lifecycle activity requirements to meet current and future LOS presented herein have been developed using a lifecycle focussed approach, separate from the current needs-based approach used in the existing capital budgeting process.
- For certain asset classes, the asset ownership/responsibility is not necessarily aligned to the asset functional hierarchy. As a result, the renewal costs those asset classes may be obscured or spread across different service areas.
- Many lifecycle activities serve several purposes: ensuring SOGR, improving on service delivery and addressing growth. As such, alignment between these activities and SOGR/SI/Growth budget totals is difficult.
- Current data quality and completeness is low, introducing uncertainty to all estimates and forecasts.
- Future costs beyond 2026 are escalated at 3% year over year unless drawn from specific sources that use alternative program specific escalation factors.

As the TTC further matures its EAM program and develops more robust methods of financial data gathering and analysis, it will be better able to align planned budget data to asset data to delineate and quantify true lifecycle renewal costs and infrastructure gaps.

11.3 Full Lifecycle Investment Forecasts

The results of the SOGR (renewal) forecasts are compared against the budget forecast, which is obtained from the **TTC's 2025 Operating Budget; 2025-2034 Capital Budget and Plan and 15-Year Capital Investment Plan and Real Estate Investment Plan Update** and are reflected in a summary table and figure.

The summary table lists the required annual expenditures to support sustainment of the asset condition and performance through the various lifecycle activity classes outlined above. Also included are the results of the

analyses of the investments required to address assets in poor or very poor condition. These are compared to the current planned budget to identify the average annual infrastructure gap (total investments) and SOGR gap (maintenance and renewals only) for both scenarios. Note that similar summaries broken down by asset categories are also provided the appendices.

The following figures and table illustrate the full lifecycle investment forecasts for all TTC assets. The figures include bar charts which show the year-by-year budgeted funding by activity type compared to the total overall funding required to maintain SOGR and deliver on selected service enhancement and growth projects, and to address the condition gap. The first chart shows the investment to maintain SOGR only (maintenance and renewals). The second chart show the totals, including non-infrastructure costs (operations and administrative costs and projects) as well as service improvement and growth costs. In these charts, the investment gap is indicated by the discrepancy between the bar height (budgeted funding levels) and the lines (required funding levels).

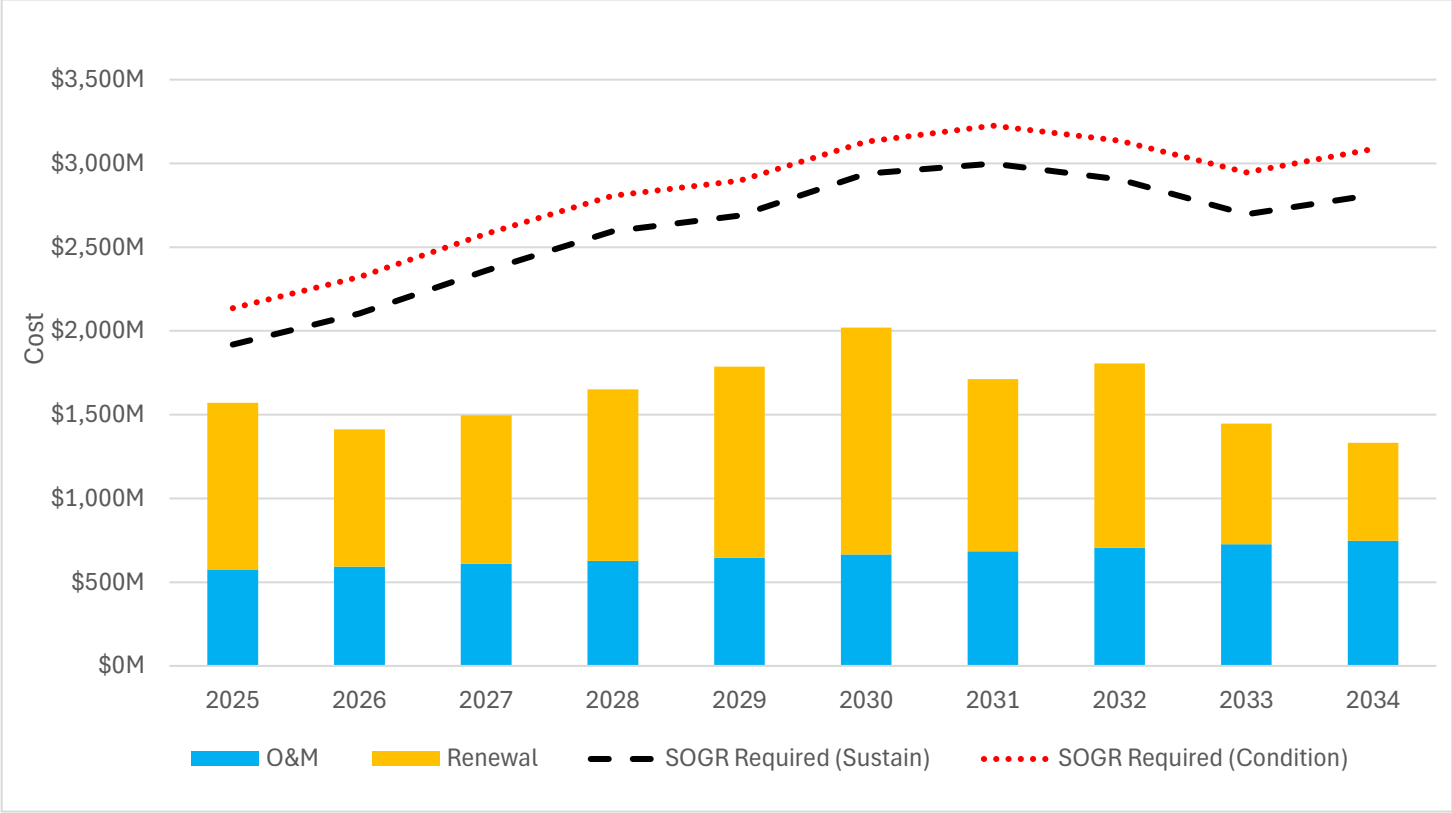


Figure 11-1: Funding vs Assessed Program Requirements – All TTC Assets (SOGR only)

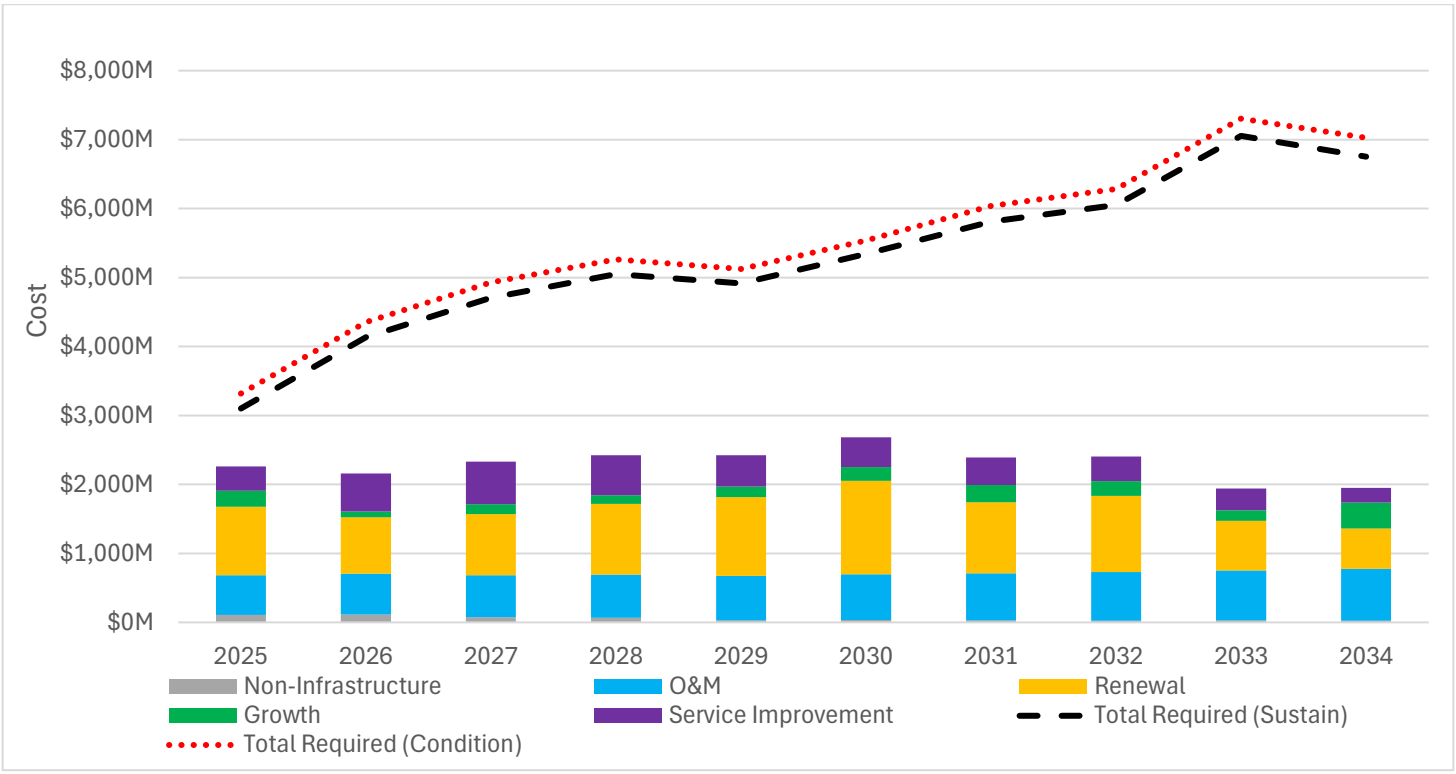


Figure 11-2: Funding vs Assessed Program Requirements – All TTC Assets

The following table summarizes the average annualized values from the figures above.

Lifecyle Activity	Planned Budget ($K)	Investment Needed to Sustain LOS ($K)	Investment Needed to Address Condition Gap ($K)
Non-Infrastructure	$53,181	$72,818	$72,818
Maintenance	$657,954	$763,416	$763,416
Renewals	$965,350	$1,837,879	$2,062,894
Growth	$192,767	$1,210,239	$1,210,239
Service Improvement	$427,342	$1,408,522	$1,408,522
Total Expenditure	$2,296,595	$5,292,874	$5,517,889
Average annual SOGR Gap		$977,991	$1,203,006
Average annual Infrastructure Gap		$2,996,279	$3,221,294

Table 11-A – Annualized Funding vs Assessed Program Requirements – All TTC Assets

The SOGR Gap identified herein is the result of a bottom-up analysis of lifecycle needs, adjusted for asset condition, while the SOGR backlog reported through the CIP represents the total of unfunded Capital projects during the planning period. As such, there is a discrepancy between these values. As TTC's asset management processes continue to evolve and mature, these numbers are ultimately expected to converge.

11.4 Risks

One of the key purposes of this AMP is to provide perspective on the relationships between investment needs, planned investments, LOS, and risks. This section provides a high-level overview of key risks related to this AMP and the results of the analyses herein. Asset category specific risks are presented in the individual Asset Category Plan documents in the appendices.

More details on AM program risks can be found in the TTC **Asset Management Strategy** document.

11.4.1 Risks Associated with Data Maturity

The asset management and forecasting analyses presented herein are dependent on the quality and completeness of available asset information and data, which includes asset inventory data. As part of the AMP development process, TTC has assessed the asset data completeness levels, as well as quality, in the form of replacement cost and condition rating confidence levels. Areas with low data confidence and completeness levels may include datasets that are incomplete, out of date, or have low reliability. The results of the AMP are dependent on the maturity level of the data that is used to support them.

Furthermore, asset data was paired to financial data to analyse the relationship between asset performance, costs, and planned budgets. The exercise of aligning budget data to asset data for the purposes of this analysis is complex, as asset-level inventory data does not often align directly to project-level budget data.

As part of the TTC's ongoing EAM improvement program, efforts are underway to further develop asset data governance processes and drive further alignment between AM and financial datasets. The TTC is committed to continue to update, maintain and improve its asset data, to provide a greater level of confidence to the analyses that will be completed for future iterations of this AMP.

11.4.2 Risks Associated with Lifecycle Strategies and Available Funding

This AMP was focused on identifying costs to support LOS expectations and compare those costs to planned budgets. As outlined above in Table 1-A, the analysis indicates that planned budgets are not sufficient to deliver SOGR, address degrading asset conditions, and to deliver on expected growth and service improvement expectations.

The asset management analyses that completed to understand these costs were completed for a 10-year forecast horizon and take into account current asset condition, age and expected service life. As infrastructure continues to age, if budgets are unable to keep up with new investment needs (as well as current backlogs), the condition and performance of TTC's assets will continue to degrade, negatively impacting reliability and availability of service.

Assets that are not able to maintain LOS targets are likely to experience a reduction in service levels over the analysis period. They may potentially experience more frequent asset failures, asset closures, or lapses in the delivery of services as a result. Assets that are not maintained in SOGR may also experience increased levels of maintenance or intervention to ensure that they remain in service, which could have impacts to the maintenance and operating costs. More details on risks associated with underinvestment for specific asset type can be found in the associated Asset Category Plan documents in the appendices.

The TTC has developed a series of asset class strategies that seek to mitigate the impacts of current identified risks for related asset portfolios. These are outlined in the TTC's **Asset Management Strategy** document.

11.4.3 Risks from External Influences & Constraints

Risks Due to Economic Factors

The economic climate in which the TTC operates has changed dramatically in in recent years, particularly in the wake of COVID-19. This combined with the current degree of economic and supply chain uncertainty has negatively impacted the TTC's ability to plan and execute lifecycle activities efficiently. Particularly, recent bouts of high inflation have elevated procurement and construction costs associated with investment in infrastructure and addressing SOGR needs. These factors may result in an increase in the overall financial impact of maintaining and replacing infrastructure, as well as constructing and procuring new assets.

Risks Due to External Constraints

Irrespective of the availability of funding, the TTC faces significant constraints in delivering the necessary infrastructure lifecycle activities. These constraints include limited access windows for performing maintenance and upgrades, which are often restricted to non-operational hours to minimize service disruptions, as well as complexities in coordinating activities with other City of Toronto service areas, projects, and initiatives. Additionally, the onboarding and training of new staff required to execute these activities can be time-consuming, further delaying project timelines.

Risks Due to Climate Change

Climate change also poses a significant risk to TTC infrastructure. The increased frequency of severe weather events has the potential to increase risk of service-affecting failures and accelerate asset degradation. Refer to Sections 3.6 and 9 for initiatives the TTC undertakes to mitigate the effects of climate change.

12. Improvement Plan

The publication of O.Reg. 588/17 in 2017 reflected the province's commitment to guide investments in municipal infrastructure and to facilitate asset management best practices throughout the municipal sector, providing a degree of consistency to Asset Management Plans, and leveraging Asset Management Planning to optimize infrastructure investment decisions.

Effective asset management ensures that an organization's assets are managed in a way that balances the achievement of the required level of performance while managing risk and reducing whole-life cost. It involves the development of strategies and plans aligned to an organization's corporate objectives that are based on lifecycle decision-making.

The province has encouraged municipalities to consider compliance with the regulation as a starting point, and this is reflected in the TTC's aim to go beyond regulatory compliance and improve its asset management maturity by fully aligning with transit asset management best practice.

The TTC has initiated an EAM program to achieve an increased maturity across the entire organization. The program has identified a series of workstreams to be delivered, which will focus on improving capability in key asset management areas, such as governance, planning and decision-making, lifecycle delivery, asset information, people, and risk management.

Implementing and embedding the level of change required across the TTC to achieve AM maturity is a long-term process, but value can be driven from outcomes along the way. The following figure shows the planned organizational maturity journey through 2030 and beyond.

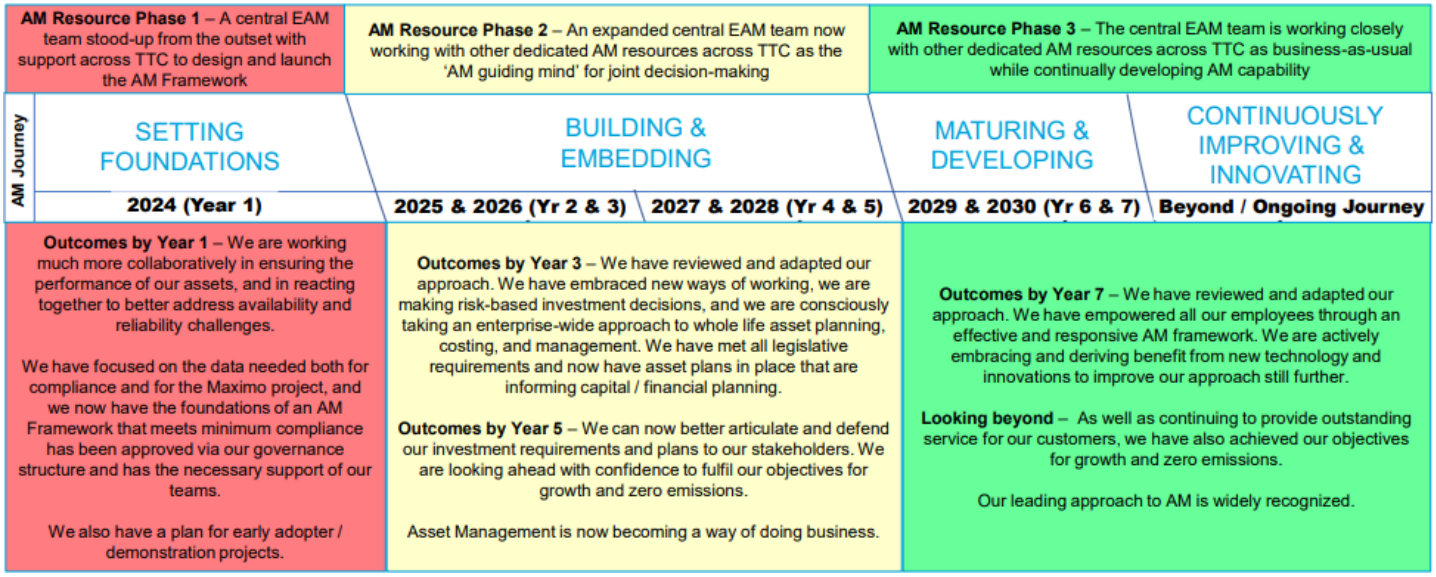


Figure 12-1: TTC's EAM Program Planned Organizational Maturity Roadmap

More details on the EAM Program roadmap and benefits can be found in the TTC **Asset Management Strategy** document.

ASSET MANAGEMENT PLAN 2025

APPENDIX A: Fleet Asset Category Plan

Toronto Transit Commission

Contents

LIST OF TABLES

LIST OF FIGURES

1. Asset Category Overview - Fleet

1.1 Introduction

The TTC vehicle fleet includes revenue vehicles and support (non-revenue) vehicles, as well as historic or heritage vehicles and industrial equipment.

Revenue vehicles owned and maintained by the TTC move passengers in the Greater Toronto Area (GTA). The TTC own over 3,500 revenue fleet assets, comprising of accessible buses, Wheel-Trans accessible vehicles, accessible streetcars, and accessible subway trains. However, the asset inventory changes regularly as new assets are commissioned and older assets are decommissioned at their end of life. All TTC revenue vehicles are accessible.

The TTC also owns and maintains a fleet of 20 special event buses, nine heritage vehicles, 736 support vehicles/equipment including both surface vehicles and rail work cars used by its employees to undertake inspection and maintenance activities across the network, and over 12,000 small and large industrial equipment used for vehicle maintenance and repair.

Service Statement

> *"TTC Revenue fleet assets provide safe, reliable, clean, accessible and reliable transit and para-transit vehicles for daily service to support the movement of residents and visitors around the Greater Toronto Area (GTA).*
>
> *TTC non-revenue and equipment fleet assets support transit services through providing repair and preventive maintenance services for vehicles and equipment to support Conventional Transit and Wheel-Trans operations and comply with legislative requirements."*

Asset Breakdown

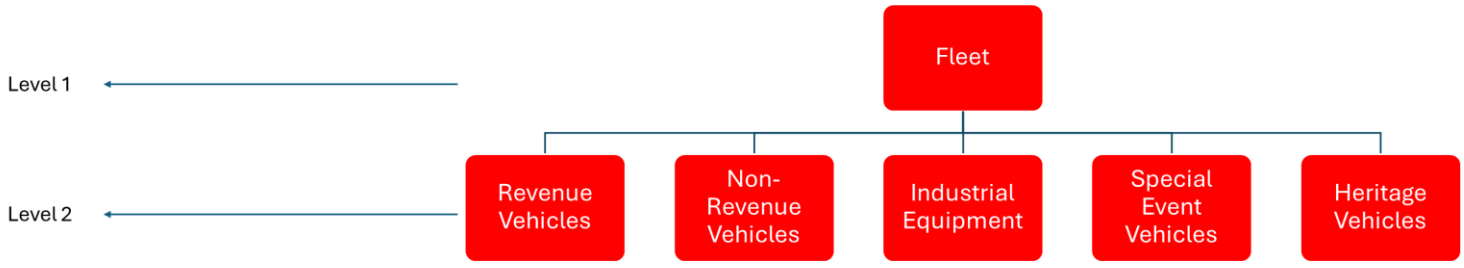


Figure 1-1: Asset Hierarchy - Fleet

1.2 State of Infrastructure

The following figure outlines a high-level overview of the state of TTC Fleet assets:

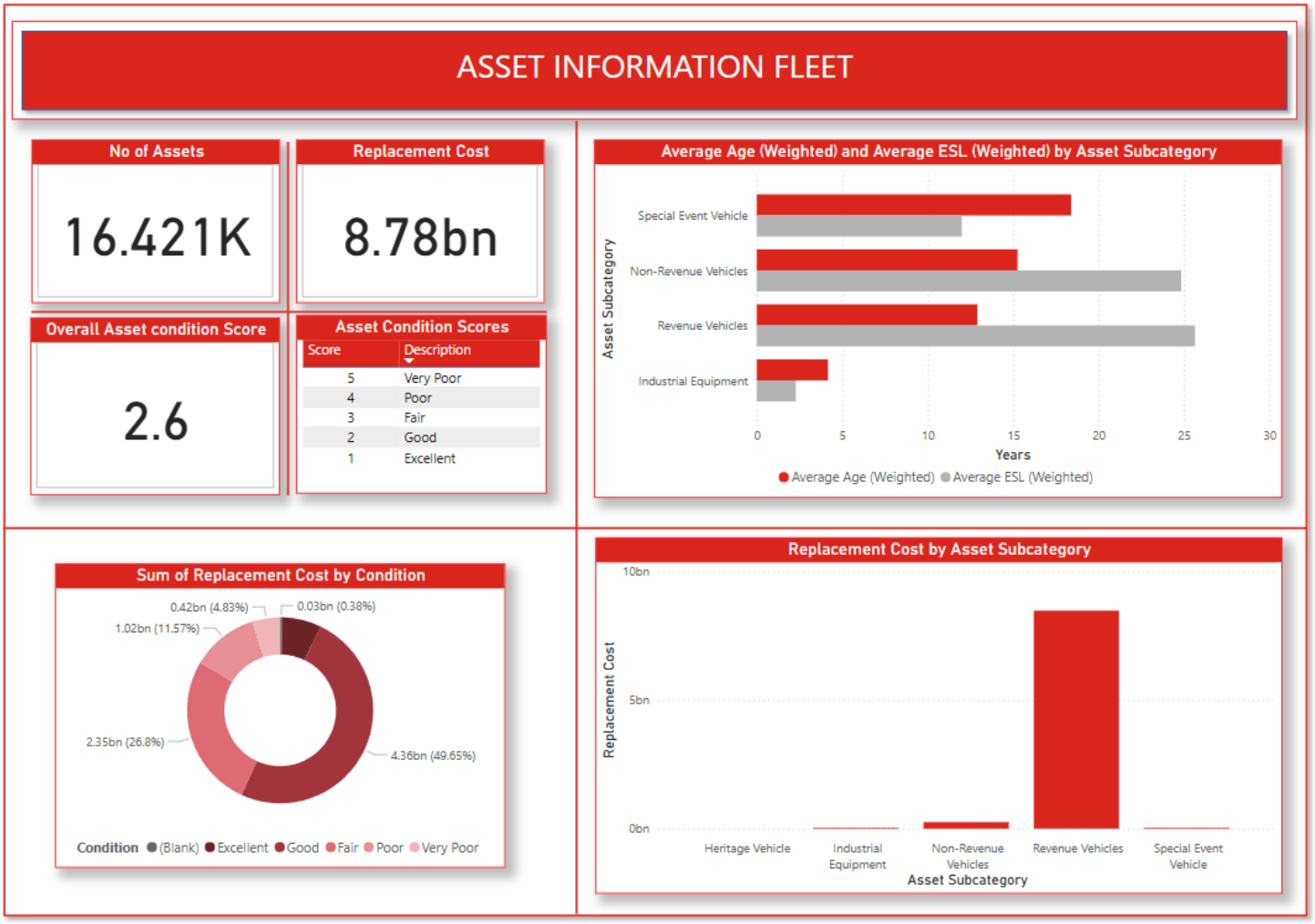


Figure 1-2: State of TTC Infrastructure Summary Dashboard - Fleet

The current state of data quality/maturity among TTC Fleet assets is outlined in the following figure:

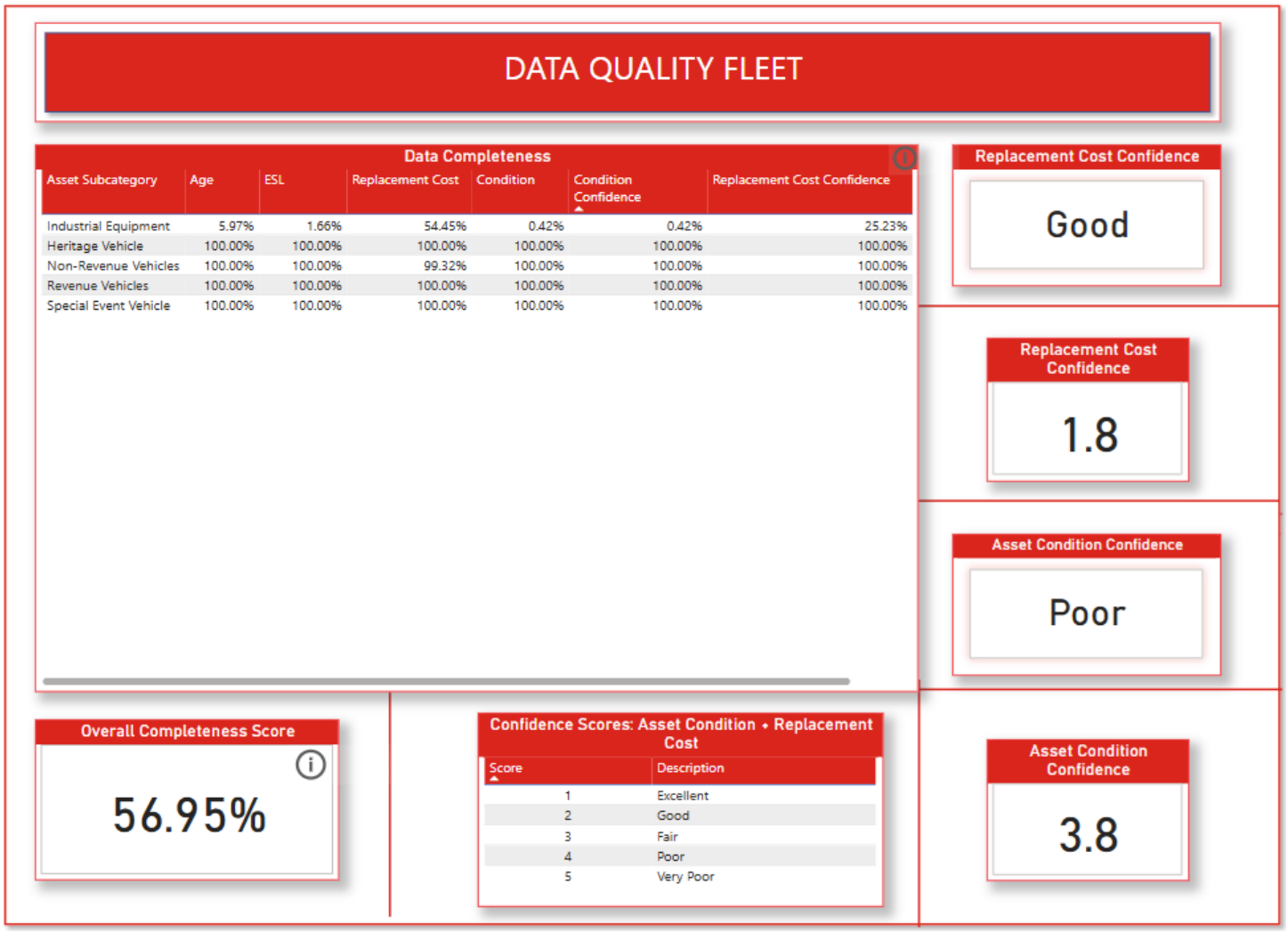


Figure 1-3: State of TTC Asset Data Summary Dashboard - Fleet

In general, data for fleet assets is relatively mature, particularly for revenue fleet vehicles. The low overall completeness score (57%) is influenced disproportionately by a lack of data on a large number of low value industrial equipment assets. As the TTC's Enterprise Asset Management (EAM) transformation project progresses, efforts will be made to improve data quality and address these gaps, while simultaneously developing and embedding the processes to keep data up to date.

1.3 Asset Levels of Service

The following table outlines how the TTC fleet assets support the overarching Transit Levels of Service (LOS):

TTC's Transportation Services…	TTC's Fleet Assets
…**meet the route and ridership demands** of the travelling public.	Sufficient serviceable fleet vehicles are available to ensure required service frequency and headways, to meet route and ridership demand, in line with TTC's fleet plan.
	Sufficient serviceable non-revenue fleet vehicles are available to ensure capacity meets infrastructure maintenance demand.
…**are reliable and on-time**, per the posted schedule/service plan.	All revenue fleet, maintenance fleet and equipment deliver services on-time, per posted schedule.
	All revenue fleet, maintenance fleet and equipment are appropriate, sufficient and maintained in a SOGR such that service affecting failures are minimized.
…**are safe to use**.	Revenue fleet vehicles are sufficient and effective to minimize system safety risks to the travelling public and community, in accordance with the relevant legislation and TTC safety policies.
	Service vehicles and equipment are inspected and maintained regularly to ensure they meet required regulatory and safety standards.
…**accommodate accessibility needs** of all customers.	Revenue fleet vehicles meet the need for the travelling public for accessibility needs.
…meet customer expectations for **cleanliness, comfort, and convenience**.	Revenue fleet vehicles to meet customer expectations for cleanliness, comfort and convenience.
…are designed in such a way as to **mitigate the environmental impact and build climate resilience** of transportation in the GTA.	TTC will transition to zero emissions fleet vehicles as soon as practicable, in line with TTC's Green Fleet targets.
	Fleet vehicles are maintained to ensure fleet runs efficiently to mitigate the environmental impact and build climate resilience within the GTA.
…are undertaken in a **cost-efficient** manner, minimizing the cost to the city for the service provided.	All fleet assets are managed to ensure that cost/value optimization is considered in the planning and execution of all lifecycle activities.

Table 1-A – TTC Asset Levels of Service - Fleet

2. Buses (Revenue)

2.1 Introduction

Through the operation of an extensive bus fleet made up of 60’ articulated buses and 40’ conventional buses, the TTC can ensure a wide coverage of the metropolitan area and access to opportunities, amenities, and other modes of transport. The revenue bus fleet consists of more than 2,100 buses operating out of eight bus garages. The bus fleet is a mix of diesel, hybrid, and electric vehicles and services over 160 regular and 27 overnight routes. In addition to regular bus service, TTC buses are also used for shuttle services to support streetcar and subway disruptions.

Service Statement

“TTC Revenue Buses support overall transit services by enable the reliable, safe and efficient movement of TTC customers using the street network within the Greater Toronto Area (GTA).”

Asset Breakdown

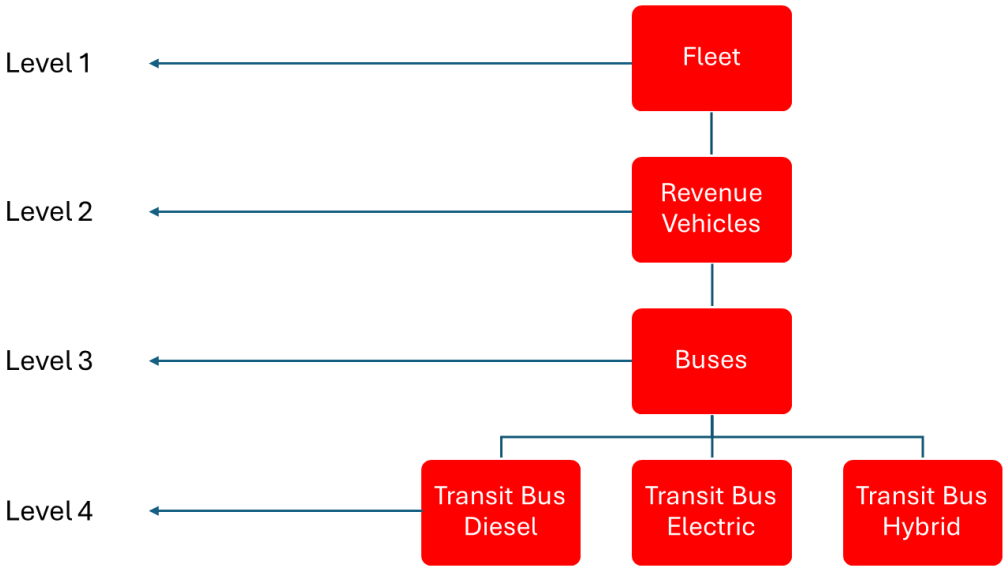


Figure 2-1: Asset Hierarchy – Revenue Buses

2.2 State of Infrastructure

The following figure outlines a high-level overview of the state of TTC Revenue Bus assets:

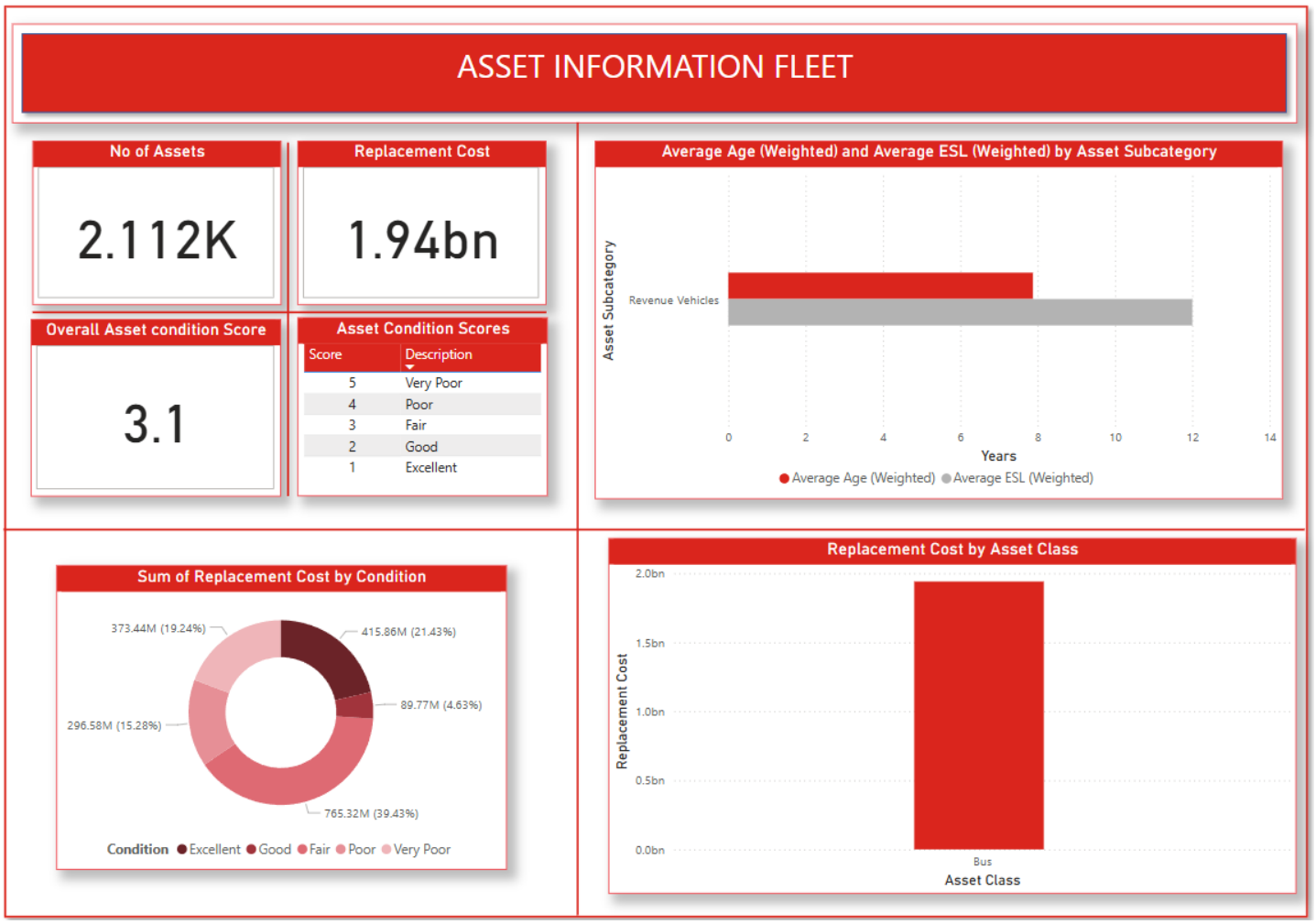


Figure 2-2: State of TTC Infrastructure Summary Dashboard – Revenue Buses

Asset Summary

Type	Sub-Asset Class	Quantity[7]	Replacement Value ($M)	Average Condition	Average age (years)	ESL (years)
Buses (Revenue Vehicles)	Transit Bus Diesel	1213	937.7	3.6	9	12
	Transit Bus Electric	89	145.2	1.9	4	12
	Transit Bus Hybrid	810	858.1	2.6	7	12

Data Source(s): TTC Transportation and Vehicles Group

Table 2-A – Asset Summary – Revenue Buses

Condition Assessment

At present, age is the only factor that TTC considers when making decisions on the replacement of revenue buses. Therefore, asset age has been utilized as the only factor in determining revenue bus condition score. Which is assigned based on the following criteria:

4. **Excellent** – asset is in its first quarter of its designed service life (0-3 years)
5. **Good** – asset is in its 2nd quarter of its designed service life (4-6 years)
6. **Fair** – asset is in its 3rd quarter of its designed service life (7-9 years)
7. **Poor** – asset is in its last quarter of its designed service life (10-12 years)
8. **Very Poor** – asset has passed its designed service life (>12 years)

As the TTC continues to mature its asset management program, condition assessment methodologies will be refined to reflect a more complete understating of asset state and to increase data confidence.

2.3 Levels of Service

Levels of Service (LOS) for Revenue Bus assets have been assessed in line with the overarching LOS framework presented in the main AMP document. Proposed LOS are encapsulated in the performance targets, as well as the initiatives outlined in the Future LOS table. The TTC believes that these proposed LOS are reasonably achievable given the available funding. Further details on risks and funding requirements are outlined in subsequent sections.

Where asset performance falls below targets, the TTC will undertake action to address. In many cases this includes accelerated SOGR programs or modified maintenance activities. Additional details can be found in the asset class strategy summaries in the **TTC Asset Management Strategy** document.

Performance Summary

Overall, Revenue Bus assets are approaching LOS targets and expectations.

While operational performance is good, there are risks associated with an aging asset base and poor condition scores.

[7] The quantity of revenue buses fluctuates on a regular basis. The data presented herein represents a snapshot in September 2024.

Current Levels of Service

Asset Category Customer Level of Service	Subcategory Technical Level of Service	Performance Measure	Performance	Target
Sufficient serviceable fleet vehicles are available to ensure required service frequency and headways, to meet route and ridership demand, in line with TTC's fleet plan	The number of revenue buses equals or exceeds the Fleet Plan	Bus Quantity	2112 buses	2044 buses
	Sufficient serviceable buses are available to deliver peak service	Bus Availability	114.4%	100% of Daily Peak Service
Revenue fleet, maintenance fleet and equipment deliver services on-time, per posted schedule	Bus services are on-time (depart end terminals within -1 to +5 minutes of scheduled departure time	On-time performance[8]	84%	90%
	Buses complete their assigned routes	Road calls and change offs[8]	21	< 24
Revenue fleet, maintenance fleet and equipment are appropriate, sufficient and maintained in a SOGR such that service affecting failures are minimized.	In service bus fleet is maintained in a SOGR. Maintenance programs are effective.	Assets in fair or better condition (value weighted average %)	65%	80%
		MDBF - eBus	22,143 km	12,000 km
		MDBF - Hybrid	> 30,000 km[9]	24,000 km
		MDBF - Diesel	> 20,000 km[9]	12,000 km
Revenue fleet vehicles are sufficient and effective to minimize system safety risks to the travelling public and community, in accordance with the relevant legislation and TTC safety policies.	All in-service buses meet Highway Traffic Act requirements and have undergone required safety inspections	Safety Inspection Compliance	All released buses comply with safety inspection requirements	N/A
Revenue fleet vehicles meet the need for the travelling public for accessibility needs.	All buses meet the AODA transportation standard	AODA audits	All buses are audited against AODA standards. 0 non-conformalities	0 non-conformalities
Revenue fleet vehicles meet customer expectations for cleanliness comfort and convenience.	Buses meet cleanliness audit standards	Bus Cleanliness (Customer Perception)	94%	90%
TTC will transition to zero emissions fleet vehicles as soon as practicable, in line with TTC's Green Fleet targets.	Bus fleet procurements are in line with green fleet plan requirements.	eBus Quantity as a percentage of total fleet size (on procurement)	19.6%[10]	19.6% (2025 TransformTO target)
	eBus operational performance	eBus Average Availability	59%[11]	80%

Table 2-B – Current Levels of Service – Revenue Buses

Future Levels of Service

[8] Metrics include operations (non-asset) issues
[9] Performance metrics are capped at these values. Actual performance exceeds this cap.
[10] 2025 projection based on current active procurements and fleet size
[11] Takes into consideration availability due to corrective maintenance, warranty issues and part availability only.

Asset Category Customer Level of Service	Asset Future Level of Service	Actions	Target Date	Initiative
Sufficient serviceable revenue fleet vehicles are available to ensure capacity meets route and ridership demand, in line with TTC's fleet plan.	Increase service to address demand	Every year, the TTC will look at all active developments near completion as part of the Annual Service Plan process to understand where additional services may be required to meet demand. Each six-week period, we will review and adjust service to accommodate customer demand.	Annually	SCE Plan Action 2.1
	Implement new services to address travel patterns	Modification and enhancement of existing routes to match changing travel patterns, plus the implementation of new routes on the street network.	Annually (as part of service plan process)	SCE Plan Action 2.2
	Restore the Express Bus system	Restore frequency and periods of operation on existing express corridors where service levels may have changed due to the pandemic.	2026	SCE Plan Action 2.6
	Expand capacity and reach of the Express Bus system	Explore modifications to Express Bus Service Standards, new express corridors and span of service on existing corridors.	2025*	SCE Plan Action 2.6
	Reduce overcrowding	Increase capacity on corridors where the currently approved service levels are not met based on crowding standards	2026	SCE Plan Action 2.6
	Expand early morning Sunday service	Explore starting Sunday service early on ~60 bus routes	2028	SCE Plan Action 2.6
	Expand the frequent network	Review opportunities to expand the frequent (10 minute) network and increase the population's access to important destinations within the city.	2028	SCE Plan Action 2.6
	Enhance the overnight network	Explore revising the minimum service level from 30 minutes to 20 minutes.	2028	SCE Plan Action 2.6
		Review opportunities to expand the number of routes in the overnight network	2028	SCE Plan Action 2.6
	Implement a 15-minute network	To design the Blue Night network so that 95% of the City's population is within a 15-minute walk of the overnight bus service.	2028	SCE Plan Action 2.6
	Enhance service equity	Collaborate with City of Toronto to refine and adopt new measures of transportation equity across all neighbourhoods, with an emphasis on transportation disadvantage and built environment factors.	2028	SCE Plan Action 2.7
	Modify Service Plan to accommodate growth	As part of the Annual Service Planning process, review active developments and adjust plan accordingly	Annually	SCE Plan Action 2.1
Sufficient serviceable revenue fleet vehicles are available to ensure capacity meets route and ridership demand, in line with TTC's fleet plan.	Increase planned in-service fleet to meet projected demand	Procure 100 additional buses (in addition to maintenance replacements)	2028	SCE Plan

Asset Category Customer Level of Service	Asset Future Level of Service	Actions	Target Date	Initiative
TTC fleet assets deliver services on-time, per posted schedule.	Improve service reliability	Review transit schedules and conduct a review of service reliability performance measures to ensure they are customer focused.	2028	SCE Plan Action 3.1
Sufficient serviceable revenue fleet vehicles are available to ensure capacity meets route and ridership demand, in line with TTC's fleet plan.	Mitigate the impact of planned and unplanned service disruptions	Increase availability of buses to minimize the effects of service disruptions on customer journeys	2028	SCE Action Plan 3.2
TTC Fleet assets allow for the appropriate and effective communications with the travelling public	Provide customers with accurate, accessible and timely information	Upgrade the next vehicle arrival data feed to provide better live and accurate information to customers		SCE Action Plan 7.3
		Enhance public announcement system clarity to ensure customers receive clear and understandable announcements during their journeys		SCE Action Plan 7.3
Revenue fleet vehicles are sufficient and effective to minimize system safety risks to the travelling public and community, in accordance with the relevant legislation and TTC safety policies.	Improve operator safety and enhance customer experience on the bus network	Successfully scope and implement the Bus Design Innovation Program that aims to reimagine bus design for operator safety and to enhance customer experience	2028	Innovation & Sustainability Strategy Action 1.2.1
TTC will transition to zero emissions fleet vehicles as soon as practicable, in line with TTC's Green Fleet targets.	Bus fleet is made up of 50% electric buses	Procure additional electric buses to meet Green Fleet targets	2030	Innovation & Sustainability Strategy Action 2.1.2
	Bus fleet is made of 100% electric buses	Procure additional electric buses to meet Green Fleet targets	2040	Innovation & Sustainability Strategy Action 2.1.2
Revenue fleet vehicles meet the need for the travelling public for accessibility needs.	Make all buses and bus stops accessible, where possible	Continue to work with ACAT and bus manufacturers to refine bus designs to further enhance accessibility.	2028	Multi-year Accessibility Plan Action 5,2,2,1

Table 2-C – Future Level of Service Initiatives – Revenue Buses

2.4 Lifecycle Management Activities

The lifecycle activities of the Revenue Bus assets vary according to the bus type, but typically include regular cleaning and inspection, replacement of wear components, replacement-on-failure of various components and a mid-life major overhaul. End of life activities involve decommissioning and procurement of new busses.

The following table outlines the assessed lifecycle activities required to maintain SOGR of Revenue Buses:

Activity	**Frequency**	**Annualized Cost** ($K)
Non-Infrastructure		
Administrative overhead, process continuous improvement	As required	
Maintenance[12]		
Regular inspection, functionality testing, and servicing	Annual	$193,039
Scheduled replacement of wear components	As required	
Corrections and replace-on-failure of minor components	As required	
Capitalized Overhauls & Renewals		
Bus Midlife Overhaul[13]	6 Year	$39,309
Replace at end of life: Revenue Buses[14]	12 Year	$338,259
Data source: TTC T&V Group – Bus Maintenance & Shops, TTC Capital Investment Plan		

Table 2-D – Lifecycle SOGR Activities – Revenue Buses

The following table provides examples of lifecycle activities that are undertaken to provide improvements to service and address ridership growth and system network expansion (meet proposed future LOS).

Activity	**Timeline**	**Program Cost** ($K, current planning period)
Non-Infrastructure		
No Revenue Bus Non-Infrastructure programs currently underway		
System Improvement		
Bus Barriers	2017-2027	$680
New Transit Supportive Technology Program	2024-2034	$27,623
Bus Design Innovation Program	2021-2034	$20,807
Growth		
Bus procurement to increase fleet size[15]	2025-2034	$152,312
Data source: TTC O&I Group – SEC, TTC Capital Investment Plan		

Table 2-E – Current & Planned Lifecycle Activities to Improve Service and Address Growth – Communications Systems

[12] Maintenance costs include the heritage and special event bus fleet
[13] Assumes Diesel bus overhaul. Hybrid and eBus overhaul values not yet determined
[14] Assumes eBus replacement in line with Green Fleet Plan
[15] Assumes increase in bus fleet by 800 vehicles over 10 years (37.5%)

2.5 Climate Change

The Innovation and Sustainability strategy outlines the plan to mitigate against the impacts of climate change. Pillar 2 of this plan focuses on environmental sustainability.

There is one specific bus initiative within this plan – Eliminate Direct GHG Emissions by Decarbonising our Fleets (scope 1) (action 2.1.2). There is a specific requirement to increase the provision of electric buses to 20% by 2025, 50% by 2030 and 100% by 2040, as articulated in the current and future LOS.

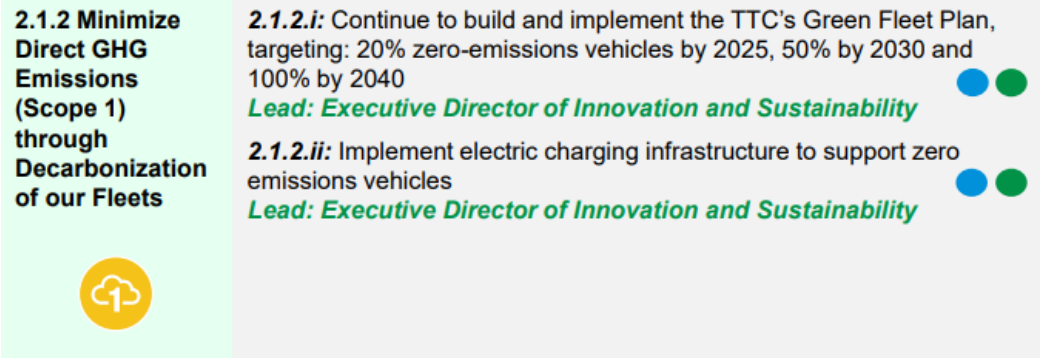


Figure 2-3: Action 2.1.2 Innovation and Sustainability strategy – Minimising Direct GHG emissions (scope 1) through decarbonisation of our fleets.

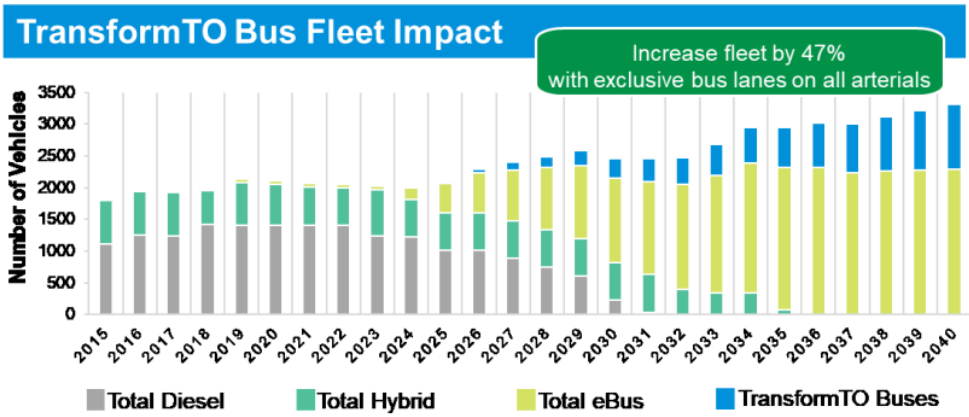


Figure 2-44: Action 2.1 Innovation and Sustainability strategy – Current bus fleet plan with the additional buses that would be required to for the TransformTO bus frequency improvement

The TTC has committed to purchasing solely accessible, low-floor, all-electric buses for all future orders to meet the Green Fleet targets. These buses offer customers an accessible ride that is quieter and reduces air pollution. Charging infrastructure will be installed ahead of bus deliveries to ensure buses are available for service.

The TTC is committed to ensuring the resilience of transit assets and will be conducting a comprehensive assessment to identify vulnerabilities and risks to critical transit assets.

2.6 Lifecycle Investment Forecasts

At the current stage of asset management maturity, lifecycle investment needs are evaluated as the annualized cost to maintain SOGR, as outlined above. Estimates have also been made for the investment required to bring all assets to “Fair” or better condition over the planning period.

The following figures and table illustrate the full lifecycle investment forecasts for revenue bus assets. The figures show the current funding by project type compared to the total overall funding required to maintain SOGR and deliver on selected service enhancement and growth projects. Condition remediation investment forecasts are also included.

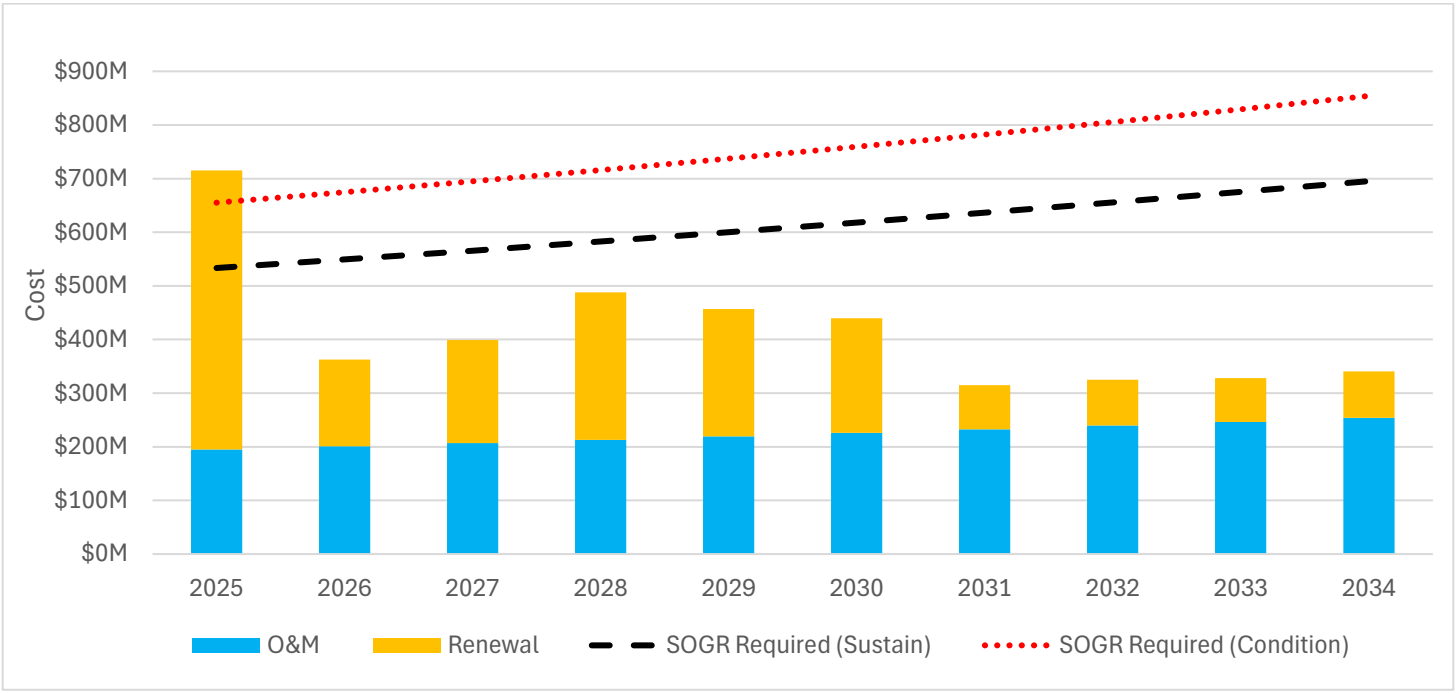


Figure 2-55: Funding vs Assessed Program Requirements – Revenue Buses (SOGR only)

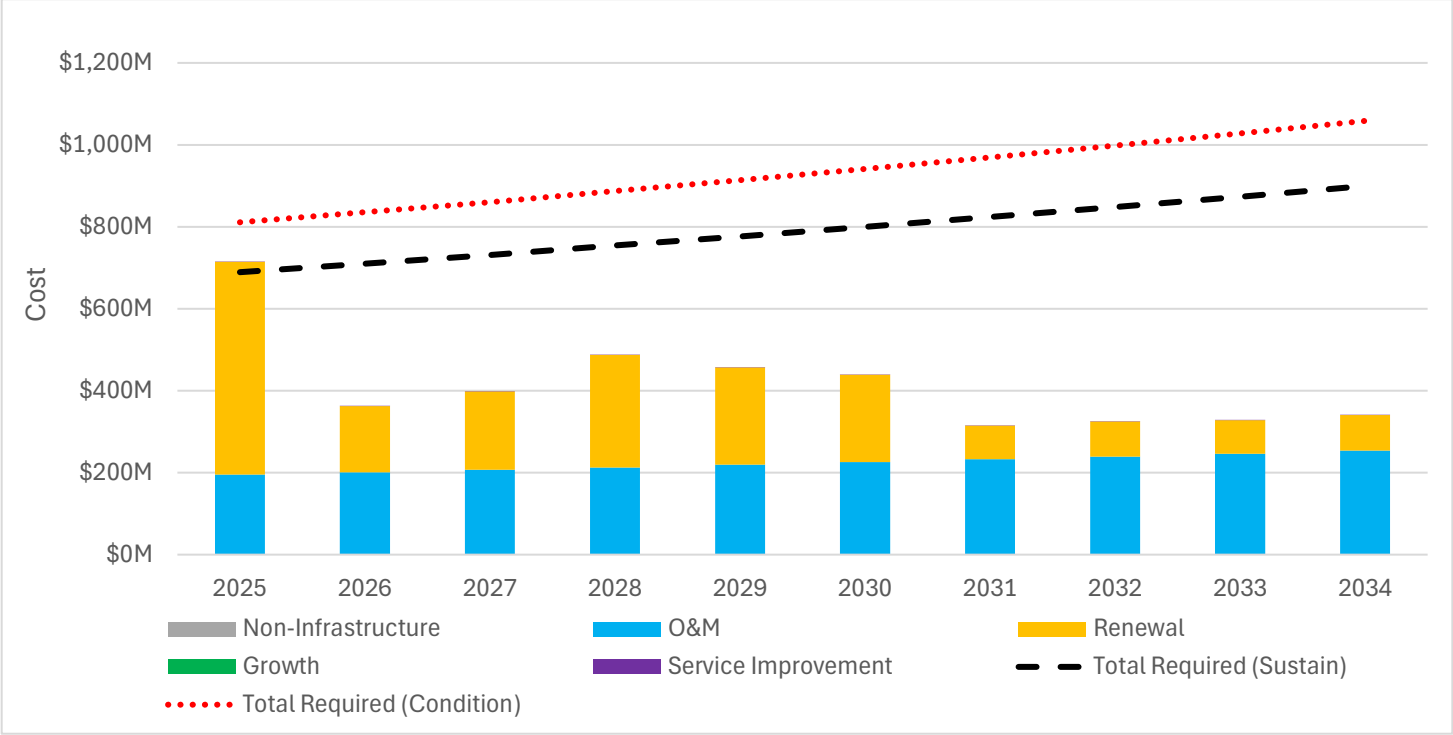


Figure 2-66: Funding vs Assessed Program Requirements – Revenue Buses

The following table summarizes the average annual budget and investment needs for the planning period:

Lifecyle Activity	Planned Budget ($K)	Investment Needed to Sustain LOS ($K)	Investment Needed to Address Condition Gap ($K)
Non-Infrastructure	$0	$0	$0
Maintenance	$223,352	$223,352	$223,352
Renewals	$193,592	$387,776	$527,375
Growth	$0	$174,608	$174,608
Service Improvement	$477	$4,911	$4,911
Total Expenditure	$417,421	$790,647	$930,247
Average annual SOGR Gap		$194,184	$333,783
Average annual Infrastructure Gap		$373,226	$512,825

Table 2-F – Annualized Funding vs Assessed Program Requirements – Communications Assets

2.7 Conclusion & Risks

The analysis undertaken in the preparation of this plan suggest that the TTC's revenue bus SOGR investment program is not sufficient to address vehicle renewal or growth requirements. This has led to an asset base in which many buses are beyond their expected service life. While operational performance remains reasonably high, significant risks are being imported due to degrading asset condition.

Looking forward, the TTC will need to increase funding to be able to maintain current service levels, whilst making the transition to a fully electric fleet. This includes investment in reliable infrastructure, plus investment

to develop new maintenance approaches and subsequently upskilling the workforce. Addressing these issues will be crucial for sustaining a reliable and efficient bus service.

The most substantial risks identified for these assets are:

1. **If the planned procurements for electric buses and charging infrastructure post-2025 are not funded**, the TTC's bus service will be significantly impacted, and operating expenditures will escalate due to an increase in required maintenance activities. This may lead to a deviation from proper lifecycle management, leading to obsolescence and potential fix on fail maintenance routines.
2. **Limited funding for bus overhauls.** Insufficient funding for overhaul works will result in preventative maintenance programs no longer being implemented, leading to a reliance upon fix on fail maintenance and the subsequent impacts to service.
3. **Electrification will require modification, conceptual change, and a new maintenance approach** to delivering service that simultaneously affects our fleet, facilities, workforce skills, processes, service and support equipment. Such a significant change introduces risk to all functions of the Bus Maintenance department and across TTC as a whole. Transition change management plans are being put in place to mitigate the impact of this risk.
4. **The TTC is experiencing a surge of modernization** as it employs more sophisticated and intelligent equipment and systems in everyday operations. These modern equipment and systems are more expensive to operate, demand more of our workforce in terms of knowledge and competence and require external support that brings a new dimension to our operating environment.
5. **The supply chain has little operating experience with supplied equipment** due to electrification and modernization, as they trial and assess products for suitability to their business model. Bus maintenance is experiencing longer lead times, higher costs, and lower reliability and availability of required materials to maintain the revenue bus fleet. Also, global supply chain disruption and lingering effects from the COVID pandemic have contributed to long lead times, sometimes over a year, for many critical spare parts. Bills of Materials are now typically submitted two years before work starts, which compresses design schedules, reduces resilience, and increases warehousing costs.
6. **The current heavy-duty mechanic knowledge and skillset are not able to meet the demands of a modern and electrified transit fleet**. The industry is aware of this knowledge gap and is working with various stakeholders to determine the scope and means to upskill the workforce. However, workforce competence developments lag far behind the fleet technology change, which creates a high risk that the workforce will not be able to maintain the effectiveness and efficiency of diagnoses, repairs, and proactive maintenance methodology. TTC is taking efforts to mitigate this risk by partnering with Centennial College to develop a rail technician apprentice program.
7. **The TTC is experiencing configuration inconsistencies across its fleet**, resulting in exponential complexity and difficulty in material management, training, diagnosing, and overall management of such a diverse fleet. There is a severe risk to maintaining current levels of service if more variations to the operating fleet continue to be introduced.

3. Streetcars (Revenue)

3.1 Introduction

Streetcars have been a core component of Toronto's public transit system serving the people of Toronto and their communities since the 19th century. A capital program was recently delivered to replace the entire streetcar fleet with 204 modern, fully accessible articulated Low Floor Light Rail Vehicles (LFLRV). These LFLRVs were commissioned in 2020, and contract options have been exercised to procure a further 60 to be delivered by the end of 2025 to accommodate growth needs. The new LFLRV fleet has required complete transformation of the business due to upgraded technology associated with the vehicle operations and the need to adjust existing infrastructure, because of elements such as increased vehicle length, roof top equipment and the new pantograph system. The streetcar system is fully integrated with the other modes of transportation enabling transfer between different modes using a single payment.

Service Statement

> *"TTC Streetcar assets support overall transit services by enabling the reliable, safe and efficient movement of TTC customers using the surface track network within the City of Toronto."*

Asset Breakdown

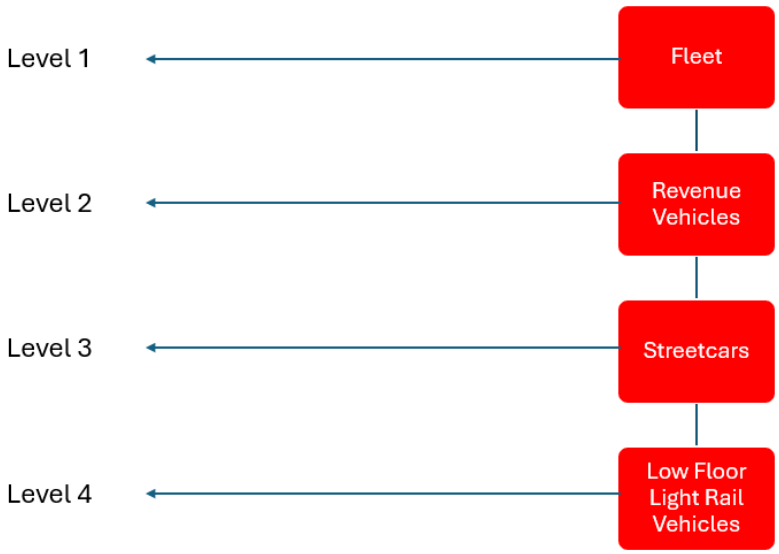


Figure 3-1: Asset Hierarchy – Streetcars

3.2 State of Infrastructure

The following figure outlines a high-level overview of the state of TTC Revenue Streetcar assets:

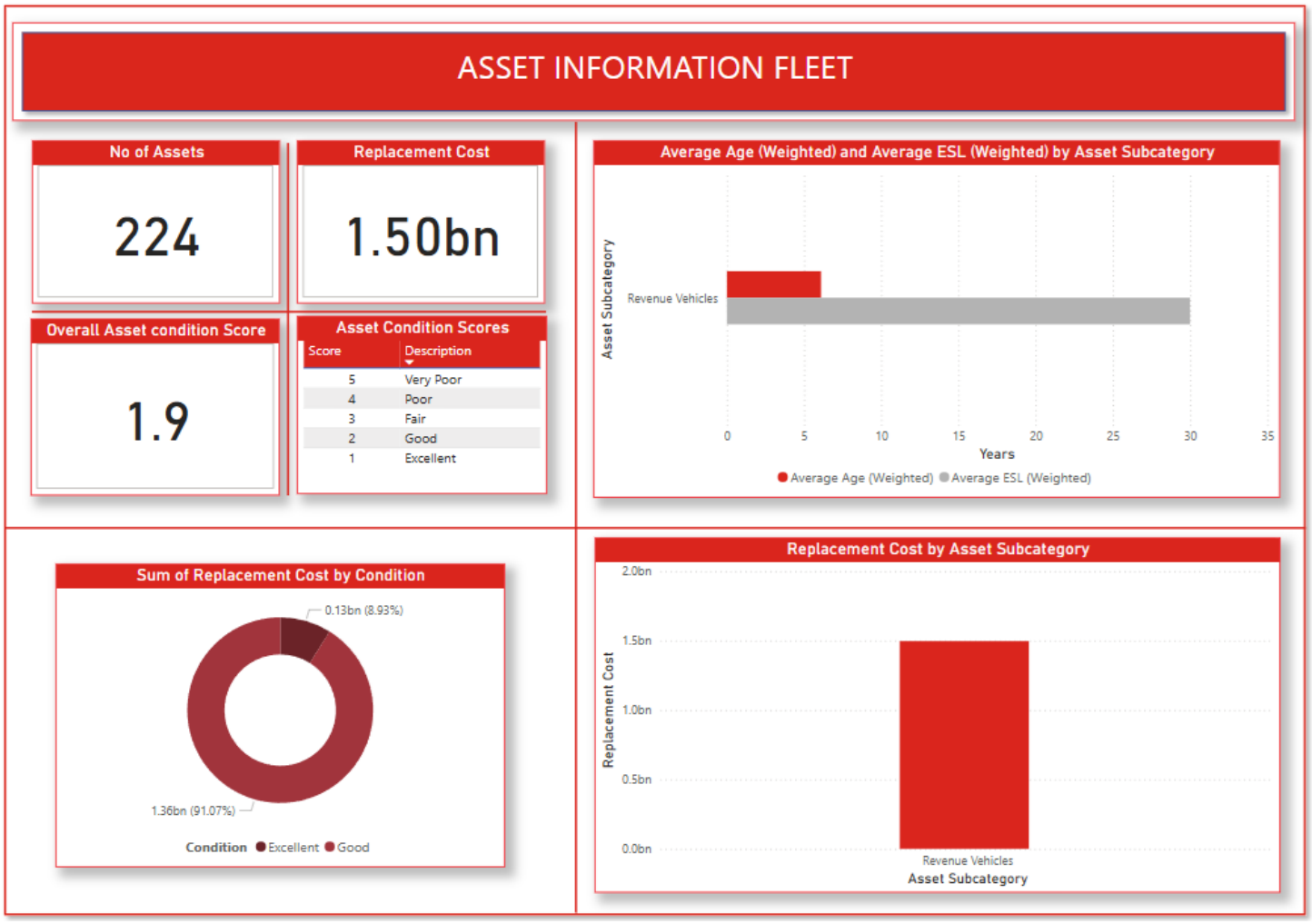


Figure 3-2: State of TTC Infrastructure Summary Dashboard – Streetcars

Asset Summary

Type	Sub-Asset Class	Quantity	Replacement Value ($M)	Average Condition	Average age (years)	ESL (years)
Streetcars	Low Floor Light Rail Vehicles	236[16]	1,576	1.9	6.1	30

Data Source(s): TTC Transportation & Vehicles Group

Table 3-A – Asset Summary – Streetcars

[16] This represents the snapshot quantity of commissioned revenue vehicles as of December 2024. Commissioning of recently procured vehicles is ongoing.

Condition Assessment

At present, age is the only factor that TTC considers when making decisions on the replacement of streetcars. Therefore, asset age has been used as the only factor on the streetcar condition score. The condition score is given with the following criteria:

1. **Excellent** – asset is in its first quarter of its designed service life (0-8 years)
2. **Good** – asset is in its 2nd quarter of its designed service life (9-15 years)
3. **Fair** – asset is in its 3rd quarter of its designed service life (16-23 years)
4. **Poor** – asset is in its last quarter of its designed service life (23-30 years)
5. **Very Poor** – asset has passed its designed service life (>30 years)

As the TTC continues to mature its asset management program, condition assessment methodologies will be refined to reflect a more complete understating of asset state and to increase data confidence.

3.3 Levels of Service

Levels of Service (LOS) for streetcar assets have been assessed in line with the overarching LOS framework presented in the main AMP document. Proposed LOS are encapsulated in the performance targets, as well as the initiatives outlined in the Future Levels of Service table. The TTC believes that these proposed LOS are reasonably achievable given the available funding. Further details on risks and funding requirements are outlined in subsequent sections.

Where asset performance falls below targets, the TTC will undertake action to address. In many cases this includes accelerated SOGR programs or modified maintenance activities. Additional details can be found in the asset class strategy summaries in the **TTC Asset Management Strategy** document.

Performance Summary

Overall, streetcars are meeting LOS targets and expectations.

While streetcars are in good condition and meeting most operational performance targets, on-time performance for the streetcar service is below target. However, this metric is impacted by operational (not asset related) issues.

Current Levels of Service

Asset Category Customer Level of Service	Subcategory Technical Level of Service	Performance Measure	Performance	Target
Sufficient serviceable fleet vehicles are available to ensure required service frequency and headways, to meet route and ridership demand, in line with TTC's fleet plan.	The number of serviceable streetcars available equals or exceeds the Fleet Plan	Vehicle Quantity	236	209[17]
	Sufficient serviceable buses are available to deliver peak service	Streetcar Availability	101%	100%
Revenue fleet, maintenance fleet and equipment deliver services on-time, per posted schedule	Streetcar services are on-time (depart end terminals within -1 to +5 minutes of scheduled departure time)	On time performance	73%	90%
	Streetcars complete their assigned routes	Road calls and change offs[18]	1	<2
		Streetcar Short Turns[18]	0.23%	1%
Revenue fleet, maintenance fleet and equipment are appropriate, sufficient and maintained in a SOGR such that service affecting failures are minimized.	Streetcar fleet is maintained in a SOGR Maintenance programs are effective.	Assets in fair or better condition (value weighted average %)	100%	80%
		Mean distance between failures (MDBF)	37,518 km	35,000 km
Revenue fleet vehicles are sufficient and effective to minimize system safety risks to the travelling public and community, in accordance with the relevant legislation and TTC safety policies.	All in-service vehicles meet safety requirements and have undergone required safety inspections (Safety inspection frequency)	Compliance to safety schedule	All safety audits have been undertaken as planned. 0 major non-conformalities	-
Revenue fleet vehicles meet the need for the travelling public for accessibility needs.	All streetcars meet the AODA transportation standard	Minimum in service standard	All streetcars are audited against AODA standards. 0 non-conformalities	-
	Make all streetcars accessible, where possible	Complete the delivery of 60 additional low-floor accessible streetcars in 2025	Final 20 additional streetcars will be delivered by June 2025.	-
Revenue fleet vehicles meet customer expectations for cleanliness comfort and convenience.	Streetcars meet cleanliness audit standards	Streetcar Cleanliness (average of pre-service, in-service and post-service results – 3rd party audit)	96.45%	90%

Table 3-B – Current Levels of Service – Streetcars

[17] Assumes 10% spares over peak service plan (190)
[18] Metrics include operations (non-asset) issues

Future Levels of Service

Asset Category Customer Level of Service	Asset Future Level of Service	Actions	Target Date	Initiative
Sufficient serviceable revenue fleet vehicles are available to ensure capacity meets route and ridership demand, in line with TTC's fleet plan.	Increase service to address demand	Every year, the TTC will look at all active developments near completion as part of the Annual Service Plan process to understand where additional services may be required to meet demand. Each six-week period, we will review and adjust service to accommodate customer demand.	Annually	SCE Plan Action 2.1
	Implement new services to address travel patterns	Modification and enhancement of existing routes to match changing travel patterns, plus the implementation of new routes on the street network.	Annually (as part of service plan process)	SCE Plan Action 2.2
	Expand the frequent network	Review opportunities to expand the frequent network and increase the population's access to important destinations within the city.	2028	SCE Plan Action 2.6
Sufficient serviceable revenue fleet vehicles are available to ensure capacity meets route and ridership demand, in line with TTC's fleet plan.	Enhance the streetcar network	Explore implementing a 6-minute-all-day, everyday streetcar service on key streetcar routes.	2028	SCE Plan Action 2.6
	Enhance service equity	Collaborate with City of Toronto to refine and adopt new measures of transportation equity across all neighbourhoods, with an emphasis on transportation disadvantage and built environment factors.	2028	SCE Plan Action 2.7
	Mitigate the impact of planned and unplanned service disruptions	Increase availability of streetcars to minimize the effects of service disruptions on customer journeys	2028	SCE Action Plan 3.2
TTC fleet assets deliver services on-time, per posted schedule.	Improve service reliability	Review transit schedules and conduct a review of service reliability performance measures to ensure they are customer focused.	2028	SCE Plan Action 3.1
TTC fleet vehicles are sufficient and effective to minimize system safety risks to the travelling public and community, in accordance with Transportation acts	Prioritize safety and security	Investigate automated camera enforcement for streetcar customer safety	2027	SCE Action Plan 6.3
TTC Fleet assets allow for the appropriate and effective communications with the travelling public	Provide customers with accurate, accessible and timely information	Upgrade the next vehicle arrival data feed to provide better live and accurate information to customers	2028	SCE Action Plan 7.3
		Enhance public announcement system clarity to ensure customers receive clear and understandable announcements during their journeys	2028	SCE Action Plan 7.3

Table 3-C – Future Level of Service Initiatives – Streetcars

3.4 Lifecycle Management Activities

The following table outlines the assessed lifecycle activities required to maintain Streetcar SOGR:

Activity	Frequency[19]	Annualized Cost ($K)
Non-Infrastructure		
Administrative overhead, process continuous improvement	As required	-
Maintenance		
Daily Inspection (pre-service inspection)	Daily	$73,820
PD inspection (replacement, cleaning, inspection and service of components and equipment)	2 Months	
Replacement, cleaning, inspection and service of components and equipment	Annual	
Seasonal Maintenance	Seasonal (fall/spring)	
2 Year Overhaul Carbody & Interior fittings, Couplers and Drawbars, Sanders & Wheel Flange Lubrication, Trucks & Suspension, Propulsion, Brakes, A,B,C Mod HPU Preventative Maintenance, Auxiliary Electrical, Doors & Ramp, Ramp Preventative Maintenance, Pantograph and Trolley Pole increase scope to include Catcher & Chain RE/RE, Train Control and Monitoring – DDD Test	2 Year	
Overhauls & Renewals		
LFLRVs		
4 Year Overhaul: New LRVs Articulation, Auxiliary Power System, Brake systems (Track & Disc), Door System & Ramp, Couplers, Car Body, Current Collection System, HVAC Pantograph and Trolley Pole, Propulsion System, Operators Cab, Train Control Monitoring & Communication, Trucks (Bogie), Wheel Flange Lubrication (on vehicles equipped with WFL), Operators Cab	4 Year	$24,341
8 Year Overhaul: New LRVs Articulation, Auxiliary Power System, Brake systems (Track & Disc), Door System & Ramp, Couplers, Car Body, Current Collection System, HVAC Pantograph and Trolley Pole, Propulsion System, Operators Cab, Train Control Monitoring & Communication, Trucks (Bogie), Wheel Flange Lubrication (on vehicles equipped with WFL), Operators Cab	8 Year	$12,529
Overhaul: Midlife Overhaul[20]	16 Year	$17,335
Replace at end of life: LFLRV	30 Year	$43,337[21]
Data source: TTC T&V Group – Streetcar Maintenance, TTC Capital Investment Plan		

Table 3-D – Lifecycle SOGR Activities – Streetcars

[19] Maintenance frequencies are currently under review
[20] Activities in the mid-life overhaul program are currently being scoped out. The LFLRV fleet will undergo the 16-year overhaul from 2028 onwards.
[21] Not currently required in the planning period due to age of assets

The following table provides examples of lifecycle activities that are undertaken to provide improvements to service and address ridership growth and system network expansion (meet proposed future LOS).

Activity	**Timeline**	**Program Cost** ($K, current planning period)
Non-Infrastructure		
No Streetcar Non-Infrastructure programs currently underway		
System Improvement		
Streetcar Camera & Monitoring Systems	2022-2026	$18,002
Streetcar Wheel Noise Reduction	2021-2026	$8,162
APC Existing/Remaining Streetcars	2023-2026	$3,423
APC Enhancement	2021-2025	$375
APC on 60 Streetcars	2023-2025	$345
Growth		
Streetcar – Purchase (up to 60 cars)	2020-2025	$144,194
Data source: TTC T&V Group – Streetcar Maintenance, TTC Capital Investment Plan		

Table 3-E – Current & Planned Lifecycle Activities to Improve Service and Address Growth – Streetcars

3.5 Climate Change

The TTC's innovation and sustainability strategy was published in September 2024 and is aligned to the city-wide GHG targets to achieve net zero by 2040 and the Sustainable City of Toronto Fleets Plan.

The TTC currently operates a fully electric streetcar fleet and any negative environmental impacts from streetcar vehicles are being reviewed on a case-by-case basis.

The TTC is committed to ensuring the resilience of transit assets and will be conducting a comprehensive assessment to identify vulnerabilities and risks to critical transit assets.

3.6 Lifecycle Investment Forecasts

At the current stage of asset management maturity, lifecycle investment needs are evaluated as the annualized cost to maintain SOGR, as outlined above. Estimates have also been made for the investment required to bring all assets to “Fair” or better condition over the planning period.

The following figures and table illustrate the full lifecycle investment forecasts for streetcar assets. The figures show the current funding by project type compared to the total overall funding required to maintain SOGR and deliver on selected service enhancement and growth projects. Condition remediation investment forecasts are also included.

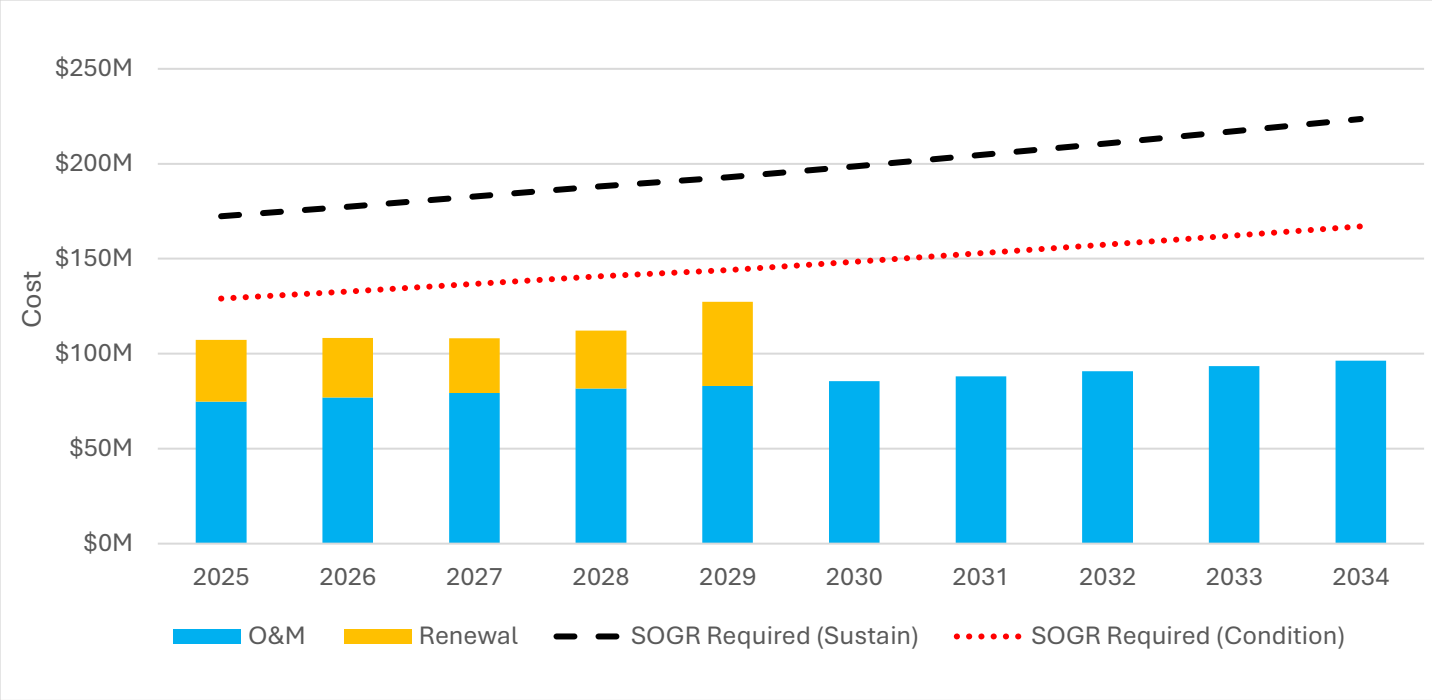


Figure 3-3: Funding vs Assessed Program Requirements – Streetcars (SOGR only)

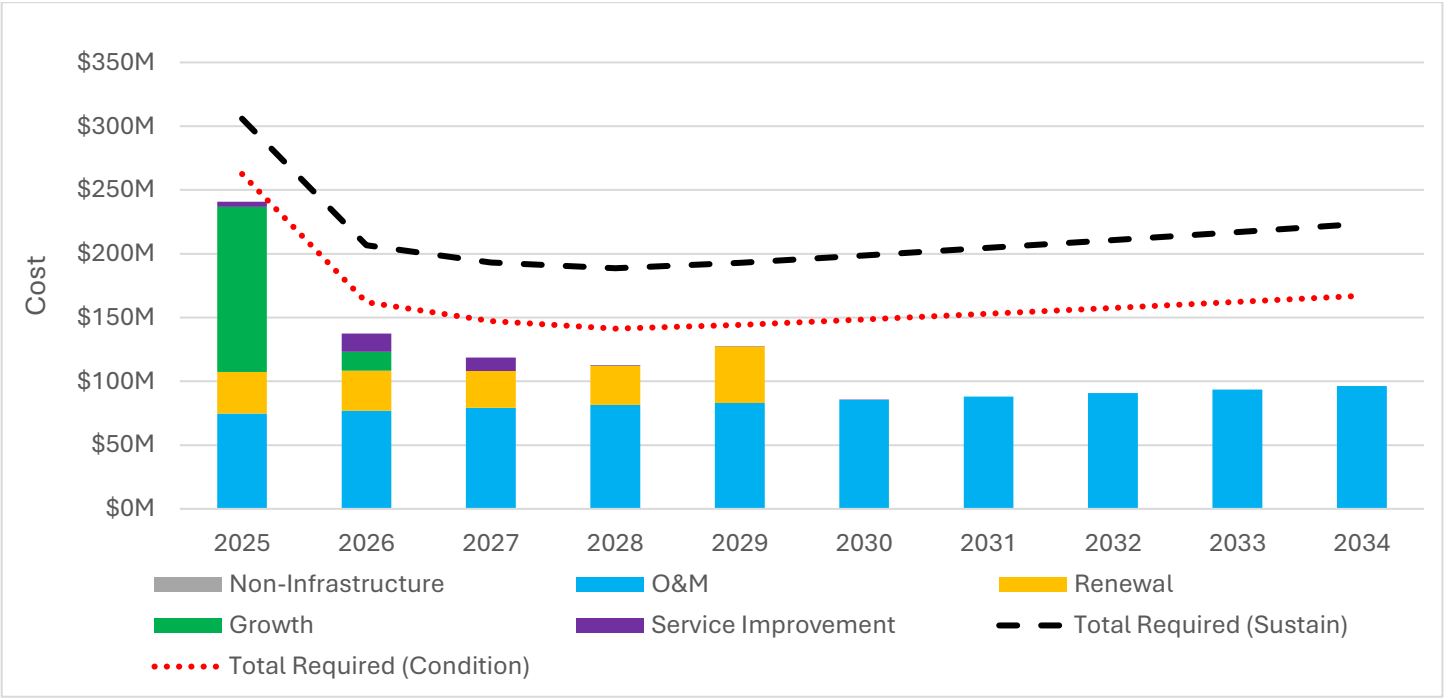


Figure 3-4: Funding vs Assessed Program Requirements – Streetcars

The following table summarizes the average annual budget and investment needs for the planning period:

Lifecyle Activity	Planned Budget ($K)	Investment Needed to Sustain LOS ($K)	Investment Needed to Address Condition Gap ($K)
Non-Infrastructure	$0	$0	$0
Maintenance	$85,010	$85,010	$85,010
Renewals	$16,764	$111,821	$62,140
Growth	$14,419	$14,419	$14,419
Service Improvement	$2,941	$2,951	$2,951
Total Expenditure	$119,134	$214,201	$164,520
Average annual SOGR Gap		$95,057	$45,376
Average annual Infrastructure Gap		$95,067	$45,386

Table 3-F – Annualized Funding vs Assessed Program Requirements – Signalling Assets

3.7 Conclusion & Risks

The TTC is currently operating a relatively new streetcar fleet, after the completion of the program to introduce the new LFLRV completed in 2024, with deliveries continuing through 2025. This has resulted in increased performance of the streetcar service.

However, the TTC faces several critical challenges in maintaining its streetcar fleet moving forward. These include the need for a major overhaul of the streetcar fleet, due to start in 2028, dealing with obsolete components, and reliance on single-source suppliers. Additionally, contractual obligations with the original equipment manufacturer (OEM) restrict alternative sourcing, and customised equipment specific to TTC vehicles complicates the overall maintenance. Workforce availability further exacerbates these issues. Without

proper funding and strategic planning, these factors will collectively risk future significant service disruptions and will result in increased maintenance costs.

The most substantial risks identified for these assets are:

1. **Major overhaul for the LFLRVs is within the next few years.** As the fleet approaches the age at which mid-life overhaul is due, there is a risk that without proper funding for the overhaul program there will be a reliance upon fix-on-fail maintenance regimes leading to service disruption. Furthermore, existing maintenance facilities are not sufficient to support the required work.
2. **Obsolete components.** Some of the equipment on streetcars currently has components that are now obsolete. This results in equipment failure with no possibility of replacement of the appropriate component. To mitigate this risk, TTC has built provisions into procurement contracts that obligate car suppliers to source directly replaceable components for any part that is deemed obsolete for a period of five years after delivery. Currently, over 20 obsolete parts have replaced during the project life.
3. **Single source supplier.** Many of the components on streetcars can only be obtained from a single supplier. If the component is out of stock with this supplier or they are unable to fulfil the request, then there are no alternative suppliers available with the current procurement arrangements. Having a single supplier also risks cost escalation and unaffordability.
4. **Contractual obligations with streetcar OEM.** Other suppliers who may be able to supply parts or components are being prevented from doing so due to contractual arrangements with the OEM. This risks a delay in acquiring parts.
5. **Custom-made equipment that applies only to TTC vehicles.** Some equipment on TTC streetcars is bespoke to those vehicles and can be expensive to develop and replace. This also means that equipment is not readily available when required and streetcars may remain out of service for longer than is necessary.
6. **Workforce availability.** Due to increasing obsolescence and single-source suppliers there is a need to increase the technical workforce, but there is a risk that these technical resources will not be readily available. This may limit the ability of the Streetcar Maintenance team to undertake the work required to maintain service. TTC is taking efforts to mitigate this risk by partnering with Centennial College to develop a rail technician apprentice program.

4. Subway Vehicles (Revenue)

4.1 Introduction

The TTC subway fleet consists of a total 849 subway cars forming 141 subway trains, split across two generations of vehicle: the Toronto Rocket (TR) and the T1 class.

The TTC operates its most modern fleet of TR subway trains on Line 1. In 2022, the TTC completed ATC installation which enabled more frequent train service in the future to accommodate demand. Additional trains are required to accommodate any growth in future ridership on Line 1. The additional trains will increase capacity to up to 36,000 passengers per hour with other infrastructure and operational improvements made through the Line 1 Capacity Enhancement Program. Coupled with the Ontario Line opening in the early-2030s, this additional capacity improvement is expected to accommodate projected demand on Line 1 until the early-2040s. Further, the Line 1 extension will require additional trains to service the extension and provide capacity for the additional customers it will serve.

On Line 2, the TTC operates T1 fleet, which have a design life of 30 years and will start reaching the end of its design life in 2026. The New Subway Train Program replacing the T1 fleet is initiated in 2024 and is currently at RFP phase. The Program is acquiring 70 new subway trains in the coming 8-10 years replacing the current 55 trains on Line 2. At the same time, TTC is initiating a Life Extension Overhaul Program on the current Line 2 fleet to maintain its level of service before the new trains start to operate.

All subway trains are fully electric and are designed to be fully accessible.

Service Statement

> *"TTC Subway Vehicle assets support overall transit services by enabling the reliable, safe and efficient movement of TTC customers using the subway network within the City of Toronto."*

Asset Breakdown

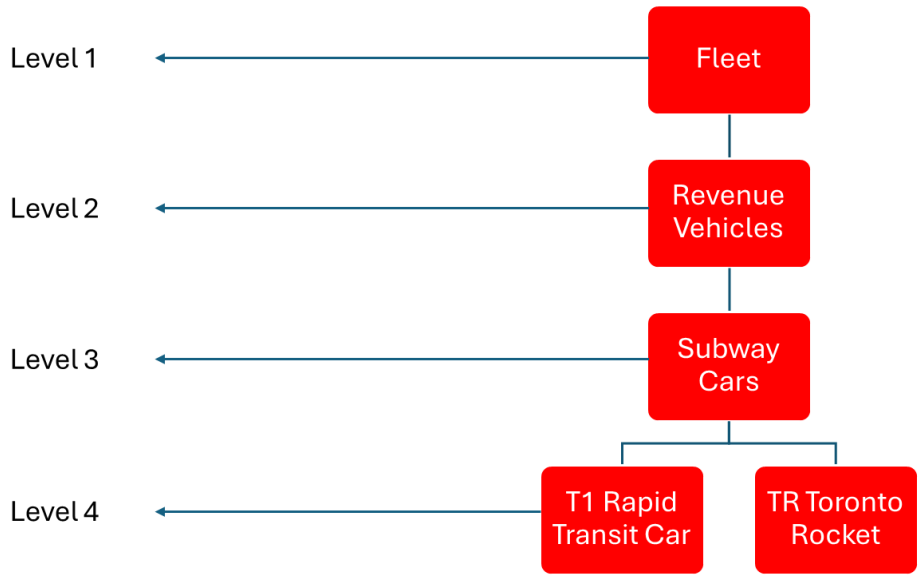


Figure 4-1: Asset Hierarchy – Subway Vehicles

4.2 State of Infrastructure

The following figure outlines a high-level overview of the state of TTC Subway Vehicle assets:

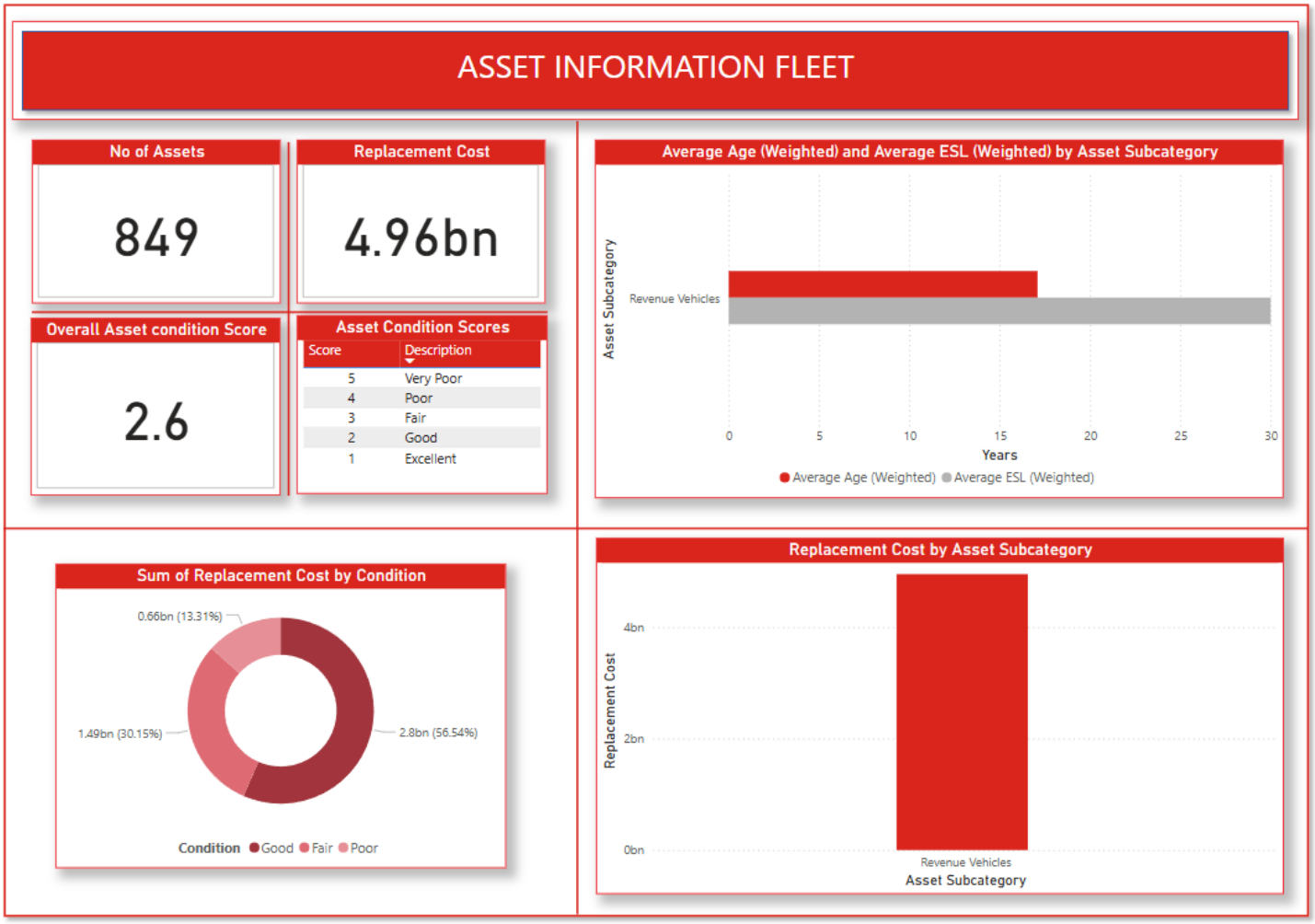


Figure 4-2: State of TTC Infrastructure Summary Dashboard – Subway Vehicles

Asset Summary

Type	Sub-Asset Class	Quantity	Replacement Value ($M)	Average Condition	Average age (years)	ESL (years)
Revenue Subway Car	TR	480	2,801.6	2.0	11	30
	T1	369	2,153.7	4.0	25	30

Data Source(s): TTC Transportation and Vehicles Group

Table 4-A – Asset Summary – Subway Vehicles

Condition Assessment

At present, age is the only factor that TTC considers when making decisions on the replacement of subway vehicles. Therefore, asset age has been used as the only factor on the subway vehicle condition score. The condition score is given with the following criteria:

1. **Excellent** – asset is in its first quarter of its designed service life (0-8 years)
2. **Good** – asset is in its 2nd quarter of its designed service life (9-15 years)
3. **Fair** – asset is in its 3rd quarter of its designed service life (16-23 years)
4. **Poor** – asset is in its last quarter of its designed service life (23-30 years)
5. **Very Poor** – asset has passed its designed service life (>30 years)

As the TTC continues to mature its asset management program, condition assessment methodologies will be refined to reflect a more complete understating of asset state and to increase data confidence.

4.3 Levels of Service

Levels of Service (LOS) for Subway Vehicle assets have been assessed in line with the overarching LOS framework presented in the main AMP document. Proposed LOS are encapsulated in the performance targets, as well as the initiatives outlined in the Future LOS table. The TTC believes that these proposed LOS are reasonably achievable given the available funding. Further details on risks and funding requirements are outlined in subsequent sections.

Where asset performance falls below targets, the TTC will undertake action to address. In many cases this includes accelerated SOGR programs or modified maintenance activities. Additional details can be found in the asset class strategy summaries in the **TTC Asset Management Strategy** document.

Performance Summary

Overall, Subway Vehicles are meeting or exceeding LOS targets and expectations.

While operational performance remains in an acceptable range, there are risks associated with asset condition. These are being addressed through capital investments outlined below.

Current Levels of Service

Asset Category Customer Level of Service	Subcategory Technical Level of Service	Performance Measure	Current Performance	Target
Sufficient serviceable fleet vehicles are available to ensure required service frequency and headways, to meet route and ridership demand, in line with TTC's fleet plan.	The number of serviceable subway trains available equals or exceeds the Fleet Plan	Vehicle Quantity	143	143
	Sufficient serviceable subway vehicles are available to deliver peak service	Subway Availability	106%	100%
Revenue fleet, maintenance fleet and equipment deliver services on-time, per posted schedule	Subway services are on-time (depart end terminals within -1 to +5 minutes of scheduled departure time)	On time performance	92%	90%

Asset Category Customer Level of Service	Subcategory Technical Level of Service	Performance Measure	Current Performance	Target
Revenue fleet, maintenance fleet and equipment are appropriate, sufficient and maintained in a SOGR such that service affecting failures are minimized.	Subway fleet is maintained in a state of good repair. Maintenance programs are effective.	Assets in fair or better condition (value weighted average %)	87%	80%
		MDBF – TR	640,300 km	600,000 km
		MDBF – T1	438,629km	330,000 km
Revenue fleet vehicles are sufficient and effective to minimize system safety risks to the travelling public and community, in accordance with the relevant legislation and TTC safety policies.	All in-service subway vehicles meet safety requirements and have undergone required safety inspections (inspection frequency)	SOGR	All safety audits have been undertaken as planned. 0 major non-conformalities	As low as reasonably practicable.
Revenue fleet vehicles meet the need for the travelling public for accessibility needs.	All subway vehicles meet the AODA transportation standard	Minimum in Service Standard	All streetcars are audited against AODA standards. 0 non-conformalities	Defects which affect accessibility features beyond the MISS result in removal from which affects availability
Revenue fleet vehicles meet customer expectations for cleanliness comfort and convenience.	Subway vehicles meet cleanliness audit standards	Subway Cleanliness (Quarterly 3rd party audit)	92.8%	90%

Table 4-B – Current Levels of Service – Subway Vehicles

Future Levels of Service

Asset Category Customer Level of Service	Asset Future Levels of Service	Actions	Target Date	Initiative
Sufficient serviceable revenue fleet vehicles are available to ensure capacity meets route and ridership demand, in line with TTC's fleet plan.	Increase planned in-service fleet to meet projected demand	Procure 17 subway trains (in addition to maintenance replacements). This includes 10 line 1 trains, 6 line 2 trains and 1 line 4 train.	2034	SCE Plan
	Increase service to address demand	Every year, the TTC will look at all active developments near completion as part of the Annual Service Plan process to understand where additional services may be required to meet demand. Each six-week period, we will review and adjust service to accommodate customer demand.	Annually	SCE Plan Action 2.1
	Expand the frequent network	Review opportunities to expand the frequent network and increase the population's access to important destinations within the city.	2028	SCE Plan Action 2.6
	Enhance service equity	Collaborate with City of Toronto to refine and adopt new measures of transportation equity across all neighbourhoods, with an emphasis on transportation	2028	SCE Plan Action 2.7

Asset Category Customer Level of Service	Asset Future Levels of Service	Actions	Target Date	Initiative
		disadvantage and built environment factors.		
Sufficient serviceable revenue fleet vehicles are available to ensure capacity meets route and ridership demand, in line with TTC's fleet plan.	Modify Service Plan to accommodate growth	As part of the Annual Service Planning process, review active developments and adjust plan accordingly	Annually	SCE Plan Action 2.1
	Mitigate the impact of planned and unplanned service disruptions	Increase availability of subway trains to minimize the effects of service disruptions on customer journeys		SCE Action Plan 3.2
TTC Fleet assets allow for the appropriate and effective communications with the travelling public	Provide customers with accurate, accessible and timely information	Upgrade the next vehicle arrival data feed to provide better live and accurate information to customers[22]		SCE Action Plan 7.3
		Enhance public announcement system clarity to ensure customers receive clear and understandable announcements during their journeys		SCE Action Plan 7.3

Table 4-C – Future Level of Service Initiatives – Subway Vehicles

4.4 Lifecycle Management Activities

The following table outlines the assessed lifecycle activities required to maintain TR and T1 subway vehicles in a SOGR:

Activity	Frequency	Annualized Cost ($K)
Non-Infrastructure		
Administrative overhead, process continuous improvement	As required	-
Maintenance		
Daily and periodic preventive maintenance, cleaning, and inspections	Continuous	$75,031
Scheduled replacement of wear components	As required	
Corrections and replace-on-failure of minor components	As required	
Capitalised Overhauls & Renewals		
Major Overhaul – T1[23] Air Compressor, Batteries, Braking System, Coupler, Master Controller, Trucks, Static & Dynamic Tests	5 Year	$3,558
Major Overhaul – TR[23] Air Brake System, Coupler, HVAC System	5 Year	$4,629
Mid-Life Overhaul – T1[23]	15 Year	$21,537

[22] Dependent on improved wireless network infrastructure implementation
[23] Overhaul activities aggregated for simplicity, some intervals vary

Air Compressor, Batteries, Braking System, Coupler, Master Controller, Trucks, Static & Dynamic Tests, Test Equipment, Car Body, Car Monitoring Unit, Door Systems, Lighting – LEDs, Monitoring Terminal Units, Propulsion, Undercar Air Hoses, Horn (Secondary)		
Mid-Life Overhaul – TR[23] Air Brake System, Coupler, HVAC System, Trucks, Car Body, Door Systems	15 Year	$28,016
End of Life Replacement – T1	30 Year	$71,790
End of Life Replacement – TR	30 Year	$93,386
Data source: TTC T&V Group – Railcars & Shops, TTC Capital Investment Plan		

Table 4-D – Lifecycle SOGR Activities – Subway Vehicles

The following table provides examples of lifecycle activities that are undertaken to provide improvements to service and address ridership growth and system network expansion (meet proposed future LOS).

It is important to note that here are several programs associated with technology updates to the communications systems that will bring additional improvements to service delivery and support future growth. As these are primarily driven by SOGR, they are included in the table above.

Activity	**Timeline**	**Program Cost** ($K, current planning period)
Non-Infrastructure		
No Subway Vehicle Non-Infrastructure programs currently underway		
System Improvement		
Subway Cars – Purchase Service Maturity	2035	$3,799
Growth		
Subway Cars Additional Purchase (Growth)	2022-2034	$850,216
Data source: TTC T&V Group – Railcars and Shops, TTC Capital Investment Plan		

Table 4-E – Current & Planned Lifecycle Activities to Improve Service and Address Growth – Subway Vehicles

4.5 Climate Change

TTC's Innovation and Sustainability strategy outlines the plan to mitigate against the impacts of climate change. Pillar 2 of this plan focuses on environmental sustainability.

One action from this plan is to eliminate Direct GHG Emissions by Decarbonising our Fleets (scope 1) (action 2.1.2). TTC currently operates a fully electric subway fleet.

The TTC is committed to ensuring the resilience of transit assets and will be conducting a comprehensive assessment to identify vulnerabilities and risks to critical transit assets.

4.6 Lifecycle Investment Forecasts

At the current stage of asset management maturity, lifecycle investment needs are evaluated as the annualized cost to maintain SOGR, as outlined above. Estimates have also been made for the investment required to bring all assets to “Fair” or better condition over the planning period.

The following figures and table illustrate the full lifecycle investment forecasts for subway vehicle assets. The figures show the current funding by project type compared to the total overall funding required to maintain SOGR and deliver on selected service enhancement and growth projects. Condition remediation investment forecasts are also included.

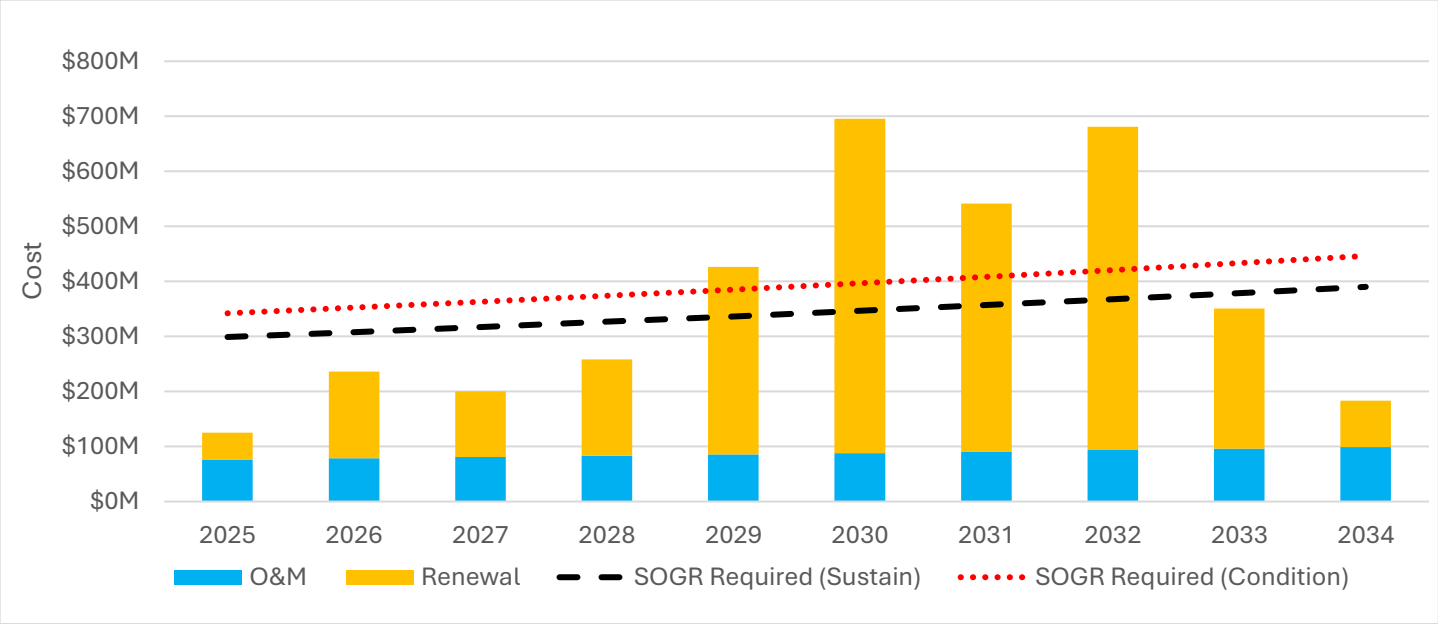


Figure 4-3: Funding vs Assessed Program Requirements – Subway Vehicles (SOGR only)

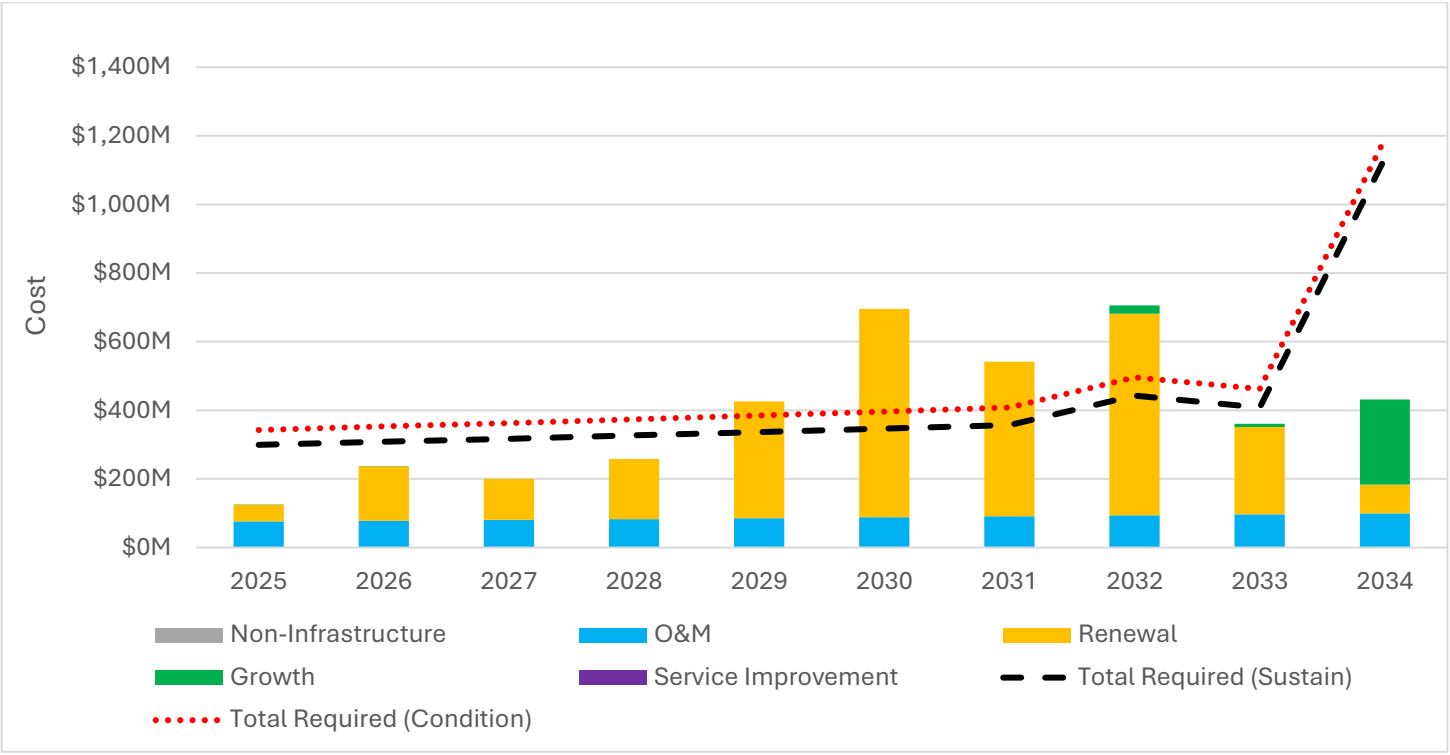


Figure 4-4: Funding vs Assessed Program Requirements – Subway Vehicles

Note that the significant step change shown in 2034 in Figure 4-4 represents unfunded vehicle procurement activities associated with CPI project 7031.

The following table summarizes the average annual budget and investment needs for the planning period:

Lifecyle Activity	Planned Budget ($K)	Investment Needed to Sustain LOS ($K)	Investment Needed to Address Condition Gap ($K)
Non-Infrastructure	$0	$0	$0
Maintenance	$87,161	$87,161	$87,161
Renewals	$282,727	$255,548	$304,927
Growth	$28,383	$85,022	$85,022
Service Improvement	$0	$0	$0
Total Expenditure	$398,272	$427,731	$477,110
Average annual SOGR Gap		-$27,180	$22,200
Average annual Infrastructure Gap		$29,459	$78,839

Table 4-F – Annualized Funding vs Assessed Program Requirements – Subway Vehicles

4.7 Conclusion & Risks

The analyses undertaken in this plan indicate that the TTC Subway Vehicles are being effectively managed. Performance against LOS expectations is high, and funding is largely appropriate to sustain performance and asset condition. Nevertheless, there exist a number of risks to long-term asset performance as outlined below.

The most substantial risks identified for these assets are:

1. **Aging assets.** Aging assets require increased maintenance to counteract the higher fault rate. As a greater number of assets move towards end-of-life, the increased maintenance demand poses a risk of reduced service, as more vehicles are taken for repair at a given time.
2. **Technology obsolescence.** An aging fleet has the resultant impact that much of the technology on board the vehicles is obsolete or nearing obsolescence. This removes access to spare components, causing difficulty with maintenance and subsequently impacting service.
3. **Supply chain challenges.** Global supply chain disruption and lingering effects from the COVID pandemic have contributed to very long lead times (greater than one year) for many critical spare parts. Bills of materials are now typically submitted two years before work starts, which compresses design schedules, reduces resilience, and increases warehousing costs.
4. **Long-term funding stability.** TR SOGR funding interruption in 2026-2028 risks inability to deliver SOGR work, which elevates risk of service disruptions. T1 vehicles are also approaching the end of design life with no fully funded replacement program. Funding interruptions prevent development of long-term relationships with supply partners, increasing supply chain challenges and costs.
5. **Lack of resources.** Challenges around retention and recruitment of appropriate talent risks a shortfall in the required numbers of personnel to undertake the activities required to maintain service and SOGR. An increase in rail construction has led to a decrease in the talent pool available locally.
6. **Lack of funding for new trains or life extension works**. There is a risk to the available capacity on Line 1 if funding is not received for new trains or life extension programs.

5. Wheel-Trans Vehicles (Revenue)

5.1 Introduction

The Wheel-Trans service provides a safe and reliable transportation option for persons with temporary or permanent disabilities, using accessible buses and contracted accessible taxi minivans and sedan taxis. The TTC requires eligible customers to submit a completed application to use the wheel-trans service. The wheel-trans fleet consists of 334 vehicles (accessible buses only).

Service Statement

> *"TTC Wheel-Trans provides safe, reliable, courteous, and efficient specialized door-to-door transportation service for persons with the greatest need for accessible transportation."*

Asset Breakdown

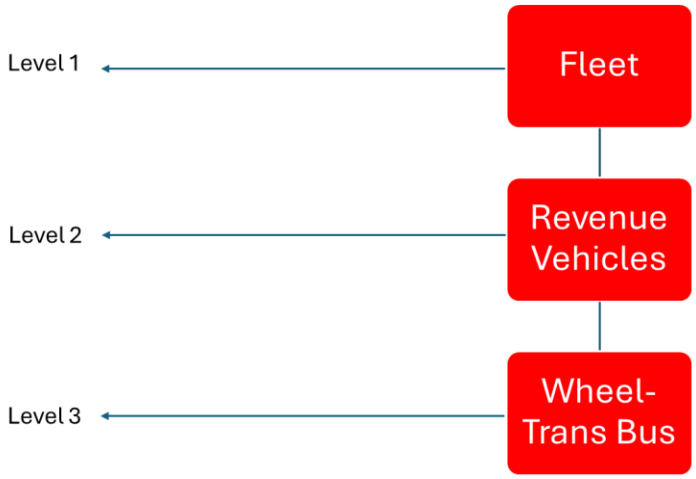


Figure 5-1: Asset Hierarchy – Wheel-Trans Vehicles

5.2 State of Infrastructure

The following figure outlines a high-level overview of the state of TTC Wheel-Trans Vehicle assets:

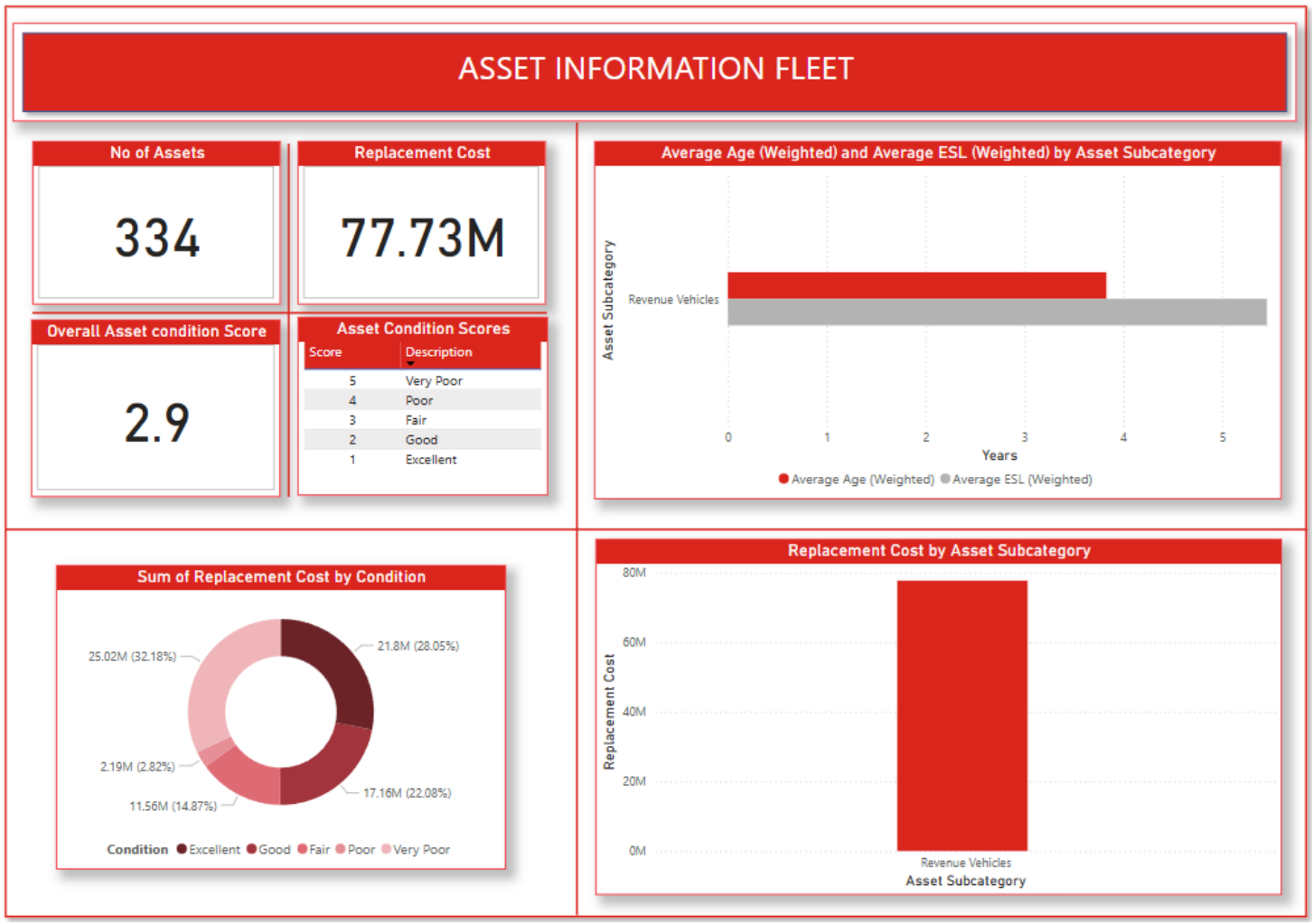


Figure 5-2: State of TTC Infrastructure Summary Dashboard – Wheel-Trans Vehicles

Asset Summary

Type	Sub-Asset Class	Quantity	Replacement Value ($M)	Average Condition	Average age (years)	ESL (years)
Wheel Trans Bus	Ram Promaster 6M	196	42.64	3.6	4	5
	Ram Promaster 7M	138	35.09	2.1	2	6

Data Source(s): TTC Transportation and Vehicles Group

Table 5-A – Asset Summary – Wheel-Trans Vehicles

Condition Assessment

At present, age is the only factor that TTC considers when making decisions on the replacement of Wheel-Trans vehicles. Therefore, asset age has been used as the only factor on the Wheel-Trans vehicle condition score. The condition score is given with the following criteria:

1. **Excellent** – asset is in its first quarter of its designed service life
2. **Good** – asset is in its 2nd quarter of its designed service life
3. **Fair** – asset is in its 3rd quarter of its designed service life
4. **Poor** – asset is in its last quarter of its designed service life
5. **Very Poor** – asset has passed its designed service life

As the TTC continues to mature its asset management program, condition assessment methodologies will be refined to reflect a more complete understating of asset state and to increase data confidence.

5.3 Levels of Service

Levels of Service (LOS) for Wheel-Trans vehicle assets have been assessed in line with the overarching LOS framework presented in the main AMP document. Proposed LOS are encapsulated in the performance targets, as well as the initiatives outlined in the Future LOS table. The TTC believes that these proposed LOS are reasonably achievable given the available funding. Further details on risks and funding requirements are outlined in subsequent sections.

Where asset performance falls below targets, the TTC will undertake action to address. In many cases this includes accelerated SOGR programs or modified maintenance activities. Additional details can be found in the asset class strategy summaries in the **TTC Asset Management Strategy** document.

Performance Summary

GOOD

Overall, Wheel-Trans vehicles are meeting LOS targets and expectations.

While operational performance remains high, the advanced age of some vehicles presents a risk to sustaining future performance.

Current Levels of Service

Asset Category Customer Level of Service	Subcategory Technical Level of Service	Performance Measure	Current Performance	Target
Sufficient serviceable fleet vehicles are available to ensure required service frequency and headways, to meet route and ridership demand, in line with TTC's fleet plan.	The number of serviceable buses available equals or exceeds the Fleet Plan	WT Bus Availability (spare ratio)	20%	19%
Revenue fleet, maintenance fleet and equipment deliver services on-time, per posted schedule	Wheel-Trans services are on-time (must arrive within 20 mins of scheduled arrival)	On-time performance	95.7%	90%
	Wheel-Trans Vehicles complete their assigned routes	Road Calls, Change Offs (RCCO)	0.8%	1.5% of peak service

Asset Category Customer Level of Service	Subcategory Technical Level of Service	Performance Measure	Current Performance	Target
Revenue fleet, maintenance fleet and equipment are appropriate, sufficient and maintained in a SOGR such that service affecting failures are minimized.	Wheel-Trans fleet is maintained in a state of good repair. Maintenance programs are effective.	Assets in fair or better condition (value weighted average %)	65%	80%
		MDBF	38,662 km	20,000 km
Revenue fleet vehicles are sufficient and effective to minimize system safety risks to the travelling public and community, in accordance with the relevant legislation and TTC safety policies.	All in-service Wheel-trans vehicles meet Highway Traffic Act requirements and have undergone required safety inspections (safety inspection frequency)	All in-service buses meet Highway Traffic Act requirements and have undergone required safety inspections	Safety Inspection Compliance	All released buses comply with safety inspection requirements
Revenue fleet vehicles meet the need for the travelling public for accessibility needs.	All Wheel-Trans vehicles meet the AODA transportation standard	AODA Regulations and audits	0 non-conformalities	All Wheel-Trans vehicles meet AODA standards for accessibility
Revenue fleet vehicles meet customer expectations for cleanliness comfort and convenience.	Wheel-Trans vehicles meet cleanliness audit standards	Vehicle Cleanliness (3rd party audit)	97%	97%
TTC will transition to zero emissions fleet vehicles as soon as practicable, in line with TTC's Green Fleet targets.	Transition to zero emissions Wheel-Trans fleet	Wheel-Trans bus pilot underway	Pilot underway to test 5 eBuses between 2026 - 2027	-

Table 5-B – Current Levels of Service – Wheel-Trans Vehicles

Future Levels of Service

Asset Category Customer Level of Service	Asset Future Levels of Service	Actions	Target Date	Initiative
Revenue fleet vehicles meet the need for the travelling public for accessibility needs.	Improve the options available for customers to book Wheel-Trans trips.	Implement improvements to the Interactive Voice Response (IVR) system for customers calling to book or cancel trips	2028	Multi-year Accessibility Plan Action 5.3.2.1
	Expansion of Family of Services routes	Expand to approximately 100 FOS routes and more than 600 vehicle transfer stops across the city	2027	Multi-year Accessibility Plan Action 5.3.3.1
TTC will transition to zero emissions fleet vehicles as soon as practicable, in line with TTC's Green Fleet targets.	Transition 50% of the Wheel-Trans fleet to zero emissions vehicles	Procure additional electric buses to meet Green Fleet targets	2030	Innovation & Sustainability Strategy Action 2.1.2
	Transition 100% of the Wheel-Trans fleet to zero emissions vehicles	Procure additional electric buses to meet Green Fleet targets	2040	Innovation & Sustainability Strategy Action 2.1.2

Table 5-C – Future Level of Service Initiatives – Subway Vehicles

5.4 Lifecycle Management Activities

The following table outlines the assessed lifecycle activities required to maintain Wheel-Trans vehicles in a SOGR:

Activity	Frequency	Annualized Cost ($K)
Non-Infrastructure		
Administrative overhead, process continuous improvement	As required	-
Maintenance		
Ram Promaster 6M		$14,048
Service Check Inspection Programme	5,000 km	
O reg 199/07 inspections		
OEM inspections <10,000km and <1 month		
Lubrication, Engine Oil/Filter Change		
Minor Inspection Program	10,000 km	
O reg 199/07 inspections		
OEM inspections <25,000 kms and >1 months <5 months		
Lubrication, Engine Oil/Filter Change		
Semi-Annual Safety Inspection	6 months	
O reg 199/07 inspections		
OEM inspections <25,000 kms and >5 months <8 months		
Called Items	In line with closest Minor Inspection or Service Check based on mileage	
OEM inspections >8 months		
Captures other recommended maintenance intervention from OEM (typically higher milage and age)		
RAM Promaster 7M		
Service Check Inspection Programme	6,000 km	
O reg 199/07 inspections		
OEM inspections <10,000km and <1 month		
Lubrication, Engine Oil/Filter Change		
Minor Inspection Program	12,000 km	
O reg 199/07 inspections		
OEM inspections <25,000 kms and >1 months <5 months		
Lubrication, Engine Oil/Filter Change		
Semi-Annual Safety Inspection	6 months	
O reg 199/07 inspections		
OEM inspections <25,000 kms and >5 months <8 months		

Called Items	In line with closest Minor Inspection or Service Check based on mileage	
OEM inspections >8 months		
Captures other recommended maintenance intervention from OEM (typically higher milage and age)		
Capitalised Overhauls & Renewals		
Replace at end of life: Gasoline WT buses - 6M	5 Year	$10,060
Replace at end of life: Gasoline WT buses - 7M	6 Year	$6,027
Replace at end of life: Electric WT bus	-	-
Data source: TTC O&I Group – SEC, TTC Capital Investment Plan		

Table 5-D – Lifecycle SOGR Activities – Wheel-Trans Vehicles

The following table provides examples of lifecycle activities that are undertaken to provide improvements to service and address ridership growth and system network expansion (meet proposed future LOS).

It is important to note that here are several programs associated with technology updates to the communications systems that will bring additional improvements to service delivery and support future growth. As these are primarily driven by SOGR, they are included in the table above.

Activity	**Timeline**	**Program Cost** ($K, current planning period)
Non-Infrastructure		
No Wheel-Trans Vehicle Non-Infrastructure programs currently underway		
System Improvement		
Procure Pilot WT Buses to electrify fleet	2025-2028	$8,074
Growth		
No Wheel-Trans Vehicle Growth programs currently underway		
Data source: TTC T&V Group – Railcars and Shops, TTC Capital Investment Plan		

Table 5-E – Current & Planned Lifecycle Activities to Improve Service and Address Growth – Wheel-Trans Vehicles

5.5 Climate Change

The Innovation and Sustainability strategy outlines the plan to mitigate against the impacts of climate change. Pillar 2 of this plan focuses on environmental sustainability. Action 2.12 calls for the electrification of the Wheel-Trans Fleet to reduce GHG emissions.

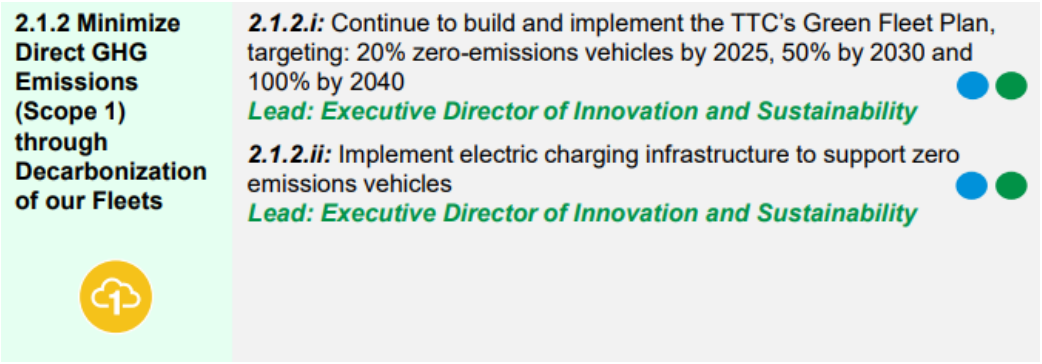


Figure 5-3: Action 2.1.2 Innovation and Sustainability strategy – Minimising Direct GHG emissions (scope 1) through decarbonisation of our fleets

In February 2025, the TTC awarded a contract for the supply and delivery of five battery-electric Wheel-Trans buses. Delivery will be completed by 2026 which will be followed by a two-year evaluation of the pilot vehicles which will inform technical and commercial specifications for future large-scale procurements as the TTC begins to transition to a zero-emissions fleet. The new Wheel-Trans fleet will offer customers a quieter ride, while reducing air pollution. Charging infrastructure will be installed ahead of bus deliveries to ensure all-electric buses are available for service. While undergoing the energy transition, the primary goal remains a fully accessible vehicle that meets the needs of TTC customers. As such, the Advisory Committee on Accessible Transit (ACAT) will remain a key evaluator for all-electric buses.

The TTC is committed to ensuring the resilience of transit assets and will be conducting a comprehensive assessment to identify vulnerabilities and risks to critical transit assets.

5.6 Lifecycle Investment Forecasts

At the current stage of asset management maturity, lifecycle investment needs are evaluated as the annualized cost to maintain SOGR, as outlined above. Estimates have also been made for the investment required to bring all assets to “Fair” or better condition over the planning period.

The following figures and table illustrate the full lifecycle investment forecasts for Wheel-Trans vehicle assets. The figures show the current funding by project type compared to the total overall funding required to maintain SOGR and deliver on selected service enhancement and growth projects. Condition remediation investment forecasts are also included.

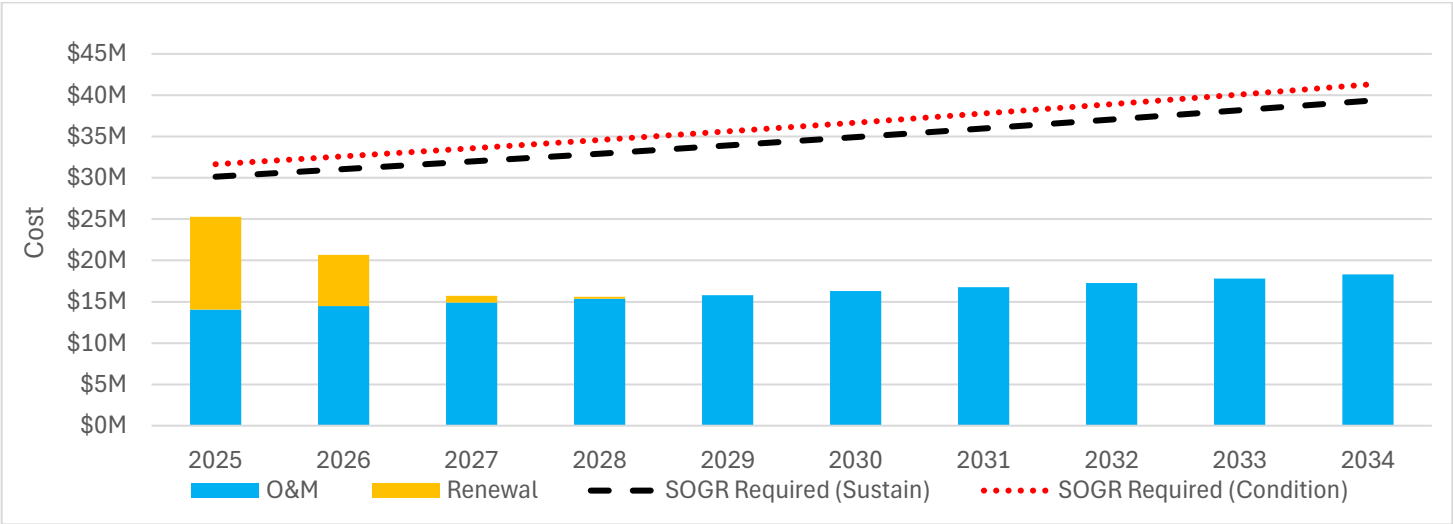


Figure 5-4: Funding vs Assessed Program Requirements – Wheel-Trans Vehicles (SOGR only)

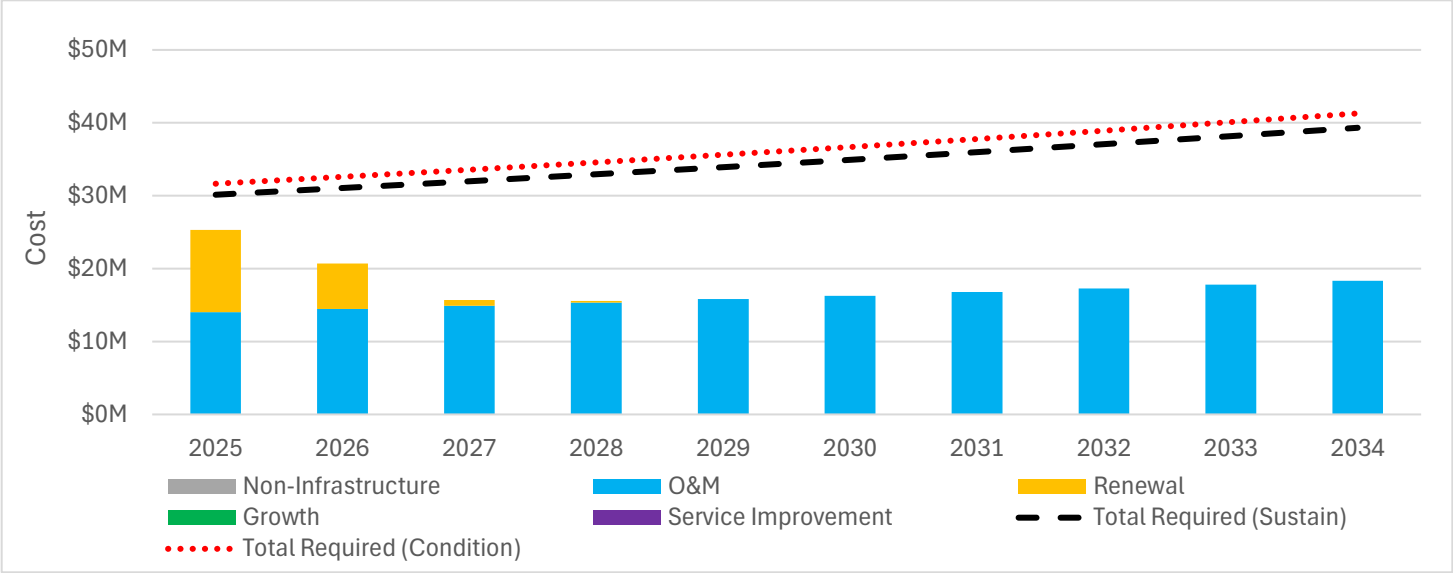


Figure 5-5: Funding vs Assessed Program Requirements – Wheel-Trans Vehicles

The following table summarizes the average annual budget and investment needs for the planning period:

Lifecyle Activity	Planned Budget ($K)	Investment Needed to Sustain LOS ($K)	Investment Needed to Address Condition Gap ($K)
Non-Infrastructure	$0	$0	$0
Maintenance	$16,105	$16,105	$16,105
Renewals	$1,850	$18,442	$20,172
Growth	$0	$0	$0
Service Improvement	$0	$0	$0
Total Expenditure	$17,954	$34,547	$36,277
Average annual SOGR Gap		$16,592	$18,322
Average annual Infrastructure Gap		$16,592	$18,322

Table 5-F – Annualized Funding vs Assessed Program Requirements – Wheel-Trans Vehicles

5.7 Conclusion & Risks

Current approved renewal funding for Wheel-Trans vehicles is not sustainable. There are no significant investments beyond 2026. Without dedicated sustained funding, Wheel-Trans LOS will experience major impacts. Furthermore, there are significant unknowns regarding future operating costs given the intention to transition to an electric fleet. Current sustaining funding models are based on gasoline fleet vehicles.

While service levels are currently good, there are substantial risks to the Wheel-Trans Program, as outlined below.

The most substantial risks identified for these assets are:

1. **If the planned procurements for electric buses and charging infrastructure post-2025 are not funded,** the TTC's bus service will be significantly impacted, and operating expenditures will escalate due to an

increase in required maintenance activities. This may result in proper lifecycle management no longer being adhered to, leading to obsolescence and potential fix on fail maintenance routines.

2. **Electrification will require modification, conceptual change, and a new maintenance approach** to delivering service that simultaneously affects our fleet, facilities, workforce skills, processes, service and support equipment. Such a significant change is unprecedented in the industry, and the TTC is not able to rely on industry knowledge, resulting in a high level of risk to all functions of the Bus Maintenance Department.
3. **The TTC is experiencing a surge of modernization** as it employs more sophisticated and intelligent equipment and systems in everyday operations. These modern equipment and systems are more expensive to operate, demand more of our workforce in terms of knowledge and competence and require external support that brings a new dimension to our operating environment.
4. **The supply chain has little operating experience with supplied equipment** due to electrification and modernization, as they trial and assess products for suitability to their business model. Bus maintenance is experiencing longer lead times, higher costs, and lower reliability and availability of required materials to maintain the revenue bus fleet. Also, global supply chain disruption and lingering effects from the COVID pandemic have contributed to long lead times, sometimes over a year, for many critical spare parts. Bills of Materials are now typically submitted two years before work starts, which compresses design schedules, reduces resilience, and increases warehousing costs.
5. **The current heavy-duty mechanic knowledge and skillset are not able to meet the demands of a modern and electrified transit fleet.** The industry is aware of this knowledge gap and is working with various stakeholders to determine the scope and means to upskill the workforce. However, workforce competence developments lag far behind the fleet technology change, which creates a high risk that the workforce will not be able to maintain the effectiveness and efficiency of diagnoses, repairs, and proactive maintenance methodology.
6. **The TTC is experiencing configuration inconsistencies across its fleet**, resulting in exponential complexity and difficulty in material management, training, diagnostics, and overall management of such a diverse fleet. There is a severe risk to maintaining current LOS if more variations to the operating fleet continue to be introduced.

6. Surface Vehicles & Equipment (Non-Revenue)

6.1 Introduction

TTC's non-revenue surface vehicles and equipment fleet is essential to the operation and maintenance of the network. The fleet consists of automotive on-road vehicles, off-road equipment and trailers.

Standard automotive vehicles are used alongside custom fabricated units for specific purposes, such as overhead streetcar wire de-icing, rail track mounted equipment, snow clearing, vacuum trucks, sweepers, rail sanding trailers, revenue support vehicles and many more.

Service Statement

> *"TTC non-revenue surface vehicles support overall transit services by enabling the effective direct transportation of TTC staff throughout the network, providing accessibility and support to conduct inspections, maintenance and repairs to surface infrastructure, allowing material handling and transportation, and providing the ability to undertake specialized maintenance and service work."*

Asset Breakdown

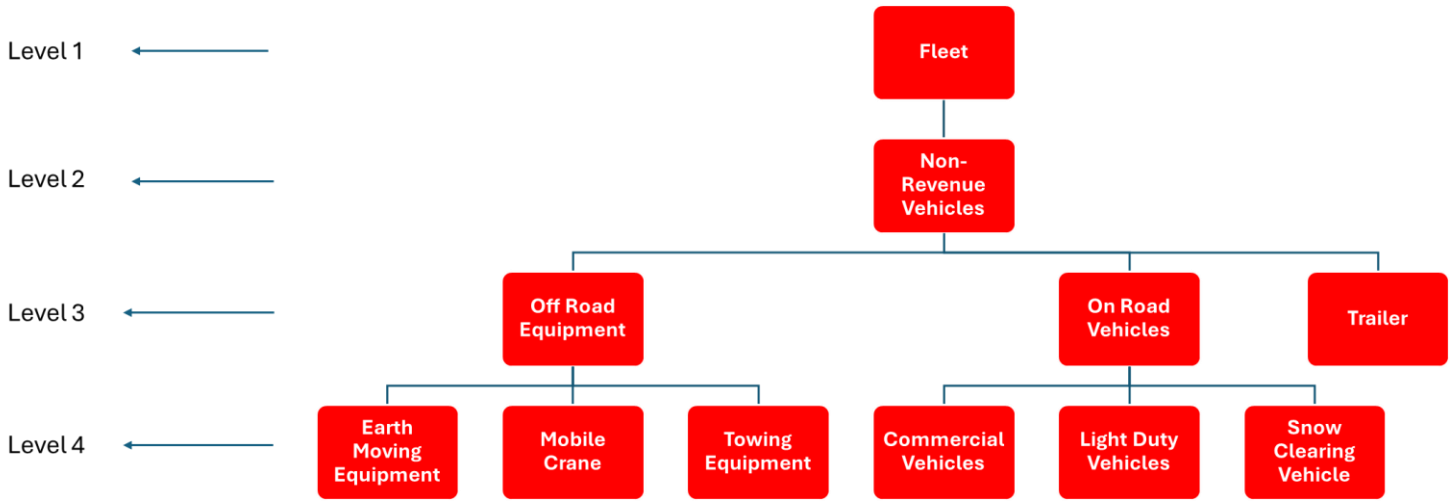


Figure 6-1: Asset Hierarchy – Non-revenue Surface Vehicles and Equipment

6.2 State of Infrastructure

The following figure outlines a high-level overview of the state of TTC's non-revenue surface vehicles and equipment assets:

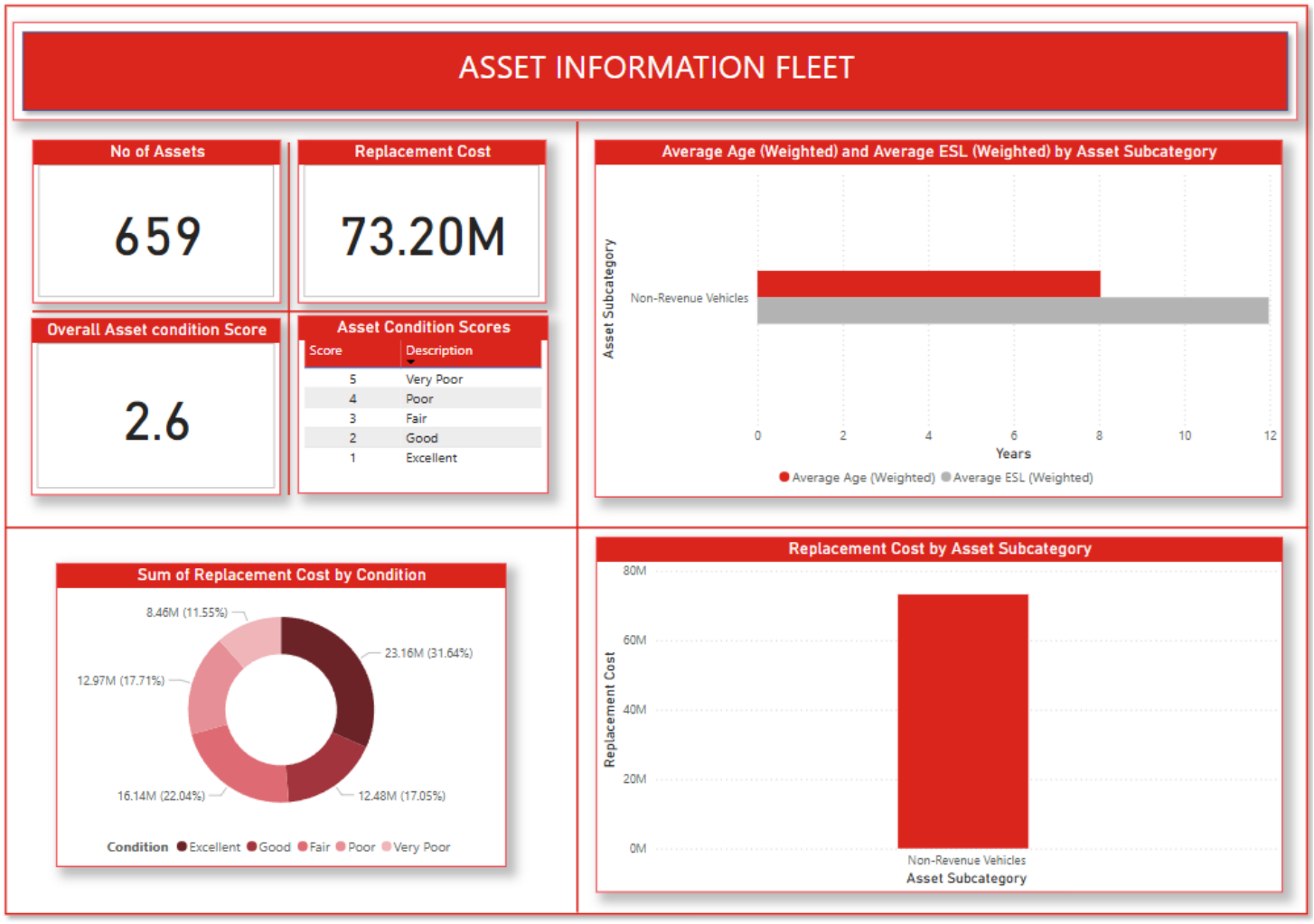


Figure 6-2: State of TTC Infrastructure Summary Dashboard – Non-revenue Surface Vehicles and Equipment

Asset Summary

Type	Sub-Asset Class	Quantity	Replacement Value ($M)	Average Condition	Average age (years)	ESL (years)
Off-Road Equipment	Earth Moving Equipment	26	3.79	3.6	15.81	17
	Mobile Crane	9	4.13	2.8	7.9	16
	Towing Equipment	22	2.08	2.9	11.34	15
On Road Vehicles	Commercial Vehicles	198	38.4	2.8	8.27	12
	Light Duty Vehicles	340	21.05	2.0	5.8	8
	Snow Clearing Vehicles	6	0.6	1.0	3	14
Trailer	N/A	58	3.14	2.6	9.8	16

Data Source(s): TTC Transportation and Vehicles Group

Table 6-A – Asset Summary – Non-revenue Surface Vehicles and Equipment

Condition Assessment

Yearly inspections are performed by TTC on each vehicle. These are primarily visual inspections and tests that verify and assess multiple systems of the road vehicle (e.g. Exterior Body, Engine Bay, Drive Line, Brake System, Steering/Suspension/Chassis, tires) and determine the need for repairs or interventions. A qualitative assessment is used to determine a condition score, based on the guidance given in the main document.

6.3 Levels of Service

Levels of Service (LOS) for TTC's non-revenue surface vehicles and equipment assets have been assessed in line with the overarching LOS framework presented in the main AMP document. Proposed LOS are encapsulated in the performance targets, as well as the initiatives outlined in the Future LOS table. The TTC believes that these proposed LOS are reasonably achievable given the available funding. Further details on risks and funding requirements are outlined in subsequent sections.

Where asset performance falls below target, the TTC will undertake action to address. In many cases this includes accelerated SOGR programs or modified maintenance activities. Additional details can be found in the asset class strategy summaries in the **TTC Asset Management Strategy** document.

Performance Summary

Overall, the non-revenue surface vehicle and equipment fleet is meeting LOS targets and expectations.

While the condition and performance of these assets are generally sufficient to support the required levels of service and largely meet operational performance targets, the high number of repeaters (vehicles and equipment which require regular repeated interventions) and average vehicle condition do not meet targets.

Current Levels of Service

Asset Category Customer Level of Service	Subcategory Technical Level of Service	Performance Measure	Current Performance	Target
Sufficient serviceable non-revenue fleet vehicles are available to ensure capacity meets infrastructure maintenance demand	The number of serviceable non-revenue surface vehicles available equals or exceeds the infrastructure maintenance needs forecast	Vehicle Qty	650 non-revenue surface vehicles	650
	Non-revenue surface vehicle maintenance needs do not substantially limit the availability of vehicles to perform work	Open Work Orders (0-5 days)	64%	Min 60% of total work orders
		Open Work Orders (5-10 days)	16%	Max 20% of total work orders
		Open Work Orders (10+ days)	21%	Max 20% of total work orders
All revenue fleet, maintenance fleet and equipment are appropriate, sufficient and maintained in a SOGR such that service affecting failures are minimized.	Non-revenue surface fleet is maintained in a state of good repair.	Assets in fair or better condition (value weighted average %)	71%	80%
		% of corrective work orders	7%*	Max 20% of total work orders
		% of preventative work orders	93%*	Min 80% of total work orders
		Repeaters	11%	5% of work orders
Service vehicles and equipment are inspected and maintained regularly to ensure they meet required regulatory and safety standards.	All in-service work cars meet safety requirements and have undergone required safety inspections (Safety inspection frequency)	% inspected within prescribed interval	100% (384 assets subjected to MTO annual inspection - average of 32 inspections per month)	100%
TTC will transition to zero emissions fleet vehicles as soon as practicable, in line with TTC's Green Fleet targets.	Non-revenue fleet will make efforts to trial and transition to zero emissions vehicles	Zero emissions vehicles trial underway	Pilot program of 7 Electric Vehicles is underway for 2025	-

Table 6-B – Current Levels of Service – Non-revenue Surface Vehicles and Equipment

Future Levels of Service

Asset Category Customer Level of Service	Asset Future Levels of Service	Actions	Target Date	Initiative
TTC will transition to zero emissions fleet vehicles as soon as practicable, in line with TTC's Green Fleet targets.	Transition all city buses, wheel- trans buses, and non-revenue vehicles to 100% zero-emissions by 2040	Upgrade to ensure a fully electric fleet is in use to meet Green Fleet targets	2040	Innovation & Sustainability Strategy Action 2.1.2

Table 6-C – Future Level of Service Initiatives – Non-revenue Surface Vehicles and Equipment

6.4 Lifecycle Management Activities

The following table outlines the assessed lifecycle activities required to maintain non-revenue surface vehicles and equipment in a SOGR:

Activity	Frequency	Annualized Cost ($K)
Non-Infrastructure		
Administrative overhead, process continuous improvement	As required	-
Maintenance		
Ariel Lubes – Lubrication of Ariel Device associated systems (Millwrights support)	90 days	$11,533
MTO - Inspection and repairs associated with Highway traffic act	1 Year	
Emissions Testing – To be compliant with Ontario Reg – Vehicle emissions	1 Year	
Major Service – Lube and services are evaluated and completed within OEM recommended internals (Transmissions service, Differentials, Transfer case, Coolant)	Bi-Annual	
Minor Service - Lube and services are evaluated and completed within OEM recommended internals (Transmissions service, Differentials, Transfer case, Coolant)	Bi-Annual (offset 6 months with Major Service)	
Seasonal Preparation – Full inspections on fleet required for seasonal specific tasks and installation and/or removal of accessories (e.g. snow, blades, slaters)	Bi-Annual	
Dielectric Testing – Inspect and repair all isolation points on vehicles with devices to assist workforce on the Streetcar Overhead lines	1 Year	
High Rail Inspections – Inspect all equipment on vehicles with rail adapters	1 Year	
Waste Tank Services – Associated with waste removal vehicles (includes inspections of Tank by leakage test, Piping, Valves, seals)	1 Year	
Ariel Device PM – Includes Dielectric, Structural, Hi Rail, Hydraulics	1 Year	
Mobile Cranes – PM inspection of structural, hydraulics, winch/lifting devices	1 Year	
Magnetic Flux – Inspections associated with hooks and grapples on speciality equipment	1 Year	
Fuel Tank Inspections – inspect bulk fuel storage cell on equipped vehicles	1 Year	

Capitalised Overhauls & Renewals		
Replacement at End of Life – Road Vehicles	7[24]	$5,744
Revenue at end of life – Off road vehicles and equipment	11[24]	$668
Data source: TTC T&V Group – Bus Maintenance & Shops, TTC Capital Investment Plan		

Table 6-D – Lifecycle SOGR Activities – Non-revenue Surface Vehicles and Equipment

The following table provides examples of lifecycle activities that are undertaken to provide improvements to service and address ridership growth and system network expansion (meet proposed future levels of service).

Activity	**Timeline**	**Program Cost** ($K, current planning period)
Non-Infrastructure		
No Non-revenue Surface Vehicle and Equipment Non-Infrastructure programs currently underway		
System Improvement		
No Non-revenue Surface Vehicle and Equipment Service Improvement programs currently underway		
Growth		
Procurement of additional fleet to support various TTC departments in their expansion and increased scope	2025-2034	$32,357
Data source: TTC T&V Group – Railcars and Shops, TTC Capital Investment Plan		

Table 6-E – Current & Planned Lifecycle Activities to Improve Service and Address Growth – Non-revenue Surface Vehicles and Equipment

6.5 Climate Change

The Innovation and Sustainability strategy outlines the plan to mitigate against the impacts of climate change. Pillar 2 of this plan focuses on environmental sustainability. Action 2.12 calls for the decarbonization of TTC Fleet vehicles, including non-revenue road vehicles, to reduce GHG emissions.

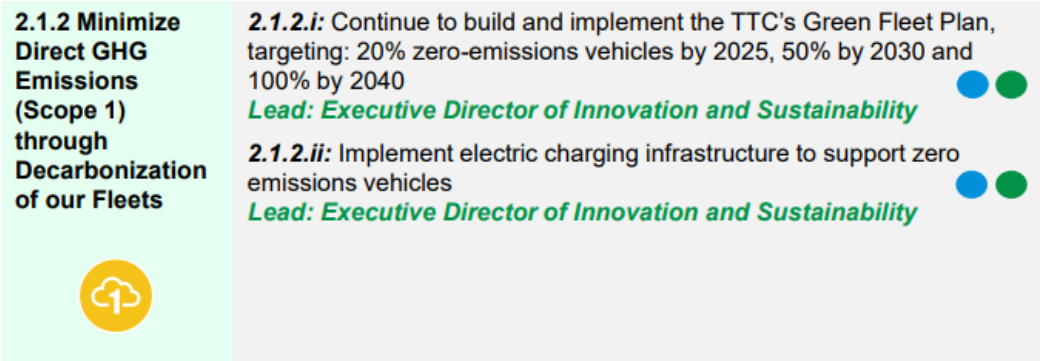


Figure 6-3: Action 2.1.2 Innovation and Sustainability strategy – Minimising Direct GHG emissions (scope 1) through decarbonisation of our fleets

[24] Average expected service life shown. Varies with vehicle/equipment type.

In 2024, the TTC launched an initiative to pilot electric non-revenue fleet. TTC currently own seven electric vehicles as part of that pilot, supported by four electric vehicle charging points. The TTC plan to expand the proportion of electric vehicles in 2025, 2026 and beyond to meet the Green Fleet target of transitioning all non-revenue fleet vehicles to 100% zero emissions by 2040.

The TTC is committed to ensuring the resilience of transit assets and will be conducting a comprehensive assessment to identify vulnerabilities and risks to critical transit assets.

6.6 Lifecycle Investment Forecasts

At the current stage of asset management maturity, lifecycle investment needs are evaluated as the annualized cost to maintain SOGR, as outlined above. Estimates have also been made for the investment required to bring all assets to “Fair” or better condition over the planning period.

The following figures and table illustrate the full lifecycle investment forecasts for TTC’s non-revenue surface vehicles and equipment assets. The figures show the current funding by project type compared to the total overall funding required to maintain SOGR and deliver on selected service enhancement and growth projects. Condition remediation investment forecasts are also included.

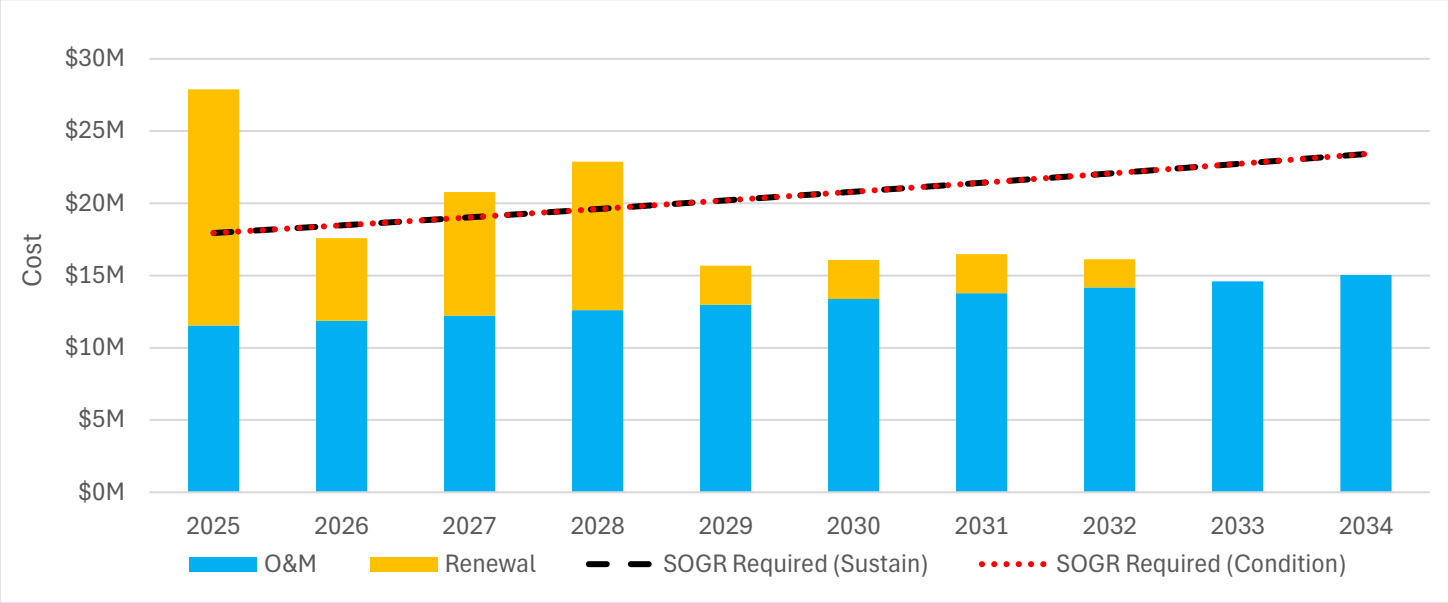


Figure 6-4: Funding vs Assessed Program Requirements – Non-revenue Surface Vehicles and Equipment (SOGR only)

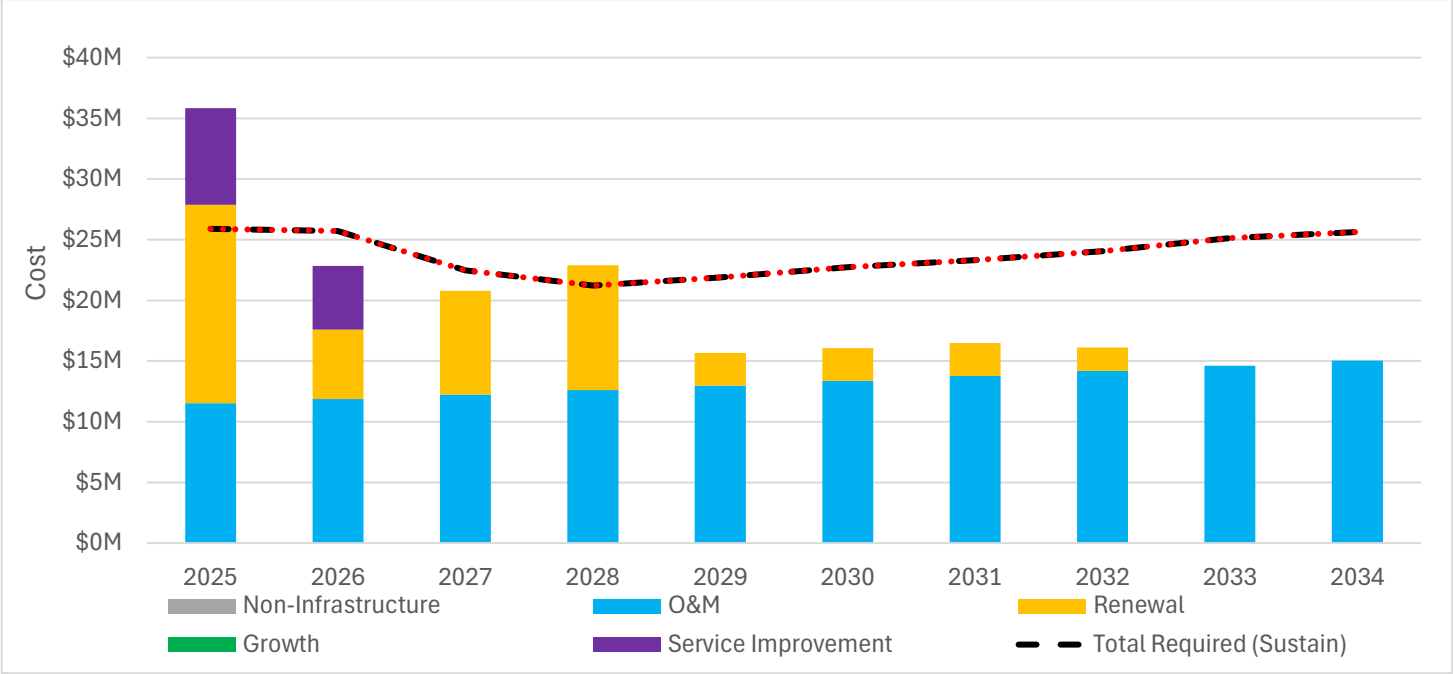


Figure 6-5: Funding vs Assessed Program Requirements – Non-revenue Surface Vehicles and Equipment

The following table summarizes the average annual budget and investment needs for the planning period:

Lifecyle Activity	Planned Budget ($K)	Investment Needed to Sustain LOS ($K)	Investment Needed to Address Condition Gap ($K)
Non-Infrastructure	$0	$0	$0
Maintenance	$13,222	$13,222	$13,222
Renewals	$5,094	$7,350	$7,350
Growth	$0	$0	$0
Service Improvement	$1,320	$3,236	$3,236
Total Expenditure	$19,636	$23,808	$23,808
Average annual SOGR Gap		$2,256	$2,256
Average annual Infrastructure Gap		$4,171	$4,171

Table 6-F – Annualized Funding vs Assessed Program Requirements – Non-revenue Surface Vehicles and Equipment

6.7 Conclusion & Risks

Overall performance of non-revenue surface vehicles and equipment against current level of service expectations is good. However, availability of vehicles to undertake work is often cited as a key constraint, suggesting that expectations (and LOS targets) are low. This constraint presents a risk to the timely execution of work, and overall system reliability. Current approved funding, while largely sufficient to sustain the existing fleet, does not account for the growth requirements, or the current advanced age (and resulting poor condition) of many assets.

The most substantial risks identified for these assets are:

1. **Funding required to procure more aggressively**, to bring support vehicle fleet age down to midlife. Current funding levels will not facilitate a fleet that has an average age of ‘mid-life’, so certain vehicles are exceeding their life expectancy. Funding is required for vehicle purchase, but also for resources to produce vehicle specifications. There is a risk of an increase in associated maintenance costs and faults and that service levels cannot be maintained as the fleet requires additional maintenance and repair.
2. **Growth of EV infrastructure does not keep pace with acquisition of vehicles**. There is currently a low-medium risk that as the number of EV vehicles in service increases (as the TTC transition to an EV fleet) they not supported by an appropriate level of EV charging facilities and other infrastructure to support effective maintenance and repair activities. The performance and reliability of this new evolving technology is also not yet well understood. This may lead to delays and a reduction in the availability of the non-revenue fleet and adversely impact the service levels of these vehicles.
3. **Spatial requirements within the Duncan facility do not meet current and future fleet requirements.** The existing facility is likely to be insufficient to undertake work efficiently on an expanded fleet.
4. **Difficulties and complexities in communicating requirements is impacting procurement timescales.** Current procurement leads are approaching 30 weeks, far exceeding targets of 16-18 weeks. This negatively impacts the ability to put out a scheduled service.

7. Rail Vehicles (Non-Revenue)

7.1 Introduction

TTC's non-revenue rail vehicle fleet is used to support maintenance activities within the subway system, such as track, structure, and signal maintenance. Some of the equipment is purchased new, while others are unique vehicles, which have been converted from decommissioned revenue service cars.

There are 77 rail service vehicles that include, but are not limited to, tunnel leak cars, asbestos crew cars, ballast cars, snow blowers, flatcars, and inspection vehicles.

Service Statement

TTC non-revenue rail vehicles support overall transit services by enabling the effective and efficient execution of TTC maintenance activities along the subway network.

Asset Breakdown

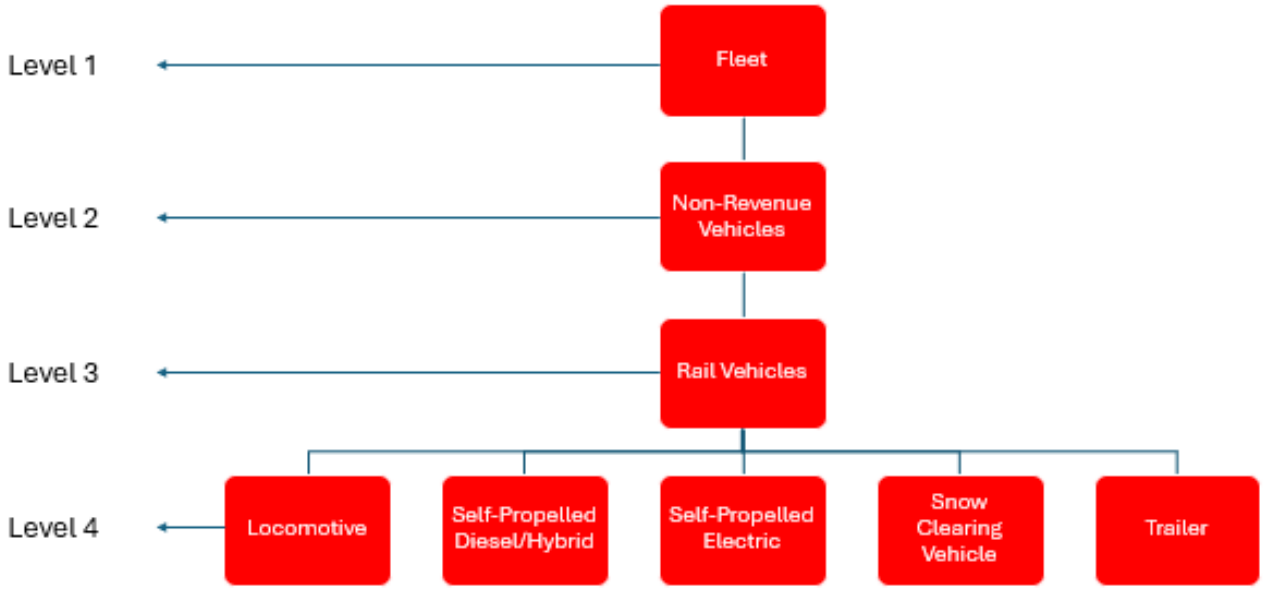


Figure 7-1: Asset Hierarchy – Non-revenue Rail Vehicles

7.2 State of Infrastructure

The following figure outlines a high-level overview of the state of TTC's non-revenue rail vehicles:

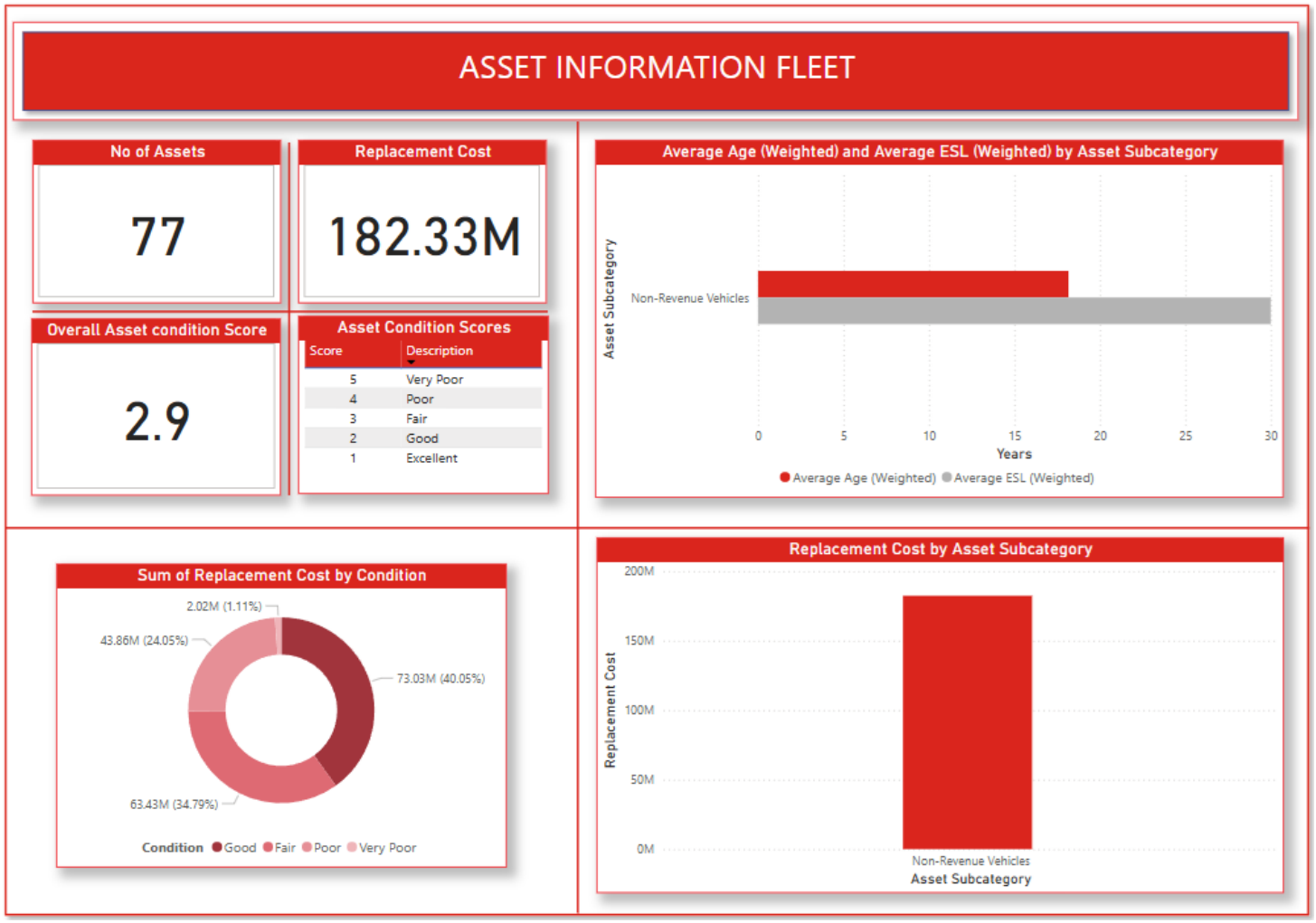


Figure 7-2: State of TTC Infrastructure Summary Dashboard – Non-revenue Rail Vehicles

Asset Summary

Type	Sub-Asset Class	Quantity	Replacement Value ($M)	Average Condition	Average age (years)	ESL (years)
Rail Vehicles	Locomotive	3	13.69	3.3	22.4	30
	Self-Propelled Diesel/Hybrid	13	44	2.4	13.4	30
	Self-Propelled Electric	38	105.4	3	19.2	30
	Snow Clearing Vehicle	6	2.87	3	26	30
	Trailer	17	16.30	3.1	19.44	30
Data Source(s): TTC Transportation and Vehicles Group						

Table 7-A – Asset Summary – Non-revenue Rail Vehicles

Condition Assessment

At present, age is the only factor that TTC considers when making decisions on the replacement of non-revenue rail vehicles. Therefore, asset age has been used as the only factor for condition rating. The condition score is given with the following criteria:

1. **Excellent** – asset is in its first quarter of its designed service life (0-8 years)
2. **Good** – asset is in its 2nd quarter of its designed service life (9-15 years)
3. **Fair** – asset is in its 3rd quarter of its designed service life (16-23 years)
4. **Poor** – asset is in its last quarter of its designed service life (23-30 years)
5. **Very Poor** – asset has passed its designed service life (>30 years)

As the TTC continues to mature its asset management program, condition assessment methodologies will be refined to reflect a more complete understating of asset state and to increase data confidence.

7.3 Levels of Service

Levels of Service (LOS) for TTC's non-revenue rail vehicle assets have been assessed in line with the overarching LOS framework presented in the main AMP document. Proposed LOS are encapsulated in the performance targets, as well as the initiatives outlined in the Future LOS table. The TTC believes that these proposed levels of service are reasonably achievable given the available funding. Further details on risks and funding requirements are outlined in subsequent sections.

Where asset performance falls below targets, the TTC will undertake action to address. In many cases this includes accelerated SOGR programs or modified maintenance activities. Additional details can be found in the asset class strategy summaries in the **TTC Asset Management Strategy** document.

Performance Summary

FAIR

Overall, the non-revenue rail vehicle and equipment fleet is approaching level of service targets and expectations.

Vehicle condition and reliability is impacting the ability of subway maintenance crews to execute work.

Current Levels of Service

Asset Category Customer Level of Service	Subcategory Technical Level of Service	Performance Measure	Current Performance	Target
Sufficient serviceable non-revenue fleet vehicles are available to ensure capacity meets infrastructure maintenance demand	The number of serviceable non-revenue subway trains available equals or exceeds the infrastructure maintenance needs forecast	Vehicle Qty	77 work cars	77 work cars[25]
Revenue fleet, maintenance fleet and equipment deliver services on-time, per posted schedule	Serviceable non-revenue work cars are available for each day's maintenance window	Availability	76%	90%
Revenue fleet, maintenance fleet and equipment are appropriate, sufficient and maintained in a SOGR such that service affecting failures are minimized.	Non-revenue rail vehicle fleet is maintained in a SOGR	Assets in fair or better condition (value weighted average %)	67%	80%
Service vehicles and equipment are inspected and maintained regularly to ensure they meet required regulatory and safety standards.	All in-service work cars meet safety requirements and have undergone required safety inspections (Safety inspection frequency)	Work car safety inspection adherence	Work cars are not put into service without having undergone safety inspections	-

Table 7-B – Current Levels of Service – Non-revenue Rail Vehicles

Future Levels of Service

Asset Category Customer Level of Service	Asset Future Levels of Service	Actions	Target Date	Initiative
TTC will transition to zero emissions fleet vehicles as soon as practicable, in line with TTC's Green Fleet targets.	Transition all non-revenue vehicles to 100% zero emissions by 2040.	Switch from diesel/hybrid vehicles and procure additional electric vehicles to meet Green Fleet targets	2040	TTC Green Fleet Targets

Table 7-C – Future Level of Service Initiatives – Non-revenue Rail Vehicles

[25] Anecdotal feedback and overall work car reliability suggest this target is artificially low.

7.4 Lifecycle Management Activities

The following table outlines the assessed lifecycle activities required to maintain non-revenue rail vehicles in a SOGR:

Activity	Frequency	Annualized Cost ($K)
Non-Infrastructure		
Administrative overhead, process continuous improvement	As required	-
Maintenance		
Daily preventative maintenance	Daily	$11,557
Periodic preventative maintenance (Inspections, cleaning, testing and replacement of consumables. As-required repairs)	Periodic	
Other OEM recommended maintenance work as required	Periodic	
Capitalised Overhauls & Renewals		
Work Car Overhaul Program	Continuous (covers multiple asset subcategories)	$2,615
Replace at end of life: Various non-revenue rail vehicles	20 Year	$6,078
Data source: TTC O&I Group – SEC, TTC Capital Investment Plan		

Table 7-D – Lifecycle SOGR Activities – Non-revenue Rail Vehicles

The following table provides examples of lifecycle activities that are undertaken to provide improvements to service and address ridership growth and system network expansion (meet proposed future levels of service).

Activity	Timeline	Program Cost ($K, current planning period)
Non-Infrastructure		
No non-revenue rail vehicle Non-Infrastructure programs currently underway		
System Improvement		
Purchase of Geometric/NDT Work car	2020-2027	$13,233
Retrofit of Automated Train Protection on existing Workcars	2016-2027	$2,298
Purchase of Multi-purpose Tamper	2024-2028	$4,765
Purchase of Rail Milling Workcar	2023-2026	$12,500
Growth		
Purchase Additional Workcars	2025-2027	$5,000
Purchase Additional Electric Combo Flatcars	2015-2023	$59
Purchase Dual Cab Electric Flatcar	2027-2032	$1,625
Data source: TTC T&V Group – Streetcar Maintenance, TTC Capital Investment Plan		

Table 7-E – Current & Planned Lifecycle Activities to Improve Service and Address Growth – Non-revenue Rail Vehicles

7.5 Climate Change

In response to the Green Fleets target to have fully electric non-revenue fleet by 2040, plans are being explored to replace diesel work cars with Battery Electric Vehicles (BEV).

The TTC is committed to ensuring the resilience of transit assets and will be conducting a comprehensive assessment to identify vulnerabilities and risks to critical transit assets.

7.6 Lifecycle Investment Forecasts

At the current stage of asset management maturity, lifecycle investment needs are evaluated as the annualized cost to maintain SOGR, as outlined above. Estimates have also been made for the investment required to bring all assets to “Fair” or better condition over the planning period.

The following figures and table illustrate the full lifecycle investment forecasts for TTC’s non-revenue rail vehicles. The figures show the current funding by project type compared to the total overall funding required to maintain SOGR and deliver on selected service enhancement and growth projects. Condition remediation investment forecasts are also included.

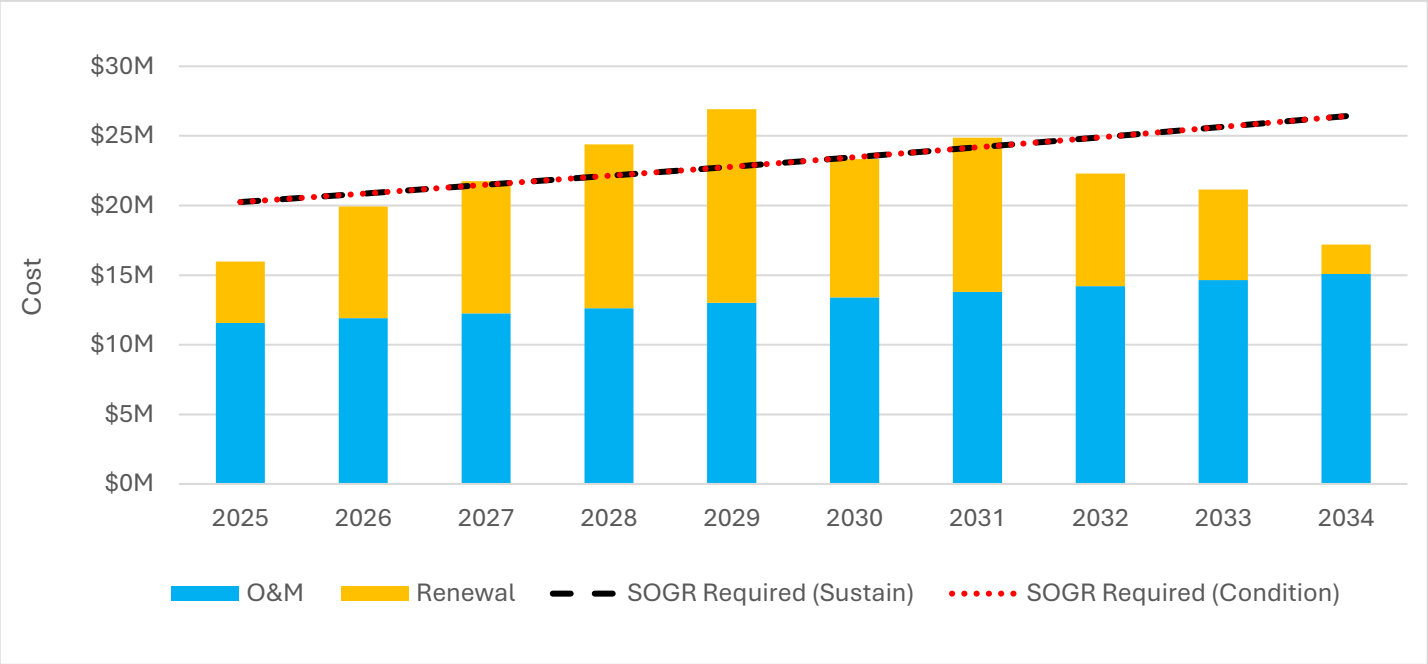


Figure 7-3: Funding vs Assessed Program Requirements – Non-revenue Rail Vehicles (SOGR only)

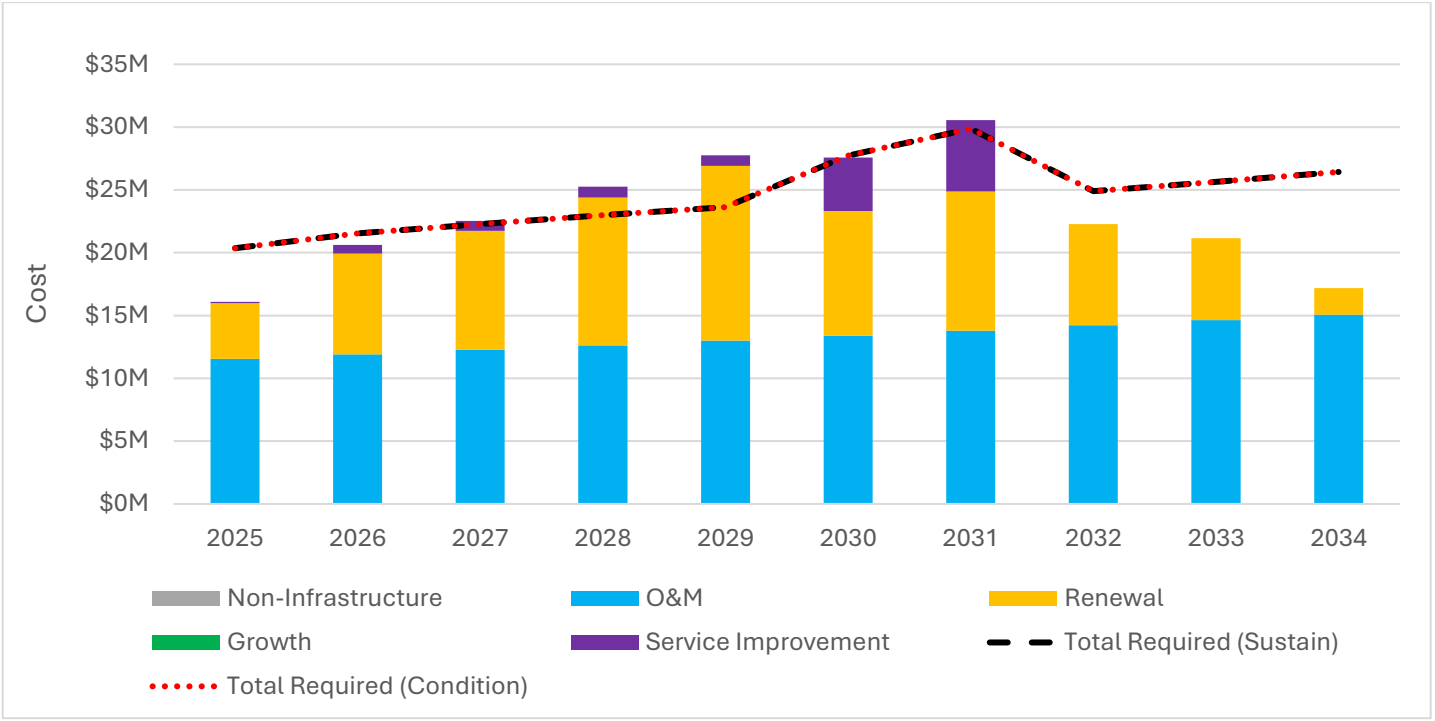


Figure 7-4: Funding vs Assessed Program Requirements – Non-revenue Rail Vehicles

The following table summarizes the average annual budget and investment needs for the planning period:

Lifecyle Activity	Planned Budget ($K)	Investment Needed to Sustain LOS ($K)	Investment Needed to Address Condition Gap ($K)
Non-Infrastructure	$0	$0	$0
Maintenance	$13,249	$13,249	$13,249
Renewals	$8,529	$9,965	$9,965
Growth	$0	$0	$0
Service Improvement	$1,323	$1,323	$1,323
Total Expenditure	$23,102	$24,537	$24,537
Average annual SOGR Gap		$1,436	$1,436
Average annual Infrastructure Gap		$1,436	$1,436

Table 7-F – Annualized Funding vs Assessed Program Requirements – Non-revenue Rail Vehicles

7.7 Conclusion & Risks

While the analysis undertaken in the preparation of this report suggests that funding levels are approaching levels required to sustain LOS and address the condition gap, in the case of these assets, there is the risk that the analysis methodology[26] has hidden some requirements. In general, work car condition and reliability does not meet expected service targets, and work car availability is often cited as a constraint in undertaking subway maintenance and lifecycle activities.

[26] The value weighted condition averaging methodology to determine condition gap investment requirements could mask older work cars needs behind good condition high-value electric vehicles.

The most substantial risks identified for these assets are:

1. **Long lead times with respect to vehicle repairs, modifications, and procurement**. Delays to the repair and modification of existing vehicles and the acquisition of new vehicles may result in a shortfall of necessary resources to undertake essential repairs and maintenance to subway infrastructure, resulting in a reduction in performance of the subway service.
2. **Resources required to improve preventative maintenance programs.** The non-revenue rail fleet has grown over the years, but the resources available to maintain the fleet has remained constant, leading to a lack of resources to implement and improve preventative maintenance programs.

8. Industrial Equipment

8.1 Introduction

TTC's industrial equipment is categorized into small handheld equipment and large mobile equipment housed in car houses and shops, with over 12,000 individual tracked assets in use throughout the network. This equipment is critical to the effective maintenance of TTC's fleet of buses, streetcars, rail cars, and non-revenue vehicles, as well as network infrastructure.

Service Statement

> *"TTC's Industrial Equipment assets support overall transit services by allowing staff to undertake maintenance activities safely and effectively."*

Asset Breakdown

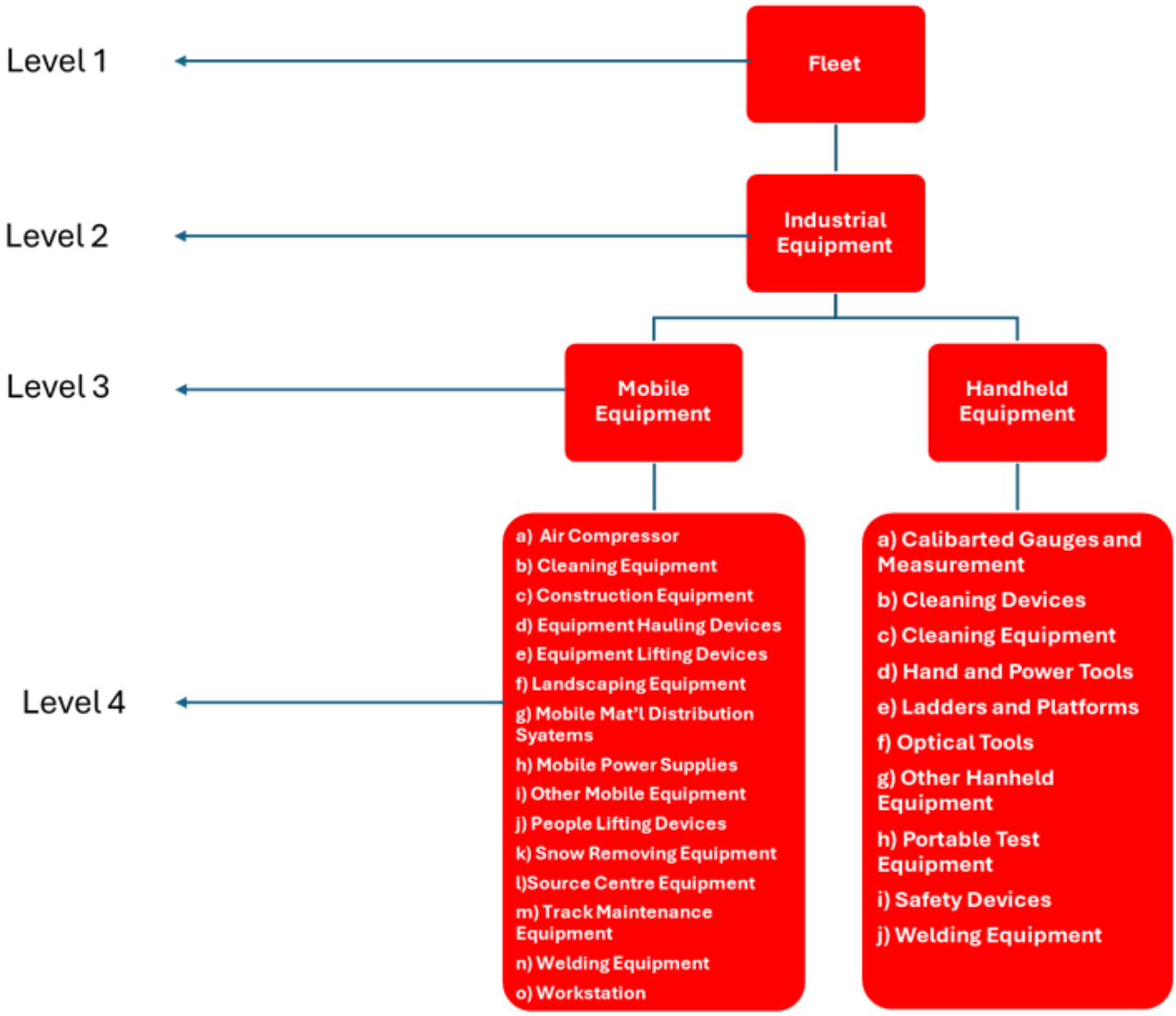


Figure 8-1: Asset Hierarchy – Industrial Equipment

8.2 State of Infrastructure

The following figure outlines a high-level overview of the state of TTC's industrial equipment assets:

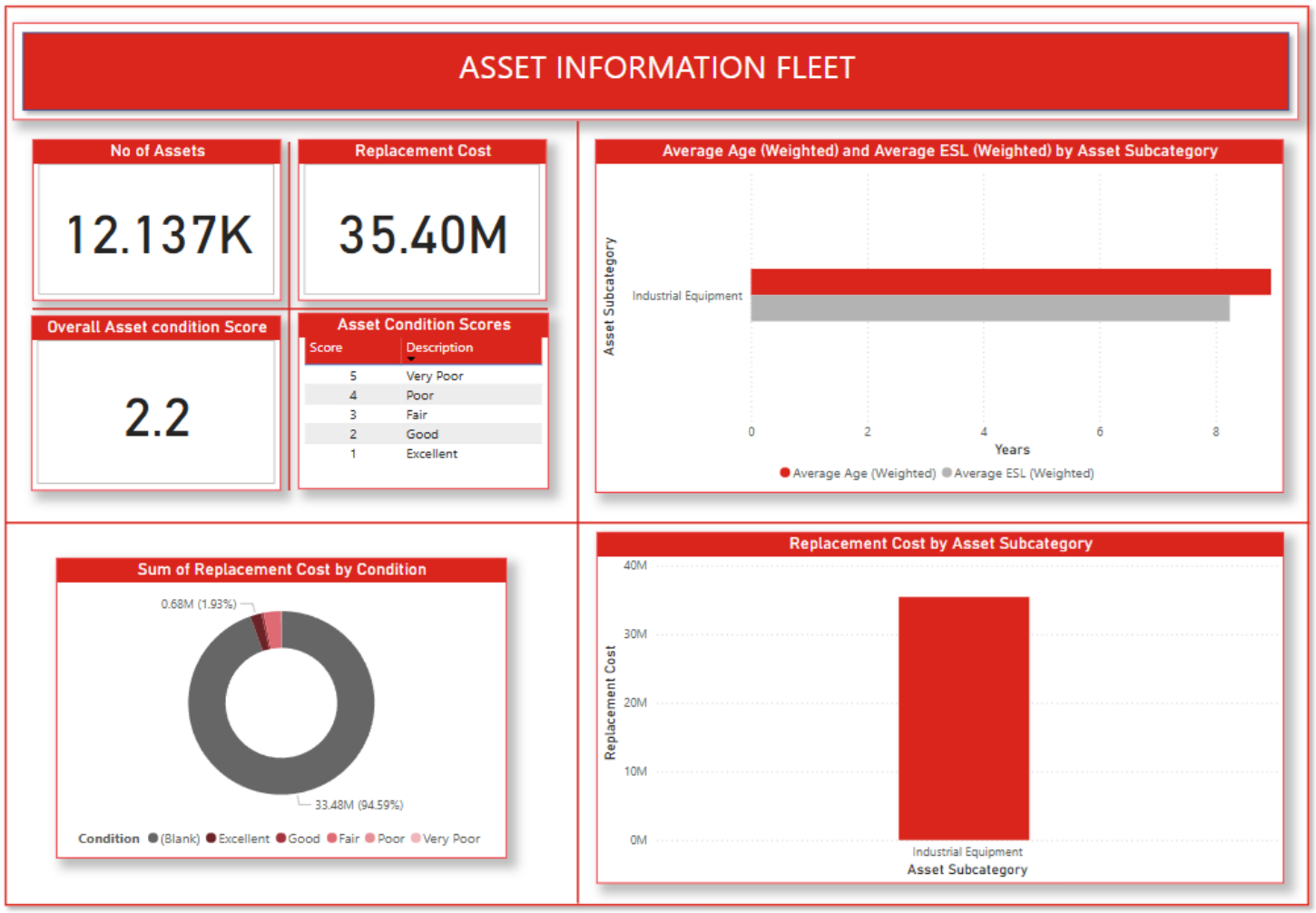


Figure 8-2: State of TTC Infrastructure Summary Dashboard – Industrial Equipment

Asset Summary

The criteria defining Industrial Equipment is currently undergoing review and refinement to ensure that the scope of assets included in this plan as well as the current hierarchical categorization. The current iteration covers all active tools and equipment that are in use of the three fleet maintenance departments:

- Rail Cars and Shops,
- Bus Maintenance and Shops,
- Streetcar Maintenance.

The varying information management tools used across the three departments, result in inconsistent data. In the future, a common standard shall be agreed upon by different teams on qualifying tools and equipment as a recordable asset. Additionally, standard attributes of the recordable tools shall be aligned across all management systems.

The current data maturity for TTC industrial equipment assets is very low. The results and analyses presented herein represent our best estimate given the data available. Due to these data gaps, the current plan reflects only the number of tools and equipment that are recorded in each information systems. The replacement value,

condition, asset age, expected service life as well as the detailed makes and models of each tool are only partially available thus are not included in the chart below.

Type	Sub-Asset Class	Quantity	Replacement Value ($M)	Average Condition	Average age (years)	ESL (years)
Handheld Equipment	Calibrated Gauges and Measurement	2,886				
	Cleaning Devices	173				
	Cleaning Equipment	-				
	Hand and Power Tools	2817				
	Ladders and Platforms	1248				
	Optical Tools	30				
	Other Handheld Equipment	1,435				
	Portable Test Equipment	458				
	Safety Devices	82				
	Welding Equipment	-				
Mobile Equipment	Air Compressor	99				
	Cleaning Equipment	-				
	Construction Equipment	3				
	Equipment Hauling Devices	252				
	Equipment Lifting Devices	1332				
	Landscaping Equipment	11				
	Mobile Mat'l Distribution Systems	204				
	Mobile Power Supplies	205				
	Other Mobile Equipment	253				
	People Lifting Devices	26				
	Snow Removing Equipment	18				
	Source Capture Equipment	221				
	Track Maintenance Equipment	14				
	Welding Equipment	201				
	Workstation	30				

Data Source(s): TTC Transportation and Vehicles Group

Table 8-A – Asset Summary – Industrial Equipment

Condition Assessment

Condition data across the large range of industrial equipment is not available and the TTC does not routinely undertake condition inspections on this equipment. Reactive assessment and disposal of this equipment is appropriate as there are sufficient spares readily available, such that there are no significant impacts on

operations. Small handheld devices are disposed of and replaced (if necessary) on failure or are no longer fit for purpose.

The condition assessment approach for this AMP is to elect top critical equipment for each fleet division. The condition evaluation of the critical equipment is based on its failure occurrence frequency:

Condition score	Failure occurrence	Probability of occurring on a specific Individual Item	Probability of occurring on the entire fleet or inventory
5	**Frequent**	Likely to occur often in the life of these items, probability of occurrence > 1E-1 in that life.	Continuously experienced
4	**Probable**	Will occur several times in the life of an item, probability of occurrence <1E-1 but >1E-2 in that life	Will occur frequently
3	**Occasional**	Likely to occur sometime in the life of an item, probability of occurrence <1E-2 but >1E-3 in that life	Will occur several times
2	**Remote**	Unlikely but possible to occur in the life of an item, probability of occurrence <1E-3 but >1E-6 in that life	Unlikely but can reasonably be expected to occur
1	**Improbable**	Very unlikely, probability of occurrence <1E-6 in that life	Unlikely to occur, but possible

Table 8-B – Condition Rating Methodology – Industrial Equipment

8.3 Levels of Service

Levels of Service (LOS) for TTC's industrial equipment assets have been assessed in line with the overarching LOS framework presented in the main AMP document. Proposed LOS are encapsulated in the performance targets, as well as the initiatives outlined in the Future LOS table. The TTC believes that these proposed LOS are reasonably achievable given the available funding. Further details on risks and funding requirements are outlined in subsequent sections.

Where asset performance falls below targets, the TTC will undertake action to address. In many cases this includes accelerated SOGR programs or modified maintenance activities. Additional details can be found in the asset class strategy summaries in the **TTC Asset Management Strategy** document.

Performance Summary

While, Industrial Equipment assets are currently supporting maintenance activities and are allowing work to be undertaken, there is insufficient data to provide a reasonable assessment of overall performance.

Current Levels of Service

Asset Category Customer Level of Service	Subcategory Technical Level of Service	Performance Measure	Current Performance	Target
Sufficient serviceable non-revenue fleet vehicles and equipment are available to ensure capacity meets infrastructure maintenance demand.	The quantity of industrial equipment available equals or exceeds the maintenance needs forecast	Quantity sufficient to meet capacity	12,000 Industrial Equipment assets	-
All revenue fleet, maintenance fleet and equipment deliver services on-time, per posted schedule	Industrial Equipment is available for each day's maintenance window	Availability	Not currently tracked	-
Revenue fleet, maintenance fleet and equipment are appropriate, sufficient and maintained in a SOGR such that service affecting failures are minimized.	Serviceable industrial equipment is maintained in a state of good repair	Assets in fair or better condition (value weighted average %)	98%[27]	80%
Service vehicles and equipment are inspected and maintained regularly to ensure they meet required regulatory and safety standards.	All critical industrial equipment meets safety requirements and have undergone required safety inspections (Safety inspection frequency)	% inspected within prescribed interval	For all safety critical Industrial Equipment as planned. No major non-conformalities	-

Table 8-C – Current Levels of Service – Industrial Equipment

Future Levels of Service

Asset Category Customer Level of Service	Asset Future Levels of Service	Actions	Target Date	Initiative
No initiatives currently planned or underway				

Table 8-D – Future Level of Service Initiatives – Industrial Equipment

[27] Among assets with known condition ratings (5.4% of the asset base by value)

8.4 Lifecycle Management Activities

The lifecycle activities of industrial equipment assets vary greatly depending on equipment type. These will typically include regular cleaning and inspection, functionality testing, and replacement-on-failure of system subcomponents. End of life activities typically involve disposal and procurement of a replacement.

The following table outlines the assessed lifecycle activities required to maintain industrial equipment assets in a SOGR:

Activity	**Frequency**	**Annualized Cost** ($K)
Non-Infrastructure		
Administrative overhead, process continuous improvement	As required	-
Maintenance		
Regular inspection, functionality testing, and servicing	On use or as scheduled	-[28]
Replacement-on-failure of non-capitalized assets	As required	
Capitalised Overhauls & Renewals		
Renew assets approaching EOL: Warehouse Consolidation – Materials Management	As required	$32
Renew assets approaching EOL: Vehicle Engineering Shop Equipment	As required	$17
Renew assets approaching EOL: Materials Management – WH and MAT Handling Equip	As required	$531
Renew assets approaching EOL: Vehicle Equipment	As required	$3,613
Data source: TTC T&V Group – Bus Maintenance and Shops, Streetcar Maintenance, Railcars and Shops, TTC Capital Investment Plan		

Table 8-E – Lifecycle SOGR Activities – Industrial Equipment

The following table provides examples of lifecycle activities that are undertaken to provide improvements to service and address ridership growth and system network expansion (meet proposed future levels of service).

Activity	**Timeline**	**Program Cost** ($K, current planning period)
Non-Infrastructure		
No industrial equipment Non-Infrastructure programs currently underway		
System Improvement		
No industrial equipment Service Improvement programs currently underway		
Growth		
No industrial equipment Growth programs currently underway		
Data source: TTC T&V Group, TTC Capital Investment Plan		

Table 8-F – Current & Planned Lifecycle Activities to Improve Service and Address Growth – Industrial Equipment

[28] Operating expenses relating to industrial equipment are currently included within revenue fleet and maintenance facilities operating budgets.

8.5 Climate Change

The TTC is currently assessing the feasibility of transitioning from fossil fuel to electric industrial equipment for select equipment types. No asset specific initiatives are currently underway.

8.6 Lifecycle Investment Forecasts

At the current stage of asset management maturity, lifecycle investment needs are evaluated as the annualized cost to maintain SOGR, as outlined above. Estimates have also been made for the investment required to bring all assets to “Fair” or better condition over the planning period.

The following figures and table illustrate the full lifecycle investment forecasts for TTC’s industrial equipment assets. The figures show the current funding by project type compared to the total overall funding required to maintain SOGR and deliver on selected service enhancement and growth projects. Condition remediation investment forecasts are also included.

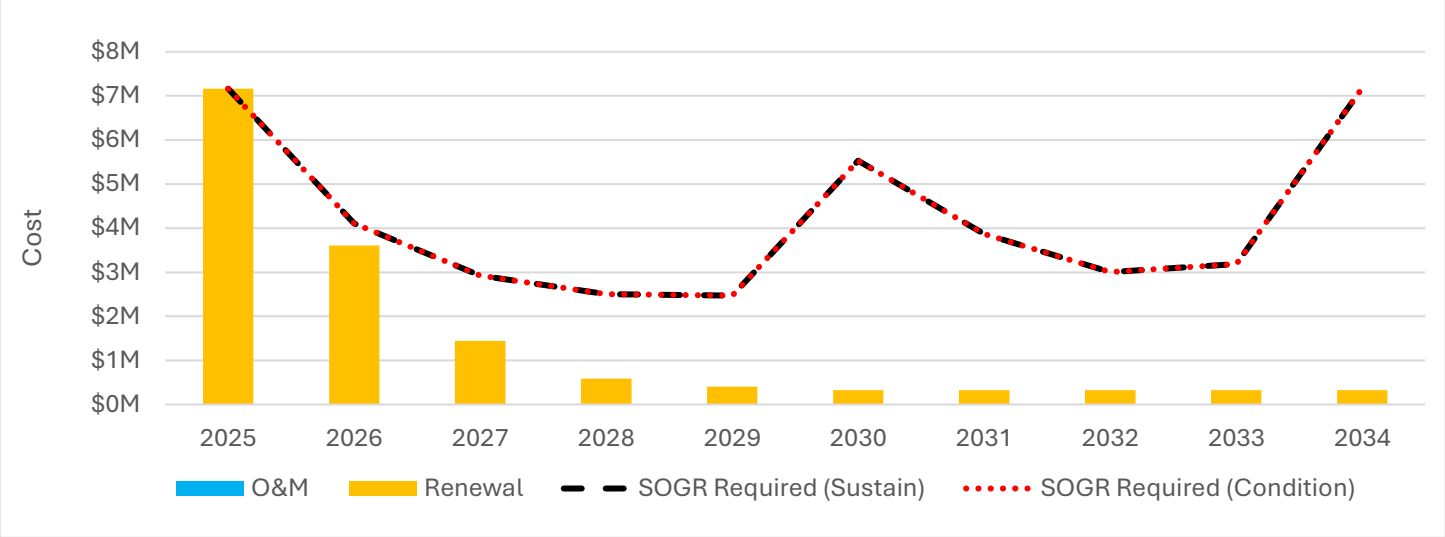


Figure 8-3: Funding vs Assessed Program Requirements – Industrial Equipment (SOGR only)

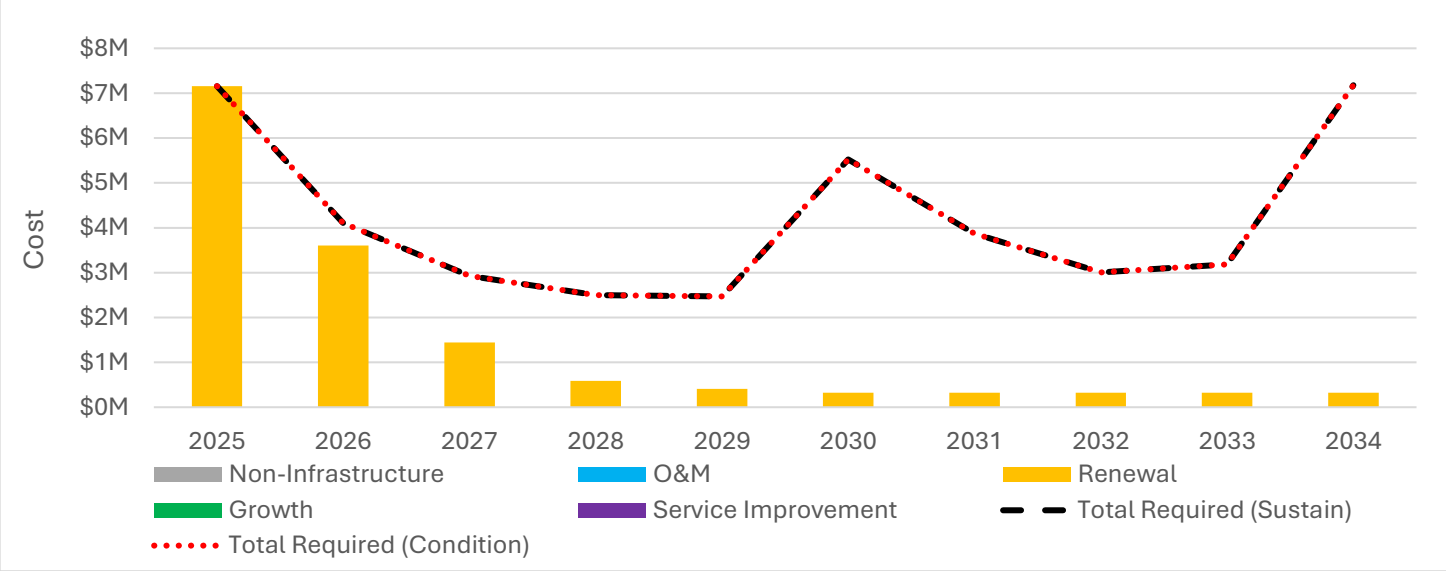


Figure 8-4: Funding vs Assessed Program Requirements – Industrial Equipment

The following table summarizes the average annual budget and investment needs for the planning period:

Lifecyle Activity	Planned Budget ($K)	Investment Needed to Sustain LOS ($K)	Investment Needed to Address Condition Gap ($K)
Non-Infrastructure	$0	$0	$0
Maintenance	$0	$0	$0
Renewals	$1,483	$4,192	$4,192
Growth	$0	$0	$0
Service Improvement	$0	$0	$0
Total Expenditure	$1,483	$4,192	$4,192
Average annual SOGR Gap		$2,709	$2,709
Average annual Infrastructure Gap		$2,709	$2,709

Table 8-G – Annualized Funding vs Assessed Program Requirements – Industrial Equipment

8.7 Conclusion & Risks

Analysis of the asset management needs and performance of TTC's industrial equipment is limited due to the current low level of asset data maturity. The results and assessments presented herein represents the best possible evaluation given the data at hand.

As the TTC's EAM maturity journey continues, efforts will be undertaken to improve data quality, resulting in more meaningful and reliable analysis.

The most substantial risks identified for these assets are:

1. **High-cost industrial equipment has limited redundancy.** Equipment, such as train washers, vehicle hoists and wheel turn machines are critical to service delivery. Long-term loss of this equipment risks affecting service availability and/or quality.

2. **Critical industrial equipment is under-invested.** The criticality of industrial equipment to maintaining service delivery is not always well understood or documented, primarily due to a lack of data of the Industrial Equipment asset base. Therefore, it is difficult to prioritize investment for Industrial Equipment and link this to service delivery.

3. **Procurement can be challenging.** Lack of suitable vendors to design, build and manufacture the industrial equipment needed by the TTC risks delays in obtaining the equipment necessary to maintain service delivery.

4. **Lack of sufficiently skilled resources** to support the process of procuring and specifying equipment risks delays in obtaining the equipment necessary to maintain service delivery.

ASSET MANAGEMENT PLAN 2025

APPENDIX B. Linear Infrastructure Asset Category Plan

Toronto Transit Commission

Contents

LIST OF TABLES

LIST OF FIGURES

1. Asset Category Overview - Linear Infrastructure

1.1 Introduction

Linear infrastructure consists of repeating sections of assets which provide a pathway for vehicles to move along between destinations, and the necessary support infrastructure to provide power to the vehicles. For TTC assets, this includes Subway Track, Streetcar Way and Overhead Contact System, along with related support structures such as poles, track substructure and joints or fixings, and additional assets that improve safety and support maintenance and cleaning activities. Although these supporting features can be classified as point assets, they are included with linear infrastructure due to the physical connections they often have to the linear assets and the owning departments within the TTC who are responsible for their maintenance.

Service Statement

> *"TTC linear infrastructure assets are essential for delivering safe, reliable, and efficient transit services. The TTC commits to maintaining these assets in a state of good repair to ensure continuous operation, minimize disruptions, and enhance passenger safety."*

Asset Breakdown

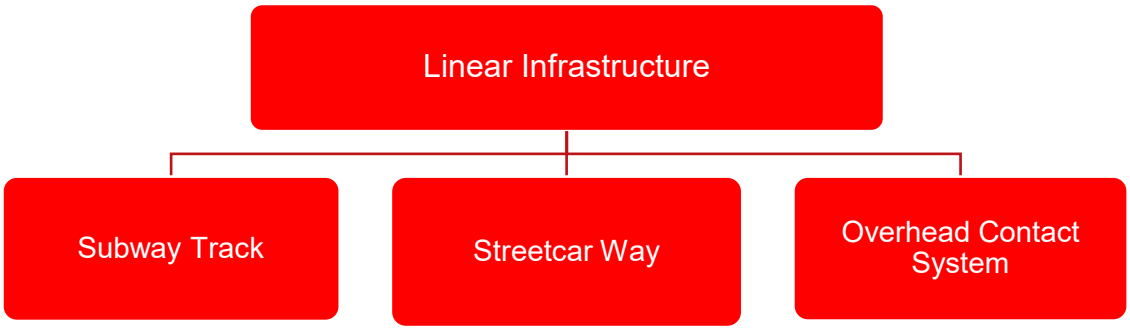


Figure 1-1: Asset Hierarchy – Linear Infrastructure

1.2 State of Infrastructure

The following figure outlines a high-level overview of the state of TTC Linear Infrastructure assets:

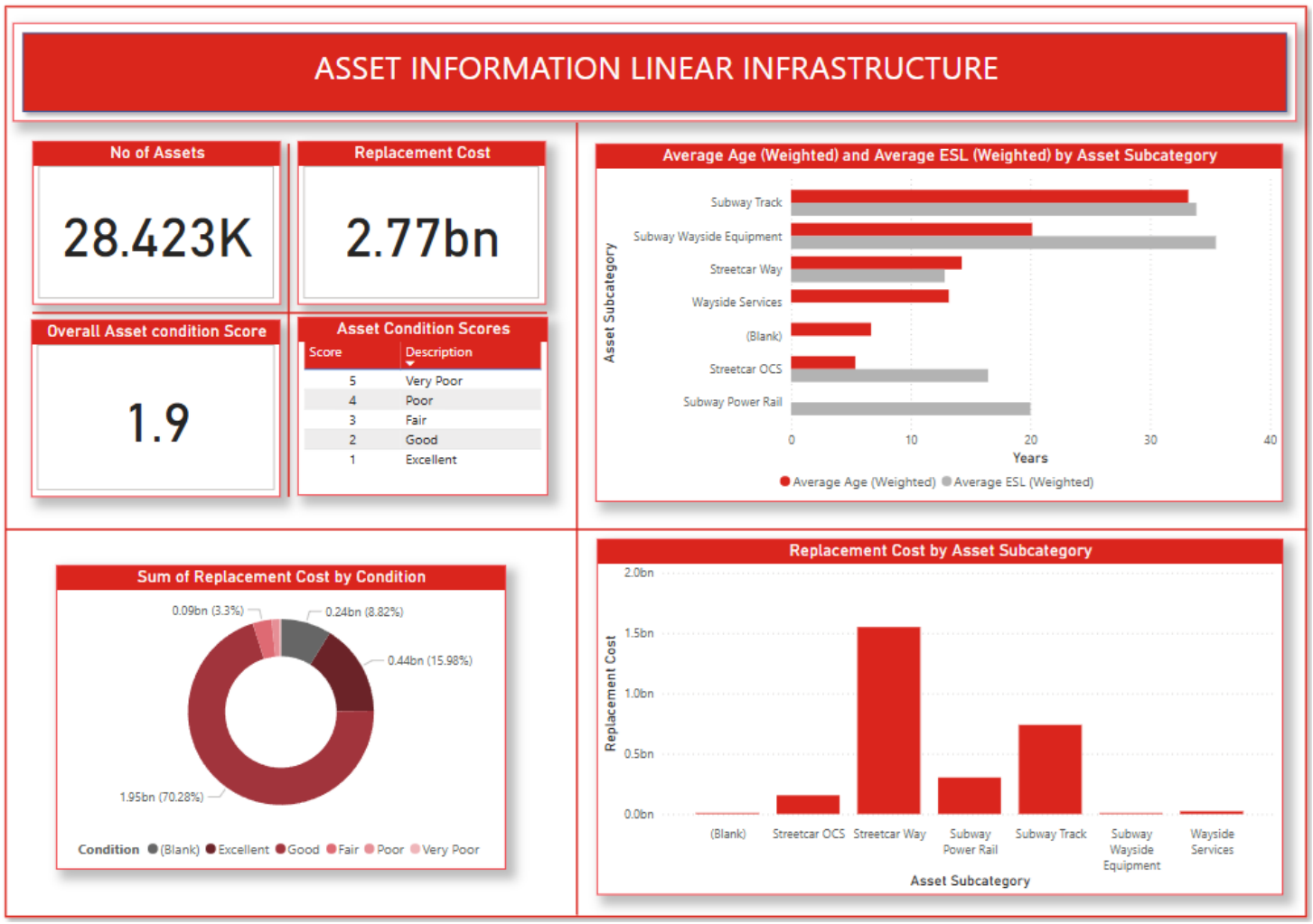


Figure 1-2: State of TTC Infrastructure Summary Dashboard - Linear Infrastructure

Whilst the condition of Linear Infrastructure assets falls within the Excellent to Good score, this rating is skewed by missing data which is not yet included in the asset register. Condition of Subway Track for example is predominantly based on rail wear, which despite being an important measure does not incorporate other assets which would contribute to the full picture of track health. A low confidence rating in the condition score reflects this on the following dashboard. A breakdown on the condition metrics used can be found in the subcategory sections below.

The replacement value of TTC Linear Infrastructure assets is approximately $2.77B, which differs from the $2.88 valuation in the 2024 AMP. The change in asset valuation results from new methodologies used, with the current assessment using a combination of individual asset component replacement costs aggregated alongside average length unit costs where appropriate. The TTC believe these values to be more representative of the true costs to replace the asset base, with further work needed to increase the confidence further from Fair to Excellent.

The current state of data quality/maturity among TTC assets is outlined in the following figure:

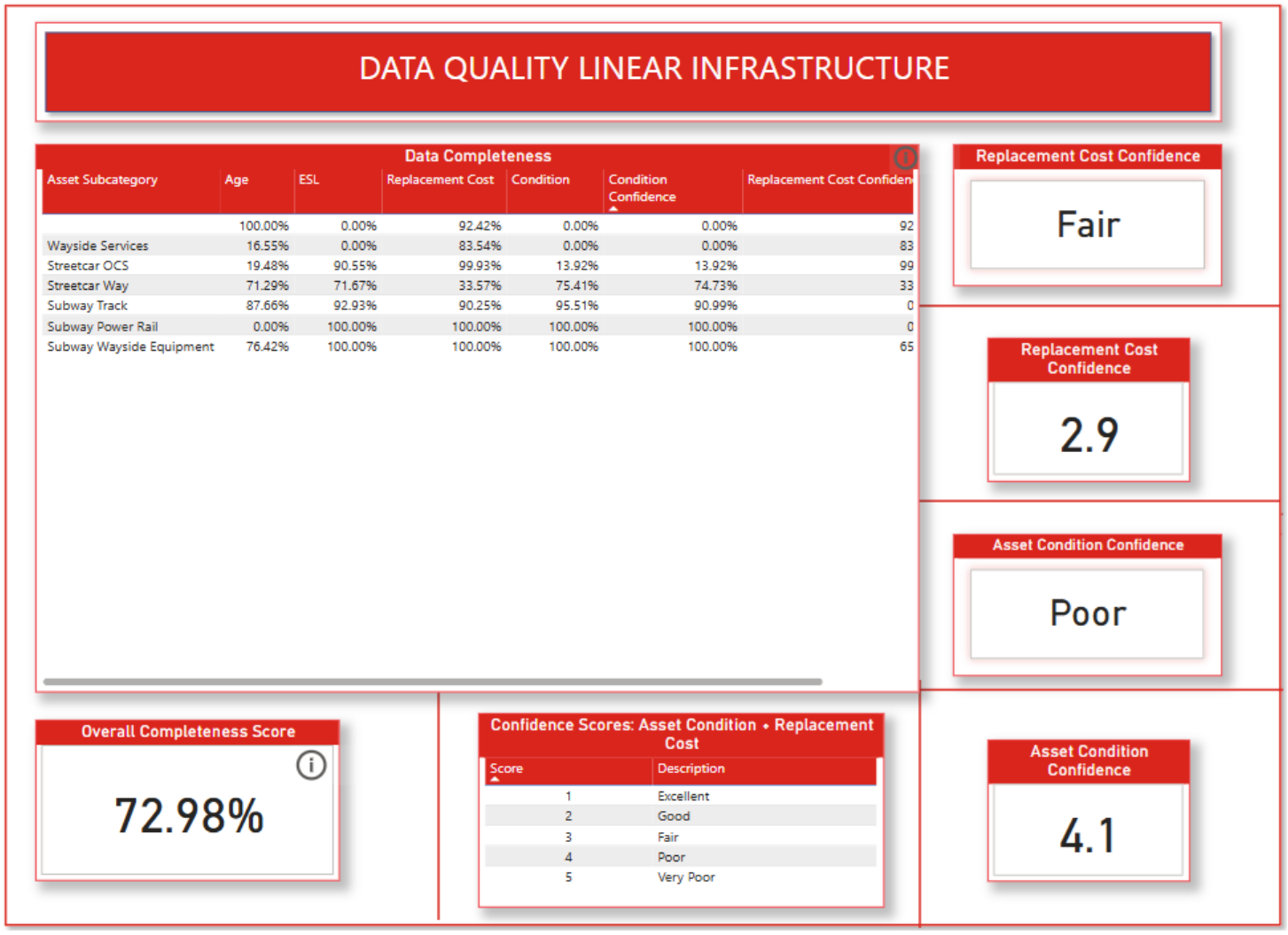


Figure 1-3: State of TTC Asset Data Summary Dashboard - Linear Infrastructure

Due to the low level of asset specific data maturity in Linear Infrastructure assets, the majority of key asset state data has been evaluated at the asset class level, rather that the individual asset level. This enabled organising and summarising estimated replacement cost, age, and asset condition in the previous table and the asset summary tables below. As the TTC's Enterprise Asset Management (EAM) transformation project continues efforts will be taken to improve data quality and address gaps, while simultaneously developing and embedding the processes to keep data up to date.

1.3 Asset Levels of Service

The following table outlines how the TTC Linear Infrastructure assets support the overarching Transit Levels of Service (LOS).

TTC's Transportation Services…	TTC's Linear Infrastructure Assets…
…**meet the route and ridership demands** of the travelling public.	…are sufficient and appropriate to meet ridership demands of the travelling public.
…**are reliable and on-time**, per the posted schedule/service plan.	…are maintained in a State of Good Repair (SOGR) such that service affecting failures and restricted speed zones are minimized.
…**are safe** to use.	…include safety assurance systems and are inspected within required timescales, minimizing transit system safety risks to the travelling public and community.
…**accommodate accessibility needs** of all customers.	…are constructed and maintained such that accessible movement of customers is facilitated across the network.
…meet customer expectations for **cleanliness, comfort, and convenience**.	…allow for comfortable, efficient travel for customers on the subway and streetcar networks.
…are designed in such a way as to **mitigate the environmental impact and build climate resilience** of transportation in the GTA.	…are maintained with a consideration for the environmental impact of these activities, such as the minimizing of waste material and energy.
…are undertaken in a **cost-efficient** manner, minimizing the cost to the city for the service provided.	…are managed in a cost-effective manner across the full lifecycle of the assets.

Table 1-1: TTC Asset Levels of Service - Linear Infrastructure

2. Subway Track

2.1 Introduction

TTC Subway Track includes the rails, switches, and the associated support infrastructure which fixes the rails in place and provides power to the vehicles through a power rail. Also included in this asset class are a variety of wayside equipment and services, which include access and safety features, and equipment installed adjacent to the track to support operation and maintenance, such as signage and markers.

Service Statement

> *"Subway track assets support efficient, comfortable travel be enabling the movement of revenue and non-revenue subway vehicles across the city through provision of rails, a power supply and the associated infrastructure needed to keep trains moving at required speeds."*

Asset Breakdown

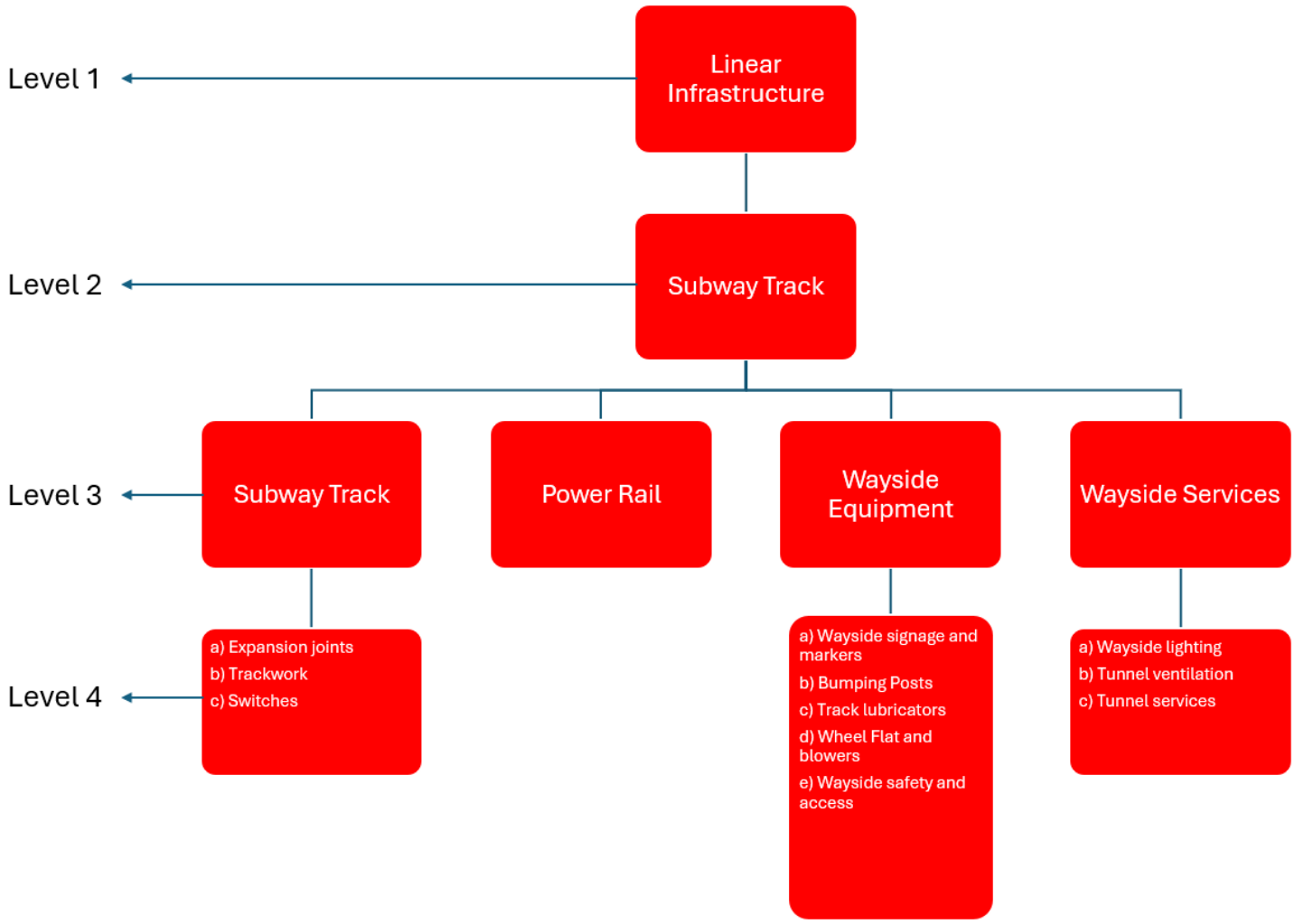


Figure 2-1: Asset Hierarchy – Subway Track

2.2 State of Infrastructure

The following figure outlines a high-level overview of the state of TTC Subway Track assets:

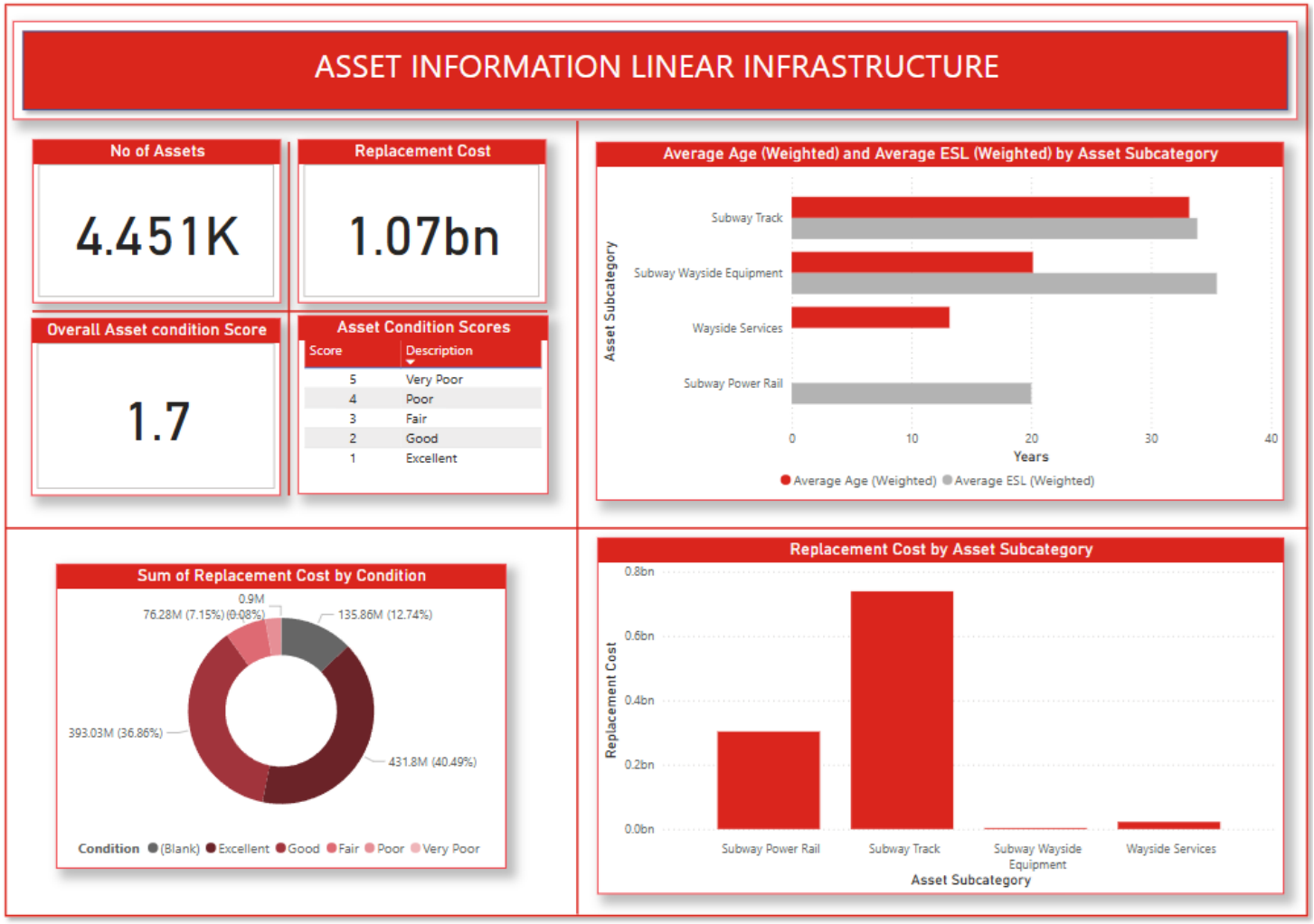


Figure 2-2: State of TTC Infrastructure Summary Dashboard – Linear Infrastructure

Asset Summary

Asset Class	Asset Subclass	Quantity	Replacement Value ($M)	Average Condition	Average age (years)	ESL (years)
Subway Track	Switches	373	229.2	1.9	30	40
	Trackwork	1687[29]	507.2	1.2	34	36
	Trackwork Components	1149	2.2	2	41	40
Power Rail	Power Rail Components	7	302.8	2	*	20
Wayside Equipment	Bumping Posts	81	2.1	1.9	22	40
	Track Lubricators	42	0.6	2.8	14	20
Wayside Services	Tunnel Services	13	0.08	*	*	*
	Tunnel Ventilation	1099	22.2	*	13	*

Data Source: TTC Operations & Infrastructure Group

Table 2-1: Asset Summary – Subway Track

The following table provides a further breakdown on the condition score of rail, based on wear measurements.

Line	Length (km)	Condition Score				
		1	2	3	4	5
Line 1	38	85%	14%	1%	0%	0%
Line 2	26	82%	16%	2%	0%	0%
Line 4	6	*Line 4 measurements not available for publication.*				

Data Source: TTC Operations & Infrastructure Group

Table 2-2: Asset Summary - Subway Track rail condition scores

Condition Assessment

The condition of mainline rail is evaluated through various inspection programs. On a biannual basis, rail wear is measured using a vehicle-mounted device that detects the vertical and horizontal rail profile, with thresholds assigned to convert the wear into a 1-5 condition score. A separate inspection records detailed measurements of Line 2 rail on a weekly basis. These measurements are collected using equipment installed on a T1 vehicle operating during revenue hours. Due to the T1 vehicles missing ATC equipment, this vehicle is unable to inspect Line 1.

Other sub assets within trackwork, including ballast, ties, fasteners and joints have condition scores based on deterioration recorded during detailed inspections. This data is in the process of being adapted to the format required for this report and is not yet available for publication in this report. A track condition index is in development by the Subway Track team which provides an overall score for each track section, based on

[29] Trackwork assets are instanced as track sections. These sections can vary in length.

weighted scores from each sub asset. Details on this index will be provided in future AMPs once the methodology is agreed.

Condition Score	Description	Rail Wear (inches)
1	Excellent	0-0.05
2	Good	0.05-0.2
3	Fair	0.2
4	Poor	0.375
5	Very Poor	0.5

Table 2-3: Rail Condition Scoring Methodology

The remainder of Subway Track assets listed in the summary table have a condition rating based on asset age. As the TTC continues to mature its asset management program, condition assessment methodologies will be refined to reflect a more complete understating of asset state and to increase data confidence.

2.3 Levels of Service

Levels of service (LOS) for Subway Track assets have been assessed in line with the overarching LOS framework presented in the main AMP document. Proposed LOS are encapsulated in the performance targets, as well as the initiatives outlined in the Future LOS table. The TTC believes that these proposed LOS are reasonably achievable given the available funding. Further details on risks and funding requirements are outlined in subsequent sections.

In the 2025 AMP, the performance measures for each LOS are based on existing measures collected by either the Subway Track team or the broader organization. As a result, there is scope to introduce new, optimized performance measures as the data maturity of the TTC increases over time. For example, a track condition index which consists of a weighted scoring of individual track components is in development. This may prove to be a more suitable future performance measure than the 2025 measures below.

Where asset performance falls below targets, the TTC will undertake actions to address. In many cases this includes accelerated SOGR programs or modified maintenance activities. Additional details can be found in the asset class strategy summaries in the **TTC Asset Management Strategy** document.

Performance Summary

Overall, Subway Track assets are approaching service targets and expectations.

While Subway Track components are generally maintained in a SOGR, there are insufficient recorded performance measures to fully assess subway track performance against LOS expectations. Despite the asset condition scores, customers experience service impacts through restricted speed zones and ineffective wheel-rail interface management. Further LOS are under investigation to give a clearer picture of performance.

Current Levels of Service

Asset Category Customer Level of Service	Subcategory Technical Level of Service	Performance Measure	Performance	Target
TTC Subway Track assets are sufficient and appropriate to meet ridership demands of the travelling public.	Subway track infrastructure does not limit the intended subway service plan	N/A	The network is sufficient to meet ridership needs.	-
TTC Subway Track assets are reliable and maintained in a SOGR such that service affecting failures and restricted speed zones are minimized.	Subway Track assets are maintained in a SOGR	% of all Subway Track assets in fair or better condition (value weighted)	95%	80%
		% of Rail in fair or better condition	100%	95%
		% of Turnouts in fair or better condition	92%	90%
		% of Ties in fair or better condition	84%	80%
	Subway Track assets are available for normal service operation	Number of restricted speed zones in effect		12 at any one time
TTC Subway Track assets allow for comfortable, efficient travel for customers on the subway network.	TTC effectively manages the wheel-rail interface to minimize noise and vibration	Number of active lubricators	57%	100%
		Customer noise complaints relating to noise and vibration	84	-

Table 2-4 – Current Levels of Service – Subway Track

Future Levels of Service

Asset Category Customer Level of Service	Asset Future Level of Service	Actions	Target Date	Initiative
TTC Subway Track assets allow for comfortable, efficient travel for customers on the subway network.	Improve lubrication across the network	Install lubricators at new locations, with remote monitoring functionality	Ongoing	N/A

Table 2-5 – Future Level of Service Initiatives – Subway Track

2.4 Lifecycle Management Activities

The lifecycle activities for Subway Track assets comprise of inspections and capitalized overhauls and renewals. Walked visual inspections are completed every 72 hours with an annual detailed inspection on the mainline. Due to the nature of the inspections, these are completed during non-revenue hours.

Capital overhauls and renewals are grouped into track and special trackwork rehabilitation programs, which include the replacement of all assets within the respective trackwork and switch subclasses. The assets in each subclass have varying service lives so are replaced at the appropriate frequency.

The following table outlines the assessed lifecycle activities requires to maintain Subway Track SOGR:

Activity	Frequency	Annualized Cost ($K)
Non-Infrastructure		
Administrative overhead, process continuous improvement	As required	-
Maintenance		
Visual walked inspection of mainline trackwork	72 Hours	$30,260
Visual inspection of yard trackwork	2 Year	
Detailed inspection of entire mainline	Annual	
Detailed inspection of Line 2	Weekly	
Detailed inspection of critically located special trackwork	Annual	
Detailed inspection of non-critically located special trackwork	2 Year	
Mainline lubricator inspection (location dependent)	1-2 Weeks	
Yard lubrication inspection	Monthly	
Asset-specific inspection, corrective maintenance and preventative maintenance from contractors	Annual	
Capitalized Overhauls & Renewals		
Trackwork		
Rail milling and grinding	3-4 Year	$6,318
Major maintenance of steel components	10-25 Year	$18,424
Ballast tamping and replacement	10-25 Year	
Re-insulation of trackwork	10-25 Year	
Renewal of power rail sections	10-25 Year	
Tie replacement	37-60 Year	
Switches		
Major maintenance of steel and tie replacement	10-25 Year	$12,815
Full turnout replacement (mainline)	20-50 Year	
Full turnout replacement (yards)	20-50 Year	
Wayside Services		
Replace lighting	-	$532
Replace lighting (open cut sections)	-	$9,493
Replace fire ventilation	-	$23,054
Wayside Equipment		
Replace track side heating equipment	-	$656
Data source: TTC O&I Group – Subway Track, TTC Capital Investment Plan		

Table 2-6 – Lifecycle SOGR Activities – Subway Track

The following table provides examples of lifecycle activities that are undertaken to provide improvements to service and address ridership growth and system network expansion (meet proposed future LOS).

It is important to note that there are several programs associated with updates to subway infrastructure that will bring additional improvements to service delivery, such as the replacement of ties with a composite material and lubricators with remote monitoring. As these are primarily driven by SOGR needs for assets during their end-of-life renewals, they are included in the capital activities above.

Further system improvements that are in the design and evaluation stage, such as the installation of direct fixation track, are not included in the 2025 AMP.

Activity	**Timeline**	**Program Cost** ($K, current planning period)
Non-Infrastructure		
No Non-Infrastructure programs currently underway		
System Improvement		
Conversion of SRT Right of Way into Busway	2027	$93,850
Installation of shorting switches for power rail	2039	$14,417
Growth[30]		
No Growth programs currently underway		
Data source: TTC O&I Group – Subway Track, TTC Capital Investment Plan		

Table 2-7 – Current & Planned Lifecycle Activities to Improve Service and Address Growth – Subway Track

2.5 Climate Change

Whilst the TTC maintains an overall commitment to environmental sustainability, there are no programs underway within the Subway Track team to directly contribute to a reduction in emissions or mitigate the impact of climate change.

2.6 Lifecycle Investment Forecasts

At the current stage of asset management maturity, lifecycle investment needs are evaluated as the annualized cost to maintain SOGR, as outlined above. Estimates have also been made for the investment required to bring all assets to “Fair” or better condition over the planning period.

The following figures and table illustrate the full lifecycle investment forecasts for Subway Track assets. The figures show the current funding by project type compared to the total overall funding required to maintain SOGR and deliver on selected service enhancement projects. Condition remediation investment forecasts are also included. Data gaps and low confidence data for subway track assets, particularly in asset condition ratings, impacts the accuracy and reliability of the financial analysis. As TTC’s EAM maturity journey continues, data confidence scores will improve, increasing accuracy and reliability of analyses.

[30] Linear Infrastructure growth projects associated with new line construction (Lines 5 & 6) are not included in this document.

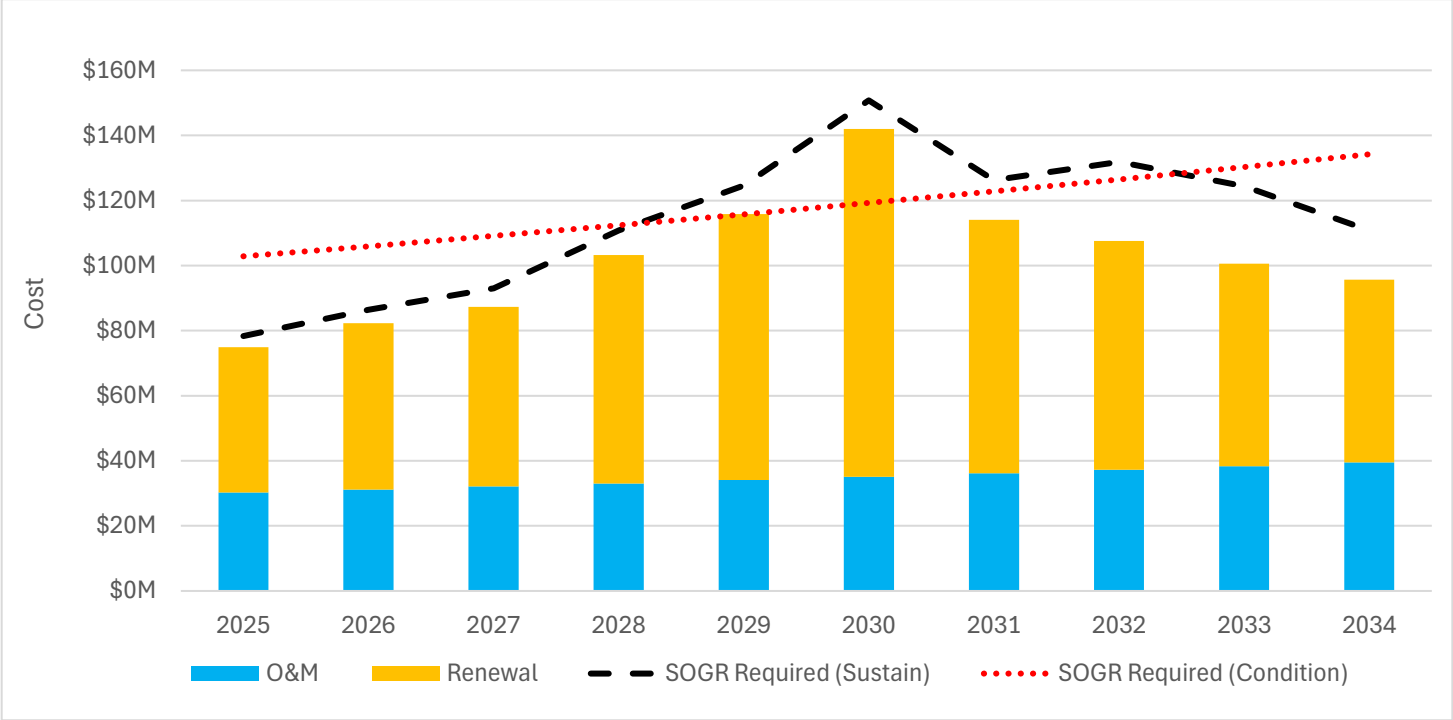


Figure 2-3: Funding vs Assessed Program Requirements – Subway Track (SOGR only)

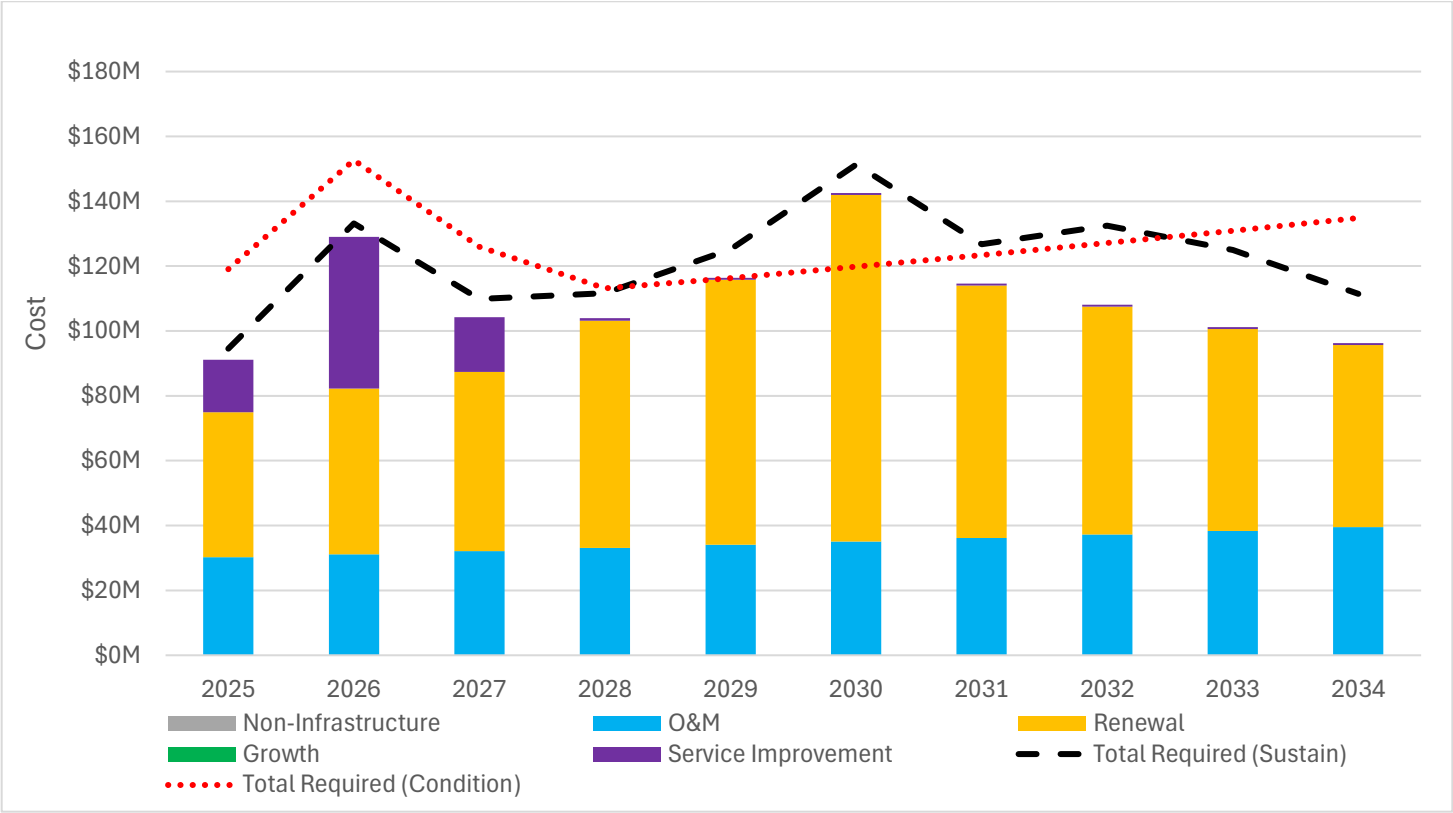


Figure 2-4: Funding vs Assessed Program Requirements – Subway Track

The following table summarizes the average annual budget and investment needs for the planning period:

Lifecyle Activity	Planned Budget ($K)	Investment Needed to Sustain LoS ($K)	Investment Needed to Address Condition Gap ($K)
Non-Infrastructure	$0	$0	$0
Maintenance	$34,687	$34,687	$34,687
Renewals	$67,646	$79,033	$83,219
Growth	$0	$0	$0
Service Improvement	$8,419	$8,424	$8,424
Total Expenditure	$110,753	$122,144	$126,330
Average annual SOGR Gap		$11,386	$15,573
Average annual Infrastructure Gap		$11,391	$15,577

Table 2-8 – Annualized Funding vs Assessed Program Requirements – Subway Track Assets

2.7 Conclusion & Risks

The analysis undertaken to prepare the 2025 AMP suggests that Subway Track assets are underfunded to deliver SOGR, with a more significant investment required to increase the assets to a condition of Fair or better. This has a direct impact on customers, with restricted speed zones being implemented to ensure safe operation of the network whilst renewals are carried out on track that is below the threshold for safe normal speed operation.

Furthermore, current data maturity limits the reliability of the estimates and analyses presented herein. Planned enhancements to condition reporting such as a track condition index will help future planning, as works can be prioritized in a more efficient way to maximise the track availability during non-revenue hours to carry out maintenance and renewals.

The most substantial risks identified for these assets are:

1. **Insufficient funding:** Shortfalls in funding results in deferred maintenance and reduced performance against LOS expectations. Despite assets largely meeting current condition targets increased funding will allow for higher targets each year, reducing the likelihood of asset failure and the impact this has on service. Compounding the problem is the fact that aging assets such as those included in subway track require a more intense maintenance regime, with deferred maintenance further increasing risk.
2. **Data quality:** Low asset condition confidence indicates that the condition data used for investment planning across the Subway Track asset class do not reflect the realistic investment need, with a greater value likely to be required than can be reported using data in this AMP.
3. **Track access:** Short time windows to perform maintenance during non-revenue hours reduces the capacity to deliver work. A backlog is more likely to develop if the required maintenance and renewal activities cannot be completed during the window, and track issues which lead to restricted speed zones will take longer to fix.

3. Streetcar Way

3.1 Introduction

TTC Streetcar Way assets, or surface track, is the track and supporting infrastructure on which streetcars travel across the network and primarily consists of the structural components such as concrete and its foundations, the embedded running rail, switch components, drainage and wayside lubrication.

Service Statement

> *"TTC Streetcar Way assets support the service plan by enabling safe, comfortable journeys for streetcar riders across the streetcar network on its guideway and through its support infrastructure."*

Asset Breakdown

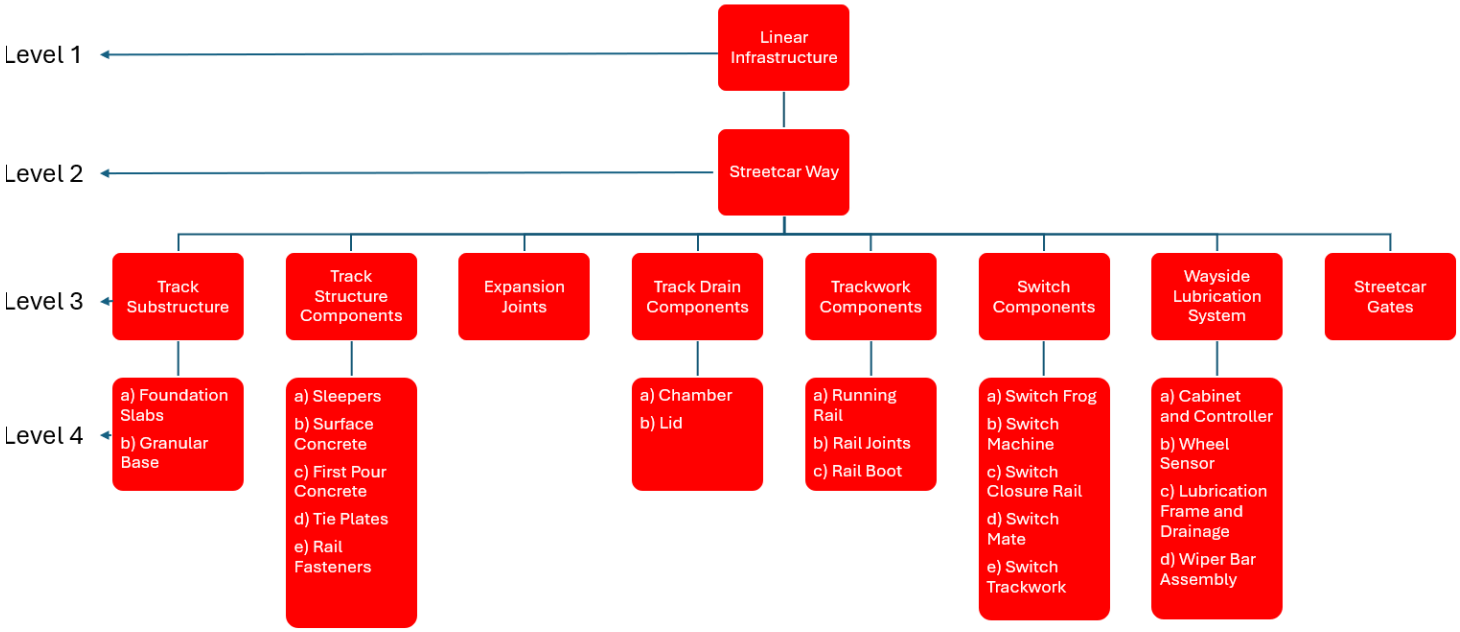


Figure 3-1: Asset Hierarchy – Streetcar Way

3.2 State of Infrastructure

The following figure outlines a high-level overview of the state of TTC Streetcar Way assets:

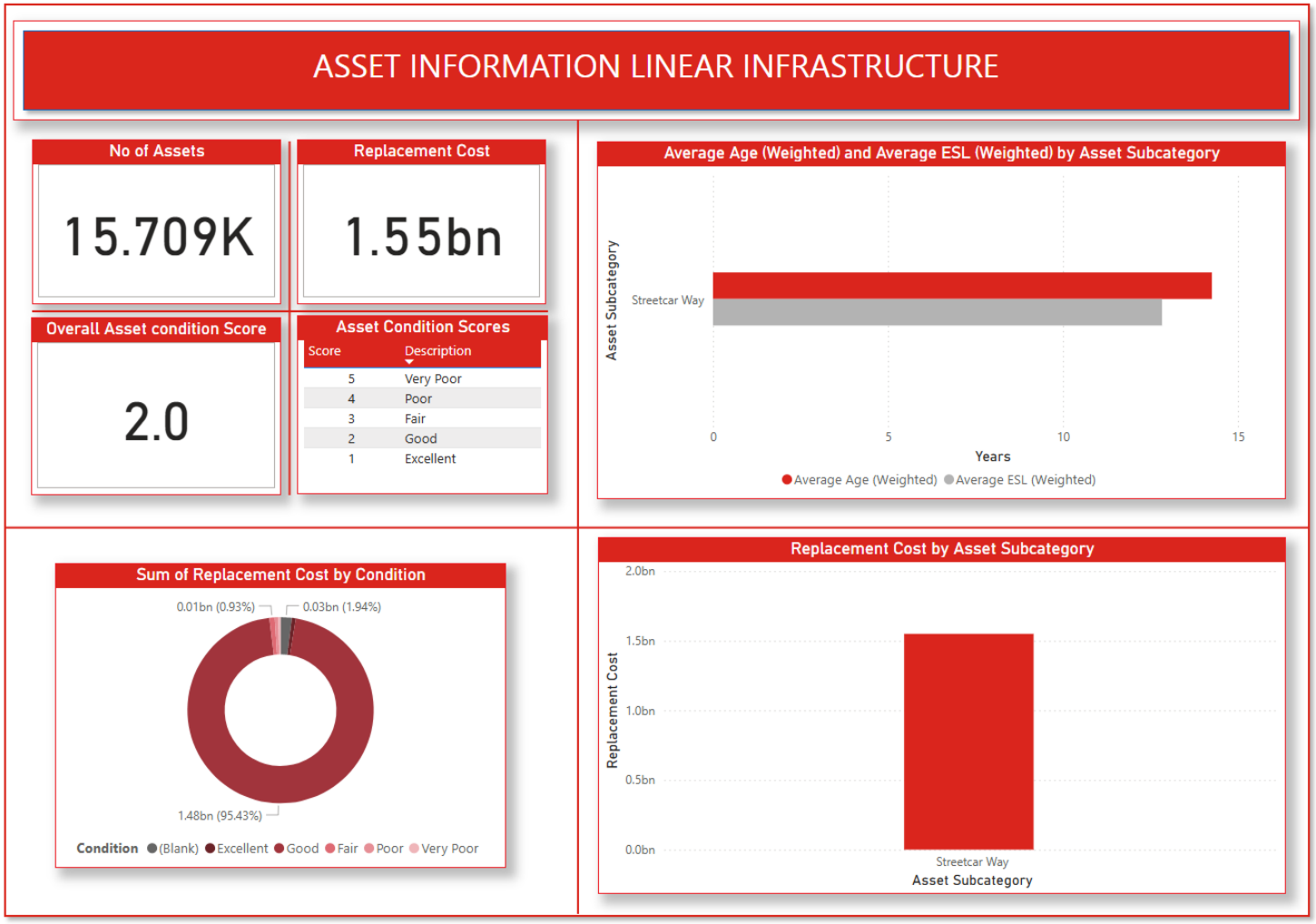


Figure 3-2: State of TTC Infrastructure Summary Dashboard – Streetcar Way

Asset Summary

Asset Class	Asset Subclass	Quantity	Replacement Value ($M)	Average Condition	Average age (years)	ESL (years)
Track Substructure	Track Substructure Components	771[31]	126.7	2	*	*
Expansion Joints	Expansion Joints	108	5.4	2	15	*
Trackwork	Trackwork	12826[31]	991.2	2	15	20
	Closure Rails	33	*	*	*	*
	Intersection	59	230.2	2	15	*
	Loop	24	114.1	2	15	*
	Track Drains	465	*	*	*	20
	Turnouts	414	3.3	*	*	*
	Rail Joints	117	*	*	*	*
Switches	Switches	666	66.6	2.8	8	20
Wayside Lubrication	Lubricators	90	12.1	2	*	15

Data Source(s): TTC Operations & Infrastructure Group

Table 3-1 – Asset Summary – Streetcar Way

The following table provides a further breakdown on the condition score of rail, based on the methodology outlined below.

Total length (km)	Condition Score				
	1	2	3	4	5
90.7	58%	41%	1%	0%	0%

Data Source: TTC Operations & Infrastructure Group

Table 3-2: Asset Summary - Streetcar Way condition scores

Condition Assessment

The condition for a section of Streetcar Way is calculated using a weighted scoring system which factors in pavement, headwear and floorwear condition, the number and severity of open work orders on that section, and the severity of corrugation on the rail. Each component of the formula is given an initial score of 1-10, with the weighting applied to the assessment. The overall score is the total of each weighted component, which is adjusted for a total score out of 100. Each 20th percentile provides the threshold for a condition rating of 1-5 to align with the scale found throughout the AMP. The table below summarizes the scoring methodology and weighting, with sample data from a section on Carlton Street, between Yonge Street and Parliament Street.

[31] Trackwork and substructure assets are instanced as track sections. These sections can vary in length.

Component	Rating 1-10	Weighting Factor	Score	Score (adjusted for 100 max.)
Pavement	3	6	18	14.4
Headwear	1.125	2	2.25	1.8
Floorwear	3	2.5	7.5	6
Open Work Orders	1.6	1.5	2.4	1.9
Corrugation	3	0.5	1.5	1.2
			Total	**25.3**

Table 3-3: Streetcar Way condition methodology

Remaining assets are given a condition score based on asset age, which can be adjusted based on a qualitative assessment during visual inspection if required. As the TTC continues to mature its EAM program, condition assessment methodologies will be refined to reflect a more complete understating of asset state and to increase data confidence.

3.3 Levels of Service

Levels of Service (LOS) for Streetcar Way assets have been assessed in line with the overarching LOS framework presented in the main AMP document. Proposed LOS are encapsulated in the performance targets, as well as the initiatives outlined in the Future LOS table. The TTC believes that these proposed LOS are reasonably achievable given the available funding. Further details on risks and funding requirements are outlined in subsequent sections.

Where asset performance falls below targets, the TTC will consider accelerated SOGR programs or modified maintenance activities. Additional details can be found in the asset class strategy summaries in the **TTC Asset Management Strategy** document.

Performance Summary

Overall, Streetcar Way assets are approaching LOS targets and expectations.

Despite the assets provide an effective streetcar service for the TTC, there is room to improve service levels further through adherence to inspections, and investigation into restricted speed zones to identify root causes and deliver work proactively across the network.

Current Levels of Service

Asset Category Customer Level of Service	Subcategory Technical Level of Service	Performance Measure	Performance	Target
TTC Streetcar Way assets are sufficient and appropriate to meet ridership demands of the travelling public.	Infrastructure is constructed to meet subway access in line with the TTC service plan	N/A	The network is sufficient to meet ridership needs.	-
	Streetcar Way assets allow for the streetcar service to run on time	On time performance[32]	73%	90%
TTC Streetcar Way assets are maintained in a State of Good Repair (SOGR) such that service affecting failures and restricted speed zones are minimized.	Streetcar Way assets are maintained in SOGR	% of assets in fair or better condition	99%	80%
	Streetcar Way assets are available for normal service operation	Number of restricted speed zones in effect due to Streetcar Way assets		0
TTC Streetcar Way assets include safety assurance systems and are inspected within required timescales, minimizing transit system safety risks to the travelling public and community.	Conformity to track patrol inspection (90 day and 72 hourly combined)	% inspections completed against program	98.2%	100%
TTC Streetcar Way assets allow for comfortable, efficient travel for customers on the streetcar network.	Noise	Customer complaints relating to streetcar track noise	334	-

Table 3-4 – Current Levels of Service – Streetcar Way

Future Levels of Service

Asset Category Customer Level of Service	Asset Future Level of Service	Actions	Target Date	Initiative
TTC Streetcar Way assets allow for comfortable, efficient travel for customers on the streetcar network.	Improve lubrication across the network to reduce noise and vibration.	Install lubricators at new locations across the network.	2034	Ongoing; based on customer complaints and analysis

Table 3-5 – Future Level of Service Initiatives – Streetcar Way

3.4 Lifecycle Management Activities

The lifecycle activities for Streetcar Way assets comprise of inspections and capitalized overhauls and renewals. Walked visual inspections are completed every 72 hours, 90 days or annually depending on the risk to the location, with further detailed inspections taking place annually to measure rail wear and perform non-destructive testing.

Capital overhauls and renewals are grouped into track and special trackwork replacement programs, which include the replacement of all assets within the respective trackwork and switch subclasses.

The following table outlines the assessed lifecycle activities requires to maintain Streetcar Way SOGR:

[32] Also impacted by streetcar vehicle issues

Activity	Frequency	Annualized Cost ($K)
Non-Infrastructure		
Administrative overhead, process continuous improvement	As required	-
Maintenance		
Mainline tunnels inspection	72 Hours	$14,470
Mainline walked visual inspection	90 Days	
Mainline NDT inspection	Annual	
Yard and carhouse track inspection	Annual	
Monitoring and inspection of carstop condition	Annual	
Mainline switch visual inspection	24 Hours (Winter) 96 Hours (Summer)	
Detailed switch inspection	6 Months	
Passenger platforms: inspection and maintenance	9 Days	
Renewals		
Track Structure		
Track civil works replacement	50 Year	$2,130
Renew track at Russell carhouse	50-70 Year	$796
Repair direct fixation section	20-25 Year	$37,935
Repair open cut section	15-20 Year	
Replace grout pad	20-25 Year	
Anchor bolt drilling	20-25 Year	
Fastener re-insulation	20-25 year	
Trackwork		
Replacement of expansion joints	15-20 Year	
Replace embedded tangent rail section	20 Year	
Replace embedded curved rail section	15 Year	
Replace direct fixation track in tunnels	25 Year	
Replace rail at carstops	10 Year	
Track Drainage		
Replace track drains	15-20 Year	
Replace switch drains	15-20 Year	
Wayside Lubrication		
Replace lubricators	15 Year	
Switches		
Replace mainline intersection/special trackwork, including substructure	20-25 Year	$33,565
Replace yard trackwork/special trackwork, including substructure	50 Year	
Data source: TTC O&I Group – Streetcar Infrastructure, TTC Capital Investment Plan		

Table 3-6 – Lifecycle SOGR Activities – Streetcar Way

The following lifecycle activities are undertaken to provide improvements to service and address ridership growth and system network expansion (meet proposed future LOS).

Activity	**Timeline**	**Program Cost** ($K, current planning period)
Non-Infrastructure		
No Streetcar Way Non-Infrastructure programs currently underway		
System Improvement		
Modification to King/Queen/Roncesvalles track	2034	$13,597
Improvement work on York Street and Adelaide Street to support service closure for Ontario line construction. Metrolinx will be responsible for payment of the final cost.	2025	$11,246
Growth		
Exhibition Loop to Dufferin Gates Loop streetcar connection design work	2030	$27,799
NOTE: *Other streetcar network growth supporting activities may be included in major expansion projects*		
Data source: TTC O&I Group – Streetcar Infrastructure, TTC Capital Investment Plan		

Table 3-7 – Current & Planned Lifecycle Activities to Improve Service and Address Growth – Streetcar Way

3.5 Climate Change

Whilst the TTC maintains an overall commitment to environmental sustainability, there are no programs underway within the Streetcar Way team to directly contribute to a reduction in emissions or mitigate the impact of climate change.

3.6 Lifecycle Investment Forecasts

At the current stage of asset management maturity, lifecycle investment needs are evaluated as the annualized cost to maintain SOGR, as outlined above. Estimates have also been made for the investment required to bring all assets to “Fair” or better condition over the planning period.

The following figures and table illustrate the full lifecycle investment forecasts for Streetcar Way assets. The figures show the current funding by project type compared to the total overall funding required to maintain SOGR and deliver on selected service enhancement projects. Condition remediation investment forecasts are also included. Data gaps and low confidence data for streetcar way assets, particularly in asset condition ratings, impact the accuracy and reliability of the financial analysis. As TTC’s EAM maturity journey continues, data confidence scores will be improved, increasing accuracy and reliability of analyses.

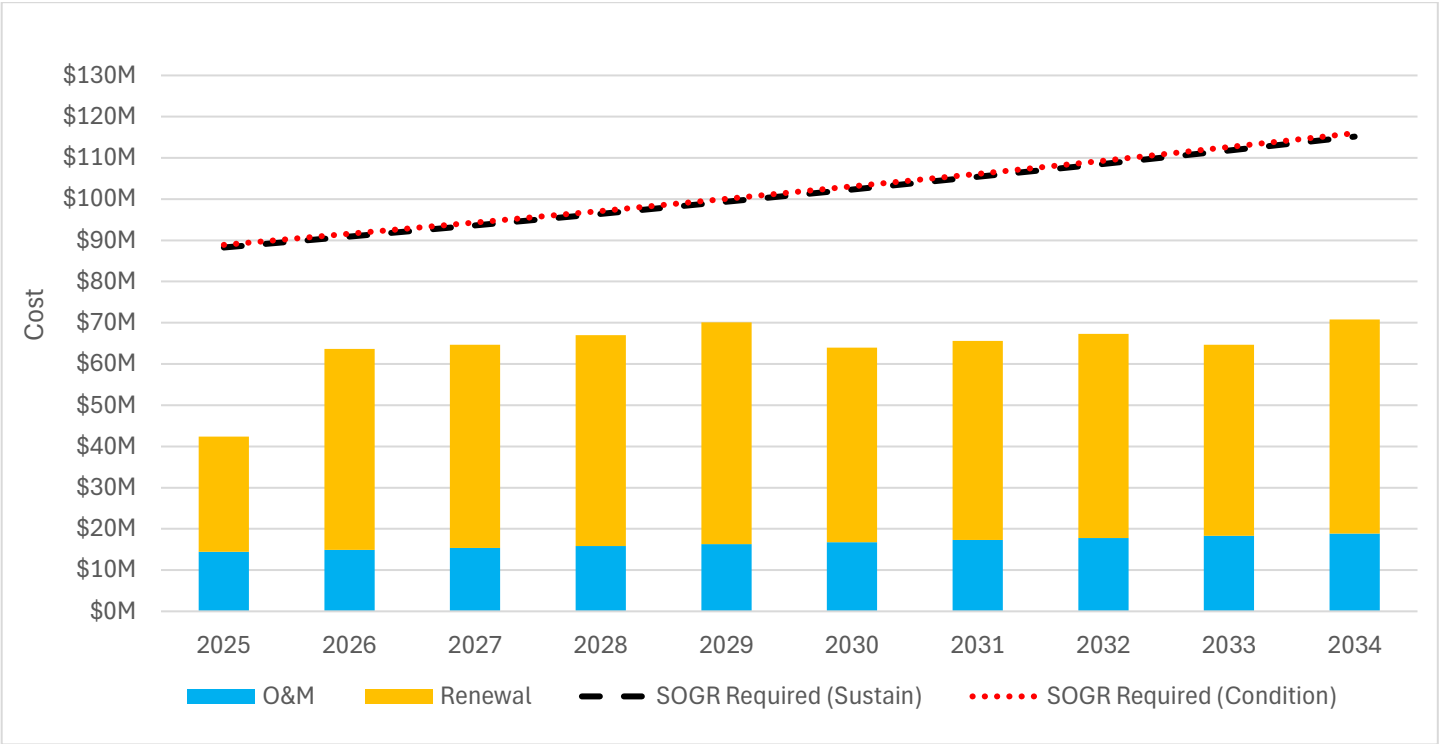


Figure 3-3: Funding vs Assessed Program Requirements – Streetcar Way (SOGR only)

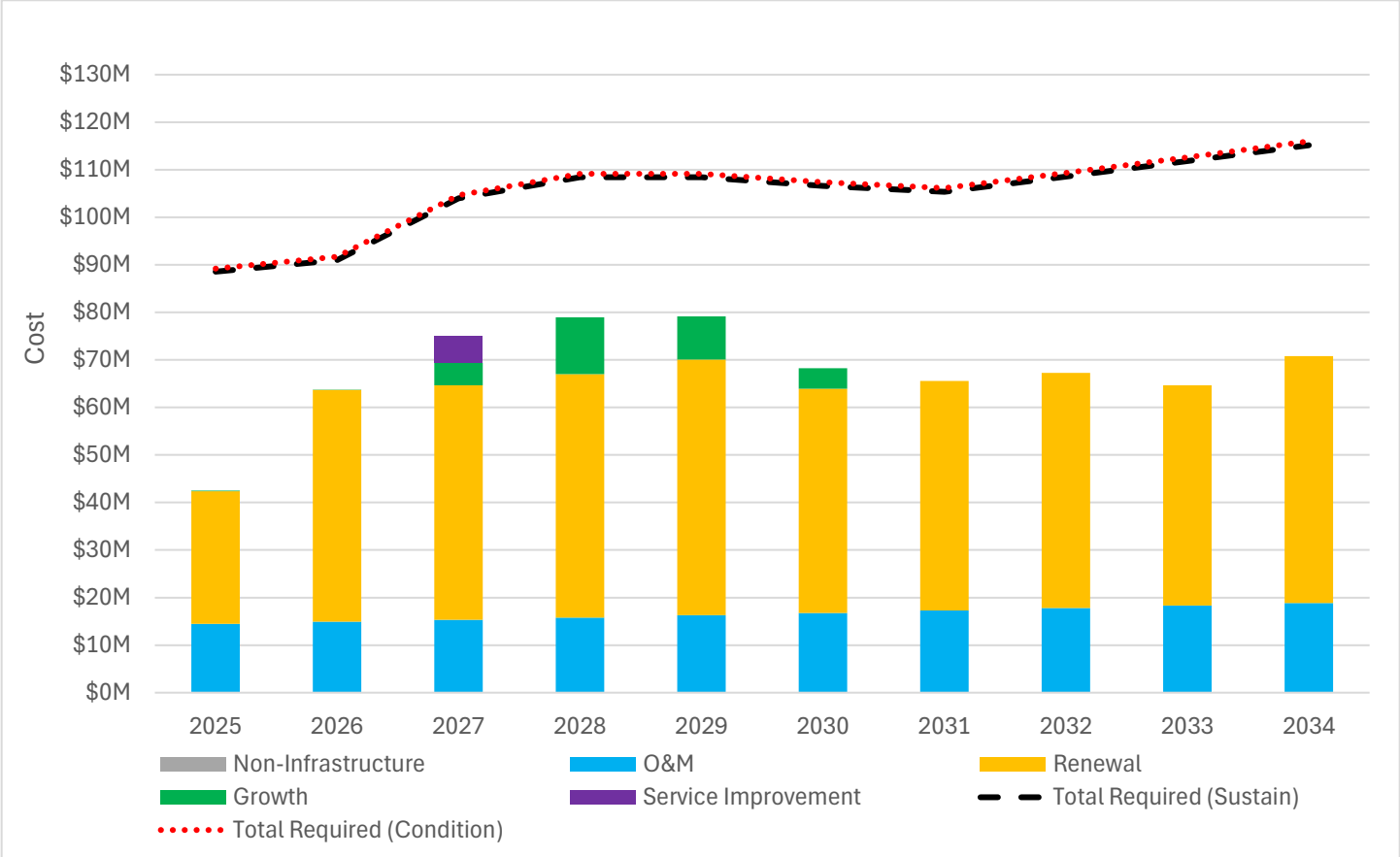


Figure 3-4: Funding vs Assessed Program Requirements – Streetcar Way

The following table summarizes the average annual budget and investment needs for the planning period:

Lifecyle Activity	Planned Budget ($K)	Investment Needed to Sustain LoS ($K)	Investment Needed to Address Condition Gap ($K)
Non-Infrastructure	$0	$0	$0
Maintenance	$16,589	$16,589	$16,589
Renewals	$47,413	$84,587	$85,321
Growth	$3,034	$3,034	$3,034
Service Improvement	$561	$581	$581
Total Expenditure	$67,597	$104,790	$105,525
Average annual SOGR Gap		$37,174	$37,908
Average annual Infrastructure Gap		$37,194	$37,928

Table 3-8 – Annualized Funding vs Assessed Program Requirements – Streetcar Way

3.7 Conclusion & Risks

Despite the present average condition score of Good for Streetcar Way assets, the analysis carried out in preparation of this AMP suggests that the volume of capital work required to maintain the assets in a SOGR over the coming years is significantly underfunded.

Like other linear infrastructure asset classes, Streetcar Way teams have limited windows throughout the year to perform maintenance and renewal activities due to right-of-way access to the track. This results in scheduling and financial implications to maintenance activities, particularly in the case of unfunded deferred maintenance activities.

Additionally, tangent track is delivering an estimated service life of 20 years, down from the initial 25-year expected life. This can be attributed to the combination of a 24/7 schedule and increased traffic from non-streetcar vehicles on the many locations which share road space. Consequently, the shorter service life increases pressure to deliver the required track renewals in a timely manner to ensure that the entire network is renewed before reaching an unacceptable condition.

The data confidence across the Streetcar Way class is rated as Poor, however the inspection regime and condition scoring methodology are well understood and recorded. As the TTC matures its asset management practices, a further understanding of the remaining asset condition will be achieved through clear assessment methodologies. All asset data should be migrated to the central asset information system, to enable consistent investment planning across all subclasses.

The most substantial risks identified for these assets are:

1. Significant underfunding of capital budget: Streetcar Way assets are at risk of falling below an acceptable condition if the required maintenance and renewal activities are not carried out within the required timescales.

2. Limited access to the track for maintenance: The Streetcar Way team is limited in access times, increasing the need to stay on top of maintenance programs.

4. Overhead Contact System

4.1 Introduction

The purpose of the Overhead Contact System (OCS) is to provide traction power to streetcars via a contact wire, along which the pantograph attached to the streetcar runs. This asset class contains the contact wire and necessary supporting infrastructure to hold the wire in place at a suitable tension along each section. The support infrastructure includes poles, contact wire assemblies, self-tensioners and safety features such as bridge troughing for underpasses and diodes for safe electrical power distribution. Also included are switch mechanisms which are connected to Streetcar Way intersections and allow streetcars to turn.

Service Statement

> *"Overhead power assets will provide a consistent power supply to streetcars through contact wires and their support infrastructure and will be managed safely and effectively to reduce the risk to the local community and allow streetcars to meet the service plan."*

Asset Breakdown

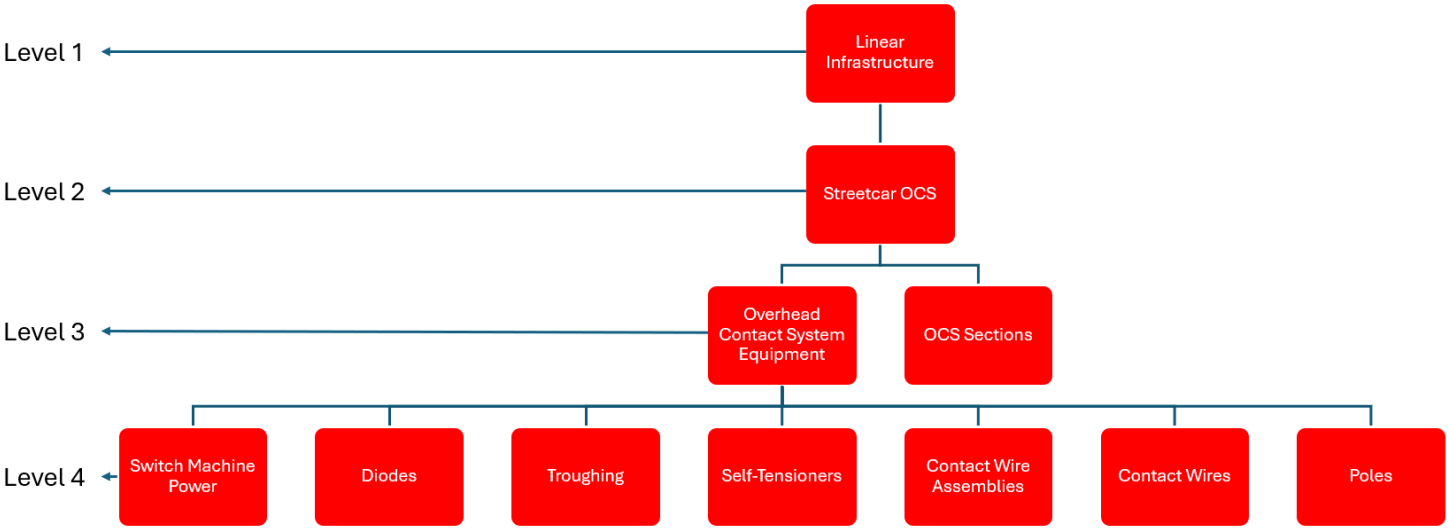


Figure 4-1: Asset Hierarchy – OCS

4.2 State of Infrastructure

The following figure outlines a high-level overview of the state of TTC OCS assets:

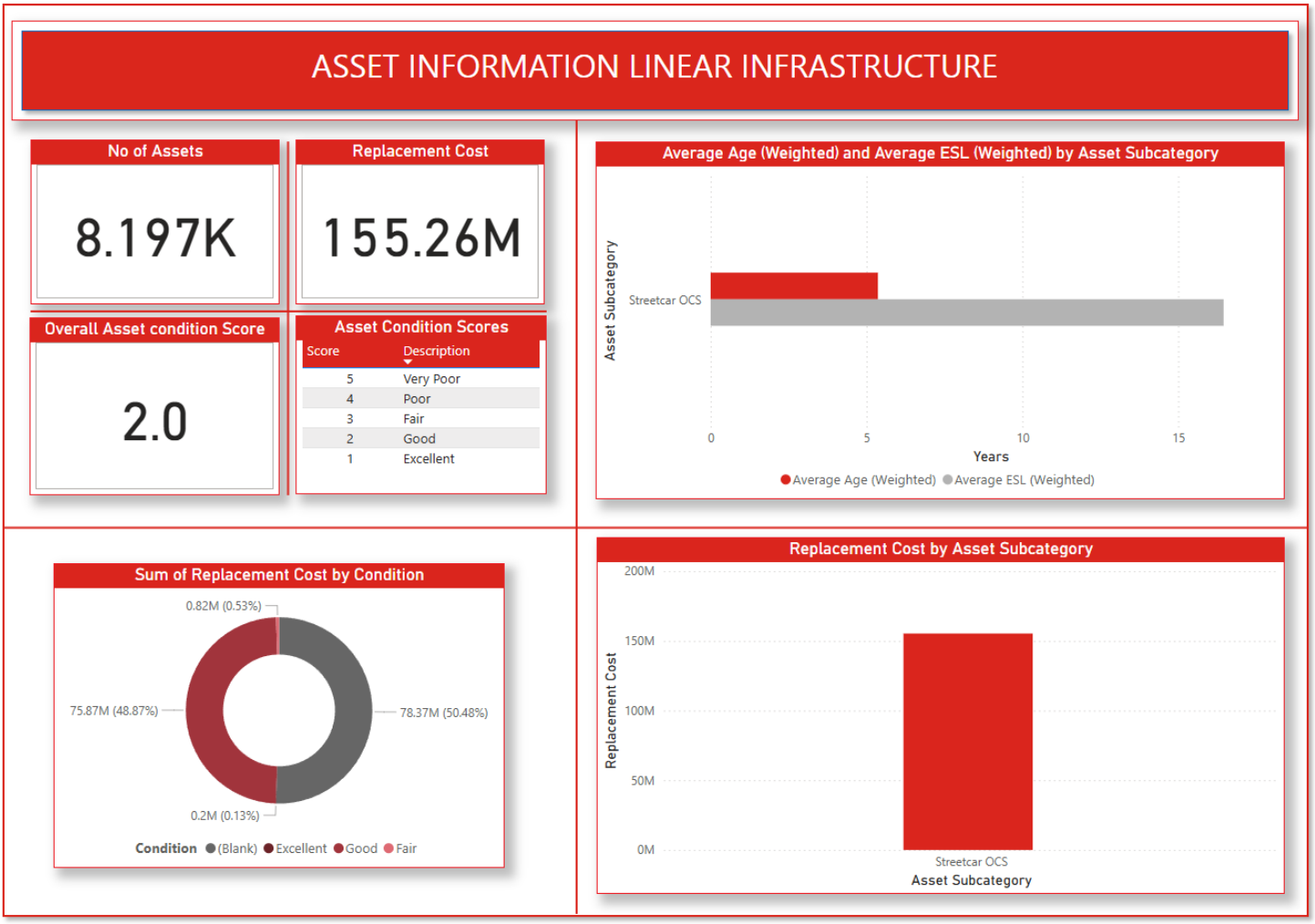


Figure 4-2: State of TTC Infrastructure Summary Dashboard – OCS

Asset Summary

Type	Sub-Asset Class	Quantity	Replacement Value ($M)	Average Condition	Average age (years)	ESL (years)
Contact Wire	Contact Wire	112[33]	26.1	2	3.4	10-20
Switch Machine Power	Switch Machine Power	669	20	*	8	*
Poles	Poles	7310	50.8	2.1	2	40
OCS Sections	Curve	1	0.6	2	10	*
	Intersection	74	40.7	2	8	20
	Loop	27	14.9	2	9	*
	Yard	4	2.2	2	9	*

Data Source(s): TTC Operations & Infrastructure Group

Table 4-1 – Asset Summary – OCS

Condition Assessment

In general, condition ratings for OCS assets are based on asset age, with visual inspections providing adjustments or leading to the creation of work orders for maintenance where necessary.

Wear on the contact wire is measured using callipers during annual line inspections, and scanned using LiDAR technology every two years, including measurements of sag between poles to give an indication of tension as this cannot be measured directly on installed wire. Wire condition is assigned based on total wear of the cross-sectional area, with the table below showing rating system used. A maximum of 30% wire wear is allowed, with accelerated electrical fatigue, increased sag in cold weather, increased risk of wire breakages and accelerated wear points at fittings a higher risk beyond 30% wear.

Remaining %	Cross Section Remaining (mm^2)	Wear (mm^2)	Condition rating
100	107.4	-	-
95	102.0	5.4	1
90	96.7	10.7	2
85	91.3	16.1	3
80	85.9	21.5	4
75	80.6	26.9	5

Table 4-2: OCS Contact Wire condition scoring methodology

[33] Contact wire assets are instanced as sections. These sections vary in length.

4.3 Levels of Service

Levels of Service (LOS) for OCS System assets have been assessed in line with the overarching LOS framework presented in the main AMP document. Proposed LOS are encapsulated in the performance targets and in the initiatives outlined in the Future LOS table. The TTC believes that these proposed LOS are reasonably achievable given the available funding. Further details on risks and funding requirements are outlined in subsequent sections.

The TTC will undertake accelerated SOGR programs or modified maintenance activities where asset performance does not meet targets. Additional details can be found in the asset class strategy summaries in the **TTC Asset Management Strategy** document.

Performance Summary

FAIR

Overall, OCS assets are beginning to meet LOS targets and expectations.

The OCS Maintenance team is delivering strongly on preventative maintenance and proactively managing the contact wire by keeping the wear below 30%, reducing the risk of asset failure. Nevertheless, there are insufficient recorded performance measures to fully assess performance against LOS expectations. Further LOS are under investigation to give a clearer picture of performance.

Current Levels of Service

Asset Category Customer Level of Service	Subcategory Technical Level of Service	Performance Measure	Performance	Target
TTC OCS assets are sufficient and appropriate to meet ridership demands of the travelling public.	The OCS network provides sufficient electrical power to allow streetcars to meet required service frequency and headways	N/A	OCS is effective and appropriate to allow service plan to be met.	-
TTC OCS assets are maintained in a State of Good Repair (SOGR) such that service affecting failures and restricted speed zones are minimized.	OCS assets are maintained in SOGR	% of assets in fair or better condition (value weighted)	99%[34]	80%
	Contact wire is kept to below 30% across the system	% contact wire below 30% wear	100%	100%
	Preventative maintenance is delivered on time	Preventative maintenance activities delivered against plan	Delivered 39 maintenance activities over target	100%
		Average time to complete corrective maintenance		4 wks
TTC OCS assets include safety assurance systems and are inspected within required timescales, minimizing transit system safety risks to the travelling public and community.	Tree pruning to reduce the risk of insulation bypass	Pruning program delivered against target by contractor	100%	100%

[34] Of assets for which condition ratings are available (49% of assets by value)

Asset Category Customer Level of Service	Subcategory Technical Level of Service	Performance Measure	Performance	Target
TTC OCS assets allow for comfortable, efficient travel on the streetcar network.	Minimize stopped/delayed journeys due to automatic drop down (ADD) of pantograph	ADDs attributable to OCS Issues		0
TTC OCS assets are managed in a cost-effective manner across the full lifecycle of the assets.	Preventative maintenance is delivered on time	Preventative maintenance activities delivered against plan	Delivered 39 maintenance activities over target	100%

Table 4-3 – Current Levels of Service – OCS

Future Levels of Service

Asset Category Customer Level of Service	Asset Future Level of Service	Actions	Target Date	Initiative
TTC OCS assets are maintained with a consideration for the environmental impact of these activities, such as the minimizing of waste material and energy.	Provide an optimized OCS network for streetcars now all using pantograph.	Finish conversion of hybrid OCS network to pantograph-only.	2043	CIP 6366
TTC OCS assets are managed in a cost-effective manner across the full lifecycle of the assets.	Improve collection and storage of data for OCS assets.	Implement new asset inventory management and GIS mapping.	2032	CIP 7137

Table 4-4 – Future Level of Service Initiatives – OCS

4.4 Lifecycle Management Activities

OCS lifecycle activities primarily fall under maintenance and renewal, with maintenance activities involving annual inspections and light maintenance work such as cleaning that can be delivered as needed.

Capital work in the form of renewals tends to be planned based on asset age and expectation of asset life, which can vary by location depending on the volume of traffic but is expected to be 10 years for contact wire, in some cases up to 20 years. As actual wear rates at each location of the TTC network are understood, future planning may need to be adjusted.

Currently, rehabilitation work takes place every 10 years whereby contact wires are replaced and other connected assets such as assemblies will be replaced if their expected remaining life is less than 10 years. Even if the non-contact wire assets have several years left, it is unlikely they will last another 10 years until the next capital work. The OCS team has limited access time to many parts of the network, making a return trip in only a few years not economical for smaller component replacement. After 20 years, an overhaul is conducted to replace all overhead assets, ensuring those not captured in the 10-year rehabilitation will be renewed before failure.

During the reconstruction of OCS assets under the rehabilitation/overhaul program for SOGR purposes, progress will continue on the hybrid to pantograph-only design. The need to renew some hybrid and already converted pantograph only assets each year will be balanced alongside conversion in other parts of the network, with an approximate 1:1 ratio required to maintain SOGR whilst delivering the remainder of the conversion. The TTC plans on replacing six intersections annually alongside 9 km of contact wire, split between renewal and conversion. The complete upgrade to pantograph only is planned to finish in 2043 at this conversion rate.

The following table outlines the assessed lifecycle activities requires to maintain OCS SOGR:

Activity	Frequency	Annualized Cost ($K)
Non-Infrastructure		
Administrative overhead, process continuous improvement	As required	$0
Maintenance		
Visual inspection of poles	2 Year	$10,230
Line inspection including contact wire, assemblies, troughing, self-tensioners, suspension fittings	Annual	
Line inspection for tunnels	Monthly	
Visual inspection of contact wire	3/6/12 Months	
Scan inspection of contact wire, including sag measurements	2 Years	
Diode inspection (location dependent)	3/6/12 Months	
Switch inspection	6 Months	
Yard line inspection	6 Months	
Loop line inspection	Annual	
Tree pruning by contractors	As required	
Renewals		
Rehabilitation of OCS assets excluding poles and switches	10 Year	$13,906
Overhaul of all OCS assets excluding poles and switches	20 Year	
Installation of self-tensioners during EOL replacement	10 Year	
Switch overhaul program	35 Year	$2,816
Data source: TTC O&I Group – OCS, TTC Capital Investment Plan		

Table 4-5 – Lifecycle SOGR Activities – OCS Systems

As noted above, improvements to the OCS network to support pantograph-only design are included in SOGR budgets for rehabilitation and overhaul. Furthermore, self-tensioners are included in the table above despite being a service improvement, as their installation is driven by end-of-life renewals for existing tensioners.

The following lifecycle activities are undertaken to provide service improvements and to address ridership growth and system network expansion (meet proposed future LOS).

Activity	Timeline	Program Cost ($K, current planning period)
Non-Infrastructure		
Introduction of new asset inventory management system and GIS mapping capability	2037	$5,012
System Improvement		
No specific System Improvement activities for OCS.		
Growth		
No specific Growth activities for OCS.		
Data source: TTC O&I Group – OCS, TTC Capital Investment Plan		

Table 4-6 – Current & Planned Lifecycle Activities to Improve Service and Address Growth – OCS

4.5 Climate Change

Whilst the TTC maintains an overall commitment to environmental sustainability, there are no programs underway within the OCS team to specifically contribute to a reduction in emissions or mitigate the impact of climate change.

4.6 Lifecycle Investment Forecasts

At the current stage of asset management maturity, lifecycle investment needs are evaluated as the annualized cost to maintain SOGR, as outlined above. Estimates have also been made for the investment required to bring all assets to “Fair” or better condition over the planning period.

The following figures and table illustrate the full lifecycle investment forecasts for OCS assets. The figures show the current funding by project type compared to the total overall funding required to maintain SOGR and deliver on selected service enhancement and growth projects. Condition remediation investment forecasts are also included.

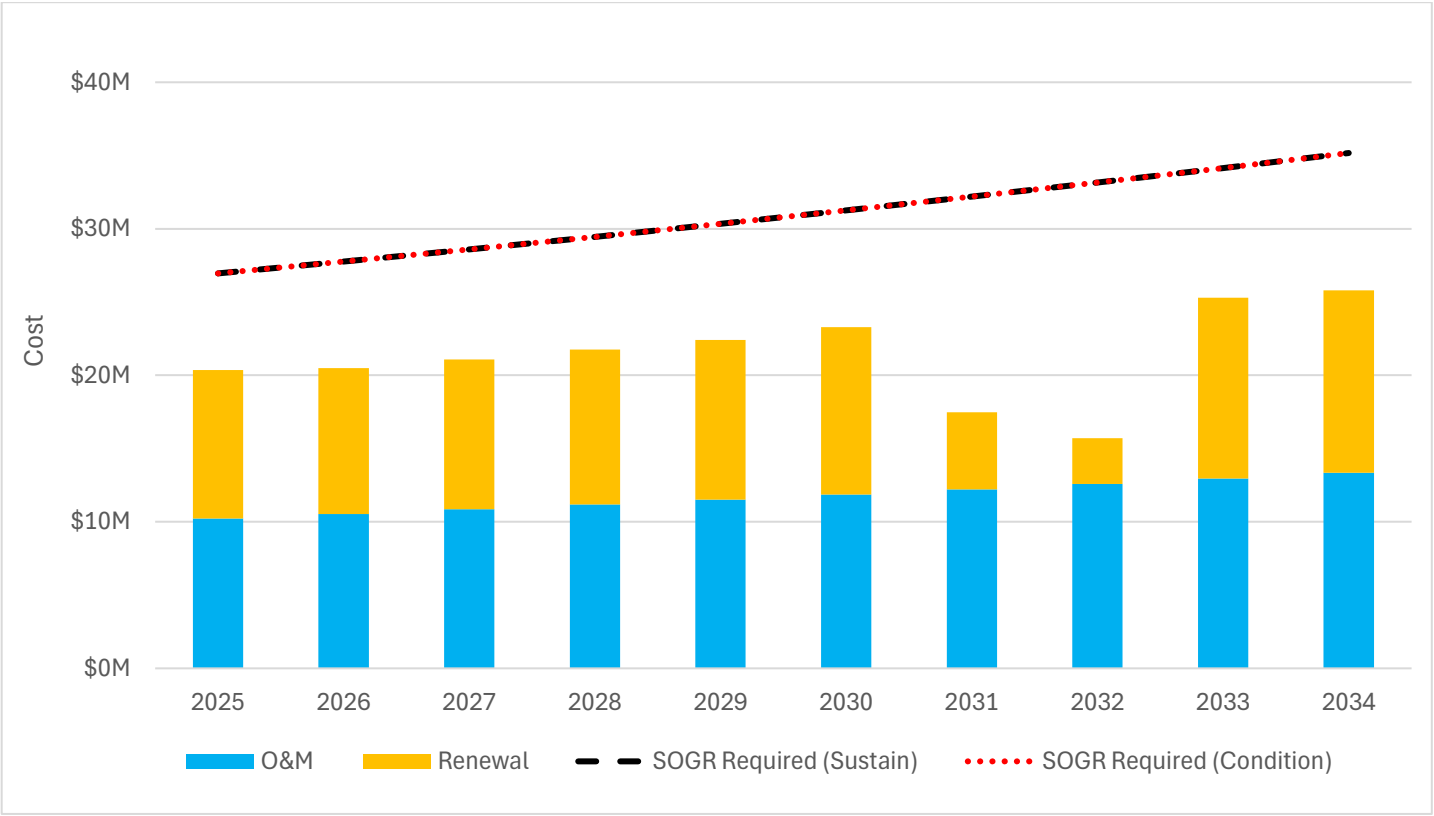


Table 4-7: Funding vs Assessed Program Requirements – OCS (SOGR only)

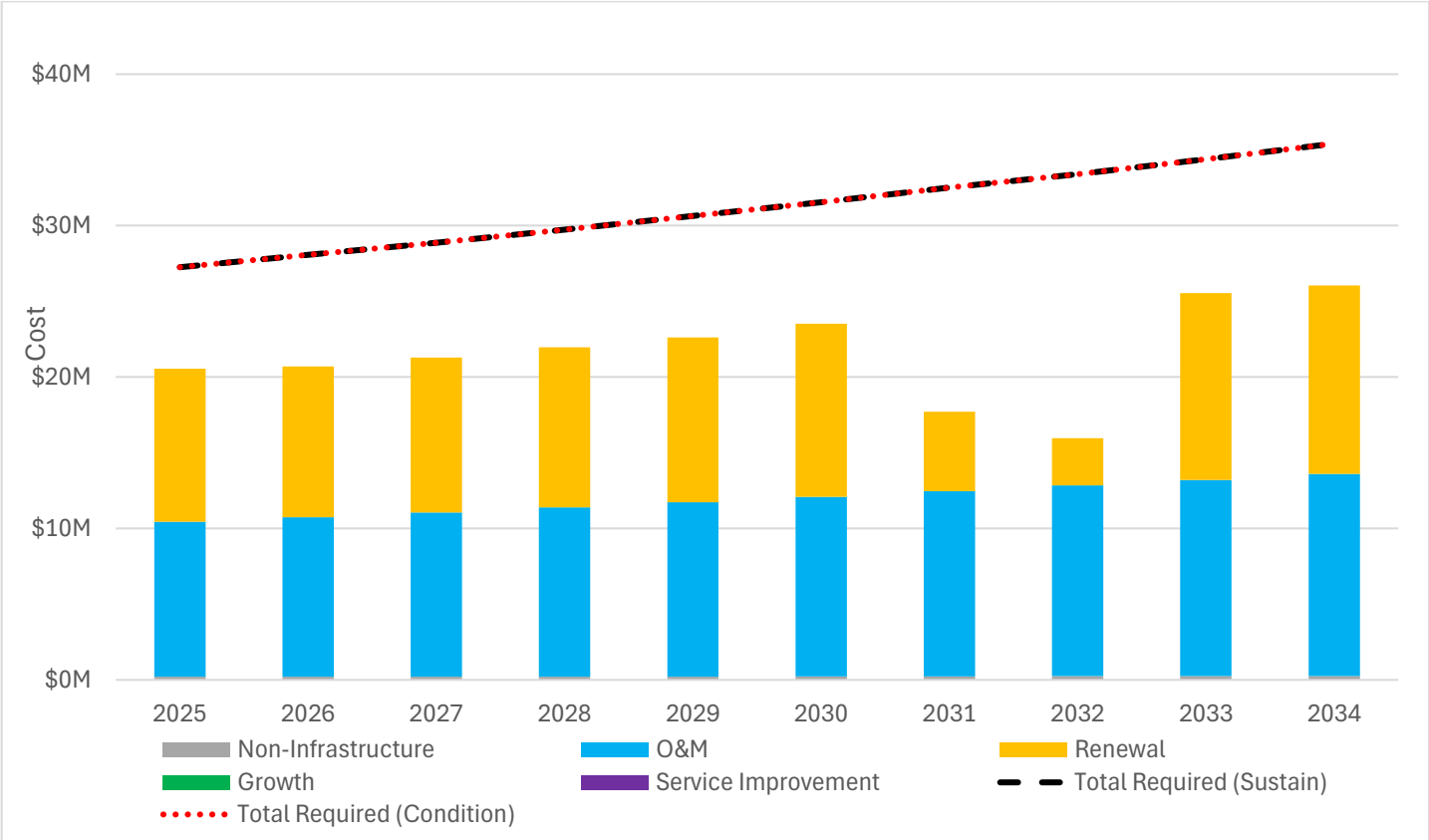


Table 4-8: Funding vs Assessed Program Requirements – OCS

The following table summarizes the average annual budget and investment needs for the planning period:

Lifecyle Activity	Planned Budget ($K)	Investment Needed to Sustain LoS ($K)	Investment Needed to Address Condition Gap* ($K)
Non-Infrastructure	$224	$281	$281
Maintenance	$11,733	$11,733	$11,733
Renewals	$9,634	$19,170	$19,170
Growth	$0	$0	$0
Service Improvement	$0	$0	$0
Total Expenditure	$21,591	$31,184	$31,184
SOGR Gap		$9,535	$9,535
Infrastructure Gap		$9,593	$9,593

Table 4-9 – Annualized Funding vs Assessed Program Requirements –OCS Assets

4.7 Conclusion & Risks

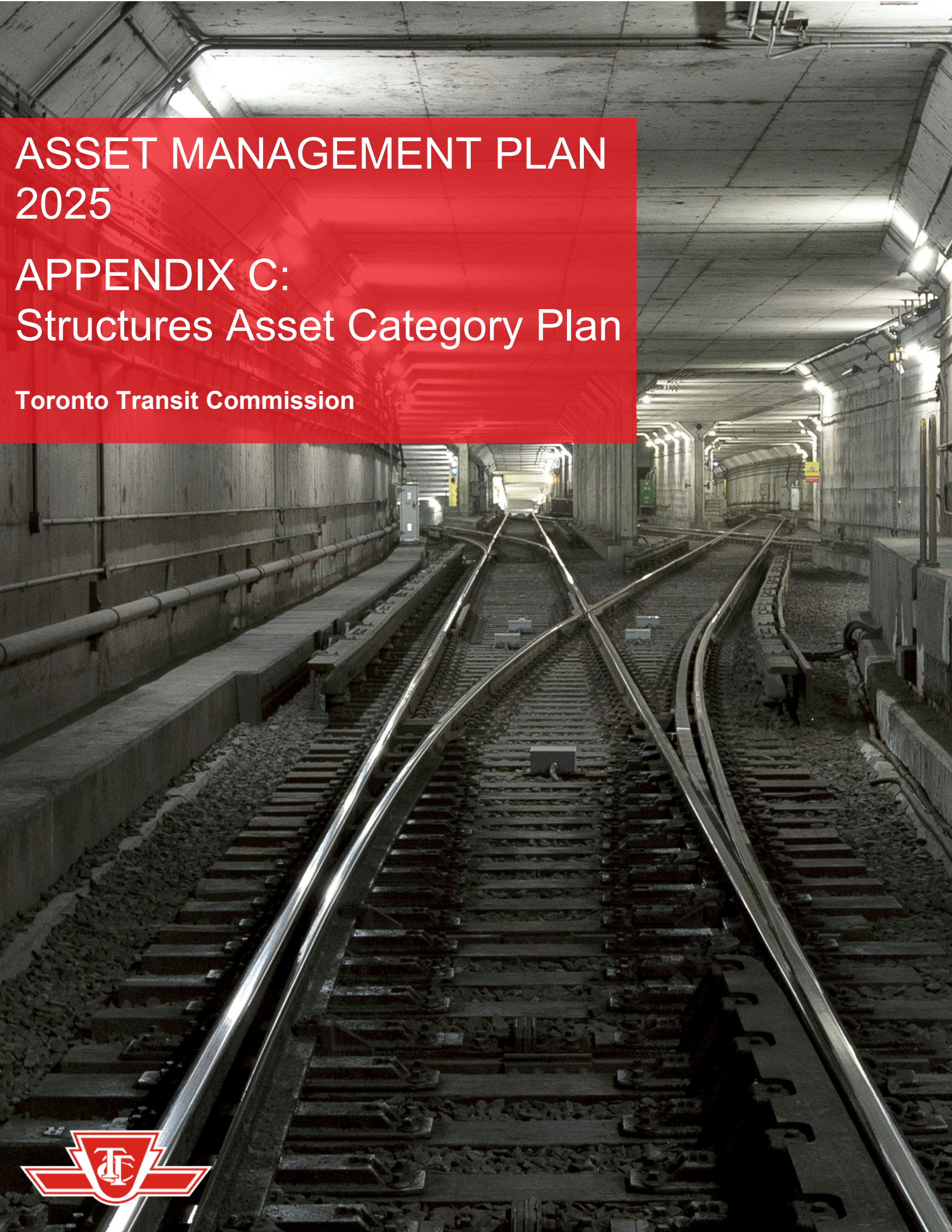
Given the significance of the OCS assets to an effective streetcar network, the analysis undertaken to prepare this AMP suggests that the asset base is underfunded for the AMP period to maintain current LOS. There is a confidence rating of Poor for the condition score, due to many records not yet included in the asset register used to perform analysis for this AMP.

Lack of available data will continue to limit the accuracy and reliability of the analyses undertaken in this AMP. Work is underway to update data management processes and transfer paper records into the Maximo EAM system.

Conversion of the hybrid pole/pantograph network to pantograph only is an ongoing program expected to finish in 2043, at which point full reliability benefits can be achieved across the network including reduced Automatic Drop Downs (ADDs) which cause service delays, and reduced maintenance on pantograph carbons required due to the distributed wear pattern from the staggered contact wire.

The most substantial risks identified for these assets are:

1. **Data Quality:** Asset condition and value data has low confidence ratings due to significant missing data. Lifecycle investment models are immature and not likely to reflect the true investment needs for the OCS class. Continued effort is required to add historic asset data to the asset management system and adopt the use of Maximo as intended.
2. **Insufficient Funding:** Significant shortfalls in funding to replace key sub-asset groups. This may lead to deferred maintenance, which will increase the risk of asset failure and delay the pantograph only conversion during the overhead rehabilitation program.
3. **Right-of-way access:** With limited access to the network each year, OCS teams must make the most of the available maintenance windows. The team completed more preventative maintenance activities than planned in 2024; this must continue into the future and also apply to capital work.



ASSET MANAGEMENT PLAN 2025

APPENDIX C: Structures Asset Category Plan

Toronto Transit Commission

Contents

LIST OF TABLES

LIST OF FIGURES

1. Asset Category Overview - Structures

1.1 Introduction

The TTC maintains the structures required for the operation of the subway and streetcar network, which enable all modes of transport to navigate the City of Toronto and facilitate efficient transit services. These include box structures, bored tunnels, stations, bridges, culverts, retaining walls and miscellaneous structures but exclude overhead structures.

Service Statement

“TTC Structures assets support overall transit services by shaping the environment as necessary to support transit operations, including providing underground subway paths and station facilities, adjacent slope stability, and water, road and other infrastructure crossings.”

Asset Breakdown

Structures are categorized by type or use, as outlined below.

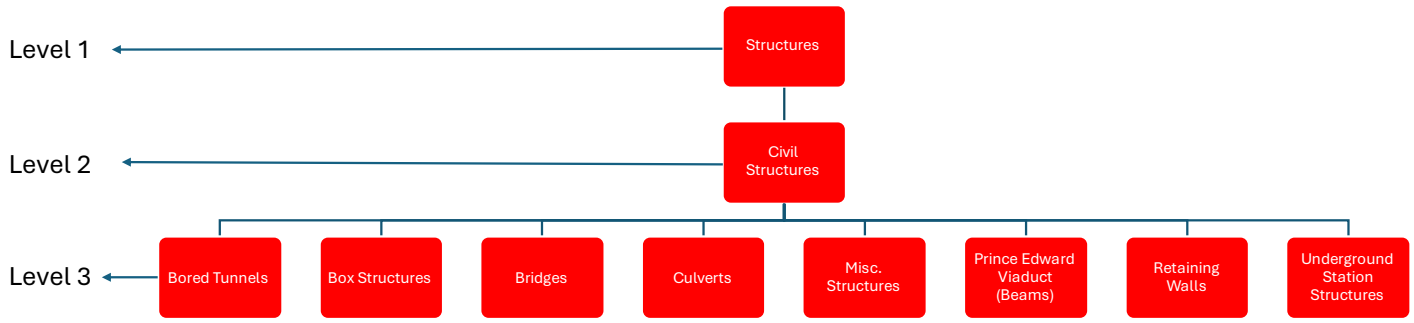


Figure 1-1: Asset Hierarchy Structures by type

The categorization of miscellaneous structures may evolve over time as the TTC conducts thorough inspections and integrates them into station facilities, necessitating periodic updates to asset records and management strategies.

1.2 State of Infrastructure

The following figure outlines a high-level overview of the state of TTC Structure assets:

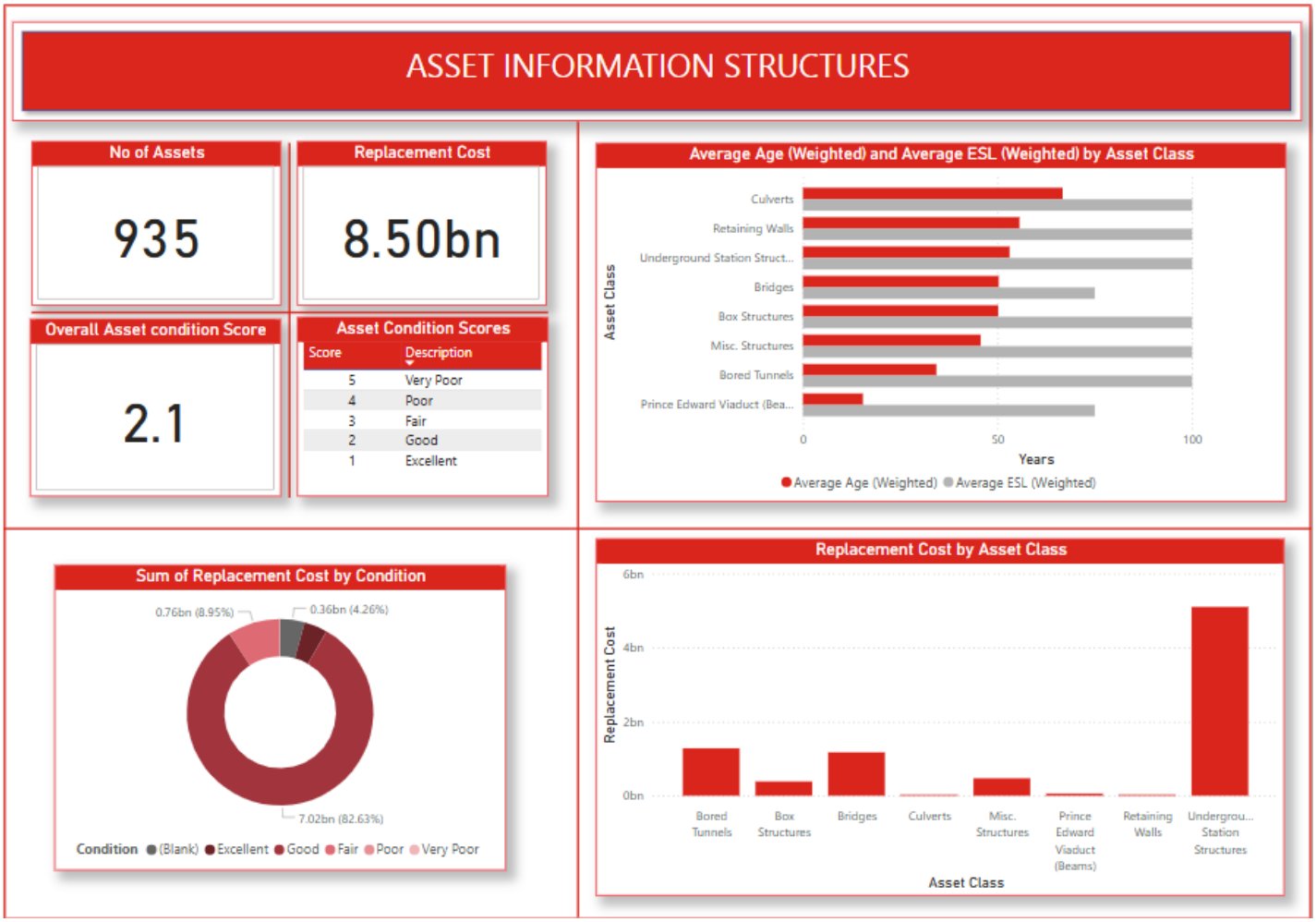


Figure 1-2: State of TTC Infrastructure Summary Dashboard – Structures

The condition of TTC structures is generally good, with the majority of structures being maintained in a state of good repair. More details can be found in the subcategory sections below.

The current assessed replacement value of TTC Structures is $8.50B, which represents a minor drop from the $9B reported in the 2024 AMP. This is due to the change in methodologies used as well as a slight scope adjustment (Structures valuation in the 2024 AMP included underground track, which is now included in Linear Infrastructure). The costs shown in the dashboard include the replacement costs of all the sub-assets and is based on like-to-like replacement of the structures.

The current state of data quality/maturity among TTC assets is outlined in the following figure:

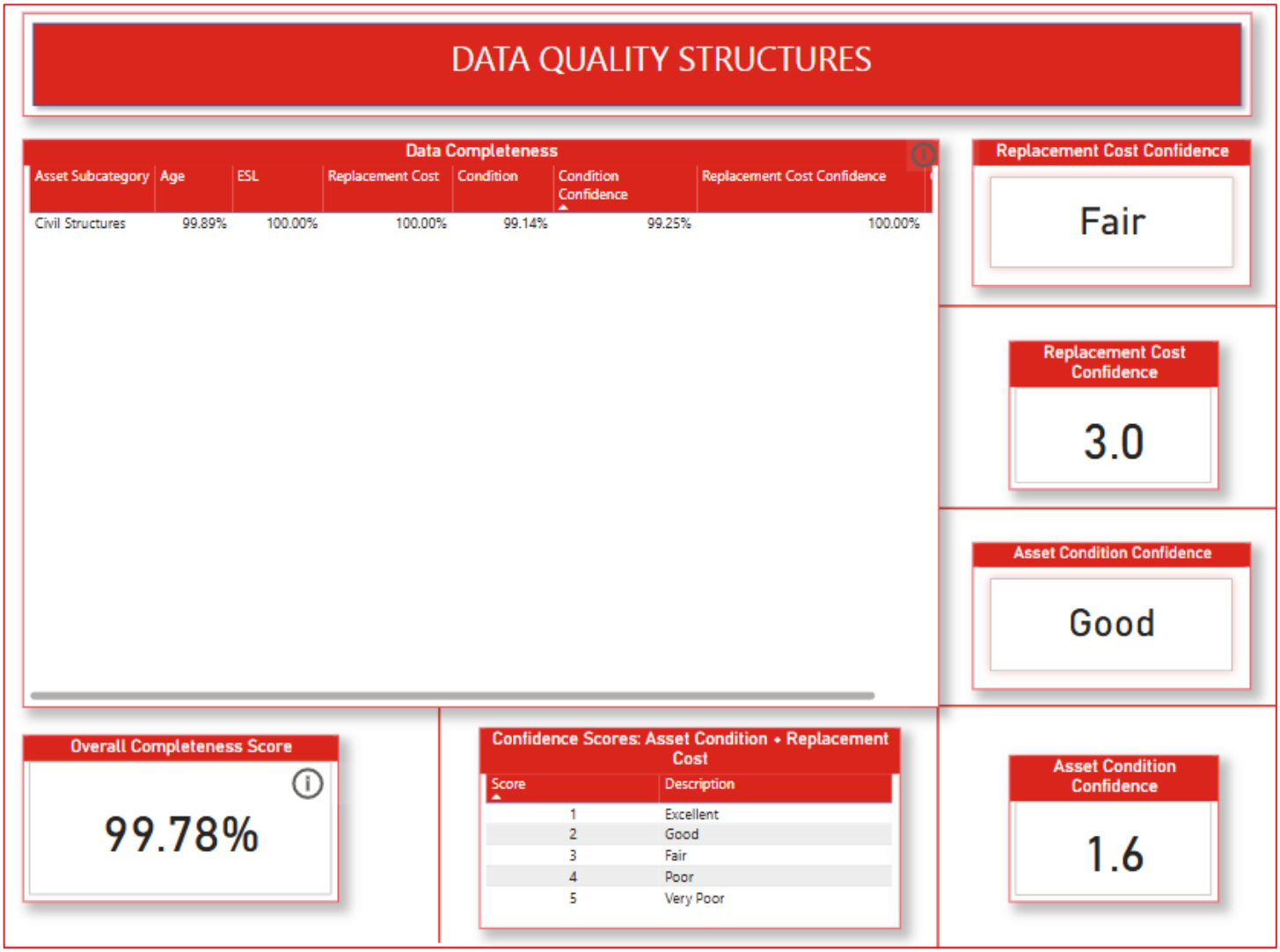


Figure 1-3: State of TTC Asset Data Summary Dashboard – Structures

The data collected and reviewed for the 2025 AMP represents a significant improvement over the previous version, with a relatively high data completeness score. However, confidence levels of asset replacement costs, which are based on data and assumptions available at the time of publishing, are low. As the TTC continues to mature its asset management program, condition assessment methodologies will be refined to reflect a more complete understating of asset state and to increase data confidence.

1.3 Asset Levels of Service

The following table outlines how the TTC Structures support the overarching Transit levels of Service:

TTC's Transportation Services…	TTC's Facilities Assets…
…**meet the route and ridership demands** of the travelling public.	…are sufficient and appropriate to support the expected route and passenger flow needs of the travelling public.
	…are scaled and outfitted appropriately to support TTC operations, maintenance, and administrative activities.
…**are reliable and on-time**, per the posted schedule/service plan.	…are maintained in a SOGR such that failures do not negatively impact regular services and reliable operations, maintenance, and administrative activities are supported.
…**are safe** to use and operate.	…allow safe navigation of the travelling public.
	…allow TTC staff to execute their duties safely.
	…include safety assurance services that are sufficient and effective in minimizing system safety risks to TTC staff, the travelling public and the surrounding communities.
…**accommodate accessibility needs** of all customers.	…accommodate the accessibility needs of TTC staff, guests, and the travelling public.
…meet customer expectations for **cleanliness, comfort, and convenience**.	…meet customer and stakeholder expectations for cleanliness, comfort, and convenience.
…are designed in such a way as to **mitigate the environmental impact and build climate resilience** of transportation in the GTA.	…are sufficient and appropriate to mitigate the negative environmental impacts of TTC operations.
	…are scaled and outfitted appropriately to support fleet electrification.
…are undertaken in a **cost-efficient** manner, minimizing the cost to the city for the service provided.	…are managed to ensure that cost/value optimization is considered in all lifecycle activities planning and execution.

Table 1-A: TTC Asset Levels of Service – Structures

2. Civil Structures

The following classes of civil structures are covered in this appendix:

2.1.1 Bored Tunnels

Bored tunnels are excavated or drilled in situ without disturbance of the soil above or activities on the surface. As with any tunnel, bored tunnels can also develop leaks, deterioration, and delamination and some locations require monitoring for shape changes due to their thinner walls and overall tunnel behaviour. Leak remediation of circular tunnel liners is more sensitive because of thin walls, which are at risk of deformation due to the back pressure of pumped grout.

2.1.2 Box Structures

Box structures are typically underground structures built by excavating a trench and constructing a reinforced or precast concrete tunnel from the top down or bottom up. The site is accessed from the surface and this method of construction is commonly referred to as “cut and cover”.

Due to the age of TTC subway tunnels and the constant seepage of road run off with salt, many box structures have been subjected to ingress of contaminants and water through failed expansion joints and concrete cracks, delamination and various forms of concrete deterioration. They require continuous rehabilitation, removal of loose concrete, leak remediation and concrete rehabilitation. As the age of the box structures is increasing, rehabilitation is increasing in scale.

2.1.3 Bridges

Bridges of various construction form and material are part of the asset portfolio of TTC. The life cycle activities of individual bridges are governed and influenced by the material of construction and environment in which the structure is located.

As the City of Toronto and the TTC have evolved, so does the history of bridge ownership. The responsibilities for inspection and maintenance on each structure on the TTC’s network are defined in negotiated agreements with the City of Toronto. The TTC is typically responsible for the inspection and maintenance of all bridges that support the operation of the subway.

2.1.4 Culverts

Culverts play a crucial role in managing surface water runoff, preventing flooding, erosion, and damage to roadways and surrounding properties. Well maintained culverts are key to resilience of the infrastructure especially during extreme weather events and other scenario resulting from climate change etc. By enabling natural drainage systems to function effectively, culverts help maintain the stability and longevity of transportation networks. They come in various types, including pipe culverts, box culverts, and arch culverts, each suited to different environmental conditions and water flow requirements. The TTC is responsible for the inspection and maintenance of four culverts to ensure they remain in State of Good Repair (SOGR).

2.1.5 Substructures associated with Prince Edward Viaduct

The Prince Edward Viaduct (PEV) was an existing structure prior to the construction of Line 2. On the upper deck, the PEV is a public road for vehicular traffic, and the lower deck supports the subway track between Broadview Station and Castle Frank Station in both directions.

While the City of Toronto is responsible for the overall inspection and maintenance of the PEV, the TTC maintains the portion of the structure on the lower deck on which the tracks are laid (the beams), as well as the adjacent steel sidewalk panels and inspection platforms.

The track across the bridge is supported by a series of concrete beams with each rail directly fixed on to the beams. The length of the beams varies with location, but they are typically 6.4 metres long and span between the bridge's girders supported on bearings at each end of the beam.

These beams are deteriorating due to the freeze-thaw, ingress of water and contaminants from the environment as well as the stresses introduced.

2.1.6 Retaining Walls

Retaining walls are vertical walls designed to keep a large mass of soil on one side, sometimes at a steep angle. They are often present in subway "open cut" sections where the track is deeper than the soil around it or when the track is above the surrounding soil. In addition, the TTC is monitoring retaining walls above the subway where it is determined that their deteriorating condition may affect subway structures or the track. Retaining walls are critical as they may be supporting the track itself or protecting the track from nearby soil at a higher level.

The TTC inspects and maintains the retaining walls to ensure they remain in a SOGR. Some external retaining walls that can affect the TTC are monitored in collaboration with third-party owners as required to ensure the safety of the TTC assets.

2.1.7 Underground Station Structures

Stations are typically box structures that provide vertical mobility and access for the public to the subway trains. They can be above, below, or partially below grade. Stations have many functionally and structurally complex components including public areas, ancillary structures for station operations such as shafts, escalator structures, ventilation shafts, and connections to the surrounding buildings.

Five TTC stations are classified as Interchange Stations where the public can transfer from one subway line to another. These are Sheppard-Yonge, Bloor-Yonge, St. George, Spadina, and until recently, Kennedy Stations. There are two Spadina Stations (one on Line 1 and one on Line 2) connected by a pedestrian passage. Additionally, Spadina Station on Line 2 serves as a transfer station to streetcars.

Three stations enable transfers directly from a subway line to a streetcar line; Broadview, St. Clair, and St. Clair West Stations. Union Station enables transfers to a variety of other transportation providers as well as the TTC streetcar network via Queens Quay Station. As part of transit expansion program, more stations are being modified to become Interchange Stations (i.e. Eglinton West and Eglinton Stations with ECLRT). The interface between TTC maintenance teams, who are responsible for maintaining the structures and existing stations, and future Metrolinx contractors, responsible for maintaining the new stations will be defined.

There are two stations that are not used by the public. The construction of Queen Lower was not completed and Bay Lower has been decommissioned (other than for special occasions) since 1966.

As with other reinforced concrete structures, the presence of leaks and loose concrete in the stations necessitates the need for ongoing maintenance. Due to the presence of the public, it is important to ensure the safety and good repair of public areas of stations without interfering with public access.

2.1.8 Miscellaneous Structures

Miscellaneous structures are classified as all other structures on the track level not belonging to previously defined structure types, such as:

- Emergency exits.
- Ventilation and access shafts.
- Pump and breaker rooms, and chambers along main subway lines.
- Hostler platforms.
- Car house pit support columns.

2.2 State of Infrastructure

The following table outlines a high-level overview of the state of TTC Structures:

Asset Summary

Asset Class	Sub-asset Class	Quantity	Replacement Value ($M)	Average Condition	Average age (years)	ESL (years)
Structures	Bored Tunnel	43 (18.1 km)	1280	2.1	34.29	100
	Box Structures	77 (33.2 km)	384	2.3	50.18	100
	Bridges	75	1170	2.1	50.31	75
	Culverts	4	0.1	2.8	66.75	100
	Prince Edward Viaduct Beams	7	58.6	2.0	15.42	75
	Retaining Walls	170 (11.6 km)	28.8	2.0	55.65	100
	Underground Station Structures	85	5100	2.0	53.11	100
	Misc Structures	474	471	2.2	45.69	100

Table 2-A: Asset Summary – Structures

2.2.1 Structures Data Collection – Key Assumptions

- Asset Criticality: Due to the nature of the structures category, it is difficult to define criticality. All items in the asset register would impact service operations, therefore most of these items are defined as either high (Asset has a high-risk impact to service operations) or very high (Asset has a very high-risk impact to service operations)
- It is assumed that all locations except Scarborough Rapid Transit (SRT) and Queen Lower, are listed in the 2024 asset register dump and have a condition rating against them, they are assumed operational and in service as confirmed with TTC stakeholders.
- Total Expected Service Life (ESL): Based on the TTC Design manual (0301-01) expected life of bridges is 75 years, and 80-100 years for underground and above ground, boxes, structures etc. for concrete assets. ESL for PEV Beams is also considered as 75 years. It is to be noted that even though the ESL for bridges is 75 years, bridge components (such as decks, parapet walls, and

beams) are typically replaced at least once within that timeframe. All PEV beams have already been replaced at least once, with some near expansion joints replaced multiple times.

- Asset condition confidence: The inspection list included all assets, therefore the condition confidence was solely based on date of inspection
- In-service date: Utilized commissioned date for in service date
- Asset age: The current year subtracted by the in-service date was assumed.
- Remaining service life: Total expected service life subtracted by asset age in years was assumed.
- Underground assets utilize chainage from (West or South end), and chainage to (East or North end) markers as well as the unit of measure (ft or m). However, the chainage on the University portion of Line 1 runs from the north end to the south end.
- Above ground assets utilize latitude and longitude which was taken from the City of Toronto GIS system which is publicly available (https://open.toronto.ca/)
- Asset condition was taken from TTC available data – utilized weighted averages for all assets using our AMP condition criteria
- Replacement cost and cost confidence are a combination of RS Means available commercial data for 2024 Q4 for the Toronto area, similar recent CAPEX transportation construction project costs within the City of Toronto and other jurisdictions within the Greater Toronto and Hamilton Area, and commercially available catalogues for concrete construction pricing. Where the prices are from previous years, CPI was used to calculate the current price for these items. Cost of labour was also considered where appropriate, applicable, and where there is comparable data for the line item. Various dimensions are estimated and averaged to provide a holistic pricing approach, and the associated confidence should be noted and taken into consideration when reviewing pricing estimations.
    - On the material costs sourced from RSMeans data (as this is not included in the total unit cost), sales taxes were additionally added.
    - Unit costs of items include the bare cost plus the contractor's Overhead & Profit (O&P)
    - Labor cost for the replacement of the asset is estimated based on the "union labor" costs from the national average using union agreements.
    - The location was adjusted for Toronto, Ontario, Canada to localize the data, and data was referenced from RSMeans Data (2024 Q4) edition.
    - For items where exact dimensions of the structure were not available, approximate dimensions as well as the average unit cost were used to determine the replacement costs.
    - Cost of asset replacement determined based on RSMeans data were also compared with other commercial concrete catalogues to verify any estimated parameters and values to create a more accurate costing representation.
- Warranty provider, warranty end date, model name, serial number, manufacturer, acquisition date are not reported the structures category considering the relevance.
- The timelines of the data collection related to the structure assets are as follows:
    - The data on the condition of the structures assets was collected and available as of 02/19/2024
    - Box structures, bored tunnels, stations, bridges, and overheads were inspected in 2023 and 2024

- Retaining walls and Misc structures were inspected in the period 2021 to 2024
- Data presented on asset criticality, expected service life, condition confidence, in service date, asset age, remaining service life etc. were based on the data available as of December 2024.

2.2.2 Asset Condition

As required by Ontario Regulation 472/10: Standard for Bridges (O.Reg. 472), made under the Public Transportation and Highway Improvement Act, 1990, the TTC operates a comprehensive structural inspection program. This program covers the inspection of all structures and plays an important role in providing a safe network of elevated, above ground, and underground structures.

The TTC's subway system continues to age and deteriorate and so an accurate and thorough inspection of each structure is critical in maintaining safe and efficient operations.

The goal of the structural inspection program is to maintain structures to an acceptable standard in terms of structure safety, public safety, comfort, convenience and reliability.

Most of the structural inspections of existing TTC structures are carried out by TTC inspection crews. Each inspection crew is led by a Professional Engineer with a background in structural inspections, design or construction, or by trained structural inspectors under the supervision of a Professional Engineer.

The durability and resulting condition of the structures is impacted by various factors such as structure types, their components, structural material, and their locations. As such, intervals of TTC routine inspections are specified, alongside the guidance provided by other organizations and standards.

Inspections are usually undertaken every two years, depending on the structure and condition of key structural components are reported as the relevant standards. The stated intervals of TTC routine inspections are regarded as the minimum requirement. They are supplemented with additional inspections/monitoring as recommended by inspectors/engineers based on the observed condition of structural elements and the risks associated with safe operational use (in the case of structural or functional failure).

2.2.2.1 Bridge Condition Index and AMP 2025 Asset Condition Rating

For all structure types, the TTC uses a combination of the *Customized Weighted Average* methodology and the *Worst-Conditioned Component* methodology to generate a condition rating score, which is then used to prioritize maintenance activities. These methods are common in the industry and are further customized to meet the TTC's needs, operating environment, funding sources and organizational structure.

Comparison of the BCI to the asset condition rating score adopted in the 2025 AMP is provided in Table 2-B.

BCI Value	Condition rating as per BCI	Condition rating as per AMP	Condition rating score as per AMP 2025	Description as per AMP 2025	Details as per AMP 2025
90 ≤ BCI ≤ 100	Very Good	Excellent	1	Fit for Future	No noticeable degradation. New or like new (>75% life remaining).
80 ≤ BCI < 90	Good	Good	2	Acceptable for now	Normal wear and tear. Any defects have been addressed (repaired, planned, or mitigated). Asset is generally in the mid stage of expected service life (75%-25% life remaining).
65 ≤ BCI < 80	Fair	Fair	3	Requires attention	Measured asset condition is below action thresholds, but within acceptable limits. Defects do not significantly degrade performance. Maintenance/rehabilitation is required. Asset is approaching end of service life (<25% life remaining).
40 ≤ BCI < 65	Poor	Poor	4	Increasing potential of affecting service	Measured asset condition is below action thresholds and approaching condemnable limits. Asset is considered unfit for service without risk assessment/mitigation. Significant maintenance/rehabilitation is required. Asset is at or beyond end of service life.
BCI < 40	Very Poor	Very Poor	5	Unfit for sustained service	Measured asset condition is at or beyond condemnable limits. Asset is unfit for service without major risk mitigation activities. Replacement/rehabilitation is required. Asset is well beyond service life.

Table 2-B: BCI and AMP 2025 Condition Rating – Mapping

2.2.2.2 Asset Condition Rating Confidences

As the condition of the structure does not change significantly in short term and structural deterioration typically progresses more slowly deterioration of other types of assets, the timelines specified in Table 2-C are used to define the asset condition confidence for structures.

Code	Confidence	Method of assessment	Sampling	Timeliness
1	Excellent	Score is based on quantified wear or degradation parameters or qualified SME assessment.	All assets	<2 years
2	Good	Score is based on qualitative assessment by a competent assessor.	All or most (>75%) assets	< 6 years
3	Fair	Score is based on qualitative assessment by a competent assessor.	Statistically significant (>25%) random sample of the asset base	<8 years
4	Poor	Score is based on statistical assessment of layperson (operator or public) accounts, or is purely based on known asset age vs assumed life	Small batch (<25%) random sample	<10 years
5	Very Poor	Score is assumed based on anecdotal accounts, age estimates, or similar.	Anecdotal or estimation only	>10 years

Table 2-C: Asset Condition Confidence Rating for structures

It is to be noted that quality of the asset condition assessment is dependent on various factors including but limited to type of structural inspections, competency of the assessor and the site condition during the inspections. Hence, it should be ensured that structural assessments and inspections are undertaken by suitably experienced and competent staff. Staff training, certification and standardized guidelines for structural

assessments, planning and management of inspections should be adopted to ensure that assessors are able to perform their duties accurately, consistently, thoroughly and safely.

The majority of box structures, bridges and culverts, underground station structures have been inspected in the last two years. Roughly half of the retaining walls and miscellaneous structures have been inspected in the last two years, and nearly all structural assets have been inspected in last four years.

2.3 Levels of Service

Levels of Service (LOS) for structures have been assessed in line with the overarching LOS framework presented in the main AMP document. Proposed LOS are encapsulated in the performance targets, as well as the initiatives outlined in the Future LOS table. The TTC believes that these proposed LOS are reasonably achievable given the available funding. Further details on risks and funding requirements are outlined in subsequent sections.

The TTC will undertake accelerated SOGR programs or modified maintenance activities for under-target assets. Additional details can be found in the asset class strategy summaries in the **TTC Asset Management Strategy** document.

Performance Summary

Overall, structures are meeting LOS targets and expectations.

While structures are generally sufficient and allow transit operations as planned and condition remains within acceptable limits, life cycle management activities need to be undertaken to ensure the LOS are maintained, and that modern structural safety standards are met.

Current Levels of Service

Asset Category Customer Level of Service	Subcategory Technical Level of Service	Performance Measure	Performance	Target
TTC Structures assets are sufficient and appropriate to support the expected route and passenger flow needs of the travelling public.	Structures assets does not limit the intended subway service plan	N/A	The network is sufficient to meet ridership needs.	
TTC Subway structures assets are reliable and maintained in a SOGR such that service affecting failures and restricted speed zones are minimized.	Structures assets are maintained in a SOGR	% of all bridges in fair or better condition	97.5%	95%
		% of all culverts in fair or better condition	50%[35]	95%
		% of box structures in fair or better condition	100%	95%
		% of bored tunnel in fair or better condition	100%	95%
		% of underground station structures in fair or better condition	100%	95%
		% of Retaining walls in fair or better condition	98.8%	95%
		% of Miscellaneous structures in fair or better condition	96.4%	95%
		% of PEV in fair or better condition	100%	95%

Table 2-D: Current Levels of Service – Structures

[35] Two of the four culverts (50%) do not meet the target condition. These culverts are currently under investigation by a consultant, with rehabilitation planned in upcoming years (EC&E project).

Future Levels of Service

Asset Category Customer Level of Service	Asset Future Level of Service	Actions	Target Date	Initiative
TTC structures assets minimize Environmental Impacts and Build Resiliency for a Climate Changed Future	TTC structure ensure resilient to the impacts of extreme weather events. As these events become more frequent and severe, resiliency will be critical to ensure transit remains a reliable mobility option	To undertake a comprehensive assessment of existing assets to assess vulnerabilities, risks, and potential adaptations needed	2041	Corp Plan 3.3.2
TTC Structures assets are sufficient and appropriate to support the expected route and passenger flow needs of the travelling public.	Support an increase in line capacity of 55% (over 2019 levels)	Enhance Line 1 Structures reliability to accommodate additional traffic	2041	Corp Plan 3.1.1
	Support an increase in line capacity of 18% (over 2019 levels)	Enhance Line 2 Stations to accommodate additional traffic	2041	Corp Plan 3.1.3
TTC Structures assets allow safe navigation of the travelling public.	TTC Structures meet modern standards for safety	Ensure structure can support the delivery of safe and reliable transit services to customers	2032	Corp Plan 2.4.2

Table 2-E: Future Level of Service Initiatives – Structures

2.4 Lifecycle Management Activities

The following significant structural maintenance projects are being undertaken as specified in the TTC Capital Investment Plan:

- Structural Paving Rehabilitation Program
- Bridges and Structures Maintenance Program
- Leak Remediation Program for Stations and Tunnels
- Structure Rehabilitation Program
- Prince Edward Viaduct Beam Replacement.
- Culverts and East Don River
- Asbestos Abatement.
- EC&E Major Rehabilitation Programs.

These activities are reviewed continuously to ensure the highest priority defects are addressed as identified by the latest data from structural inspections and condition assessments and to minimise the impact of work on TTC operations.

The following table outlines the assessed lifecycle activities requires to maintain Structures SOGR:

Activity	Frequency	Annualized Cost ($K)
Non-Infrastructure		
Administrative overhead, process continuous improvement	As required	
Maintenance		
Regular inspection, cleaning, and servicing	Periodic	$4,530
Minor maintenance interventions	As required	

Capitalized Overhauls & Renewals		
Bridge & Surface Structure Ongoing Renewal Program	Ongoing	$12,429
Underground Structure Ongoing Renewal Program	Ongoing	$20,749
Tunnel Leak Remediation	Ongoing	$5,170
Culverts and East Don River Bridge Renewal	Through 2029	$2,312[36]
PEV Beam Replacements	Ongoing	$2,529
Maintenance of Joint TTC/TOR Transport Bridges	Ongoing	$2,658
Data source: *TTC O&I Group – Plant Maintenance, TTC Capital Investment Plan*		

Table 2-F: Lifecycle SOGR Activities – Structures

The following table provides examples of lifecycle activities that are undertaken to provide improvements to service and address ridership growth and system network expansion (meet proposed future LOS).

Activity	**Timeline**	**Program Cost** ($K, current planning period)
Non-Infrastructure		
Tunnel Mapping - GIS	Ongoing	$14,250
System Improvement		
Asbestos Abatement Program	Ongoing	$57,076
Growth		
No Civil Structures specific growth programs currently underway		
NOTE: *Other ES&D growth supporting activities are included in major expansion projects (e.g.: Line 5 implementation)*		
Data source: *TTC O&I Group – Plant Maintenance, TTC Capital Investment Plan*		

Table 2-G: Current & Planned Lifecycle Activities to Improve Service and Address Growth – Structures

2.5 Lifecycle Investment Forecasts

At the current stage of asset management maturity, lifecycle investment needs are evaluated as the annualized cost to maintain SOGR, as outlined above. The following figures and table illustrate the full lifecycle investment forecasts for Structures. The figures show the current funding by project type compared to the total overall funding required to maintain SOGR and deliver on selected service enhancement and growth projects.

[36] Annualized of 10 years. Actual annual costs through 2029 are higher (see CIP).

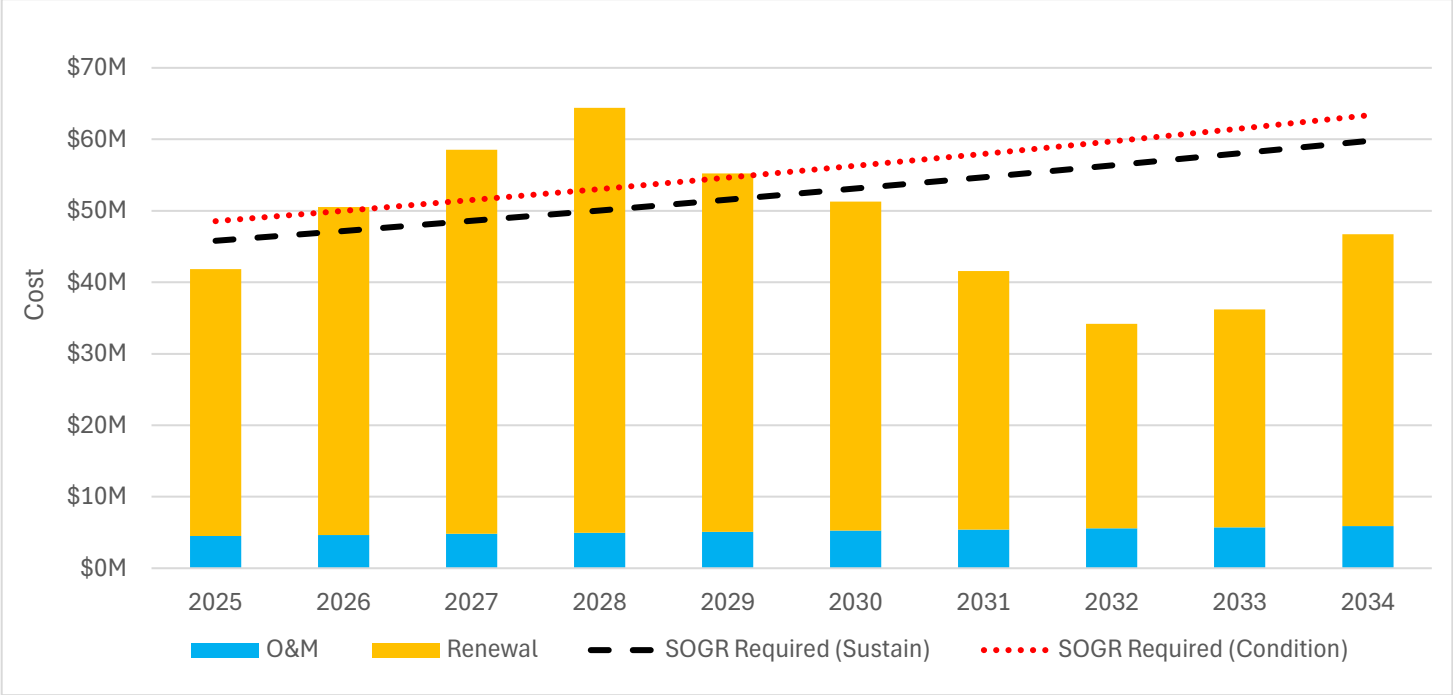


Figure 2-1: Funding vs Assessed Program Requirements – Structures (SOGR only)

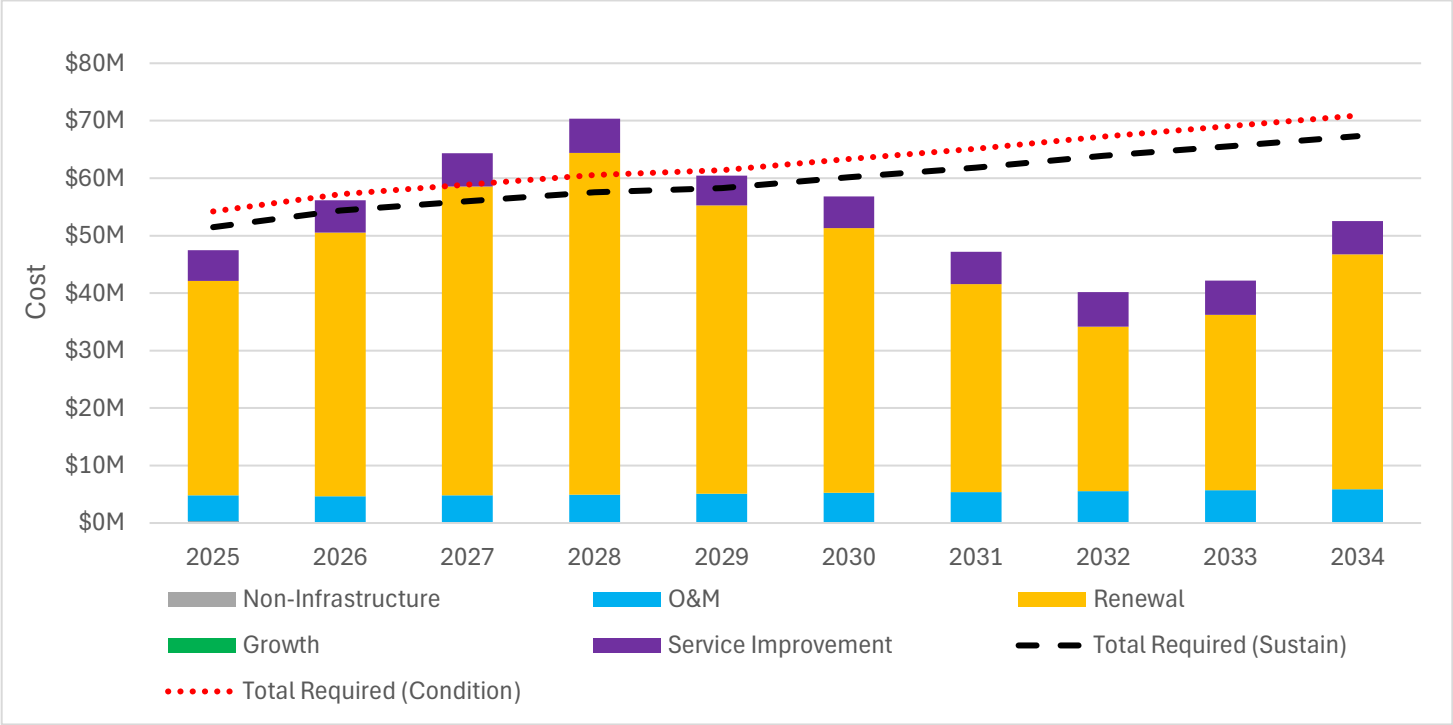


Figure 2-2: Funding vs Assessed Program Requirements – Structures

The following table summarizes the average annual budget and investment needs for the planning period:

Lifecyle Activity	Planned Budget ($K)	Investment Needed to Sustain LoS ($K)	Investment Needed to Address Condition Gap ($K)
Non-Infrastructure	$30	$1,425	$1,425
Maintenance	$5,191	$5,191	$5,191
Renewals	$42,865	$47,322	$50,469
Growth	$0	$0	$0
Service Improvement	$5,685	$5,708	$5,708
Total Expenditure	$53,771	$59,646	$62,793
Average annual SOGR Gap		$4,458	$7,604
Average annual Infrastructure Gap		$5,875	$9,021

Table 2-H: Annualized Funding vs Assessed Program Requirements – Structures

3. Conclusion & Risks

The following list outlines key risks to delivering on the TTC Structures assets LOS. Specific safety, operational, and commercial risks that may be negatively impacted by the broader concerns outlined below can be found in TTC's Structure Risk Register.

1. **Aging Infrastructure** - Many structural assets were built decades ago and require extensive maintenance and renewal interventions to meet current safety standards. Rehabilitation of these assets is required to ensure that they continue to meet LOS.
2. **Funding Shortfalls** - Current funding levels do not meet requirements to sustain structure condition and LOS, nor to address the condition gap resulting from aging infrastructure. If appropriate funding levels are not assured, asset condition and performance will continue to degrade. Increased maintenance demands could strain available resources and funding as reactive and stopgap maintenance activities become necessary.
3. **Environmental Stressors** – As climate changes increases the volatility of weather and environmental conditions, exposure to these conditions, temperature extremes, as well as urban pollutants accelerates structure asset degradation. There are rising concerns about climate resilience and the need for adaptive strategies to mitigate potential impacts.
4. **Operational Constraints** - Maintenance windows are often limited by operational schedules, necessitating efficient planning and execution.
5. **Limited Staffing and Resource Availability** – Lack of data has limited the ability to undertake a robust analysis to evaluate of the operating budget requirements. Anecdotal evidence suggests that the actual operating budgets required to sustain SOGR and undertake timely inspections and repairs are higher than presented. The TTC is working to improve this model as the EAM program matures.

ASSET MANAGEMENT PLAN 2025

APPENDIX D: Facilities Asset Category Plan

Toronto Transit Commission

Contents

LIST OF TABLES

LIST OF FIGURES

4. Asset Category Overview - Facilities

4.1 Introduction

A facility is a physical space or building designed to support specific functions and activities. It is characterized by its location, structure, and purpose, and is influenced by its surrounding environment. Within the TTC's asset hierarchy, facilities are categorized by function as outlined in Figure 4-1. Facility assets include all elements related to the building's infrastructure, such as HVAC systems, plumbing, electrical systems, and security systems.

Certain assets that meet the definition of a facility asset are not included in this category and are included elsewhere in the hierarchy (e.g., communication systems, specialized equipment, IT infrastructure), or may be currently out of scope (e.g., temporary installations, leased equipment).

Service Statement

> *"TTC Facilities assets support overall delivery of transit, they enable the delivery of core services, supporting the movement of passengers, and ensuring the reliability and safety of transit operations. Facilities assets ensure a safe and comfortable environment for passengers and staff, providing essential services such as heating, ventilation, air conditioning, plumbing, and security."*

Asset Breakdown

Facilities are categorized by type or use, as outlined below.

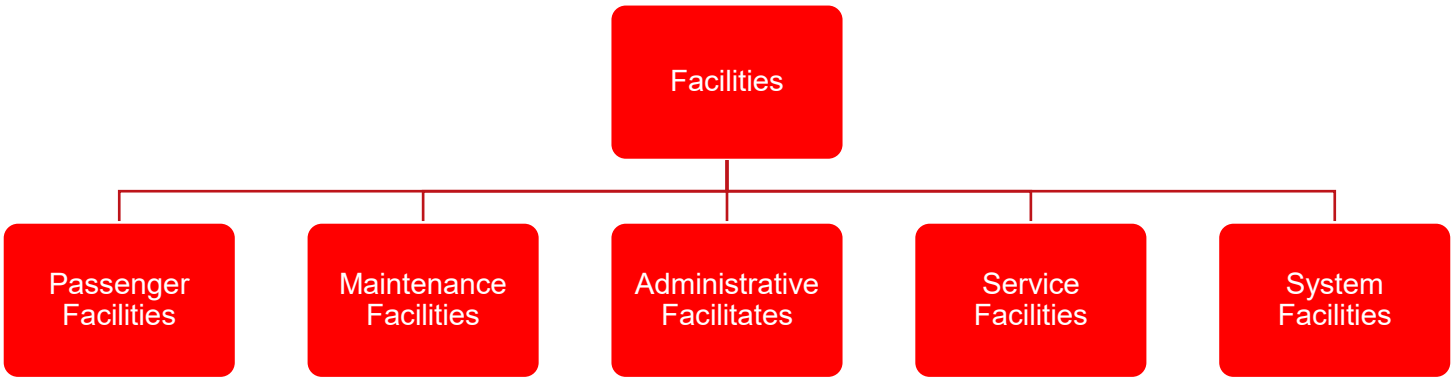


Figure 4-1: Asset Hierarchy – Facilities by type

They can also be broken into the different types of assets or elements that make them up, as shown below.

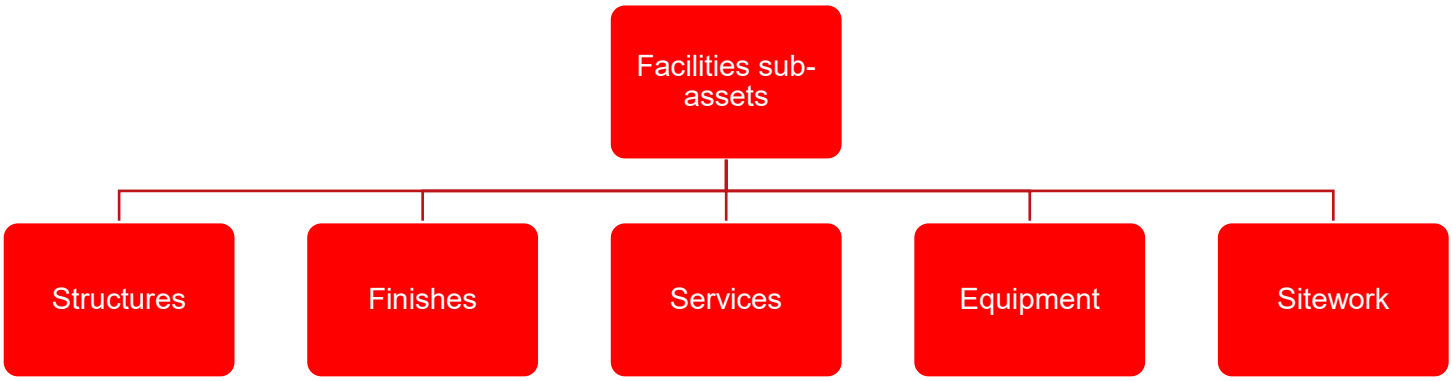


Figure 4-2: Asset Hierarchy – Facilities by sub-asset class

4.2 State of Infrastructure

The following figure outlines a high-level overview of the state of TTC Facilities assets[37]:

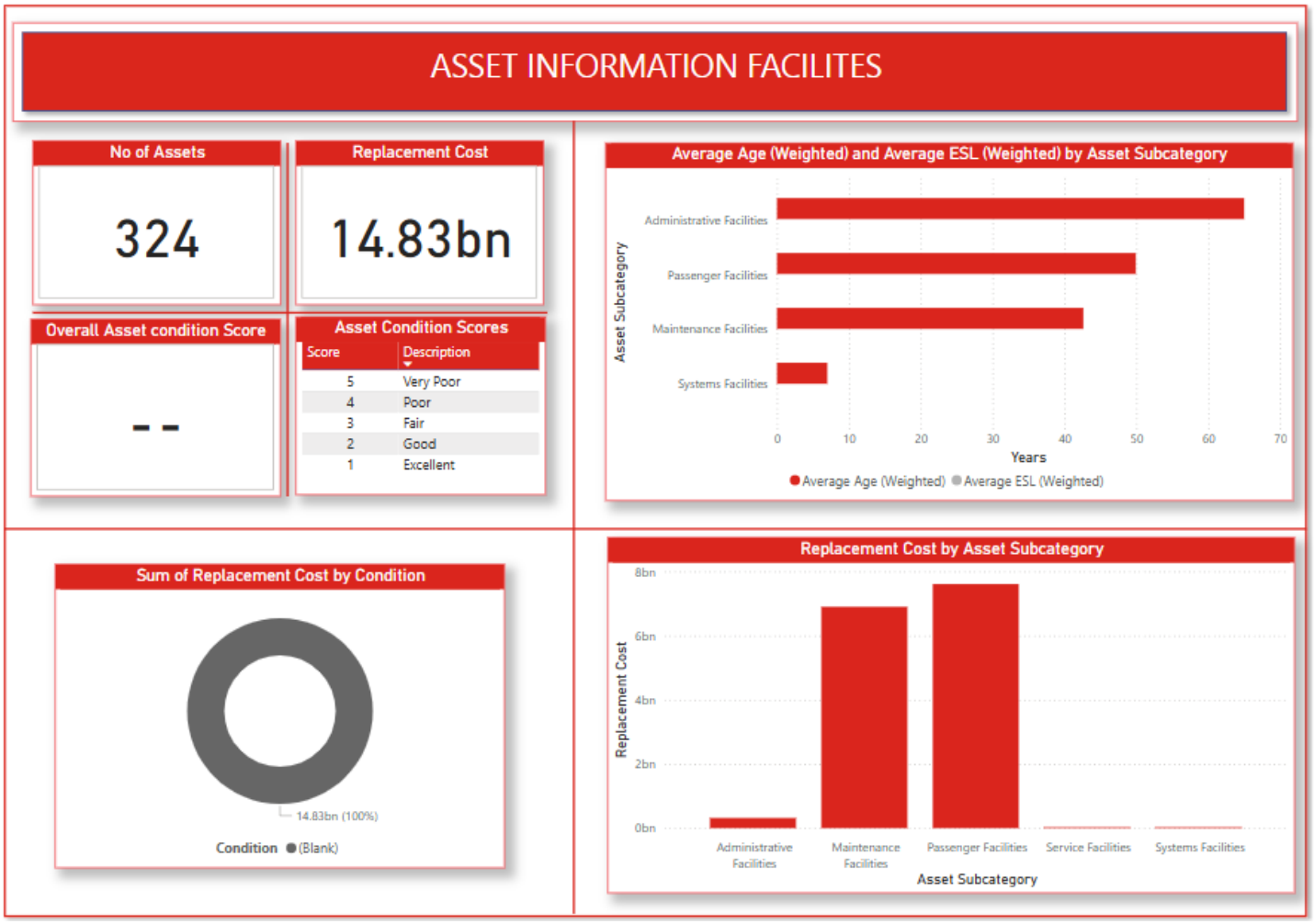


Figure 4-3: State of TTC Infrastructure Summary Dashboard – Facilities

[37] Note that asset condition data is not yet represented at the Facility level, and is included in Section 8 at the facility sub-asset level

The current assessed replacement value of TTC Facilities is approximately $14.83B, which is a significant uplift from the $5B reported in the 2024 AMP. This increase reflects the difference in methodologies used, with the current assessment factoring in recent construction/acquisition/installation of new facilities in the TTC to determine the replacement cost. The costs shown in the dashboard include the replacement costs of all the sub-assets found within each type of facility (e.g., electrical systems, HVAC, interiors finishes, etc.) but do not include any bespoke equipment (e.g., vehicle maintenance equipment). The TTC believes that the values in the 2025 AMP are more representative of the true costs to replace the asset base, although the current low level of data maturity and cost data availability limits the ultimate accuracy.

The current state of data quality/maturity among TTC assets is outlined in the following figure:

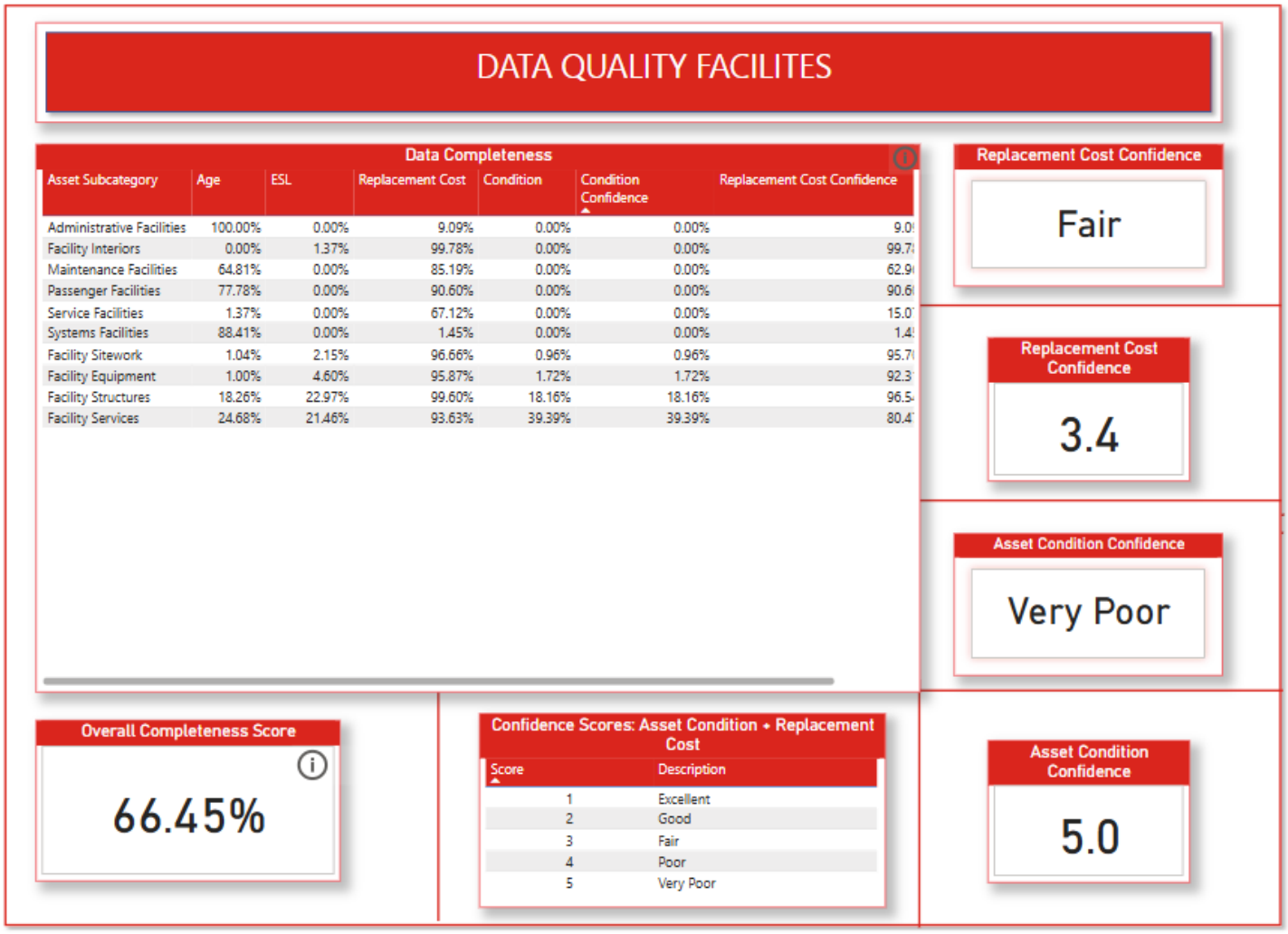


Figure 4-4: State of TTC Asset Data Summary Dashboard – Facilities

Due to the complexities in representing data for facilities and their sub-assets, asset data for the purposes of this AMP is at a low level of maturity. It is important to note that this does not necessarily reflect a lack of data or a lack of understanding of the factors that the data represents. The Facilities maintenance and engineering teams are working with similar or complimentary data, but this has not yet been translated into a format that can be presented in this document. As such, the majority of key asset state data has been evaluated at the sub-asset class level, rather than the Facility-type level. The condition assessment of Facilities sub-assets will be presented in the Section 8. As the TTC continues to mature its asset management program, condition assessment methodologies will be refined to reflect a more complete understating of asset state and to increase data maturity and confidence.

4.3 Asset Levels of Service

The following table outlines how the TTC Facilities support the overarching Transit Levels of Service (LOS).

TTC's Transportation Services…	TTC's Facilities Assets…
…**meet the route and ridership demands** of the travelling public.	…are sufficient and appropriate to support the expected route and passenger flow needs of the travelling public.
	…are scaled and outfitted appropriately to support TTC operations, maintenance, and administrative activities.
…**are reliable and on-time**, per the posted schedule/service plan.	…are maintained in a SOGR such that failures do not negatively impact regular services and reliable operations, maintenance, and administrative activities are supported.
…**are safe** to use and operate.	…allow safe navigation of the travelling public.
	…allow TTC staff to execute their duties safely.
	…include safety assurance services that are sufficient and effective in minimizing system safety risks to TTC staff, the travelling public and the surrounding communities.
…**accommodate accessibility needs** of all customers.	…accommodate the accessibility needs of TTC staff, guests, and the travelling public.
…meet customer expectations for **cleanliness, comfort, and convenience**.	…meet customer and stakeholder expectations for cleanliness, comfort, and convenience.
…are designed in such a way as to **mitigate the environmental impact and build climate resilience** of transportation in the GTA.	…are sufficient and appropriate to mitigate the negative environmental impacts of TTC operations.
	…are scaled and outfitted appropriately to support fleet electrification.
…are undertaken in a **cost-efficient** manner, minimizing the cost to the city for the service provided.	…are managed to ensure that cost/value optimization is considered in all lifecycle activities planning and execution.

Table 4-A: TTC Asset Levels of Service – Facilities

5. Passenger Facilities

5.1 Introduction

Passenger facilities are public-facing facilities that provide access points to the transit services, and include subway stations, bus and streetcar stops and shelters, as well as Wheel-Trans hubs. The TTC's passenger facilities are strategically located at key points throughout the City of Toronto, such as major intersections, commercial areas, or other points of interest, to ensure that the travelling public can navigate the city conveniently. Within the TTC's asset hierarchy, passenger facilities are categorized by transit mode and service provided.

Service Statement

> *"TTC passenger facilities ensure that the travelling public are safe, comfortable and appropriately informed with wayfinding and other information as they seek out public transportation services, and that all accessibility needs are met."*

Asset Breakdown

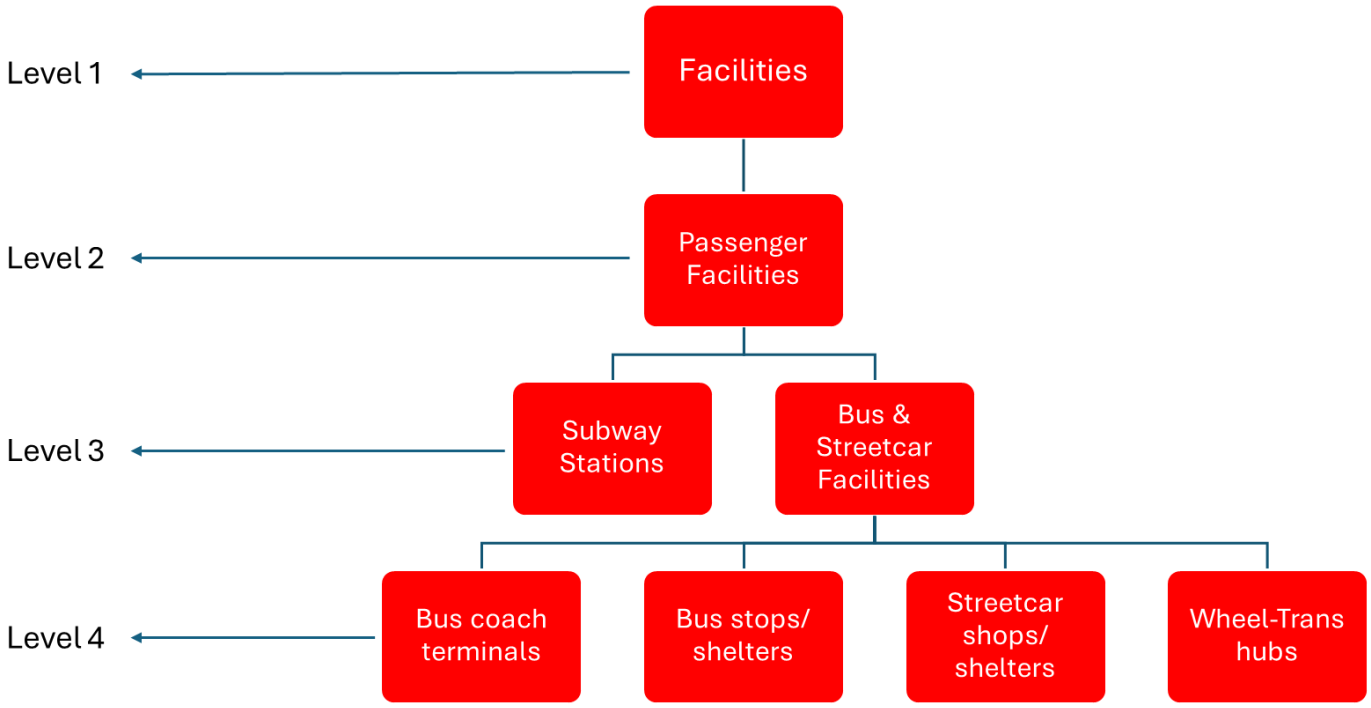


Figure 5-1: Asset Hierarchy – Passenger Facilities

5.2 State of Infrastructure

The following table outlines a high-level overview of the state of TTC Passenger Facilities:

Asset Summary

Asset Class	Sub-asset Class	Quantity	Replacement Value ($M)	Average Condition	Average age (years)	ESL (years)
Subway	Stations	70	$15,200M	Not available	50	Not available
Bus & Streetcar	Bus stops	8,879	$7.3M		-	
	Streetcar stops	620			-	
	Wheel-Trans Access Hubs	15			4	
	Shelters[38]	3			-	

Data Source(s): *TTC Operations & Infrastructure Group and Transportation & Vehicles Group*

Table 5-A: Asset Summary – Passenger Facilities

5.3 Levels of Service

Levels of service (LOS) for Passenger Facilities have been assessed in line with the overarching LOS framework presented in the main AMP document. Proposed LOS are encapsulated in the performance targets, as well as the initiatives outlined in the Future LOS table. The TTC believes that these proposed LOS are reasonably achievable given the available funding. Further details on risks and funding requirements are outlined in subsequent sections.

The TTC will undertake accelerated SOGR programs or modified maintenance activities to achieve the targets if not. Additional details can be found in the asset class strategy summaries in the **TTC Asset Management Strategy** document.

Performance Summary

Overall, passenger facilities are approaching LOS targets and expectations.

While passenger facilities are generally sufficient and allow transit operations as planned, reliability is below acceptable thresholds and customer feedback indicates that public communications do not meet expectations.

[38] Does not include bus shelters to are managed and maintained by the City of Toronto

Current Levels of Service

Asset Category Customer Level of Service	Subcategory Technical Level of Service	Performance Measure	Performance	Target
TTC Facilities assets are sufficient and appropriate to support the expected route and passenger flow needs of the travelling public.	Passenger facilities are scaled and designed appropriately for passenger traffic	N/A	Passenger facilities are sufficient to support current service plan	-
TTC Facilities assets are maintained in a SOGR such that failures do not negatively impact regular services and reliable operations, maintenance, and administrative activities are supported.	Passenger facilities assets are maintained in fair or better condition	Assets in fair or better condition (value weighted average %)	Not available	-
	Passenger facility maintenance program is effectively executed	One Time WO Closure Rate[39]	94%	90%
TTC Facilities assets allow safe navigation of the travelling public.	TTC Passenger facilities and associated safety assurance systems are regularly inspected and/or certified to ensure any safety hazards are appropriately mitigated.	Safety Critical Inspection/Maintenance compliance	100%	100%
		JHSC Open Items – Monthly Average (>6 months)[39]	4	10
TTC Facilities assets accommodate the accessibility needs of TTC staff, guests, and the travelling public.	Passenger facilities meet AODA accessibility standards	Elevator availability (%)	97.9	98
		Automatic door availability (%)	99.3	99.8
		Customer Service Communications – Facility Accessibility	262	-
		Customer Service Communications – Station Lighting	16	-
TTC Facilities assets meet customer and stakeholder expectations for cleanliness, comfort, and convenience.	Passenger facilities are clean and well maintained	Subway Station Cleanliness (Customer Perception)	58%	63%
		Bus Stop Cleanliness (Customer Perception)	61%	65%
		Streetcar Stop Cleanliness (Customer Perception)	57%	62%
		Customer Service Communications – Station Cleanliness	323	-
		Customer Service Communications – Station Equipment & Structural	233	-
		Customer Service Communications – Streetcar Facilities	70	-
		Graffiti response time (Days)	0.78	1
	Escalators in passenger facilities are available and functional	Escalator availability (%)	94.0	97

Table 5-B: Current Levels of Service – Passenger Facilities

[39] Applies across all facility asset classes

Future Levels of Service

Asset Category Customer Level of Service	Asset Future Level of Service	Actions	Target Date	Initiative
TTC Facilities assets are sufficient and appropriate to support the expected route and passenger flow needs of the travelling public.	Support an increase in Line 1 capacity of 55% (over 2019 levels)	Enhance Line 1 Stations to accommodate additional traffic	2041	Corp Plan 3.1.1
	Support passengers increase of 86% (over 2019 levels) at Bloor-Yonge Station	Enhance Bloor-Yonge Station with a new second platform on Line 2, extended Line 1 platforms, new accessibility features, fire ventilation upgrades, a new accessible entrance and exit, and improvements for passenger flow and customer experience.	2035	Corp Plan 3.1.2
	Support an increase in Line 2 capacity of 18% (over 2019 levels)	Enhance Line 2 Stations to accommodate additional traffic	2041	Corp Plan 3.1.3
TTC Facilities assets allow safe navigation of the travelling public.	TTC Facilities meet modern standards for safety	Construct secondary exits and fire ventilation upgrades at key subway stations.	2032	Corp Plan 2.4.2

Table 5-C: Future Level of Service Initiatives – Passenger Facilities

5.4 Lifecycle Management Activities

The following table provides examples of the type of lifecycle activities that are undertaken across all TTC passenger facilities to maintain in a State of Good Repair (SOGR). It is important to note that lifecycle activities of facilities assets vary depending on the asset or element that forms the facility and will be detailed in the Facilities Sub-assets section below.

The following table outlines the assessed lifecycle activities requires to maintain Passenger Facilities SOGR:

Activity	Frequency	Annualized Cost ($K)
Maintenance		
O&M activities are covered in the Facilities Assets section of this document		
Renewals		
Passenger facilities renewals and rehabilitation programs	As required	$15,416
Data source: *TTC O&I Group – Plant Maintenance, TTC Capital Investment Plan*		

Table 5-D: Lifecycle SOGR Activities – Passenger Facilities

The following table lists lifecycle activities that are undertaken to provide improvements to service and address ridership growth and system network expansion (meet proposed future LOS).

Activity	Timeline	Program Cost ($K, current planning period)
System Improvement		
Bus/streetcar Stop Accessibility Improvements	Ongoing	$217,418
Transit Signal Priority	2023-2034	$36,820
Rapid TO Bus Lanes	2020-2032	$131,381
Warden Station Redevelopment	2022-2029	$136,895
Enhanced Station Access Programs	2017-2030	$145,948
Islington Station Redevelopment	2023-2029	$117,669
Platform Edge Doors	2026-2039	$368,080
Stations Transformations	2015-2025	$5,235
Subway Station Second Exits	2020-2030	$170,758
Pattison Digital	2023-2026	$35,688
Growth		
Eglinton Bus Terminal	2024-2027	$25,470
Park Lawn Loop	2026-2029	$20,714
Platform Modifications for Artic Buses	2023-2033	$82,626
Bloor-Yonge Capacity Enhancements	2022-2035	$1,306,052
Data source: *TTC O&I Group – Plant Maintenance, TTC Capital Investment Plan*		

Table 5-E: Current & Planned Lifecycle Activities to Improve Service and Address Growth – Passenger Facilities

5.5 Climate Change

In 2019, the TTC's existing facilities accounted for 16% of Scope 1 greenhouse gas (GHG) emissions. The largest source of facility emissions is from the use of natural gas to heat buildings. The Innovation and Sustainability Strategy (ISS) work stream 2.13 outlines the plan to decarbonize TTC facilities. To reduce facility-related emissions, TTC will develop zero-carbon transition plans for each facility in the TTC portfolio by the end of 2027.

Actions coming out of zero-carbon transition plans will incorporate:

- Energy efficiency programs to reduce energy consumption.
- Fuel switching for heating of buildings.
- Integrated design processes and deep retrofits to maximize efficiencies while improving the overall building's performance.
- A refrigerant inventory and processes for leak management and responsible disposal.

These actions will support TTC's Green Facility Targets, achieving net-zero GHG emissions by 2040 by:

- Eliminating 90% of direct emissions through conservation programs, and fuel switching from natural gas heating to electric mechanical systems.

- Maximizing use of zero-emission on-site generation, including utilizing solar PV systems on 100% of available roofs and parking lots.
- Deploying battery energy storage systems to shift the time-of-day use of electricity to the evening when the electricity supply is low-emissions.

5.6 Lifecycle Investment Forecasts

At the current stage of asset management maturity, lifecycle investment needs are evaluated as the annualized cost to maintain SOGR, as outlined above. The following figures and table illustrate the full lifecycle investment forecasts for Passenger Facilities. The figures show the current funding by project type compared to the total overall funding required to maintain SOGR and deliver on selected service enhancement and growth projects.

The funding gap is significantly bigger between 2028 and 2032. This gap is because of the Subway Facility Renewal Program being underfunded by $132M in the current Capital Investment Plan (CIP).

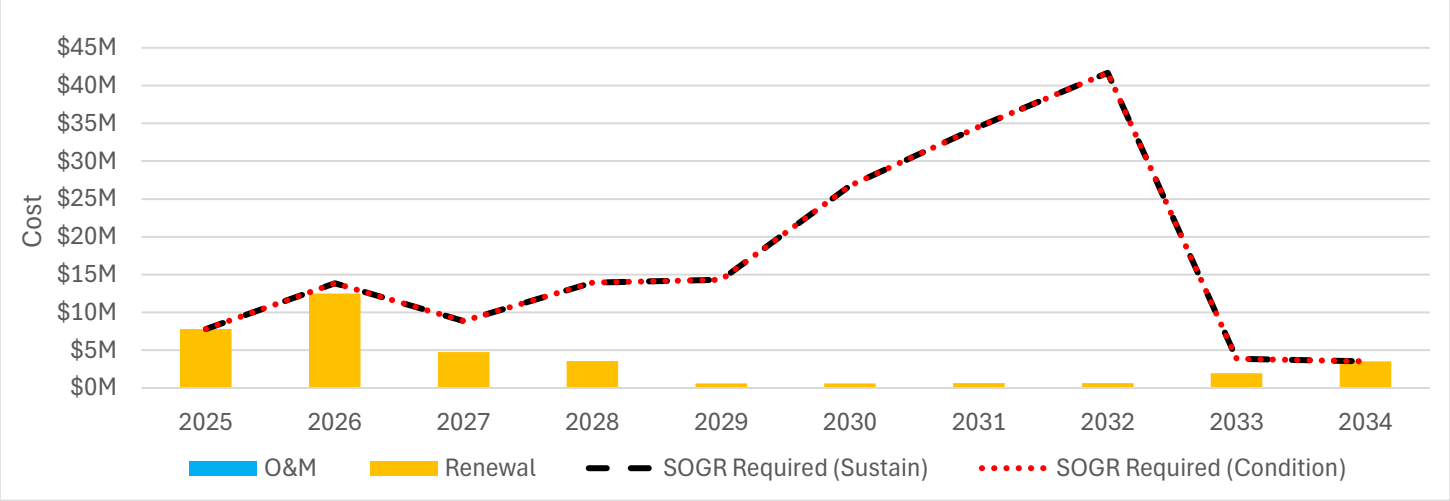


Figure 5-2: Funding vs Assessed Program Requirements – Passenger Facilities (SOGR only)

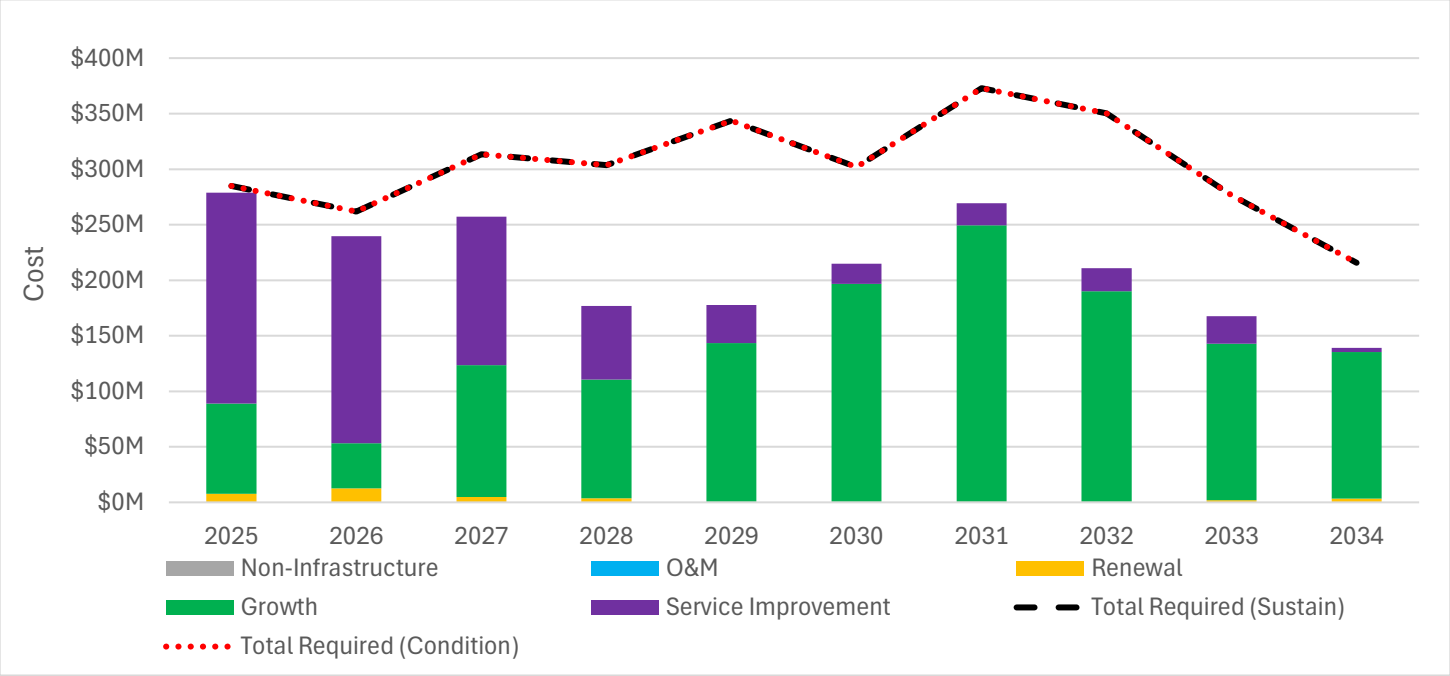


Figure 5-3: Funding vs Assessed Program Requirements – Passenger Facilities

The following table summarizes the average annual budget and investment needs for the planning period:

Lifecyle Activity	Planned Budget ($K)	Investment Needed to Sustain LOS ($K)	Investment Needed to Address Condition Gap ($K)
Non-Infrastructure	$0	$0	$0
Maintenance	$0	$0	$0
Renewals	$3,662	$16,915	$16,915
Growth	$139,714	$148,978	$148,978
Service Improvement	$69,828	$136,589	$136,589
Total Expenditure	$213,204	$302,482	$302,482
Average annual SOGR Gap		$13,253	$13,253
Average annual Infrastructure Gap		$89,278	$89,278

Table 5-F: Annualized Funding vs Assessed Program Requirements – Passenger Facilities

6. Maintenance and Administrative Facilities

6.1 Introduction

Maintenance and administrative facilities are specialized locations designed to support the efficient operation and management of transit services. These facilities include garages, shops, depots, and administrative offices, each playing a crucial role in maintaining the transit system's infrastructure and ensuring smooth operations. TTC's maintenance facilities are equipped with the necessary tools and equipment to perform routine inspections, repairs, and overhauls of its fleet and infrastructure. Administrative facilities house the personnel responsible for planning, scheduling, and managing transit operations, as well as supporting functions such as human resources, finance, and customer service.

Service Statement

> *"TTC maintenance and administrative facilities ensure that the TTC's fleet and infrastructure is maintained required condition to deliver its function and meet the customer expectations of service."*

Asset Breakdown

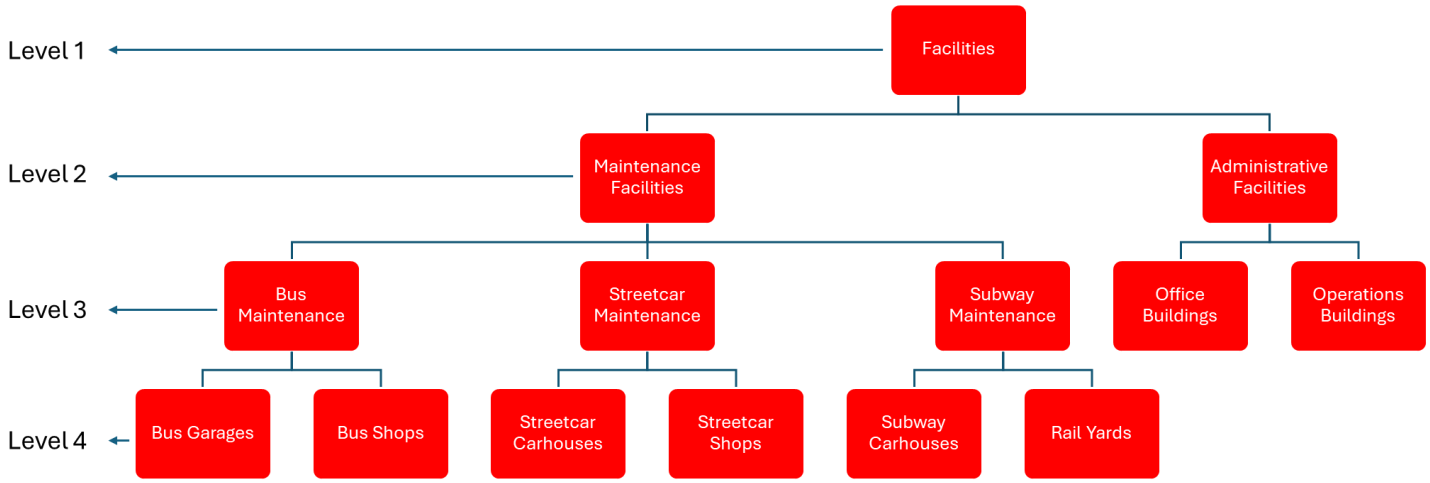


Figure 6-1: Asset Hierarchy – Maintenance and Administrative Facilities

6.2 State of Infrastructure

The following table outlines a high-level overview of the state of TTC Maintenance and Administrative Facilities:

Asset Summary

Asset Class	Sub-asset Class	Quantity	Replacement Value ($M)	Average Condition	Average age (years)	ESL (years)
Bus Maintenance	Garages	14	$2,900	Not Available	35	Not Available
	Shops	1			39	
Streetcar Maintenance	Carhouses and Shops	5	$1,600		63	
	Yards	3			69	
Subway Maintenance	Carhouses and Shops	13	$2,390M		44	
	Yards	4			54	
Administrative Buildings	Office Buildings	5	$317M		58	
	Operations Buildings	6			65	

Data Source(s): *TTC Operations & Infrastructure Group and Transportation & Vehicles Group*

Table 6-A: Asset Summary – Maintenance and Administrative Facilities

6.3 Levels of Service

Levels of Service (LOS) for Maintenance and Administrative Facilities have been assessed in line with the overarching LOS framework presented in the main AMP document. Proposed LOS are encapsulated in the performance targets, as well as the initiatives outlined in the Future LOS table. The TTC believes that these proposed LOS are reasonably achievable given the available funding. Further details on risks and funding requirements are outlined in subsequent sections.

Where asset performance falls below targets, the TTC will undertake action to address. In many cases this includes accelerated SOGR programs or modified maintenance activities. Additional details can be found in the asset class strategy summaries in the **TTC Asset Management Strategy** document.

Performance Summary

Overall, maintenance and administrative facilities are meeting LOS targets and expectations.

Maintenance and administrative facilities are generally sufficient and allow transit operations as planned, however, there is limited data on some of the performance metrics.

Current Levels of Service

Asset Category Customer Level of Service	Subcategory Technical Level of Service	Performance Measure	Performance	Target
TTC Facilities assets are scaled and outfitted appropriately to support TTC operations, maintenance, and administrative activities.	TTC Maintenance and administrative facilities are appropriate to allow effective operations, maintenance, and administrative activities.	N/A	Maintenance facilities are sufficient to support current maintenance plan requirements	-
TTC Facilities assets are maintained in a SOGR such that failures do not negatively impact regular services and reliable operations, maintenance, and administrative activities are supported.	Maintenance and administrative facilities are available and functional	Overhead door availability	99.7%	98%
		Hoist availability	98.4%	97%
	Maintenance and administrative facilities assets are maintained in fair or better condition	Assets in fair or better condition (value weighted average %)	Not Available	-
	Facility maintenance program is effectively executed	One Time WO Closure Rate[40]	94%	90%
TTC Facilities assets allow TTC staff to execute their duties safely.	Maintenance and administrative facility safety equipment is regularly inspected and certified	Lift Equipment Inspection/Maintenance compliance	82%	80%
		Gas Monitoring Equipment Inspection/Maintenance compliance	100%	100%
		Fall Arrest Equipment Inspection/Maintenance compliance	8	9
		Eyewash Equipment Inspection/Maintenance compliance	32	35
		JHSC Open Items – Monthly Average (>6 months)[40]	4	10
TTC Facilities assets are sufficient and appropriate to mitigate the negative environmental impacts of TTC operations.	TTC waste processing equipment is regularly inspected and certified to ensure effectiveness	Sediment Pit Inspection/Maintenance compliance	55	59
		Oil interceptor & Separator Inspection/Maintenance compliance	99	101

Table 6-B: Current Levels of Service – Maintenance and Administrative Facilities

Future Levels of Service

Asset Category Customer Level of Service	Asset Future Level of Service	Actions	Target Date	Initiative
TTC Facilities assets are sufficient and appropriate to support the expected route and passenger flow needs of the travelling public.	Support an increase in Line 1 capacity of 55% (over 2019 levels)	Establish a new train maintenance and storage facility along Line 1 to support expanded fleet	2041	Corp Plan 3.1.1

Table 6-C: Future Level of Service Initiatives – Maintenance and Administrative Facilities

[40] Applies across all facility classes

6.4 Lifecycle Management Activities

The following table provides examples of the type of lifecycle activities that are undertaken across all TTC Maintenance and Administrative Facilities to maintain in a State of Good Repair (SOGR). It is important to note that lifecycle activities of facilities assets vary depending on the asset or element that forms the facility and will be detailed in the Facilities Sub-assets section below.

The following table outlines the assessed lifecycle activities requires to maintain Maintenance and Administrative Facilities SOGR:

Activity	**Frequency**	**Annualized Cost** ($K)
Maintenance		
O&M activities are covered in the Facilities Assets section of this document		
Renewals		
Maintenance facilities renewals and rehabilitation	As required	$48,504
Data source: *TTC O&I Group – Plant Maintenance, TTC Capital Investment Plan*		

Table 6-D: Lifecycle SOGR Activities – Maintenance and Administrative Facilities

The following table provides a list of lifecycle activities to improve service and address ridership growth and system network expansion (meet proposed future LOS).

Activity	**Timeline**	**Program Cost** ($K, current planning period)
Non-Infrastructure		
Maintenance & admin facilities improvement/renovation studies		$16,030
System Improvement		
Hillcrest Streetcar Maintenance & Storage Facility		$147,790
Decarbonization of Facilities		$980,460
Office Space Management/Renewal Program		$13,947
Design & Construction Major Control Centre		$482,398
Growth		
10th Bus Garage & Maintenance Facility		$172,352
New Subway M&S Facility (Western Yard)		$15,320
Hillcrest Facility Study		$5,141
McNicoll Bus Garage		$4,170
Leslie Barns		$6,472
New Subway Maintenance & Storage Facility		$1,555,353
Transit Enforcement & Revenue Protection Facility Replacement		$25,250
Data source: *TTC O&I Group – Plant Maintenance, TTC Capital Investment Plan*		

Table 6-E: Current & Planned Lifecycle Activities to Improve Service and Address Growth – Maintenance and Administrative Facilities

6.5 Climate Change

Similar to passenger facilities, TTC will develop zero-carbon transition plans for each maintenance facility in the TTC portfolio by the end of 2027 as per ISS Work Stream 2.13. More detailed actions and targets are outlined in Section 5.5, and in the ISS document.

6.6 Lifecycle Investment Forecasts

At the current stage of asset management maturity, lifecycle investment needs are evaluated as the annualized cost to maintain SOGR, as outlined above.

The following figures and table illustrate the full lifecycle investment forecasts for Maintenance and Administrative Facilities. The figures show the current funding by project type compared to the total overall funding required to maintain SOGR and deliver on selected service enhancement and growth projects. Condition remediation investment forecasts are also included.

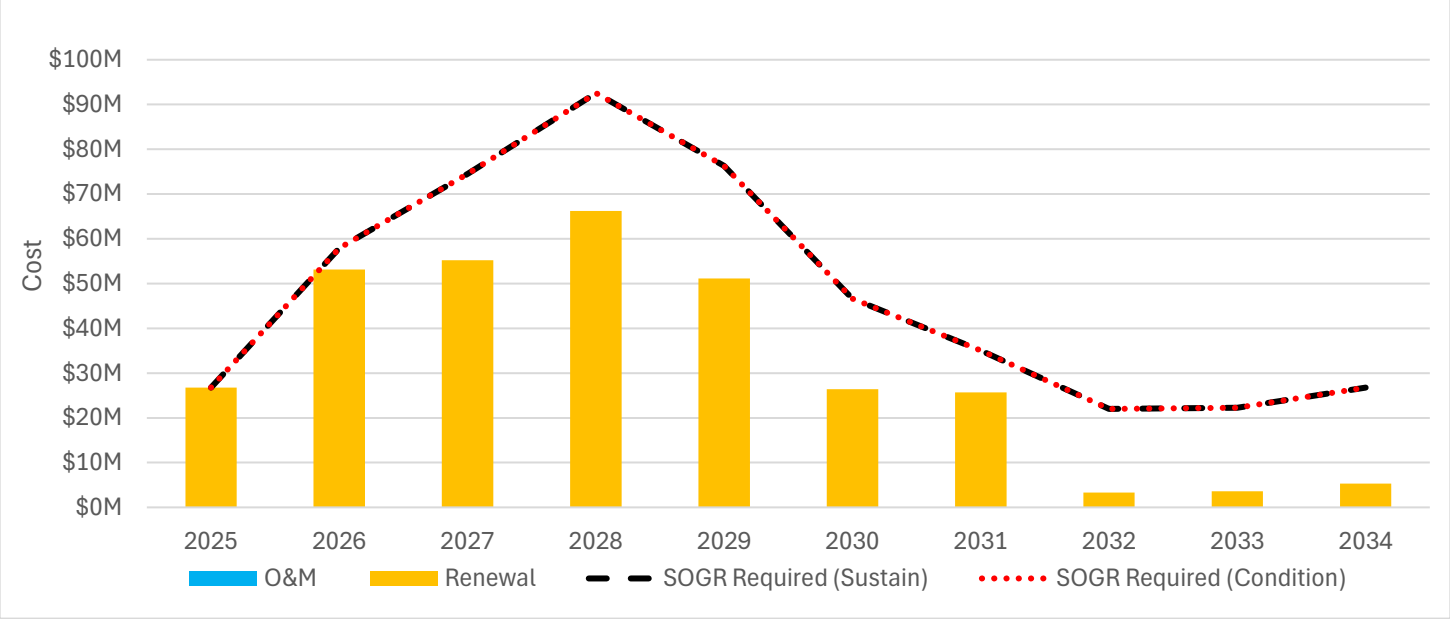


Figure 6-2: Funding vs Assessed Program Requirements – Maintenance and Administrative Facilities (SOGR only)

The graph below shows a significant gap in funding post 2030, this is mainly due to plans for new maintenance facilities currently unfunded.

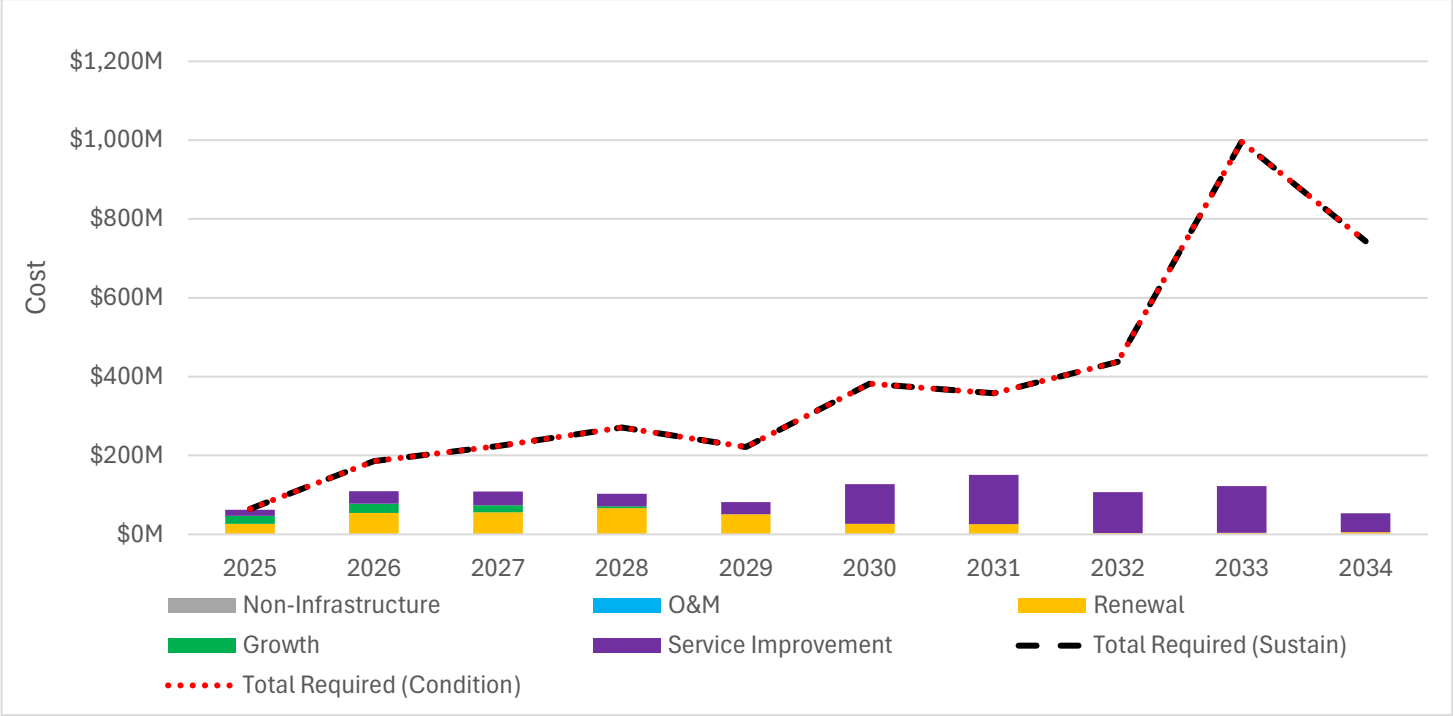


Figure 6-3: Funding vs Assessed Program Requirements – Maintenance and Administrative Facilities

The following table summarizes the average annual budget and investment needs for the planning period:

Lifecyle Activity	Planned Budget ($K)	Investment Needed to Sustain LOS ($K)	Investment Needed to Address Condition Gap ($K)
Non-Infrastructure	$267	$1,089	$1,089
Maintenance	$0	$0	$0
Renewals	$31,672	$48,077	$48,077
Growth	$6,570	$176,874	$176,874
Service Improvement	$64,128	$162,460	$162,460
Total Expenditure	$102,637	$388,499	$388,499
Average annual SOGR Gap		$16,405	$16,405
Average annual Infrastructure Gap		$285,863	$285,863

Table 6-F: Annualized Funding vs Assessed Program Requirements – Maintenance and Administrative Facilities

7. Service and Systems Facilities

7.1 Introduction

Service and systems facilities are specialized locations that support the seamless operation of a transit network, including the power supply for subway trains and the signalling systems that control train movements under both normal and emergency operational modes. These buildings house essential equipment and systems that ensure the safety and reliability of the TTC network.

Service Statement

> *"TTC service and systems facilities contain the appropriate equipment and systems that ensure the safety and reliability of the TTC network."*

Asset Breakdown

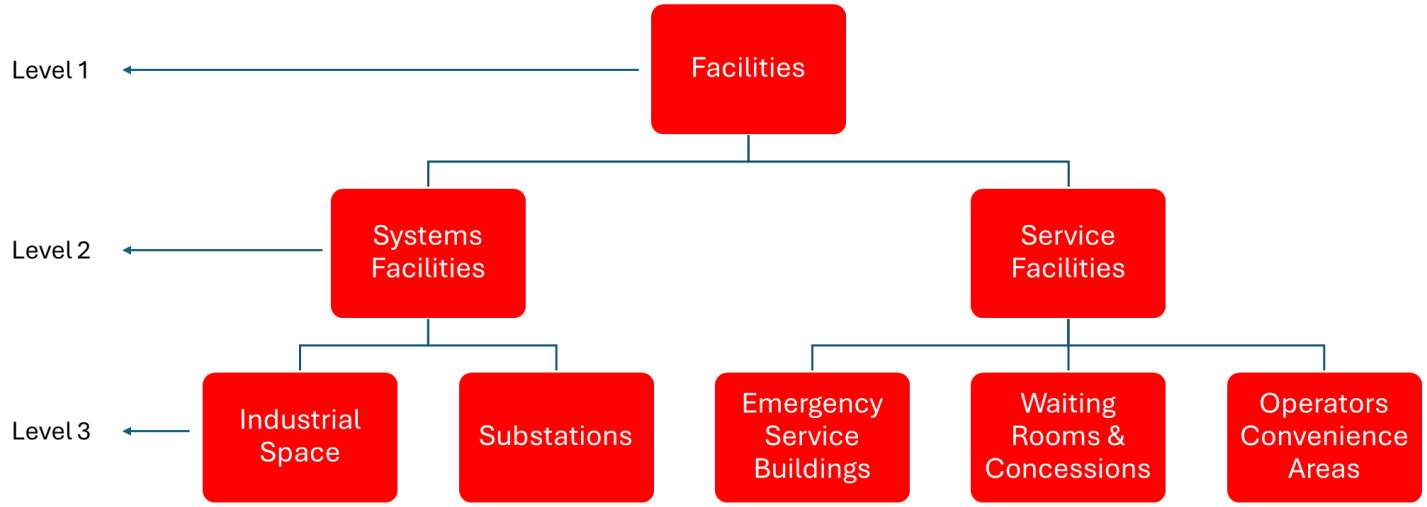


Figure 7-1: Asset Hierarchy – Service and Systems Facilities

7.2 State of Infrastructure

Asset Summary

Type	Sub-Asset Class	Quantity	Replacement Value ($M)	Average Condition	Average age (years)	ESL (years)
Service Facilities	Operators Convenience Areas	-	$5,790	Not Available	-	Not Available
	Waiting Rooms & Concessions	-			-	
	Emergency Services Buildings	32			-	
Systems Facilities	Substations	62	$0.24M		-	
	Industrial Space	7			-	

Data Source(s): *TTC Operations & Infrastructure Group and Transportation & Vehicles Group*

Table 7-A: Asset Summary – Service and Systems Facilities

7.3 Levels of Service

Levels of Service (LOS) for Service and Systems Facilities have been assessed in line with the overarching LOS framework presented in the main AMP document. Proposed LOS are encapsulated in the performance targets, as well as the initiatives outlined in the Future LOS table. The TTC believes that these proposed LOS are reasonably achievable given the available funding. Further details on risks and funding requirements are outlined in subsequent sections.

The TTC will undertake actions such as accelerated SOGR programs or modified maintenance activities to address low asset performance. Additional details can be found in the asset class strategy summaries in the **TTC Asset Management Strategy** document.

Performance Summary

Overall, service and system facilities are meeting LOS targets and expectations. However, there is limited data on some of the performance metrics.

Current Levels of Service

Asset Category Customer Level of Service	Subcategory Technical Level of Service	Performance Measure	Performance	Target
TTC Facilities assets are scaled and outfitted appropriately to support TTC operations, maintenance, and administrative activities.	TTC service and ancillary facilities are appropriate to allow effective operations, maintenance, and administrative activities.	N/A	Maintenance facilities are sufficient to support current maintenance plan requirements	-
TTC Facilities assets are maintained in a SOGR such that failures do not negatively impact regular services and reliable operations, maintenance, and administrative activities are supported.	TTC service and ancillary facilities assets are maintained in fair or better condition	Assets in fair or better condition (value weighted average %)	Not Available	-
TTC Facilities assets allow TTC staff to execute their duties safely.	TTC service and ancillary facility safety equipment is regularly inspected and certified	JHSC Open Items – Monthly Average (>6 months)[41]	4	10

Table 7-B: Current Levels of Service – Service and Systems Facilities

Future Levels of Service

Asset Category Customer Level of Service	Asset Future Level of Service	Actions	Target Date	Initiative
No initiatives currently planned				

Table 7-C: Future Level of Service Initiatives – Service and Systems Facilities

7.4 Lifecycle Management Activities

The lifecycle activities of the Service and Systems Facilities vary according to the asset subcategory. The following table provides examples of the type of lifecycle activities that are undertaken across all TTC facilities for these different subcategories to ensure that the system is maintained in a SOGR.

Activity	Frequency	Annualized Cost ($K)
Maintenance		
O&M activities are covered in the facilities components section of this document		
Renewals		
Service and systems facilities renewals and rehabilitation	As required	$2,172
Data source: *TTC O&I Group – Plant Maintenance, TTC Capital Investment Plan*		

Table 7-D: Lifecycle SOGR Activities – Service and Systems Facilities

[41] Applies across all facility asset classes

The following table provides examples of lifecycle activities that are undertaken to provide improvements to service and address ridership growth and system network expansion (meet proposed future LOS).

Activity	Timeline	**Program Cost** ($K, current planning period)
System Improvement		
Assessment of Employee Built Environment for Accessibility		$2,500
Growth		
Industrial space purchase		$123,000,000
Data source: *TTC O&I Group – Plant Maintenance, TTC Capital Investment Plan*		

Table 7-E: Current & Planned Lifecycle Activities to Improve Service and Address Growth – Service and Systems Facilities

7.5 Climate Change

Similar to other types of facilities, TTC will develop zero-carbon transition plans for each service and systems facility in the TTC portfolio by the end of 2027 as per ISS Work Stream 2.13. Actions and targets are outlined in Section 5.5, and in the ISS document.

7.6 Lifecycle Investment Forecasts

At the current stage of asset management maturity, lifecycle investment needs are evaluated as the annualized cost to maintain SOGR, as outlined above.

The following figures and table illustrate the full lifecycle investment forecasts for Service and Systems Facilities. The figures show the current funding by project type compared to the total overall funding required to maintain SOGR and deliver on selected service enhancement and growth projects.

The main SOGR gap in funding is between 2029 and 2031, which represents to currently unfunded program to rehabilitate the Davisville Yard Antenna Building.

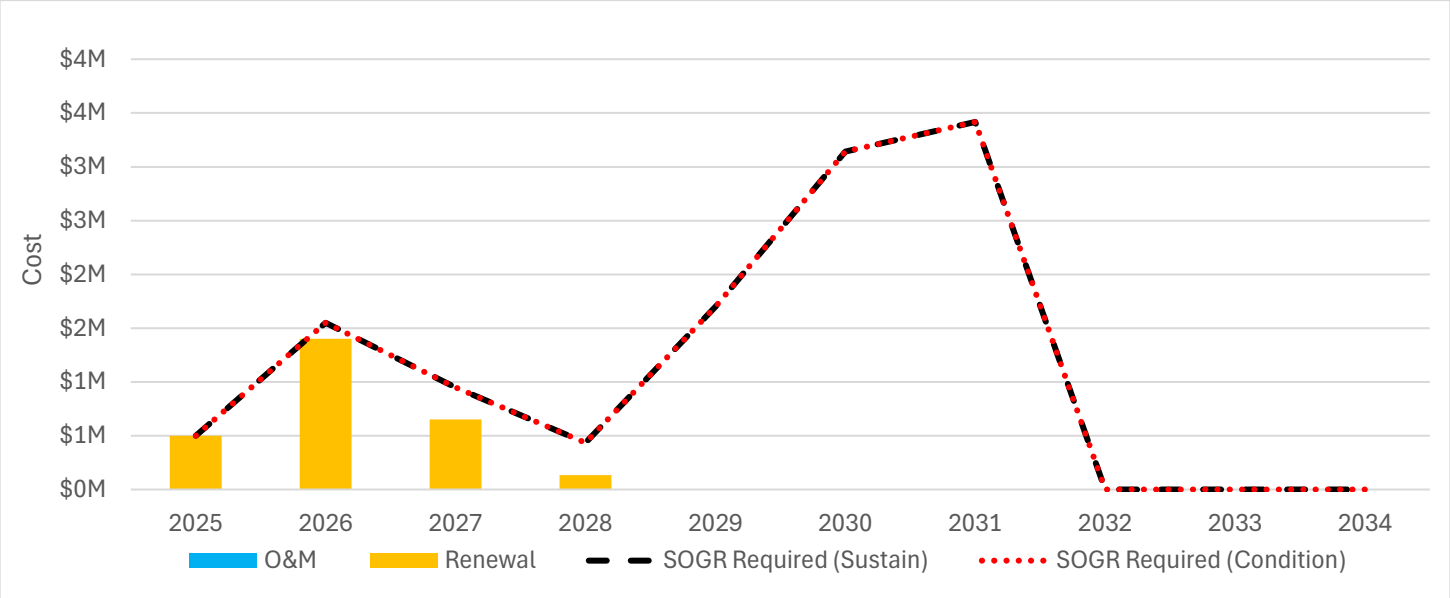


Figure 7-2: Funding vs Assessed Program Requirements – Service and Systems Facilities (SOGR only)

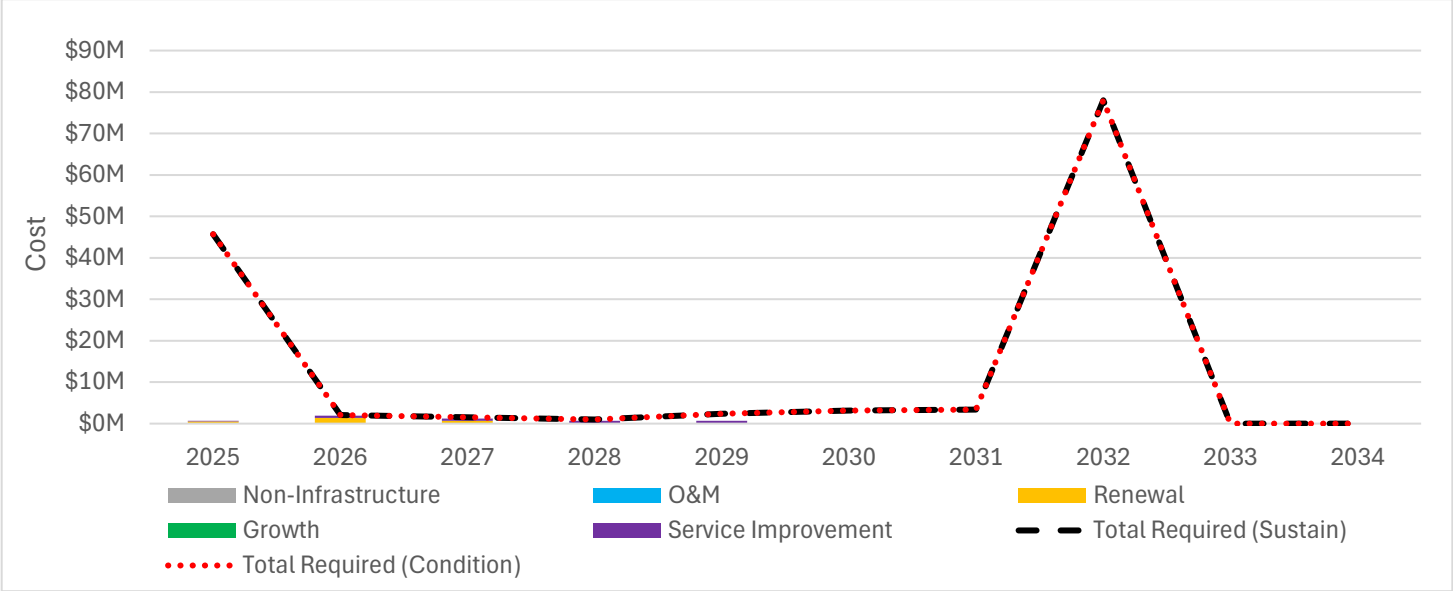


Figure 7-3: Funding vs Assessed Program Requirements – Service and Systems Facilities

The following table summarizes the average annual budget and investment needs for the planning period:

Lifecyle Activity	Planned Budget ($K)	Investment Needed to Sustain LOS ($K)	Investment Needed to Address Condition Gap ($K)
Non-Infrastructure	$0	$0	$0
Maintenance	$0	$0	$0
Renewals	$268	$1,169	$1,169
Growth	$0	$12,300	$12,300
Service Improvement	$250	$250	$250
Total Expenditure	$518	$13,719	$13,719
Average annual SOGR Gap		$901	$901
Average annual Infrastructure Gap		$13,201	$13,201

Table 7-F: Annualized Funding vs Assessed Program Requirements – Service and Systems Facilities

8. Facilities Sub-assets

8.1 Introduction

As well as the type or use of a facility, the TTC's asset hierarchy for facilities also includes the sub-asset categories that make up a facility. These include the exterior and interior structure of the facility, services such as electrical and plumbing, and equipment used to maintain the TTC's vehicles which are categorized following the UNIFORMAT II Elemental Classification (NIST 6389) standard.

Asset Breakdown

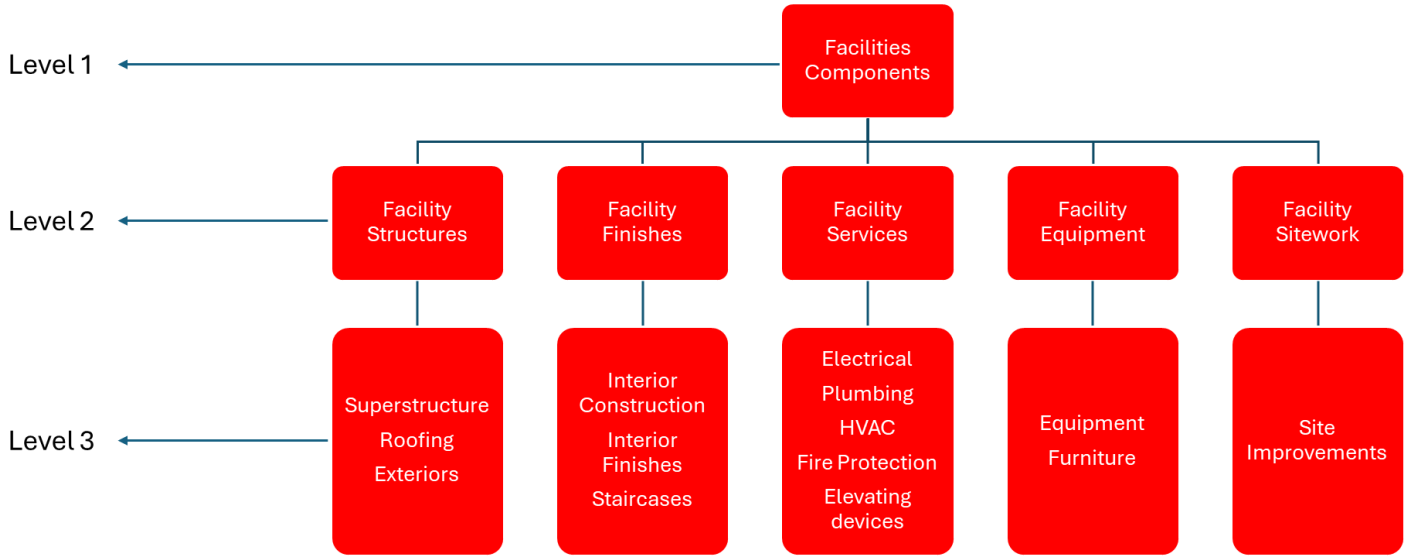


Figure 8-1: Asset Hierarchy – Facilities sub-asset classes

8.2 State of Infrastructure

As stated in Section 1, the current assessed replacement value of TTC Facilities is approximately $14.83B. This includes the replacement costs of all the sub-assets found within each type of facility (e.g., electrical systems, HVAC, interiors finishes, etc.) but does not include any bespoke equipment (e.g., vehicle maintenance equipment). The dashboard below represents the condition and replacement costs of individual sub-assets that make up the Facilities. It is important to note that the replacement values indicated in

Figure 8-2 and Table 8-A are duplicated in the facility overall replacement values indicated above in

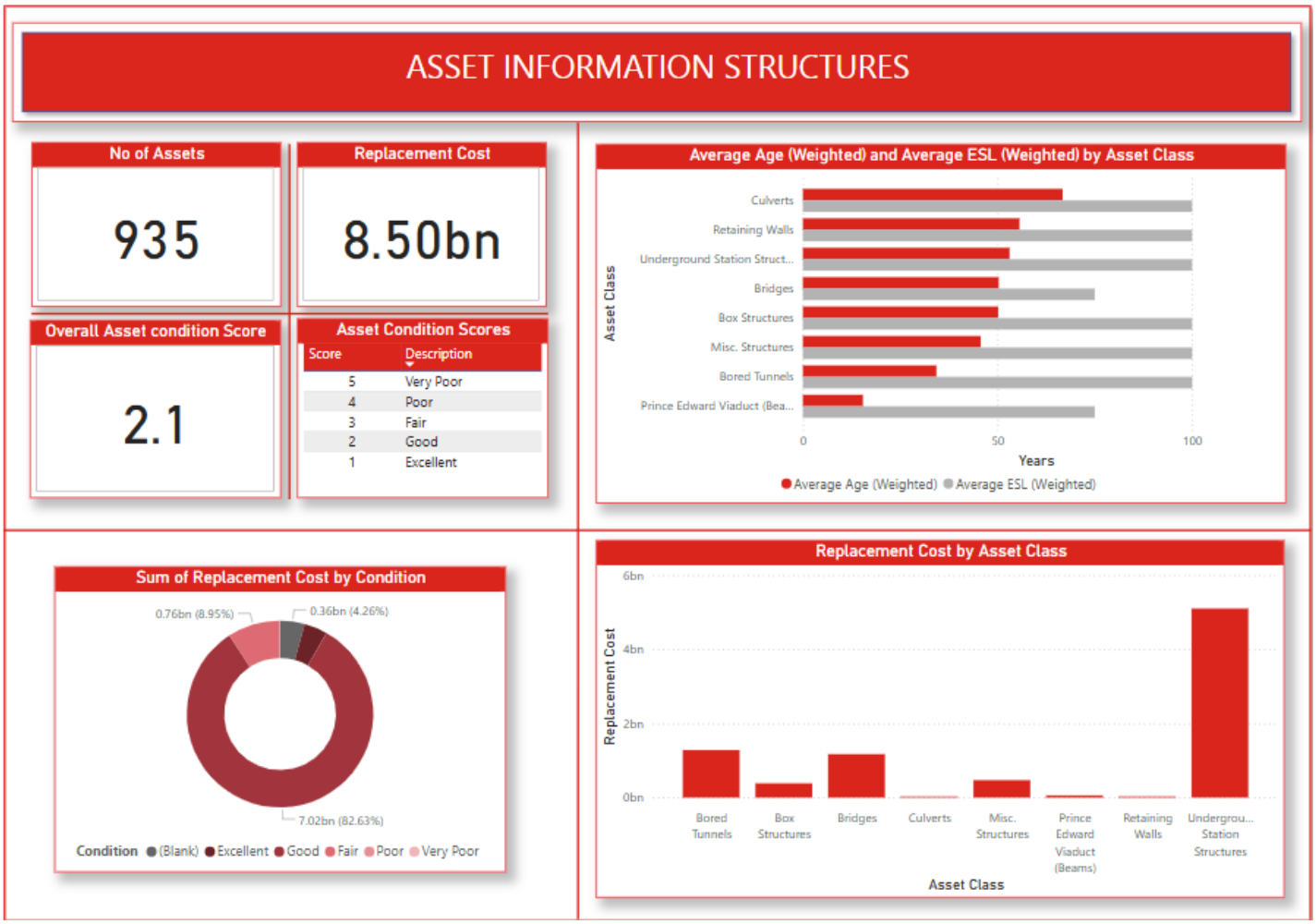


Figure 1-2, with the exception of facilities equipment noted as Sub-Asset Class: Equipment in Table 8-A. Furthermore, due to the low level of asset data maturity, these values should be taken as indicative and representative, as ultimate accuracy and reliability is limited.

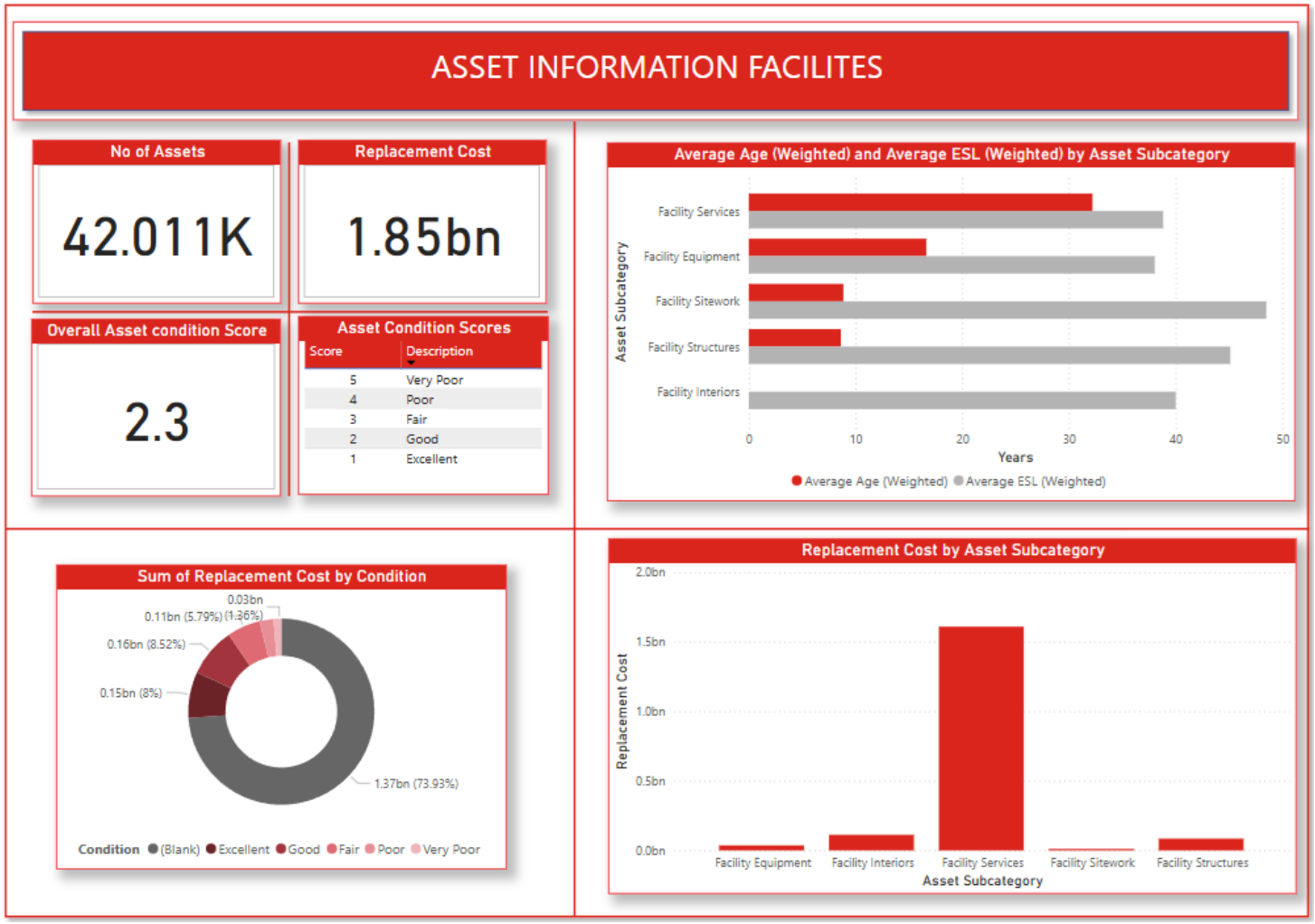


Figure 8-2: State of TTC Infrastructure Summary Dashboard – Facilities sub-asset classes

Asset Summary

Type	Sub-Asset Class	Quantity	Replacement Value ($M)	Average Condition	Average age (years)	ESL (years)
Facilities services	Electrical	-[42]	$16	1.7	Not Available	Not Available
	HVAC	-[42]	$505	2.4		
	Plumbing	-[42]	$356	2.7		
	Conveying devices	478	$845	4		
	Fire protection	-[42]	$233	1.8		
Facilities structures	Exterior	-[42]	$85	2.2	8	40
	Roofing	-[42]				
	Superstructure	-[42]				

[42] Total asset quantities for these assets are under review. Data is not yet mature enough for presentation.

Type	Sub-Asset Class	Quantity	Replacement Value ($M)	Average Condition	Average age (years)	ESL (years)
Facilities interiors	Construction	-[42]	$112	-	Not Available	Not Available
	Finishes					
Facilities equipment	Equipment	-[42]	$28	2.9		
	Furnishing	-[42]	$9	-		
Facilities sitework	Site improvements	-[42]	$11	1.7		

Data Source(s): *TTC Operations & Infrastructure Group and Transportation & Vehicles Group*

Table 8-A: Asset Summary – Facilities sub-asset classes

8.3 Levels of Service

Levels of Service (LOS) have been assessed at facility type level, not at sub-asset class level.

8.4 Lifecycle Management Activities

The lifecycle activities of the Facilities sub-assets provided in the following table are defined based on the use of each subcategory to ensure that the sub-assets support the whole system in a State of Good Repair (SOGR).

Activity	Frequency	Annualized Cost ($K)
Non-Infrastructure	As required	$2,172
Ongoing capital condition assessment programme	Ongoing	$2,827,812
Maintenance		
Routine and legislative/manufacturers inspections	Ongoing	$78,466
Reactive repairs and replacement of minor components	As required	
Preventative maintenance	As required	
Overhaul of all facilities sub-assets	As required	
Renewals		
Facilities Structures		
Masonry structure restoration	As required	$488
Exterior finishes renewals or restorations	As required	
Roofing rehabilitation and skylights replacement	As required	$34,265
Replace at end of life: Overhead doors	As required	$6,337
Facilities Interiors		
Station interior finishes renewal	As required	$6,610
Facilities Services		
Elevator and escalator overhaul and renewals	As required	$64,782
Electrical systems overhaul and renewals	As required	$4,592

Activity	Frequency	Annualized Cost ($K)
Plumbing systems overhaul and renewals	As required	$2,162
HVAC systems overhaul and renewals	As required	$3,068
Fire protection systems overhaul and renewals	As required	$14,869
Facilities Equipment		
Equipment overhaul and end of life replacement	As required	$18,259
Furnishing overhaul and end of life replacement	As required	$446
Facility Sitework		
Paving Rehabilitation Program	As required	$22,866
Improvement to TTC Properties	As required	$1,079
Data source: *TTC O&I Group – Plant Maintenance, TTC Capital Investment Plan*		

Table 8-B: Lifecycle SOGR Activities – Facilities sub-asset classes

The following table lists lifecycle activities that are undertaken to provide improvements to service and address ridership growth and system network expansion (meet proposed future LOS).

Activity	Timeline	Program Cost ($K, current planning period)
System Improvement		$2,500
Platform edge and tactile wayfinding upgrade		$58,656
Energy storage and efficiency		$188,192
Fall prevention systems		$45,171
e-Bus charging systems		$1,575,074
Storage Tank Replacements		$56,703
Garage Subsurface Remediation		$3,109
Growth		
TTC Presto Project		$26,657
Data source: *TTC O&I Group – Plant Maintenance, TTC Capital Investment Plan*		

Table 8-C: Current & Planned Lifecycle Activities to Improve Service and Address Growth – Facilities sub-asset classes

8.5 Climate Change

TTC will develop zero-carbon transition plans for each facility in the TTC portfolio by the end of 2027 as per ISS Work Stream 2.13. Actions and targets for this work stream are outlined in Section 5.5, and in the ISS document.

8.6 Lifecycle Investment Forecasts

At the current stage of asset management maturity, lifecycle investment needs are evaluated as the annualized cost to maintain SOGR, as outlined above.

The following figures illustrate the full lifecycle investment forecasts for all facilities sub-assets. The figures show the current funding by project type compared to the total overall funding required to maintain SOGR and deliver on selected service enhancement and growth projects.

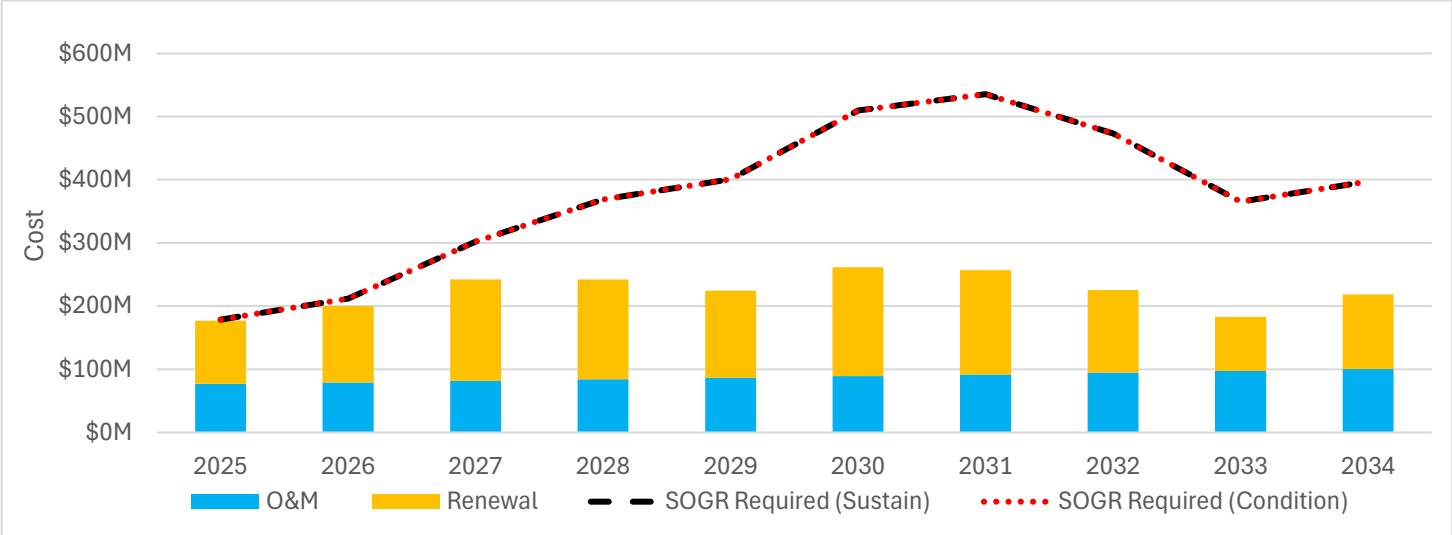


Figure 8-3: Funding vs Assessed Program Requirements – Facilities sub-asset classes (SOGR only)

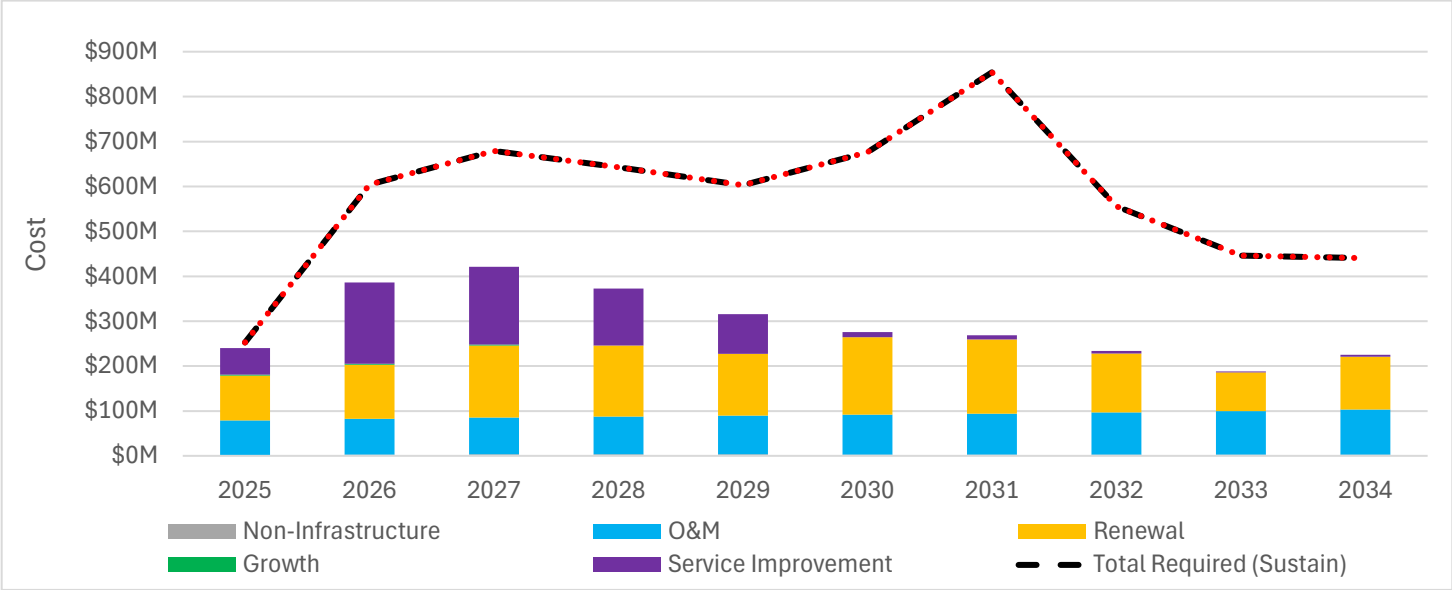


Figure 8-4: Funding vs Assessed Program Requirements – Facilities sub-asset classes

The following table summarizes the average annual budget and investment needs for the planning period:

Lifecyle Activity	Planned Budget ($K)	Investment Needed to Sustain LOS ($K)	Investment Needed to Address Condition Gap ($K)
Non-Infrastructure	$2,843	$2,843	$2,843
Maintenance	$88,096	$89,952	$89,952
Renewals	$134,899	$284,297	$284,297
Growth	$647	$5,547	$5,547
Service Improvement	$66,121	$192,691	$192,691
Total Expenditure	$292,606	$575,331	$575,331
Average annual SOGR Gap		$151,255	$151,255
Average annual Infrastructure Gap		$282,725	$282,725

Table 8-D: Annualized Funding vs Assessed Program Requirements – Facilities sub-asset classes

9. Conclusion & Risks

The following risks are applicable for all the above mentioned TTC facilities and facility sub-assets:

1. **There are several facility renewal programs covering subway stations garages, yards, carhouses and various other buildings.** These programs are required not only to ensure building assets, such as HVAC, boilers, roofs and structures are functional and maintained in a SOGR but also to contribute to achieving Net Zero 2040 through retrofitting to reduce energy consumption. As the CIP identifies $167 million in unfunded requirements for the facility renewal programs, delays in executing renewal programs may pose risks that range from Occupational Health and Safety violations, works refusals and/or partial to full closure of facilities which could affect the overall service program.
2. **Maintenance facilities bespoke equipment is critical to perform routine inspections, repairs, and overhauls of TTC's fleet and ensure safe operation of the transit system.** The CIP currently identifies $167 million unfunded programs for the maintenance of vehicle maintenance equipment for buses, streetcars and subways.
3. **Ongoing significant capital investment is required to address the current SOGR for elevators and escalators that are past their designed life expectancy.** Current levels of funding fall well short of the steady state SOGR requirements, which has increased the SOGR backlog. In the next 10 years, the CIP identifies $370 million in unfunded requirements for the overhaul of elevators and escalators across all TTC facilities. Failure to address the funding requirements could have the following consequences:
    - Aging components requiring additional maintenance, adding pressure to the operating budget.
    - Parts will become obsolete, which may lead to decreased reliability and increased asset downtime.
    - Potential non-compliance with the Accessibility for Ontarians with Disabilities Act (AODA).
    - Crowding in stations and platforms causing a safety concerns and negatively impacting service delivery and customer experience.
4. **Investment is required to redesign plumbing layouts in existing infrastructure** as often elevating devices can be impacted by flooding resulting in costly repairs, lengthy downtimes and accelerated deterioration. New construction must follow the TTC design specifications, which keeps the plumbing separate from the elevating devices.
5. **Subway sanitary, storm and track pumps and pumping system are over 20 years and are approaching their end of useful life.** There is a $315 million unfunded program to replace and rehabilitate these pumps. Failure to address the funding requirements could have the following consequences:
    - Increased pump failures due to delays to repairs as a result of poor access for maintenance of existing pumps.
    - Increased risk of flooding and service disruption in the subway due to prolonged pump failures.
    - Increased operating costs due to flooding, service disruption and pump failures.
    - Washroom and other facility shutdowns that result in public and worker complaints due to pump failures.
6. **Maintenance facilities HVAC systems approaching end of service life.** Regular maintenance and timely replacement of HVAC systems are crucial to ensure efficient, safe, and compliant operations of TTC's maintenance facilities. There is a $265 million unfunded program for HVAC systems end of life replacement. Failure to replace these systems could result in:

- HVAC systems lose efficiency, leading to higher energy consumption and increased operational costs
- Aging systems more prone to failures and breakdowns, causing unexpected downtime and potentially disrupting transit operations. This will lead to increased frequency and cost of repairs.
- Old HVAC systems may fail to filter and circulate air properly, leading to poor indoor air quality. This can result in health issues for employees and passengers. Worn-out components can also pose safety risks, including electrical hazards and the potential for fires
- Failing to maintain or replace HVAC systems can lead to non-compliance with regulations

7. **Many of the roof assets at TTC facilities (including subway and rapid transit stations, garages, car-houses, shops, substations, office buildings and other facilities) exceed the normal life expectancy.** A sustained replacement and rehabilitation program is required to avoid excessive maintenance costs, deterioration of building structures and detrimental effects on mechanical and electrical equipment through prolonged exposure to moisture. The program is currently under-funded as the CIP identifies a need for $211 million in the first 10 years and a further $113 million in the five years post. If replacements of roofing systems are not carried out, then deterioration will continue; leakage will increase, damage to the underlying building structures and equipment will increase and slippery conditions will be created at floor levels will result in unsafe conditions, operational delays, and increased annual maintenance costs.

ASSET MANAGEMENT PLAN 2025

APPENDIX E: Systems Asset Category Plan

Toronto Transit Commission

Contents

LIST OF TABLES

LIST OF FIGURES

1. Asset Category Overview - Systems

1.1 Introduction

A system is a group of interacting or interrelated elements that act according to a set of rules to form a unified whole. A system, surrounded and influenced by its environment, is described by its boundaries, structure, and purpose, and is expressed by the function it is fulfilling. Within the TTC's asset hierarchy, Systems assets include all elements of communications, train signalling and electrical power and distribution. Certain assets that meet the definition of a system are not included in this category and are included elsewhere in the hierarchy (e.g. facility electrical and mechanical systems, and wayside systems), or are currently out of scope (e.g. business and IT systems).

Service Statement

> *"TTC Systems assets support overall transit services by enabling the collection and dissemination of live data and information, control of assets in operation, and delivery of electrical power."*

Asset Breakdown

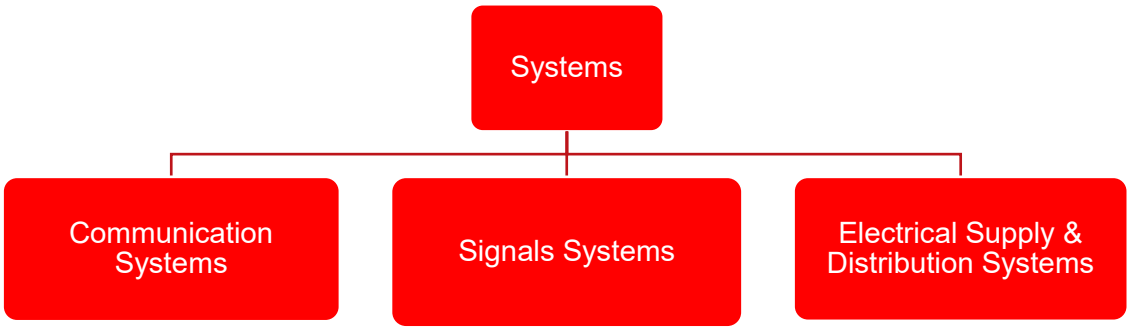


Figure 1-1: Asset Hierarchy - Systems

1.2 State of Infrastructure

The following figure outlines a high-level overview of the state of TTC Systems assets:

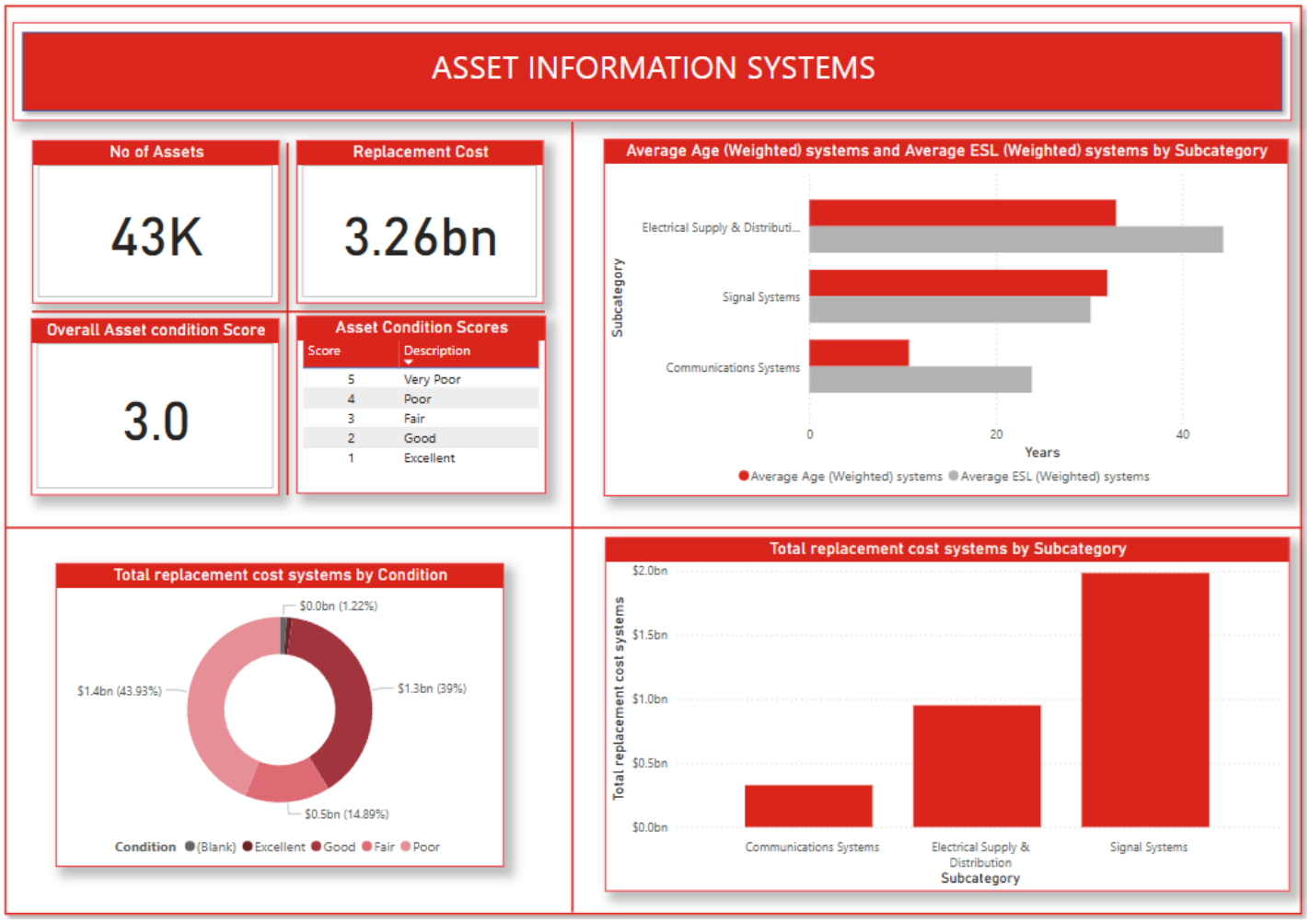


Figure 1-2: State of TTC Infrastructure Summary Dashboard - Systems

The condition of TTC systems assets varies greatly, with almost 50% in poor condition. More details can be found in the subcategory sections below.

The current assessed replacement value of TTC Systems assets is approximately $3.26B, which is a significant uplift from the $1B reported in the 2024 AMP. This increase reflects the difference in methodologies used, with the current assessment using individual asset component replacement costs aggregated within the asset register. The TTC believes these values represent the more realistic replacement costs of the asset base despite the compromised accuracy driven by the current low level of data maturity.

The current state of data quality/maturity among TTC systems assets is outlined in the following figure:

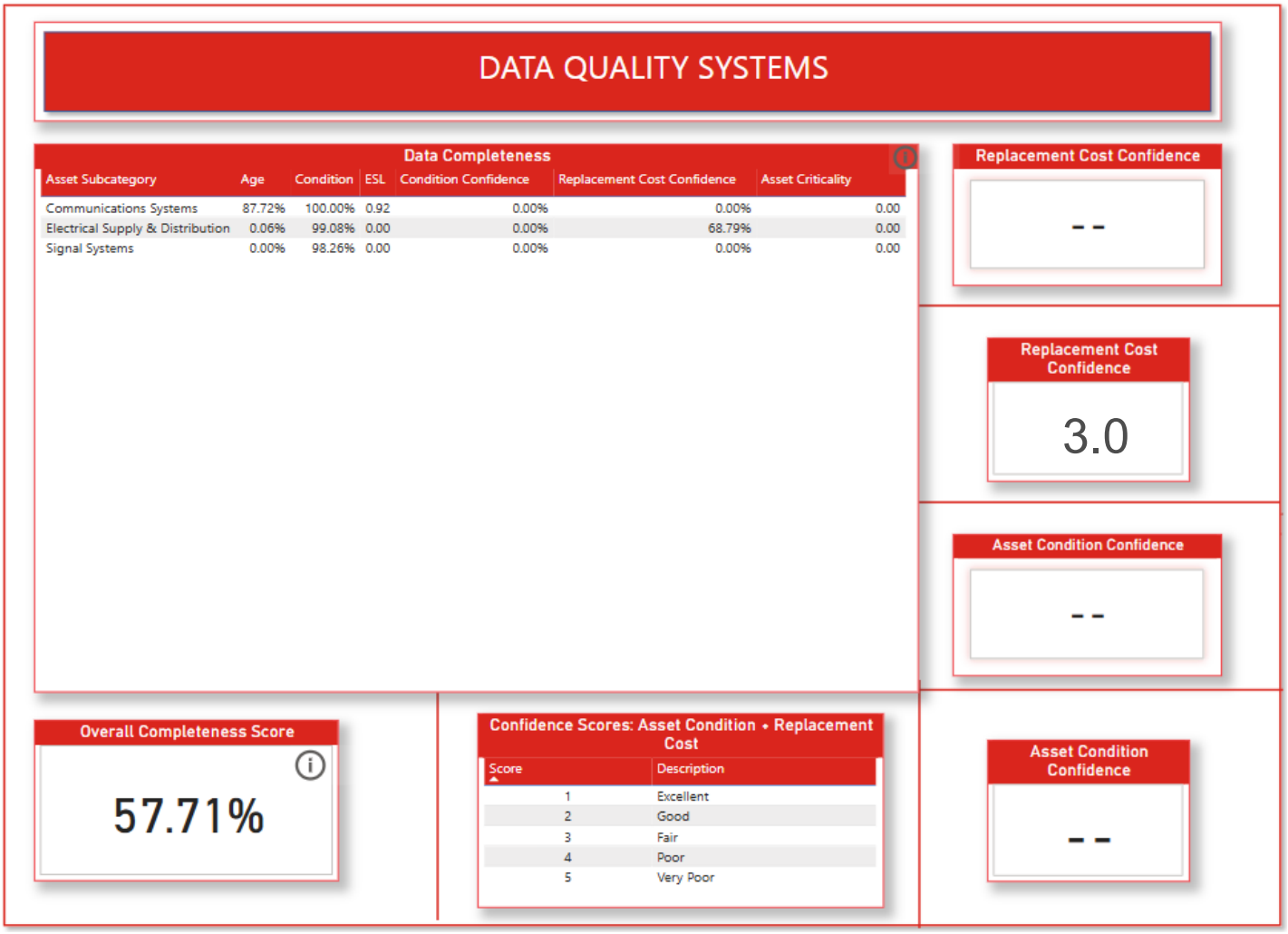


Figure 1-3: State of TTC Asset Data Summary Dashboard - Systems

Due to the low level of asset specific data maturity in Systems assets, the majority of key asset state data has been evaluated at the asset class level, rather that the individual asset level. This has allowed the presentations of estimated replacement cost, age, and asset condition as shown in the asset summary tables below. As the TTC's Enterprise Asset Management (EAM) transformation project continues, the improvement of the data quality will be focused while simultaneously developing and embedding the processes to manage data consistently.

1.3 Asset Levels of Service

The following table outlines how the TTC systems assets support the overarching Transit Levels of Service (LOS):

TTC's Transportation Services…	TTC's Systems Assets…
…**meet the route and ridership demands** of the travelling public.	…are sufficient and appropriate to allow revenue vehicles to meet required service frequency and headways.
…**are reliable and on-time**, per the posted schedule/service plan.	…are reliable and maintained in a SOGR such that service affecting failures are minimized.
	…are designed with sufficient redundancy to mitigate the impact of single point failures.
…**are safe** to use and operate.	…include safety assurance systems that are sufficient and effective to minimize transit system safety risks to TTC staff, the travelling public, and the surrounding communities.
…**accommodate accessibility needs** of all customers.	…meet the needs of the travelling public for accessible communication and information.
…meet customer expectations for **cleanliness, comfort, and convenience**.	…allow for appropriate and effective communication with the travelling public.
…are designed in such a way as to **mitigate the environmental impact and build climate resilience** of transportation in the GTA.	…support fleet electrification.
…are undertaken in a **cost-efficient** manner, minimizing the cost to the city for the service provided.	…are managed to ensure that cost/value optimization is considered in all lifecycle activities planning and execution.

Table 1-A – TTC Asset Levels of Service - Systems

2. Communications Systems

2.1 Introduction

TTC communications system assets include all engineered networks or arrangements of elements that enable the transmission, reception and exchange of information. These systems typically involve the use of various devices, such as transmitters, receivers, servers, switches, displays, and software and configuration protocols to facilitate the transfer of data or signals. This subcategory does not include assets relating to automated train control and signalling (outlined below) or business and IT systems (currently out of scope).

Service Statement

> *"TTC Communications Systems assets support overall transit services by enabling the collection and dissemination of live data and information as well as voice communication throughout the network."*

Asset Breakdown

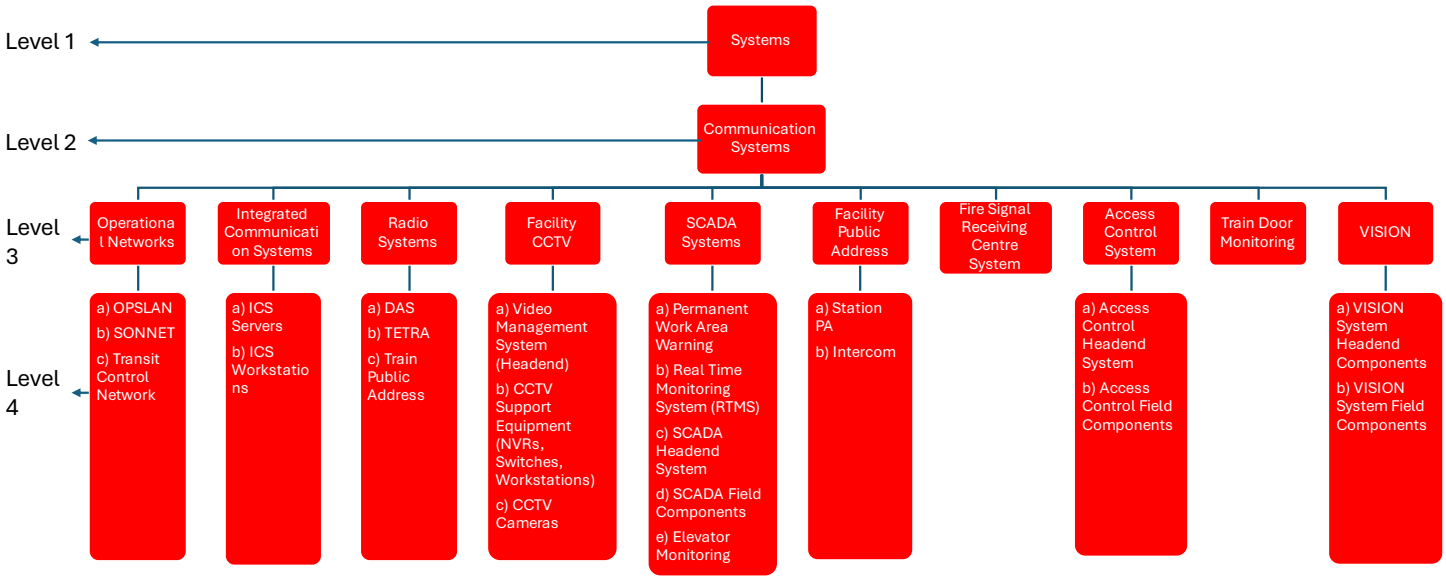


Figure 2-1: Asset Hierarchy – Communications Systems

2.2 State of Infrastructure

The following figures outlines a high-level overview of the state of TTC Communications Systems assets:

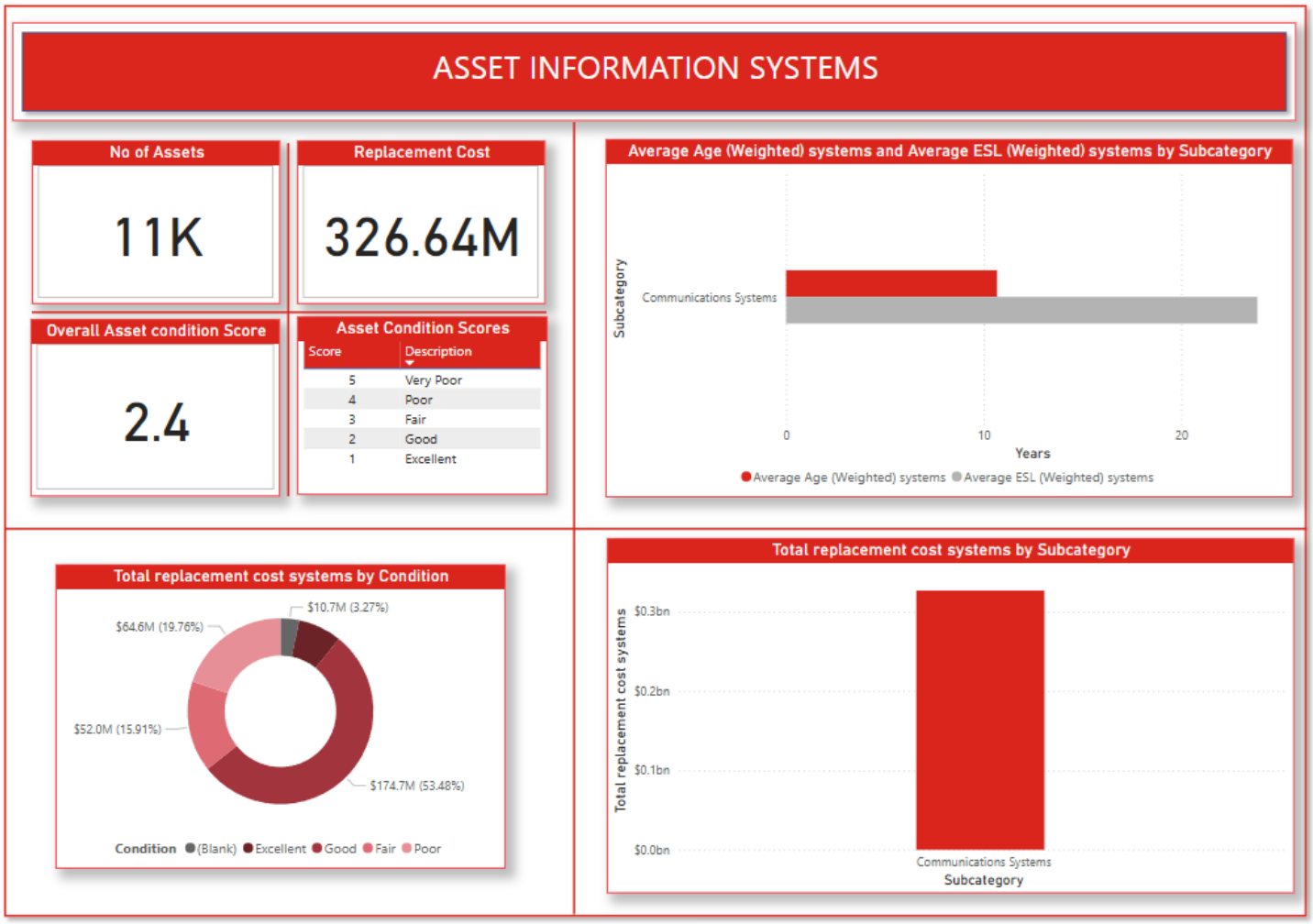


Figure 2-2: State of TTC Infrastructure Summary Dashboard – Communications Systems

Asset Summary

Asset Class	Asset Subclass	Quantity	Replacement Value ($M)	Average Condition	Average age (years)	ESL (years)
Communications Backbone	Cabling & Fibre	-[43]	6.6	2.5	22	40
Operational Networks	OPSLAN	900	5.6	2.5	9	10
	SONNET	-[43]	5.7	3.5	9	10
	Transit Control Network	-[43]	5.0	2	*	10
CCTV	Headed & Support Equipment	-[43]	2.0	1.5	2	10
	Cameras	5,378	18.3	3.1	5	10
Public Address	Station PA	1,009	24.0	3.4	13-14	15
	Intercom	120	0.3	3.4	13-14	10
Radio Systems	Distributed Antenna System	-[43]	17.6	3.9	12	15
	Tetra Radio System	8,036	19.5	1.5	3	15
VISION	VISION Headend	-[43]	9.6	1.5	5	30
	Bus Displays	-[43]	102.1	2.5	5	10
Intrusion Access & Control (IAC) System	IAC Headend	-[43]	0.4	2.0	6	10
	IAC Field Components	-[43]	1.0	2.0	6	10
Fire Signal Receiving Centre	FSRC	10	1.5	4	11	10
Integrated Communication System	ICS Servers	-[43]	5.9	2.0	6	10
	ICS Workstations	-[43]	2.5	2.0	6	10
SCADA Systems	SCADA Headend	-[43]	15.7	3.9	15-16	20
	SCADA Field	-[43]	7.5	3.9	15-16	15
	Emergency Trip System	-[43]	25.2	4	35	30
	Permanent Work Area Warning (PWAW)	169	24.7	1.1	2-3	30
Train Door Monitoring	TDM System	1,403	28.1	2.4	5-6	30

Data Source(s): TTC Operations & Infrastructure Group

Table 2-A – Asset Summary – Communications Systems

[43] Total asset quantities for these assets are under review. Data is not yet mature enough for presentation.

Condition Assessment

At present, condition ratings for Communications assets are based primarily on asset age, occasionally adjusted based on qualitative assessments made for systems with below acceptable reliability levels.

As the TTC continues to mature its asset management program, condition assessment methodologies will be refined to reflect a more complete understating of asset state and to increase data confidence.

2.3 Levels of Service

Levels of Service (LOS) for Communications assets have been assessed in line with the overarching LOS framework presented in the main AMP document. Proposed LOS are encapsulated in the performance targets, as well as the initiatives outlined in the Future LOS table. The TTC believes that these proposed LOS are reasonably achievable given the available funding. Further details on risks and funding requirements are outlined in subsequent sections.

Where asset performance falls below targets, the TTC will undertake action to address. In many cases this includes accelerated SOGR programs or modified maintenance activities. Additional details can be found in the asset class strategy summaries in the **TTC Asset Management Strategy** document.

Performance Summary

Overall, Communications assets are approaching LOS targets and expectations.

While communications systems are generally sufficient and allow system operations as planned, reliability is below acceptable thresholds and customer feedback indicates that public communications do not meet expectations.

Current Levels of Service

Asset Category Customer Level of Service	Subcategory Technical Level of Service	Performance Measure	Performance	Target
TTC Systems assets are sufficient and appropriate to allow revenue vehicles to meet required service frequency and headways	Communications systems do not limit the ability of revenue vehicles to meet required service frequency and headways	N/A	Comm systems are effective and appropriate to allow service plan to be met.	-
TTC Systems assets are reliable and maintained in a SOGR such that service affecting failures are minimized.	Communications system assets are available and functional	Comms Delay incidents	782	524
		Trouble Calls by system (CCTV)	1263	1219
		Trouble Calls by system (PAI)	616	917
		Trouble Calls by system (Phone)	472	510
		Trouble Calls by system (PA)	225	286
		Trouble Calls by system (SCADA)	166	86
	Communications system assets are maintained in fair or better condition	% of assets in fair or better condition	77%	80%

Asset Category Customer Level of Service	Subcategory Technical Level of Service	Performance Measure	Performance	Target
TTC Systems assets include safety assurance systems that are sufficient and effective to minimize transit system safety risks to the travelling public and community.	TTC Communications systems allow staff to communicate effectively in emergency situations	N/A	Comm systems are sufficient to allow effective emergency management.	-
	CCTV Coverage in subway stations	CCTV Coverage %	85%	90%
TTC Systems assets meet the needs of the travelling public for accessible communication and information.	TTC Communications systems meet AODA standards	AODA Compliance	Comm systems provide AODA compliant communications	-
TTC Systems assets allow for appropriate and effective communication with the travelling public	TTC Communications systems allow for appropriate and effective communication with the travelling public	Customer Perception - Availability and Accuracy of Real-Time Travel Information[44]	66%	-
		Customer Service Communications – Announcement related[44]	142	-

Table 2-B – Current Levels of Service – Communications Systems

Future Levels of Service

Asset Category Customer Level of Service	Asset Future Level of Service	Actions	Target Date	Initiative
TTC Systems assets are sufficient and appropriate to allow revenue vehicles to meet required service frequency and headways	Improve efficiency of bus transit through Transit Signal Priority	Implement ATSP and install up to 50 locations per year	2028	SCE Plan Action 4.3
TTC Systems assets include safety assurance systems that are sufficient and effective to minimize transit system safety risks to the travelling public and community.	Improve streetcar passenger safety by targeting and reducing illegal passing of a stationary streetcar in the act of taking on or discharging passengers	Investigate automated camera enforcement for streetcar customer safety	2028	SCE Plan Action 6.3
TTC Systems assets allow for appropriate and effective communication with the travelling public	Improve customer access to wayfinding and real-time schedule information	Upgrade the next vehicle arrival data feed to provide better information to customers	2028	SCE Plan Action 7.3
		Improve display screens for real-time information and signage for unplanned events	2028	SCE Plan Action 7.3
		Enhance Public Announcement system clarity	2028	SCE Plan Action 7.3
		Expand E-Alerts to planned service changes, stop-level alerts and SMS alerts	2028	SCE Plan Action 7.3

Table 2-C – Future Level of Service Initiatives – Communications Systems

[44] Metric includes operational (non-asset) issues.

2.4 Lifecycle Management Activities

The lifecycle activities of the Communication Systems assets vary according to the asset class, but typically include regular cleaning and inspection, functionality testing, software updates, and replacement-on-failure of system subcomponents. End of life activities typically involve system redesign and technology upgrades.

The following table outlines the assessed lifecycle activities required to maintain Communications Systems SOGR:

Activity	Frequency	Annualized Cost ($K)
Non-Infrastructure		
Administrative overhead, process continuous improvement	As required	-
Maintenance		
Regular inspection, functionality testing, and servicing	Annual	$29,102
Scheduled replacement of wear components	As required	
Corrections and replace-on-failure of minor components	As required	
Capitalized Overhauls & Renewals		
Operational Networks		
Replace at end of life: OPSLAN Hardware & Infrastructure	10 Year	$562
Replace at end of life: SONNET Hardware & Infrastructure	10 Year	$567
Replace at end of life: TCN Hardware & Infrastructure	10 Year	$500
Replace at end of life: Systemwide Cabling & Fibre	40 Year	$166
Integrated Communication System		$655
Continuous Development: Software	Annual	
Replace at end of life: Servers and Workstations	10 Year	
Replace at end of life: Voice Recording Equipment	10 Year	
CCTV		$1,013
Replace at end of life: CCTV Headend Servers, Equipment & Software	10 Year	
Replace at end of life: NVRs, DVRs	10 Year	
Replace at end of life: CCTV Cameras	5-10 Year	
Public Address		
Replace at end of life: PAI System	10 Year	$33
Replace at end of life: PA Headend Equipment	15 Year	$268
Replace at end of life: Station PA	15 Year	$1,334
Replace at end of life: Maintenance Facility PA	20 Year	$368
Access Control		
Replace at end of life: AC Components	10 Year	$141
Fire Signal Receiving Centre		
Replace at end of life: FSRC Components	10 Year	$150
SCADA System		
Replace at end of life: SCADA Master Systems (Head & Field)	20 Year	$755

Activity	Frequency	Annualized Cost ($K)
Software Update: Stability/compatibility	5 Year	$60
Replace at end of life: Servers	10 Year	$151
Replace at end of life: Power Supplies, Switches, etc	15 Year	$50
Replace at end of life: RTUs	15 Year	$503
Replace at end of life: Emergency Trip System	30 Year	$840
Replace at end of life: PWAW System	30 Year	$825
Radio System		
Replace at end of life: DAS Backup Batteries	3 Year	$116
Replace at end of life: TETRA Servers, Switches, Recorders	5 Year	$650
Replace at end of life: TETRA Radio Units	10 Year	
Replace at end of life: TETRA Base Stations	15 Year	
Replace at end of life: DAS Equipment	15 Year	$1,175
VISION System		
Replace at end of life: Full system	30 Year	$3,722
Replace at end of life: Servers	10 Year	$1,117
Replace at end of life: Power Supplies, Switches, etc	15 Year	$149
Replace at end of life: Vehicle Displays	10 Year	$1,117
Train Door Monitoring System		
Replace at end of life: Full system	30 Year	$937
Data source: TTC O&I Group – SEC, TTC Capital Investment Plan		

Table 2-D – Lifecycle SOGR Activities – Communications Systems

It is important to note that several programs associated with technology updates to the communications systems are identified to bring additional improvements to service delivery and support future growth. As these are primarily driven by SOGR, they are included in the table above.

The following table provides examples of lifecycle activities that are undertaken to provide improvements to service and address ridership growth and system network expansion (meet proposed future LOS).

Activity	Timeline	Program Cost ($K, current planning period)
Non-Infrastructure		
No Comms Non-Infrastructure programs currently underway		
System Improvement		
Improve Safety & Efficiency – Train Door Monitoring	2017-2030	$8,556
Improve Worker Safety – PWAW Modular Work Zone Devices	2014-2030	$305
Improve Convenience – Customer Facing Information Screen	2020-2025	$943
Enhance Accessibility – Elevator AODA Upgrades (PAI)	2017-2025	$769

Growth[45]		
Address the Changing Landscape – Relocate McBrien Radio Equipment	2023-2032	$344
Data source: TTC O&I Group – SEC, TTC Capital Investment Plan		

Table 2-E – Current & Planned Lifecycle Activities to Improve Service and Address Growth – Communications Systems

2.5 Climate Change

While the Signals, Electrical, & Communications (SEC) team supports the organization's overall commitment to mitigating and adapting to the effects of climate change, there are currently no Communications asset specific initiatives underway.

2.6 Lifecycle Investment Forecasts

At the current stage of asset management maturity, lifecycle investment needs are evaluated as the annualized cost to maintain SOGR, as outlined above. Estimates have also been made for the investment required to bring all assets to "Fair" or better condition over the planning period.

The following figures and table illustrate the full lifecycle investment forecasts for Communications System assets. The figures show the current funding by project type compared to the total overall funding required to maintain SOGR and deliver on selected service enhancement and growth projects. Condition remediation investment forecasts are also included.

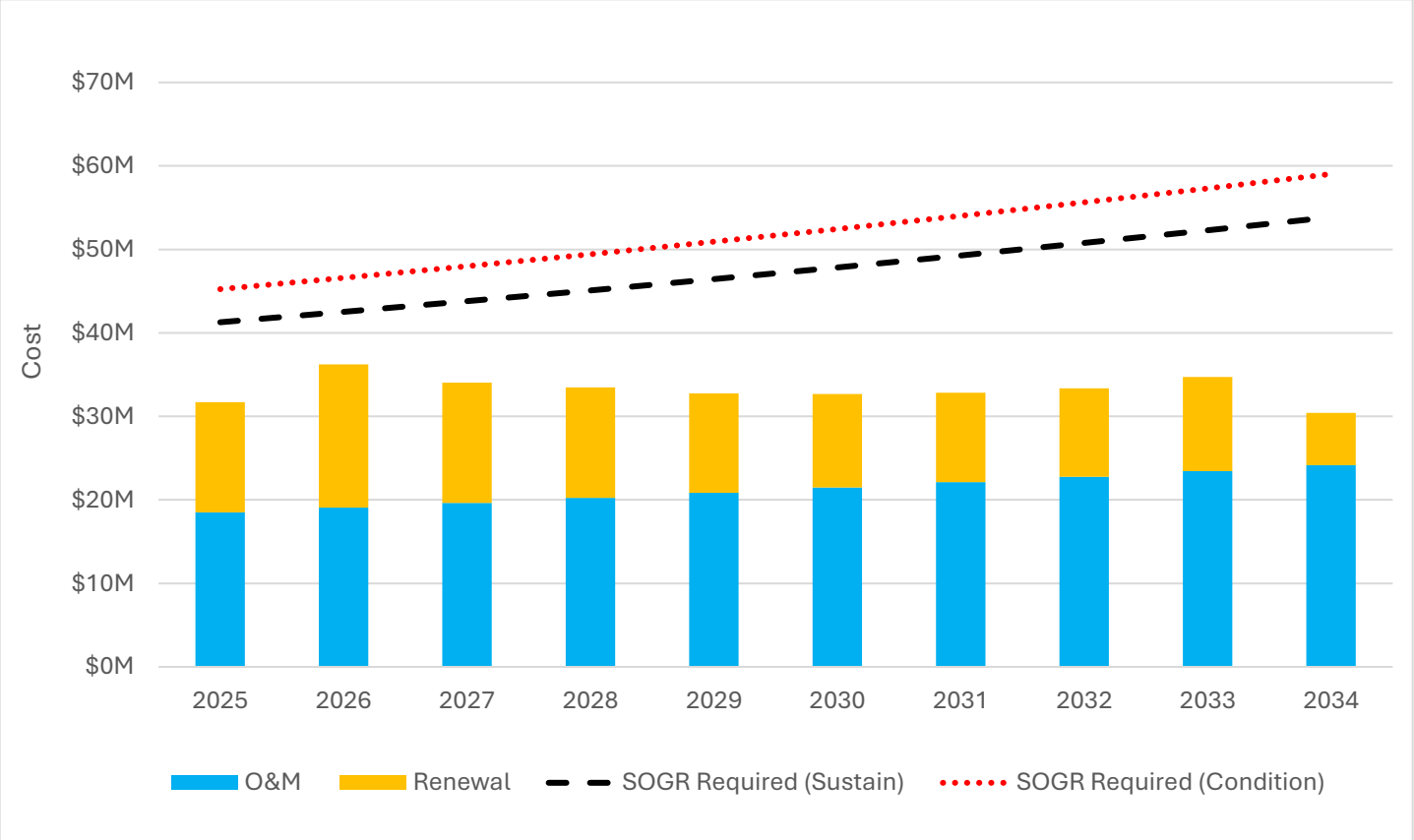


Figure 2-3: Funding vs Assessed Program Requirements – Communications Systems (SOGR only)

[45] *Growth supporting activities associated with major expansion projects (e.g.: Line 5 & 6 implementation) are not included.*

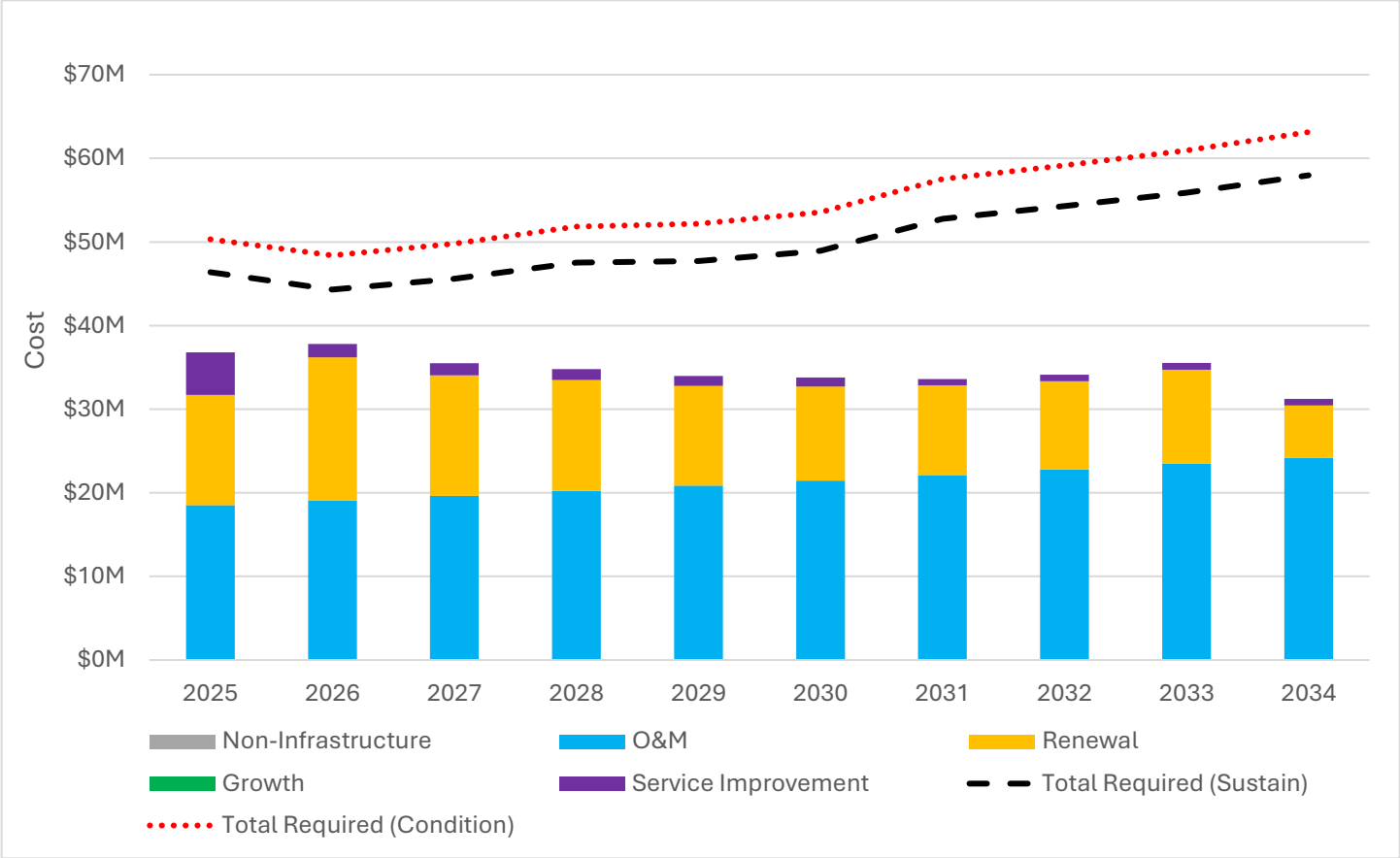


Figure 2-4: Funding vs Assessed Program Requirements – Communications Systems

The following table summarizes the average annual budget and investment needs for the planning period:

Lifecyle Activity	Planned Budget ($K)	Investment Needed to Sustain LOS ($K)	Investment Needed to Address Condition Gap ($K)
Non-Infrastructure	$0	$0	$0
Maintenance	$21,231	$29,255	$29,255
Renewals	$11,996	$18,065	$22,608
Growth	$0	$0	$0
Service Improvement	$1,486	$2,821	$2,821
Total Expenditure	$34,712	$50,141	$54,684
Average annual SOGR Gap		$14,094	$18,637
Average annual Infrastructure Gap		$15,429	$19,972

Table 2-F – Annualized Funding vs Assessed Program Requirements – Communications Assets

2.7 Conclusion & Risks

The analyses undertaken in the preparation of this plan suggest that the TTC's Communications systems are significantly underfunded, both in terms of capital investment, and operational budget. Capital shortfalls have led to poor system performance against service expectations as the asset ages and degrades. Capital funding is triaged to address immediate need, supporting continued operations, but at reduced quality of communications and data. The operating shortfall has resulted in a similar need for prioritization, emphasising efforts to keep the system running in the short term, while sacrificing efforts to collect data and develop systems to support long term efficiency.

While the significant data quality gaps in the communications asset base limit the reliability of the funding analyses, the data that is available supports this analysis. As the TTC matures its EAM program, risks and uncertainties resulting from poor data quality will be reduced.

The most substantial risks identified for these assets are:

1. **Insufficient Funding:** Significant shortfalls in both operational and capital funding threaten communications system service quality and availability. De-prioritization of monitoring system upgrades (ex: OPSLAN/TCN NMS software) results in lack of understanding of operational risk.
2. **Hidden Operational Budget Shortfalls:** The analysis undertaken in the evaluation of the operating budget requirements does not consider the extent to which Communications maintenance and engineering staff are required to support extra-departmental projects. This suggests that the actual operating budgets required to sustain SOGR are higher than presented. The TTC will improve this model as the EAM program matures.
3. **Data Quality:** Asset condition and value data has low confidence ratings. Lifecycle investment models are immature and unvalidated.
4. **Systems Complexity:** The high levels of complexity and interdependencies in systems assets make the assessment of the cost of future lifecycle activities more challenging. It may not be possible to replace a single subsystem without incurring knock-on requirements to undertake upgrades of connecting systems. This could reduce the effective useful life of key systems and/or result in inaccuracies in our financial models. Furthermore, the ultimate effects of increasing complexity in new modern systems are often underestimated when evaluating expected ongoing maintenance costs.
5. **Asset Obsolescence:** Delays in capital replacements (reengineering) of aged systems introduce operational risk as obsolete components cannot be replaced (eg: JMUX/JPAX).
6. **Approval/Execution Delay:** Lead times for communications project planning and execution are significant, from design development to potential onboarding of staff. Appropriate funding must be identified and committed in the early stage of each project.
7. **Lack of Cost Clarity:** The current financial operating environment within the communications group has ongoing maintenance activities occasionally funded through capital projects. This can lead to misunderstandings in the true cost of sustaining maintenance activities.
8. **Lowest Bidder Procurement:** Current procurement strategies are heavily weighted towards the lowest bidder, and do not have strong mechanisms to assess or weigh the risks to ongoing maintainability and total lifecycle costs. This can lead to reduced system total life value, and unanticipated increased maintenance operating costs.

3. Signalling Systems

3.1 Introduction

TTC Signalling Systems assets are a system of engineered software and relay-based control networks, devices, equipment, and protocols used to control the movement of the subway trains. The primary objective of signalling assets is to prevent collisions, manage traffic, and facilitate the safe and orderly movement of rolling stock along railway tracks.

Service Statement

> *"TTC Signalling Systems assets support overall transit services by enabling the coordinated controlled movements of subway revenue and non-revenue vehicles, ensuring that operational service and maintenance plans can be met safely and effectively."*

Asset Breakdown

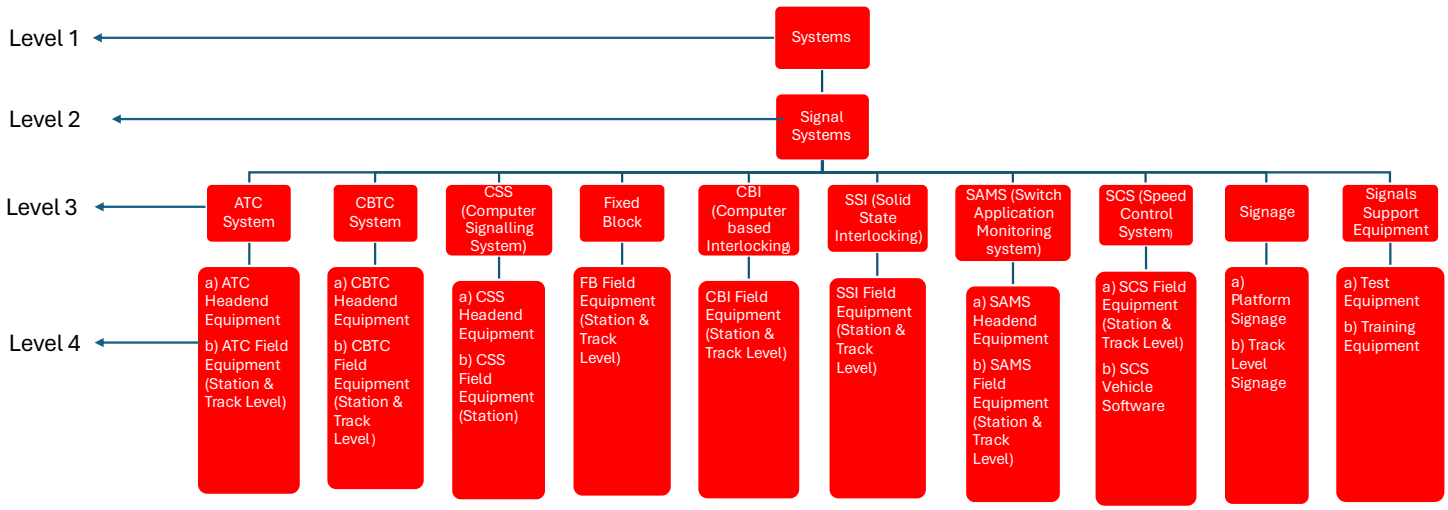


Figure 3-1: Asset Hierarchy – Signalling Systems

3.2 State of Infrastructure

The following figure outlines a high-level overview of the state of TTC Signalling Systems assets:

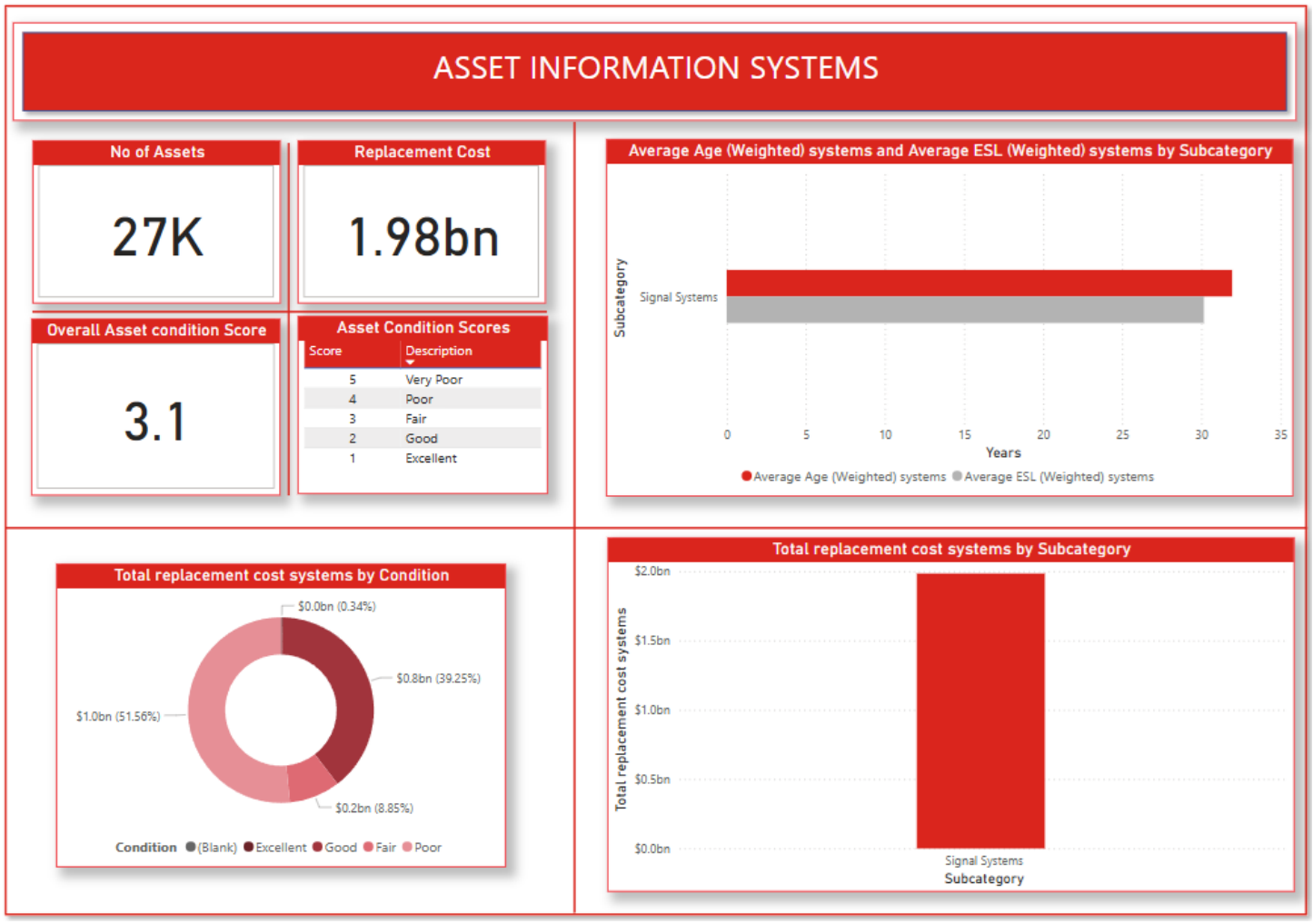


Figure 3-2: State of TTC Infrastructure Summary Dashboard – Signalling Systems

Asset Summary

Asset Class	Asset Subclass	Quantity	Replacement Value ($M)	Average Condition	Average age (years)	ESL (years)
Signalling Networks	Line 1	15,960	710.1	1.9	8	30
	Line 2	7,033	812.6[46]	4	59	30
	Line 4	1,780	136.4[46]	2.8	23	30
	Wilson Yard	1,314	39.0	1.5	8	30
	Greenwood Yard	-[47]	19.5[46]	4.5	59	30
	Davisville Yard	-[47]	6.7[46]	-	-	-
Headend Equipment	CSS	38	60.8	3.5	23	30
	SAMS	-[47]	20.7	2.2	10	35
	SCS	-[47]	72.6	3.7	12	35
Signage	Platform Signage	24	0.6	2.7	12	20
	Track Level Signage	658	0.5	2.7	18	30
Support Equipment	Relay Shop	61	6.7	2.5	35	30
	Training Systems	110	1.7	1.8	10	30

Data Source(s): TTC Operations & Infrastructure Group

Table 3-A – Asset Summary – Signalling Systems

Condition Assessment

At present, condition ratings for Signalling assets are based primarily on asset age, occasionally adjusted based on qualitative assessments made for systems with below acceptable reliability levels.

As the TTC continues to mature its Enterprise Asset Management (EAM) program, condition assessment methodologies will be refined to reflect a more complete understating of asset state and to increase data confidence.

3.3 Levels of Service

Levels of Service (LOS) for Signalling assets have been assessed in line with the overarching LOS framework presented in the main AMP document. Proposed LOS are encapsulated in the performance targets, as well as the initiatives outlined in the Future LOS table. The TTC believes that these proposed LOS are reasonably achievable given the available funding. Further details on risks and funding requirements are outlined in subsequent sections.

Where asset performance falls below targets, the TTC will undertake action to address. In many cases this includes accelerated SOGR programs or modified maintenance activities. Additional details can be found in the asset class strategy summaries in the **TTC Asset Management Strategy** document.

[46] Assumes ATC upgrade
[47] Total asset quantities for these assets are under review. Data is not yet mature enough for presentation.

Performance Summary

FAIR

Overall, signalling assets are approaching LOS targets and expectations.

While these systems are generally sufficient and allow system operations as planned, reliability for legacy networks is below acceptable thresholds.

Current Levels of Service

Asset Category Customer Level of Service	Subcategory Technical Level of Service	Performance Measure	Performance	Target
TTC Systems assets are sufficient and appropriate to allow revenue vehicles to meet required service frequency and headways	Signalling and train control systems are sufficient and appropriate to allow the Subway trains to meet required service frequency and headways	Design performance specifications	Signal systems are effective and appropriate to allow service plan to be met.	-
TTC Systems assets are reliable and maintained in a SOGR such that service affecting failures are minimized.	Signals assets are available and functional	Corridor Availability	99.972%	99.95%
		Signal Incident Total Delay Minutes (w/o external factors)	2232	1200
		Breakdown Failures	155	99
		Trouble Calls	437	336
	Signals assets are maintained in fair or better condition	Assets in fair or better condition (value weighted average %)	59%	80%
	Signal maintenance program is effectively executed	Compliance to planned maintenance program (PMs Completed)	16808	14840
		Inspection compliance – Line 1	100%	100%
		Inspection compliance – Line 2	97%	100%
		Inspection compliance – Line 4	100%	100%
		Inspection compliance – Yards	100%	100%
TTC Systems assets are designed with sufficient redundancy to mitigate the impact of single point failures.	All safety critical signals systems are redundant.	System Redundancy	Operational resiliency is assured through redundancy on line 1. Legacy lines do not currently have redundancy	Redundancy on all Subway lines (ATC Implementation)
TTC Systems assets include safety assurance systems that are sufficient and effective to minimize transit system safety risks to TTC staff, the travelling public, and the surrounding communities.	Signals systems are designed and implemented to appropriate safety standards, and are inspected to ensure that meet safety standards	Design safety standards	All signalling systems meet design safety standards	-

Table 3-B – Current Levels of Service – Signalling Systems

Future Levels of Service

Asset Category Customer Level of Service	Asset Future Level of Service	Actions	Target Date	Initiative
TTC Systems assets are sufficient and appropriate to allow revenue vehicles to meet required service frequency and headways	Enhance signalling systems to support reduced headways and improve reliability to accommodate increased ridership on Line 2	Line 2 ATC re-signalling	2033	Corp Plan 3.1.3

Table 3-C – Future Level of Service Initiatives – Signalling Systems

3.4 Lifecycle Management Activities

The lifecycle activities of the Signalling Systems assets vary according to the asset class, but typically include regular cleaning and inspection, functionality testing, software updates, and replacement-on-failure of system subcomponents. End of life activities typically involve system redesign and technology upgrades.

The following table outlines the assessed lifecycle activities required to maintain Signalling Systems SOGR:

Activity	Frequency	Annualized Cost ($K)
Non-Infrastructure		
Administrative overhead, process continuous improvement	As required	-
Maintenance		
Regular inspection, functionality testing, and servicing	Annual	$22,896
Scheduled replacement of wear components	As required	
Corrections and replace-on-failure of minor components	As required	
Renewals		
Line 1		
EOL Replacement: Full system technology replacement	30 Year	$23,672
Software Update: Stability/compatibility	5 Year	$17
Refurbishment: Relay rack, ZCC, LC, CLC	5 Year	$169
EOL Replacement: Entry Tags	5 Year	$15
EOL Replacement: Servers & Workstations, TRE	10 Year	$2,294
EOL Replacement: SMIO, DCS BTN, UPS, Rectifiers, ACS Cubicle, BTE	15 Year	$606
EOL Replacement: Power Supplies, Beacons, Axle Counters, Relay Rack, Battery Banks, ZC, LC, CLC	20 Year	$700
EOL Replacement: Trainstops	30 Year	$371
Line 2		
EOL Replacement: Full system technology replacement	30 Year	$27,087
EOL Replacement: Signal Equipment Cases	30 Year	$216
Software Update: Stability/compatibility	5 Year	$17
Refurbishment: Relay rack, ZCC, LC, CLC	5 Year	$192
EOL Replacement: Entry Tags	5 Year	$17
EOL Replacement: Servers & Workstations, TRE	10 Year	$2,625

Activity	Frequency	Annualized Cost ($K)
EOL Replacement: SMIO, DCS BTN, UPS, Rectifiers, ACS Cubicle, BTE	15 Year	$693
EOL Replacement: Power Supplies, Beacons, Axle Counters, Relay Rack, Battery Banks, ZC, LC, CLC	20 Year	$800
EOL Replacement: Trainstops	30 Year	$303
Line 4[48]		
EOL Replacement: Full system technology replacement	30 Year	$4,548
Software Update: Stability/compatibility	5 Year	$17
Refurbishment: Relay rack, ZCC, LC, CLC	5 Year	$32
EOL Replacement: Entry Tags	5 Year	$3
EOL Replacement: Servers & Workstations, TRE	10 Year	$440
EOL Replacement: SMIO, DCS BTN, UPS, Rectifiers, ACS Cubicle, BTE	15 Year	$116
EOL Replacement: Power Supplies, Beacons, Axle Counters, Relay Rack, Battery Banks, ZC, LC, CLC	20 Year	$134
EOL Replacement: Trainstops	30 Year	$49
Yard Signalling		
EOL Replacement: Wilson Yard Signalling	30 Year	$1,300
EOL Replacement: Davisville Yard Signalling	30 Year	$222
EOL Replacement: Greenwood Yard Signalling	30 Year	$650
CSS		
EOL Replacement: Full system technology replacement	30 Year	$2,033
SAMS		
EOL Replacement: Event Recorders	35 Year	$591
EOL Replacement: Field Signal Cable	35 Year	$219
SCS		
EOL Replacement: Full system technology replacement	30 Year	$2,074
Signage		
EOL Replacement: Platform Signage	20 Year	$29
EOL Replacement: Wayside Signage	30 Year	$18
Support Equipment		
EOL Replacement: Relay Shop Equipment	30 Year	$224
EOL Replacement: Training Equipment	30 Year	$58
Data source: TTC O&I Group – SEC, TTC Capital Investment Plan		

Table 3-D – Lifecycle SOGR Activities – Signalling Systems

It is important to note that here are several programs associated with technology updates to the signals systems that will bring additional improvements to service delivery and support future growth. As these are primarily driven by SOGR, they are included in the table above.

[48] Assumes ATC upgrade

As noted in the following table, there are no specific lifecycle activities underway to provide improvements to service and address ridership growth and system network expansion (meet proposed future LOS).

Activity	**Timeline**	**Program Cost** ($K, current planning period)
Non-Infrastructure		
No Signals Non-Infrastructure programs currently underway		
System Improvement		
No Signals System Improvement programs currently underway		
Growth[49]		
No Signals Growth programs currently underway		
Data source: TTC O&I Group – SEC, TTC Capital Investment Plan		

Table 3-E – Current & Planned Lifecycle Activities to Improve Service and Address Growth – Signalling Systems

3.5 Climate Change

While the Signals, Electrical, & Communications (SEC) team supports the organization's overall commitment to mitigating and adapting to the effects of climate change, there are currently no Signalling Systems asset specific initiatives underway.

3.6 Lifecycle Investment Forecasts

At the current stage of asset management maturity, lifecycle investment needs are evaluated as the annualized cost to maintain SOGR, as outlined above. Estimates have also been made for the investment required to bring all assets to "Fair" or better condition over the planning period.

The following figures and table illustrate the full lifecycle investment forecasts for Signalling Systems assets. The figures show the current funding by project type compared to the total overall funding required to maintain SOGR and deliver on selected service enhancement and growth projects. Condition remediation investment forecasts are also included.

[49] *Growth supporting activities associated with major expansion projects (e.g.: Line 5 & 6 implementation) are not included.*

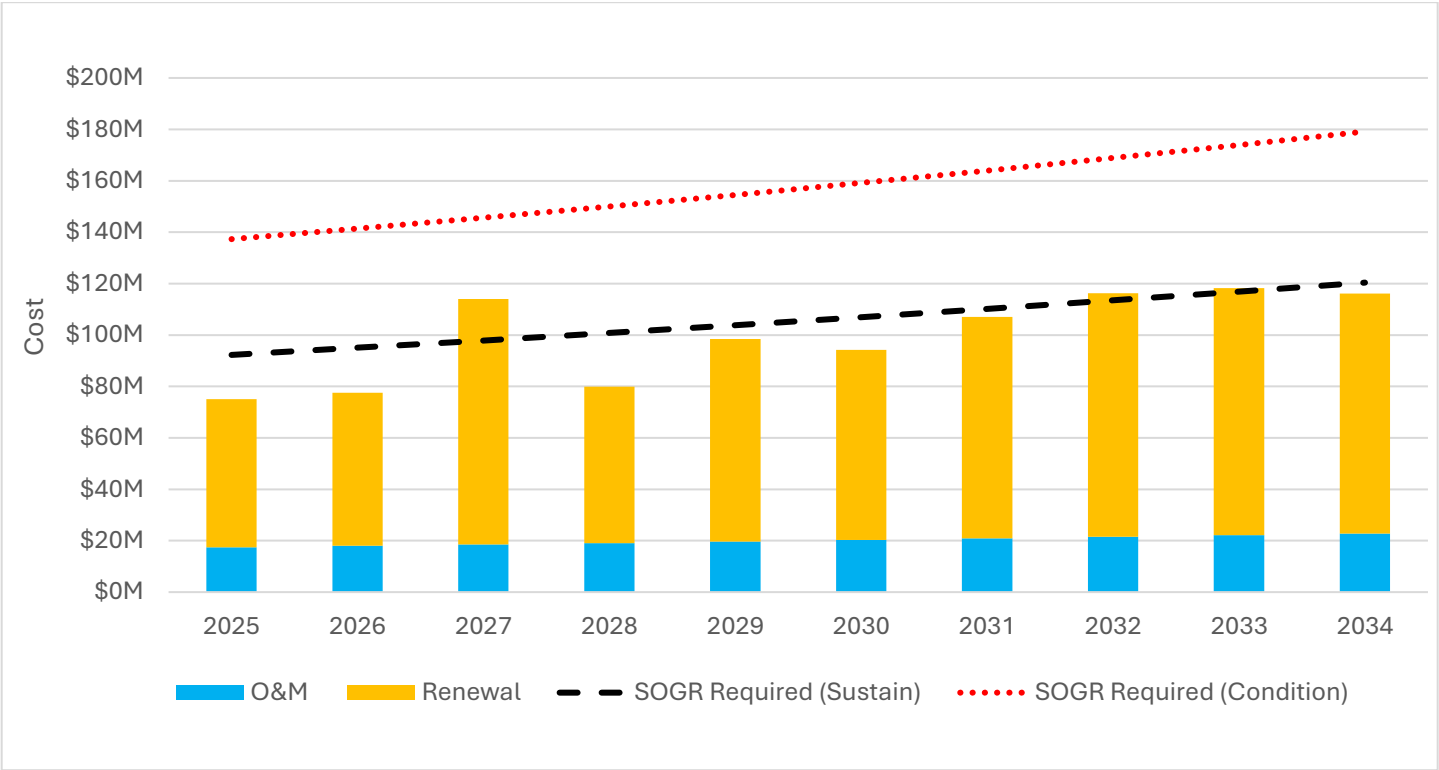


Figure 3-3: Funding vs Assessed Program Requirements – Signalling Systems (SOGR only)

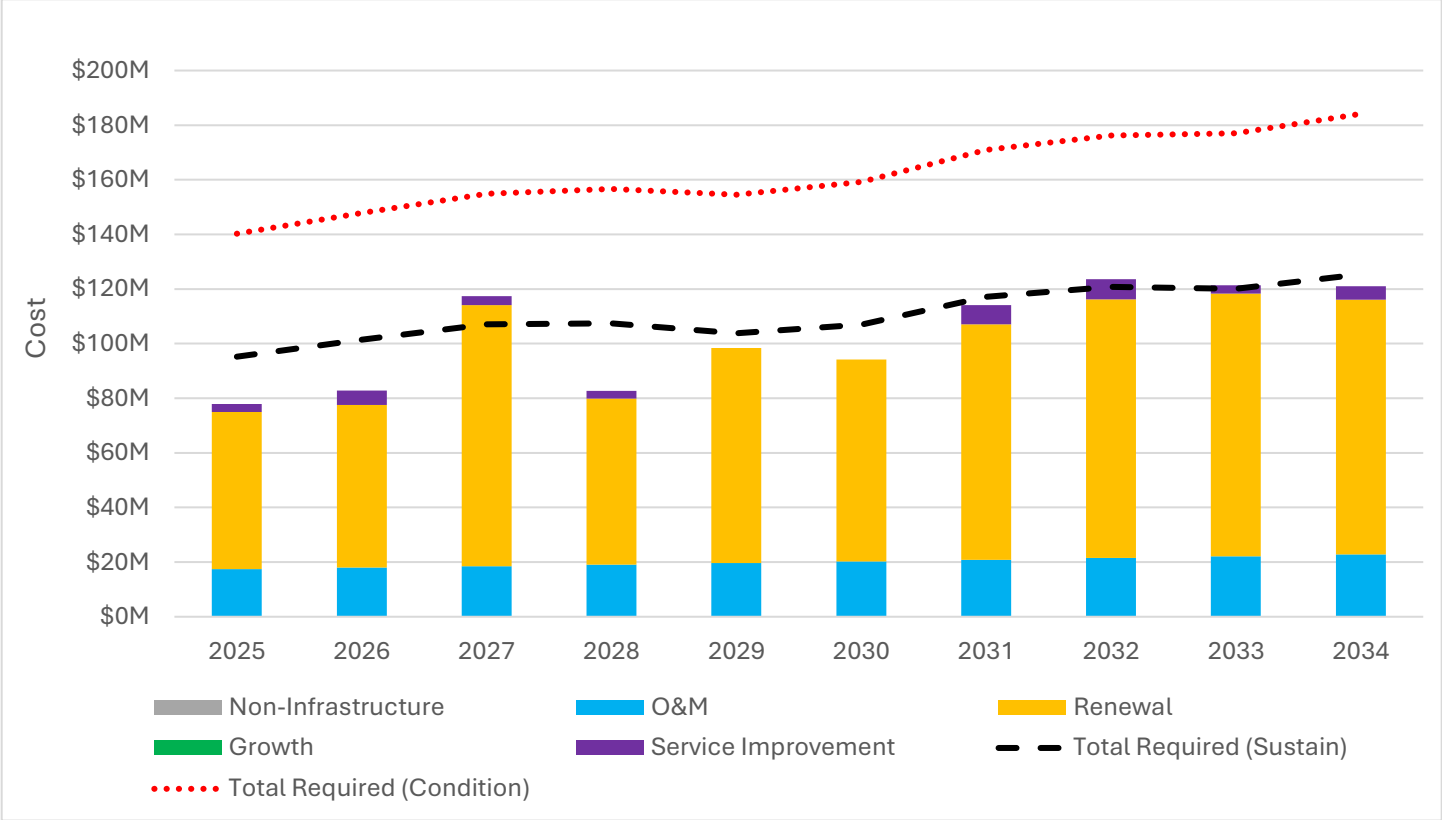


Figure 3-4: Funding vs Assessed Program Requirements – Signalling Systems

The following table summarizes the average annual budget and investment needs for the planning period:

Lifecyle Activity	Planned Budget ($K)	Investment Needed to Sustain LOS ($K)	Investment Needed to Address Condition Gap ($K)
Non-Infrastructure	$0	$0	$0
Maintenance	$20,038	$22,929	$22,929
Renewals	$79,638	$82,848	$134,475
Growth	$0	$0	$0
Service Improvement	$3,679	$4,760	$4,760
Total Expenditure	$103,355	$110,538	$162,165
Average annual SOGR Gap		$6,101	$57,728
Average annual Infrastructure Gap		$7,183	$58,810

Table 3-F – Annualized Funding vs Assessed Program Requirements – Signalling Assets

3.7 Conclusion & Risks

The TTC is currently operating several different generations of subway signalling technology, the oldest being the Line 2 fixed block system, which has been in service in most sections for up to 58 years (commissioned between 1966 and 1980). These legacy systems are less efficient, and less reliable than modern systems, and require a significant amount of effort to integrate into modern train control operations.

Funds have been allocated to upgrade the Line 2 system to ATC and work is expected to begin in the planning period. In the interim, SOGR programs to ensure reliability of the legacy systems are underway.

Despite recent funding allocations, our analysis suggests that the current funding levels are not sufficient to maintain the signalling system asset in a SOGR and deliver on LOS expectations. The signalling SOGR is a top priority to ensure continuous subway corridor availability, current passenger-carrying capacity, and compliance with industry standards and safety.

Additionally, data quality gaps limit the reliability of the funding analyses. As the TTC matures its EAM program, risks and uncertainties resulting from poor data quality will be reduced.

The most substantial risks identified for these assets are:

1. **Hidden Operational Budget Shortfalls:** The analysis undertaken in the evaluation of the operating budget requirements does not take into account the extent to which Signals maintenance and engineering staff are required to support extra-departmental projects. This suggests that the actual operating budgets required to sustain SOGR are higher than presented. The TTC is working to improve this model as the EAM program matures.
2. **Effective Performance Monitoring:** Keeping signal assets and systems in a fail-safe operating condition and in a SOGR is critical to reducing duration and frequency of occasional impacts on overall subway corridor availability. Current operational budget limitations have resulted in de-prioritizing the collection of operational data in support of maintaining ongoing maintenance operations. Crucial data regarding the performance of the signalling system and status changes are not currently available or limited due to the absence of adequate recording of essential events, performance monitoring, and preventative diagnostic of signal assets failures. This results in increased troubleshooting time due to the lack of data to pinpoint the root cause of a malfunctioning system as well as the lack of data available for analysis at a remote location prior to intervention crews being dispatched to the field. This information is required to support and justify adequate capital reserves to fund the Signals SOGR Program. Failing to secure required funding will result in further assets deterioration and unmanageable backlog of Capital work.

3. **Modernization and Obsolescence:** Legacy and CBI signalling equipment has been discontinued by their original manufacturer. Implementation of alternatives require engineering and manufacturing efforts to design, test and certify they are safe to use for their application and to secure an adequate quantity of spares for system replacement. This will result in higher operating and maintenance costs and could result in a drop off in performance of the subway line through delays and line closures.
4. **Aging Infrastructure:** Ongoing significant capital investment is required to address and maximize efficiency of SOGR activities for conventional and computer-based signalling systems.
5. **Data Quality:** Asset condition and value data has low confidence ratings. Lifecycle investment models are immature and unvalidated.
6. **Systems Complexity:** The assessment of the true cost of future lifecycle activities is difficult due to the high levels of complexity and interdependencies in systems assets. It may not be possible to replace a single subsystem without incurring knock-on requirements to undertake upgrades of connecting systems. This could reduce the effective useful life of key systems and/or result in inaccuracies in our financial models. Furthermore, the ultimate effects of increasing complexity in new modern systems are often underestimated when evaluating expected ongoing maintenance costs.

4. Electrical Supply & Distribution Systems

4.1 Introduction

TTC Electrical Supply and Distribution (ES&D) assets include all components of the electrical power control and distribution network, up to the point of use by other TTC asset groups. Electrical power components that are not included in this asset subcategory include facility low voltage electrical services (panel, wiring and electrical devices), traction power rail, Overhead Contact System (OCS), and vehicle-based electrical systems. This subcategory includes substation power components (switchgear, transformers, and metering) as well as distribution wiring and cabling.

Service Statement

> *"TTC Electrical Supply and Distribution assets support overall transit services by ensuring that there is sufficient electrical power supplied to all electrically powered TTC assets, and that this power can be effectively monitored and controlled to support safe, efficient and reliable operations, maintenance, and lifecycle activities."*

Asset Breakdown

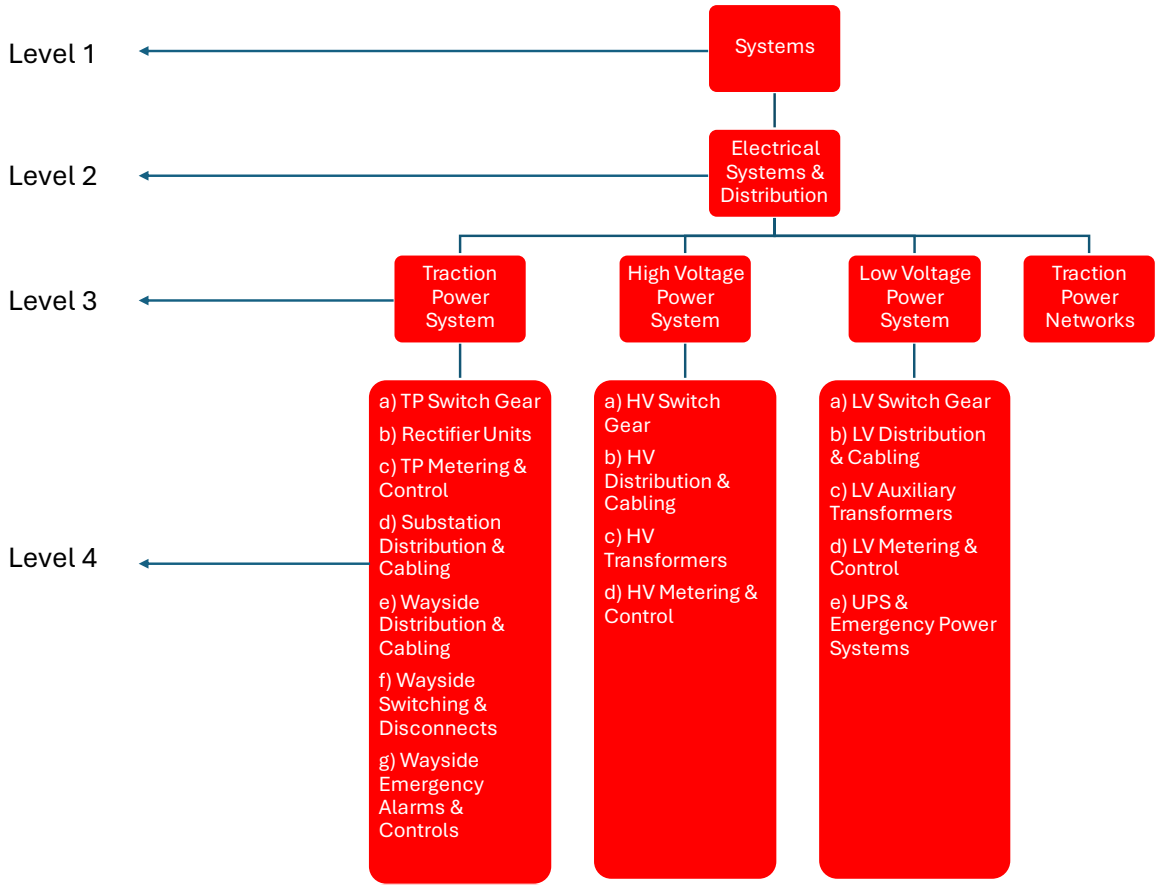


Figure 4-1: Asset Hierarchy – ES&D Systems

4.2 State of Infrastructure

The following figure outlines a high-level overview of the state of TTC ES&D Systems assets:

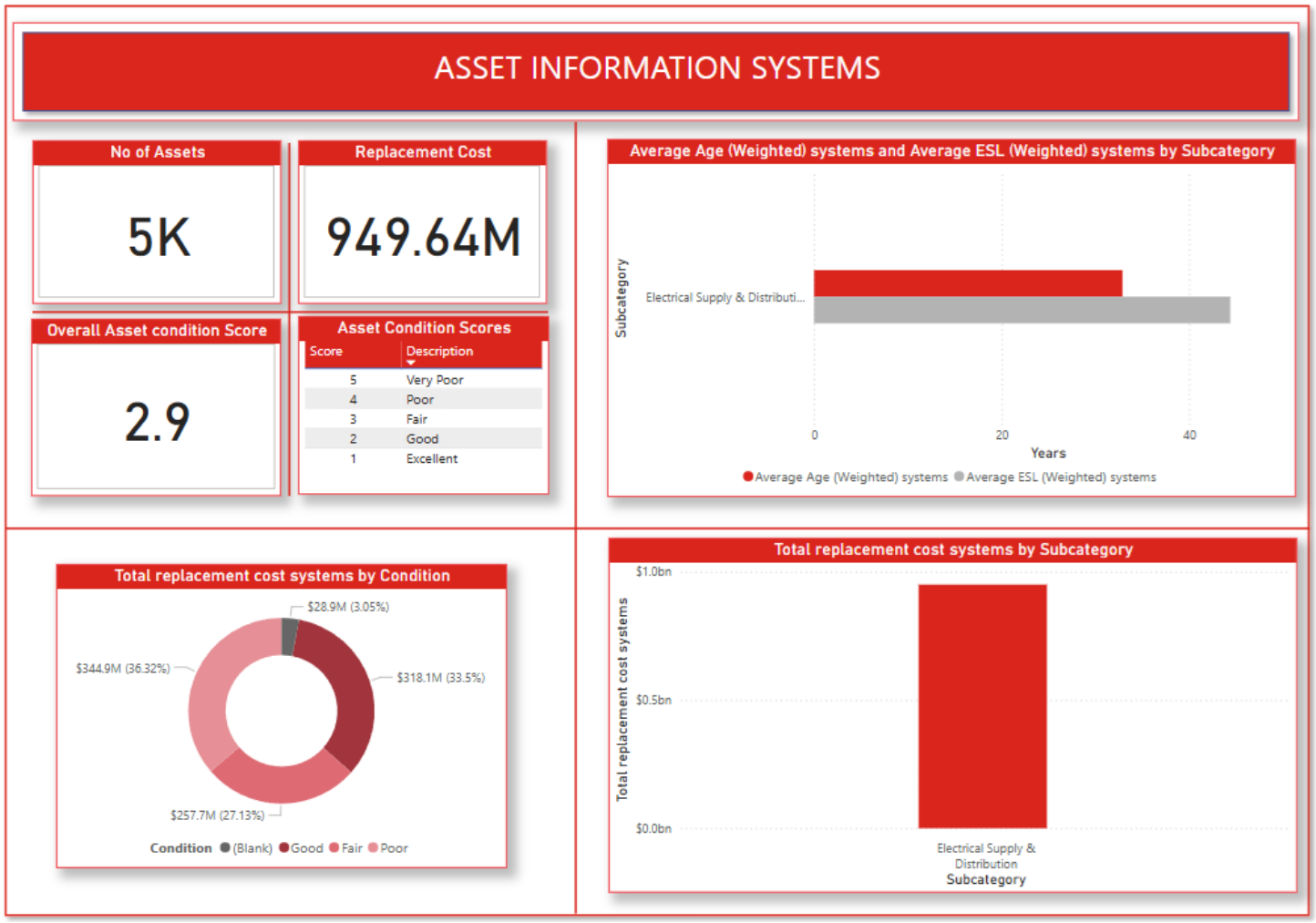


Figure 4-2: State of TTC Infrastructure Summary Dashboard – ES&D Systems

Asset Summary

Type	Sub-Asset Class	Quantity	Replacement Value ($M)	Average Condition	Average age (years)	ESL (years)
Traction Power System	TP Switchgear	836	92.7	2.6	26	50
	Rectifier Units	136	58.3	2.9	30	50
	TP Metering & Control	400	25.7	-	26	50
	Wayside Distribution & Cabling	-[50]	252.6	-	45	35
	Wayside Switching & Controls	-[50]	151.2	-	20	50
High Voltage System	HV Switchgear	377	61.0	2.9	29	50
	HV Transformers	198	116.1	2.5	24	50
	HV Distribution & Cabling	-[50]	6.0	3.9	29	50
	HV Metering & Control	5,378	38.8	3.2	29	50
Low Voltage System	LV Switch Gear	3		2.0	24	50
	LV Distribution Panels	-[50]	1,650	2.0	24	30
	LV Cabling	-[50]	2,886	-	37	50
	UPS & Emergency Power Systems	175	1,650	3.0	13	15

Data Source(s): TTC Operations & Infrastructure Group

Table 4-A – Asset Summary – ES&D Systems

Condition Assessment

In general, condition ratings for ES&D assets are based heavily on asset age. Where data is available, these ratings are adjusted based on visual inspections, assessments, and wear data. The most recent systemwide condition assessments were undertaken more than 10 years ago, resulting in a low overall condition confidence.

As the TTC continues to mature its Enterprise Asset Management (EAM) program, condition assessment methodologies will be refined to reflect a more complete understating of asset state and to increase data confidence.

[50] Total asset quantities for these assets are under review. Data is not yet mature enough for presentation.

4.3 Levels of Service

Levels of Service (LOS) for ES&D System assets have been assessed in line with the overarching LOS framework presented in the main AMP document. Proposed LOS are encapsulated in the performance targets, as well as the initiatives outlined in the Future LOS table. The TTC believes that these proposed LOS are reasonably achievable given the available funding. Further details on risks and funding requirements are outlined in subsequent sections.

Where asset performance falls below targets, the TTC will undertake action to address. In many cases this includes accelerated SOGR programs or modified maintenance activities. Additional details can be found in the asset class strategy summaries in the **TTC Asset Management Strategy** document.

Performance Summary

Overall, ES&D assets are meeting LOS targets and expectations.

While operational performance remains in an acceptable range, there are risks associated with asset condition. These are being addressed through capital investments outlined below.

Current Levels of Service

Asset Category Customer Level of Service	Subcategory Technical Level of Service	Performance Measure	Performance	Target
TTC Systems assets are sufficient and appropriate to allow revenue vehicles to meet required service frequency and headways	Traction power supply and distribution systems provide sufficient electrical power to allow subway and streetcar vehicles to meet required service frequency and headways	N/A	Traction power systems are effective and appropriate to allow service plan to be met.	-
TTC Systems assets are reliable and maintained in a SOGR such that service affecting failures are minimized.	ES&D assets are available and functional	Major Faults	11	10
	ES&D assets are maintained in good or better condition	% of assets in fair or better condition	65%	80%
TTC Systems assets are designed with sufficient redundancy to mitigate the impact of single point failures.	Traction power networks (OCS and subway power rail) are dual fed.	% of dual fed power sections (Subway)	99%	99%
		% of dual fed power sections (Streetcar)	88%	88%
	Passenger Stations are dual fed.	% of dual fed power stations	99%	99%
TTC Systems assets include safety assurance systems that are sufficient and effective to minimize	ES&D safety systems meet safety standards and are regularly inspected to validate	N/A	All safety audits have been undertaken as	-

Asset Category Customer Level of Service	Subcategory Technical Level of Service	Performance Measure	Performance	Target
transit system safety risks to the travelling public and community.			planned. No major non-conformities	
	UPS systems are available and operate as per OBC requirements.	% of systems that meet backup power minute requirements (>180 minutes)	100%	100%
TTC Systems assets support fleet electrification.	ES&D Systems are scaled appropriately to support bus fleet electrification	N/A	Power systems are sufficient and effective to allow for charging of the current electric vehicle fleet	-

Table 4-B – Current Levels of Service – ES&D Systems

Future Levels of Service

Asset Category Customer Level of Service	Asset Future Levels of Service	Actions	Target Date	Initiative
TTC Systems assets are sufficient and appropriate to allow revenue vehicles to meet required service frequency and headways	Support a 55% increase in Subway Line 1 ridership by 2041 (over 2019 levels	Enhance Line 1 Traction power capacity to support 100 second headways	2041	Corporate Plan Action 3.1.1
	Support a 18% increase in Subway Line 2 ridership by 2041 (over 2019 levels	Enhance Line 2 Traction power capacity to support 120 second headways	2041	Corporate Plan Action 3.1.3
TTC Systems assets support fleet electrification.	TTC bus fleet meets the following targets for zero emission vehicles: 20% by 2025 50% by 2030 100% by 2040	Construct and integrate appropriate charging infrastructure and expand system capacity.	2040	Corporate Plan Action 3.3.1

Table 4-C – Future Level of Service Initiatives – ES&D Systems

4.4 Lifecycle Management Activities

The lifecycle activities of the ES&D Systems assets vary according to the asset class, but typically include regular cleaning and inspection, functionality testing, replacement of wear components, and replacement-on-condition or replacement-on-failure of system subcomponents. End of life activities typically involve key component replacements, often as location-based campaigns.

The following table outlines the assessed lifecycle activities required to maintain ES&D Systems SOGR:

Activity	Frequency	Annualized Cost ($K)
Non-Infrastructure		
Administrative overhead, process continuous improvement	As required	$0
Maintenance		
Regular inspection, functionality testing, and servicing	Annual	$21,831
Scheduled replacement of wear components	As required	
Corrections and replace-on-failure of minor components	As required	
Renewals		
Traction Power		
Replace at end of life: DC switchgear and substation cabling	50 Year	$1,854
Replace at end of life: Blocking & isolating diodes	50 Year	$137
Replace at end of life: Drain switches	50 Year	$134
Replace at end of life: Rectifier units	50 Year	$1,167
Replace at end of life: FNAGS units	35 Year	$47
Replace at end of life: Load measuring/Auto-reclose Systems	50 Year	$466
Replace at end of life: Surface traction cabling (Streetcar)	35 Year	$1,284
Replace at end of life: Yard traction cabling (Streetcar)	35 Year	$99
Replace at end of life: Underground traction cabling	50 Year	$2,162
Replace at end of life: Subway EOIS	35 Year	$463
Overhaul/Renew: Cable Chambers & Vaults	50 Year	$1,413
Overhaul/Renew: Negative Power Return Network	50 Year	$560
High Voltage System		
Replace at end of life: HV AC switchgear and substation cabling	50 Year	$1,220
Replace at end of life: Substation interconnection	50 Year	$121
Replace at end of life: Rectifier transformers (Traction Power)	50 Year	$1,725
Replace at end of life: Auxiliary transformers (LV Power)	50 Year	$598
Replace at end of life: Overcurrent Relays	50 Year	$676
Replace at end of life: Current & Potential Transformers	50 Year	$99
Low Voltage System		
Replace at end of life: LV Distribution Panels & ATS	35 Year	$550
Replace at end of life: LV Distribution Cabling	50 Year	$2,104
Replace at end of life: Signals Backup Power Systems	50 Year	$349
Replace at end of life: Station & Substation Battery Systems	15 Years	$962
Replace at end of life: Station & Substation UPS Systems	15 Years	$1065
Replace at end of life: Standby Generators	35 Years	$827
Data source: TTC O&I Group – SEC, TTC Capital Investment Plan		

Table 4-D – Lifecycle SOGR Activities – ES&D Systems

The following table provides examples of lifecycle activities that are undertaken to provide improvements to service and address ridership growth and system network expansion (meet proposed future LOS).

Activity	Timeline	Program Cost ($K, current planning period)
Non-Infrastructure		
No ES&D Non-Infrastructure programs currently underway		$0
System Improvement		
Reliability Enhancement - Implement streetcar alternate feeds	2015-2038	$13,480
Efficiency & Environment - Wayside Energy Storage	2022-2025	$3,490
Incident Response - Mobile Generator Connections	2022-2034	$3,013
Growth[51]		
Meet Future Power Needs – Install New Neville Loop Substation	2023-2027	$3,759
Data source: TTC O&I Group – SEC, TTC Capital Investment Plan		

Table 4-E – Current & Planned Lifecycle Activities to Improve Service and Address Growth – ES&D Systems

4.5 Climate Change

TTC's ES&D assets play an important role in the organization's overall efforts to mitigate and adapt to the effects of climate change as electrical networks must be expanded to facilitate bus, Wheel-Trans, and fleet vehicle electric charging under the Green Fleet program, as well as facility carbon reduction efforts and other electrification initiatives.

4.6 Lifecycle Investment Forecasts

At the current stage of asset management maturity, lifecycle investment needs are evaluated as the annualized cost to maintain SOGR, as outlined above. Estimates have also been made for the investment required to bring all assets to "Fair" or better condition over the planning period.

The following figures and table illustrate the full lifecycle investment forecasts for ES&D Systems assets. The figures show the current funding by project type compared to the total overall funding required to maintain SOGR and deliver on selected service enhancement and growth projects. Condition remediation investment forecasts are also included.

[51] *Growth supporting activities associated with major expansion projects (e.g.: Line 5 & 6 implementation) are not included.*

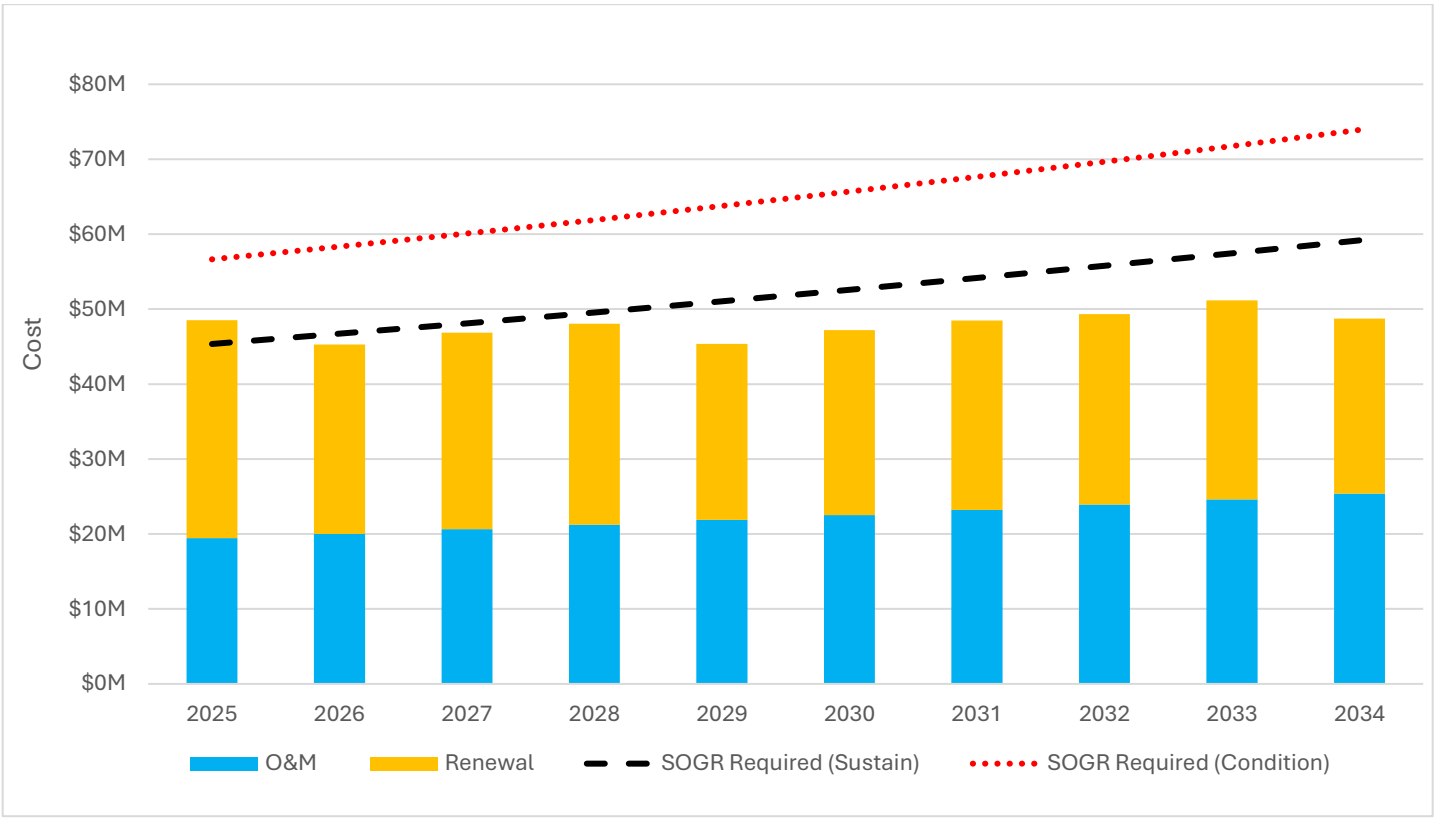


Figure 4-3: Funding vs Assessed Program Requirements – ES&D Systems (SOGR only)

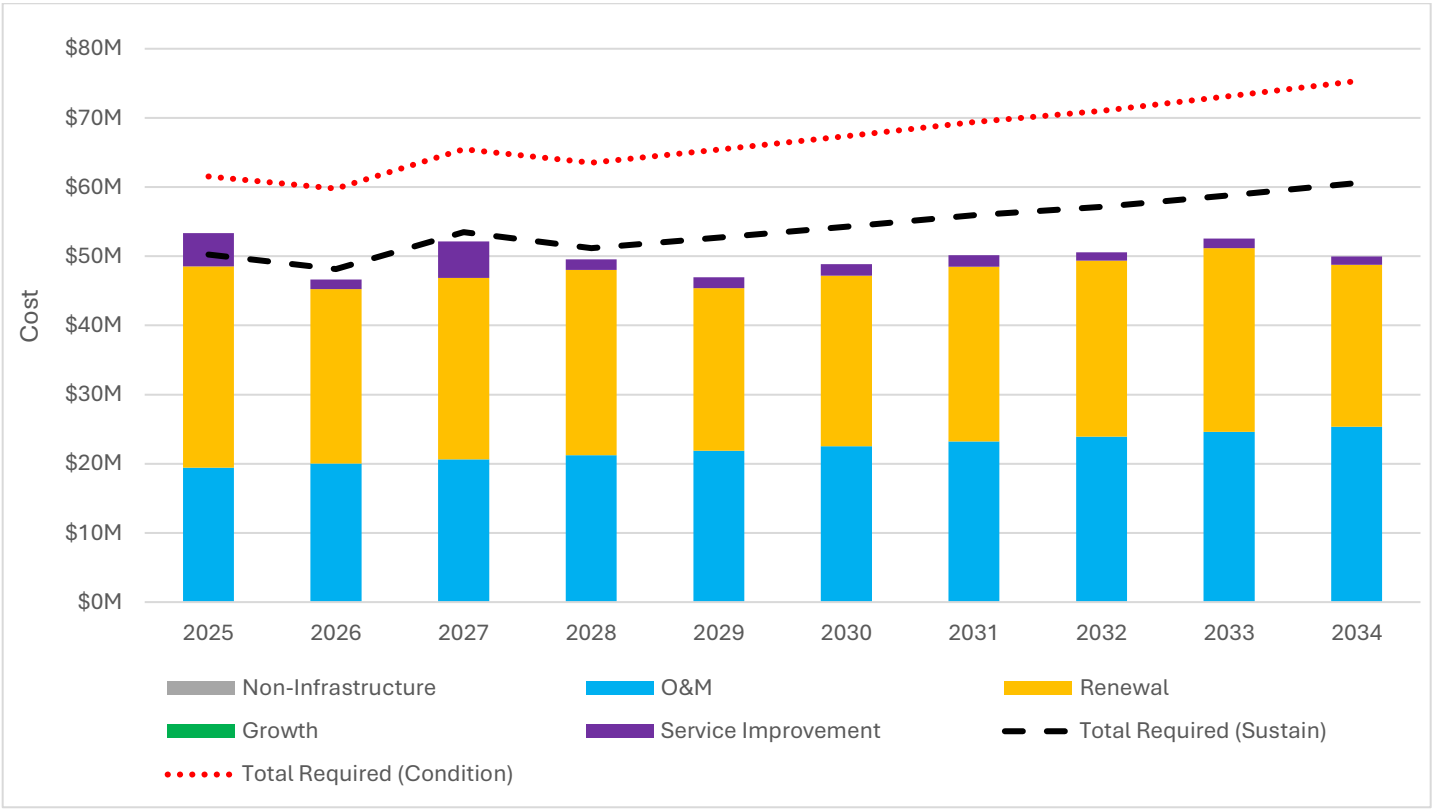


Figure 4-4: Funding vs Assessed Program Requirements – ES&D Systems

The following table summarizes the average annual budget and investment needs for the planning period:

Lifecyle Activity	Planned Budget ($K)	Investment Needed to Sustain LOS ($K)	Investment Needed to Address Condition Gap ($K)
Non-Infrastructure	$0	$0	$0
Maintenance	$22,290	$25,027	$25,027
Renewals	$25,617	$26,966	$39,915
Growth	$0	$0	$0
Service Improvement	$2,169	$2,254	$2,254
Total Expenditure	$50,076	$54,247	$67,196
SOGR Gap		$4,086	$17,035
Infrastructure Gap		$4,171	$17,120

Table 4-F – Annualized Funding vs Assessed Program Requirements – ES&D Assets

4.7 Conclusion & Risks

The TTC operates a complex traction power distribution system, from substations to power rail and overhead catenary wire and everything in between, to provide the electrical power to move subway trains and streetcars, and to provide power to the various TTC facilities and systems.

The TTC operates multiple substations that have outdoor electrical switchgear enclosures. The reliability of the substation equipment is critical for daily operations and revenue service. Some of this equipment was originally installed in the 1950s and 1960s. The Cable Replacement program is designed to replace deteriorated or damaged cabling throughout the tunnels to ensure safe and continuous delivery of power to the network. Subway station breakers control various station equipment, such as communication systems, escalators, elevators, fans, lighting, and critical emergency lighting. These breakers are becoming unreliable due to age, wear and tear. While backup power systems (UPS, Inverters, Motor Alternator/DC) that provide emergency power to stations, shops, car houses, and buildings during power outages typically have a lifecycle of 10-to-15 years, many of the existing units are in operation for over 20 years and are becoming unreliable.

The maintenance and repair of this equipment is difficult as the necessary spare parts are often not available. In addition, equipment is not being replaced at the appropriate pace in relation to its age and condition due to recent inflation in pricing of parts. As the assets deteriorate, so too does the reliability of the network. The pressure on the operating budget also rises as maintenance activities increase in the absence of a fully funded capital replacement program.

While these assets have ongoing funding in the CIP, and current data suggests that the funding levels are appropriate to sustain performance on average, this does not address the current age and condition of the assets. Several key capital projects remain unfunded, and maintenance operating expenses habitually exceed budget.

Data quality gaps add challenges to the reliability of the funding analyses. As the TTC matures its EAM program, risks and uncertainties resulting from poor data quality will be reduced.

The most substantial risks identified for these assets are:

1. **Aging Infrastructure:** Consistent replacement and maintenance of aging substation equipment as part of our SOGR is required to prevent a backlog of aging and unreliable equipment.
1. **Data Quality:** Asset condition and value data has low confidence ratings. Lifecycle investment models are immature and unvalidated.

2. **Insufficient Funding:** ES&D assets have ongoing funding in the CIP, however, the unfunded capital projects for the replacement of key sub asset groups remain unfunded, and maintenance operating costs exceed budget.
3. **Hidden Operational Budget Shortfalls:** The analysis undertaken in the evaluation of the operating budget requirements does not take into account the extent to which ES&D maintenance and engineering staff are required to support extra-departmental projects. This suggests that the actual operating budgets required to sustain SOGR are higher than presented. The TTC is working to improve this model as the EAM program matures.
4. **Maintenance Access/Capacity to Deliver:** Irrespective of the availability of funding, there are significant constraints to delivering the necessary infrastructure lifecycle activities for ES&D assets. These constraints include limited access windows for performing maintenance and upgrades, which are often restricted to non-operational hours to minimize service disruptions, and limited availability of work cars and maintenance equipment. Additionally, the onboarding and training of new engineering or electrician staff required to execute these activities can be time-consuming, further delaying project timelines.