Utilities Kingston
Report to Council
Report Number 25-237

To:	**Mayor and Members of Council**
From:	**David Fell, President & CEO, Utilities Kingston**
Resource Staff:	**Julie Runions, Director, Engineering, Utilities Kingston**
	Corey Martin, Manager, Asset Management & Climate Action, Engineering, Utilities Kingston
Date of Meeting:	**October 21, 2025**
Subject:	**Asset Management Plan Updates for Water, Wastewater, Natural Gas and Water Heater Assets**

Executive Summary:

The Infrastructure for Jobs and Prosperity Act, 2015 includes an authority for the province to regulate municipal asset management planning. Further, Ontario Regulation 588/17 prescribes the requirements to be satisfied in undertaking asset management, one of which is the requirement to have asset management plans approved by a resolution passed by the municipal Council. With respect of City-owned assets that are managed, operated and maintained by Utilities Kingston, Council has approved plans related to water and wastewater in 2021 and natural gas and water heater assets in 2024.

As part of the final phase of complying with Ontario Regulation 588/17, additional information was to be added to each asset management plan by July 1, 2025. Accordingly, the following plan updates have been completed to meet the 2025 requirements and are being submitted to Council for approval:

- Water and Wastewater Asset Management Plan Update 2025
- Natural Gas Asset Management Plan Update 2025
- Water Heater Asset Management Plan Update 2025

Recommendation:

That the Asset Management Plans attached as Exhibits A, B and C to Report Number 25-237 be approved as it relates to the City owned assets managed by Utilities Kingston in accordance with Ontario Regulation 588/17.

Authorizing Signatures:

ORIGINAL SIGNED BY PRESIDENT

& CEO, UTILITIES KINGSTON

David Fell, President & CEO,
Utilities Kingston

p.p. ORIGINAL SIGNED BY CHIEF

ADMINISTRATIVE OFFICER

Lanie Hurdle, Chief
Administrative Officer

Consultation with the following Members of the Corporate Management Team:

Paige Agnew, Commissioner, Growth & Development Services	Not required
Jennifer Campbell, Commissioner, Community Services	Not required
Neil Carbone, Commissioner, Corporate & Emergency Services	Not required
Desirée Kennedy, Chief Financial Officer & City Treasurer	Not required
Jenna Morley, City Solicitor	Not required
Ian Semple, Commissioner, Transportation & Infrastructure Services	Not required

Options/Discussion:

Background

In 2016, the Province of Ontario enacted the Infrastructure for Jobs and Prosperity Act, 2015 that included an authority for the province to regulate municipal asset management planning. Ontario Regulation 588/17 was later passed which prescribes the requirements to be satisfied in undertaking asset management, including the requirement to have asset management plans approved by a resolution passed by the municipal Council and updated every 5 years thereafter.

In accordance with the phased compliance requirements set out in Ontario Regulation 588/17 and amended by Ontario Regulation 193/21 and with respect of City-owned assets managed, operated and maintained by Utilities Kingston, Council has historically approved the following plans and policies:

- A Water and Wastewater Asset Management Plan in 2021 (Report Number 21-234)
- Asset Management Policy, most recently revised in 2023 (Report Number EITP-23-005)
- A Natural Gas Asset Management Plan and a Water Heater Asset Management Plan in 2024 (Report Number 24-171)

As part of the final phase of complying with Ontario Regulation 588/17, every asset management plan must include additional information by July 1, 2025 related to the levels of service that the municipality proposes to provide for a 10-year period and an explanation of the lifecycle management and financial strategies required to provide the proposed levels of service. Accordingly, the following plan updates have been completed to meet the 2025 requirements and are being submitted to Council for approval:

- Water and Wastewater Asset Management Plan Update 2025
- Natural Gas Asset Management Plan Update 2025
- Water Heater Asset Management Plan Update 2025

Analysis

The attached Asset Management Plans reflect the current state of asset management and local infrastructure at Utilities Kingston across the following general categories:

- State of the infrastructure: including a summary of available information related to asset age, condition and valuation
- Expected levels of service: supported by a review of key performance indicators relative to targets
- Asset management strategy: including growth planning, risk management, lifecycle decision making and maintenance management
- Financial and funding strategy: including a projection of annual funds required over the next 10 years to maintain the desired levels of service relative to budgets available

The plan updates were led by the recently established Asset Management and Climate Action Branch operating out of the Utilities Engineering Department.

Public Engagement

In accordance with Ontario Regulation 588/17, Section 10, all of the updated asset management plans will be made available to the public on Utilities Kingston's website following Council approval.

Climate Risk Considerations

As part of Utilities Kingston's 2021 to 2025 Strategic Plan – Theme 5 for Asset Management, Utilities Kingston is managing its assets for sustainability, climate action, and a smart utility.

Through the current plan updates, Utilities Kingston has integrated new sustainability Key Performance Indicators related to greenhouse gas emissions intensity of its water, wastewater and natural gas facilities. The plans also acknowledge that climate change is introducing uncertainty and additional stress on infrastructure and call for improvements in risk management to integrate climate risk scenarios into future planning and project prioritization frameworks.

Existing Policy/By-Law

Utilities Kingston's Asset Management Policy was most recently revised in 2023 (Report Number EITP-23-005).

In line with the requirements set out in Section 3 of Ontario Regulation 588/17, requiring review and, if necessary, updates at least every five years, the Utilities Kingston Strategic Asset Management Policy is currently undergoing a review and update cycle.

Financial Considerations

Updates to the asset management plans include financial forecasts and strategies that contain budget forecasts, developed using an "end-of-life" replacement cost approach. These forecasts are provided for information only and will be reviewed alongside other asset management and capital planning activities to support future budget cycles.

In updating the water, wastewater and natural gas asset management plans, the projection of annual funds required over the next 10 years to maintain the desired levels of service was reviewed against currently approved and forecasted funding available. In each case, an annual average funding deficit is projected as summarized in Table 1.

Table 1: Annual financial considerations

Asset Group	Budget Required	Funding Available	Difference
Water	$51.6M	$33.4M	[$18.1M]
Wastewater	$117.8M	$41.2M	[$76.6M]
Natural Gas	$6.9M	$6.8M	[$115K]

Addressing the projected deficits requires a focused set of lifecycle activities, including rehabilitation, major upgrades, replacement and maintenance. Deferring infrastructure renewal activities risks accelerated asset failure, reductions in levels of service and reduced service reliability. To manage these risks, a risk-based prioritization framework will be employed to focus available resources where they are most needed. Additionally, cost-effective strategies such as routine maintenance programs, the implementation of the new enterprise asset management software at Utilities Kingston, and the use of asset monitoring technologies will be implemented to maintain existing levels of service while minimizing expenditures.

It is important to note; the projected deficits provide an indication of where additional financial resources may be required as well as the need to employ a risk-based prioritization of available funds and do not necessarily represent the precise budget that will be requested in future years.

For the Water Heater Asset Management Plans, a financial model was developed to review a variety of servicing scenarios to balance customer satisfaction with financial sustainability. Ultimately, Utilities Kingston is proposing to shift its renewal strategy to optimize expenditures, focusing on proactively replacing units that are 15 years or older to improve customer satisfaction and decrease operating expenses over time.

Contacts:

Corey Martin, Manager, Asset Management & Climate Action, Engineering, Utilities Kingston, 613-546-1181, ext 2355

Other Utilities Kingston Staff Consulted:

Lauren Scanlan, Project Advisor – Risk & Research, Asset Management & Climate Action

Julie Runions, Director, Engineering

Kevin McCauley, Director, Telecommunications and Technology

Kate Tindal, Director, Energy Services

Exhibits Attached:

Exhibit A – Water and Wastewater Asset Management Plans 2025 to 2034

Exhibit B – Natural Gas Utilities Asset Management Plan 2025 to 2034

Exhibit C – Water Heater Asset Management Plan 2025

Exhibit A
Report Number 25-237

Water and Wastewater Utilities Asset Management Plans 2025 to 2034

Updated Asset Management Plan for Water and Wastewater Utilities

Prepared for:
Utilities Kingston

Prepared by:
Stantec

August 26, 2025

Project/File:
UK-24-28 Water, Wastewater and Natural Gas Asset Management Plan Updates

Stantec Consulting Ltd.

Revision Schedule

Revision	Description	Author	Date	Quality Check	Date	Independent Review	Date
0	Initial Draft	Haile Tecle Woldesellasse & Hadi Ganjidoost	April 3, 2025	Craig Omundsen	April 16, 2025	Laith Alfaqih	April 4, 2025
1	Final Draft	Haile Tecle Woldesellasse & Hadi Ganjidoost	May 28, 2025	Craig Omundsen	May 28, 2025	Laith Alfaqih	May 31, 2025
2	Final Report	Haile Tecle Woldesellasse & Hadi Ganjidoost	August 26,2025	Craig Omundsen	August 26,2025	Laith Alfaqih	May 31, 2025

Disclaimer

The conclusions in the Report titled Water and Wastewater Utilities Asset Management Plans 2025 to 2034 are Stantec's professional opinion, as of the time of the Report, and concerning the scope described in the Report. The opinions in the document are based on conditions and information existing at the time the scope of work was conducted and do not take into account any subsequent changes. The Report relates solely to the specific project for which Stantec was retained and the stated purpose for which the Report was prepared. The Report is not to be used or relied on for any variation or extension of the project, or for any other project or purpose, and any unauthorized use or reliance is at the recipient's own risk.

Stantec has assumed all information received from UK (the "Client") and third parties in the preparation of the Report to be correct. While Stantec has exercised a customary level of judgment or due diligence in the use of such information, Stantec assumes no responsibility for the consequences of any error or omission contained therein.

This Report is intended solely for use by the Client in accordance with Stantec's contract with the Client. While the Report may be provided by the Client to applicable authorities having jurisdiction and to other third parties in connection with the project, Stantec disclaims any legal duty based upon warranty, reliance or any other theory to any third party, and will not be liable to such third party for any damages or losses of any kind that may result.

Prepared by: Woldesellasse, HaileTecle Digitally signed by Woldesellasse, HaileTecle Date: 2025.08.28 10:20:20 -04'00'

Haile Tecle Woldesellasse
Asset Management Consultant

Ganjidoost, Hadi Digitally signed by Ganjidoost, Hadi Date: 2025.08.28 10:07:02 -04'00'

Hadi Ganjidoost, PhD, IAM Cert.
Senior Asset Management Consultant

Reviewed by: Digitally signed by Omundsen, Craig Date: 2025.08.28 11:23:54 -05'00'

Craig Omundsen, BE, MIAM,
Asset Management Specialist

Approved by: Alfaqih, Laith Digitally signed by Alfaqih, Laith Date: 2025.08.28 11:35:27 -04'00'

Laith Alfaqih, PhD, PE, CRL, MIAM, SDRM
Senior Principal

Table of Contents

List of Tables

List of Figures

List of Appendices

A. Executive Summary

A.1 Overview

Utilities Kingston (UK) is a corporation dedicated to the operation and maintenance of the city's water, wastewater, gas, electric, and fibre utilities. As an asset management corporation, UK is responsible for ensuring that these five utilities are operated effectively, efficiently, safely, and reliably. This commitment is reflected in UK's mission, vision, and values:

Mission: To manage, operate, and maintain community infrastructure to deliver safe, reliable services and a personal customer experience.

Vision: Advance the unique multi-utility model to benefit our customers and build better communities.

Values: Safety, integrity, innovation, and reliability.

The Water and Wastewater Utilities Asset Management Plans 2025 to 2034 outlines the current state of Asset Management at UK and provides recommendations to further develop and formalize the process in order to maximize its benefits.

Asset Management is current best practice. As an Asset Management system is formalized, adopted, and entrenched in the organization, it is expected that it will provide:

i. Stronger governance and accountability,
ii. More sustainable decision-making,
iii. Enhanced customer service,
iv. More effective risk management, and,
v. Improved financial efficiency.

The 2021-2025 Strategic Plan for UK identifies Asset Management as a corporate priority for the next several years. Asset Management has been the core function of UK since its inception. This plan documents current processes and provides recommendations for future plans to improve UK's Water and Wastewater Infrastructure management.

The current Water and Wastewater Utilities Asset Management Plans are structured similar to the previous 2021 Asset Management Plan, with numbers, figures, project lists, and quantities updated to reflect end-of-2024 conditions.

A.2 Asset Inventory and State of Local Infrastructure

UK's Water Utility provides potable water to approximately 40,000 homes and businesses through a treatment and distribution network that includes three water treatment plants, one booster station, three reservoir and booster station facilities, five elevated storage tanks, and approximately 593 kilometers of watermains. The watermains are equipped with 5,612 valves and 3,602 hydrants. In addition, the system is estimated to contain approximately 439 kilometers of water service lines.

The Wastewater Utility collects and treats the wastewater through a network of over 490 kilometers of Gravity Mains, 29 kilometers of sewage Forcemain, 32 Pumping Stations, nine Combined Sewage Overflow Tanks, and three Wastewater Treatment Plants. The Gravity Mains are also equipped with approximately 6,944 Maintenance Holes. In addition, approximately 39,528 services exist to customers, and services to the property line representing an additional 427 kilometers in pipeline.

The Water and Wastewater Utilities have net book values of approximately $436 million and $919 million, respectively, and replacement values of $1.091 billion and $2.035 billion, respectively.

Within the Water Utility, approximately 12% (71 kilometers) of watermains are considered to be at the end of their useful life based on age. However, condition assessment data, based on break history and age, indicates that only about 4.70% (27.85 kilometers) are in poor condition and 3.81% (22.62 kilometers) are in very poor condition. Out of the 71 kilometers of watermains identified as having reached the end of their service life based on age, 15.23 km and 10.02 km are in poor and very poor condition, respectively. Most of the non-linear infrastructure is in fair to good condition, with recently constructed facilities are in very good condition.

Within the Wastewater Utility, up to 8.6% of the linear assets are considered to be at the end of their useful life from an age perspective (with much of this percentage assumed to be older pipe with unknown age). From condition assessment information approximately 13.9% of gravity mains are in “poor” or “fail” condition warranting rehabilitation. Forcemain condition remains unknown. Wastewater Treatment Plants (WWTPs) condition ratings indicate that the Cana WWTP, Ravensview WWTP, and Cataraqui Bay WWTP are in acceptable operational condition, although Ravensview WWTP shows slightly higher deterioration. There are also two Pump Stations (SPS) that are in a condition suggestive of major rehabilitation works.

A.3 Levels of Service

UK has developed Level of Service (LOS) statements that align with several key theme areas of the 2021-2025 Strategic Plan. These statements are general in nature and reflect the qualitative objectives used to guide the management of the utilities. The theme areas are as follows:

- Meeting customer expectations
- Asset management
- Climate action leadership

Based on these theme areas, the LOS statements were developed. **Table 1** presents these statements.

Table 1: Level of Service Statements by Theme Area

Theme	Level of Service Statement
Performance and Reliability	UK will operate the Utility efficiently, effectively, safely, and reliably to meet customer service expectations.
Risk Management	UK will identify, prioritize, and mitigate risks associated with management of the Utility.
Growth and Planning	UK will facilitate the growth of the customer base, ensuring the Utility can meet current needs and the needs of the future.
Sustainability	UK will improve the environmental and operational sustainability of the Utility to support the community vision of becoming Canada's most Sustainable City.
Financial Management	UK will operate the utility in a manner that is adequately funded and financially responsible to the shareholder and customers.

Each LOS statement is supported by a set of Key Performance Indicators (KPIs) that align with the theme of the statement. These KPIs are primarily quantitative measures of the utility's performance and are evaluated against standards developed by staff. Where possible, regulatory and frequently reported KPIs are used. For example, several are drawn from the annual Municipal Performance Measurement Program reporting.

This section of the report outlines how the Utility assesses its current LOS KPIs across the defined theme areas. In many cases, it is not just the current value of a KPI that is important, but also the trend it demonstrates over time. Both the KPIs and their interpretation will continue to evolve to ensure they provide meaningful value through ongoing tracking and analysis. Additionally, as required by Ontario Regulation 588/17, municipalities must report on both current and proposed levels of service in their updated asset management plans. Accordingly, new KPIs are also proposed to outline the utility's service level targets for the next 10 years.

A.4 Asset Management Strategy

The Asset Management Strategy focuses on four main sections:

i. Growth Planning and Demand Management

ii. Risk Management

iii. Lifecycle Decision Making

iv. Maintenance Management

A.1.1 Growth Planning and Demand Management

Infrastructure planning is responsible for ensuring that infrastructure is sufficient to meet the needs of both current and future customer demands, taking into account existing and anticipated regulatory requirements, as well as projected service growth.

Planning for growth involves numerous studies conducted by both the City of Kingston and UK. These include growth strategies, master plans, development charges studies, infrastructure capital planning, environmental assessments, development studies, and analyses of uncommitted plant reserve capacity - all of which help identify the infrastructure needed to support future growth.

Typical results of such studies include the identification of projects involving the replacement or major upgrades of assets, construction of new assets, decommissioning of existing assets, as well as specific strategic initiatives aimed at reducing the need for, or altering the impact of, growth-related requirements.

The Water Utility has identified approximately $37.3 million in expenditure over the next 10 years (through to 2034) specifically to support growth.

The Wastewater Utility has identified approximately $79.9 million of expenditure over the next 10 years to support growth (through to 2034).

Demand Management is also included in this section, as it encompasses programs and processes that are instrumental in reducing the demand for new assets. The Water Utility is engaged in three primary programs: investigating means to reduce the use of treated potable water for non-potable purposes, implementing water conservation programs and reducing non-revenue water losses.

The Wastewater Utility makes gains from the efforts of demand management focused on the Water Utility as well as efforts that reduce the use of sanitary sewers. The Wastewater Utility undertakes several programs to reduce the impact of extraneous flows, including both private- and public-side efforts to reduce inflow and infiltration of runoff, surface, and groundwater, as well as moving forward with sewer separation projects to eliminate stormwater directed to the sanitary sewer system.

A.1.2 Risk Management

Risk Management includes the process of identifying projects needed to mitigate the increased risks to UK caused by aging and degradation of assets. The risk assessment process uses indicators of both the consequence of failure (criticality) and the likelihood of failure (condition) to generate a risk score. This score is then used to prioritize actions and expenditures to remedy the deficiencies.

Fundamental to risk management is conducting condition assessments at a frequency commensurate with the criticality of the assets. For both utilities, this includes completing significant water and wastewater Facility Condition Assessments to evaluate the condition, value, criticality, and risk associated with plants and pump/booster facilities. Wastewater linear infrastructure is assessed through an annual cleaning and inspection program, with trunk sewers inspected more frequently than collector and local sewers. A condition assessment process is needed for forcemains, as none currently exists. Watermains are not currently assessed using inspection-based condition assessment processes; however, such assessments are recommended at a minimum for larger watermains. Other programs in place include valve and hydrant inspection and maintenance, hydrant flow testing, and watermain leak detection.

Within the Wastewater Utility additional risks are present, and these include the risks of sewage bypass to the environment by way of combined sewer overflows, as well as the additional risks of sewage backups into basements.

Most risks identified through these various processes are typically condition-based, resulting from the degradation of assets over their lifecycle. Addressing these risks on a priority basis is known as lifecycle replacement or annual asset renewal. However, risk-based studies sometimes recommend the addition of new assets. The Water Utility has identified approximately $31.8 million in capital expenditures over the next 10 years (through 2034) specifically for risk mitigation. The Wastewater Utility has identified approximately $71.6 million in new assets required over the same period.

A.1.3 Lifecycle Decision Making

The lifecycle decision-making process identifies one of the following categories as the most appropriate course of action: new, increased or accelerated maintenance, rehabilitation or major upgrades, and replacement, based on an informal benefit-cost analysis. The lifecycle process also considers multi-criteria factors such as impacts on parent or child assets, budget and timing constraints, and overlapping needs between assets.

The plants and facilities are primarily managed through maintenance and minor upgrades, rather than major upgrades and replacements. However, when they are identified through planning exercises as needing a significant increase in capacity or a change or improvement to the treatment process, they are managed through major upgrades or facility replacement. Linear assets are typically managed on a “worst-first” basis. Low-risk minor deficiencies are addressed through dig-and-repair, or, if planning studies identify pipes with capacity issues, they may be promoted to the joint reconstruction program. Higher-risk linear assets are generally addressed through replacement or rehabilitation lining.

A.1.4 Maintenance Management

Maintenance activities are an integral part of optimizing the lifecycle of assets. When no triggers for replacement, upgrades, capacity increases, or updating treatment standards are required, routine maintenance is performed to ensure the continued effective operation of the Water and Wastewater Utilities. Condition and risk indicators should guide maintenance activities, even after the estimated lifecycle of a facility is complete.

All maintenance activities are recommended to be documented and tracked by asset within an Enterprise Asset Management System (EAM) and made accessible to approved UK staff. Currently, this is not fully implemented across all asset classes within the utilities. Additionally, the existing tracking systems are not consistently accessible and require significant manipulation to coordinate asset management activities across asset classes. Addressing this issue has been identified as a priority moving forward.

A.5 Financial Strategy

The Financial Strategy identifies projects required to ensure the water and wastewater utilities can meet both current and future needs. These projects range from those needed to maintain existing infrastructure to those supporting the growth of the customer base as the population of the City of Kingston increases.

A model is used to estimate the funding requirements for each utility. The model includes the following primary expenditure categories:

- Renewal of existing infrastructure: Capital projects required to maintain and upgrade existing infrastructure based on lifecycle needs. This category assumes assets are replaced at the end of their life expectancy.
- Construction of new assets: Capital projects identified through growth-based and risk-based studies.
- Renewal of new assets: Ongoing upkeep required for newly added assets, representing the future maintenance of the expanding asset base described in the first category. These assets are excluded from the current 2025–2034 capital plan because they are newly added and lack the detailed data needed for accurate renewal forecasting.
- Inflation.

In 2025, the Water Utility requires approximately $44.7 million in annual funding for infrastructure renewal. This need is expected to grow as new assets are added. Additionally, over the next 10 years, approximately $69.14 million is needed for the construction of new assets to meet growth-related demands - representing an average annual requirement of about $6.9 million.

In 2025, the Wastewater Utility required approximately $100.8 million in annual funding for infrastructure renewal. This need is expected to grow as new assets are added. Over the next 10 years, approximately $169.5 million is required for new assets. These represent an additional $16.9 million per year, bringing the total average annual funding requirement to $117.8 million.

Funding for these activities will be sourced from rate-based revenues, impost fees, new debt (as required), and Provincial/Federal grants when available.

Considering current budget levels from user rates, imposts, and new debt, there is a projected funding deficit of approximately $181.7 million for the Water Utility and $765.9 million deficit for the Wastewater Utility over the next 10 years.

A.6 Moving Forward

The AMPs sections contain an indicator of the maturity level of that portion of the AMP. The indicators are not intended to be a rating of the AMP, but to describe different levels that an organization should strive towards. Overall Asset Management within UK is currently considered to be in the “minimum” Maturity Index for the water and wastewater AMPs. The AMP sections provide recommendations on moving forward and improving the manner in which UK manages the water and wastewater infrastructure. Implementation of the following recommendations will not directly relate to improvements within the Maturity Indices but will improve the overall asset management programs within UK striving towards an overall “Core” Maturity Index.

Asset management software is deemed to be essential to take UK’s Water and Wastewater Utilities’ Asset Management Plan to a more advanced level. Tracking all assets for condition, risk, expenditures, lifecycles and work orders within a dedicated software tool will improve the evaluation and prioritization strategies and project reviews, resulting in better decision making.

UK is currently entering the implementation phase of a new EAM System, following the completion of vendor selection and procurement. The EAM will strengthen the asset management processes by centralizing data, improving work and lifecycle management, and supporting greater consistency, coordination, and long-term planning - ultimately advancing overall asset management maturity.

.

B. Introduction

B.1 Introduction

UK owned by the City of Kingston, provides the Kingston community with safe and reliable utility services. This Asset Management Plan (AMP) focuses on updating the AMPs for Water and Wastewater Utilities of UK. The Water Utility provides safe and reliable water services to 40,000 homes and businesses, focusing on two primary functions: i) treatment of potable water, and ii) distribution/conveyance. The Wastewater Utility provides safe and reliable wastewater services to nearly 39,000 homes and businesses, focusing on three main functions: i) collection, ii) conveyance, and iii) treatment of wastewater. These utilities represent a significant societal investment that has been built over the past century and beyond.

UK will adopt and apply recognized asset management practices to plan, design, construct, operate, maintain, renew, upgrade, and dispose of UK's assets in a way that delivers the desired level of service (LOS) and effective risk management with a financially sustainable approach. This approach aims to meet the revised and additional LOS and key performance indicators (KPIs) over the 10-year planning period from 2025 to 2034.

B.1.1 What is Asset Management

Asset Management is a comprehensive approach focused on managing both existing and future infrastructure to ensure the delivery of the required LOS in a cost-effective manner (NAMS, 2011). It involves planning, finance, engineering, maintenance, and operations, all aimed at maximizing benefits, minimizing risks, and providing reliable services to the community. This is achieved through a lifecycle approach that spans from asset planning to disposal, with the goal of minimizing lifecycle costs while maintaining service standards.

According to the International Infrastructure Management Manual (IIMM), key elements of asset management plans include: defining LOS and monitoring performance; managing the impact of growth through demand management and infrastructure investment; adopting a lifecycle approach to develop long-term, cost-effective management strategies that meet the defined LOS; identifying, assessing, and controlling risks appropriately; and developing a long-term financial plan that identifies required expenditures and how they will be funded.

This integrated approach ensures that assets are managed sustainably in a socially, culturally, environmentally, and economically responsible way, supported by skilled professionals, effective processes, and appropriate technology for efficient service delivery.

B.1.2 Developing the Asset Management Plan

The development of the current AMP was guided by asset management strategies and objectives identified through discussions with UK staff and detailed analysis of UK's capital asset data. The key steps in the development process of this AMP are summarized below:

- **Asset Inventory and Analysis**: The asset inventory was obtained and analyzed for data completeness, ensuring that relevant asset attributes such as quantity, installation date, expected useful life, condition, and others were included. Asset valuation and replacement costs were derived from recent financial files shared by UK, condition assessment reports for the plants and facilities, and unit rates proposed by Stantec.
- **Condition Analysis**: Asset conditions were analyzed and reported based on available condition assessments. In cases where condition assessments were unavailable, age-based assessments were applied to determine assets that have exceeded their expected useful life.
- **Key Performance Indicators (KPIs) Update**: The KPIs for the current level of service were updated using updated data obtained from 2023 and 2024, as well as information from various reports. Stantec reviewed the existing KPIs and recommended additional, new, and modified KPIs.
- **Asset Management Strategy and Capital Works**: The asset management strategy was updated, focusing primarily on planning and growth-related projects, along with the renewal of existing infrastructure. The outputs of these strategies were used to develop forecasts for annual capital and significant operating expenditures for each asset class.
- **Documentation and Report Preparation**: All the aforementioned information was documented, and the AMP report was prepared.

The previous AMP was used as a reference in several sections of the current AMP, as the strategies and approach to UK's asset management have remained consistent.

B.1.3 State of the Asset Management Plan

The O. Reg. 588/17 recommends that every municipality review and update its asset management plans at least five years after the year in which the plan was completed. In 2021, UK last prepared an asset management plan for its water and wastewater utilities. This document serves as an update to the 2021 asset management plan for the water and wastewater utilities. This update is essential for ensuring UK's utilities operate effectively, efficiently, safely, and reliably. It will help UK meet service levels, manage lifecycle costs, and enhance asset performance and reliability over the long term. The figures and tables discussed in this document are based on 2024 data.

Although the water and wastewater utilities plans are prepared separately in this document, partly because they have their own revenue streams, the decision-making process in reality include multiple asset groups, including water, wastewater, roads and bridges. The City of Kingston Multi-Year Joint Road

Reconstruction Program can be taken as an example on how their works involve roads, water utility, and wastewater utility assets.

Each section of the water and wastewater plans will have its own maturity index, based on the information provided and the assessments conducted. This will help UK measure the maturity of each section in relation to the standards outlined in the IIMM. **Table 2** provides an example of a maturity index scale for the 'Decision-Making' process. While the overall maturity is still at the 'Minimum' level, certain elements show more advanced maturity.

Table 2: Example Maturity Index Scale

Maturity Level	Description
Minimum	Basic physical information recorded in a spreadsheet or similar (e.g. location, size, type), but may be based on broad assumptions or not complete.
Core	Sufficient information to complete asset valuation – as for 'minimum' plus replacement cost and asset age/life. Asset hierarchy, asset identification and asset attribute systems documented.
Intermediate	A reliable register of physical and financial attributes recorded in an information system with data analysis and reporting functionality.
Advanced	Systematic and documented data collection process in place. High level of confidence in critical asset data.

B.1.4 Utilities Kingston Asset Management Policy

UK developed an asset management policy that provides the guiding principles for the asset management strategy and plan. The strategy and plan are inherently linked to the organization's mission, vision and values.

Mission: To manage, operate, and maintain community infrastructure to deliver safe, reliable services and a personal customer experience.

Vision: Advance the unique multi-utility model to benefit our customers and build better communities.

Values: Safety, integrity, innovation, and reliability.

The Asset Management Policy is provided in **Appendix A**.

B.1.5 Utilities Kingston Strategic Plan

The current Strategic Plan includes the following related theme areas:

- Meeting customer expectations.
- Asset Management.
- Climate action leadership.

The asset management directive is contained within the Theme Area "Asset Management", which continues to be a core focus area of UK's mandate and activities. Critical to its success in infrastructure management are strategic initiatives that:

- Provide the organization with a leadership role in asset management.
- Provide for long-term infrastructure planning that is appropriately linked to all aspects of financial management, including rate revenue and non-rate revenues.
- Respond to new initiatives driven by intensification, extreme weather, and urban growth expansion.

The Asset Management theme contains several goals and initiatives as follows:

- Goal 1 – Manage Assets for sustainability.
  - Initiative 1: Continue with a long-term capital infrastructure plan. The plan should balance asset renewal strategies with growth-related asset expansion. It should meet the infrastructure needs of new commercial and residential investors, while ensuring continued reliability for existing customers.
  - Initiative 2: Review and evaluate the construction and contract management methodologies implemented at Cataraqui Bay Wastewater Treatment Plant, with the intent to adopt these practices in managing future facility asset renewal or replacement projects.
  - Initiative 3: Investigate new and innovative ways to understand asset condition, replace or rehabilitate infrastructure assets and apply pilot applications.
- Goal 2 – Manage assets for climate action.
  - Initiative 1: Review and report on the implications of greenhouse gas reduction planning, within the natural gas and electricity service areas.
  - Initiative 2: For facility renewal or replacement, ensure that:
    - Clean energy benchmarks and standards form part of the strategic plan.
    - All projects consider the goal of reducing the total energy footprint of the facility.
- Goal 3: Manage assets for a smart utility.
  - Initiative 1: Plan and implement proactive capital asset replacement programs in facility upgrades.
  - Initiative 2: Inventory technology communicating with existing assets, to develop a long-term plan for capable, reliable and secure communications.
  - Initiative 3: Plan and prioritize the application of real-time data collection technologies to support data-driven decision making.

C. Water

C.1 State of Local Infrastructure – Water Utility

UK provides clean and reliable water services to 40,000 homes and businesses in Kingston, Ontario. The primary objective of this section is to provide a high-level asset inventory and insights into the overall valuation, replacement value, age, and condition of the assets owned by UK, as required by O.Reg. 588/17. The water utility assets are categorized into linear and non-linear assets. The linear assets include watermains as parent assets, with child assets such as valves, hydrants, meters, and services. The non-linear assets consist of plants and facilities that deliver water to the distribution system, including treatment plants, booster stations, reservoirs, and elevated tanks. The data for the remainder of this section is sourced from the GIS asset inventory, PSAB reporting, Water and Wastewater Facility Condition Assessment report, and other relevant reports.

C.1.1 Asset Inventory

The Water Services inventory consists of linear assets, including watermains, hydrants, valves, meters, and water services, as well as several non-linear assets, including water reservoirs, booster stations, water treatment plants, and elevated storage. The inventory information is obtained from the City of Kingston's administered Enterprise GIS system. **Table 3** and **Table 4** summarize the linear and non-linear assets in UK's water transmission and distribution system.

Table 3: Asset Summary – Water System (Linear)

Asset Type	In Asset Inventory	Total System Quantity
Watermains	Yes	593.16 kilometers
Valves	Yes	5,612 (each)
Hydrants	Yes	3,602 (each)
Meters	Yes	40,650 (each)
Services	No	40,677 (1) 439.31 kilometers (2)

Notes:

(1) Water customer count for 2024, obtained from customer billing data.

(2) Length of services estimated using water customer count for 2024 and average right of way. The average right of way is used 21.6m and the service length is assumed to be half of this on average.

Table 4: Asset Summary – Plants and Facilities (Non-Linear)

Plant / Facility	In Asset Inventory	Quantity (each)
Water Treatment Plant	Yes	3
Booster Station	Yes	1
Reservoir and Booster Station	Yes	3
Elevated Storage	Yes	5

C.1.1.1 Linear Assets

C.1.1.1.1 Watermain

Table 5 and **Figure 1** summarize the length of watermain by material, with the majority of pipes made of PVC, cast iron (CI), and ductile iron (DI). The other pipe material category includes CU, CPP, 160PVC, HDPE, AC, SP, PEX, PE, and CIPP. As seen in **Figure 2**, CI was the dominant pipe material until 1970, and after 1980, PVC and DI began to be used in the system. The outdated CI pipes are being replaced with PVC and DI.

Table 5: Length of Watermain by Material

Material	Length (km)	Percentage of Watermain Length
Polyvinyl Chloride (PVC)	252.65	42.59%
Cast Iron (CI)	170.46	28.74%
Ductile Iron (DI)	121.20	20.43%
Concrete	25.38	4.28%
Unknown	12.91	2.18%
Polyvinyl Chloride (160PVC)	5.68	0.96%
High-Density Polyethylene (HDPE)	2.05	0.35%
Asbestos Concrete (AC)	1.90	0.32%
Copper (CU)	0.75	0.13%
Steel (SP)	0.15	0.03%
Polyethylene (PE)	0.01	0.00%
PEX	0.01	0.00%
Total	**593.16**	**100%**

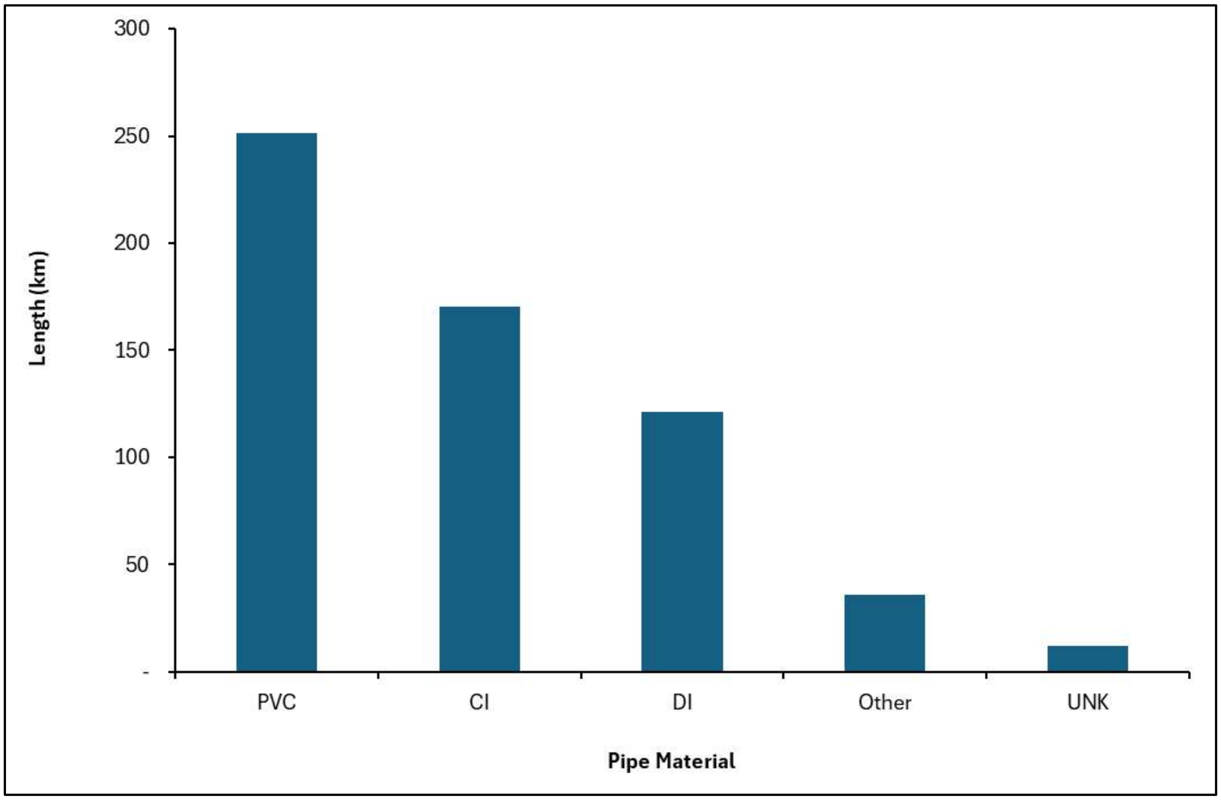

Figure 1: Watermain Material by Length

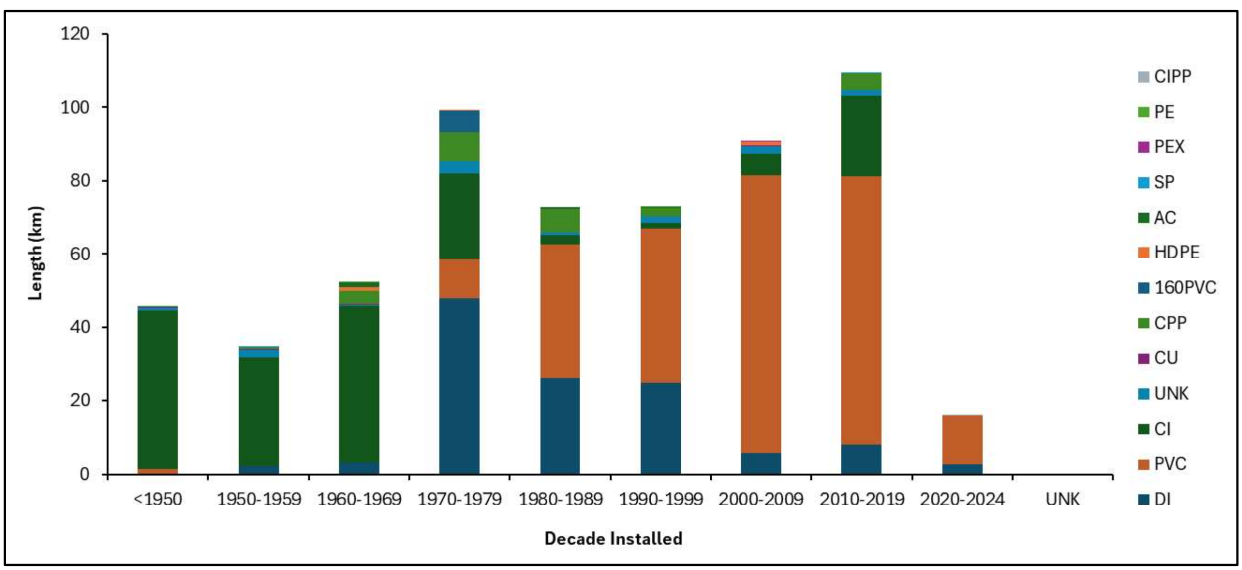

Figure 2: Watermain Installed by Material and Decade of Installation

The water system is made up of watermains ranging from 25 mm to 1200 mm in diameter. **Table 6** shows the length of watermain by diameter, with majority of the pipes having diameters of 150 mm, 200 mm, and

300 mm. The minimum standard diameter for watermains in the City of Kingston is currently 200 mm. As the watermains are replaced across the system, the smaller diameter watermains will gradually be removed.

Figure 3 summarizes the length of watermain by their material and diameter, showing that most of the pipes with diameter greater than 450mm are made of DI. Pipes with 200 mm diameter constitute the largest portion of the network, and are primarily made of PVC, DI, and CI.

Table 6: Length of Watermain by Diameter

Diameter	Length (km)	Percentage of Watermain Length
< 150	6.73	1.13%
150	140.10	23.62%
175	0.12	0.02%
200	203.33	34.28%
250	33.43	5.64%
300	100.76	16.99%
350	0.22	0.04%
400	58.48	9.86%
450	10.60	1.79%
>450	38.77	6.54%
UNK	0.61	0.10%
Total	**593.16**	**100%**

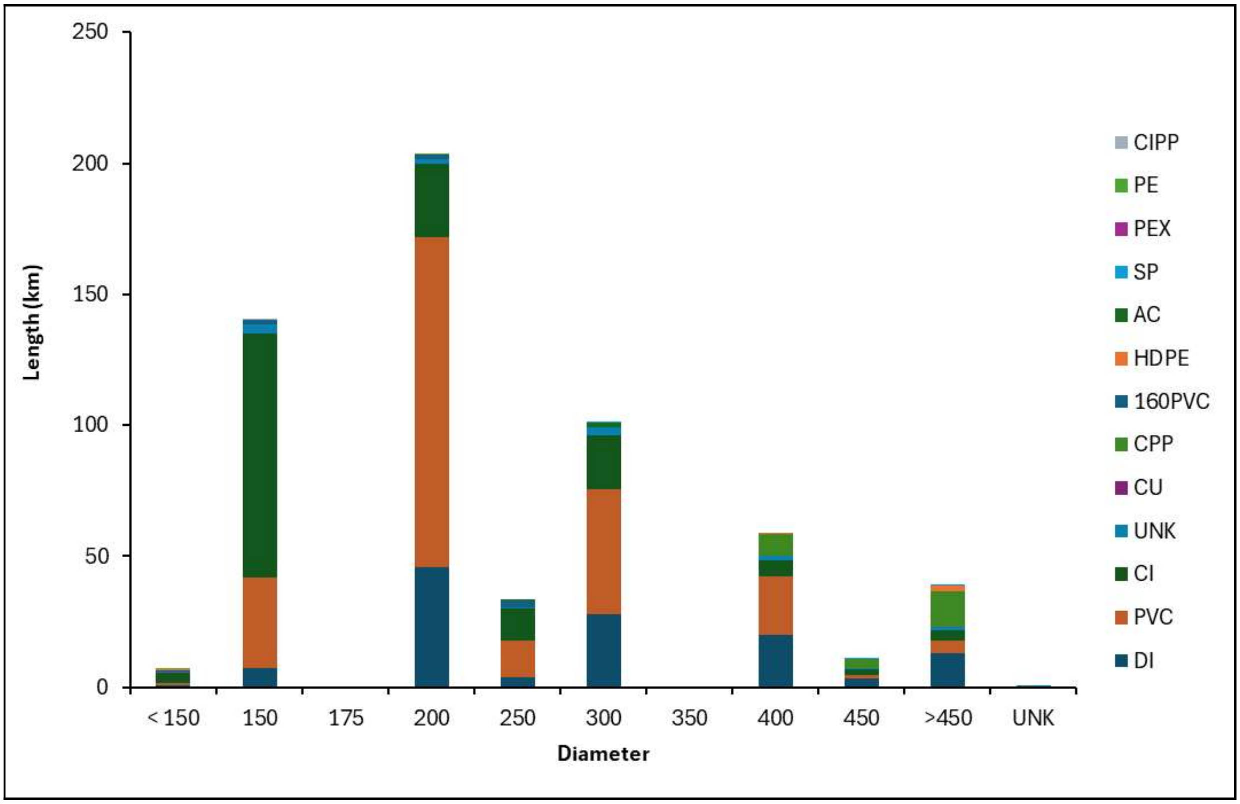

Figure 3: Watermain Length by Diameter and Material

C.1.1.1.2 Valves

Table 7 summarizes the breakdown of the system valve inventory by size, with most valves measuring 200mm and 150mm. **Table 8** and **Figure 4** shows the number of valves installed by decade based on their size and total number, with the highest number of installations observed between 2010 and 2019. It is noted that UK also maintains a small inventory of 106 control valves of various sizes and types (e.g., blowoff, check, pressure reducing, air release, combination).

Table 7: Number of System Valves by Size

Size (mm)	Number of Installed Valves
<150	127
150	1,376
200	2,393
250	287
300	916
400	319
450	53
> 450	114

Size (mm)	Number of Installed Valves
UNK	27
Total	**5,612**

Table 8: Number of System Valves by Size and Decade of Installation

Size (mm)	<150	150	200	250	300	400	450	>450	UNK	Total
Year										
<1950	27	309	34	5	10	11	3	4	0	**403**
1950-1959	11	121	17	13	21	11	1	15	0	**210**
1960-1969	8	114	76	19	64	4	0	10	0	**295**
1970-1979	2	145	234	56	122	40	8	14	0	**621**
1980-1989	5	154	190	28	138	38	3	1	0	**557**
1990-1999	13	79	300	17	148	61	9	9	0	**636**
2000-2009	17	90	675	78	73	67	11	7	0	**1,018**
2010-2019	22	239	655	61	251	62	16	41	14	**1,361**
>2019	10	74	172	5	53	17	2	10	1	**344**
UNK	12	51	40	5	36	8	0	3	12	**167**
Total	**127**	**1,376**	**2,393**	**287**	**916**	**319**	**53**	**114**	**27**	**5,612**

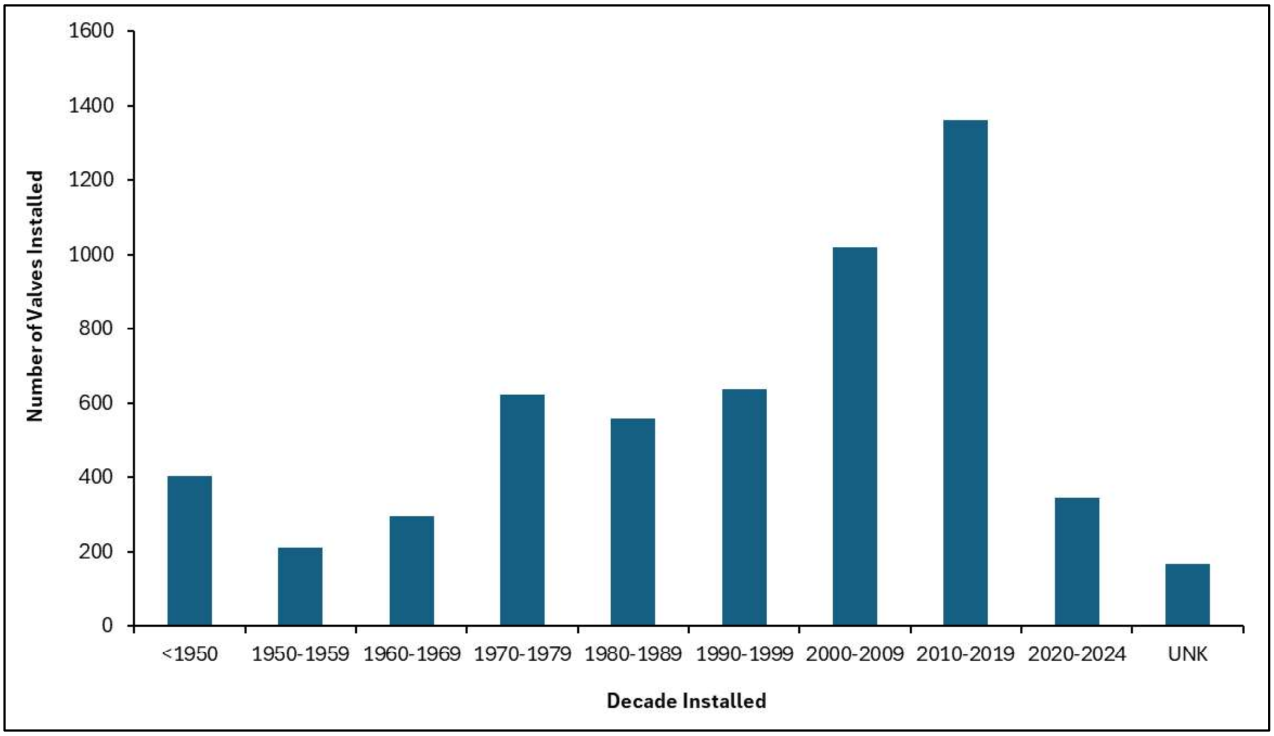

Figure 4: Number of System Valves by Decade of Installation

C.1.1.1.3 Hydrants

Hydrant assets are used for fire protection and system maintenance. **Table 9** and **Figure 5** shows the number of hydrants installed by decade, with installation dates only beginning to be recorded after 2010. However, around 76% of the hydrant inventory lacks an installation date. It is reasonable to assume that most of these hydrants were installed at the same time as the watermains to which they are connected. It is recommended that UK update hydrant data in the asset inventory to improve the completeness of the asset records.

Table 9: Number of Hydrants by Decade of Installation

Decade Installed	Number of Installed Hydrants
2010-2019	655
2020-2024	201
Unknown	2,746
Total	**3,602**

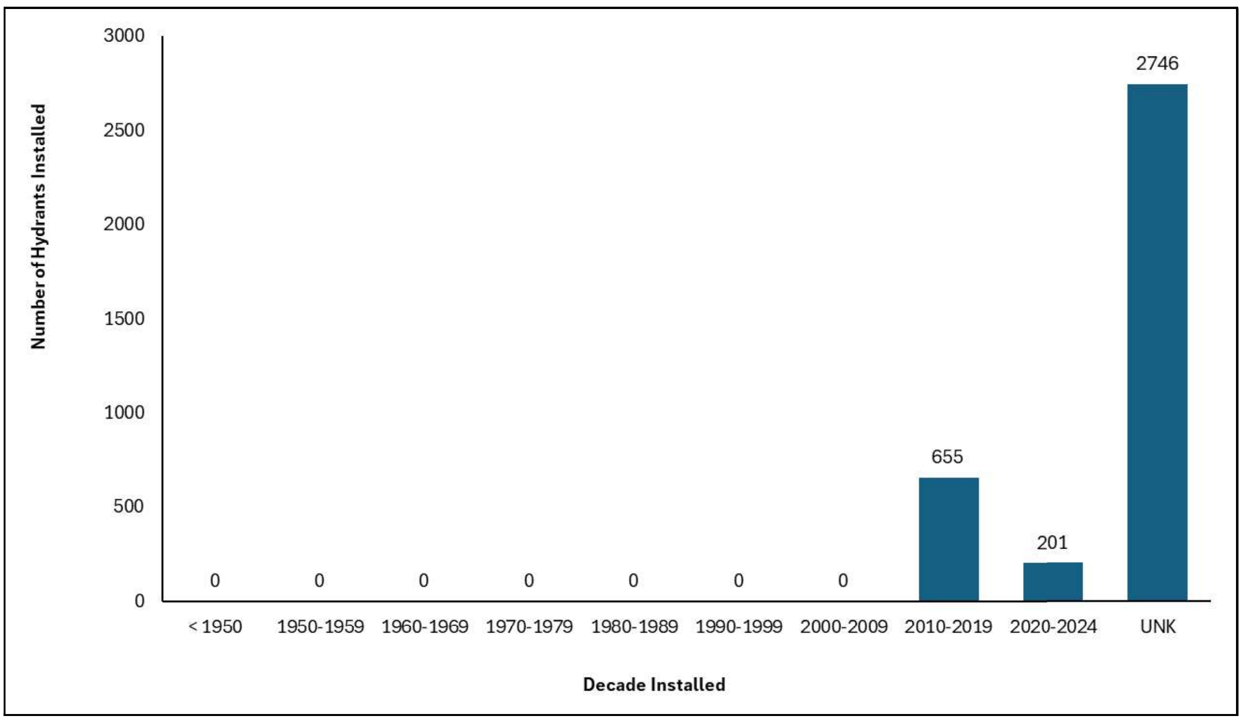

Figure 5: Number of Hydrants Installed by Decade of Installation

C.1.1.1.4 Meters

Table 10 provides a breakdown of the meters inventory by size, showing that most meters are 5/8x3/4 inches or 5/8 inches. Additionally, **Figure 6** shows the number of meters installed by decade, with the highest number of installations observed between 2010 and 2019.

Table 10: Number of Meters by Size

Size (Inches)	Count
5/8	12,428
5/8x3/4	24,939
3/4	1,591
1	721
1 1/2	464
2	264
3	177
4	50
6	9
8	3
10	2
12	2
Total	**40,650**

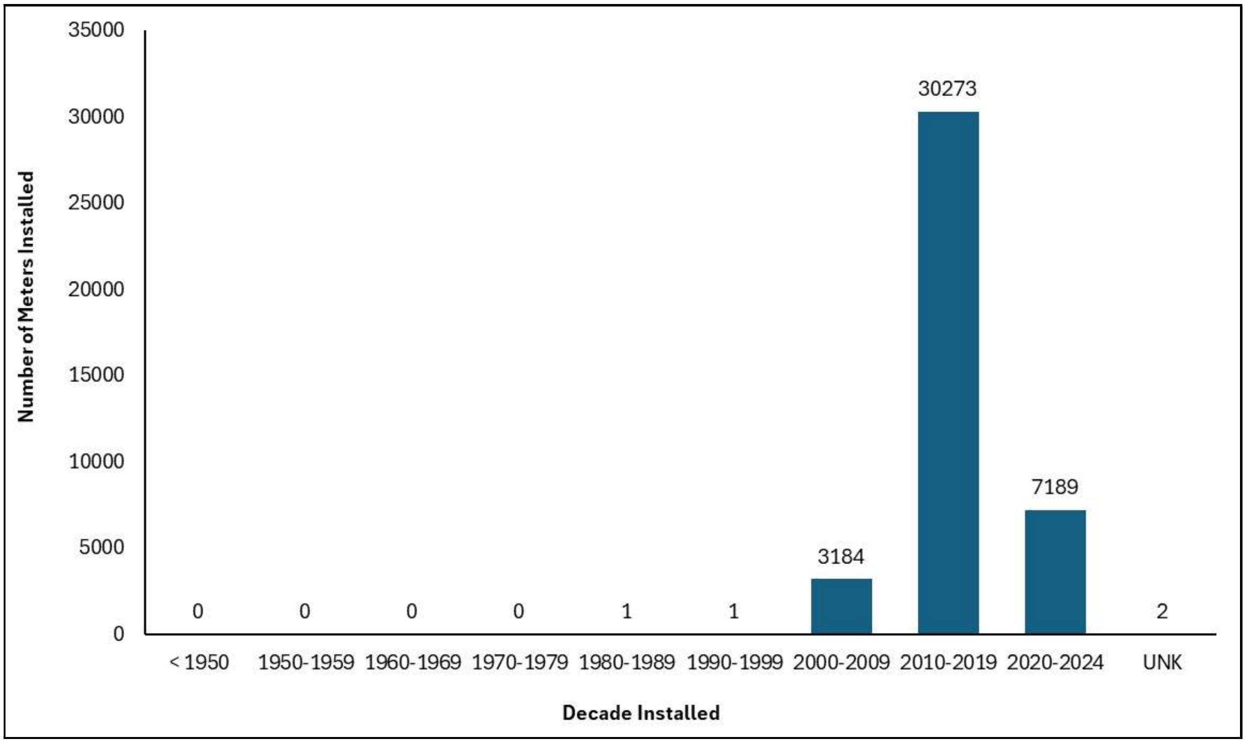

Figure 6: Number of Meters Installed by Decade of Installation

C.1.1.1.5 Services

The information regarding water services is not currently included in the GIS inventory, and therefore, the available data is limited. UK is responsible for maintaining services up to the curb stops at the property line. Based on an average road right-of-way of 21.6 meters, a water customer count of 40,677 from billing data, and assuming that each service extends half this distance, the estimated total length of services within this asset class is approximately 439.31 km.

C.1.1.2 Non-Linear Assets

A detailed asset registry for non-linear facilities is not yet available; however, UK is currently in the process of developing one. **Table 11** shows the breakdown of the non-linear assets used for water distribution and treatment. The water facilities consist of three water reservoirs, four booster stations, three water treatment plants (WTP), and five elevated storage towers. The water storage facilities hold up to 5.3 million litres of water for consumption and fire protection. Point Pleasant WTP serves the west distribution area, while the King Street WTP serves the central and east distribution areas. The Cana WTP serves an independent water system located north of the city.

Table 11: Non-Linear Asset Summary

Asset Class	Asset Name
Water Reservoir and Booster Station	Third Avenue
	Progress Ave
	O'Connor Dr
Booster Station	James Street
Water Treatment Plant	King Street
	Cana
	Point Pleasant
Elevated Storage	Creekford Rd. Water Tower
	Forest Dr. Standpipe
	Innovation Dr. Water Tower
	O'Connor Dr. Water Tower
	Tower St. Water Tower

C.1.1.3 Summary

The asset inventory presented in this section was compiled by sourcing information from various documents and data sources. The Enterprise GIS is a logical and appropriate location to store asset information for true linear infrastructure, such as water mains, hydrants, valves, and water meters. However, it is unclear whether a GIS system is suitable for populating and storing information about more complex asset classes with hierarchical structures, such as the plants and facilities of the Water Utility. It is recommended that UK and the City of Kingston assess and select a suitable software package for an assist registry.

C.1.2 Replacement Costs and Valuation

The aim of this section is to discuss the valuation and replacement costs for the water utility asset classes. The asset valuation represents the ‘Net Book Value,’ which is determined based on PSAB files obtained from the City’s Citywide financial database for linear assets, and a Facility Condition Assessment Report for non-linear assets. The replacement cost for linear assets is derived from unit rates recommended by Stantec, while the replacement cost for non-linear assets is based on the Facility Condition Assessment Report.

The watermains have the highest replacement value in the portfolio (59%) as shown in **Figure 7**. The remainder of the asset’s accounts for 41% of the value associated with the total portfolio assets.

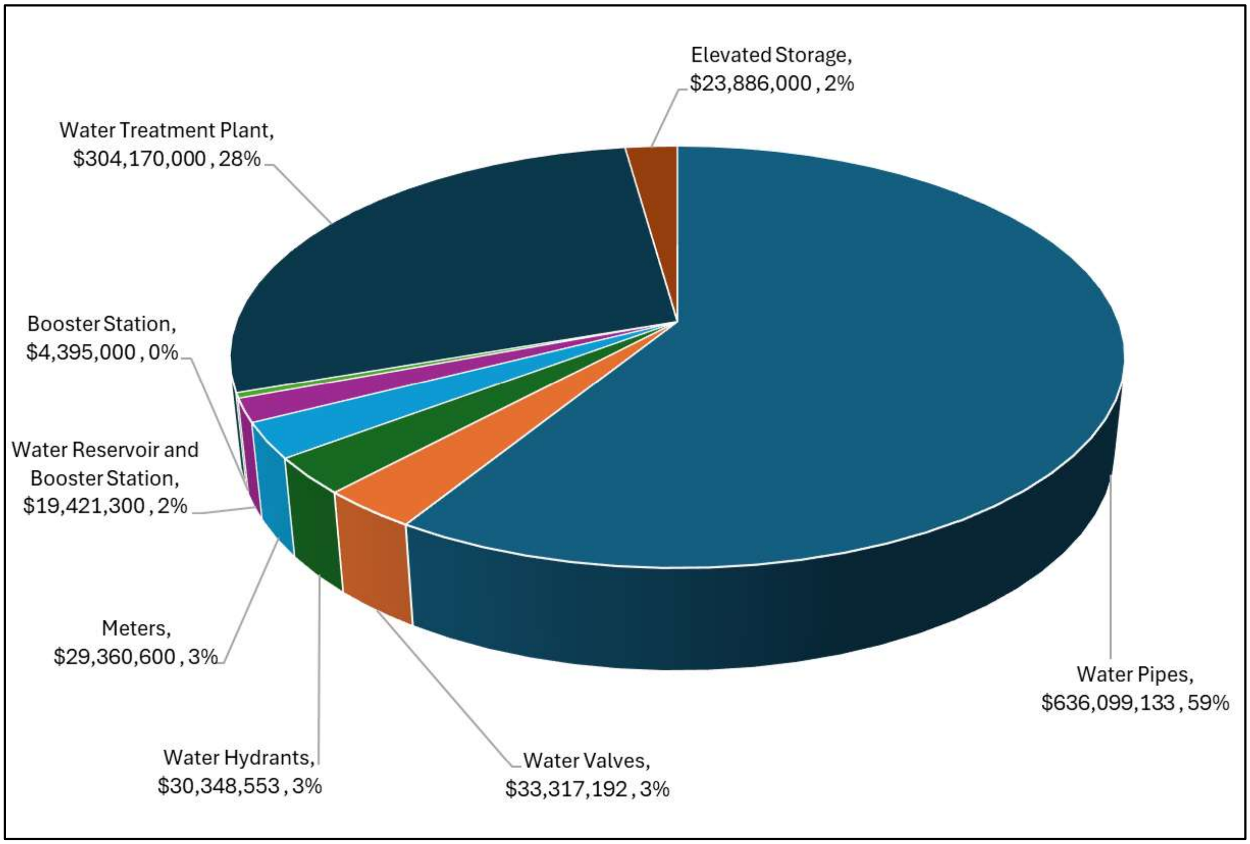

Figure 7: Asset Replacement Value for Water Assets

C.1.2.1 Linear Assets

Table 12 includes the net book value and total replacement cost of each asset class in UK's water services inventory.

Table 12: Linear Asset Value and Replacement Cost

Asset	Net Book Value (PSAB 2025)	Replacement Cost (2025)
Watermains	$210,410,616	$636,099,133
Valves	$12,742,113	$33,317,192
Hydrants	$8,290,492	$30,348,553
Meters	$8,098,611	$39,924,400
Services	$312,788	-
Total	**$239,854,619**	**$739,689,278**

C.1.2.2 Non-Linear Assets

Table 13 summarizes the estimated current asset value and estimated asset replacement value of the non-linear infrastructure. Both values are based on the 2025 Facility Condition Assessment Report, prepared by J.L. Richards & Associates Limited (JLR).

Table 13: Non-Linear Asset Value and Replacement Cost

Asset	Asset Name	Estimated Current Asset Value	Estimated Asset Replacement Value
Water Reservoir and Booster Station	Third Avenue	$5,470,905	$11,149,000
	Progress Ave	$2,848,404	$5,813,000
	O'Connor Dr	$4,293,871	$2,459,300
Booster Station	James Street	$2,459,300	$4,395,000
Water Treatment Plant	King Street	$52,966,872	$129,689,000
	Cana	$ 888,741	$ 1,504,000
	Point Pleasant	$113,748,464	$172,977,000
Elevated Storage	Creekford Rd. Water Tower	$4,035,960	$5,699,000
	Forest Dr. Standpipe	1,951,567	$3,739,000
	Innovation Dr. Water Tower	$4,630,942	$6,069,000
	O'Connor Dr. Water Tower	$990,615	$2,528,000
	Tower St. Water Tower	$1,911,287	$5,851,000
Total		**$196,196,929**	**$351,872,300**

C.1.2.3 Summary

The valuation of the linear assets is based on the PSAB report from 2025, and the replacement cost is derived from recent unit rates recommended by Stantec. The estimated current asset value and replacement cost for the non-linear assets are obtained from the 2025 Facility Condition Assessment Report, and the estimate is more accurate due to its recent nature and the detailed breakdown provided for the different divisions of the plants and facilities. The overall estimation of the valuation and replacement cost can be considered reliable, given that the sources of information used are very recent.

C.1.3 Asset Age and Condition Assessment

The average asset age and condition information represents the remaining life of the asset, which is crucial for developing capital projects and maintenance programs aimed at infrastructure improvements. This is particularly important when dealing with aging assets, where failure modes may emerge after a long period of stable operation. Understanding the remaining service life of individual assets enables development of long-term capital planning for asset replacement, prioritizing investments, and refining UK's maintenance programs. This section explores the average age and condition of assets within the system, using various measures and indicators for both linear and non-linear assets.

C.1.3.1 Linear Assets

Table 14 summarizes the life expectancy (LE) of each asset category, the percentage of assets currently past their LE, and those that will reach the end of their service life in the next five and ten years. The LE of each asset category is primarily obtained from the data used to prepare the 2021 AMP and PSAB reporting. For the LE of assets not found in these two sources, the consultant referred to the LE of assets in other similar AMP reports. A detailed discussion of the asset age and condition for each category is provided below.

Table 14: Asset Age and Life Expectancy

Asset	Life Expectancy (LE)	Past LE Current	Past LE in Next Five Years	Past LE in Next Ten Years	Total System Quantity
Watermains (km)	70 years	71.13	114.48	149.58	593
Valves (each)	50 years	1,096	1,529	1,793	5,612
Hydrants (each)	60 years	0	0	0	3,602
Meters (each)	20 years	21	3,186	12,318	40,650

Figure 8 illustrates the water asset average age in relation to the average life expectancy by asset type.

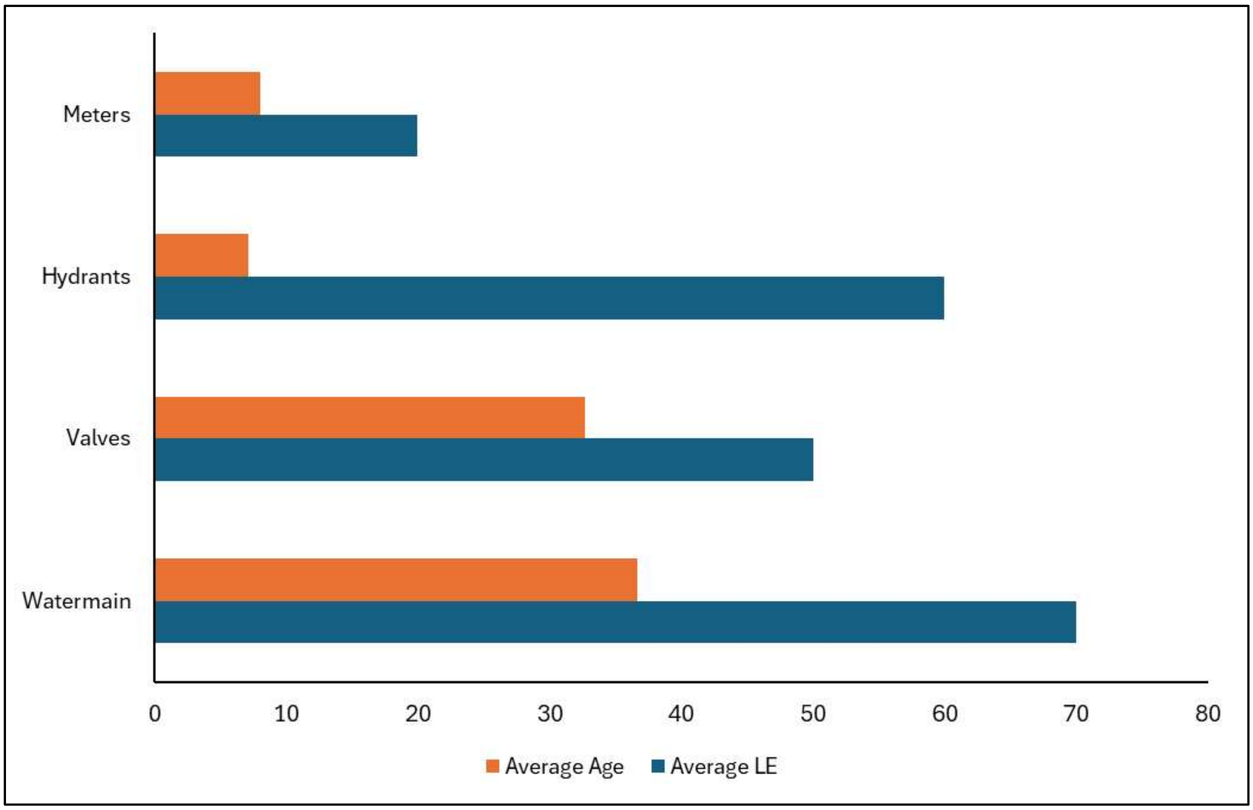

Figure 8: Average Age in relation to the Average Life Expectancy by Asset Type

C.1.3.1.1 Watermains

The LE of the watermain pipes generally depends on the pipe material. The weighted average LE of the existing watermain in the distribution system, based on PSAB LE values for pipe materials and their quantities, is 70 years. Approximately 71 kilometers of watermains are currently beyond their expected service life.

Due to inherent inaccessibility of the watermain, there are currently no inspection-based condition assessment available. Because of this UK calculated the condition score of watermains by summing the break history factor (the number of breaks for each pipe section) and the age factor (the pipe's age expressed as a percentage of its material lifespan) (**Table 15**).

Table 15: Attribute Description and Scoring for Pipe Condition

Attribute	Basis	Impact to Score
Break History	The break history factor was determined based on the number of repairs recorded for a specific pipe section. A higher number of breaks indicates a greater likelihood that the pipe is in poor condition.	Breaks = 0: +0.0
		Breaks = 1: +1.0
		Breaks = 2: +2.0
		Breaks = 3: +3.0
		Breaks = 4: +4.0
		Breaks ≥ 5: +5.0
Age	Pipe age, expressed as a percentage of its expected lifespan, was used in the assessment, as pipe condition typically deteriorates over time.	Age = 0% - <25%: +1.0
		Age = 25% - <50%: +2.0
		Age = 50% - <75%: +3.0
		Age = 75% - <100%: +4.0
		Age ≥ 100%: +5.0

Table 16 summarizes the number of breaks from before 1950 to 2024 for different watermain materials, as well as the number of breaks per kilometer for each material. This information is also visually presented in **Figure 9** and **Figure 10**. CI pipes have the highest number of breaks per kilometre compared to the other pipe materials. This is primarily due to CI being the dominant pipe material prior to the 1970s and gradually being replaced with other pipe materials.

Table 16: Breaks per Kilometer by Watermain Material

Material	Number of Breaks	Length of Pipe (km)	Breaks/km
CI	652	170.46	3.82
DI	121	121.20	1.00
PVC	82	252.65	0.32
UNK	20	12.91	1.55
160PVC	18	5.68	3.17
CPP	9	25.38	0.35

Material	Number of Breaks	Length of Pipe (km)	Breaks/km
AC	3	1.90	1.58
CU	1	0.75	1.34
HDPE	0	2.05	0.00
SP	0	0.17	0.00
PE	0	0.02	0.00
PEX	0	0.00	0.00
CIPP	0	0.00	0.00
Total	**906**	**593.16**	**1.53**

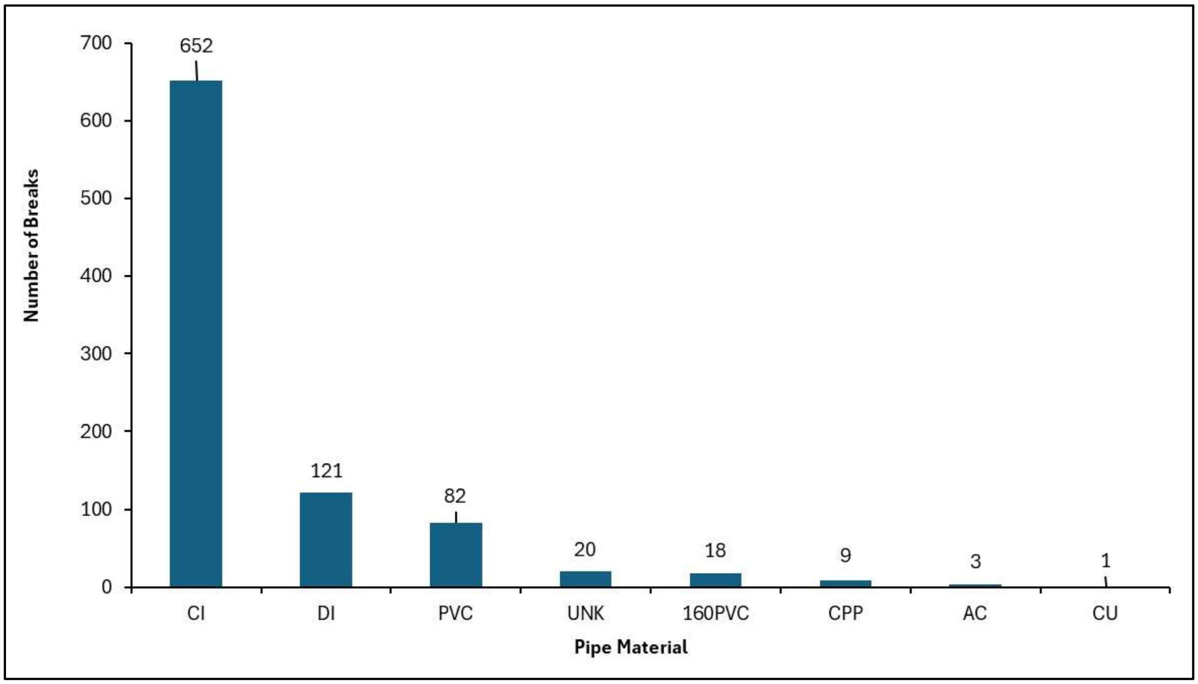

Figure 9: Number of Breaks by Pipe Material

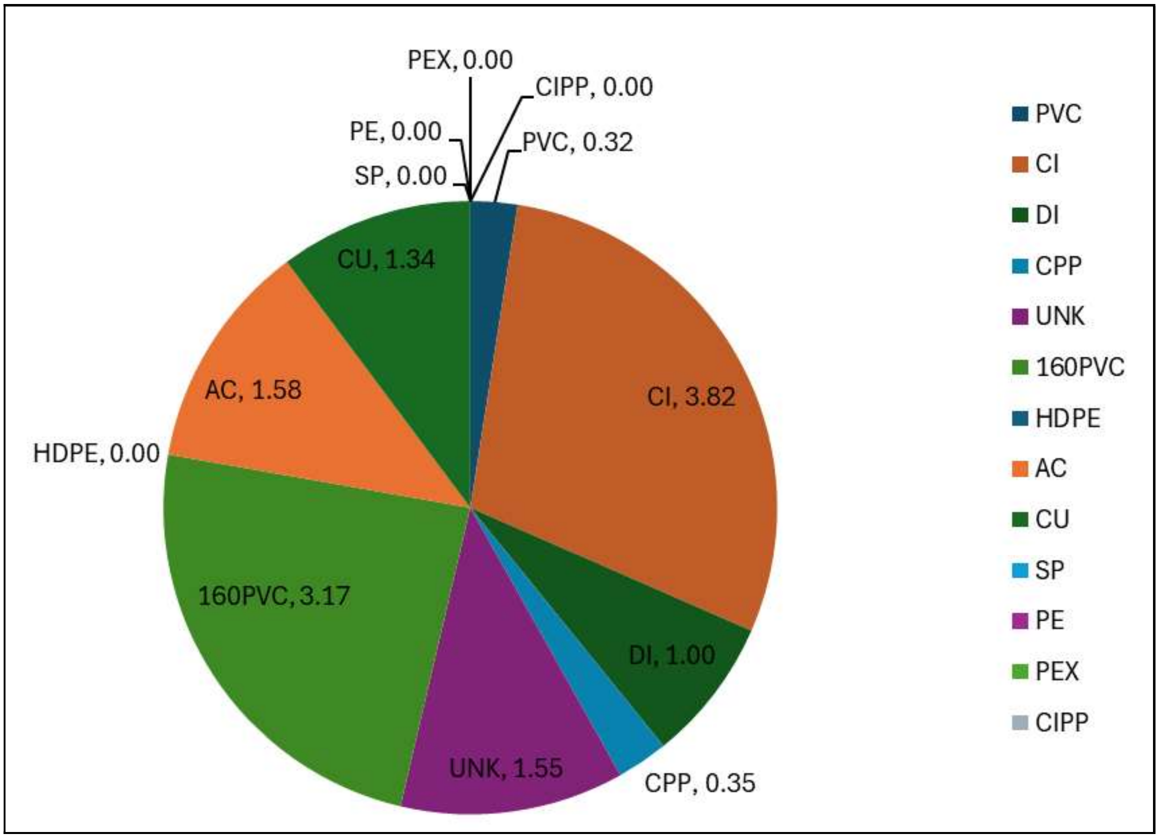

Figure 10: Summary of the Number of Breaks per Kilometer for Different Pipe Materials

To align with the condition grading system, a five-point scale (ranging from one to five) was used.

Table 17 below summarizes the relationship between the condition grades and the corresponding condition scores.

Table 17: Condition Grading System

Condition Grade	Condition Score	Condition Grade Description
Very Good	1	• New or near new condition • Some wear or discoloration but no evidence of damage. • Can include refurbished or repaired assets where the refurbishment or repair upgrades the asset to as good as the original condition.
Good	2 or 3	• Deterioration or minor damage that may affect performance. • Includes most assets that have been refurbished or repaired.

Condition Grade	Condition Score	Condition Grade Description
Fair	4 or 5	• Clearly needs some attention but is still working. • Structure in need of repair. • Includes assets that have been repaired, where the repair is deteriorated.
Poor	6	• Either not working or is working poorly because of damage or deterioration. • Condition of structure is poor or structural integrity in question.
Very Poor	7 to 10	• Needs immediate attention.

Table 18 and **Figure 11** summarizes the condition grade distribution of the watermains by their length and percentage. Overall, the majority of the watermains are in Good condition (216.34 km), followed by Fair condition (182.19 km). The pipes in Very Poor condition (22.62 km) account for approximately 3.81% of the total watermains network, and these assets requires immediate attention for rehabilitation or replacement.

Table 18: Condition Grade Distribution for Watermains

Condition Grade Score	Condition Grade Description	Length (km)
1	Very Good	144.15
2	Good	216.34
3	Fair	182.19
4	Poor	27.85
5	Very Poor	22.62
Total		**593.16**

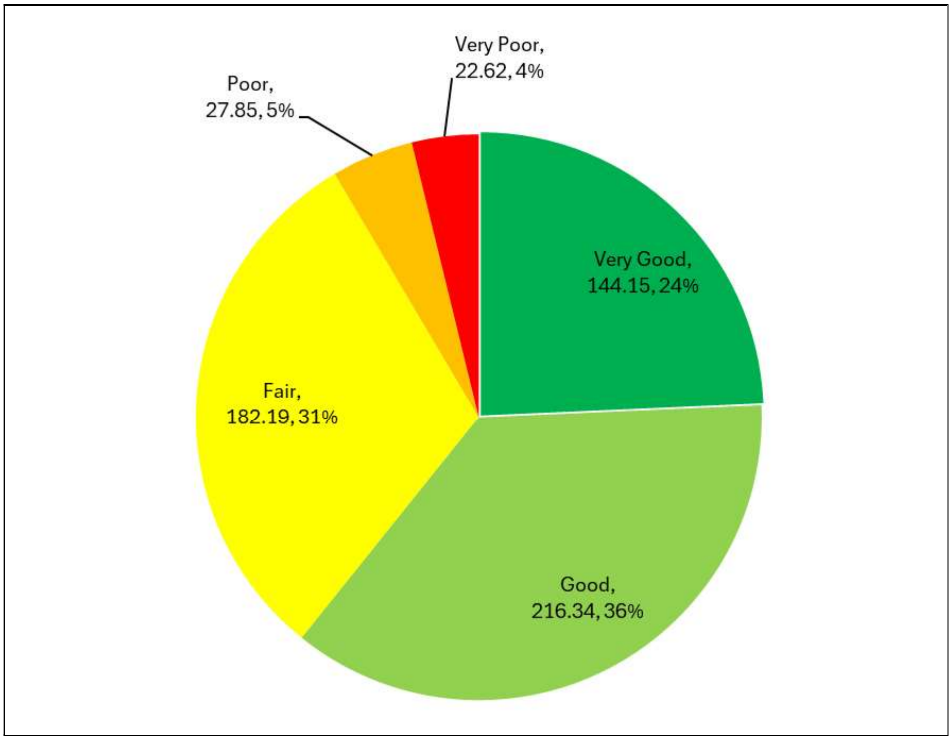

Figure 11: Condition Grade Distribution for Watermains

C.1.3.1.2 Valves

The LE of valves is influenced by the watermain material, with a minimum expected service life of 50 years. **Table 14** summarizes the number of valves that have surpassed their expected service life. For some pipe materials, such as PVC, the expected service LE of the pipe is actually much longer. Typically, valves are replaced with the watermain (the parent asset) which means a large percentage of the valves are used well beyond their expected service life. Alternatively, the valve records may not be updated in GIS when the valve was replaced.

The condition of system valves at UK is generally assessed in-house through a Standard Operating Procedure (SOP) for valve maintenance and operation. Valves 400mm in diameter and larger should be inspected and exercised at least once every five years & valves 300 mm in diameter and smaller should be inspected and exercised at least once every ten years. Valve condition is also summarized based on maintenance records. **Table 19** summarizes the valve condition data.

Approximately 2,656 system valves either lack a condition assessment or are not listed in the valve maintenance record database. It is recommended that UK update the missing system valve condition data. Among those with an asset condition, the majority are in a Good condition (2,445).

The condition of control valves is currently omitted from the SOP for valve maintenance and operation. Improvements to categorize and assign accountability for these valves is underway. Most recently, Utilities Kingston retained a 3rd party to inspect its control and air release valves, a subset of the control valve category. The 2022 inspection report identified valves that require immediate and near-term repair and is currently being used to guide maintenance plans. Additional work is needed to improve the control valve inventory, incorporate the 3rd party inspection reports in GIS and update the valve maintenance and operation plan to account for all valves.

Table 19: System Valve Condition Summary

Valve Condition	Quantity (each)
Good	2,445
Fair	452
Poor	39
Not Operable	9
Stiff	11
Leaking	0
UNK	2,656
Total	**5,612**

C.1.3.1.3 Hydrants

Table 14 summarizes the number of hydrants that have surpassed their expected LE. Currently, none of the hydrants with a recorded installation date are beyond their expected service life. However, since many hydrants are missing installation date information, it is recommended that UK update the hydrant data in the asset inventory and assess the service life of the remaining hydrants once the missing installation dates are provided.

UK conducts annual inspections on all municipal hydrants, including additional checks for new and repaired hydrants before and after use. The hydrant flow rate data from the NFPA Fire Flow Testing can be used as an indicator of the condition of a hydrant, but it is not always definitive. The test measures the flow rate of water from the hydrant, and a "RED" rating (flow rates <31 LPS) could suggest that the hydrant itself is in poor condition, potentially due to blockages, damage, or maintenance issues. However, the low flow rate could also reflect issues with the local water distribution system (e.g., inadequate pressure or capacity) rather than the hydrant itself.

The hydrant condition is also summarized based on the hydrant inspection survey provided by UK. **Table 20** summarizes the hydrant condition data. Approximately 64 hydrants either lack a condition assessment or are not listed in the hydrant inspection survey database. Several of these hydrants are either temporary or newly installed, which is why they do not yet have a condition assessment. Among those with a provided condition, the majority are in a Good / OK condition (3,273).

Table 20: Hydrant Condition Summary

Hydrant Condition	Quantity (each)
Good / OK	3,273
Needs Maintenance	233
Bagged Out / Inoperable	17
Turns Hard	15
UNK	64
Total	**3,602**

C.1.3.1.4 Meters

There is no condition assessment for the water meters. **Table 14** summarizes the number of meters that have surpassed their expected LE, and the numbers will exponentially increase in the coming five to ten years if meters are not replaced.

C.1.3.1.5 Services

There is no condition assessment for the water services. The assets are not tracked in the GIS inventory, and there is limited information regarding their age, material, or expected service life.

C.1.3.2 Non-Linear Assets

Table 21 summarizes the non-linear asset class, asset names, construction years, and years of renovation and upgrades. Facilities like the Third Avenue Water Reservoir and Booster Station were renovated or upgraded recently in 2024. Other facilities, such as the King Street and Point Pleasant WTPs, have also undergone multiple upgrades throughout their service life.

Table 21: Summary of Non-Linear Assets Age and Upgrades

Asset Class	Facility Name	Constructed	Years Renovated / Upgraded
Water Reservoir and Booster Station	Progress Ave	1962	1992, 2012, 2017
Water Reservoir and Booster Station	Third Avenue	1964	2024
Water Reservoir and Booster Station	O'Connor Dr	2011	
Booster Station	James Street	1991	2017
Water Treatment Plant	King Street	1950	1968,1969,1994,1998, 20011,2003, 2006, 2009, 2019, 2020, 2021
Water Treatment Plant	Cana	2003	
Water Treatment Plant	Point Pleasant	1971	1975,1989,2003, 2016
Elevated Storage	Creekford Rd. Water Tower	2006	
Elevated Storage	Forest Dr. Standpipe	1981	

Asset Class	Facility Name	Constructed	Years Renovated / Upgraded
Elevated Storage	Innovation Dr. Water Tower	2012	
Elevated Storage	O'Connor Dr. Water Tower	1962	1996
Elevated Storage	Tower St. Water Tower	1954	2018

Table 22 summarizes the condition assessments of the non-linear assets. The condition assessments are based on the Water and Wastewater Facility Condition Assessment Report. The assessment was conducted in detail at the facility discipline and component levels. In the FCA report, a reliability rating was not calculated for the water treatment plants due to their complexity. Therefore, in the rating system, water treatment plants were assessed only based on the condition scores of their sub-facilities. The reported condition score for each WTP is derived by averaging the condition scores of its sub-facilities.

Table 22: Non-Linear Assets Condition, Criticality, and Facility Risk, and Overall Rating Summary

Asset Name	Facility Criticality(1)	Condition Rating(1)	Total Facility Risk(1)	Overall Rating(1)
Progress Ave Reservoir & Booster Station	4	2.7	3.2	C
Third Avenue Reservoir & Booster Station	4	1.7	3.4	B
O'Connor Dr Reservoir & Booster Station	4	2.4	3.9	C
James Street Booster Station	4	2.5	3.9	C
King Street WTP	N/A	2.9(2)	N/A	N/A
Cana WTP	N/A	2.6(2)	N/A	N/A
Point Pleasant WTP	N/A	2.1(2)	N/A	N/A
Creekford Rd. Water Tower	3	2.3	3.8	C
Forest Dr. Standpipe	2	2.6	2.4	B
Innovation Dr. Water Tower	3	2.2	3.4	B
O'Connor Dr. Water Tower	3	2.7	3.8	C
Tower St. Water Tower	3	2.7	3.8	C

Notes:
(1) Data from Water and Wastewater Condition Assessments / Water Facilities -report (J.L. Richards, 2025)
(2) The condition score has been calculated based on the average scores of sub-facilities

The condition assessment provides a visual condition score for each component of all facilities and sub-facilities. **Table 23** below outlines the condition scores along with their definitions. The condition rating for the Point Pleasant WTP indicates it is in good condition, while the Cana and King Street WTPs are declining toward a fair condition rating.

Table 23: Visual Condition Score

Visual Condition	Score	Description
Very Good	1	Like-new physical condition.
Good	2	Acceptable physical condition – minor wear and tear, minimum risk of physical failure. No immediate repair work required, or only minor work required.
Fair	3	Acceptable physical condition – moderate wear and tear, moderate risk of physical failure. Minor components or isolated sections of the asset may need replacement or repair now, but asset still functions safely at adequate level of service. Minor work may be required, but asset is still serviceable
Poor	4	Poor physical condition – heavy wear and tear, failure is likely in short term. Substantial work required in short term, asset barely serviceable.
Very Poor	5	Failed or failure imminent. Immediate need to replace most or all of asset. Health and safety hazards exist, or asset cannot be serviced or operated without risk to personnel / public / environment. Major work or replacement required urgently
Not Inspected	NI	Team unable to access or see the component (i.e. buried piping, certain inaccessible roofs, etc.)

The Overall Rating system is used to determine the recommended action timeframe for each water facility. **Table 24** summarizes the criteria for overall ratings that range from A to E. This rating system supports UK in prioritizing investments, developing short- and medium-term maintenance plans, and ensuring service continuity by addressing emerging risks before they escalate into critical failures. Except for the Third Avenue Water Reservoir and Booster Station, and the Elevated Storage facilities at Forest Dr. and Innovation Dr., which have an overall rating of 'B' and may require minor repairs to non-critical components, the remaining facilities have an overall rating of 'C', indicating that certain equipment will need to be replaced in the future.

Table 24: Overall Rating Description

Overall Rating	Reliability Rating	Description
A	0 - 10	No action required.
B	11 - 20	Minor Repairs may be required to non-critical components. Review required, but no work required immediately.
C	21 - 30	Certain assets/equipment may need replacing in the future. Review and plan maintenance.

Overall Rating	Reliability Rating	Description
D	31- 40	Certain assets/equipment may need replacing in the immediate future and review is required to outline maintenance.
E	41+	Immediate action required to prevent failure and minimize impact to customers.

C.1.4 Maturity and Moving Forward

C.1.4.1 Asset Inventory and Valuation Maturity

Asset inventory maturity reflects the quality, and completeness of information recorded and managed about an organization's infrastructure assets. The linear assets, excluding services, are included in the inventory, which is managed through the City of Kingston's Enterprise GIS system. The inventory contains varying levels of detail for each asset. Overall, the watermain inventory includes detailed information, though some data on material and diameter attributes are missing. The water break information is stored in a separate GIS layer, but it lacks a pipe ID to associate it with the watermain inventory, making analysis more challenging. The missing installation date information for hydrants was noted as a recommendation in previous sections, suggesting that UK update it to improve the completeness of the asset records. UK is also transitioning into the implementation phase of a new Enterprise Asset Management System (EAMS), which will enhance the asset inventory maturity. As summarized in

Table 25, the maturity level of UK linear assets inventory is currently assessed at the 'Core' level, with a short-term target to upgrade to the 'Intermediate' level by 2029.

In contrast, the non-linear facilities currently lack a detailed asset registry, and UK is in the process of developing one for these non-linear assets. Considering these factors, the overall asset inventory is in a 'minimum' state, with a short-term target to upgrade to the 'Core' level by 2029 (**Table 25**), in accordance with the IIMM (NAMS, 2011) guidelines.

To advance UK’s asset inventory maturity, Stantec recommends the following actions:

1. Services should be included in the Enterprise GIS, and ensure all essential attributes are complete.
2. Update missing attribute information in the Enterprise GIS system for all linear and non-linear assets. For example, installation dates for most hydrants, some valve sizes, and installation date, material, and diameter information for certain watermains are currently missing and need to be updated.
3. Plants and facilities have detailed asset attributes. To enable more effective asset management, it is necessary to determine an appropriate asset inventory and develop a hierarchy of information at the process, component, and sub-component levels.

Table 25: Current Maturity of Asset Inventory and Valuation

Maturity Level	Description	Status for Linear Assets	Status for Non-linear Assets
Minimum	Basic physical information recorded in a spreadsheet or similar (e.g. location, size, type), but may be based on broad assumptions or not complete.		We are here
Core	Sufficient information to complete asset valuation – as for ‘minimum’ plus replacement cost and asset age/life. Asset hierarchy, asset identification and asset attribute systems documented.	We are here	Short-term Target for 2029
Intermediate	A reliable register of physical and financial attributes recorded in an information system with data analysis and reporting functionality. Systematic and documented data collection process in place. High level of confidence in critical asset data.	Short-term Target for 2029	
Advanced	Information on work history type and cost, condition, performance, etc. recorded at asset component level. Systematic and fully optimized data collection program. Complete database for critical assets; minimal assumptions for non-critical assets		

C.1.4.2 Asset Age and Condition Assessment Maturity

Asset age and condition assessment maturity measures how effectively asset age and condition data are collected, analyzed, and used to support risk management, maintenance planning, and investment decisions. The watermain desktop condition assessment is conducted by UK as part of the risk assessment, with condition calculated based on break history and age data. Valve and hydrant condition assessments are obtained from maintenance records and hydrant inspection surveys, respectively. Additionally, asset age and expected life (LE) are used to determine the number of linear assets that have surpassed their expected service life. The water and wastewater condition assessment report documents the condition of non-linear assets. Considering all these factors, the overall maturity is assessed at the ‘Core’ level, as summarized in **Table 26**, with a short-term target to upgrade to the 'Intermediate' level by 2029.

Table 26: Current Maturity of Asset Age and Condition Assessment

Maturity Level	Description	Status of Current Plan
Minimum	Condition assessment at asset group level (‘top- down’). Supports minimum requirements for managing critical assets and statutory requirements (e.g. safety).	
Core	Condition assessment program in place for major asset types, prioritized based on asset risk. Data supports asset life assessment. Data management standards and processes documented. Program for data improvement developed.	We are here.
Intermediate	Condition assessment program derived from benefit-cost analysis of options. A good range of condition data for all asset types (may be sampling-based). Data management processes fully integrated into business processes. Data validation process in place.	Short-term Target for 2029

Advanced	The quality and completements of condition information supports risk management, lifecycle decision-making and financial/performance reporting. Periodic reviews of program suitability carried out.	

To advance UK's asset age and condition assessment maturity, Stantec recommends the following actions:

1. The condition assessment, operational, and maintenance data of assets must be included in the asset inventory.
2. Larger diameter watermains should undergo inspection-based condition assessments to obtain more accurate information on their condition, which enables better risk management and maintenance planning.

C.2 Current and Proposed Levels of Service (LOS)

Levels of service indicate the quality of service provided and help guide UK in managing infrastructure to meet specific service quality targets. The Ontario Regulation 588/17 requires municipalities to report on both current and proposed levels of service for their assets in the updated asset management plan. Current levels of service are determined using metrics based on data from the two preceding years, while proposed levels of service outline the municipality's targets for the next 10 years. The current and proposed levels of service for the UK water utility are discussed separately in this section.

C.2.1 Current Levels of Service

For the 2025 AMP, UK has begun with updating the current LOS KPIs for the performance measurement to better understand performance levels and to identify areas for improvement. **Table 27** to **Table 31** summarize the performance measures for the current LOS.

UK is currently monitoring both Customer Levels of Service (C-LOS) and Technical Levels of Service (T-LOS). C-LOS provides a means for evaluating how well customer expectations are being met, while T-LOS defines the specific, quantifiable service standards that an asset is expected to deliver throughout its lifecycle. The C-LOS indicators presented in **Table 27** to **Table 31** include the following:

- Number of adverse Drinking Water Quality Notifications
- Number of days under a Boil Water Advisory issued by the Medical Officer of Health
- Number of watermain breaks per 100 kilometers of watermain per year
- Compliance rate with the Cross-Connection Backflow Control Program
- Combined Water and Wastewater costs to customers

These metrics support a comprehensive understanding of both customer satisfaction and asset performance, ensuring alignment with regulatory and operational objectives.

Table 27: Performance and Reliability - Water

Key Performance Indicator	2023	Current (2024)	Target (2021 AMP)	Unit/Notes
1. Percentage of time when Raw Water Flow is within 75% of Permit to Take Water Capacity	Kings St.: 3% Point Pleasant: 0.0 Cana: 0.0	Kings St.: 0.0 Point Pleasant: 0.0 Cana: 0.0	Good: < 10% of the time Acceptable: 10 - 15% of the time Unacceptable: > 15% of the time	Source: Operational group treatment plant flow tracking - UK Unet
2. Percentage of time when Treated Water Flow is within 75% of Treatment Capacity	Kings St.: 0.0 Point Pleasant: 0.0 Cana: 0.0	Kings St.: 0.0 Point Pleasant: 0.0 Cana: 0.0	Good: < 10% of the time Acceptable: 10 - 15% of the time Unacceptable: > 15% of the time	Source: Operational group treatment plant flow tracking - UK Unet
3. Number of adverse Drinking Water Quality Notifications – Annually.	King St. WTP: 0 Point Pleasant WTP: 0 Kingston System: 2 Cana System: 0	King St. WTP: 0 Point Pleasant WTP: 0 Kingston System: 4 Cana System: 1	Good: < 10 Acceptable: 10 – 15 Unacceptable > 15	The King St and Point Pleasant WTPs are part of the Kingston Distribution System. (Source: Utilities Kingston Annual Water Quality reports)
4. Number of days when a boil water advisory was issued by medical officer of health	Kingston System: 0 Cana System: 0	Kingston System: 6 Cana System: 3	Good: 0.0 Unacceptable: > 0.0	The number of days when a boil water advisory was issued by medical officer of health are 1 event each for Kingston System and Cana System in 2024, but they lasted for 6 and 3 days, respectively. (Source: Water treatment operations).
5. Ministry of Environment, Drinking Water System Inspection Report, Inspection Rating Record (IRR)	Kings St.: 100% Point Pleasant:100% Cana: 100%	Kings St.: 100% Point Pleasant:100% Cana: 100%	Good: > 95% Acceptable: 90 - 95 % Unacceptable < 90%	Source: Operations Group - Annual Inspection and report conducted by MOE.

Table 28: Risk Management - Water

Key Performance Indicator	2023	Current (2024)	Target (2021 AMP)	Unit/Notes
1. Percent of watermain infrastructure beyond design service life	11%	12%	Good: < 5%, Acceptable: 5 - 10 %, Unacceptable: > 10%	Source: Enterprise GIS Inventory
2. Percent of watermain infrastructure considered to be a priority for replacement or rehabilitation - high risk.	-	2.26%	Good: < 5%, Acceptable: 5 - 10 %, Unacceptable: > 10%	High risk is defined as receiving a Risk Priority score of 1, where risk score is calculated based on the probability and consequence of failure. (Source: Watermains Risk Assessment 2025)
3. Number of watermain breaks per 100 kilometers of watermain per year	5.39	4.38	Good: < 10, Acceptable: 10 – 15, Unacceptable: > 15	Source: Enterprise GIS Inventory
4. Percent of red hydrants in the distribution system – risk impact for fire fighting requirements.	-	0.44%	Good: < 5%, Acceptable: 5 - 10%, Unacceptable: >15%	Source = Hydrant inspection survey
5. Percent of system valves = or > 400mm diameter inspected per year	-	3.09%	Good: > 20%, Acceptable: –15-20%, Unacceptable: < 15%	Source = Valve maintenance tracking sheets
6. Percentage of system valves = or < 300mm diameter inspected per year	-	6.64%	Good: > 10%, Acceptable: –7-10%, Unacceptable: <7%	Source = Valve maintenance tracking sheets
7. Percent of non-operable valves in the system identified per year.	-	0.09%	Good: < 5%, Acceptable: 5 - 10%, Unacceptable: > 10%	Source = Valve maintenance tracking sheets

Table 29: Growth and Planning - Water

Key Performance Indicator	2023	Current (2024)	Target (2021 AMP)	Unit/Notes
1. Maturity of Water Master Plan (1)	7 years	8 years	Good: 5 years since update Acceptable: 6-7 years since update Unacceptable: 8+ years since update	The age of the most recent Water Master Plan (Last update completed in 2017)
2. Maturity of Condition Assessment (3rd Party) on Water Treatment Facilities	-	0 year (Last Updated in 2025)	Good: <= 8 years, Acceptable: 8 -10 years Unacceptable > 10 years	The age of the most recent Plants & Facilities Condition Assessment (Latest: FCA, 2025)
3. Maturity of Condition Assessment (3rd Party) on Booster Stations	-	0 year (Last Updated in 2025)	Good: <= 8 years Acceptable: 8 -10 years Unacceptable: >10 years	The age of the most recent Plants & Facilities Condition Assessment (Latest: FCA, 2025)
4. Uncommitted Reserve Capacity at Water Treatment Plant - Based on Ministry Procedure D-5-1. Number of years of Growth Capacity, Point Pleasant WTP and King Street WTP	-	31.6	Good: > 10 Acceptable: 7-10 Unacceptable: < 7	Source: Uncommitted Reserve Capacity studies and Water Master Plan

(1) The next Water Master Plan has been initiated, with an expected completion date of 2026.

Table 30: Sustainability - Water

Key Performance Indicator	2023	Current (2024)	Target (2021 AMP)	Unit/Notes
1. Percent of treated water that is non-revenue	38.56%	No data (meter issues)	Good: < 15% Acceptable: 15 - 25 % Unacceptable: > 25 %	Source: Operations Group - Water Balance Spreadsheet
2. Cross connection backflow control program - Percent of customers in Compliance	83%	88%	Good: > 80% Acceptable: 70 - 80 % Unacceptable: < 70 %	Source: Backflow Prevention Program tracking sheets.

Table 31: Financial - Water

Key Performance Indicator	2023	Current (2024)	Target (2021 AMP)	Unit/Notes
1. Combined Water & Wastewater Costs to Customer a) As a percentage of household income b) As a dollar amount	a) Residential: Burden: 1.2% b) Burden: $1,262 (Mid) 2.32% below average	a) Residential: Burden: 5.6% b) Burden: $1,294 (Mid) 7.1% below average	Good: < 10% Acceptable: 10 - 20% Unacceptable: > 20%	Source: Municipal Study for water/sewer cost data.
2. Debt Repayment a) Debt Interest repayment as a percentage of revenue b) Total debt repayment as a percentage of revenue	a) 4.8% b) 9.7%	a) 4.7% b) 9.8%	Good:<25% Undesirable: >25%	This % represents the total debt repayment as compared to total income (Source: UK Financial Plan)
3. Water Debt Outstanding per Customer	$1,261	$ 1,209	No ranges defined.	Source: UK Financial Plan
4. Estimated Annual Budget Deficit	-	$ 18.17 M per year	No ranges defined.	Total estimated required capital less total estimated available funds (per year). (Source: UK Finance)

C.2.2 Proposed Levels of Service

Stantec recommends refining the LOS KPIs by removing existing KPIs due to limited actionable insights derived from this measure. These include those in the risk management LOS (KPI numbers 5, 6, and 7) and in the Growth and Planning LOS (KPI numbers 1, 2, and 3). Instead, new KPIs are proposed for the different LOS. **Table 32** outlines the proposed new KPIs alongside the existing ones that the UK will continue to monitor. The C-LOS indicators presented in **Table 32** include the following:

- Number of days per year where a boil water advisory notice is in place compared to the total number of connected properties.
- Percent of properties where minimum required fire flow is available.

In general, UK is not proposing any significant changes or enhancements to its current lifecycle activities or operational service levels over the next 10 years. This decision reflects a balanced approach to service delivery, financial sustainability, and risk management. Although there is an identified infrastructure funding gap of approximately $18.17 million, the current levels of service are considered both achievable and appropriate within UK's existing financial and operational capacity.

Several factors support the decision to maintain existing service levels. The operating budget, funded through stable and predictable revenue sources, is sufficient to support ongoing maintenance and operations. The current service levels align with community expectations and have proven to be both effective and affordable. Maintaining these levels also allows the municipality to accommodate future growth-related infrastructure needs without placing additional financial strain on existing resources. Furthermore, the condition of existing assets and the associated risks are being actively managed through planned renewal activities, ensuring that potential service disruptions remain within a manageable range. This approach supports long-term sustainability while avoiding unnecessary cost escalations or service reductions.

Table 32: Proposed KPIs - Water

LOS	Key Performance Indicator	2023	Current (2024)	Target (2025 to 2034)	Unit/Notes
Performance and Reliability	1. Percentage of time when Raw Water Flow is within 75% of Permit to Take Water Capacity	Kings St.: 3% Point Pleasant: 0.0 Cana: 0.0	Kings St.: 0.0 Point Pleasant: 0.0 Cana: 0.0	Good: < 10% of the time Acceptable: 10 - 15% of the time Unacceptable: > 15% of the time	Source: Operational group treatment plant flow tracking - UK Unet
	2. Percentage of time when Treated Water Flow is within 75% of Treatment Capacity	Kings St.: 0.0 Point Pleasant: 0.0 Cana: 0.0	Kings St.: 0.0 Point Pleasant: 0.0 Cana: 0.0	Good: < 10% of the time Acceptable: 10 - 15% of the time Unacceptable: > 15% of the time	Source: Operational group treatment plant flow tracking - UK Unet
	3. Number of adverse Drinking Water Quality Notifications - Annually	King St. WTP: 0 Point Pleasant WTP: 0 Kingston System: 2 Cana System: 0	King St. WTP: 0 Point Pleasant WTP: 0 Kingston System: 4 Cana System: 1	Good: < 10 Acceptable: 10 – 15 Unacceptable > 15	The King St and Point Pleasant WTPs are part of the Kingston Distribution System. (Source: Utilities Kingston Annual Water Quality reports)

LOS	Key Performance Indicator	2023	Current (2024)	Target (2025 to 2034)	Unit/Notes
	4. Revised: The number of days per year where a boil water advisory notice is in place compared to the total number of properties connected to the municipal water system	0.49 days per 10,000 properties per year	2.21 days per 10,000 properties per year	Good: 0.0 Unacceptable: > 0.0	The number of days per 10,000 properties per year (Source: Water treatment operations).
	5. Ministry of Environment, Drinking Water System Inspection Report, Inspection Rating Record (IRR)	Kings St.: 100% Point Pleasant:100% Cana: 100%	Kings St.: 100% Point Pleasant:100% Cana: 100%	Good: > 95% Acceptable: 90 - 95 % Unacceptable < 90%	Source: Operations Group - Annual Inspection and report conducted by MOE.
Risk Management	1. Percent of watermain infrastructure beyond design service life	11%	12%	Good: < 5%, Acceptable: 5 - 10 %, Unacceptable: > 10%	Source: Enterprise GIS Inventory
	2. Percent of watermain infrastructure considered to be a priority for replacement or rehabilitation - high risk[(2)].	-	2.26%	Good: < 5%, Acceptable: 5 - 10 %, Unacceptable: > 10%	High risk is defined as receiving a Risk Priority score of 1, where risk score is calculated based on the probability and consequence of failure. (Source: Watermains Risk Assessment 2025)
	3. Number of watermain breaks per 100 kilometers of watermain per year	5.39	4.38	Good: < 10, Acceptable: 10 – 15, Unacceptable: > 15	Source: Enterprise GIS Inventory
	4. NEW KPI: Water Treatment Plant Risk Level[(1)]	-	King St. WTP: Low- Point Pleasant WTP: Low Cana(: Low	Good: Low Acceptable: Moderate Unacceptable: High	The perceived risk associated with the condition of the three facilities is low, as all WTPs have a condition rating of 2.1- 2.95 for 2025, which is categorized as 'Good'. (Source: Water Facilities Condition Assessment, J, L. Richards & Associates, 2025)

LOS	Key Performance Indicator	2023	Current (2024)	Target (2025 to 2034)	Unit/Notes
	5. NEW KPI: Booster Stations Risk Level(1)	-	James Street: C	Good: Low (A, B) Acceptable: Moderate (C) Unacceptable: High (D, E)	The overall ratings of boosters and reservoirs correspond to the target measures as follows: Good: Overall Rating A; Acceptable: Overall Ratings B & C; Unacceptable: Overall Ratings D & E. (Source: Water Facilities Condition Assessment, J, L. Richards & Associates, 2025)
	6. NEW KPI: Water Reservoirs and Booster Station Risk Level(1)	-	Progress Ave.: C Third Ave.: B O'Connor Dr: C	Good: Low (A, B) Acceptable: Moderate (C) Unacceptable: High (D, E)	The overall ratings of boosters and reservoirs correspond to the target measures as follows: Good: Overall Rating A; Acceptable: Overall Ratings B & C; Unacceptable: Overall Ratings D & E. (Source: Water Facilities Condition Assessment, J, L. Richards & Associates, 2025)
	7. Revised: Percent of properties where minimum required fire flow is available.	-	-	Acceptable: 100%, Unacceptable: <100%	Source: N/A
Growth and Planning	1. Uncommitted Reserve Capacity at Water Treatment Plant - Based on Ministry Procedure D-5-1. Number of years of Growth Capacity, Point Pleasant WTP and King Street WTP	-	31.6	Good: > 10 Acceptable: 7-10 Unacceptable: < 7	Source: Uncommitted Reserve Capacity studies and Water Master Plan
Sustainability	1. Percent of treated water that is non-revenue	38.56%	No Data (meter issues)	Good: < 15% Acceptable: 15 - 25 % Unacceptable: > 25 %	Source: Operations Group - Water Balance Spreadsheet

LOS	Key Performance Indicator	2023	Current (2024)	Target (2025 to 2034)	Unit/Notes
	2. Cross connection backflow control program - Percent of customers in Compliance	83%	88%	Good: > 40% Acceptable: 10 - 40 % Unacceptable: < 10 %	Source: Backflow Prevention Program tracking sheets.
	3. NEW KPI: Water Total GHG Emissions Intensity (GHGI) from Utility Energy Usage reduction compared to 2018 baseline values (as a %)	1. King St. WTP: -9.7% 2. Pt Pleasant WTP: -15.3%	1. King St. WTP: -6.9% 2. Pt Pleasant WTP: -8.1%	Good: <= -50% Acceptable: >-50% to +10% Unacceptable: >+10%	Source: Utility Energy Usage reduction compared to 2018 baseline values (as a percentage)
Financial	1. Combined Water & Wastewater Costs to Customer a) As a percentage of household income b) As a dollar amount	a) Residential: Burden: 1.2% b) Burden: $1,262 (Mid) 2.32% below average	a) Residential: Burden: 5.6% b) Burden: $1,294 (Mid) 7.1% below average	Good: < 10% Acceptable: 10 - 20% Unacceptable: > 20%	Source: Municipal Study for water/sewer cost data.
	2. Debt Repayment a) Debt Interest repayment as a percentage of revenue b) Total debt repayment as a percentage of revenue	a) 4.8% b) 9.7%	a) 4.7% b) 9.8%	Good:<25% Undesirable: >25%	This % represents the total debt repayment as compared to total income (Source: UK Financial Plan)
	3. Water Debt Outstanding per Customer	$1,261	$ 1,209	No ranges defined.	Source: UK Financial Plan
	4. Estimated Annual Budget Deficit	-	$ 18.17 M per year	No ranges defined.	Total estimated required capital less total estimated available funds (per year). (Source: UK Finance)

(1) UK used reliability ratings and overall facility ratings to assess the condition and criticality of facilities (see **Table** *24*). Due to their complexity, reliability ratings were not calculated for the WTPs; instead, they were assessed based on condition scores, as discussed in **Section C.1.3.2**. It is recommended that UK assess WTP risk in the future. The overall ratings of boosters and reservoirs correspond to the target measures as follows: Good: Overall Rating A; Acceptable: Overall Ratings B & C; Unacceptable: Overall Ratings D & E.

The performance and reliability KPI 'Number of days when a boil water advisory issued by medical officer of health' has been revised to 'The number of days per year where a boil water advisory notice is in place compared to the total number of properties connected to the municipal water system'. The risk management KPI ‘Percent of red hydrants in the distribution system – risk impact for fire fighting requirements’ has been revised to ‘Percent of properties where minimum required fire flow is available’. Data for 2023 and 2024 are unavailable, as UK’s water hydraulic model is currently being rebuilt as part of the Master Plan project. Three new KPIs related to the risk management have also been added, and these include WTP risk level, booster station risk level, and water reservoirs and booster stations risk levels. UK will update the risk levels for the WTPs in the coming years. A new sustainability-related KPI, 'WTP Total GHG Emissions Intensity', has been added, with performance measures provided for 2023 and 2024.

Overall, the proposed LOS are achievable since the KPIs are similar to the current ones, with only a few new KPIs added and some removed. The newly added KPIs are also straightforward to calculate, either from the existing raw data or by beginning to monitor and track them starting next year. With the current investment in the infrastructure, the majority of the current KPIs are meeting the target performance, except for a few (e.g., the KPI on the percent of treated water that is non-revenue). In the future, UK will review allocation of funding and resources to ensure that all of the proposed KPIs achieve the target performance.

C.2.3 Maturity and Moving Forward

The LOS considered in the current AMP are similar to the existing ones, and the performance of the KPIs is reported based on the latest available information from the past two years. Most of the KPIs are calculated from the raw data, and in the future, UK will begin tracking these KPIs annually. Additionally, newly proposed LOS KPIs that align with the requirements of O.Reg. 588/17 will be included in the next AMP. Considering all these factors, the maturity level can be described as primarily at a “Minimum” level, but with some of it’s elements (e.g., the LOS and performance measures covers a range of service attributes) transitioning to a “Core” level (**Table 33**), as per the IIMM (NAMS, 2011) guidelines.

Table 33: Level of Service Maturity Index

Maturity Level	Description	Status of Current Plan
Minimum	Asset contribution to organization’s objectives and some basic levels of service have been defined.	We are here
Core	Customer Groups defined and requirements informally understood. Levels of service and performance measures in place covering a range of service attributes. Annual reporting against performance targets.	Short-term Target
Intermediate	Customer Group needs analyzed. Costs to deliver alternate key levels of service are assessed. Customers are consulted on significant service levels and options.	
Advanced	Levels of service consultation strategy developed and implemented. Technical and customer levels of service are integral to decision-making and business planning.	

C.3 Asset Management Strategy

UK's asset management strategy is based on four key categories:

1. **Infrastructure Planning:** focuses on addressing UK's growth-related needs.
2. **Risk Management:** supports decision-making by evaluating the risks associated with assets and asset failure. This includes condition and criticality assessments.
3. **Lifecycle Decision-making:** helps to determine the asset interventions based on the information obtained from infrastructure planning and risk assessments.
4. **Maintenance Management:** focuses on maintaining assets when there are no immediate triggers for refurbishment, replacement or upgrades. Maintenance management includes both preventive and reactive maintenance activities (**Figure 12**).

Together, these categories ensure effective asset management and support the long-term development of the UK water system. Each category is discussed in the following section in detail.

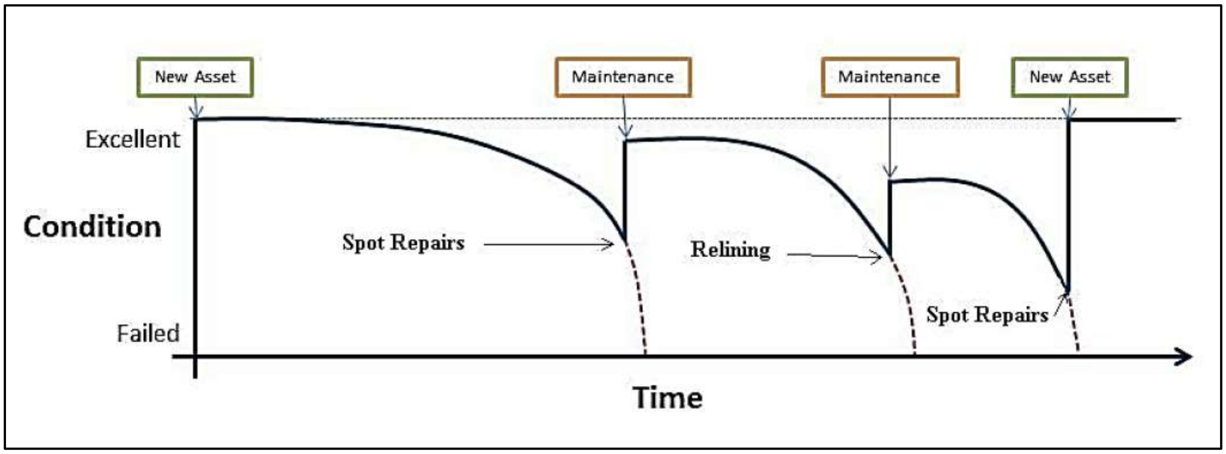

Figure 12: Example lifecycle of a Watermain Pipe Asset

C.3.1 Infrastructure Planning

The purpose of infrastructure planning in the water utility is to ensure that the water system can meet both current and future customer demands, while adhering to drinking water quality standards.

The planning process involves various studies (as shown in **Table 34**), which outline the different infrastructure planning studies and the asset classes they impact. In addition to these planning studies, asset-specific and condition assessment studies are used to determine when infrastructure requires replacement or upgrades. These studies generate triggers for replacement or major upgrades, construction of new assets, and decommissioning of old assets. Any failures not addressed by infrastructure planning studies, as well as those that occur during the asset's lifecycle, are managed through day-to-day operations and maintenance.

Table 34: Infrastructure Planning Studies

Study	Description	Frequency	Assets
Growth Strategy	Growth Strategies are undertaken by the City of Kingston Planning Department to identify future areas for growth. Utilities are considered during the analysis at a high-level.	5- 10 year Cycle.	Major facilities including WTP, BS, reservoirs, elevated storage tanks and larger watermains.
Master Plan (MP)	Water Master Planning assignments are initiated by UK when a major change in the water infrastructure takes place or change in overarching growth projections. The MP typically precedes a Growth Strategy and examines all major development areas considered within a 25-year horizon. It provides recommendations on system upgrades or replacements required to meet growth projections.	5 - 10 year Cycle.	Major and moderate sized facilities including WTP, BS, reservoirs, elevated storage tanks, and linear distribution systems.
Development Charges Planning Studies	Development Charges as per the Municipal Act are imposed to recover the capital costs of sewer and water infrastructure related to future expansion of the service systems. Impost fee studies examine expected future growth within the city and relate that to future infrastructure needs. This forms the growth-related components of the capital infrastructure plans which are then utilized to allocate the costs to be recovered through future impost fees.	5 year Cycle	Major facilities including WTP, BS, reservoirs, elevated storage tanks and larger watermains.
Infrastructure Capital Planning	Capital Road Reconstruction Planning (and Linear Infrastructure Risk Assessment) assignments are initiated by UK and the City of Kingston in order to prioritize road reconstruction and utility replacement/rehabilitation projects.	4 year Cycle	All linear assets.
Environmental Assessments (EA)	Environmental Assessments are often conducted as a result of recommended projects from MP, but sometimes are initiated due to internally driven, or City-driven, initiatives. At times they include scales larger than the facility or asset being studied and may derive recommendations that impact other assets as well.	As required	Variable. Can include any and all asset classes.
Development Studies	Larger-scale developments precipitate the need for studies that may generate recommendations for facilities or linear assets at any scale.	As required	Variable. Can include any and all asset classes.
Uncommitted Plant Reserve Capacity Analyses	UK Internal - Water Treatment Plant Capacity tracking in conjunction with above Studies and Plans to ensure capacity upgrades are initiated in a timely manner. The exercise generally follows MOE Procedure D-5-1. The Analysis has not been conducted in recent years, and the process needs to be reinitiated.	Annually	WTP

C.3.1.1 Growth Estimation

UK plans for growth through its infrastructure planning studies shown in

Table *34*, which provides guidance for identifying projects, such as capacity expansions of its WTPs, new or expanded booster stations, and storage tanks, that are required to meet both current and future customer demands while adhering to drinking water quality standards. However, these infrastructure planning projects do not address the anticipated increase in annual capital expenditure needed to maintain and operate the infrastructure once it is built. As more watermains and assets are added to the system, the annual expenditure needed to maintain them should rise accordingly.

The following two sources of information is used to determine the average annual growth rate, which helps in projecting the increases in annual budgets:

1. A 5-year historical water customer accounts are reviewed to understand the short-term growth requirements.
2. A draft report on Population, Housing and Employment Growth Forecast Update to 2051 is reviewed to understand the long-term projections.

Short-term growth is assessed based on recent trends in water customer accounts. Between 2020 and 2025, the total number of water customers increased from 39,474 to 40,677, an overall growth of approximately 3.05%. This corresponds to an average annual growth of 0.74%, which is lower than previous short-term projections that estimated an average annual growth of 1.3%.

Long-term growth projections are informed by the findings of the Population, Housing, and Employment Growth Forecast Update to 2051 report. According to the study, Kingston’s permanent population is expected to grow from approximately 136,300 in 2021 to 197,000 by 2051. The student population is also projected to increase, from 17,800 to 23,900 over the same period. Combined, the total population (permanent and student) is forecasted to rise from 154,100 in 2021 to 220,900 by 2051, as shown in **Figure 13**.

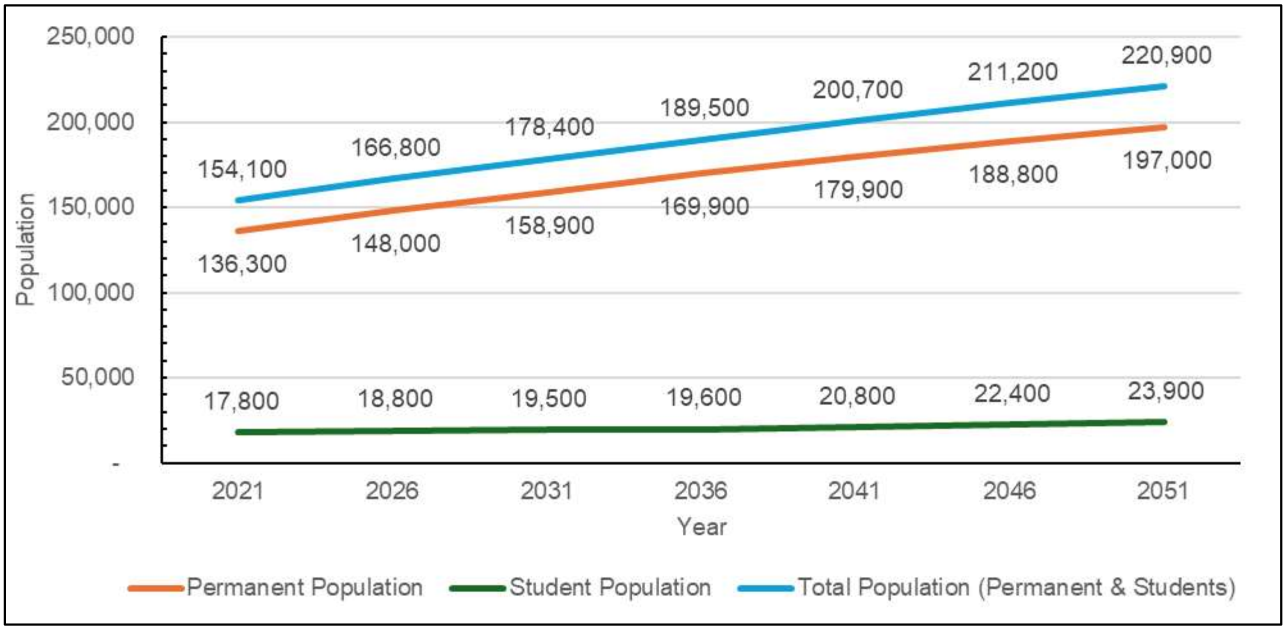

Figure 13: City of Kingston Population Forecast, 2021 to 2051 (Watson and Associates, 2024)

This reflects a total population growth of approximately 43% over 30 years, or an average annual growth rate of 1.2%. Including the student population in the analysis is essential, as students typically reside in Kingston for most of the year and contribute significantly to water demand and service requirements.

Based on these projections, it is reasonable to assume that asset growth will align with the projected growth in the customer base, approximately 1.2% annually over the next decade. While major infrastructure such as trunk watermains will be addressed through upcoming master planning updates, supporting assets like local watermains, hydrants, valves, and service connections are also expected to grow at this projected rate.

C.3.1.2 Water Demand Management

The City of Kingston focuses on water demand management to reduce water use and improve infrastructure capacity through three main areas:

1. Use of treated potable water for non-potable purposes.
2. Water conservation programs.
3. Non-revenue water losses.

The City of Kingston By-law No. 2006-122 regulates the municipal water supply, including restrictions on external water use. From June 15 to September 15, outdoor watering is restricted based on the address number, with odd-numbered addresses allowed on odd days and even-numbered addresses on even days. Outdoor watering can be done at any time using hand-held hoses, cans, or buckets for tasks like lawn watering or car washing. Sprinklers can only be used in the mornings, between 5 and 10 a.m., on the designated watering day.

UK's water rate structure consists of two components: a volumetric charge and a monthly service charge. To promote water conservation and reduce excessive usage, the utility has implemented an increasing block rate structure for residential consumers. Under this structure, the volumetric rate increases after the first 25m³ of water usage each month. Effective from March 1, 2025, to December 31, 2025, the monthly service charge will be $23.36, and the current rates for residential consumers are $1.8764 per m³ for the first 25m³, with the rate rising to $2.3381 per m³ for usage beyond that amount.

In addition to various water conservation programs and customer information sessions, such as the water conservation garden, and rain barrel programs, UK has implemented a Water Efficiency Retrofit Incentive Program (WERIP) for its commercial, institutional, and multi-residential customers. This program encourages investments in water efficiency to help reduce the costs of providing water and sewer services. Eligible projects include institutional toilet replacements, retrofits of heavily used commercial laundry or kitchen equipment, and any other initiatives that permanently reduce water consumption and sewer discharges.

UK has also implemented a Water Loss Reduction Strategy aimed at reducing non-revenue water, which is the difference between the water supplied and authorized consumption. The main cause of non-revenue water is meter inaccuracies, non-metered consumption, and system leakage. Based on the most recent data for 2023, the total water supplied was 24,140.382 ML/year, with revenue water accounting for 14,833.029 ML/year, leaving 9,307.353 ML/year as non-revenue water. The strategy's key recommendations to minimize this include installing District Metered Areas (DMA) to locate high water loss areas, improving leak detection and repair processes, and establishing a dedicated team to identify unauthorized water use.

Although the water demand management strategies may not have immediate impact on the budget, they can provide long-term benefits by delaying the need for treatment plant expansions, slowing down upgrades to the distribution system, and lowering operating and treatment expenses through decreased water usage and losses.

C.3.1.3 Planning and Growth Implications

The 2017 Water Master Plan (MP) identified a number of growth-related projects, and UK has been using it to support capital planning since its release. UK has also initiated a new Master Plan project, which is expected to be completed in 2026. Additionally, UK maintains a hydraulic water model to monitor growth and development projects and to regularly identify or adjust capital project needs.

In the absence of a recent Master Plan, UK's 2025 ten-year budget forecast serves as the most current source of information for tracking growth-related projects. This forecast was developed with consideration of all other planning documents previously referenced (**Table 34**).

C.3.2 Risk Management

Risk management strategy is used to prioritize capital investments and to provide UK with a standardized definition of asset criticality and condition grades. Risk is ideally determined by multiplying the likelihood of asset failure by the consequence of asset failure. However, since quantifying the probability and consequence of failure is not an easy task and requires in-depth research, in practice, a combination of criticality (instead of the consequence of failure) and likelihood of failure are used to estimate the risk index of an asset. The likelihood of failure can be computed based on available condition data and deterioration models. The criticality of an asset is determined based on its physical attributes and other community impact factors. The final risk score for each asset is calculated by multiplying the criticality score by the likelihood of failure score. This information is then used to prioritize assets for capital intervention.

Each of these components is discussed in detail below within the context of UK.

C.3.2.1 Criticality Assessment

The criticality of an asset is defined in terms of its importance to the utility or severity of its consequence of failure. For example, a large transmission watermain pipe with potential social and environmental impacts has higher criticality compared to a smaller distribution watermain pipe. The facility criticality assessments are summarized based on the Water and Wastewater Facility Condition Assessment Report. The scores are adopted from the 2017 Water Master Plan (WSP). The criticality score ranges from 1 (minor) to 5 (critical).

C.3.2.1.1 Linear Assets

The criticality for the linear infrastructure is assessed in-house as part of the UK Infrastructure Capital Planning process. The criticality of valves, hydrants, and services can be assigned based on the criticality of the parent watermain asset. All meters could be assigned a low criticality.

The criticality of the watermain is assessed using economic (repair and operational costs) and social (traffic impacts and service interruptions) parameters. The economic parameter is assessed based on the size of the pipe, with larger diameter watermains generally being more costly to repair and resulting in greater water and energy loss during operation. The social parameter is assessed based on the watermain's location, with large watermains located on arterial roads having a higher traffic impact compared to those on other roads. The most recent information available on criticality is from 2025.

C.3.2.1.2 Non-Linear Assets

In the 2021 AMP, a letter criticality grade of A, B or C, was used to identify criticality level for water treatment plants, booster stations and reservoirs, with A being most critical and C being the least critical. More recently, the 2025 Water Facilities Condition Assessment reviewed and confirmed criticality ratings for reservoirs, booster stations and elevated storage towers using a numeric approach that ranges from 1 (minor) to 5 (critical). UK should maintain consistency in criticality assignments across all non-linear assets, particularly for water treatment plants. For future assessments, a hybrid approach combining both top-down and bottom-up methods is recommended.

- Top-Down Approach: Initially, WTPs can be assigned a high criticality rating (e.g., a 5 on the FCA scale) at the plant level due to their essential role in public water supply. This ensures that the entire facility is recognized as a critical asset from the outset and maintains consistency with how other critical non-linear assets are prioritized.
- Bottom-Up Approach: For greater precision and to support effective maintenance and risk management, the criticality assessment should then be refined by evaluating sub-facilities or individual equipment within the WTP. Key assets such as pumps and motors, which have a significant impact on process performance, should be assessed at the equipment level. Aggregating equipment criticalities by process allows identification of the most critical operational areas, enabling targeted interventions and more accurate risk prioritization.

Table 35 summarizes the current criticality scores for the non-linear assets.

Table 35: Non-Linear Criticality Assessment

Asset	Asset Name	Criticality
Water Reservoir and Booster Station	Third Avenue	4
Water Reservoir and Booster Station	Progress Ave	4
Water Reservoir and Booster Station	O'Connor Dr	4
Booster Station	James Street	4
Water Treatment Plant	King Street	N/A(1)
Water Treatment Plant	Cana	N/A(1)
Water Treatment Plant	Point Pleasant	N/A(1)
Elevated Storage	Creekford Rd. Water Tower	3
Elevated Storage	Forest Dr. Standpipe	2
Elevated Storage	Innovation Dr. Water Tower	3
Elevated Storage	O'Connor Dr. Water Towe	3
Elevated Storage	Tower St. Water Tower	3

(1) By virtue of the purpose of water treatment plants, all plants were assigned a criticality grade of ‘A’ in the 2021 AMP. Currently, no criticality grade exists for water treatment plants.

C.3.2.2 Condition Assessment

The condition of water assets is determined either through a condition assessment or based on the age of the asset as presented in **Section C.1.3**. The details of the condition assessment for non-linear and linear infrastructure are discussed below.

C.3.2.2.1 Linear Assets

UK has historically not conducted inspection based condition assessments for watermains and services, as these asset classes are not easily accessible. Instead, the watermains are assessed in a more reactive manner, relying on break and repair history and leak detection surveys as the primary assessment tools, rather than through formal programs. The valves and hydrants are assessed through routine inspection, flow testing and leak detection surveys. The meters don't have a condition assessment program. The service assumes the assessed condition of the parent watermain asset, similar to the criticality assessment.

Table *36* summarizes the condition assessment programs for the linear assets.

The condition of a watermain is calculated summing the break history factor (the number of breaks for each pipe section) and the age factor (the pipe's age expressed as a percentage of its material lifespan) as discussed in **Section C.1.3.1.1**.

Table 36: Condition Assessment –Linear

Process	Description	Frequency	Asset Classes
Large Diameter Watermain Condition Assessment	No formal program has yet been developed and implemented for condition assessment of the Water Pipe asset class. This requires immediate development and implementation, specifically for the larger critical watermains. Visual inspections of pipes are conducted, where possible, on completion of break repairs.	Frequency to be assigned based on criticality.	Water Pipe
Valve Inspection and Maintenance (SOP)	Valve inspection is to be conducted on all municipal valves with the following recommended frequency: • >= 400 mm in Ø and larger – every five years. • <= 300 mm in Ø - valve operation program every ten years. • Valves are also inspected and exercised prior to water main isolation for maintenance, repair, and reconstruction activities. Valves requiring repairs are flagged for operations.	Frequency assigned based on valve size.	Valves
Hydrant Inspection and Maintenance (SOP)	Hydrant inspection is conducted on all municipal hydrants on an annual basis, with additional inspections for new and repaired hydrants prior to placing into service. Hydrants are also inspected after use. Hydrants requiring repairs are flagged for operations.	Annually and as required.	Hydrants
Hydrant Flow Testing	Hydrant flow testing is conducted annually on approximately 20% of hydrants per year.	20% per year cycle.	Hydrants

Process	Description	Frequency	Asset Classes
Leak Detection Survey	A Leak Detection survey is conducted on municipal hydrants on an annual basis, with specific surveys conducted in areas of suspected leaks. Areas of potential leaks are flagged for repair with operations.	In Conjunction with Hydrant Survey and Flow Testing	Water Pipe, Hydrants, Valves and Services
Services Condition Assessment	No formal program has been developed for Services and none is anticipated. Due to the low inherent criticality of individual services, and the cost associated with inspection, Services will not be subjected to a condition assessment program. Water services may be a major contributor to system water loss.	A run-to-failure approach is deemed acceptable for Services.	Services

C.3.2.2.2 Non-Linear Assets

In general, the condition assessment for the plants and facilities is conducted either by external consultants every 10 years or by inspection staff on a regular basis. **Table 21** and **Table 23** summarizes the condition score of the plants and facilities, and the condition score definition. The facility condition assessments are summarized from the Water and Wastewater Facility Condition Assessment Report. **Table 37** summarizes the condition assessment process description for plants and facilities, conducted by both consultants and staff.

Table 37: Condition Assessment Process – Non-Linear

Process	Description	Frequency	Asset Classes
Facility Condition Assessment (Consultant led)	The Facility Condition Assessment study is a rigorous process that involves assessment of criticality and condition down to the major component level and uses a risk assessment framework to recommend proactive works on all facilities and/or recommendations for replacements and/or major upgrades. It also reviews regulatory and code compliance issues. Includes a 10-year outlook to the next cycle. Improvements need to be made to this program and recommendations for maintenance need to be reviewed.	~10 years	Water Treatment Plants, Booster Stations, Elevated Storage Tanks, Storage Reservoirs
Facility Condition Assessment (Staff led)	Treatment Group staff in the Water and Wastewater Infrastructure Department undertake light to rigorous condition assessments on a daily, weekly and monthly basis. As per above, this process should take into consideration recommendations from consultant-lead condition assessment projects.	~continuous	Water Treatment Plants, Booster Stations, Elevated Storage Tanks, Storage Reservoirs

C.3.2.3 Risk Assessment and Prioritization

The risk assessment is conducted by considering the criticality and condition assessments discussed in **Section C.3.2.1** and **Section C.3.2.2**. The required works are then identified by prioritizing the assets based on their risk scores.

C.3.2.3.1 Linear Assets

The risk assessment for the linear infrastructure is completed in-house and focuses on the parent watermain asset, which is linked in GIS inventory to the City of Kingston Road Inventory Management System (RIMS) Section. The scores for the probability of failure and consequence of failure, discussed in the previous sections, are used to estimate the quantitative risk score. The risk scores are then prioritized based on their risk categories (Good, Fair, Average, and Poor). **Table 38** and **Figure 14** summarize the risk assessment analysis for the watermain, with the majority of the watermains falling into the Good (87.33%) and Fair (8.82%) risk categories.

Finally, more efficient and effective capital works programs can be achieved by overlapping water capital works with those of other assets, such as wastewater, gas, and city roads and infrastructure, and collaborating with the respective teams to program capital works across multiple infrastructure portfolios.

Table 38: Watermain Assets – Risk Evaluation

Asset Risk	Watermain Length (km)	% of Asset Class
Good	517.99	87.33%
Fair	52.29	8.82%
Average	9.46	1.59%
Poor	13.42	2.26%
Total	**593.16**	**100%**

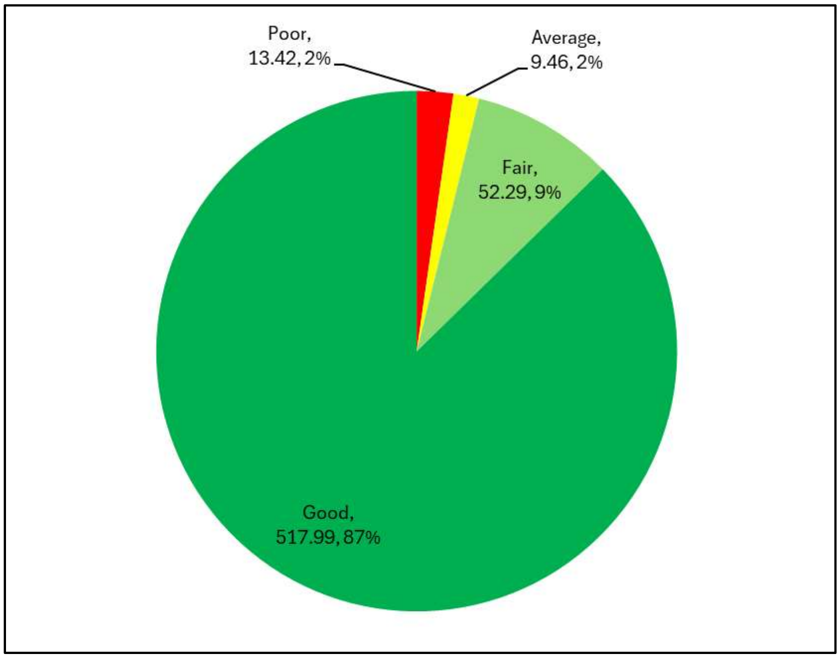

Figure 14: Summary of the Watermain Asset Risk Category

C.3.2.3.2 Non-Linear Assets

The required risk-based maintenance and upgrade work for the plants and facilities at UK is determined either through operational risk assessments or condition assessments led by consultants. The operational risk assessment is carried out by UK's Operations Group for major non-linear assets and some critical linear assets as part of the Drinking Water Quality Management System (DWQMS). This assessment focuses on ensuring a safe water supply by addressing risks from treatment facility failures, storage system failures, booster station failures, and other facility component failures. It helps identify and manage risks through maintenance programs and recommends responses, such as using backup pumps or power, in case of failures. The most recent information available in the DWQMS report, at the time of writing this report, is from 2023.

The consultant-led condition assessments are also used to create a prioritized list of required maintenance and upgrades. UK utilizes a reliability rating to assess the condition and criticality of facilities and their components, helping to determine repair, rehabilitation, and replacement needs (**Table 22**). This reliability rating methodology was applied consistently in both the Water and Wastewater Master Plan and the Water and Wastewater Condition Assessments report. The list of required capital works is developed alongside infrastructure planning studies, ensuring it addresses full facility replacements, upgrades, and maintenance activities.

C.3.3 Lifecycle Decision Making

The infrastructure planning and risk management outlined in **Sections C.3.1** and **C.3.2** are used to identify assets that require rehabilitation or replacement. Once these assets are identified, decisions are made on how they should be addressed through the Lifecycle Decision Making process. Under this process, assets are selected for one of the following actions:

1. New, increased, or accelerated maintenance.
2. Rehabilitation or major upgrade.
3. Replacement.

To maintain the current and proposed LOS, the lifecycle activities included in this section of the lifecycle decision making need to be properly undertaken. These include renewal and rehabilitation, as identified through ongoing maintenance, inspection, and condition assessments. The routine maintenance program should be incorporated for all linear and non-linear assets. Assets that have reached the end of their useful life should also be replaced. UK can proactively utilize these lifecycle activities to prepare a budget- and performance-based capital investment scenario. These will help determine the minimum investment required to maintain the current LOS and the lifecycle activities that need to be undertaken.

Potential risks associated with these activities include increased lifecycle costs if renewal and rehabilitation are not performed correctly. A lack of a proper inspection program could also lead to a higher percentage of treated water being non-revenue. Inadequate maintenance may result in asset failure, causing service disruptions, while improper disposal could have environmental impacts and lead to cost overruns.

The details of the lifecycle decision-making considerations for each asset group are discussed below.

C.3.3.1 Linear Assets

C.3.3.1.1 Watermains, Valves and Services

Due to the parent/child relationship, valves and services are typically managed alongside the watermains. The asset management process of watermains is not well defined and generally relies on a “worst first” approach and a run-to-failure maintenance strategy. Lifecycle decisions are based on the planning studies and the risk assessment process discussed in **Sections C.3.1** and **C.3.2**.

- An asset should typically be maintained through digging and repairs if it shows minor deficiencies and a lower risk of failure. These activities do not impact the asset's expected lifecycle, as most of the asset and its components remain in their current condition.
- If planning studies identify the need for capacity improvements, these upgrades will be prioritized for the Joint Reconstruction Program, if possible, within the planned timeframe. If they cannot be included, UK may address the replacement as a separate, one-off project.

- An asset should be considered for the following options if it is identified as high-risk, where maintenance activities will not be cost-effective in reducing the risk. **Figure 15** shows the remediation decision tree used in the process:
    - Replacement of an asset and its dependents (valves and services) in conjunction with a joint (City/UK) Road Reconstruction Project, where feasible.
    - Reconstruction outside of Joint Program: Replacement of pipe, including dependent asset classes
    - Rehabilitation lining, with due consideration to the condition of dependent assets and appropriate rehabilitation, cathodic protection, or replacement of dependent assets.

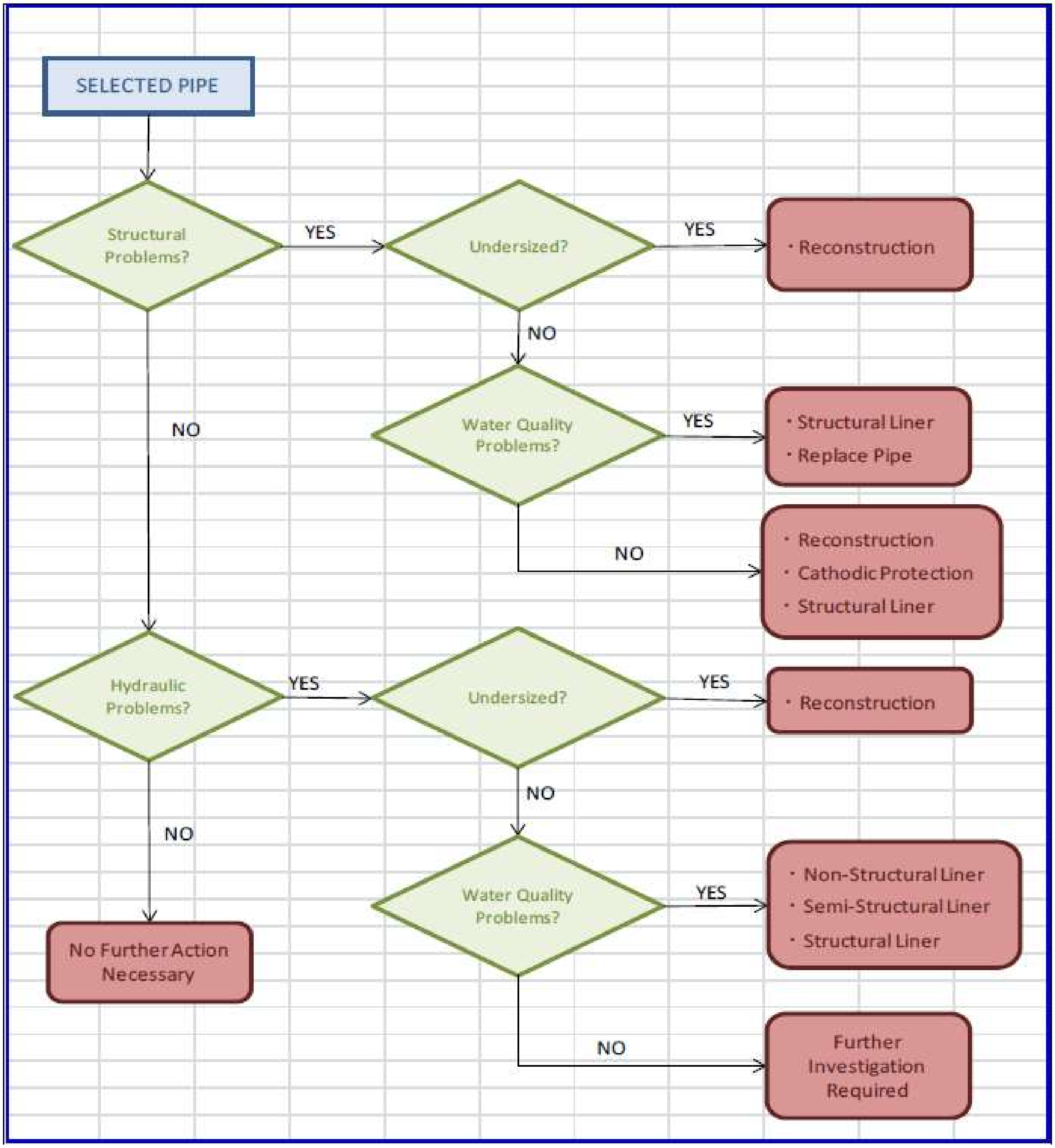

Figure 15: Example Remediation Decision Tree

3.3.1.2 Hydrants

The lifecycle process of hydrants is generally relying on a run-to-failure maintenance approach. They are also considered sub-dependent assets of the parent watermain on which they are located. The decision-making process of hydrant asset includes:

- An asset should typically be maintained through digging and repairs technique if operations staff (UK Hydrant Inspections or City of Kingston Fire Dept.) identifies deficiencies. Repairs are tracked through SOP and then updated in the asset inventory.
- Hydrant replacement may occur alongside parent watermain upgrades or as part of a joint (City/UK) Road Reconstruction Project when feasible.

C.3.3.2 Non-Linear Assets

The plants and facilities are primarily managed through maintenance and minor upgrades, rather than major upgrades and replacements. However, when they are identified through planning exercises as needing a significant increase in capacity or a change or improvement to the treatment process, they are managed through major upgrades or facility replacement. **Table 39** summarizes the lifecycle decision actions for the plants and facilities.

Table 39: Lifecycle Decision Making – Plants and Facilities

Asset	Routine Maintenance	Major Upgrade	Replacement	Other
Water Treatment Plants	Applicable	Applicable	Applicable	• Continued or additional prescribed maintenance
Booster Stations	Applicable	Applicable	Applicable	• Based on operation staff and contractor input, other maintenance activities • Maintenance activities prescribed by the Condition Assessment
Reservoirs and Elevated Storage Tanks	Applicable	-	-	• Maintenance activities prescribed by the Condition Assessment • Consider upgrades as per Planning exercises, specifically Master Plans (MP) • Consider decommissioning or repurposing as per Planning exercises

C.3.4 Maintenance Management

Maintenance is integral to ensure the Water Utility's effective operation in the absence of triggers for replacement, upgrades, or capacity increase. Condition and risk indicators should drive these activities. All maintenance activities should be documented, tracked by asset, and accessible to UK staff. However, current tracking systems are inconsistent and require significant effort to coordinate asset management activities across the asset classes. Existing tracking methods include:

- Various tracking sheets maintained by "Operations" for linear infrastructure (e.g., watermain, hydrant, and valve repairs).
- The GIS Asset Inventory can track works on the linear infrastructure, but maintenance activities (except for replacements and lining) are currently tracked on individual sheets. It is recommended to track and catalog all maintenance works in GIS or other asset management software.

The existing individual processes are not adequate for comprehensive asset management across the water utility, and addressing this issue is a priority moving forward.

C.3.5 New Assets

The Water Utility continuously adds new assets through two primary activities: acquisition from developers (due to growth) and in-house construction (driven by growth, reassessed capacity needs, or internal risk assessments). These assets, across all asset classes, should be documented in the Asset Inventory and incorporated into the Replacement Cost and PSAB Valuation financial summaries. Most major assets are identified during Master Planning exercises, which also has an Opinions of Probable Cost (OPC) and a suggested timeline.

C.3.6 Decommissioning

When an asset is deemed unnecessary, it should be decommissioned or repurposed if applicable. Available decommissioning options include:

- Decommissioning the facility in conjunction with its replacement where applicable.
- Repurposing assets, such as converting booster stations into metering stations or alternative pressure feed locations between pressure zones.
- Carrying out the necessary studies and procedures to properly decommission facilities that are no longer required.

Salvage and reuse of parts should also be considered where possible.

C.3.7 Summary

An adequate asset management program requires a variety of program and related processes, and the program includes:

- Infrastructure Planning: These primarily focus on growth-related needs, improvements to the distribution system, and requirements for major capital projects.
- Risk Assessment: These focus on risk-based needs, identified through a combination of condition and criticality assessments.
- Lifecycle Options: These involve physical intervention processes that result in repaired, upgraded, or new assets or facilities.

Table 40 summarizes a non-exhaustive list of programs and processes used for water utility asset management. These programs are assumed to be the same as those provided in the 2021 AMP.

Table 40: Summary of Programs for Water Utility Asset Management

Type/Program	Frequency	Tactic	Watermain	Valves	Hydrants	Meters	Services	WTP	Booster	Reservoirs	Elevated
Infrastructure Planning: Growth Strategy	~ 10 yrs	Proactive	Yes	Yes	-	-	-	Yes	Yes	Yes	Yes
Infrastructure Planning: Master Plan	~ 5-10 yrs	Proactive	Yes	Yes	-	-	-	Yes	Yes	Yes	Yes
Infrastructure Planning: Development Charges	~5 yrs	Proactive	Yes	-	-	-	-	Yes	Yes	Yes	Yes
Infrastructure Planning: Infrastructure Capital Planning	4-yr Plans	Proactive	Yes	Yes	Yes	-	Yes	Yes	Yes	Yes	Yes
Infrastructure Planning: Project-Specific Environmental Assessments	As Required	Proactive	Yes	-	-	-	-	Yes	Yes	Yes	Yes
Infrastructure Planning: Development-Specific Studies	As Required	Proactive	Yes	-	-	-	-	Yes	Yes	Yes	Yes
Infrastructure Planning: Uncommitted Plant Capacity Reserve Analyses	Annually	Proactive	-	-	-	-	-	Yes	-	-	-
Risk Management: Facility Condition Assessment (External)	10 yrs	Proactive	-	-	-	-	-	Yes	Yes	Yes	Yes
Risk Management: Facility Condition Assessment (Internal)	Continuous	Proactive	-	-	-	-	-	Yes	Yes	Yes	Yes
Risk Management: Large Diameter Watermain Condition Assessment	TBD	Proactive	Yes	-	-	-	-	-	-	-	-
Risk Management: Valve Inspection and Maintenance	Size Specific Cycle	Proactive	-	Yes	-	-	-	-	-	-	-
Risk Management: Hydrant Inspection and Maintenance and Flow Testing	Annually/5-yr Cycle	Proactive	Yes	-	Yes	-	-	-	-	-	-
Risk Management: Leak Detection Survey	Annually	Proactive	Yes	Yes	Yes	-	Yes	-	-	-	-
Lifecycle Options: Scheduled Maintenance	Asset Specific	Proactive	-	-	-	-	-	Yes	Yes	Yes	Yes
Lifecycle Options: Unscheduled Maintenance	As Required	Reactive	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lifecycle Options: Rehabilitation (Lining, minor upgrades etc.)	Asset Specific	Proactive	Yes	Yes	Yes	-	-	Yes	Yes	Yes	Yes
Lifecycle Options: Facility Major Upgrades	Asset Specific	Proactive	-	-	-	-	-	Yes	Yes	Yes	Yes
Lifecycle Options: Asset Replacement	Asset Specific	Proactive	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lifecycle Options: Asset Replacement	As Required	Reactive	Yes	Yes	Yes	Yes	Yes	-	Yes	-	-
Lifecycle Options: New Asset Construction/Assumption	As Required	N/A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lifecycle Options: Asset Decommissioning/Retirement	As Required	N/A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

C.3.8 Maturity and Moving Forward

C.3.8.1 Forecasting Future Demand

UK conducts several infrastructure planning studies, all of which identify projects aimed at upgrading and expanding infrastructure to meet both current and future customer demands. The need for growth-based infrastructure works is primarily guided by population growth projections, the master plan, growth strategy, and infrastructure capital planning. The MP is used to identify major assets, such as trunk watermains, while the growth of other assets, like local watermains, hydrants, valves, and services, can be roughly tracked in relation to forecasted population growth. Once growth-based works are identified, UK conducts project-specific analyses during the environmental assessment process. The uncommitted plant capacity reserve analysis should be conducted annually for the WTPs. Considering all these factors, the maturity level for forecasting future demand is currently at the 'Core' level (**Table 41**). Looking ahead, demand forecasts could be further refined through mathematical analysis of past trends and consideration of demand factors.

Table 41: Forecasting Future Demand Maturity Index

Maturity Level	Description	Status of Current Plan
Minimum	Demand forecasts based on experienced staff predictions, with consideration of known past demand trends and likely future growth patterns	
Core	Demand forecasts based on robust projection of a primary demand factor (i.e. population growth) and extrapolation of historic trends. Risk associated with demand change broadly understood and documented.	We are here
Intermediate	Demand forecasts based on mathematical analysis of past trends and primary demand factors. A range of demand scenarios is developed.	Short-term Target
Advanced	As above, plus risk assessment of different demand scenarios with mitigation actions identified.	

C.3.8.2 Identifying Risks

UK has developed an operational risk framework for all plants and facilities, as well as major critical watermains, utilizing both internal and external consultant-based reports. The risk assessment for non-linear assets is more structured and comprehensive compared to the assessment for linear infrastructure. For example, the risk assessment for most of the linear infrastructure is conducted internally on an inconsistent basis, focusing on the parent watermain assets in a GIS-linked section. The watermain risk score is calculated using a combination of probability of failure, which considers age, and break history, and consequence of failure, which considers size and location. There is no inspection based condition assessment for watermains due to accessibility challenges. Instead, watermains are assessed reactively, relying on break and repair history and leak detection surveys as the primary assessment tools, rather than through formal programs.

The risk assessment framework for linear assets requires further development and is currently considered to be at the 'Minimum' level. In contrast, the risk framework for the non-linear assets — excluding the WTPs, which are at a 'Minimum' level— can be considered at the 'Core' level and is approaching the 'Intermediate' level of maturity in terms of identifying high-risk assets, as shown in **Table 42**.

Table 42: Risk Identification Maturity Index

Maturity Level	Description	Status of Linear Assets	Status of Non-linear Assets
Minimum	Critical assets understood by staff involved in maintenance/renewal decisions.	Linear: We are here	
Core	Risk framework developed. Critical assets and high risks identified. Documented risk management strategies for critical assets and high risks.	Linear: Short-term Target	Non-Linear, excluding the WTPs: We are here
Intermediate	Systemic risk analysis to assist key decision making. Risk register regularly monitored and reported. Risk managed consistently across the organization.		Non-Linear: Short-term Target
Advanced	Formal risk management policy n place. Risk is quantified and risk mitigation options evaluated. Risk is integrated into all aspects of decision-making.		

C.3.8.3 Lifecycle Decision-Making

For linear infrastructure, lifecycle decision-making is primarily based on planning studies and the risk assessment process. For example, a high-risk watermain asset, where maintenance activities would not be cost-effective in reducing the risk, is selected for replacement or rehabilitation through a remediation decision tree process. For non-linear assets, a formal or informal cost-benefit analysis is typically conducted before proceeding with the work, and a multi-criteria analysis is usually performed within the context of the Environmental Assessment Framework. Considering all these factors, the maturity of lifecycle decision-making is assessed at the 'Core' level (**Table 43**), as per the IIMM (NAMS, 2011).

Table 43: Lifecycle Decision-Making Maturity Index

Maturity Level	Description	Status of Current Plan
Minimum	AM decisions based largely on staff judgement and agreed corporate priorities.	
Core	Formal decision-making techniques (MCA/BCA) are applied to major projects and programs.	We are here
Intermediate	Formal decision-making and prioritization techniques are applied to all operational and capital asset programs within each main budget category. Critical assumptions and estimates are tested for sensitivity to results.	Short-term Target
Advanced	As for 'intermediate', plus… The framework enables projects and programs to be optimized across all activity areas. Formal risk-based sensitivity analysis is carried out.	

C.3.8.4 Capital Works Strategies

UK typically projects its financial budgeting for capital expenditures for a 10-year horizon, though formal business-case analysis is not always conducted for these expenditures. As a result, the current level of strategizing for capital works is assessed at a 'Core' level of maturity (**Table 44**), with certain elements of the planning process approaching an 'Intermediate' level of maturity.

Table 44: Capital Works Strategies Maturity Index

Maturity Level	Description	Status of Current Plan
Minimum	There is a schedule of proposed capital projects and associated costs, based on staff judgement of future requirements.	
Core	Projects have been collated from a wide range of sources such as hydraulic models, operational staff and risk-processes. Capital projects for the next three years are fully scoped and estimated.	We are here
Intermediate	As above, plus formal options analysis and business case development has been completed for major projects in the 3-5 year period. Major capital projects for the next 10-20 years are conceptually identified, and broad cost estimates are available.	Short-term Target
Advanced	Long-term capital investment programs are developed using advanced decision-making techniques such as predictive renewal modeling.	

C.3.8.5 Moving Forward

The Asset Management Strategy can be improved in the future by addressing the following:

1. It is recommended that the UK utilize asset management capital planning software.
2. Develop a formal risk assessment process for both linear and non-linear assets, ensuring that risk assessments are conducted for all assets in the inventory. The risk assessment process for watermains will likely need to be re-evaluated to incorporate additional contributing factors. Additionally, it is important that the UK maintains consistent condition, criticality, and risk categories across the asset portfolio.
3. The criticality assessment for non-linear assets should be updated and broken down into major components or system processes, similar to the condition assessment conducted for the assets.
4. Consider implementing a condition assessment program for critical watermains, incorporating inspection-based methods such as CCTV, leak detection techniques, and other destructive or non-destructive techniques. These methods provide more accurate, asset-specific data for asset condition, to support proactive maintenance and renewal planning.

D. Wastewater

D.1 State of Local Infrastructure – Wastewater Utility

UK manages wastewater services for approximately 39,528 residential and industrial, commercial, institutional (ICI) customers, making effective asset management crucial for maintaining reliable and sustainable services, safeguarding public health, and ensuring environmental compliance. The purpose of this chapter is to thoroughly outline the current state of UK's wastewater assets, including their inventory, replacement costs, valuations, age profiles, conditions, and ongoing maturity plans.

To accurately depict the status of these assets, this assessment utilizes various authoritative sources. The GIS Asset Inventory primarily focuses on linear infrastructure, incorporating facilities and plants. The inventory data referenced in this report reflects a snapshot from the Enterprise GIS database as of January 2025. Additionally, the Closed-Circuit Television (CCTV) database provides comprehensive condition assessments for gravity sewer mains based on inspections conducted between 2002and 2023. These inspections assessed using the Water Research Centre (WRC) method between 2002 and 2014 and the Pipeline and Maintenance Hole Assessment and Certification Program (PACP/MACP) rating methods beyond 2014, offer crucial insights into the infrastructure's condition, with data current as of December 2024.

Asset valuation is addressed through Public Sector Accounting Board (PSAB) reporting, following applicable standards. The data used in this analysis is drawn from the City of Kingston's Citywide financial management system, current as of the end of 2024. In addition to earlier sources such as the 2017 Water and Wastewater Master Plan Update, which outlines condition and growth-based capital project recommendations, more recent data has also been incorporated. This includes the Facility Condition Assessments (FCAs) conducted by JLR in 2025, which identified specific asset condition needs, as well as the City's approved 10-year capital budget forecast and the 2-year budgets approved by council in 2025.

The assessment is further enhanced by additional supplementary reports and operational data sources, including replacement cost estimates, wastewater treatment plant operational metrics (flow and effluent quality), inspection reports, and pumping station failure records. These combined resources create a comprehensive foundation for evaluating UK's wastewater infrastructure, informing strategic decision-making to maintain reliable service and effectively plan future asset management.

D.1.1 Asset Inventory

The UK wastewater infrastructure comprises both linear and, plants and facilities assets, essential for system functionality and operational reliability. The wastewater inventory consists of gravity mains, force mains, manholes, wastewater valves, and wastewater facilities, such as pump stations, Combined Sewer Overflow (CSO) tanks, and wastewater treatment plants. The inventory information is obtained from the City of Kingston's administered Enterprise GIS system. **Table** *45* summarizes the linear and non-linear assets in UK's wastewater collection system.

Table 45: Overview of Wastewater Utility Asset Classes

Group	Class	In GIS Inventory?	Count (1)	Quantity (km) (1)
Linear	Gravity Mains	Yes	7,955	490.0
Linear	Force Mains	Yes	216	29.4
Linear	Manholes	Yes	6,944	-
Linear	Control Valves	Yes	88	-
Linear	System Valves	Yes	84	-
Linear	Services	No (2)	~ 39,528 (3)	~ 427.1 (4)
Plants and Facilities	Wastewater Treatment Plants	Yes	3	-
Plants and Facilities	Sewage Pump Stations	Yes	32 (5)	-
Plants and Facilities	CSO Storage Tank	Yes	8	-

Notes:

(1) As per Enterprise GIS, summarized January 2024, rounded.

(2) Work in progress. Services are added to GIS as built/replaced.

(3) Customer count as of January 2024. Assumed one service per customer.

(4) The average Right-of-Way width is 21.61m, and the average sewer lateral length is estimated at half this amount.

(5) UK is taking over a 33rd sewage pumping station in May 2025 - the Dockside Drive Sewage Pump Station. This is a newly constructed station that is servicing a new development and not currently represented in UK's inventory summarized herein.

D.1.1.1 Linear Assets

UK manages a significant inventory of linear wastewater assets, primarily consisting of gravity mains, force mains, service laterals, and junction assets. **Table** *46* summarizes linear asset quantities categorized by asset class and sub-class based on data from the Enterprise GIS as of January 2024. The assets are grouped into Gravity Mains, Force Mains, Services, and Junctions, with detailed breakdowns provided by sub-class.

Gravity mains total approximately 490 km, distributed across trunk (9.0%), collector (10.4%), local (79.0%), facility (1.4%), service, facility trunk, and unknown classifications. Local gravity mains, making up the majority at 79%, underscore the critical role of neighborhood-level wastewater collection networks.

Gravity Mains constitute the largest portion, totaling 490 km in length across 7,955 assets. The Local sub-class is predominant, comprising 387 km (79.0% by length) across 6,377 individual assets. Collector and Trunk sub-classes follow, measuring 51 km (10.4%) and 44.3 km (9.0%), respectively. Service, Facility, Facility Trunk, and Unknown categories represent minimal lengths (less than 2% combined).

Force Mains cover a total length of 29.4 km, dominated by the Trunk sub-class at 17.6 km (59.7%), followed by the Local sub-class at 11.7 km (39.8%). Facility Trunk constitutes a minimal length of 0.2 km (0.5%).

Service Laterals are under active development with ongoing data integration into GIS. Currently, there are 39,528 customer services totaling approximately 427.1 km in length, calculated based on an average Right-of-Way width of 21.61 m and an estimated lateral length of half this value per customer.

Junction assets include 7,116 elements, comprising 6,944 Manholes and 172 Fittings.

Table 46: Summary of Linear Asset Inventory

Class	Sub-class	In Asset Inventory	Quantity (Count) (1)	Quantity (Length km?) (1)	% by Length
Gravity Mains	Trunk	Yes	523	44.3	9.0%
Gravity Mains	Collector	Yes	775	51.0	10.4%
Gravity Mains	Local	Yes	6,377	387.0	79.0%
Gravity Mains	Service	Yes	11	0.1	0.0%
Gravity Mains	Facility	Yes	243	7.0	1.4%
Gravity Mains	Facility Trunk	Yes	23	0.3	0.1%
Gravity Mains	Unknown	Yes	3	0.3	0.1%
Gravity Mains	**Total**	**Yes**	**7,955**	**490.0**	**100.0%**
Force Mains	Trunk	Yes	72	17.6	59.7%
Force Mains	Local	Yes	126	11.7	39.8%
Force Mains	Facility Trunk	Yes	18	0.2	0.5%
Force Mains	**Total**	**Yes**	**216**	**29.4**	**100.0%**
Services	**Laterals**	**No (4)**	**39528 (2)**	**427.1 (3)**	**-**
Junctions	Manholes	Yes	6944	-	-
Junctions	Fittings	Yes	172	-	-
Junctions	**Total**	**Yes**	**7116**	**-**	**-**

Notes:
(1) As per Enterprise GIS, summarized January 2024, rounded.
(2) Customer count as of January 2024. Assumed one service per customer.
(3) The average Right-of-Way width is 21.61m, and the average sewer lateral length is estimated at half this amount.
(4) Work in progress. Services are added to GIS as built/replaced.

Table *47* provides a detailed distribution of Gravity Mains by diameter size. Approximately, half (48.5%) of gravity mains measure 200 mm or less, while 34.8% range between 201-400 mm.

Table 47: Gravity Mains by Diameter

Diameter (mm)	Length (m)	Length (km)	% by Length
≤ 200	237,591.80	237.59	48.5%
201-400	170,446.50	170.45	34.8%
401-600	40,083.97	40.08	8.2%
601-900	23,056.35	23.06	4.7%
> 900	17,022.22	17.02	3.4%
Unknown	1,756.03	1.76	0.4%
Total	**489,956.87**	**489.96**	**100.0%**

Size distribution for force mains shows a balanced mix, with smaller pipes (≤200 mm) accounting for 32.9%, and larger sizes (>900 mm) representing 18.3%. **+** presents the distribution of Force Mains by diameter size.

Table 48: Force Mains by Diameter

Diameter (mm)	Length (m)	Length (km)	% by Length
≤ 200	9,682.35	9.68	32.9%
201-400	4,698.17	4.70	16.0%
401-600	5,617.47	5.62	19.1%
601-900	3,891.62	3.89	13.2%
> 900	5,383.28	5.38	18.3%
Unknown	144.33	0.14	0.5%
Total	**29,417.22**	**29.42**	**100.0%**

Material-wise, plastic pipes constitute the largest portion of gravity mains at 40.6%, followed by unknown materials (35.4%), asbestos-cement (13.5%), concrete (8.1%), and others in minor percentages. **Table** *49* presents the details of gravity mains distribution by material.

Table 49: Gravity Mains by Material

Material	Length (m)	% of Total Length
Concrete	39,519.89	8.1%
Plastic	198,869.04	40.6%
Asbestos-Cement	66,186.50	13.5%
Cured-In-Place	4,643.65	0.9%
Clay	5,911.51	1.2%
Stone	1,411.07	0.3%
DIP (Ductile Iron Pipe)	202.53	0.0%
Unknown	173,212.68	35.4%
Total	**489,956.87**	**100.0%**

Notably, material information of force mains remains largely undocumented (62.7%), highlighting a key area for future data improvement. *Table 50* provides the details of force mains distribution by material.

Table 50: Force Mains by Material

Material	Length (m)	% of Total Length
Concrete	2,899.10	9.9%
Plastic	4,862.77	16.5%
Asbestos-Cement	1,064.03	3.6%
Cured-In-Place	2.76	0.0%
Metallic	2,139.23	7.3%
Unknown	18,449.33	62.7%
Total	**29,417.22**	**100.0%**

Table 51 and **Table 52** provide insights into gravity and force main asset classes, respectively, based on their percentage of total pipe length. For gravity mains, local pipes dominate, accounting for 79.0% of the total length, while collector and trunk pipes follow at 10.4% and 9.0%, respectively. In contrast, force mains are predominantly trunk pipes, comprising 59.7% of total length. Local pipes are the next significant category, making up 39.8%.

Table 51: Gravity Main Asset Classes

Pipe class	% by Length
Trunk	9.0%
Collector	10.4%
Local	79.0%
Service	0.0%
Facility	1.4%
Facility Trunk	0.1%
Unknown	0.1%

Table 52: Force Main Asset Classes

Pipe class	% by Length
Trunk	59.7%
Collector	0.0%
Local	39.8%
Facility Trunk	0.5%

Combined sewers are designed to handle both sanitary sewage and stormwater runoff. However, these systems inherently carry higher risks to public health and safety due to potential basement flooding and overflow incidents during periods of heavy rainfall. To address these issues, the City's Master Plan (WSP, 2017) explicitly recommends replacing combined sewers with separated sewer systems.

Table 53 outlines the distribution of gravity mains by sewer type, highlighting the percentage breakdown between combined and separated sewers for the years 2021 and values for 2025. In 2021, combined sewers made up 3.78% of the total sewer network, while separated sewers constituted the remaining 96.22%. By 2025, the share of combined sewers has been declined to 3.37%, indicating continued infrastructure enhancements.

Table 53: Gravity Main Breakdown by Type

Pipe class	% by Length (2021)	% by Length (2025)
Combined Sewers	3.78%	3.37%
Separated Sewers	96.22%	96.63%

The elimination of combined sewer systems is critical in achieving the City's target of virtually eliminating combined sewage bypass events. This effort supports broader sustainability objectives by significantly reducing environmental and public health risks linked to sewer overflow incidents.

While the rate of sewer separation has slowed down in the last 5 years, in part due to the COVID-19 pandemic and resource limitations, it continues to remain a priority for the City and UK. The ongoing Water and Wastewater Master Plan project will consider the preparation of a Pollution Prevention & Control Plan including the development of a Strategic Sewer Separation Plan to be completed in 2026.

D.1.1.2 Plants and Facilities

The inventory of wastewater plants and facilities (or non-linear assets), includes Wastewater Treatment Plants (WWTP), Sewage Pump Stations (SPS), and Combined Sewage Overflow (CSO) Storage Tanks. Specifically, the inventory includes two large wastewater treatment plants servicing over 10,000 customers each and one very small plant serving fewer than 100 customers. Sewage pump stations are categorized into four large stations (each serving over 10,000 customers), three medium stations (serving between 1,000 and 10,000 customers), eighteen small stations (serving between 100 and 1,000 customers), and four very small stations (each serving fewer than 100 customers). Additionally, the infrastructure includes three large active CSO storage tanks (capacity ranging from 2,400 to 10,000 m^3) and five small passive CSO storage tanks (capacity under 500 m^3). **Table** *54* summarizes the details of wastewater plants and facilities.

Table 54: Plants and Facilities Asset Summary

Class	Sub-class	In Asset Inventory	Quantity (Count)
Wastewater Treatment Plants	Large (>10,000 customers)	Yes	2
Wastewater Treatment Plants	Very Small (<100 customers)	Yes	1
Sewage Pump Stations	Large (>10,000 customers)	Yes	4

Class	Sub-class	In Asset Inventory	Quantity (Count)
Sewage Pump Stations	Medium (1,000-10,000 customers)	Yes	3
Sewage Pump Stations	Small (100-1,000 customers)	Yes	18 (1)
Sewage Pump Stations	Very Small (<100 customers)	Yes	4
CSO Storage Tanks	Large (Active) (2,400-10,000m^3)	Yes	3
CSO Storage Tanks	Small (Passive) (<500m^3)	Yes	5

(1) The Dockside Drive Sewage Pump Station will be added as the 19th small pump station and is expected to be in service in 2025.

D.1.1.3 Summary

The wastewater infrastructure includes linear assets (gravity mains, force mains, manholes, wastewater valves, and services) and plants and facilities (wastewater treatment plants, sewage pump stations, and CSO storage tanks). The inventory, maintained via the City of Kingston's Enterprise GIS system (as of January 2025), highlights key assets including 490 km of gravity mains (predominantly local networks at 79%) and 29.4 km of force mains (primarily trunk lines at 59.7%). Approximately half of gravity mains measure ≤200 mm, and plastic constitutes the majority material at 40.6%. Force mains feature diverse sizes, with smaller pipes (≤200 mm) comprising about one-third and larger pipes (>900 mm) 18.3%. Material data gaps exist, particularly with force mains (62.7% unknown), indicating areas for future improvement.

The system also includes 39,528 customer service laterals (approximately 427.1 km), currently being integrated into GIS. Junction assets include 6,944 manholes and 172 fittings. To address combined sewer overflow risks, the City, with support from UK, is aiming to systematically eliminate combined sewers, thus enhancing infrastructure resilience and public health.

Facility assets comprise two large wastewater treatment plants serving over 10,000 customers each, one very small plant (<100 customers), and 32 sewage pump stations categorized by service capacity. Additionally, eight CSO storage tanks provide critical overflow management, three of which are large active tanks.

D.1.2 Replacement Costs and Valuation

This section provides a detailed overview of the estimated replacement costs and current book valuations of UK's wastewater infrastructure. Replacement cost estimates represent the financial requirement to replace the assets. Net Book Values (NBVs) reflect the depreciated value of these assets according to the 2024 Public Sector Accounting Board (PSAB) 3150 Tangible Capital Asset Reporting standards. Replacement costs provide a useful approximation of long-term capital requirements, while NBVs assist in understanding the remaining service life of the assets from a financial reporting perspective. The replacement cost for linear assets is derived from unit rates recommended by Stantec, while the replacement cost for non-linear assets is based on the Facility Condition Assessment Report.

As shown in **Table 55**, the total replacement cost of all wastewater assets is estimated at $2.02 billion, while the total Net Book Value stands at approximately $351 million. The largest contributor to the replacement cost is the wastewater treatment plants, accounting for $1.27 billion (63%) of the total, followed by gravity mains at $308 million (15%), and services at $147 million (7%). Other asset classes, including force mains, pump stations, manholes, and valves, comprise the remaining value. **Figure 16** visually illustrates the distribution of these costs across asset categories.

Table 55: Summary of Wastewater Utility Replacement Costs and Valuations

Group	Asset Class	Replacement Cost (in 2025$)	Net Book Value (PSAB, 2025$)
Linear Assets	Gravity Mains	$308,653,000	$107,542,000
Linear Assets	Force Mains	$46,061,000	N/A(2)
Linear Assets	Control Valves	$1,551,000	$156,000
Linear Assets	System Valves	$2,883,000	$3,432,000
Linear Assets	Manholes	$67,182,000	$8,742,000
Linear Assets	Services	$147,151,000	N/A(2)
Linear Assets	**Subtotal**	**$573,481,000**	**$119,873,000**
Plants and Facilities	Wastewater Treatment Plants	$1,271,316,000	$702,418,000
Plants and Facilities	Pump Stations	$175,106,000	$88,807,000
Plants and Facilities	CSO Tanks (1)	$15,552,000	$8,087,000
Plants and Facilities	**Subtotal**	**$1,461,974,000**	**$799,312,000**
ALL	**TOTAL**	**$2,035,455,000**	**$919,185,000**

Notes:

(1) Only the large CSO tanks are considered under facility valuation. Small tanks are included in linear infrastructure since they are simply oversized pipes

(2) Net Book value is pooled with Gravity Mains.

(3) The replacement pipes for service/lateral connections are assumed to be 150 mm PVC pipes.

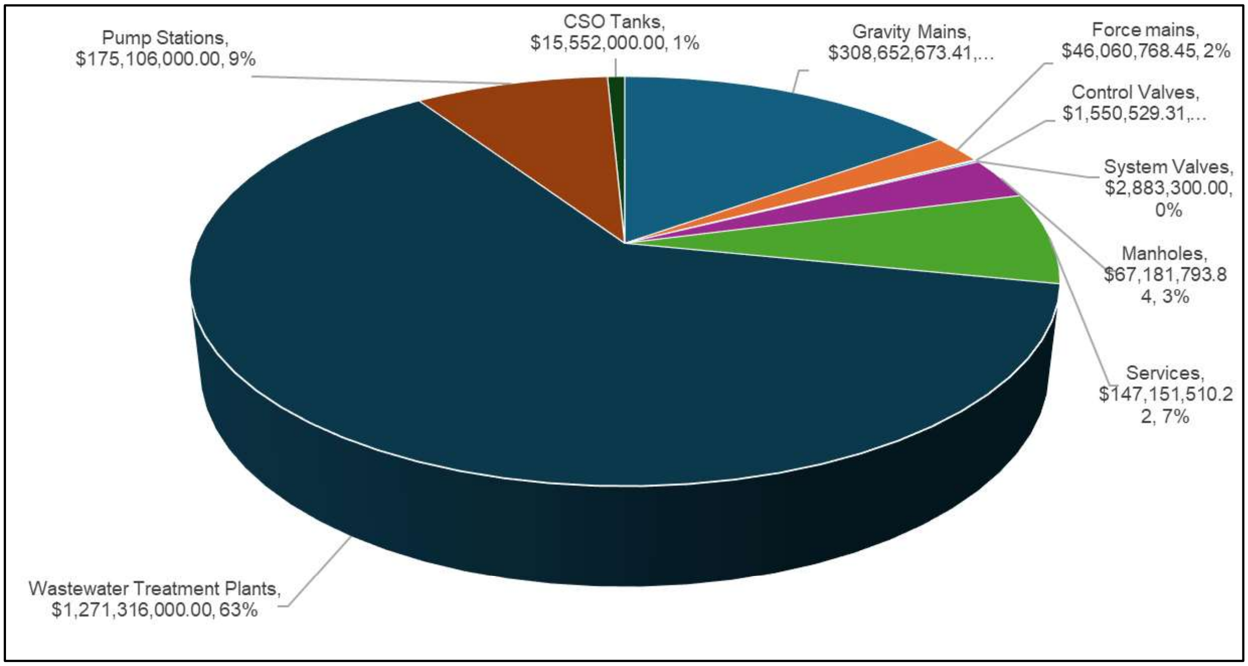

Figure 16. Asset Replacement Value for Wastewater Assets

D.1.2.1 Linear Assets

Linear assets form the backbone of the wastewater collection network and include gravity mains, force mains, manholes, valves, and service laterals. Their replacement cost is estimated at $573.48 million, with a PSAB NBV of $119.87 million, which reflects both depreciation and historical valuation pooling strategies.

Gravity Mains represent the largest linear component, accounting for a replacement cost of $308.65 million. The detailed breakdown of pipe sizes and materials, presented in **Table 56**, shows a wide range of pipe diameters from under 150 mm to over 3,000 mm, each contributing variably to the total cost. Notably, unknown-size pipes still represent a significant component of total valuation, with a PSAB NBV of over $60 million.

Force mains, with a total length of approximately 29.4 km, represent a smaller but essential pressure-based network component. The total replacement cost is estimated at $46.06 million. Due to accounting practices, their PSAB value is pooled under gravity mains and therefore not reported separately.

Manholes, control valves, and system valves are included under junction elements and collectively account for approximately $71.6 million in replacement cost. Their NBV is notably lower due to relatively older asset ages and historical valuation limits.

Services (laterals) are estimated at $147.15 million, assuming 150 mm PVC pipes, though they do not have a standalone PSAB value due to being grouped under gravity mains. Their extensive reach of over 427 km highlights their importance despite limited direct visibility in legacy valuation records.

Table 56: Detail of Linear Infrastructure Replacement Costs and Valuations

Group	Size	Quantity (Length, m)	Units	Replacement Cost ($2024)	PSAB Valuation (2024)
Gravity Main	<150mm	1,181.0	m	$453,179	$2,921,806
Gravity Main	150mm	5,284.6	m	$1,803,962	$1,144,195
Gravity Main	200mm	231,126.2	m	$111,738,045	$10,013,500
Gravity Main	225mm	9,031.3	m	$5,219,460	$586,545
Gravity Main	250mm	77,786.4	m	$45,232,728	$3,213,254
Gravity Main	300mm	54,177.3	m	$34,101,156	$3,683,133
Gravity Main	350mm	3,344.7	m	$2,469,865	$439,700
Gravity Main	375mm	23,063.8	m	$17,117,163	$2,948,035
Gravity Main	400mm	3,043.0	m	$2,264,664	$2,826,489
Gravity Main	450mm	23,213.9	m	$17,873,194	$3,876,285
Gravity Main	500mm	1,732.7	m	$1,369,712	$1,667,207
Gravity Main	525mm	6,074.2	m	$4,854,336	$2,351,075
Gravity Main	600mm	9,063.1	m	$7,866,258	$3,070,869
Gravity Main	675mm	3,354.7	m	$3,231,430	$146,264
Gravity Main	750mm	4,303.4	m	$4,536,161	$906,014
Gravity Main	825mm	3,715.0	m	$4,229,229	$669,999
Gravity Main	900mm	11,683.3	m	$14,741,220	$1,924,515
Gravity Main	1050mm	3,789.0	m	$5,432,120	$1,879,049
Gravity Main	1069mm	83.9	m	$121,604	$77,279
Gravity Main	1200mm	10,089.4	m	$15,729,338	$2,020,732
Gravity Main	1339mm	188.8	m	$354,793	$0

Group	Size	Quantity (Length, m)	Units	Replacement Cost ($2024)	PSAB Valuation (2024)
Gravity Main	1350mm	1,298.5	m	$2,570,403	$626,361
Gravity Main	1500mm	1,449.5	m	$3,333,886	$0
Gravity Main	2400mm	119.9	m	$473,616	$436,007
Gravity Main	3200mm	3.2	m	$16,331	$68,618
Gravity Main	Unknown	1,756.0	m	$1,518,823	$60,045,307
Gravity Main	**Subtotal**	**489,956.9**	**m**	**$308,652,673**	**$107,542,239**
Force Main	50	49.7	m	$49,475	N/A(1)
Force Main	75	258.2	m	$257,046	N/A(1)
Force Main	100	538.5	m	$432,899	N/A(1)
Force Main	150	5544.5	m	$4,696,540	N/A(1)
Force Main	200	3291.5	m	$3,004,482	N/A(1)
Force Main	250	1838.6	m	$1,746,658	N/A(1)
Force Main	300	1363.9	m	$1,375,177	N/A(1)
Force Main	350	632.0	m	$673,282	N/A(1)
Force Main	400	863.7	m	$970,399	N/A(1)
Force Main	450	2134.9	m	$2,910,700	N/A(1)
Force Main	500	49.3	m	$97,764	N/A(1)
Force Main	600	3433.3	m	$6,344,776	N/A(1)
Force Main	750	20.4	m	$41,364	N/A(1)
Force Main	900	3871.2	m	$8,578,218	N/A(1)
Force Main	933	2289.8	m	$5,446,975	N/A(1)
Force Main	1050	3093.5	m	$9,181,220	N/A(1)

Group	Size	Quantity (Length, m)	Units	Replacement Cost ($2024)	PSAB Valuation (2024)
Force Main	Unknown	144.3	m	$253,793	N/A(1)
Force Main	**Subtotal**	**29,417.2**	**m**	**$46,060,768**	**N/A(1)**
Junction	Manholes	6,944	ea	$67,181,794	$8,742,024
Junction	Control Valves	36	ea	$1,550,529	$155,946
Junction	System Valves	84	ea	$2,883,300	$3,432,430
Service	Laterals	427,100	m	$147,151,510	N/A(2)
ALL	**TOTAL**			**$573,480,575**	**$119,872,639**

Notes:
(1) Force mains and services are pooled with Gravity Mains for PSAB valuation.
(2) Net Book value is pooled with Gravity Mains.

D.1.2.2 Plants and Facilities

Facility-based assets encompass wastewater treatment plants (WWTPs), sewage pump stations, and combined sewer overflow (CSO) tanks. These assets are often complex, site-specific, and capital-intensive.

The total replacement cost for all plants and facilities is estimated at $1.46 billion, with a corresponding NBV of $799.3 million.

WWTPs make up the largest share of facility costs, totaling $1.27 billion in replacement value. As detailed in **Table 57**, the Ravensview and Cataraqui Bay WWTPs are the most significant facilities, accounting for $782 million and $485 million respectively, with their PSAB values at $399 million and $300 million. The Cana WWTP represents a significantly smaller share due to its size and service scope.

Sewage Pump Stations, comprising 29 facilities, collectively account for $175 million in replacement value. The highest individual cost is attributed to the River Street PS ($46.4 million), reflecting both its size and operational complexity. Other pump stations range from under $300,000 to over $24 million, depending on their scale and role within the system.

Large CSO Tanks (Collingwood, Emma Martin Park, and O'Kill/King) have a combined replacement value of $15.6 million, with a PSAB valuation of $8.1 million. Only large CSO tanks are included under facility valuation; smaller tanks are treated as linear infrastructure due to their functional similarity to large-diameter pipes.

Table 57: Detail of Plants and Facilities Replacement Costs and Valuations

Asset Class	Name of Facility	Replacement Cost (FCA Report) (2024$)	PSAB Valuation (2024$)
Wastewater Treatment Plants	Cataraqui Bay WWTP	$484,650,000	$299,616,868
Wastewater Treatment Plants	Ravensview WWTP	$782,321,000	$399,383,895
Wastewater Treatment Plants	CANA WWTP	$4,345,000	$3,417,239
Wastewater Treatment Plants	**Subtotal**	**$1,271,316,000**	**$702,418,002**
Sewage Pump Stations	Barret Crt. PS	$5,834,000	$2,080,304
Sewage Pump Stations	Bath Rd. PS	$2,900,000	$2,062,917
Sewage Pump Stations	Bath-Collins Bay Rd. PS	$736,000	$243,658
Sewage Pump Stations	Bath-Lower Dr. PS	$417,000	$130,554
Sewage Pump Stations	Bayridge Dr. PS	$1,580,000	$680,804
Sewage Pump Stations	Collins Bay Rd. PS	$757,000	$301,474
Sewage Pump Stations	Coverdale Dr. PS	$1,808,000	$728,762
Sewage Pump Stations	Crerar Blvd. PS	$4,063,000	$2,255,278
Sewage Pump Stations	Dalton Ave. PS	$21,628,000	$8,940,068
Sewage Pump Stations	Days Rd. PS	$24,984,000	$24,254,513
Sewage Pump Stations	Greenview Dr. PS	$1,810,000	$912,567
Sewage Pump Stations	Hillview Rd. PS	$6,112,000	$2,688,444
Sewage Pump Stations	Hwy-15 PS	$3,305,000	$1,322,698
Sewage Pump Stations	James St. PS	$2,439,000	$957,997
Sewage Pump Stations	John Counter Blvd. PS	$3,476,000	$2,286,622
Sewage Pump Stations	Kenwoods Cir. PS	$2,154,000	$876,409
Sewage Pump Stations	King St. PS	$18,354,000	$7,956,948
Sewage Pump Stations	King-Elevator Bay PS	$4,478,000	$1,874,257
Sewage Pump Stations	King-Lake Ontario Park PS	$350,000	$113,879
Sewage Pump Stations	King-Portsmouth PS	$9,089,000	$3,406,912
Sewage Pump Stations	Lakeshore Blvd. PS	$4,371,000	$1,594,469
Sewage Pump Stations	Morton St. PS	$2,044,000	$864,834
Sewage Pump Stations	Notch Hill Rd. PS	$277,000	$89,380
Sewage Pump Stations	Palace Rd. PS	$2,466,000	$1,386,104
Sewage Pump Stations	Rankin Cres. PS	$1,138,000	$469,715
Sewage Pump Stations	River St. PS	$46,418,000	$18,850,988
Sewage Pump Stations	Riverview Way PS	$1,170,000	$981,183
Sewage Pump Stations	Westbrook Rd. PS	$671,000	$387,891
Sewage Pump Stations	Yonge St. PS	$277,000	$107,275
Sewage Pump Stations	**Subtotal**	**$175,106,000**	**$88,806,904**
Combined Sewer Overflow (CSO) Tanks	Collingwood CSO	$2,514,000	$1,428,432
Combined Sewer Overflow (CSO) Tanks	Emma Martin Park CSO	$8,071,000	$4,013,614
Combined Sewer Overflow (CSO) Tanks	O'Kill/King CSO	$4,967,000	$2,645,020
Combined Sewer Overflow (CSO) Tanks	**Subtotal**	**$15,552,000**	**$8,087,066**
All	**Total**	**$1,461,974,000**	**$799,311,972**

D.1.2.3 Summary

The combined estimated replacement cost for UK's wastewater infrastructure stands at $2.02 billion, whereas the total NBV under PSAB reporting is $919.2 million. This substantial gap underscores both the aging profile of existing assets and the escalating cost of infrastructure renewal. As shown in **Table** *55* and **Figure 16**, most of the investment need lies in WWTPs and buried linear assets such as gravity mains and service laterals. These findings support the ongoing need for robust asset management planning, lifecycle cost modeling, and risk-based prioritization to ensure sustainable infrastructure performance over the long term.

D.1.3 Asset Age

This section presents the known age information of assets in UK's Wastewater Utility.

D.1.3.1 Linear Assets

Linear assets, including gravity mains, force mains, sewer valves, and manholes, have varying estimated useful lives based on PSAB 3150 Reporting. Sewers have an estimated useful life ranging from 50 to 80 years, with an average of 64 years assumed for both gravity mains and force mains. Sewer valves have an expected useful life of 50 years, and manholes are expected to have a lifespan of 75 years.

Table *58* presents the age distribution of gravity mains. The data shows a significant portion (17.2%) of the pipes are between 21-30 years old, closely followed by pipes aged 11-20 years (15.9%). Notably, 12.2% of gravity mains are approaching the upper end of their life expectancy (61-70 years). Additionally, 2.9% of the gravity mains have exceeded 100 years of age, emphasizing potential imminent maintenance or replacement needs.

Table 58: Gravity Main Age Distribution

Age	Percentage of Total Pipe Length
0-10 years	6.1%
11-20 years	15.9%
21-30 years	17.2%
31-40 years	12.0%
41-50 years	15.0%
51-60 years	12.7%
61-70 years	12.2%
71-80 years	2.3%
81-90 years	0.7%
91-100 years	0.3%
> 100 years	2.9%
Unknown Age	2.7%

Table *59* outlines the gravity mains in terms of their expected useful life. Approximately 44.6% of the gravity mains have utilized between 50-100% of their life expectancy, indicating a significant proportion of infrastructure approaching critical condition stages. Another 12.1% of gravity mains have surpassed their expected useful life of 64 years, highlighting areas requiring immediate attention.

Table 59: Gravity Main - Percentage of Expected Useful Life

Age	Life Percentage	Percentage of Life expended
<32	<50%	40.6%
32-64	50-100%	44.6%
>64	>100%	12.1%
Unknown	Unknown	2.7%

Table 60 provides the age distribution of force mains. A considerable portion (19.3%) of force mains are aged between 41-50 years, while another significant segment (13.2%) falls within 61-70 years. A high percentage (41.4%) of force mains have unknown ages, indicating potential gaps in data and the need for improved record-keeping to better assess condition and replacement needs.

Table 60: Force Main Age Distribution

Age	Percentage of Total Pipe Length
0-10 years	4.5%
11-20 years	3.4%
21-30 years	7.0%
31-40 years	4.3%
41-50 years	19.3%
51-60 years	4.1%
61-70 years	13.2%
71-80 years	2.4%
81-90 years	0.0%
91-100 years	0.0%
> 100 years	0.3%
Unknown Age	41.4%

Table 61 shows the percentage of expected useful life expended for force mains. Approximately one-third (33.2%) of the force mains have expended between 50-100% of their expected life, and another 10.1% are already beyond their expected useful life. The high percentage of assets with unknown ages (41.4%) underscores a substantial uncertainty in managing this infrastructure effectively.

Table 61: Force Main - Percentage of Expected Useful Life

Age	Life Percentage	Percentage of Life expended
<32	<50%	15.3%
32-64	50-100%	33.2%
>64	>100%	10.1%
Unknown	Unknown	41.4%

Table 62 highlights sewer valve age distribution. The majority (20.9%) of sewer valves are 21-30 years old, with an additional 16.9% between 11-20 years. Notably, nearly half (48.3%) of sewer valves have an unknown age, suggesting a critical area to improve knowledge.

Table 62: Sewer Valve Age Distribution

Age	Percentage of Total Pipe Length
0-10 years	3.5%
11-20 years	16.9%
21-30 years	20.9%
31-40 years	3.5%
41-50 years	6.4%
51-60 years	0.6%
61-70 years	0.0%
71-80 years	0.0%
81-90 years	0.0%
91-100 years	0.0%
> 100 years	0.0%
Unknown Age	48.3%

Table 63 indicates the sewer valves' expended life percentage. Roughly one-third (33.7%) of sewer valves have used less than half their life expectancy, suggesting relatively younger infrastructure. However, the substantial percentage of valves with unknown age (48.3%) represents a notable management challenge.

Table 63: Sewer Valve - Percentage of Expected Useful Life

Age	Life Percentage	Percentage of Life expended
<25	<50%	33.7%
25-50	50-100%	17.4%
>50	>100%	0.6%
Unknown	Unknown	48.3%

Table 64 illustrates the age distribution of manholes. The highest proportions are observed in the 11-to-30-year range (approximately 25.3% combined), indicating relatively newer infrastructure. Almost half (47.5%) of the manholes have an unknown age, emphasizing the need for enhanced asset data management.

Table 64: Manhole Age Distribution

Age	% of Total Pipe Length
0-10 years	7.4%
11-20 years	12.6%
21-30 years	12.7%
31-40 years	6.1%
41-50 years	5.2%
51-60 years	3.0%
61-70 years	5.1%
71-80 years	0.4%
81-90 years	0.0%
91-100 years	0.0%
> 100 years	0.0%
Unknown Age	47.5%

Table 65 reflects manholes expected useful life expended, showing that 37.8% have utilized less than half their lifespan. A small proportion (0.1%) of manholes has surpassed their life expectancy, which suggests minimal immediate concerns; however, the high percentage of unknown ages (47.5%) points to potential risks requiring further investigation. It is reasonable to assume that most of these manholes were installed at the same time as the gravity mains to which they are connected. It is recommended that UK update manhole data in the asset inventory to improve the completeness of the asset records.

Table 65: Manhole - Percentage of Expected Useful Life

Age	Life %	% of Life expended
<37.5	<50%	37.8%
37.5-75	50-100%	14.6%
>75	>100%	0.1%
Unknown	Unknown	47.5%

D.1.3.2 Plants and Facilities

Table 66 summarizes the construction years and major upgrades for various wastewater treatment plants and pump stations operated by UK. Facilities such as the Cana WWTP, constructed recently in 2017, represent the newer infrastructure with updated standards. Cataraqui Bay WWTP, built in 1962, has undergone multiple major upgrades, the latest in 2022, highlighting ongoing investments in older infrastructure to maintain performance standards. Similarly, Ravensview WWTP, built in 1957, underwent significant upgrades between 2007-2009 and again in 2017, emphasizing UK's commitment to maintaining critical infrastructure.

The majority of pump stations exhibit varied construction years ranging from the oldest, King-Portsmouth PS built in 1954, to newer facilities like Riverview Way PS, constructed in 2018, and Days Rd. PS, completed in 2023. Facilities such as Dalton Ave. PS, River St. PS, and Morton St. PS have seen multiple significant upgrades, reinforcing the strategic importance and high utilization of these assets. However, several pump stations, including Bath-Collins Bay Rd. PS, Bath-Lower Dr. PS, and Hillview Rd. PS, have not had major upgrades recorded, indicating potential upcoming investment needs.

CSO storage tanks are relatively newer, with Collingwood CSO and Emma Martin Park CSO both constructed in 2006, reflecting modern standards. O'Kill CSO, built in 1996 and upgraded in 2012, showcases a proactive approach in managing older facilities through upgrades to ensure reliable performance.

Table 66: Summary of Plant and Facility Age and Upgrades

Asset Class	Name of Facility	Estimated Year Built	Major Upgrades
Wastewater Treatment Plants	Cana WWTP	2017	Replacement of original facility.
Wastewater Treatment Plants	Cataraqui Bay WWTP	1962	1973, 1989, 1993, 2004, 2022
Wastewater Treatment Plants	Ravensview WWTP	1957	2007 - 2009, 2017
Pump Stations	Barret Crt. PS	1975	1986(1)
Pump Stations	Bath Rd. PS	1968	2011(1)
Pump Stations	Bath-Collins Bay Rd. PS	1977	-
Pump Stations	Bath-Lower Dr. PS	1981	-
Pump Stations	Bayridge Dr. PS	2000	-
Pump Stations	Collins Bay Rd. PS	1997	-
Pump Stations	Coverdale Dr. PS	1991	-
Pump Stations	Crerar Blvd. PS	1962	1995(1), 2011
Pump Stations	Dalton Ave. PS	1958	1976, 2007, 2020
Pump Stations	Days Rd. PS	2023	
Pump Stations	Greenview Dr. PS	1970	2017
Pump Stations	Hillview Rd. PS	1997	-

Asset Class	Name of Facility	Estimated Year Built	Major Upgrades
Pump Stations	Hwy-15 PS	1979	1995
Pump Stations	James St. PS	1979	1995
Pump Stations	John Counter Blvd. PS	2012	-
Pump Stations	Kenwoods Cir. PS	1990	-
Pump Stations	King St. PS	1957	1996(1),2012
Pump Stations	King-Elevator Bay PS	1988	-
Pump Stations	King-Lake Ontario Park PS	1966	-
Pump Stations	King-Portsmouth PS	1954	2000
Pump Stations	Lakeshore Blvd. PS	1974	1995, 2017
Pump Stations	Morton St. PS	1959	2005, 2018
Pump Stations	Notch Hill Rd. PS	1970	-
Pump Stations	Palace Rd. PS	1979	2005(1)
Pump Stations	Rankin Cres. PS	1981	-
Pump Stations	River St. PS	1957	2004, 2006, 2012
Pump Stations	Riverview Way PS	2018	-
Pump Stations	Westbrook Rd. PS	1994	2018
Pump Stations	Yonge St. PS	1979	1993, 2011(1)
CSO Storage Tank	Collingwood CSO	2006	-
CSO Storage Tank	Emma Martin Park CSO	2006	-
CSO Storage Tank	O'Kill CSO	1996	2012

Notes:
(1) Complete replacement or rebuild of facility (or believed to have been).

D.1.3.3 Summary

In summary, asset age information highlights both proactive management through consistent upgrades and areas requiring immediate attention. While significant investments in plants and facilities demonstrate UK's commitment to maintaining infrastructure, notable gaps in age documentation for linear assets and facility assets suggest opportunities for improvement in asset record management. Enhancing the completeness of asset age data will significantly support future maintenance planning and resource allocation decisions.

D.1.4 Asset Condition

This section presents the condition assessment information of assets in UK's Wastewater Utility.

D.1.4.1 Linear Assets

UK employs multiple contract types to undertake condition assessments of its linear assets. Most recent condition inspections (i.e., later than 2014) are based on the National Association of Sewer Service Companies (NASSCO) Pipeline Assessment Certification Program (PACP) and the Manhole Assessment Certification Program (MACP) standards. Historic condition inspections between 2002 and 2014 were based on the Water Research Centre method.

The PACP grading system (for local gravity mains) and consultant-led grading system (for trunk sewers) assesses sewer pipe conditions based on observed structural and operational & maintenance (O&M) defects, assigning grades from 1 to 5. Grade 1 indicates minor defects unlikely to lead to pipe failure in the foreseeable future, while Grade 5 represents severe defects with the highest potential for imminent pipe failure. Grades 4 and 5 are classified as poor conditions, requiring immediate or near-term attention. **Table 67** utilize this grading scale to summarize the condition of gravity mains.

Table 67: Condition Grade Summary of Gravity Main Asset Class

Gravity Main Condition Grade	Percentage of Gravity Mains by Length (Kilometers)
0 or 1 (Excellent)	67.5%
2 (Good)	11.8%
3 (Satisfactory)	6.9%
4 (Poor)	5.3%
5 (Fail)	8.6%

UK categorizes gravity mains with a PACP condition grade of 4 (poor) as undesirable and 5 (failed) as unacceptable. Approximately 67.5% of gravity mains are in excellent condition (grade 0 or 1), while 8.6% are considered to have failed (grade 5) and 5.3% are rated poor (grade 4), indicating immediate maintenance or replacement requirements. A notable portion (11.8%) is graded as good, indicating adequate short-term condition but warranting future monitoring.

Currently, there is no established condition assessment process for force mains using CCTV technology, which is commonly used for gravity mains. Furthermore, dedicated condition assessment programs for sewage valves and services are not in place. Service laterals are managed using a 'run-to-failure' approach.

Manhole condition assessments also utilize NASSCO’s MACP inspection standards based on a consultant-led grading system, assigning scores for structural (StG) and serviceability (SrG) deficiencies. **Table 68** summarizes manhole conditions, revealing that 73% of inspected manholes are in good condition, while approximately 14.4% fall into the bad or failed categories. These results highlight the need for targeted maintenance and potential renewal for a small but significant portion of the manhole inventory.

Table 68: Condition Grade Summary of Inspected Manhole Assets

Manhole Condition Grade	Percentage of Inspected Manholes
0 or 1 (Good)	73.0%
2 (Fair)	11.8%
3 (Poor)	5.7%
4 (Bad)	8.0%
5 (Failed)	1.4%

D.1.4.2 Plants and Facilities

UK continuously assesses the condition of its plants and facilities. **Table 70** summarizes these condition assessments, which were recently conducted by an external consultant for various wastewater facilities, including pump stations, WWTPs, and combined sewer overflow (CSO) storage tanks. The assessments are based on the *Water and Wastewater Condition Assessments* (by J.L. Richards & Associates Limited, 2025).

The Overall Rating system is used to summarize the general condition and maintenance urgency of wastewater utility assets. It provides a qualitative representation of infrastructure performance based on recent condition assessments. **Table 69** describes the reliability ratings range from A to D. This rating system supports UK in prioritizing investments, developing short- and medium-term maintenance plans, and ensuring service continuity by addressing emerging risks before they escalate into critical failures.

Table 69: Reliability Rating Description

Reliability Rating	Description
A	No action Required.
B	Minor repairs may be required to non-critical components. Review required, but no work required immediately.
C	Certain Assets/Equipment may need replacing in the near future. Review and plan maintenance.
D	Certain Assets/Equipment may need replacing in the immediate future and review is required to outline maintenance.

Most pump stations received a rating of B or C, indicating generally moderate conditions with varying degrees of maintenance needs. A total of six pump stations—Days Rd., Greenview Dr., John Counter Blvd., King-Lake Ontario Park, King-Portsmouth, and Riverview Way—received an A rating, suggesting good condition and no immediate maintenance needs. In contrast, Dalton Ave. PS and River St. PS were rated D, indicating deteriorated conditions and a higher urgency for action. King St. PS also received a D rating, warranting similar concern. The majority of other stations received B or C ratings, reflecting the need for planned upgrades or targeted maintenance.

WWTPs condition ratings indicate that Cana WWTP, Ravensview WWTP, and Cataraqui Bay WWTP are in acceptable operational condition, although Ravensview WWTP shows slightly higher deterioration. It is important to note that WWTPs are not currently assigned criticality, risk, or reliability ratings, as these complex facilities may require a separate and dedicated assessment framework beyond the current methodology. Similarly, large CSO tanks such as Collingwood, Emma Martin Park, and O'Kill/King demonstrate relatively consistent condition scores, reflecting adequate current conditions with moderate deterioration observed. These CSO facilities also do not currently have assigned criticality or overall risk ratings.

Table 70: Condition and Risk Assessment Summary for Pump Stations, WWTPs and Large CSO Tanks

Name of Pump Station	Total Facility Risk (1)	Total Equipment Risk (1)	Total Condition Score (1)	Reliability Rating	Overall Rating (1)
Barret Crt. PS	3	3.3	3	29.4	C
Bath Rd. PS	2.5	2.2	2.7	14.9	B
Bath-Collins Bay Rd PS	2.5	2.6	3.1	20.9	C
Bath-Lower Dr. PS	1.7	2.2	3.4	12.9	B
Bayridge Dr. PS	3	2.5	2.9	21.7	C
Collins Bay Rd. PS	2.5	2.9	3.2	22.9	C
Coverdale Dr. PS	1.9	2.6	3.2	16.4	B
Crerar Blvd. PS	2.3	2.1	2.8	13.5	B
Dalton Ave. PS	3.4	2.9	3	30.4	D
Days Rd. PS	3.8	2.4	1.1	10.1	A
Greenview Dr. PS	1.8	2.2	2.4	9.5	A
Hillview Rd. PS	3.2	2.7	2.8	24.2	C
Hwy-15 PS	2.6	2.5	2.8	17.9	B
James St. PS	3	2.7	2.8	22.7	C
John Counter Blvd. PS	1.9	2	2.2	8.1	A
Kenwoods Cir. PS	2	2.5	2.9	14.5	B
King St. PS	3.5	3	3.1	32.1	D
King-Elevator Bay PS	1.9	2.8	2.8	14.5	B
King-Lake Ontario Park PS	1.8	2.1	2.6	9.3	A
King-Portsmouth PS	1.8	2.2	2.8	10.7	A
Lakeshore Blvd. PS	2.1	2.5	2.7	14.6	B
Morton St. PS	2.5	2.3	2.6	15.4	B
Notch Hill Rd. PS	1.8	2.2	3.3	12.4	B
Palace Rd. PS	1.8	2	2.8	9.9	A
Rankin Cres. PS	1.7	2.5	2.9	12.1	B
River St. PS	3	3.3	3.2	32.4	D

Name of Pump Station	Total Facility Risk (1)	Total Equipment Risk (1)	Total Condition Score (1)	Reliability Rating	Overall Rating (1)
Riverview Way PS	1.7	1.6	2	5.5	A
Westbrook Rd. PS	2.1	1.9	2.7	10.6	A
Yonge St. PS	1.9	2.2	2.9	12.1	B
CANA WWTP	N/A	N/A	2.1 (2)	N/A	N/A
Ravensview WWTP	N/A	N/A	2.8 (2)	N/A	N/A
Cataraqui Bay WWTP	N/A	N/A	2.19 (2)	N/A	N/A
Collingwood CSO	N/A	N/A	2.4	N/A	N/A
Emma Martin Park CSO	N/A	N/A	2.3	N/A	N/A
O'Kill/King CSO	N/A	N/A	2.8	N/A	N/A

Notes:
(1) Data from Water and Wastewater Condition Assessments / Wastewater Facilities report (J.L. Richards, 2025).
(2) The amount has been calculated based on the average scores of sub-facilities.

D.1.4.3 Summary

In summary, condition assessments reveal a mixed but generally manageable status of UK's wastewater assets. While many gravity mains are in good to excellent condition, a notable percentage requires immediate intervention. Facilities such as pump stations predominantly require scheduled maintenance or rehabilitation, and the presence of facilities rated poor or bad underscores the importance of ongoing monitoring and proactive asset management practices. Improved condition assessment methodologies and documentation processes, particularly for force mains, junctions, and service laterals, remain crucial to enhancing future infrastructure resilience and reliability.

D.1.5 Maturity Plan

This section evaluates the maturity of UK's asset management practices in terms of both asset inventory and condition assessment. It uses recognized maturity index frameworks to benchmark current practices, identify gaps, and outline pathways for improvement.

D.1.5.1 Asset Inventory Maturity

Asset inventory maturity reflects the quality and completeness of data used to manage infrastructure assets. As summarized in

Table 71, UK's current asset inventory maturity level is assessed at the “Core” level for both linear and non-linear (plants and facilities) assets, as per IIMM (NAMS, 2011) guidelines. This indicates that the organization has achieved a fundamental baseline of information, including sufficient data for asset valuation and documentation of asset hierarchies, identification systems, and basic attributes such as age and type.

However, the system still relies heavily on GIS and spreadsheets, and there remain deficiencies in completeness and detail—particularly for asset classes such as sewer laterals, valves, and wastewater facilities. The next goal is to reach the “Intermediate” level by 2029, where a reliable and centralized asset register should provide both physical and financial information, along with integrated data analysis and reporting functionality. Achieving this level will require systematic data collection processes, improved data accuracy, and high confidence in data for all critical assets.

Table 71: Maturity Index - Asset Inventory

Maturity Level	Description	Status for Linear Assets	Status for Plants and Facilities (Non-linear) Assets
Minimum	Basic physical information recorded in a spreadsheet or similar (e.g. location, size, type), but may be based on broad assumptions or not complete.		
Core	Sufficient information to complete asset valuation – as for ‘minimum’ plus replacement cost and asset age/life. Asset hierarchy, asset identification and asset attribute systems documented.	We are here.	We are here.
Intermediate	A reliable register of physical and financial attributes recorded in an information system with data analysis and reporting functionality. Systematic and documented data collection process in place. High level of confidence in critical asset data.	Short-term Target for 2029	Short-term Target for 2029
Advanced	Information on work history type and cost, condition, performance, etc. recorded at asset component level. Systematic and fully optimized data collection program. Complete database for critical assets; minimal assumptions for non- critical assets		

D.1.5.2 Condition Assessment Maturity

Condition assessment maturity measures how effectively asset condition data is collected, analyzed, and used to support risk management, maintenance planning, and investment decisions. **Table 72** summarizes UK’s current position as being at the “Core” maturity level. This reflects the fact that structured condition assessment programs are in place for major asset types such as gravity mains, manholes, and wastewater facilities, and that condition data is being used to support life expectancy assessments and maintenance prioritization.

Despite this progress, there are still challenges, particularly the absence of condition assessment programs for force mains. Additionally, many assessments are conducted through contracts or on an ad hoc basis, with limited integration into centralized asset systems. The strategic objective is to reach the "Intermediate" level by 2029. This would entail developing a benefit-cost-driven assessment program, expanding condition data collection to all asset types (even through representative sampling), and fully integrating data validation and documentation processes into operational workflows.

Table 72: Maturity Index - Condition Assessments

Maturity Level	Description	Status of Current Plan
Minimum	Condition assessment at asset group level ('top- down'). Supports minimum requirements for managing critical assets and statutory requirements (e.g. safety).	
Core	Condition assessment program in place for major asset types, prioritized based on asset risk. Data supports asset life assessment. Data management standards and processes documented. Program for data improvement developed.	We are here.
Intermediate	Condition assessment program derived from benefit-cost analysis of options. A good range of condition data for all asset types (may be sampling-based). Data management processes fully integrated into business processes. Data validation process in place.	Short-term Target for 2029
Advanced	The quality and completements of condition information supports risk management, lifecycle decision-making and financial/performance reporting. Periodic reviews of program suitability carried out.	

D.1.5.3 Moving Forward

To advance UK's wastewater asset management practices, a structured set of improvement actions is recommended. **Table 73** outlines specific actions categorized by asset groups and classes, along with estimated levels of time and effort required.

Table 73: Summary of Asset Management Improvement Items

Asset Group	Asset Class	Description	Time and Effort
Linear Infrastructure	Services	Include in Enterprise GIS with pertinent attribute data.	Minimal, moving forward
Linear Infrastructure	Sanitary Cleanouts	Introduce a new asset class (if applicable) for cleanouts that may be required infrastructure to support the Consolidated ECA (MECP)	Develop and implement
Linear Infrastructure	Gravity Mains and Force Mains	Identify and update missing materials and installation years.	Minimal, moving forward
Linear Infrastructure	Force mains	A condition assessment process is required for the Force main Asset Class.	Moderate
Linear Infrastructure	Gravity Mains	Reassess risk assessment program	Moderate
Plants and Facilities	ALL	Research, select and implement a suitable asset management tool (Asset Registry) for Plants and Facilities.	Substantial in terms of time, effort and cost

For linear infrastructure assets, several manageable steps can significantly improve inventory maturity. Firstly, integrating service laterals fully into the Enterprise GIS, complemented by essential attribute data, represents a minimal ongoing effort but yields significant long-term management benefits. Additionally, introducing a new asset class for sanitary cleanouts—an emerging requirement to support the Consolidated Environmental Compliance Approval (MECP)—will ensure readiness for regulatory compliance. For gravity mains and force mains, incorporating material type, installation year, and potentially operational data into GIS inventory systems will enhance condition assessments and lifecycle planning, with minimal ongoing efforts.

A moderately resource-intensive yet critical step involves establishing a CCTV condition program specifically for gravity mains. This program would provide increased accuracy and reliability for condition assessments and support targeted maintenance activities. Equally important is developing and implementing an effective condition assessment process tailored specifically to force mains, addressing the current gap where conventional CCTV inspection methods are unsuitable.

Expanding and refining the junctions' asset class is recommended, clearly distinguishing between functional/mechanical junction features such as valves—which require proactive maintenance strategies—and static features requiring minimal maintenance. This delineation and associated development represent minimal to moderate effort.

For plants and facilities, substantial improvements can be realized through two key strategic actions. First, selecting and implementing a dedicated and robust asset management tool (Asset Registry) tailored specifically to plants and facilities is essential. This initiative requires significant initial investment in time, effort, and financial resources but will provide long-term benefits in asset management capability and decision-making accuracy. Secondly, while a comprehensive wastewater Facility Condition Assessment (FCA) has recently been completed and provides a solid foundation, this program should be continued on a regular basis to ensure condition data remains current and supports ongoing renewal planning. Building on this, a comprehensive facility valuation study, focusing on updated valuations and replacement cost assessments, would further enhance financial forecasting and asset lifecycle management.

Lastly, ensuring that WWTP and CSO tanks are fully incorporated into routine condition, criticality, and risk assessment assignments will solidify their asset management framework, aiding proactive maintenance scheduling and risk mitigation.

Implementing these outlined recommendations will strategically enhance the maturity and effectiveness of UK's wastewater asset management practices, ensuring sustainable infrastructure performance and compliance.

D.2 Current and Proposed Levels of Service (LOS)

D.2.1 Current Levels of Service (LOS)

The LOS indicate the quality of service provided, helping to guide UK in their management of infrastructure to meet specific service quality targets. For the 2025 AMP, UK has started with updating the existing LOS KPIs for the performance measure and added additional LOS KPIs required by O.Reg. 588/17 to help understand performance levels and to identify improvements.

Table 74 to **Table 78** summarize the LOS performance measures for the wastewater utility, categorized by performance and reliability, risk management, growth and planning, sustainability and environment, and financial aspects.

UK is currently monitoring both Customer Levels of Service (C-LOS) and Technical Levels of Service (T-LOS). C-LOS provides a means for evaluating how well customer expectations are being met, while T-LOS defines the specific, quantifiable service standards that an asset is expected to deliver throughout its lifecycle. The C-LOS indicators presented in

Table 74 to **Table 78** include the following:

- Number of sewer back ups caused by public infrastructure per 10,000 customers
- Service/Lateral repairs per 10,000 customers
- Number of gravity main backups per 100km of wastewater main
- Combined Water & Wastewater Costs to Residential Customer, as percentage of household income

These metrics support a comprehensive understanding of both customer satisfaction and asset performance, ensuring alignment with regulatory and operational objectives.

Table 74: Performance and Reliability - Wastewater

Key Performance Indicator	2023 Performance Score	2024 (Current) Performance Score	Target (2021 AMP)	Units/Notes
A.1) Number of sewer back ups caused by public infrastructure per 10,000 customers	0.00	1.52	Good:<2, Acceptable: 2-10, Unacceptable: >10.	#/10,000 customers (sourced from On-line Reporting Tool)
A.2) Service/Lateral repairs per 10,000 customers	5.03	4.97	Good: <10, Acceptable: 10-50, Unacceptable >50	#/10,000 customers (sourced from Excavation and Contracted Work Database)
A.3) Number of gravity main backups per 100km of wastewater main	0.00	1.22	Good: <1, Acceptable: 1-2, Unacceptable >2	#/100km of Main (sourced from Excavation and Contracted Work Database)
A.4) Pump Station Failures	0	0	Good: 0, Acceptable: 1-2, Unacceptable: >2	# of unplanned events causing sewage backups or bypassing. (Source: Bypass Log)

Key Performance Indicator	2023 Performance Score	2024 (Current) Performance Score	Target (2021 AMP)	Units/Notes
A.5) WWTP Effluent Quality (relative to Regulatory Standards)	Ravensview: 100% Cataraqui Bay: 100% Cana: 100%	Ravensview: 100% Cataraqui Bay: 100% Cana: 100%	Good: 100%, Unacceptable:<100 %	% of time WWTPs meets Regulatory Standards (Source: 2023 and 2024 WWTP annual reports)
A.6) WWTP Effluent Quality (relative to Process Objectives)	Ravensview: 100%(2) Cataraqui Bay: 54%(2) Cana: 50%(2)	Ravensview: 96%(2) Cataraqui Bay: 92%(2) Cana: 79%(2)	Good:≥ 11%, Acceptable: 9%-11%, Unacceptable: <9%	% of months WWTP meets Process Objectives (.
A.7) WWTP Daily Flows (relative to Rated Capacity)	Ravensview: 93.4% Cataraqui Bay: 86.3% Cana: 95.0%	Ravensview: 98.1% Cataraqui Bay: 98.6% Cana: 100%	Good: >95%, Acceptable: 90-95%, Unacceptable: <90%	% of days that daily flow is less than rated capacity (average daily). (Source: WWTP Data)
A.8) Amount of Wastewater Treated	99.18%	100%	Good: >99%, Acceptable: 98-99%, Unacceptable: <98%	% of total wastewater that has received Secondary Treatment (Source: WWTP Data & Overflow Log)
A.9) Wet-weather flow capture	≈ 99.5%	≈ 100%	Good: >95%, Acceptable: 90-95%, Unacceptable: <90%	% of estimated total wet- weather flows treated. (Source: WWTP Data & Overflow Log)

Table 75: Risk Management – Wastewater

Key Performance Indicator	2023 Performance Score	2024 (Current) Performance Score	Target (2021 AMP)	Units/Notes
B.1) Gravity Mains Risk Level.	-	Trunks: 85.94% Collectors: 97.32% Locals: 99.01%	Good: >95%, Acceptable: 90-95%, Unacceptable: <90% (or unknown)	% of pipe length that are of acceptable risk level. (Source: Gravity Mains Risk Assessment, 2025)
B.2) Force main Risk Level	-	All: To be determined	Good: >95%, Acceptable: 90-95%, Unacceptable: <90% (or unknown)	% of force main length that is of acceptable risk level. (Source: N/A)

Key Performance Indicator	2023 Performance Score	2024 (Current) Performance Score	Target (2021 AMP)	Units/Notes
B.3) Pump Station Risk Level (by size class) (Overall Rating)	-	Large: 1/4 (25%) Medium: 1/5 (20%) Small: 14/16 (87.5%) Very Small: 4/4 (100%)	Good: Low Risk [A,B], Acceptable: Moderate Risk [C]. Unacceptable: High Risk [D]	# (and %) of facilities that are considered to be of acceptable risk level. (Wastewater Facilities Condition Assessment, J,L. Richards & Associates, 2025)
B.4) CSO Tank Risk Level	-	All: Low	Good: Low, Acceptable: Moderate, Unacceptable: High	The perceived risk associated with the condition of the three facilities is low, as all CSO tanks have a condition rating of 2.3 - 2.8 for 2025, which is categorized as 'Good'. (Wastewater Facilities Condition Assessment, J,L. Richards & Associates, 2025)
B.5) Wastewater Treatment Plant Risk Level	-	Ravensview: Low Cataraqui Bay: Low Cana: Low	Good: Low, Acceptable: Moderate, Unacceptable: High	The perceived risk associated with the condition of the three facilities is low, as all WWTPs have a condition rating of 2.1- 2.8 for 2025, which is categorized as 'Good'. (Source: N/A)

Table 76: Growth and Planning - Wastewater

Key Performance Indicator	2023 Performance Score	2024 (Current) Performance Score	Target (2021 AMP)	Units/Notes
C.1) Sewer Master Plan Maturity	6.5yrs Old	7.5yrs Old	Good: <4 years, Acceptable: 4-6 years, Unacceptable: >6years	The age of the most recent Sewer Master Plan (latest: January 2017)
C.2) Facility Condition Assessment Maturity	6.5yrs Old	0 yr Old	Good: <5 years, Acceptable: 5-8 years, Unacceptable: >8years	The age of the most recent Plants & Facilities Condition Assessment (Latest: FCA, 2025)

C.3) WWTP Uncommitted Reserve Capacity (estimated years)	-	Ravensview: >20 Cataraqui Bay: >20 Cana: N/A	Good: >20 years, Acceptable: 12-20 years, Unacceptable: <12 years	Estimated number of years required prior to next WWTP capacity upgrade, as per MOE D-5-1. Cana not assessed since no growth is permitted in service area.
C.4) Linear System Risk Assessment Completeness	-	Gravity Mains: 100%	Target: 100%, Acceptable: 80-99%, Unacceptable: <80%	Risk Assessment is founded on the Condition Assessment Results. This % represents the fraction of all assets with completed condition assessment.

Table 77: Sustainability and the Environment – Wastewater

Key Performance Indicator	2023 Performance Score	2024 (Current) Performance Score	Target (2021 AMP)	Units/Notes
D.1) Rate of Sewer Separation (relative to 2008 benchmark conditions)	2.3% (or 1.0% by area)	1.9% (or, 1.1% by area)	High: >3.0%, Moderate: 2.0-3.0%, Low: <2.0%	% of street blocks of completed sewer separation expressed as % relative to January 2008 total. (source: GIS)
D.2) Remaining Combined Sewer Service Area (relative to 2008 benchmark conditions).	49.6% (or 53.5% by area)	47.7% (or, 52.4% by area)	N/A, for Information	Estimated remaining combined sewer service area (by serviced hectare) relative to January 2008 total. (Source: GIS) Ranges are for end of 2024.
D.3) Bulk Extraneous Flow	29.6%	22.8%	Good: <10%, Acceptable: 10-20%, Unacceptable: >20%	Calculated as the percent difference between total wastewater treated and total potable water produced (source: WTP & WWTP data)

Table 78: Financial – Wastewater

Key Performance Indicator	2023 Performance Score	2024 (Current) Performance Score	Target (2021 AMP)	Units/Notes
E.1) Combined Water & Wastewater Costs to Residential Customer, as percentage of household income	1.21%	5.60%	Good: <10%, Acceptable: 10-20%, Unacceptable: >20%	UK's sewage rates as a percentage of provincial average (Source: Municipal Study, 2015). Burden is average cost to residential customer versus average household income.
E.2) Debt Repayment a) Debt Interest Repayment as percentage of revenue. b) Total Debt Repayment as percentage of revenue	a) 11% b) 22%	a) 12% b) 24%	Good: <25%, Undesirable: >25%	This % represents the total debt repayment as compared to total revenue (Source: UK Finance)
E.3) Wastewater Debt Outstanding per Customer	$3,020	$2,871	No Ranges defined.	Source: 10yr budget forecast, January, 2025
E.4) Estimated Annual Budget Deficit	N/A	$76.6 M	No Ranges defined.	Total Estimated Required Capital less estimated available funds (per year). (Source: 10-year budget forecasts)

D.2.2 Proposed Levels of Service (LOS)

Following Stantec's evaluation, several refinements to the Levels of Service (LOS) KPIs are proposed to enhance operational clarity and derive more actionable insights. Specifically, KPI A.2 (Service/Lateral Repair) is recommended for removal from the Performance and Reliability category, as it has not provided significant insights for guiding operational decisions or assessing system reliability. Additionally, KPI A.1, which addresses the number of sewage backups, has been updated to measure the number of days per year that properties connected to the municipal wastewater system experience wastewater backups. This revision provides a clearer, more accurate representation of service reliability in relation to the overall service base. Furthermore, KPI C.4 (Linear System Risk Assessment Completeness), previously under Growth and Planning, should be relocated to the Risk Management category. This repositioning ensures that the KPI more accurately aligns with its intended purpose of tracking the completeness and effectiveness of risk assessments within the system. To further strengthen environmental performance tracking, a new KPI have been introduced under the *Sustainability and the Environment* category. KPI D.4, Wastewater Total Greenhouse Gas Emissions Intensity (GHGI), tracks the percentage reduction in GHG emissions from utility energy use compared to 2018 baseline levels. Collectively, these adjustments aim to enhance the effectiveness of the KPIs in reflecting service quality, improving operational accountability, and supporting proactive system management.

Table 79 presents the updated KPIs list that the UK will continue to monitor for wastewater infrastructure system.

The C-LOS indicators presented in **Table 79** include the following:

- The number of days per year with wastewater backups, relative to the total number of properties connected to the municipal wastewater system.
- Gravity Main Backups
- Combined Water & Wastewater Costs to Residential Customer, as percentage of household income.

Table 79: Proposed KPIs - Wastewater

LOS	Key Performance Indicator	2023 Performance Score	2024 (Current) Performance Score	Target (2025-2034)	Units/Notes
A. Performance & Reliability	A.1) The number of days per year with wastewater backups, relative to the total number of properties connected to the municipal wastewater system.		-	To be determined	This is a new KPI that is not currently being tracked. To enable future reporting, the tracking mechanism will need to be updated. This should be considered for inclusion in ongoing data collection and monitoring processes.
	A.2) Gravity Main Backups	0.00	1.22	Good: <1, Acceptable: 1-2, Unacceptable >2	#/100km of Main (source: N/A)
	A.3) Pump Station Failures	0	0	Good: 0, Acceptable: 1-2, Unacceptable: >2	# of unplanned events causing sewage backups or bypassing. (Source: Bypass Log)
	A.4) WWTP Effluent Quality (relative to Regulatory Standards).	Ravensview: 100% Cataraqui Bay: 100% Cana: 100%	Ravensview: 100% Cataraqui Bay: 100% Cana: 100%	Good: 100%, Unacceptable:<100%	% of time WWTPs meets Regulatory Standards (Source: 2023 and 2024 WWTP annual reports)
	A.5) WWTP Effluent Quality (relative to Process Objectives).	Ravensview: 100%(2) Cataraqui Bay: 54%(2) Cana: 50%(2)	Ravensview: 96%(2) Cataraqui Bay: 92%(2) Cana: 79%(2)	Good:≥11, Acceptable: 9-11, Unacceptable: <9	% of months WWTP meets Process Objectives (1) Wet-weather & Plant is in reconstruction (2). TP & TSS associated with unbalanced flows.
	A.7) WWTP Daily Flows (relative to Rated Capacity)	Ravensview: 93.4% Cataraqui Bay: 97.0% Cana: 95.0%	Ravens view: 98.1% Cataraqui Bay: 98.6% Cana: 100%	Good: >95%, Acceptable: 90-95%, Unacceptable: <90%	% of days that daily flow is less than rated capacity (average daily). (Source: WWTP Data)
	A.8) Amount of Wastewater Treated	99.18%	100%	Good: >99%, Acceptable: 98-99%, Unacceptable: <98%	% of total wastewater that has received Secondary Treatment (Source: WWTP Data & Overflow Log)
	A.9) Wet-weather flow capture	≈ 99.5%	≈ 100%	Good: >95%, Acceptable: 90-95%, Unacceptable: <90%	% of estimated total wet-weather flows (Source: WWTP Data & Overflow Log)
B. Risk Management	B.1) Gravity Mains Risk Level.	-	Trunks: 86.35% Collectors: 97.32% Locals: 99.01%	Good: >95%, Acceptable: 90-95%, Unacceptable: <90% (or unknown)	% of pipes that are considered to be of acceptable risk level. (Source: Gravity Mains Risk Assessment)
	B.2) Force main Risk Level	-	-	Good: >95%, Acceptable: 90-95%, Unacceptable: <90% (or unknown)	% of force main length that is considered to be of acceptable risk level. (Source: N/A)
	B.3) Pump Station Risk Level (by size class)	-	Large: 1/4 (25%) Medium: 1/5 (20%) Small: 14/16 (87.5%) Very Small: 4/4 (100%)	Good: Low Risk [A,B], Acceptable: Moderate Risk [C]. Unacceptable: High Risk [D]	# (and %) of facilities that are considered to be of acceptable risk level .
	B.4) CSO Tank Risk Level	-	All: Low	Good: Low, Acceptable: Moderate, Unacceptable: High	The perceived risk associated with the condition of the three facilities is low, as all CSO tanks have a condition rating of 2.3 - 2.8 for 2025, which is categorized as 'Good'. (Wastewater Facilities Condition Assessment, J, L. Richards & Associates, 2025)
	B.5) Wastewater Treatment Plant Risk Level	-	Ravensview: Low Cataraqui Bay: Low Cana: Low	Good: Low, Acceptable: Moderate, Unacceptable: High	The perceived risk associated with the condition of the three facilities is low, as all WWTPs have a condition rating of 2.1- 2.8 for 2025, which is categorized as 'Good'. (Wastewater Facilities Condition Assessment, J, L. Richards & Associates, 2025)

LOS	Key Performance Indicator	2023 Performance Score	2024 (Current) Performance Score	Target (2025-2034)	Units/Notes
	B.6) Linear System Risk Assessment Completeness	-	Gravity Mains: 100%	Target: 100%, Acceptable: 80-99%, Unacceptable: <80%	Risk Assessment is founded on the Condition Assessment Results. This % represents the fraction of all assets with completed condition assessment. Note that only Dalton Ave SPS Force mains have had a condition assessment completed.
C. Growth and Planning	C.1) Sewer Master Plan Maturity	6.5yrs Old	7.5yrs Old	Good: <4 years, Acceptable: 4-6 years, Unacceptable: >6years	The age of the most recent Sewer Master Plan (latest: January 2017)
	C.2) Facility Condition Assessment Maturity	6.5yrs Old	0 yrs Old	Good: <5 years, Acceptable: 5-8 years, Unacceptable: >8years	The age of the most recent Plants & Facilities Condition Assessment (Latest: January 2017, part of MP)
	C.3) Number of years before flows are estimated to reach the plant's ECA rated capacity	-	Ravensview: >20 years Cataraqui Bay: >20 years Cana: N/A	Good: >20 years, Acceptable: 12-20 years, Unacceptable: <12 years	Estimated number of years required prior to next WWTP capacity upgrade, as per MOE D-5-1. (Source: D-F-1 Analysis by UK engineering, 2025). Cana not assessed since no growth is permitted in service area.
	C.4) Number of years before flows are estimated to reach 80% of the plant's ECA rated capacity	-	Ravensview: 14 years; Cat Bay: 14 years; Cana: N/A	No Ranges defined.	Estimated number of years before flows are estimated to reach 80% of the plant's ECA rated capacity, indicating a need to commence review. Cana does not assess since no growth is permitted in service area.
D. Sustainability and the Environment	D.1) Rate of Sewer Separation (relative to 2008 benchmark conditions)	2.3% (or 1.0% by area)	1.9% (or, 1.1% by area)	High: >3.0%, Moderate: 2.0-3.0%, Low: <2.0%	% of street blocks of completed sewer separation expressed as % relative to January 2008 total. (source: GIS)
	D.2) Remaining Combined Sewer Service Area (relative to 2008 benchmark conditions).	49.6% (or 53.5% by area)	47.7% (or, 52.4% by area)	N/A, for Information	Estimated remaining combined sewer service area (by serviced hectare) relative to January 2008 total. (Source: GIS)
	D.3) Bulk Extraneous Flow	29.6%	22.8%	Good: <10%, Acceptable: 10-20%, Unacceptable: >20%	Calculated as the percent difference between total wastewater treated and total potable water produced (source: WTP & WWTP data)
	D.4) NEW KPI: Wastewater Total GHG Emissions Intensity (GHGI) from Utility Energy Usage reduction compared to 2018 baseline values (as a %)	1. Cat Bay WWTP: +125.7% 2. Ravensview WWTP: -15.0%	1. Cat Bay WWTP: +106.7% 2. Ravensview WWTP: +15.6%	Good: ≤ -50% Acceptable: > -50% to +10% Unacceptable: > +10%	The reported greenhouse gas emissions intensity (GHGI) reflects only energy-related emissions from utility-supplied natural gas and electricity as a function of m3 of wastewater treated per day. Emissions from fleet fuel use, fugitive process emissions, and on-site biogas combustion are excluded from this total. Other notes: a) Cat Bay WWTP: A major upgrade was completed between the baseline year (2018) and present accounting for a large portion of the relative energy use increase. b) Ravensview WWTP: Energy use produced by the Combined Heat and Power (CHP) system is excluded from the energy use calculation, in line with Ministry of Energy & Mines reporting which focuses on purchased energy.
E. Financial	E.1) Combined Water & Wastewater Costs to Residential Customer, as percentage of household income.	1.21%	5.60%	Good: <10%, Acceptable: 10-20%, Unacceptable: >20%	UK's sewage rates as a percentage of provincial average (Source: Municipal Study, 2015). Burden is average cost to residential customer versus average household income.

LOS	Key Performance Indicator	2023 Performance Score	2024 (Current) Performance Score	Target (2025-2034)	Units/Notes
	E.2) Debt Repayment a) Debt Interest Repayment as percentage of revenue. b) Total Debt Repayment as percentage of revenue	a) 11% b) 22%	a) 12% b) 24%	Good: <25%, Undesirable: >25%	This % represents the total debt repayment as compared to total revenue (Source: UK Finance)
	E.3) Wastewater Debt Outstanding per Customer	$3,020	$2,871	No Ranges defined.	Source: 10yr budget forecast, January, 2025
	E.4) Estimated Annual Budget Deficit	-	$76.6 M	No Ranges defined.	Total Estimated Required Capital less estimated available funds (per year). (Source: 10 year budget forecasts)

D.2.3 Maturity

Table 80 evaluates the maturity of current LOS management practices. Currently, UK is at a minimal maturity level, with foundational definitions of service objectives. The short-term target by 2031 is to achieve a "Core" maturity level, characterized by clearly defined customer groups, established performance measures, and systematic annual reporting.

Table 80: Maturity Index - Levels of Service

Maturity Level	Description	Status of Current Plan
Minimum	Asset contribution to organization's objectives and some basic levels of service have been defined.	We are here.
Core	Customer Groups defined and requirements informally understood. Levels of service and performance measures in place covering a range of service attributes. Annual reporting against performance targets.	Short-term Target for 2031
Intermediate	Customer Group needs analyzed. Costs to deliver alternate key levels of service are assessed. Customers are consulted on significant service levels and options.	
Advanced	Levels of service consultation strategy developed and implemented. Technical and customer levels of service are integral to decision-making and business planning.	

D.2.4 Moving Forward

To progress toward the targeted "Core" maturity level, UK should focus on clearly defining customer groups and consistently incorporating their requirements into asset management planning. Establishing comprehensive performance measures covering various service attributes, along with annual reporting, will significantly enhance transparency and accountability. Additionally, implementing regular consultations with customers regarding service levels, supported by robust cost analyses of service options, will ensure that future service improvements align with community expectations and available resources. These steps will lay the foundation for advanced decision-making processes, enabling UK to transition effectively toward higher maturity in asset management practices.

D.3 Asset Management Strategy

The Asset Management Strategy for the Wastewater Utility is guided by the following foundational principles:

- **Growth** serves as the primary driver for the development of new infrastructure, asset replacements, or major system upgrades.
- **Risk** acts as a secondary driver for determining the need for asset replacement or significant upgrades.

- **Maintenance** is essential for preserving asset functionality, managing risk at acceptable levels, and achieving the lowest possible lifecycle cost while maintaining the desired level of service.

At UK, wastewater asset management is structured around four core components:

1. **Infrastructure Planning and Demand Management** – These long-term planning studies focus on managing future growth and ensuring infrastructure capacity aligns with the City's evolving needs. Typically considering a 20- to 25-year planning horizon, these studies identify necessary capacity expansions, process improvements, and new infrastructure requirements.
2. **Risk Assessment** – Risk-based assessments evaluate asset condition and criticality to proactively identify maintenance, rehabilitation, and replacement needs. The outcome is a prioritized list of assets requiring remedial actions or new infrastructure to mitigate risk and enhance system resilience.
3. **Lifecycle Decision-Making** – This component involves using lifecycle analysis to determine the most cost-effective and appropriate interventions for assets flagged during infrastructure planning or risk assessments. The focus is on optimizing timing and investment to ensure long-term performance.
4. **Maintenance Management** – In the absence of specific triggers such as growth or risk, routine maintenance serves as the default approach to preserve asset condition and service delivery. This includes ongoing inspection, cleaning, and minor repairs to maintain performance and defer major capital investments.

Detailed descriptions of each of these four components are provided in the following sub-sections.

D.3.1 Infrastructure Planning and Demand Management

Infrastructure Planning is responsible for ensuring that infrastructure is adequate to meet the needs of the existing and future customer loads in consideration of existing and future regulatory requirements. For the Wastewater Utility, this means that infrastructure is of adequate capacity to meet future growth conditions, including both Linear Infrastructure as well as Plants and Facilities. For example, the wastewater treatment plants must be able to treat future loads at existing and any anticipated regulatory standards for effluent quality within a reasonable planning window. **Table** *81* provides a list of Infrastructure Planning Studies.

Infrastructure Planning studies generally produce the following:

- Triggers for replacement or major upgrades of existing assets due to insufficient size, capacity, or effluent quality to meet existing or future needs.
- Triggers for construction of new assets to service future growth areas.

- Triggers for decommissioning of existing assets.
- Strategic approaches to accomplishing stated goals.
- Approximate timing associated with the above.

A Master Plan typically accomplishes the above. Water and Wastewater Master Planning will be undertaken in 2025, utilizing common growth and development conditions and assumptions.

Projects identified through planning exercises require capital expenditure that originates from sewer rates and/or development charges (for growth-related activities). At times, significant projects may require additional funding from sources such as grants and/or new debt.

Table 81: Infrastructure Planning Studies

Study	Description	Frequency	Assets
Master Plan (MP)	Sewer Master Planning assignments are initiated by UK with new development plans or growth projections. A Master Plan typically follows a Growth Strategy and should examine all major development areas considered within a 25-year horizon. It provides recommendations on what facility upgrades or new facilities are required to meet growth demands.	Typically, 5-7 years.	Major Facilities Including WWTP, PS, CSO, larger Gravity Sewers and Force mains
Pollution Prevention and Control Plan (PPCP)	A Pollution Prevention and Control Plan (PPCP) is typically completed in conjunction with a Master Plan. It focuses specifically on sewage overflows, combined sewer areas, extraneous flows relative to MOE Procedure F-5-5. It provides guidance on how to proceed with reduction of bypasses.	Typically, 5-7 years	Major Facilities Including WWTP, PS, CSO, larger Gravity Sewers and Force mains
Development Charges Bylaw Review	The Development Charges Act, 1997, subsection 2(1) authorizes municipalities to pass a bylaw to impose development charges against land to pay for increased capital costs required because of increased needs for services arising from development. The City collects development charges pursuant to Bylaw 2019-116, "A Bylaw To Establish Development Charges For The City Of Kingston", passed by Council on September 3, 2019	Typically, every 5 years	May include all asset classes and scales.
Environmental Assessments (EA)	Environmental Assessments are conducted for recommended projects from MP or PPCP, or, as initiated due to UK-driven or City-driven initiatives. At times they include scales larger than the facility or asset being studied itself and may derive other recommendations that impact other assets as well.	As required.	May include all asset classes and scales.
Site-Specific Development Studies	Larger-scale developments require area-specific studies that may generate recommendations for facilities or linear assets at any scale.	As required.	May include all asset classes and scales.

Study	Description	Frequency	Assets
Uncommitted Plant Reserve Capacity Analyses	Treatment Plants require diligence in tracking available capacity to ensure upgrades are initiated in a timely manner. The exercise follows MOE Procedure D-5-1.	As required.	WWTP
Capacity Assurance	A capacity assurance program should be implemented. This is not currently in place and needs to be developed.	TBD	Gravity Mains, Force mains, Pump Stations.

D.3.1.1 Growth Estimation

Growth in population and customer base directly influences the expansion of wastewater infrastructure and associated lifecycle costs. While growth-related studies such as those listed in **Table 81** guide the identification of specific capital projects—such as wastewater treatment plant (WWTP) expansions, trunk sewer construction, and new pumping stations—these studies do not address the corresponding long-term increases in asset management expenditures. As new infrastructure is added to accommodate growth, annual capital and operations & maintenance (O&M) expenditures will increase proportionally, particularly in asset-intensive classes such as gravity mains. However, since asset growth typically parallels growth in the customer base, utility rates may remain stable unless the desired level of service (LoS) is jeopardized.

A key source of information is used to inform both short- and long-term growth projections for this AMP is:

- Population, Housing and Employment Growth Analysis Study, City of Kingston (Watson & Associates Economics Ltd, 2024.

D.3.1.1.1 Short-term Growth

Short-term growth is evaluated based on recent trends in sewer customer accounts. Between 2020 and 2024, the total number of sewer customers increased from 36,800 to 39,528, representing a growth of approximately 7.4% over four years. This equates to an average annual growth rate of about 1.8%, slightly higher than previous short-term estimates of 1.0–1.3%.

The growth continues to be driven primarily by residential development, with commercial account growth remaining relatively stable. This upward trend in customer base indicates sustained development activity and aligns with the broader population growth projections. Consequently, infrastructure and asset expansion efforts must continue to accommodate this increasing demand, while maintaining current service levels and ensuring system resiliency.

D.3.1.1.2 Long-term Growth

Long-term growth projections are informed by the Population, Housing and Employment Growth Analysis Study, 2024. This source provides insight into anticipated population changes that will influence the long-term demand for wastewater services and associated infrastructure planning.

According to the studies, Kingston's permanent population is expected to increase from approximately 136,300 in 2021 to 197,000 by 2051, while the student population is projected to grow from 17,800 to 23,900 over the same period. When combined, the total population (permanent and students) is forecasted to rise from 154,100 in 2021 to 220,900 in 2051, as illustrated in **Figure 17** below.

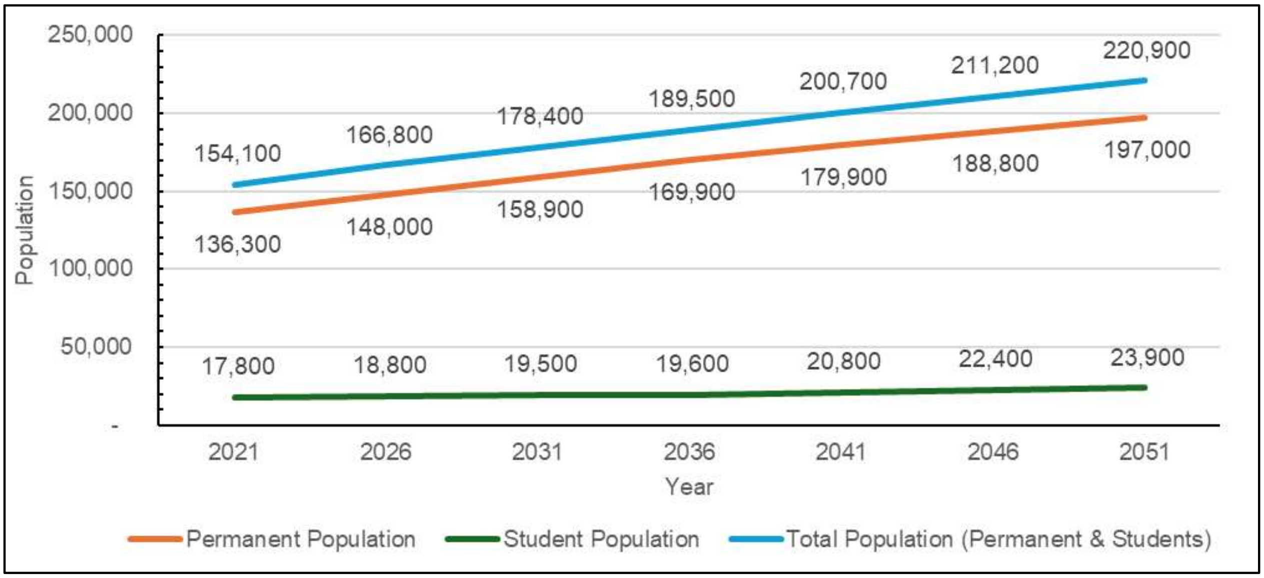

Figure 17: Population Forecast (Watson and Associates, 2024)

This projection represents a total growth rate of approximately 43% over 30 years, or an average annual growth rate of 1.2%, with growth tapering slightly in later decades. The inclusion of the student population in the analysis is essential, as students typically reside in Kingston for the majority of the year and therefore contribute meaningfully to wastewater loading and service requirements.

Given this projected population growth, it is reasonable to assume a corresponding increase in the asset base at a similar rate—particularly for localized infrastructure such as gravity mains, manholes, and service laterals, which are often constructed by developers and transferred to City ownership. This underscores the importance of long-range planning and budget forecasting to ensure service levels are maintained as the community grows.

D.3.1.2 Demand Management

In the context of wastewater infrastructure, demand management refers not to increasing service usage, as is typical in other utilities, but to reducing the volume and variability of flow entering the sanitary sewer system. This includes minimizing avoidable and non-sanitary inflows that add unnecessary strain on collection, conveyance, and treatment facilities. The key components that influence wastewater system demand include sanitary water use, extraneous flows (infiltration and inflow), and contributions from combined sewage systems.

Water consumption directly affects base sanitary flows. Efforts to reduce this demand are addressed in the Water Utility Asset Management Plan (Section B) through ongoing water conservation programs and initiatives to minimize non-revenue water. These programs, such as asset replacements, leak detection, improved metering, and public education campaigns, indirectly support wastewater demand management by reducing the volume of wastewater generated.

UK has previously implemented a range of measures to identify and remove sources of inflow and infiltration (I/I) in the sanitary system. On the public side, these have included smoke testing, CCTV inspections, cured-in-place pipe (CIPP) lining, joint sealing, and spot repairs—efforts aimed at restoring system capacity and improving reliability. On the private side, the Preventative Plumbing Program and enforcement of Sewer Use Bylaw 2008-192 have supported the disconnection of unauthorized inflow sources such as downspouts, foundation drains, and sump pumps. Revisiting and rejuvenating I&I reduction strategies will likely be an important consideration in the future Master Plan to help reduce future needs for both facility and linear infrastructure capacity upgrades.

The City of Kingston, with support from UK, has steadily worked toward eliminating its combined sewer system and transitioning to fully separated systems. While the rate of sewer separation has slowed down in the last 5 years, in part due to the COVID-19 pandemic and resource limitations, it continues to remain a priority. The ongoing Water and Wastewater Master Plan project will consider the preparation of a Pollution Prevention & Control Plan including the development of a Strategic Sewer Separation Plan to be completed in 2026. Since 2008, the rate of separation has varied; while projects from 2013 to 2020 averaged 2–3% of the system per year, the Council-endorsed plan aims to eliminate the remaining combined sewers over a 20-year period beginning in 2023. Achieving full separation will help reduce the risk of wet-weather overflows, basement flooding, and treatment plant bypass events.

Although demand management efforts do not typically result in immediate capital or operating cost reductions—given that infrastructure decisions are not always driven by wet-weather events—they yield significant long-term benefits. These include the deferral of costly capital upgrades, the potential elimination of unnecessary infrastructure, reduced stress on treatment facilities, improved system performance, and enhanced compliance with environmental regulations. UK remains committed to implementing and improving demand management programs that reduce loading on wastewater infrastructure and support sustainable utility service delivery.

D.3.1.3 Planning and Growth Implications

Planning and growth-related studies have identified a wide range of capital projects and multi-year programs that are distinct from the Utility's regular infrastructure renewal activities. These initiatives reflect the infrastructure investments required to support growth in wastewater collection sewers, pumping stations, and treatment plants across Kingston. They are typically identified through the City's Development Charges Background Study and long-range infrastructure planning documents, including the *City of Kingston Water and Wastewater Master Plan – Growth Scenario Report* (WSP, 2017), and are reflected in Utilities Kingston's 10-year budget forecast.

The capital works span a mix of new sewer installations, upsizing of existing collectors and forcemains, and major capacity upgrades to pumping stations and treatment facilities. All identified growth-related projects and programs are expected to be fully or partially funded through Development Charges (DCs). Consequently, these investments are typically co-funded by the development community and other funding sources. This multi-source funding approach should be considered when interpreting the long-range capital forecasts outlined in **Section E** of this report.

D.3.2 Risk Management

Risk management remains a fundamental element in optimizing the lifecycle of wastewater assets. Once growth and capacity-based infrastructure needs are addressed, the subsequent decision-making is rooted in risk assessment, which allows UK to proactively manage and prioritize system renewal based on urgency and impact.

Risk is determined by assessing two principal components: criticality and condition. Criticality reflects the consequence of failure and is informed by factors such as location, service population, asset size, and environmental impact. Condition represents the likelihood of failure and is derived from systematic inspections and assessments. By combining these elements, UK calculates a quantitative risk score for each asset, allowing for defensible prioritization of asset interventions. The following sub-sections describe the processes.

D.3.2.1 Criticality Assessment

Criticality is an indication of how important an asset is to the function of the wastewater utility. It is also an indication of the severity of the consequence of failure. For example, a large sewage force main that crosses a river is an asset with higher criticality than a smaller force main that services a small neighbourhood. This is because the larger force main services more customers and the consequence of its failure is much more severe. Criticality assessments have been completed on Pump Stations, CSO tanks, gravity mains and force main Asset Classes. These processes should be formalized and documented.

D.3.2.1.1 Plants and Facilities

In the 2021 AMP, a letter criticality grade of A, B or C, was used to identify criticality level for the pumping stations, CSO tanks and WWTPs, with A being most critical and C being the least critical. More recently, the Wastewater Facilities Condition Assessment (J.L. Richards & Associates, 2025) reviewed and confirmed criticality ratings for pumping stations only using a numeric approach that ranges from 1 (minor) to 5 (critical). While the 2021 AMP had identified a criticality of A and B for WWTPs and CSO Tanks by virtue of their purpose and service area, these ratings are no longer being carried forward.

Factors used in assigning criticality are as follows:

- Disruption to Customers
- Customer Type
- Risk to Public Health and Safety

- Environmental Impact
- Difficulty of Repair
- Confidence and Liability

The 2025 Wastewater Facilities Condition Assessments (FCAs), completed by J.L. Richards & Associates, also introduced a more robust, quantitative risk assessment methodology that evaluates condition, equipment criticality, and total risk scores. This methodology has been applied across the pump stations, which now have assigned condition scores, criticality assessments, and an overall reliability rating.

For future assessments, a hybrid approach combining both top-down and bottom-up methods is recommended.

- Top-Down Approach: Initially, WWTPs can be assigned a high criticality rating (e.g., a 5 on the FCA scale) at the plant level due to their essential role in public water supply. This ensures that the entire facility is recognized as a critical asset from the outset and maintains consistency with how other critical non-linear assets are prioritized.
- Bottom-Up Approach: For greater precision and to support effective maintenance and risk management, the criticality assessment should then be refined by evaluating sub-facilities or individual equipment within the WWTP. Key assets such as pumps and motors, which have a significant impact on process performance, should be assessed at the equipment level. Aggregating equipment criticalities by process allows identification of the most critical operational areas, enabling targeted interventions and more accurate risk prioritization.

Verification of criticality for plants and facilities should be completed on a 10-year cycle maximum.

D.3.2.1.2 Linear Infrastructure

For linear infrastructure, criticality has been assessed for select assets in 2025. For linear infrastructure, criticality is assigned based on the gravity main or force main asset classes. Manholes and Junctions inherit the criticality of the parent asset. Services are all assigned a low criticality.

The following factors were used in assigning criticality to linear assets:

- Size of pipe (which is akin to # of customers)
- Redundancy
- Shape (i.e. historic box sewers are more critical)
- Accessibility (i.e. less accessible infrastructure is more critical)
- Type (i.e. combined sewers are more critical since they provide two functions, sewage collection and storm drainage and have environmental issues associated with them, i.e. overflows)
- Capacity Adequacy (sewers that are identified as under-capacity by today's standards are more critical and are actually triggered for replacement versus rehabilitation)
- Material (to be employed when data set is populated, i.e. Vitrified Clay as more critical due to consistently observed problems).

The above is applied in a manner to provide a quantitative criticality score. The criticality of linear infrastructure should be updated for each iteration of the Asset Management Plan to ensure new assets are scored, or sooner, based on planning needs.

D.3.2.2 Condition Assessment

Periodic condition assessment of assets is paramount to implementing an effective asset management plan. Condition is utilized in conjunction with criticality in determining the risk. Condition is akin to the likelihood of failure, where the more advanced the deterioration of the asset, the more likely the asset is to fail. Failure of an asset is indicative of an ineffective asset management program, as failure is to be avoided by maintenance and asset replacement of rehabilitation in a proactive well- timed manner. Condition assessment results are provided in Section D.1.4.

D.3.2.2.1 Plants and Facilities

Plants and facilities in the Wastewater Utility are subject to periodic condition assessment by external consultants, as well as regular (daily, weekly and monthly) inspections by staff. These processes are complimentary, as the consultant-lead processes generates work on larger scales whereas the staff-lead works are typically smaller-scale process-related. **Table 82** summarizes the condition assessment processes for Plants and Facilities.

Table 82: Condition Assessment Processes for Wastewater Plants and Facilities

Process	Description	Frequency	Asset Classes
Facility Condition Assessment (consultant- lead)	The Facility Condition Assessment study is a rigorous process that involves assessment of criticality and condition down to the major component level and uses a risk assessment framework to recommend proactive works on all facilities and/or recommendations for replacements and/or major upgrades. It also reviews regulatory and code compliance issues. Includes a 10-year outlook to the next cycle. Improvements need to be made to this program and recommendations for maintenance need to be reviewed and entered into a suitable Asset Registry.	Typically, 5 years ±	Wastewater Treatment Plants (3) Pump Stations (29) CSO Tanks (3)
Facility Condition Assessment (staff-lead)	Staff in the Water and Wastewater Infrastructure Department undertake light to rigorous condition assessments on a daily, weekly and monthly basis. Watertrax was a software package formerly used to store maintenance requirements, but this is currently under review for a replacement asset management package for facilities. As per above, this process should take into consideration recommendations from the consultant-lead condition assessment project.	Continuous	Wastewater Treatment Plants (3) Pump Stations (29) CSO Tanks (3)

D.3.2.2.2 Linear Infrastructure

Multiple condition assessment programs are currently in place for linear infrastructure. Specifically, gravity mains and manholes are actively assessed through formal programs, as reflected in **Table 83**. In contrast, forcemains do not yet have a dedicated condition assessment program, though establishing one may be warranted given their importance and potential risk. Services (laterals) are not assessed through a formal program, which is generally acceptable due to their lower criticality, limited historical issues, and the high cost associated with proactive inspections. Additionally, junctions are not evaluated independently; their condition is typically assumed to align with the associated pipe segment. This reactive or inferred approach is considered sufficient at present for services and junctions, while opportunities to enhance forcemain condition monitoring should be explored as part of ongoing program development.

Table 83: Condition Assessment Process for Wastewater Linear Infrastructure

Program	Description	Frequency	Asset Classes
CCTV/ Cleaning Program	This is an annual contract that is responsible for cleaning/flushing of sewers as well as CCTV inspection of gravity mains. Various metrics are produced, and condition of assets inspected is summarized by structural defect score using inspection standards and grading system (for local pipes) and a consultant-led grading system (for trunk sewers). Problem manholes are noted during the process.	Program is run annually: Collectors and Locals – 12yr	Gravity Mains – Locals and Collectors and smaller Trunk Sewers. Problem Manholes noted.
Large Pipe Condition Assessment	Cleaning is undertaken separately as needed. This contract is run periodically to attain full condition assessment coverage on all Trunk Sewers utilizing structural defect score using inspection standards and grading system (for local pipes) and a consultant-led grading system (for trunk sewers). CCTV is employed as well as other technologies as required. Trunk Manholes are typically assessed during the process using NASSCO MACP inspection standards and a consultant-led grading system.	All Trunk Gravity Mains inspected on 6-year cycle.	Gravity Mains – Trunk Sewers Manholes – Trunk manholes inspected.
Force main Condition Assessment	No formal program has yet been developed and implemented for condition assessment of pipes in the Force main asset class. This requires development and implementation on a risk-based prioritization scheme.	Frequency to be assigned based on parent PS criticality.	Force mains
Services Condition Assessment	No formal program has been developed for Services and none is anticipated. Due to the low inherent criticality of individual services, and the cost associated with inspection, Services will not be subjected to a proactive condition assessment program.	A run-to- failure approach is deemed acceptable for Services. They are inspected as required to remedy issues.	Services

D.3.2.3 Risk Assessment and Prioritization

Assessing risk and prioritizing works based on risk is the risk management process. The risk assessment is undertaken by taking into consideration criticality and condition in a quantitative manner across all assets in an asset class. The results can then be sorted by risk score and used to develop a prioritized list of recommended works by addressing the assets with the greatest assigned risk first. This forms a defensible and logical manner by which to; a) utilize available funding, and b) to maintain a healthy and functional wastewater utility.

D.3.2.3.1 Plants and Facilities

The most recent risk assessment for wastewater pump stations was completed as part of the 2025 consultant-led Wastewater Facilities Condition Assessment (FCA) conducted by J.L. Richards & Associates. This assessment incorporated input from UK's staff-led condition evaluations and applied a structured methodology to produce a prioritized list of facilities based on condition, criticality, and reliability scores. This list supports decision-making for risk management across all plants and facilities.

The risk assessment was developed in alignment with broader Infrastructure Planning studies to ensure that recommendations address full facility replacements, major upgrades, and targeted maintenance at the process and component levels.

Although the 2025 FCA did not include formal risk assessments for WWTPs or CSO tanks, the condition data from that study currently serves as the most recent performance indicator for these assets. It is recommended that a full risk assessment for WWTPs and CSOs be completed in conjunction with the next Master Plan update or within a 10-year cycle, whichever comes first. The frequency of future risk assessments may be adjusted based on the evolving maturity and success of UK's Asset Management Program.

Table 84 provides the most recent Risk Assessment results of WWTPs and facilities. This is a result of a quantitative assessment of results provided in **Table 70**. The pump station risk results are taken from the most recent Wastewater Facilities Condition Assessment (J, L. Richards & Associates, 2025).

Table 84: Risk Assessment results for Wastewater Plants and Facilities

Asset Class	Facility Name	Size Class	Growth Trigger?	Overall Rating(1)
WWTP(2)	Cana Subdivision	Small (<100 customers)	No	N/A(2)
WWTP	Cataraqui Bay	Large (>10,000 customers)	Yes	N/A(2)
WWTP	Ravensview	Large (>10,000 customers)	Yes	N/A(2)
Pump Station	Barret Crt. PS	Medium (1,000-10,000 customers)	Yes	C
Pump Station	Bath Rd. PS	Small (100-1,000 customers)	Yes	B
Pump Station	Bath-Collins Bay Rd. PS	Medium (1,000-10,000 customers)	No	C

Asset Class	Facility Name	Size Class	Growth Trigger?	Overall Rating[1]
Pump Station	Bath-Lower Dr. PS	Very Small (<100 customers)	No	B
Pump Station	Bayridge Dr. PS	Medium (1,000-10,000 customers)	No	C
Pump Station	Collins Bay Rd. PS	Small (100-1,000 customers)	Yes	C
Pump Station	Coverdale Dr. PS	Small (100-1,000 customers)	No	B
Pump Station	Crerar Blvd. PS	Small (100-1,000 customers)	No	B
Pump Station	Dalton Ave. PS	Large (>10,000 customers)	No	D
Pump Station	Days Rd. PS	Large (>10,000 customers)	Yes	A
Pump Station	Greenview Dr. PS	Small (100-1,000 customers)	No	A
Pump Station	Hillview Rd. PS	Medium (1,000-10,000 customers)	Yes	C
Pump Station	Hwy-15 PS	Small (100-1,000 customers)	No	B
Pump Station	James St. PS	Small (100-1,000 customers)	No	C
Pump Station	John Counter Blvd. PS	Small (100-1,000 customers)	Yes	A
Pump Station	Kenwoods Cir. PS	Small (100-1,000 customers)	No	B
Pump Station	King St. PS	Large (>10,000 customers)	No	D
Pump Station	King-Elevator Bay PS	Small (100-1,000 customers)	No	B
Pump Station	King-Lake Ontario Park PS	Very Small (<100 customers)	No	A
Pump Station	King-Portsmouth PS	Small (100-1,000 customers)	Yes	A
Pump Station	Lakeshore Blvd. PS	Small (100-1,000 customers)	No	B
Pump Station	Morton St. PS	Small (100-1,000 customers)	No	B
Pump Station	Notch Hill Rd. PS	Very Small (<100 customers)	No	B
Pump Station	Palace Rd. PS	Small (100-1,000 customers)	No	A
Pump Station	Rankin Cres. PS	Small (100-1,000 customers)	No	B
Pump Station	River St. PS	Large (>10,000 customers)	Yes	D
Pump Station	Riverview Way PS	Small (100-1,000 customers)	No	A
Pump Station	Westbrook Rd. PS	Medium (1,000-10,000 customers)	Yes	A
Pump Station	Yonge St. PS	Very Small (<100 customers)	No	B
CSO Storage Tank	Collingwood	Medium (1,000-10,000 customers)	No	N/A[2]
CSO Storage Tank	Emma Martin Park	Large (>10,000 customers)	No	N/A[2]
CSO Storage Tank	O'Kill	Medium (1,000-10,000 customers)	No	N/A[2]

Notes:

(1) Data from Wastewater Facilities Condition Assessment, J, L. Richards & Associates, 2025

(2) Overall ratings were not assigned to WWTP & CSO Tanks in the 2025 Condition Assessment project.

D.3.2.3.2 Linear Infrastructure

The risk assessment for linear wastewater infrastructure continues to be conducted in-house. As the condition assessment database for Gravity Mains is regularly updated through routine CCTV inspections and structural defect scoring, the associated risk calculations are refreshed. For Force mains, a formal risk assessment cycle has not yet been established but will be developed in alignment with the criticality of the parent Pump Station. A risk assessment update for Force mains is anticipated on a 5–10-year interval.

Upon completion of the condition and criticality evaluations, UK employs a structured, quantitative framework to determine the risk levels of individual assets. This enables the prioritization of rehabilitation and replacement works, supporting transparent and defensible investment decisions. The first step identifies where investment is needed; the second step determines how those works should be implemented.

Table 85 summarizes the latest risk assessment results for Gravity Mains, based on 2024 condition data. This assessment uses pipe length in km as the basis for percentage calculations (as opposed to pipe counts in earlier AMP cycles), providing a more infrastructure-weighted representation of network risk.

Table 85: Risk Assessment summary for Wastewater Gravity Mains (from 2024)

Sub-Class	Very Low Risk	Low Risk	Moderate Risk	High Risk	Very High Risk
Trunk	37.6%	26.2%	22.1%	10.3%	3.8%
Collector	73.1%	12.2%	12.0%	2.2%	0.4%
Local	81.1%	10.8%	7.2%	0.8%	0.2%
All Average	**76.2%**	**12.5%**	**8.9%**	**1.8%**	**0.5%**

Notes: Percentages are based on pipe length (in km).

The updated data reveals that 2.3% of the Gravity Mains network falls into the "High" or "Very High" risk categories, based on pipe length. While this is a reduction from the 2.9% previously reported in 2021 (which used pipe counts), it still represents infrastructure segments that require targeted intervention. Notably, Trunk mains continue to exhibit the highest proportion of elevated risk, with 14.1% of trunk pipe length rated as High or Very High Risk. This reinforces the need for continued investments in large-diameter sewer infrastructure.

The risk profile for collector and local mains has improved marginally, suggesting the effectiveness of ongoing condition assessment and rehabilitation programs. The current figures validate that UK's strategy of prioritizing high-risk segments—particularly those within the Trunk category—has contributed to improved system resilience and service reliability.

D.3.2.4 Non-Condition Based Risks

While risk scores for linear infrastructure such as gravity mains and maintenance holes have been primarily derived from condition-based indicators, the 2025 Facility Condition Assessments (FCAs) for non-linear assets (e.g., pump stations) have applied a more comprehensive risk assessment approach. This includes not only physical condition but also criticality, equipment-specific risks, and reliability scoring. Therefore, condition-based risk is only one component of the broader risk landscape facing the Wastewater Utility.

In addition to condition-related risks, three major non-condition-based risk factors can significantly influence infrastructure needs and capital planning:

(1) **Environmental Impact:**
Environmental risks are assessed through the Pollution Prevention and Control Plan (PPCP), which identifies system vulnerabilities and recommends risk mitigation projects. These are further refined and integrated into the Sewer Master Plan to guide capital planning and compliance with environmental regulations.

(2) **Public Health and Safety:**
A key non-condition risk to public health and safety arises from basement flooding during high-intensity rainfall events. UK has undertaken various programs to mitigate this risk, including:

- **Preventative Plumbing Program:**
  This initiative supports private property owners in disconnecting sources of extraneous flow (e.g., sump pumps, foundation drains), thereby reducing the risk of sewer backup. It remains an active and important component of demand management.
- **Public-Side Extraneous Flow Reduction Program (formerly active):**
  This program contributed to reducing inflow and infiltration from municipal infrastructure through targeted repairs and lining projects. While not currently active, it is recommended that this program be **re-initiated** as part of a broader I&I reduction strategy, especially in the context of aging infrastructure and more frequent storm events.
- **Capital Projects for Flood Risk Mitigation:**
  Several infrastructure projects aimed at reducing flooding and system surcharge have been identified through internal assessments and brought forward in council reports.

(3) **Climate Change:**
Climate change introduces systemic uncertainty and additional stress on the wastewater system, particularly in the form of increased precipitation, storm intensity, and freeze-thaw cycles. These changes exacerbate the risks associated with extraneous flows and infrastructure capacity limits. It is recommended that climate risk scenarios be explicitly integrated into future planning studies and project prioritization frameworks.

D.3.3 Lifecycle Decision-Making

Both the Infrastructure Planning and Risk Assessment exercises described above, together, provide a means to determine which existing assets require rehabilitation or replacement. Once the assets have been identified through these processes, decisions are made on how the assets are to be remedied. This part of the process is called the Lifecycle Decision Making process and it identifies one of the following categories as the most appropriate course of action:

- Increased or accelerated Maintenance
- Rehabilitation or Major Upgrade
- Replacement

The decision making process is unique to each asset group and class, and factors in two-primary considerations:

- Estimated cost of works
- Service life of works

Together these factors produce an estimate of cost/year of service, which is akin to value. Best value is obtained by selecting an option, in comparison to others, which offers best-value over the full lifecycle. In many cases, the best value is attained by utilizing the course of action that provides best value, or in other words, the lowest cost/year of service. However, there are other factors that also need to be considered, including the following:

- Impacts to parent or child assets (i.e. if we choose to line a sewer main, what about the services? Are 100-year old services acceptable from a risk and maintenance perspective?)
- Budget/timing constraints (i.e. even if a sewer is best replaced, perhaps lining is preferred since a joint reconstruction program will not be possible in a reasonable timeframe).
- Overlapping needs (i.e. if the Gravity Main could feasibly be lined, reconstruction may be the preferred option if the road surface and water mains also need to be replaced).

The following sub-sections provide lifecycle decision making considerations for each asset group.

D.3.3.1 Plants and Facilities

Plants and facilities within the Wastewater Utility continue to be managed with an emphasis on maintenance and minor upgrades, unless planning exercises identify the need for a major capacity increase or fundamental process improvement. In such cases, major upgrades or full facility replacements may be triggered. Given the long lead times associated with such projects—often ranging from 6 to 10 years—the role of planning and forecasting remains central to effective decision-making and budgeting.

D.3.3.1.1 Wastewater Treatment Plants

Wastewater Treatment Plants (WWTPs), as the most complex and resource-intensive facilities within the Plants and Facilities asset class, now benefit from a more structured approach to asset management than in prior years. A significant advancement has been made with the completion of a comprehensive consultant-led condition assessment for all WWTPs in 2024. This represents a critical milestone, addressing previous gaps in formal risk and condition assessment for these assets. This assessment provides a solid foundation for future investment prioritization and risk-based decision-making.

The management of WWTPs continues to require a high level of detail due to the inherent complexity of their operations, and further work is needed to fully develop a process- and component-level asset registry. That said, UK now employs the following triggers to guide capital upgrades, with a growing emphasis on risk-informed planning:

- **Growth-related triggers** identified through the Wastewater Master Plan, Growth Strategies, or Uncommitted Reserve Capacity analyses. These may lead to component-level upgrades, process improvements, or entire facility expansions.
- **Regulatory drivers**, such as evolving treatment standards, which often require the addition of new processes or technology upgrades.
- **Condition-based triggers** derived from the 2024 consultant-led condition assessment, used to justify investments at the component, process, or facility level.
- **Operational input** from facility staff, which informs both routine maintenance and capital improvements where recurring issues or inefficiencies are observed.

The types of resulting interventions range from short-term corrective actions to long-term capital planning efforts:

- **Prescribed or enhanced maintenance programs** (effective up to 20 years)
- **Major upgrades** targeting specific processes or systems (~10–30 years lifecycle)
- **Full replacements** where lifecycle or condition assessments indicate end-of-service (~20–50 years)

While large-scale upgrades garner attention, ongoing maintenance remains fundamental. Staff-led condition assessments are conducted regularly and have resulted in several remedial actions in recent years. However, following the decommissioning of the Watertrax system, UK is in the process of identifying and implementing a replacement asset management software to support documentation, scheduling, and visibility of maintenance across the organization. This step is essential to ensure that maintenance continues to be timely, effective, and integrated with long-term asset planning.

D.3.3.3.2 Pump Stations

As of 2025, the decision-making framework for capital upgrades to wastewater pumping stations at UK has evolved to incorporate more robust condition and risk assessment data, thanks to the completion of a comprehensive consultant-led facility condition assessment in 2024. This assessment has provided a more accurate understanding of asset condition and risk exposure, enabling more data-driven planning and prioritization of capital investments. Capital upgrades for pumping stations continue to be primarily triggered by three core factors:

- **Growth-related triggers**, identified through the Wastewater Master Plan or specific Growth Strategy analyses, especially for medium and large pumping stations. These growth pressures often require component-level expansions, capacity upgrades, or full facility improvements to accommodate increased flow demands.
- **Condition assessments**, which are now more consistent and standardized following the 2024 evaluation of all plants and facilities. These assessments help identify components or systems that are approaching the end of their service life or exhibit elevated failure risks. Resulting upgrades may be targeted at pumps, electrical systems, instrumentation, or full structural elements.
- **Operational staff input**, which continues to be a valuable source of insight. Routine inspections, maintenance logs, and troubleshooting records often inform operations and maintenance (O&M) work but may also uncover persistent or escalating issues that justify capital-level interventions.

Furthermore, integration with the evolving asset registry and maintenance tracking system will ensure all pump station upgrades and maintenance actions are properly recorded, improving transparency and long-term lifecycle tracking. As UK refines its asset management software tools, enhanced visibility of maintenance trends and performance indicators will support more proactive and cost-effective management of these critical facilities.

D.3.3.3.3 CSO Storage Tanks

No growth-based works are scheduled for Combined Sewer Overflow (CSO) storage tanks within the next 10 years (2025-2034). As UK continues to advance sewer separation across the network, reliance on CSO infrastructure is expected to decrease progressively. However, full elimination of CSO tanks is likely to remain a long-term objective, potentially spanning several decades.

Currently, the CSO tanks remain in functional condition and continue to support compliance with the MECP Procedure F-5-5, which regulates discharges from combined sewer systems. Maintenance and component upgrades are carried out as needed, focusing primarily on electrical and process systems identified through condition assessments and routine maintenance programs.

Looking ahead, UK will continue to manage its CSO storage tank assets according to the following guiding principles:

- **Maintenance** as needed, based on findings from condition assessments and ongoing maintenance management activities.
- **Upgrades** only when identified in future planning documents, such as Master Plans (MPs) and Pollution Prevention and Control Plans (PPCPs).
- **Decommissioning or repurposing** to be considered in accordance with planning recommendations and system optimization efforts.

This strategy ensures that the CSO infrastructure remains effective and compliant in the short term while accommodating longer-term system evolution toward full separation.

D.3.3.2 Linear Infrastructure

D.3.3.2.1 Gravity Mains

The asset management and lifecycle decision-making process for gravity mains remains well-established and data driven. Larger gravity main assets, including trunk and collector sub-classes, are subject to multiple planning studies and a formalized risk assessment process. High-risk assets are managed through a structured decision-making pathway. If planning studies identify capacity constraints or the need for upsizing, projects are ideally incorporated into joint reconstruction programs. When coordination with road reconstruction programs is not feasible, UK may undertake standalone replacement projects to meet infrastructure needs within required timeframes. High-risk assets are addressed using the following decision-making process, which is depicted in **Figure 18.**

- Where planning studies have identified features for up-sizing, they shall be promoted to the joint reconstruction program, if possible, within the anticipated timeframe.
- If they cannot be accommodated in the joint reconstruction program, UK shall undertake the asset replacement as a stand-alone project within the required timeframe.
- If the asset displays minor deficiencies, or highly localized deficiencies, maintenance activities may be completed. These include dig and repair solutions and localized trenchless options. These activities do not impact the expected age-based lifecycle of the asset, since the majority of the asset and its dependents remain in the current condition. Activities however may decrease the condition score and hence the risk associated with such features thereby reducing replacement need and priority.
- Where high-risk assets are identified, and it is determined that small-scale maintenance activities will not be cost-effective in reducing the risk, the following options shall be considered:
    - Replacement of the asset and its dependents (Manholes and Services) in conjunction with a Joint (City/UK) Road Reconstruction Project where feasible.
    - Reconstruction by replacement outside the Joint City/UK Program: Replacement of pipe including dependent asset classes. This tends to be the costliest option and a last resort since there is no cost-sharing of road works.
    - Replacement by lining, with due consideration to the condition of dependent assets and appropriate rehabilitation or replacement of dependent assets. Prior to utilizing lining, the sizing adequacy should be verifying by reviewing capacity assurance data to ensure pipes are not being lined that need to be upsized. Lining is only possible on assets that are not significantly deteriorated and represent proactive replacement.

Minor or localized deficiencies in gravity mains are typically addressed through targeted maintenance, such as open-cut repair or trenchless rehabilitation. These interventions are cost-effective for maintaining performance and extending useful life, without significantly altering the asset's overall lifecycle or those of dependent assets like manholes and services. However, for gravity mains with substantial deterioration or where maintenance is not a viable long-term solution, more intensive strategies are considered. These include full replacement along with dependent assets through joint projects, standalone reconstructions, or lining interventions—provided the pipe is structurally sound and capacity assessments confirm suitability.

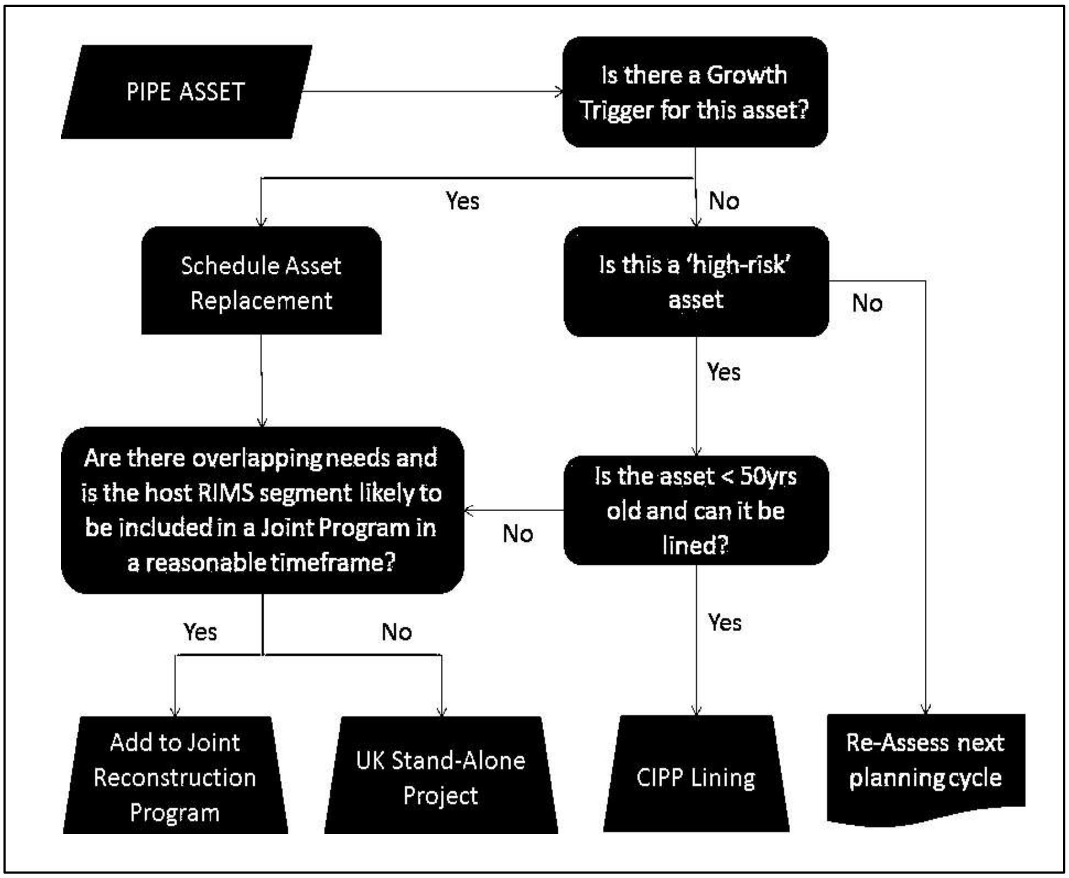

Figure 18: Generalized Gravity Mains Lifecycle Decision-Making Process

In general, maintenance and inspection activities—such as regular cleaning, CCTV inspections, and spot repairs—should be emphasized during the first 50 years of a gravity main's life. Between 50 to 75 years, decision-making becomes more dependent on specific condition assessments and available funding. Beyond 75 years, asset replacement along with dependents is typically preferred. In the absence of updated condition data for dependent assets, a full replacement strategy is assumed when the parent gravity main is replaced. The updated 2024 CCTV-based condition assessments provide enhanced accuracy in applying this strategy.

Figure 19 illustrates the influence of asset age on the decision-making process. In absence of a thorough condition assessment of localized dependent assets (Services and Junctions), it shall be assumed that a full solution is required that includes the dependent assets.

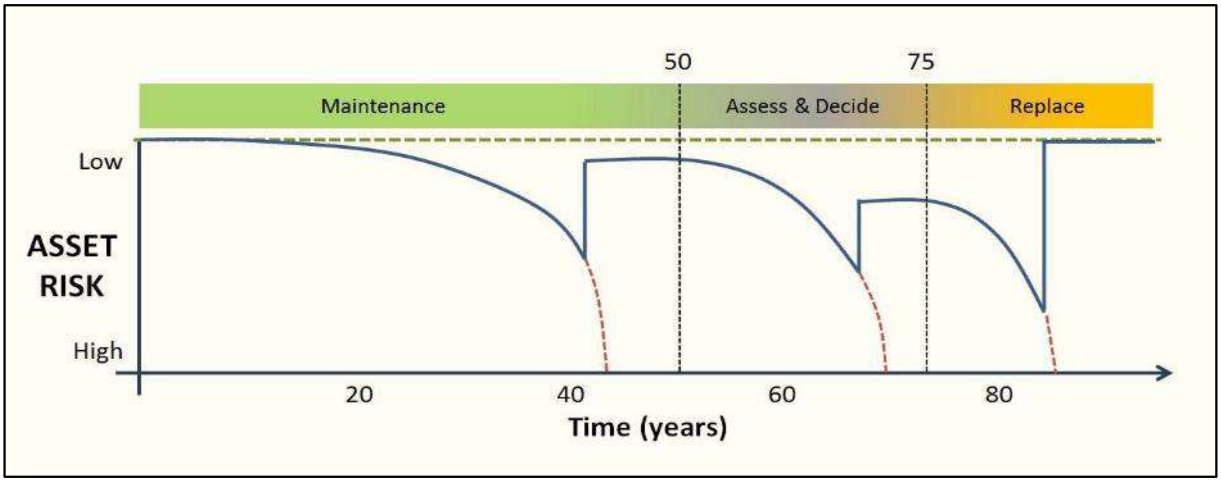

Figure 19: Gravity Main Lifecycle Decision Making

Capacity enhancements may be achieved either by replacing the asset with a larger pipe or through twinning. While twinning introduces redundancy and can ease future maintenance, it also creates long-term operational and maintenance cost implications. Therefore, twinning is only recommended when redundancy is a specified project objective.

D.3.3.2.2 Force mains

The asset management process for the force main asset class requires development but should closely resemble that of Gravity Mains described above. A condition assessment program is still required to provide the Risk Assessment deemed necessary for this asset class. The proposed decision-making process is as follows:

- The Planning process may result in triggers for replacement or twinning of the force main due to an anticipated increase in pump station capacity. Twinning is typically the preferred approach as it allows the facility to remain in service.
- If operations staff or contractors identify deficiencies, maintenance shall be completed using open-cut or trenchless techniques. Tracking of repairs should be implemented.
- Complete replacement of high-risk force mains by a suitable lining process. This should include all appurtenances including valves.
- Replace high-risk force mains in conjunction with a joint (City/UK) Road Reconstruction Project where feasible.

With force mains, decision-making is made slightly easier by the fact that there are no dependent assets inherent to force main assets.

D.3.3.2.3 Junctions

Junctions, including manholes, continue to be managed as dependent assets tied to the gravity mains on which they are situated. Their lifecycle management follows a run-to-failure model, as they are not independently assessed under a dedicated condition or risk assessment program. Instead, their condition is inferred from the parent gravity main, particularly during CCTV inspections or planned rehabilitation projects.

When opportunities arise, remaining non-manhole junctions are replaced with associated manholes to enhance maintenance access and structural integrity. Deficiencies identified through operations or inspections are addressed via targeted maintenance. Where gravity mains are lined or replaced, dependent junctions are also evaluated for rehabilitation or replacement. In some cases, full replacement of manholes is favored over rehabilitation, particularly outside of trunk systems where rehabilitation may not offer sufficient lifecycle benefits. When possible, these works are scheduled alongside joint road reconstruction projects to optimize resources.

The following describes the decision-making process for this asset class:

- Where issues are noted by operations staff or contractors, manhole repairs are completed as necessary to prevent failure of the asset (maintenance).
- As part of the gravity main lining process, the need to replace or remediate manholes is considered. Unfortunately, no rehabilitation techniques exist with a sufficient lifecycle to warrant the cost, except on trunk systems where the replacement cost is prohibitive. This may result in remediation or replacement of the manhole.
- Replace the manholes in conjunction with a joint (City/UK) Road Reconstruction Project

D.3.3.2.4 Services

The lifecycle of services is founded on a run-to-failure approach due to the low inherent risk associated with individual services. As a result, condition assessment is only undertaken on services as needed to troubleshoot issues with a customer’s service.

The following describes the hierarchy of decision-making options for sewer laterals:

- Inspection and maintenance/repairs are completed because of direct customer contact. This may include repair or replacement of the public side of the lateral, and at times, the customer is invited to cost-share replacement of the entire service if warranted.
- Services are considered a dependent asset class to the sewer main to which they connect. When a trigger, via risk assessment or planning exercise, indicates replacement is required, the following options are available:

- Replace the services in conjunction with a joint (City/UK) Road Reconstruction Project (preferred), or,
- Complete lining or replacement of services in conjunction with a UK-only sewer lining Project.

  Only under a scenario where Services are inspected and concluded to be in good condition should any Gravity Main replacement or lining works be completed without including this asset class, particularly when greater than 75 years old.

D.3.4 Maintenance Management

Maintenance activities play a pivotal role in optimizing the lifecycle of wastewater assets. In situations where there are no immediate triggers for asset replacement, upgrades, capacity expansion, or changes in treatment standards, routine maintenance ensures that infrastructure continues to operate effectively and reliably. Even after an asset reaches the end of its estimated lifecycle, decisions regarding rehabilitation or replacement should be based on condition and risk indicators rather than age alone.

To support informed decision-making, all maintenance activities should be properly documented and tracked at the asset level, with visibility across all relevant UK staff. At present, such a comprehensive system is not yet in place. While a GIS-based asset inventory currently exists and has the capability to track certain linear infrastructure works—primarily replacements and pipe lining—it does not fully capture routine maintenance activities. This lack of detailed tracking represents a gap in the asset management process. Enhancing GIS integration to catalog all maintenance activities by asset is therefore identified as a priority for future improvement.

UK is currently entering the implementation phase of new Enterprise Asset Management (EAM) System, following the completion of vendor selection and procurement. The EAM will strengthen the asset management processes by centralizing data, improving work and lifecycle management, and supporting greater consistency, coordination, and long-term planning - ultimately advancing overall asset management maturity.

D.3.5 New Assets

New assets are regularly being added to the Wastewater Utility because of two activities:

- Acquisition from a developer who is building a new subdivision with wastewater services (based on Growth).
- In-house construction of new assets (based on Growth, PPCP, Risk or Capacity issues).

This may include assets in all classes. Assets should be documented in asset inventory and added to the Replacement Cost and PSAB 3150 Valuation financial summaries. Most new major assets are identified within master planning exercises. Master planning exercises produce OPC with a suggested timing. This feeds directly into budgetary requirements.

D.3.6 Decommissioning

When a facility is deemed no longer required, the facility shall be decommissioned or re- purposed (if applicable). This may apply during a replacement of a facility, since often the activity at that facility must continue during construction of the replacement facility.

The following options for decommissioning are available:

- Undertake facility decommissioning in conjunction with replacement where applicable, typically accomplished within a single environmental assessment.
- Consider re-purposing if applicable, e.g. CSO tanks may be repurposed for storm runoff collection and treatment.
- Undertake the necessary decommissioning studies and process to properly decommission a facility that is no longer required.

Where possible, salvage activities should be considered.

D.3.7 Summary

To facilitate asset management, a variety of programs and related processes are required. All asset classes require consideration for what programs and processes will provide for adequate management, and this includes a number of types of programs, including:

- Infrastructure Planning – these studies generally comprise overarching studies that identify primarily growth-based needs and needs for major process improvements.
- Risk Assessment – these studies are generally condition assessment processes. When coupled with criticality assessment, they identify risk-based needs.
- Lifecycle Options – these are the actual physical intervention processes which result in a repaired, upgraded or newly constructed asset or facility.

Table 86 provides an overview of programs, projects and other processes that contribute to asset management of the sewer utility as well as the asset classes that they contribute to.

It should be noted that this is not an exhaustive detailed list. It covers the primary activities being completed, however, there are several regular support activities that take place. Examples include the following:

- **Flow monitoring:** Flow monitoring data is being completed at all WWTPs, many PSs, all CSO tanks as well as gravity mains in select locations (approximately 25-30 locations at any given time)
- **CSO Monitoring:** This assists in directing attention to specific CSO locations for more study or works and supports a real-time public mapping feature for transparency.

Table 86: Summary of Programs for Wastewater Utility Asset Management

Program	Frequency	Tactic	Gravity Mains	Force mains	Services	Junction	WWTP	SPS	CSO Tanks
Infrastructure Planning: Master Plan	5-7 yrs.	Proactive	Yes	Yes			Yes	Yes	Yes
Infrastructure Planning: Pollution Prevention and Control Plan	5-7 yrs.	Proactive	Yes	Yes			Yes	Yes	Yes
Infrastructure Planning: Development Charges	5 yrs.	Proactive	Yes	Yes			Yes	Yes	Yes
Infrastructure Planning: Individual Environmental Assessments	As Required	Proactive	Yes				Yes	Yes	Yes
Infrastructure Planning: Development-specific Studies	As Required	Proactive	Yes	Yes			Yes	Yes	Yes
Infrastructure Planning: Capacity Analyses	Annually	Proactive	Yes	Yes			Yes	Yes	
Risk Management: Facility Condition Assessment (External)	10 yrs.	Proactive					Yes	Yes	Yes
Risk Management: Facility Condition Assessment (Internal)	Continuous	Proactive					Yes	Yes	Yes
Risk Management: CCTV/Cleaning Program	12 yrs.	Proactive	Yes			~			
Risk Management: Large Pipe Condition Assessment	6 yrs.	Proactive	Yes			Yes			
Risk Management: Force main Inspection	TBD	Proactive							
Risk Management: Services Condition Assessment	As Required	Reactive			Yes				
Lifecycle Options: Scheduled Maintenance	Asset Specific	Proactive	Yes				Yes	Yes	Yes
Lifecycle Options: Unscheduled Maintenance	As Required	Reactive	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lifecycle Options: Rehabilitation (Lining, minor upgrades etc..)	Asset Specific	Proactive	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lifecycle Options: Facility Major Upgrades	Asset Specific	Proactive					Yes	Yes	Yes
Lifecycle Options: Asset Replacement	Asset Specific	Proactive	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lifecycle Options: Asset Replacement	As Required	Reactive			Yes	Yes		Yes	
Lifecycle Options: New Asset Construction/ Assumption	As Required	N/A	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lifecycle Options: Asset Decommissioning/ Retirement	As Required	N/A	Yes	Yes	Yes	Yes	Yes	Yes	Yes

D.3.8 Maturity

D.3.8.1 Forecasting Future Demand

UK employs a robust suite of tools for estimating future growth and the impact it will have on the Wastewater Utility. Via population growth studies, growth strategies and master planning exercises, the implications of growth are well understood at a high level. Once these studies identify the need for growth-based works, project-specific analyses are completed during the environmental assessment process. The maturity level for forecasting future demand is at the 'core' level and suitable for the Wastewater Utility's size (see **Table 87**).

Table 87: Maturity Index - Forecasting Future Demand

Maturity Level	Description	Status of Current Plan
Minimum	Demand forecasts based on experienced staff predictions, with consideration of known past demand trends and likely future growth patterns	
Core	Demand forecasts based on robust projection of a primary demand factor (i.e. population growth) and extrapolation of historic trends. Risk associated with demand change broadly understood and documented.	We are here.
Intermediate	Demand forecasts based on mathematical analysis of past trends and primary demand factors. A range of demand scenarios is developed.	Short-term Target for 2031
Advanced	As above, plus risk assessment of different demand scenarios with mitigation actions identified.	

D.3.8.2 Identifying Risks

Risk frameworks have been developed and implemented for linear infrastructure (e.g., gravity mains, manholes) through an in-house process that combines condition indicators, criticality, and other system-specific factors to produce asset-level risk scores. For plants and facilities, including WWTPs, a formal risk framework has not yet been established. Instead, risk levels for these assets have been assigned qualitatively based on recent condition assessments—primarily through overall condition and reliability ratings, without a standardized or documented risk methodology.

Within each asset class, the available risk information is reviewed to identify high-risk features and prioritize capital or maintenance interventions. While the linear infrastructure risk process is relatively well-defined, the absence of a formalized approach for facilities limits the overall consistency of risk-based planning across the utility.

As a result, UK is currently aligned with the 'Minimum' maturity level for its Risk Identification process (see **Table 88**). Although the linear infrastructure approach may support justification for a 'Core' rating in isolation, advancement at the organizational level requires formal documentation and expansion of risk frameworks across all asset types.

Table 88: Maturity Index - Risk Identification

Maturity Level	Description	Status of Current Plan
Minimum	Critical assets understood by staff involved in maintenance/renewal decisions.	We are here.
Core	Risk framework developed. Critical assets and high risks identified. Documented risk management strategies for critical assets and high risks.	Short-term Target for 2031
Intermediate	Systemic risk analysis to assist key decision making. Risk register regularly monitored and reported. Risk managed consistently across the organization.	
Advanced	Formal risk management policy n place. Risk is quantified and risk mitigation options evaluated. Risk is integrated into all aspects of decision-making.	

D.3.8.3 Lifecycle Decision-Making

Lifecycle decision-making is currently conducted in a manner that is roughly in alignment with the 'Core' level of maturity as per the IIMM (NAMS, 2011), see **Table 89**. For larger projects and programs, often a formal or informal benefit-cost analysis (BCA) will be completed prior to proceeding with the works. More importantly, for larger projects, a multi-criteria analysis (MCA) is completed within the context of the Environmental Assessment Framework. This is often the case for Plants and Facilities. Decisions on Linear Infrastructure are typically done on the merits of the need from growth or risk-based drivers, which is typically commensurate with the size and cost of the project.

Table 89: Maturity Index - Lifecycle Decision-Making

Maturity Level	Description	Status of Current Plan
Minimum	AM decisions based largely on staff judgement and agreed corporate priorities.	
Core	Formal decision-making techniques (MCA/BCA) are applied to major projects and programs.	We are here.
Intermediate	Formal decision-making and prioritization techniques are applied to all operational and capital asset programs within each main budget category. Critical assumptions and estimates are tested for sensitivity to results.	Short-term Target for 2031
Advanced	As for 'intermediate', plus… The framework enables projects and programs to be optimized across all activity areas. Formal risk-based sensitivity analysis is carried out.	

D.3.8.4 Capital Works Strategies

While financial budgeting requirements for Capital expenditures do project typically for a 10-year horizon, a business-case analysis is not always competed. For this reason, it is estimated that UK current level of

Strategizing for capital works is roughly at a ‘Core’ level of maturity (see **Table 90**) but with planning elements that approach the ‘Intermediate’ level.

Table 90: Maturity Index - Capital Works Strategies

Maturity Level	Description	Status of Current Plan
Minimum	There is a schedule of proposed capital projects and associated costs, based on staff judgement of future requirements.	
Core	Projects have been collated from a wide range of sources such as hydraulic models, operational staff and risk-processes. Capital projects for the next three years are fully scoped and estimated.	We are here.
Intermediate	As above, plus formal options analysis and business case development has been completed for major projects in the 3-5year period. Major capital projects for the next 10-20 years are conceptually identified, and broad cost estimates are available.	Short-term Target for 2031
Advanced	Long-term capital investment programs are developed using advanced decision-making techniques such as predictive renewal modeling.	

D.3.9 Moving Forward

The following are key priorities for inclusion in future iterations of the Wastewater Utility Asset Management Plan, with a focus on advancing maturity, improving data systems, and addressing current gaps:

- Initiate a Capacity Assurance Program:
  This program should be developed for gravity mains, forcemains, and pump stations, using current design parameters to estimate flow commitments and system capacity. It will support criticality analysis and provide a valuable tool for development application review. A large portion of this work is expected to be completed through updated hydraulic modeling as part of the ongoing Water Master Plan project.

- Formalize and Document Risk Assessment Procedures:
  Risk frameworks should be clearly documented and integrated into the GIS environment to support spatial risk analysis. While linear assets have a defined risk model, there is a need to develop and implement a more robust risk analysis system for plants and CSO tanks, which are currently assessed using qualitative indicators only.

- Implement Forcemain Investigations and Risk Analyses:
  Forcemains represent a critical linear asset with limited condition visibility. Targeted investigations and risk evaluations should be incorporated into future planning cycles to improve their representation in the asset management system.

- Optimize processes within the Enterprise Asset Management (EAM) Software:
  Dedicated asset management software is essential to advancing UK’s wastewater asset

management maturity. The system should support lifecycle tracking, maintenance logging, work order history, and asset-level performance indicators. In future implementations, consider integrating KPI calculations directly within the software to streamline reporting and align with AMP metrics.

- Expand Asset Class Coverage and Granularity:
  Several additional asset classes and subcomponents should be incorporated into future AMPs:

For Linear Infrastructure:

  - CSO structures: While many are configured as maintenance holes, they involve distinct operational and regulatory considerations that warrant separate tracking.
  - Passive CSO storage tanks: There are six in-line storage tanks that require dedicated management due to their unique functions.
  - Flap/Tide Gates: Numerous flap gates protect against stormwater or lake water intrusion. These assets should be catalogued in the inventory and included in a routine maintenance program. Historic flooding events (e.g., 2017 and 2019) have underscored their importance.

For Plants and Facilities:

  - WWTPs: These facilities should be further subdivided into process, component, and subcomponent levels to improve performance tracking and maintenance planning. This will require the implementation of an appropriate facility asset registry to manage the increased level of detail.
  - Pump Stations and CSO Tanks: These facilities should also be broken down into component and subcomponent levels for more granular asset management and risk analysis.

- Include Maintenance and Operational Strategies:
  While this AMP focuses primarily on capital asset management, future iterations should expand coverage to include maintenance and operational strategies. This will help bridge the gap between short-term operational decisions and long-term capital planning.

E. Financial Forecasts and Strategy

E.1 Overview

The financial and funding strategy section of this AMP focuses on outlining the strategy for financing required infrastructure work and identifying funding deficits. The sustainability of UK infrastructure depends on effective management and ensuring the optimal use of available funds. The financial and funding strategy combines user rates and development charges, debt financing, and government grants. Rate revenue is used to fund all operating expenses and debt payments. Most capital expenditures are funded on a pay as you go method. However capital expenditures can vary considerably because of the nature of the assets and the long lifecycles.

Key funding sources for both Water and Wastewater Utilities include:

- **Rates**: UK employs a user pay basis for wastewater and water utility rates. This is a full cost recovery model which includes no funding from the tax base. UK completed a cost allocation study in 2024 to ensure the fair and appropriate allocation of rates among the different rate classes.
- **Development Charges**: On a five-year cycle, capital project needs are reviewed for those projects necessary to support growth within the context of the Development Charges Act. The current charges are defined by City of Kingston Bylaw 2025-142.
- **Debt Financing**: UK works with City of Kingston finance staff to ensure debt levels remain within certain levels in line with City policy. Debt is generally incurred for larger capital projects.
- **Government Grants**: includes grants awarded by government.

The plan estimates capital expenditures over the next 10 years and outlines strategies to meet funding needs.

E.2 Budget Forecasts

The budget forecast follows the "end-of-life" replacement cost approach, in line with the Building Together Guidelines for asset management plans. This method estimates capital budget requirements based on replacing assets at the end of their useful life, providing a simple but reasonable estimation.

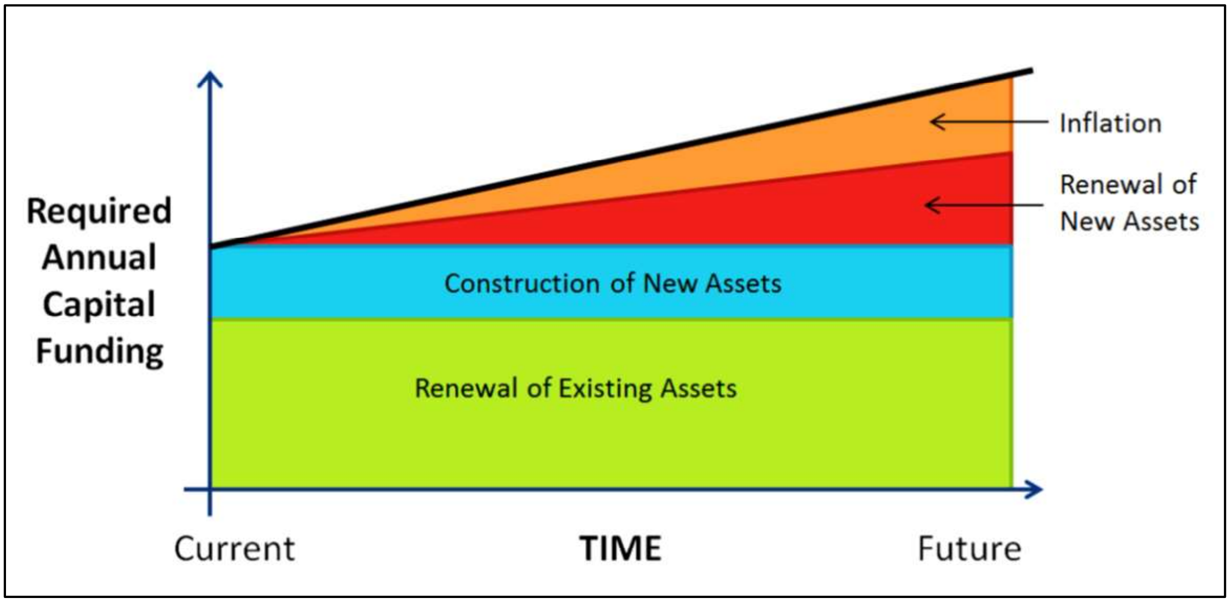

Figure 20: Annual Capital Funding Requirements Model

The funding model, shown in **Figure 20**, includes several components:

1. **Construction of New Assets**: This covers the cost of new assets needed for growth, identified through growth-based studies and risk-based assessments. This component is likely to fluctuate considerably. So, although an annual average expenditure is calculated for both the Water and Wastewater Utilities, it should be noted that averaging these over any given time period is highly dependent on two main things – the length of time over which the total is averaged, and the inclusion of major facilities with high cost. It is also noted that many growth-based projects also support the renewal (and upsizing) of existing assets. Where indicated, the portion of the project deemed to be associated with the renewal of existing assets is omitted from this category total to avoid duplicating required capital estimates in the next category.

2. **Renewal of Existing Assets**: This significant expense represents the cost to renew current assets. The renewal cost for linear assets is calculated based on asset age. For assets identified for renewal within the 10-year forecast period, replacement costs are determined using their length and a unit cost based on the pipe's diameter and material type.

   For non-linear assets, the renewal cost is estimated by considering the asset's life expectancy and its expected replacement cost at the end of its useful life. In the case of facilities, this is further broken down into major components. An 'average annual expenditure' is a reasonable means to characterize this component. For example, a wastewater gravity main with a 64-year life expectancy and a replacement cost of $100,000 would average $1,562.50 in annual expenditure.

3. **Renewal of New Assets**: As new assets are constructed, this component reflects the increase in asset base over time, meaning future renewal costs will rise as the number of assets grows.
4. **Inflation**: A 2.5% annual inflation rate has been applied to both the operating and capital forecasts.

E.2.1 Water Utility

The following provides an overview of the development of the capital budget forecast for the Water Utility.

E.2.1.1 Significant Operational Expenses

Figure 21 summarizes significant operating expenses from 2020 to 2035. Historically, approved budgets have adequately covered actual operating costs for most of the years. The increase in the operating budget highlights UK's continued efforts to effectively manage current operations while supporting planned future expansions. Based on the approved 2024 budget of $15.7 million, the approved 2025 operating budget for the water utility is $17.0 million — an increase of $1.3 million (8.0%). A further increase of $0.9 million (5.6%) is projected for 2026, with a proposed operating budget of $17.9 million.

These increases are primarily driven by rising costs for contracted services, supplies (e.g., chemicals, tools, equipment), and utilities required to maintain existing service levels. The budget also allocates additional funding for water service and lateral repairs, valve inspections and repairs, and leak detection initiatives to reduce system water loss. Furthermore, the rising budget reflects the growing inventory of water assets resulting from City expansion, which necessitates additional resources for inspection, operation, and maintenance. A notable increase in insurance costs for water infrastructure is also included in the budget.

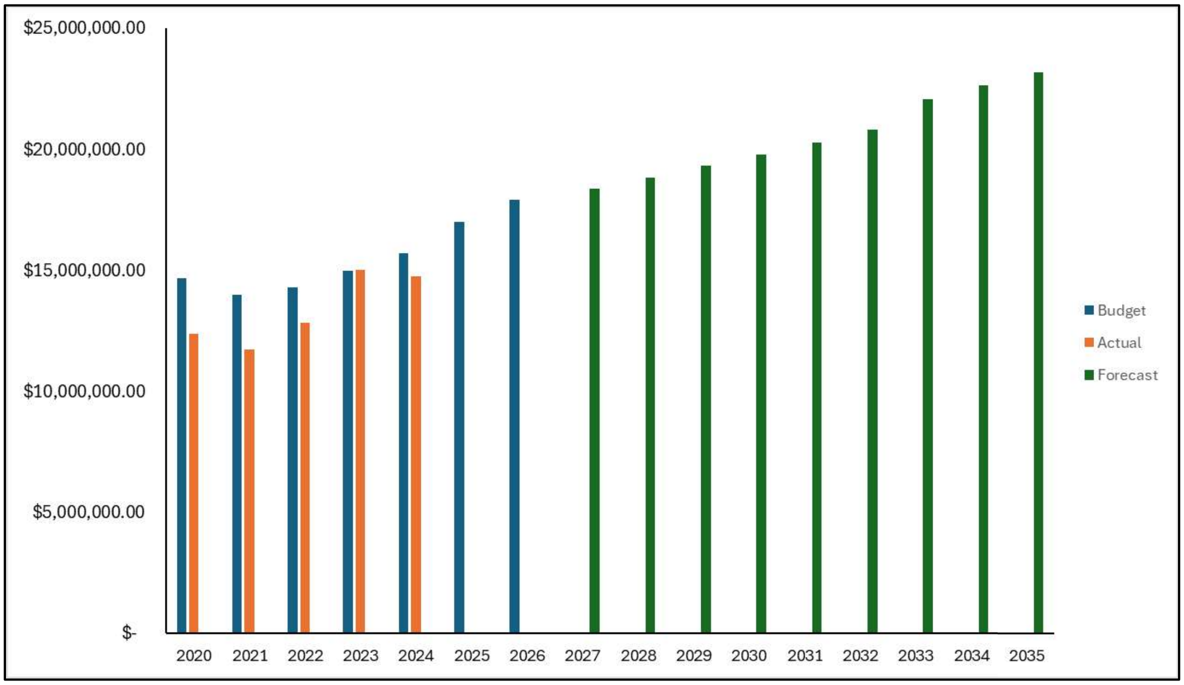

Figure 21: Significant Operating Expenses for Water

E.2.1.2 Renewal of Existing Assets

Table 91 and **Table 92** present the total projected capital renewal costs for linear and non-linear assets, respectively, over the 10-year period from 2025 to 2034.

For linear assets, the renewal needs were determined using a bottom-up approach based on asset age. Assets identified for renewal within the 10-year forecast had their replacement costs calculated using their length and a unit cost for the pipe's diameter and material type. To account for assets lacking installation date information, a proportional adjustment factor was applied. This factor is derived by assuming the percentage of assets without installation dates that are due for renewal within the 10-year forecast is the same as the percentage of assets with installation dates that are also due for renewal within the 10-year forecast. In the case of hydrants, none of the assets with known installation dates were found to be beyond their expected service life. However, due to a high proportion of hydrants missing installation date data, it was assumed that the percentage of hydrants requiring renewal would mirror that of watermains over the same period.

Table 91: Capital Expenses for Renewal of Water Linear Assets[1]

Expenditure Group	Capital Renewal Cost for Assets with Installation Date (2025-2034)	Percentage of Assets with Installation Date Identified for Renewal within 10 years (2025-2034)	Percentage of Assets without Installation Date Assumed for Renewal within 10 years (2025-2034)	Capital Renewal Cost for Assets with and without Installation Date (2025-2034)
Watermain	$188,248,000	25.2%	25.2%	$188,437,000
Water Valves	$10,901,000	31.9%	31.9%	$10,918,000
Water Hydrants	$-	0.0%	25.2%	$8,073,000
Meters	$16,379,000	30.3%	30.3%	$16,379,000
Total Capital Renewal Cost (2025-2034)				$223,806,000

1) 5.5% mark-up applied to capital replacement costs in Section C.1.2 to account for engineering and/or professional design services.

Between 2025 and 2034, the total projected capital renewal cost for water linear infrastructure assets is approximately $223.81 million. This estimate includes escalation for inflation increases over time of 2.5%. The majority of this cost is attributed to watermains, which account for $188.44 million. Water hydrants, despite having no identified installation dates, contribute approximately $8.07 million due to assumptions made for assets lacking install dates. Water valves and meters have more balanced contributions, with costs of $10.92 million and $16.38 million, respectively. This data highlights the importance of accurate asset tracking, as missing installation dates can lead to substantial estimated renewal costs.

For non-linear assets, renewal needs were estimated using an Average Annual Capital Investment (AACI) value based on a top-down assessment. Un-like linear assets, non-linear assets are much more complex and detailed asset inventories are currently unavailable, making a bottom-up approach more challenging. The AACI was calculated using a 75-year facility lifecycle, considering the five major components per PSAB standards: concrete/tankage, building components, building fixtures, mechanical, and electrical. Component replacement values are obtained from the replacement costs of non-linear assets identified in the 2025 Facility Condition Assessment report, which are broken down by facility division. Each division has then been assigned to one of the five major components. The investment forecast aligns with the lifecycle management activity of replacing deteriorated assets, as discussed in the lifecycle decision-making section.

Table 92: Capital Expenses for Renewal of Water Non-Linear Assets[1]

Asset Type	Component	Life Cycle Years	Component Value Replacement Cost[1]	Cost Over Life Cycle (2025)
Treatment Plants	Concrete and Tankage	75	$27,277,000	$27,277,000
Treatment Plants	Mechanical	25	$226,658,000	$679,975,000
Treatment Plants	Electrical	10	$111,068,000	$833,013,000

Asset Type	Component	Life Cycle Years	Component Value Replacement Cost[1]	Cost Over Life Cycle (2025)
Treatment Plants	**ALL**	**75**	**Subtotal**	**$1,540,265,000**
Booster Stations	Concrete and Tankage	75	$550,000	$550,000
Booster Stations	Building	50	$814,000	$1,220,000
Booster Stations	Mechanical	25	$1,800,000	$5,400,000
Booster Stations	Electrical	10	$2,111,000	$15,831,000
Booster Stations	**ALL**	**75**	**Subtotal**	**$23,001,000**
Reservoir and Booster Station	Concrete and Tankage	75	$16,106,000	$16,106,000
Reservoir and Booster Station	Building	50	$4,453,000	$6,680,000
Reservoir and Booster Station	Mechanical	25	$3,544,000	$10,631,000
Reservoir and Booster Station	Electrical	10	$3,456,000	$25,920,000
Reservoir and Booster Station	**ALL**	**75**	**Subtotal**	**$59,337,000**
Water Tower	Concrete and Tankage	75	$9,011,000	$9,011,000
Water Tower	Building	50	$16,048,000	$24,071,000
Water Tower	Mechanical	25	$1,846,000	$5,537,000
Water Tower	Electrical	10	$1,759,000	$13,194,000
Water Tower	**ALL**	**75**	**Subtotal**	**$51,813,000**
Full Life-Cycle Costs		**Total (over 75yr Cycle)**		**$1,674,416,000**
		Average Annual Capital Investment		**$22,326,000**

2) 20% mark-up applied to capital replacement costs in Section C.1.2 to account for professional services, engineering and project management.

The estimated AACI to maintain the existing non-linear assets is approximately $22.3 million. This represents the calculation of the asset replacement cost over its average lifecycle period, ensuring that existing infrastructure is replaced when it reaches the end of its useful life. It is noted that the AACI for non-linear infrastructure can vary significantly over the lifecycle, depending on the timing of major components reaching the end of their useful life.

E.2.1.3 New Asset Construction

To address risk mitigation and growth-based needs, numerous capital projects are planned over the next decade based on UK's recent budget information and planning spreadsheet. **Table 93** outlines investments required for risk mitigation, totaling approximately $31.8 million. These projects also support growth, and therefore have funding allotted from both user rates and development charges (DC).

Table 93: Capital Expenses for New Water Assets for Risk Mitigation

Parent	Header	Project Detail	Rates Total (2025-2034)	DC Total	Total Amount (in 2025 $) from Rates and DC
Pipes	Trunks	Westbrook Second Feed/Creekford (EA) (DC 2b)	$ 600,000	$ 900,000	$1,500,000
Pipes	Trunks	Front Rd Water Interconnection Phase 2B (Country Club Drive to Sir John A MacDonald Blvd) (DC 3b)	$ 7,256,000	$ 7,256,000	$14,513,000
Pipes	Trunks	Westbrook Second Feed (DC 2a)	$ 6,320,000	$ 9,480,000	$15,800,000
Total					**$ 31,813,000**

In parallel, **Table 94** outlines growth-related investments required to support future population and service expansion. Unless noted otherwise, each project represents a replacement of an existing asset with a larger asset, providing both an asset renewal and a new asset to support growth. As such, projects will be jointly funded by user rates and DC charges. The total required investment from DC charges in growth-related infrastructure is approximately $37.3 million. The rates total for asset replacements is not carried forward as part of the overall budget requirement forecast, as it is assumed to be covered under the asset renewal section.

Table 94: Capital Expenses for Growth Based Projects of New and/or Upsized Assets for Water

Parent	Header	Project Detail	Rates Total (2025-2034)	DC Total	Total Amount (in 2025$) from Rates and DC
Pipes	Trunks	Gardiners upsize to 500mm Princess to Fortune (DC 5)	$ 2,059,000	$ 3,701,000	$5,760,000
Pipes	Trunks	Cloggs Rd & Midland Servicing (DC 6)	-	$ 10,010,000	$10,010,000
Pipes	Locals	Princess St Ph 5, and Garrett	$ 2,450,000	$ 1,050,000	$ 3,500,000
Pipes	Locals	Queens Cres, Albert-Collingwood	$ 427,000	$ 113,000	$ 540,000
Pipes	Locals	Watermain replacement and upsizing in conjunction with combined sewer separation project on King, Alwington-Beverly & Pembroke, Union-King	$ 4,634,000	$ 1,986,000	$ 6,620,000
Pipes	Locals	Watermain replacement project and upsizing in conjunction with CSS project on Russel/Kent	$ 1,504,000	$ 265,000	$ 1,770,000
Pipes	Locals	Watermain replacement and upsizing in conjunction with	$ 9,139,000	$ 6,940,000	$16,079,000

Parent	Header	Project Detail	Rates Total (2025-2034)	DC Total	Total Amount (in 2025$) from Rates and DC
		future combined sewer separation projects (2029-2033)			
Pipes	Locals	Watermain replacement and upsizing in conjunction with future combined sewer separation projects (2034-2043) (DC 18)	$ 13,585,000	$ 8,654,000	$ 22,239,000
Pipes	Locals	Brock, Clarence, Wellington, Bagot	$ 3,724,000	$ 1,596,000	$ 5,320,000
Pipes	Locals	Gatwick Ave, Kendal to Creekford (DC 4)	-	$ 1,130,000	$ 1,130,000
Pipes	Locals	Rideau St (DC 9)	$ 96,000	$ 863,000	$959,000
Pipes	Locals	Fraser St (DC 8)	$ 1,133,000	$ 507,000	$1,640,000
Pipes	Locals	Joseph St (DC 7)	$ 425,000	$ 138,000	$ 563,000
Pipes	Locals	Bagot St (DC 10)	$ 1,215,000	$ 214,000	$1,430,000
Pipes	Locals	Montreal/Rideau/Railway Intersection (DC 11)	$ 52,000	$ 161,000	$ 213,000
Total			**$40,443,000**	**$37,330,000**	**$77,773,000**

E.2.1.4 Renewal of New Assets

Based on the identified new asset construction projects, an additional budget will be required in the future to maintain and upgrade both linear and non-linear assets that have been added to the Water Utility. These new assets are not included in the current 2025 to 2034 capital renewal costs. To ensure more accurate future forecasting of asset renewal needs, it is recommended that design submissions for new infrastructure include detailed asset information, such as material type, expected service life, and installation specifications. Incorporating this data at the design stage will allow for early integration of renewal planning into future AMP cycles, enabling UK to more accurately assess lifecycle costs and plan sustainable long-term investment strategies.

E.2.1.5 Water Utility Budget Requirement Forecast

Table 95 presents a summary of estimated budget projections for 2025-2034. Between 2025 and 2034, a total of approximately $447.06 million is anticipated for the renewal of existing linear and non-linear infrastructure, averaging $44.7 million per year. An additional $69.1 million is planned for the construction of new and/or upsized assets, including risk-mitigation and growth-based projects, with an average annual expenditure of $6.9 million. Overall, the total forecasted capital investment over the 10-year period is approximately $516.19 million, averaging $51.6 million per year.

Table 95: Estimated Required Capital Investment for the Water Utility

Expenditure Group	Asset Classes and Details	2025-2034 Total (2025$)	Average Annual Expenditure (2025$)
Renewal of Existing Infrastructure	Linear Infrastructure	$223,806,000	$22,400,000
Renewal of Existing Infrastructure	Plants and Facilities	$223,255,000	$22,300,000
Renewal of Existing Infrastructure	**Subtotal:**	**$447,062,000**	**$44,700,000**
Construction of New Assets	Risk-Mitigation	$31,813,000	$3,200,000
Construction of New Assets	Growth-based Projects (DC Total)	$37,330,000	$3,700,000
Construction of New Assets	**Subtotal:**	**$69,143,000**	**$6,900,000**
Total		**$516,205,000**	**$51,600,000**

E.2.2 Wastewater Utility

The following provides an overview of the development of the capital budget forecast for the Wastewater Utility.

E.2.2.1 Significant Operational Expenses

Figure 22 presents a summary of key operating expenses from 2020 through 2035. Historically, approved budgets have adequately covered actual operating costs. The rising trend in operating budgets reflects UK's ongoing commitment to efficiently manage existing operations while preparing for planned expansions. For 2024, the approved operating budget is $21.2 million. The approved budget for 2025 is $22.8 million, marking an increase of $1.6 million (or 7.6%). An additional increase of $1.1 million (or 4.7%) is anticipated for 2026, bringing the proposed operating budget to $23.9 million.

These increases are primarily driven by rising costs for contracted services, supplies (e.g., chemicals, tools, equipment, and parts), and utilities necessary to maintain current service levels. The budget also reflects the need for additional resources to support the inspection, operation, and maintenance of the City's growing inventory of wastewater assets, including facilities and underground infrastructure. As the City continues to expand, more funding is required to manage and sustain new and existing wastewater systems. A notable increase in insurance costs for wastewater infrastructure is also included in the budget.

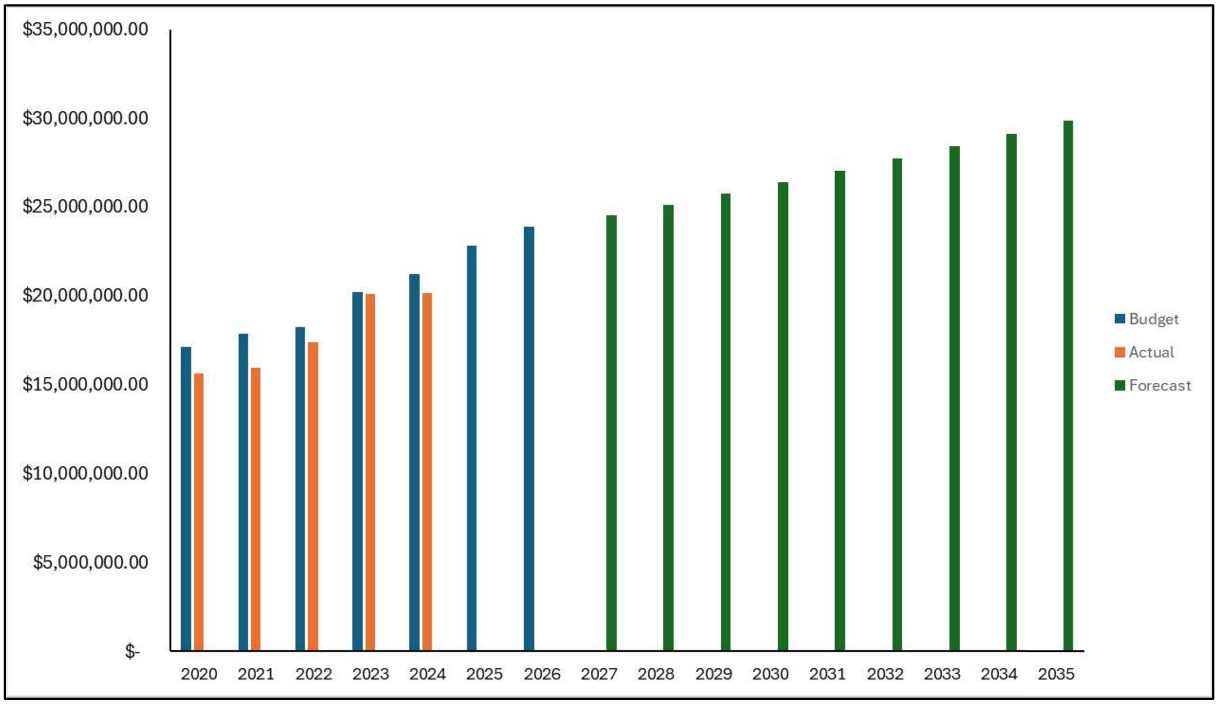

Figure 22: Significant Operating Expenses for Wastewater

E.2.2.2 Renewal of Existing Assets

Table 96 and **Table 97** present the total projected capital renewal costs for linear and non-linear (plants and facilities) assets, respectively, over the 10-year period from 2025 to 2034.

For linear assets, renewal needs were assessed based on asset age using a bottom-up approach. Assets identified for renewal within the 10-year period had their replacement costs estimated using their length and a unit cost for the pipe's diameter and material type. To account for assets with missing installation dates, a proportional adjustment factor was applied. This factor was calculated by assuming the percentage of assets without installation dates that are due for renewal within the 10-year forecast is the same as the percentage of assets with install dates that are also due for renewal within the 10-year forecast. For services (laterals), the percentage of assets assumed to require replacement within the 10-year period aligns with the percentage of gravity mains identified for renewal, as these assets are frequently replaced simultaneously during coordinated construction or rehabilitation projects.

Table 96: Capital Expenses for renewal of Wastewater Linear Assets (1)

Expenditure Group	Capital Renewal Cost for Assets with Installation Date (2025-2034)	Percentage of Assets with Installation Date Identified for Renewal within 10 years (2025-2034)	Percentage of Assets without Installation Date Assumed for Renewal within 10 years (2025-2034)	Capital Renewal Cost for Assets with and without Installation Date (2025-2034)
Gravity Mains	$49,587,000	11.45%	11.45%	$49,740,000
Force mains	$8,689,000	18.72%	18.72%	$9,363,000
Control Valves	$464,000	12.50%	12.50%	$552,000
System Valves	$43,000	1.19%	1.19%	$43,000
Manholes	$2,660,000	3.15%	3.15%	$2,736,000
Services	-	11.45%	11.45%	$17,828,000
Total Capital Renewal Cost (2025-2034)				**$80,263,000**

1) 5.5% mark-up applied to capital replacement costs in Section D.1.2 to account for engineering and/or professional design services.

The analysis shows that the highest renewal costs are associated with gravity mains and manholes, reflecting both their asset value and the high percentage of assets due for renewal. Service connections, despite having no installation date data, contribute significantly to total costs based on their assumed life cycle. The total estimated capital renewal cost for all linear assets during the planning period amounts to $80.3 million. This estimate includes escalation for inflation increases over time of 2.5%.

For non-linear assets, renewal needs were estimated using an Average Annual Capital Investment (AACI) value based on a top-down assessment. Unlike linear assets, non-linear assets are much more complex and detailed asset inventories are currently unavailable, making a bottom-up approach more challenging. The AACI was calculated using a 75-year facility lifecycle, considering component-based life expectancies of concrete/tankage, building components, building fixtures, mechanical and electrical. Component replacement values are obtained from the replacement costs of non-linear assets identified in the 2025 Facility Condition Assessment report, which are broken down by facility division. Each division is then assigned to one of the five major components. The investment forecast aligns with lifecycle management activity of replacing deteriorated assets, as discussed in the lifecycle decision-making section.

Table 97: Capital Expenses for renewal of Wastewater Non-Linear Assets

Asset Type	Component	Life Cycle Years	Component Value Replacement Cost[1]	Cost Over Life Cycle (2024)
Wastewater Treatment Plants	Building Tankage	75	$226,921,000	$226,921,000
Wastewater Treatment Plants	Building Structure	50	$0	$0
Wastewater Treatment Plants	Building Fixture	15	$0	$0

Asset Type	Component	Life Cycle Years	Component Value Replacement Cost[1]	Cost Over Life Cycle (2024)
Wastewater Treatment Plants	Mechanical	25	$839,639,000	$2,518,916,000
Wastewater Treatment Plants	Electrical	10	$459,019,000	$3,442,644,000
Wastewater Treatment Plants	**ALL**	**75**	**Subtotal**	**$6,188,482,000**
Pumping Stations	Building Tankage	75	$97,494,000	$97,494,000
Pumping Stations	Building Structure	50	$30,133,000	$45,200,000
Pumping Stations	Building Fixture	15	$4,768,800	$23,844,000
Pumping Stations	Mechanical	25	$77,618,000	$232,855,000
Pumping Stations	Electrical	10	$46,564,000	$349,227,000
Pumping Stations	**ALL**	**75**	**Subtotal**	**$748,620,000**
CSO Tanks	Building Tankage	75	$17,860,000	$17,860,000
CSO Tanks	Building Structure	50	$160,000	$239,000
CSO Tanks	Building Fixture	15	$25,000	$126,000
CSO Tanks	Mechanical	25	$358,000	$1,073,000
CSO Tanks	Electrical	10	$259,000	$1,944,000
CSO Tanks	**ALL**	**75**	**Subtotal**	$21,242,000
Full Life-Cycle Costs			**Total (Over 75yr Cycle)**	**$6,958,343,000**
			Average Annual Investment	$92,778,000
			Total Average Cost (2025-2034)	$927,779,000

1) 20% mark-up applied to capital replacement costs in Section D.1.2 to account for professional services, engineering and project management.

The estimated AACI to maintain the existing non-linear assets is approximately $92.8 million or about $928 million over the upcoming 10-year window. This represents the calculation of the asset replacement cost over the average lifecycle period, ensuring that existing infrastructure is replaced when it reaches the end of its useful life. This high capital requirement reflects the intensive and complex nature of wastewater treatment infrastructure. It is noted that the AACI for non-linear infrastructure can vary significantly over the lifecycle, depending on the timing of major components reaching the end of their useful life. The annual investment estimate is expected to increase each year as new or upgraded assets are added to the water utility system.

E.2.2.3 New Asset Construction

Table 98 outlines projected capital investments related to the development of new wastewater infrastructure aimed at risk mitigation, particularly for improving system redundancy and reducing vulnerability in key trunk sewer corridors.

The current confirmed total for risk mitigation-related wastewater capital projects between 2025 and 2034 stands at $8 million. These investments reflect the Utility's commitment to enhancing the resilience and operational security of its wastewater system in the face of aging infrastructure and future system demands.

Table 98: Capital Expenses for New Wastewater Assets for Risk Mitigation

Parent	Header	Project Detail	Rates Total (2025-2034)	DC Total	Total Amount (in $) from Rates and DC
Pipes	Trunks	Days Rd. PS Forcemain twinning (Days-CB)	$8,000,000	$0	$8,000,000
Total			$8,000,000	$0	**$8,000,000**

To address growth-based needs, numerous capital projects are planned over the next decade. **Table 99** summarizes the projected investments associated with growth-based wastewater infrastructure projects planned for implementation between 2025 and 2034. These projects focus on the construction and design of new and/or upsized wastewater assets across both local and trunk sewer networks as well as facilities. The estimates are broken down by funding source, with contributions from rate-supported revenues and Development Charges (DCs). The total estimated investment required for the delivery of these growth-related wastewater projects, excluding cost estimates allocated to replacing existing assets (assumed to be covered in the asset renewal section), is approximately $161.5 million, of which $22.5 million is anticipated to be funded through rate revenues and $139.0 million through development charges.

Table 99: Estimated Required Capital Investment Based on Growth Based Projects of New Assets for Wastewater

Parent	Header	Project Detail	Rates Total (2025-2034) Asset Replacement	Rates Total (2025-2034) New Asset	DC Total (2025-2034)	Total Amount (in $) from Rates and DC
Facilities	Treatment Plants	Cat Bay Phase 2 Solids Train upgrades, incl EA (DC 13)	$0	$0	$44,800,000	$44,800,000
Facilities	Treatment Plants	Cat Bay Phase 3 Liquid Train upgrades, incl EA (DC 12)	$0	$0	$34,543,000	$34,543,000
Facilities	Pumping Stations	Portsmouth SPS Upgrades (DC 15)	$1,741,000	$0	$5,223,000	$6,964,000
Facilities	Pumping Stations	Bath Rd SPS Capacity Upgrades (DC 16)	$1,025,000	$0	$3,075,000	$4,100,000
Facilities	Pumping Stations	Barrett Crt. SPS Capacity Upgrade (DC 17)	$6,000,000	$0	$4,000,000	$10,000,000
Pipes	Locals	Montreal/John Counter Intersection (DC 7)	$1,084,000	$0	$610,000	$1,693,000
Pipes	Locals	Queens Cres Combined Sewer Separation (DC 26)	$188,000	$0	$63,000	$251,000
Pipes	Locals	King, Alwington-Beverly, Pembroke, Union-King Combined Sewer Separation (DC)	$3,120,000	$0	$1,040,000	$4,160,000
Pipes	Locals	Russell St and Kent Combined Sewer Separation (DC)	$1,050,000	$0	$350,000	$1,400,000
Pipes	Locals	Orchard/River St Combined Sewer Separation (DC 25)	$571,000	$0	$190,000	$762,000
Pipes	Locals	Future Combined Sewer Separation Projects (2029-2033) (DC 27)	$6,919,000	$0	$3,423,000	$10,342,000
Pipes	Locals	Future Combined Sewer Separation Projects (2034-2043) (DC 28)	$10,622,000	$0	$6,651,000	$17,273,000
Pipes	Trunks	North End Trunk Sewer Twinning Ph 3, EA (DC 3b)	$0	$900,000	$600,000	$1,500,000
Pipes	Trunks	King St W Collector - Part of Front Rd Phase 2B (DC 5)	$1,741,000	$0	$1,258,000	$3,000,000
Pipes	Trunks	Portsmouth SPS Redirection: Phase 2B, Front Rd/King St, Sand Bay Lane to Country Club Drive - Front Road (DC 21b)	$0	$14,025,000	$4,675,000	$18,700,000
Pipes	Trunks	Hillview Dr SPS Forcemain Upgrade (DC 18)	$95,000	$0	$197,000	$293,000
Pipes	Trunks	Princess Collector Phase 2, Portsmouth to Sir John A Macdonald Blvd (DC 4a)	$1,668,000	$0	$1,602,000	$3,270,000
Pipes	Trunks	Bath Rd SPS Forcemain Upsize (DC 20)	$1,391,000	$0	$1,739,000	$3,130,000

Water and Wastewater Utilities Asset Management Plans 2025 to 2034

Parent	Header	Project Detail	Rates Total (2025-2034)		DC Total (2025-2034)	Total Amount (in $) from Rates and DC
			Asset Replacement	New Asset		
Pipes	Trunks	Barrett Crt SPS Forcemain Upsize (DC 19)	$1,200,000	$0	$1,500,000	$2,700,000
Pipes	Trunks	Midland Ave, Creekford to Cat Woods - New Sewer (DC 6a)	$0	$0	$5,100,000	$5,100,000
Pipes	Trunks	Midland Ave, Cat Woods to Princess - Sewer Upsize (DC 6b)	$802,700	$0	$2,737,000	$3,540,000
Pipes	Trunks	Hwy 15, Barrett Crt SPS to Gore Road (DC 1b)	$1,228,800	$0	$3,091,000	$4,320,000
Pipes	Trunks	Hwy 15, Gore Road to Innovation (DC 1a)	$2,089,300	$0	$4,051,000	$6,140,000
Pipes	Trunks	Barriefield Trunk, (Hwy 15 Outlet), Wellington to Hwy 2 (DC 1c)	$351,400	$0	$625,000	$976,000
Pipes	Trunks	North End Trunk Sewer Twinning Phase 3, JCB to Dalton Ave SPS (DC 3a)	$0	$7,593,600	$5,062,000	$12,656,000
Pipes	Trunks	North-West Collector, Lincoln to Pembridge (DC 2)	$2,469,400	$0	$1,921,000	$4,390,000
Pipes	Trunks	Notchill Collector (DC 8)	$881,900	$0	$388,000	$1,270,000
Pipes	Trunks	Rideau St Collector Upsize (DC 9)	$322,300	$0	$503,000	$825,000
		Total	**$46,563,000**	**$22,519,000**	**$139,017,000**	**$208,099,000**
		Capital Investment in Growth Based Projects (New Asset Rates Total + DC Total)	**$161,536,000**			

E.2.2.4 Renewal of New Assets

As new infrastructure is built, it becomes part of the overall asset base requiring future renewal and maintenance. While the financial implications of this added renewal burden are not explicitly forecasted in the 2025–2034 costs, UK will continue to re-evaluate and update forecasts in future AMP cycles to account for this growth in the capital renewal demand.

E.2.2.5 Wastewater Utility Budget Requirements Forecast

Table 100 presents a summary of estimated budget projections for 2025-2034. Between 2025 and 2034, a total of approximately $1.01 billion is anticipated for the renewal of existing linear and non-linear infrastructure, averaging $100.8 million per year. An additional $169.5 million is planned for the construction of new assets, including risk-mitigation and growth-based projects, with an average annual expenditure of $17.0 million. Overall, the total forecasted capital investment over the 10-year period is approximately $1.2 billion, averaging $118 million per year.

Table 100: Estimated Required Capital Investment for the Wastewater Utility

Expenditure Group	Asset Classes and Details	2025-2034 Total (2024$)	Average Annual Expenditure
Renewal of Existing Infrastructure	Linear Infrastructure	$80,263,000	$8,000,000
Renewal of Existing Infrastructure	Plants and Facilities	$927,779,000	$92,800,000
Renewal of Existing Infrastructure	**Subtotal:**	**$1,008,042,000**	**$100,800,000**
Construction of New Assets	Risk-Based Projects	$8,000,000	$800,000
	Growth-Based Projects (New Assets and DC Total)	$161,536,000	$16,200,000
Construction of New Assets	**Subtotal:**	**$169,536,000**	**$17,000,000**
Total	**All (No Inflation)**	**$1,177,578,000**	**$117,700,000**

E.3 Funding Strategy and Infrastructure Deficit

E.3.1 Water Utility

The asset management analysis in **Table 95** recommends an average annual investment of $51.6 million on the water system to ensure proper replacement cycles for existing assets and for the construction of new and/or upsized assets, including risk-mitigation and growth-based projects. **Table 101** illustrates the total funds available to support water asset capital expenditures, including approved budgets for 2025 and 2026 and forecasts through to 2034. Funding sources include revenue from rates, development charges (DC) contributions, and planned allocations from UKs financial plan.

Table 101: Funding Sources for the Water Utility

Year	Capital Renewal Totals	Capital Growth Totals	Total Available Funding
2025	$17,223,000	$15,237,000	$32,460,000
2026	$18,034,000	$15,089,000	$33,123,000
2027	$18,873,000	$4,509,000	$23,383,000
2028	$20,829,000	$4,214,000	$25,043,000
2029	$22,033,000	$4,425,000	$26,457,000
2030	$23,078,000	$4,638,000	$27,716,000
2031	$23,639,000	$4,841,000	$28,480,000
2032	$25,294,000	$5,071,000	$30,365,000
2033	$45,735,000	$5,295,000	$51,030,000
2034	$42,540,000	$13,853,000	$56,393,000
Total	**$257,277,000**	**$77,172,000**	**$334,449,000**

Over the next 10 years, projected funding from development charges totals approximately $77.2 million, compared to $257.3 million from rates. This means DCs account for roughly 23.1% of the total projected funding for the water system.

Given the assumption that asset growth will align with the projected growth in the customer base, approximately 1.2% annually over the next decade, the current level of DC contributions provides enough support for growth-related infrastructure needs. This highlights the importance of ongoing review of DC rate structures and collection assumptions to ensure that growth-related infrastructure demands are sustainably funded, and to reduce reliance on user rates or reserves to subsidize growth.

The overall financial budget summary for the Water Utility is shown in **Table 102**, with funding sources by year presented in **Figure 23**. These funding sources are detailed in **Table 101**, which outlines the total funds available to support water asset capital expenditures over the 2025-2034 period, including approved budgets for 2025 and 2026, as well as long-term forecasts. The capital renewal totals represent the budget approved and forecasted for the renewal of existing infrastructure, while the capital growth totals represent the budget approved and forecasted for the construction of new assets. **Table 102** provides a summary of the total required budget for both renewal and new asset investments over the same period. The difference between the total required budget forecasted for renewal of existing infrastructure and construction of new assets and total funding available represents the projected budget deficit over the next 10 years, as outlined in **Table 102**. As seen in **Table 102**, a 181.7 million infrastructure deficit is projected over the 10-year period.

Table 102: Financial Strategy Summary for the Water Utility

Item	Expenditure Category	Total (2025-2034)
Budget Forecast (Required)	Renewal of Infrastructure	$447,062,000
Budget Forecast (Required)	New Assets	$69,143,000

Item	Expenditure Category	Total (2025-2034)
Budget Forecast (Required)	**Total Required**	**$516,205,000**
Funding (Available)	Revenues available for Capital	$257,277,000
Funding (Available)	Impost/DC contributions	$77,172,000
Funding (Available)	**Total Available**	**$334,449,000**
Infrastructure Deficit	**Difference**	**$181,756,000**

UK is currently meeting several of its desired levels of service, with the majority of the current KPIs, such as number of adverse drinking water quality notifications, IRR report, percent of watermain infrastructure considered to be priority for replacement or rehabilitation, number of watermain breaks per 100 kilometers of watermain per year, uncommitted reserve, cross connection backflow control program, and others are within target ranges. This reflects effective management and delivery of services to date. However, sustaining this performance will require refining and addressing the projected $181.7 million funding deficit over the 10-year period. Without corrective financial strategies, current service levels may become unsustainable, and the risk of performance decline across multiple KPIs will increase.

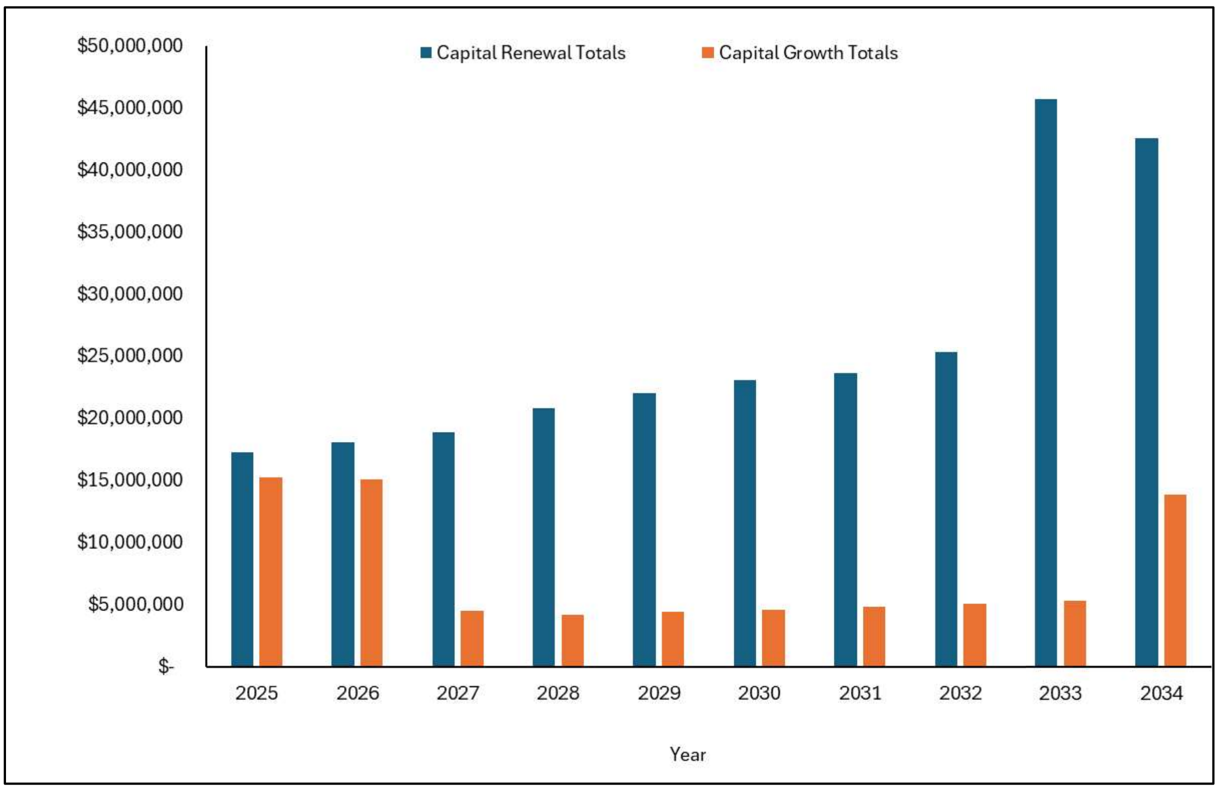

Figure 23: Water Funding by Source and Year

When evaluating lifecycle activities to maintain current levels of service the risks associated with different maintenance strategies have been considered. Reducing or deferring maintenance in an effort to lower short-term operational costs carries long-term risks associated with asset failure. Without maintenance, assets are more likely to deteriorate prematurely, increasing the likelihood of unexpected failures and service disruptions. This can lead to higher total expenditure (TOTEX) over time due to emergency repairs and early asset replacements. Furthermore, reduced maintenance may result in non-compliance with regulatory standards, particularly in critical areas such as water quality and fire protection, ultimately compromising public safety and customer satisfaction.

Over-maintaining assets, by conducting maintenance more frequently or extensively than necessary, also presents risks. While this strategy may reduce the chance of asset failure, it often leads to inefficiencies and inflated operational costs. The additional maintenance does not yield proportional improvements in asset performance or lifespan, resulting in diminishing returns. Over-maintenance diverts valuable resources away from higher-priority needs, placing unnecessary strain on budgets and reducing overall system efficiency. Both approaches highlight the importance of adopting a balanced, data-informed maintenance strategy that aligns with asset condition, risk profiles, and service level objectives.

Addressing the projected 10-yr $181.7 million infrastructure deficit requires a focused set of lifecycle activities, including rehabilitation, major upgrades, replacement, and maintenance. Deferring these activities risks accelerated asset failure, reductions in levels of service and reduced service reliability. To manage these risks, a risk-based prioritization framework will be employed to focus resources where they are most needed. Additionally, cost-effective strategies such as routine maintenance programs, the implementation of the new EAM, and the use of asset condition monitoring technologies will be implemented to maintain existing levels of service while minimizing expenditures.

Financial plans are updated annually, and alternative financing options are routinely considered to maximize the available funding to support asset management. Additionally, UK can manage the risks associated with not undertaking the proposed capital projects due to a funding shortfall by applying for federal funding from the sources recommended in the funding strategies section.

E.3.2 Wastewater Utility

The asset management analysis in **Table 100** recommends an average annual investment of $117.8 million on the wastewater system to ensure proper replacement cycles for existing assets and for the construction of new and/or upsized assets, including risk-mitigation and growth-based projects. **Table 103** illustrates the total funds available to support wastewater capital expenditures, including approved budgets for 2025 and 2026 and forecasted amounts through 2034. Funding sources include revenues from capital (rate-supported funding), development charge (DC) contributions, and planned allocations from Utilities Kingston's financial plan. The table shows year-by-year projections for capital renewal and growth funding, which together provide the basis for the total available funding.

Table 103: Funding Sources for the Wastewater Utility

Year	Capital Renewal Totals	Capital Growth Totals	Total Available Funding
2025	$13,770,000	$12,265,000	$26,035,000
2026	$14,753,000	$11,896,000	$26,649,000
2027	$35,807,000	$43,433,000	$79,240,000
2028	$18,411,000	$32,904,000	$51,315,000

Year	Capital Renewal Totals	Capital Growth Totals	Total Available Funding
2029	$18,283,000	$11,305,000	$29,588,000
2030	$19,673,000	$10,477,000	$30,150,000
2031	$20,443,000	$10,979,000	$31,422,000
2032	$22,678,000	$11,546,000	$34,224,000
2033	$24,549,000	$12,099,000	$36,648,000
2034	$28,620,000	$37,737,000	$66,357,000
Total	**$216,986,000**	**$194,641,000**	**$411,628,000**

Over the next 10 years, projected funding from development charges totals approximately $194.6 million, compared to $217.0 million from rates. This means DCs account for roughly 47.3% of the total projected funding for the water system.

Given the assumption that asset growth will align with the projected growth in the customer base, approximately 1.2% annually over the next decade, the current level of DC contributions provides enough support for growth-related infrastructure needs. This highlights the importance of ongoing review of DC rate structures and collection assumptions to ensure that growth-related infrastructure demands are sustainably funded, and to reduce reliance on user rates or reserves to subsidize growth.

The overall financial budget summary for the Wastewater Utility is shown in **Table 104**, with funding sources by year presented in **Figure 24**. These funding sources are detailed in **Table 103**, which outlines the total funds available to support wastewater asset capital expenditures over the 2025-2034 period, including approved budgets for 2025 and 2026, as well as long-term forecasts. The capital renewal totals represent the budget approved and forecasted for the renewal of existing infrastructure, while the capital growth totals represent the budget approved and forecasted for the construction of new assets. **Table 104** provides a summary of the total required budget for both renewal and new asset investments over the same period. The difference between the total required budget forecasted for renewal of existing infrastructure and construction of new assets and total funding available represents the projected budget deficit over the next 10 years. As seen in **Table 104**, a 765.9 million infrastructure deficit is projected over the 10-year period.

Table 104: Financial Strategy Summary for the Wastewater Utility

Item	Expenditure Category	Total (2025-2034)
Budget Forecast (Required)	Renewal of Infrastructure	$1,008,042,000
Budget Forecast (Required)	New Assets	$169,536,000
Budget Forecast (Required)	**Total Required**	**$1,177,578,000**
Funding (Available)	Revenues available for Capital	$216,986,000
Funding (Available)	Impost/DC contributions	$194,641,000
Funding (Available)	**Total Available**	**$411,628,000**
Budget Deficit	**Difference**	**$765,950,000**

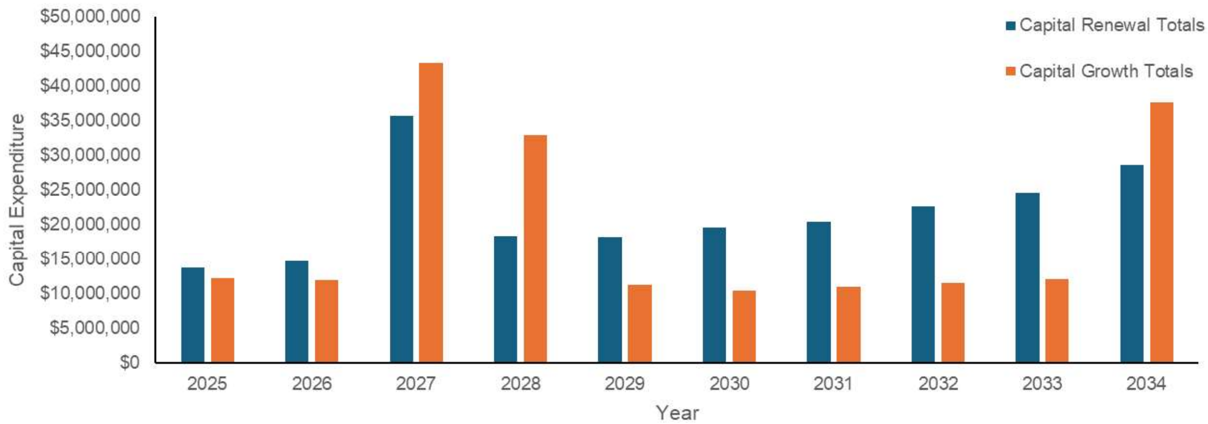

Figure 24: Wastewater Funding by Source

When evaluating lifecycle activities to maintain current levels of service, the risks associated with different maintenance strategies have been considered. Reducing or deferring maintenance in an effort to lower short-term operational costs carries long-term risks associated with asset failure. Without maintenance, assets are more likely to deteriorate prematurely, increasing the likelihood of unexpected failures and service disruptions. This can lead to higher total expenditure (TOTEX) over time due to emergency repairs and early asset replacements. Furthermore, reduced maintenance may result in non-compliance with regulatory standards, particularly in critical areas such as water quality and fire protection, ultimately compromising public safety and customer satisfaction.

Over-maintaining assets, by conducting maintenance more frequently or extensively than necessary, also presents risks. While this strategy may reduce the chance of asset failure, it often leads to inefficiencies and inflated operational costs. The additional maintenance does not yield proportional improvements in asset performance or lifespan, resulting in diminishing returns. Over-maintenance diverts valuable resources away from higher-priority needs, placing unnecessary strain on budgets and reducing overall system efficiency. Both approaches highlight the importance of adopting a balanced, data-informed maintenance strategy that aligns with asset condition, risk profiles, and service level objectives.

Addressing the projected 10-yr $765.8 million infrastructure deficit requires a focused set of lifecycle activities, including rehabilitation, major upgrades, replacement, and maintenance. Deferring these activities risks accelerated asset failure reductions in levels of service, and reduced service reliability. To manage these risks, a risk-based prioritization framework will be employed to focus resources where they are most needed. Additionally, cost-effective strategies such as routine maintenance programs, the implementation of the new EAM, and the use of asset monitoring technologies will be implemented to maintain existing levels of service while minimizing expenditures.

Financial plans are updated annually, and alternative financing options are routinely considered to maximize the available funding to support asset management. Additionally, UK can manage the risks associated with not undertaking the proposed capital projects due to a funding shortfall by applying for federal funding from the sources recommended in the funding strategies section.

E.4 Additional Funding Sources

Additional funding sources can be collected by UK through federal funding. In April 2024, the Government of Canada tabled Budget 2024: Fairness for Every Generation Budget 2024, which proposed total spending of $537.6 billion, including $53 billion in new spending this fiscal year. This budget's primary focus areas include housing, communities, Indigenous peoples, defence, innovation, and tax reforms. Specifically, as it relates to UK budget 2024 announced:

- $6.7 billion over 20 years for Public Services and Procurement Canada's portfolio of assets ($44 million in 2024-2025), which includes software acquisition.
- $2.4 billion over five years for investments in Canada's AI advantage.
- the introduction of a 15% refundable tax credit rate for eligible investments in new equipment or refurbishments related to low-emitting electricity generation systems, stationary electricity storage systems, and the transmission of electricity between provinces and territories (worth $7.2 billion from 2024-25 to 2028-29 and $25 billion from 2029-30 to 2034-35).
- $191 million over five years for Chemicals Management Plan ($95 million in 2024-25).
- $7 million over five years for early warning system for extreme weather events ($1 million in 2024-25).
- $158.5 million over two years for the Regional Economic Growth through Innovation program ($55 million in 2024-25).
- $27 million over five years to enhance cyber resiliency and implementation of additional data security.

UK may benefit from applying for federal funding through agencies such as Innovation Science and Economic Development Canada, Natural Resources Canada, or Canada Infrastructure Bank. UK, or its partner, may benefit from applying for provincial and regional funding through agencies such as Service Ontario, the Government of Ontario, the Federation of Canadian Municipalities, Independent Electricity System Operator – Save on Energy, and the Ontario Centre for Innovation. These agencies have overlapping requirements, objectives, and program goals as they endeavor to modernize, incite growth, and improve Canadian communities with sustainable development and economic empowerment opportunities while prioritizing innovation and climate resiliency. The Project may see greater benefit from some funding opportunities over others. Stantec reviewed each funding program's purpose/goals and determined that UK may meet the criteria for funding through each program and should, therefore, review all prospective options listed in the attached *Funding Opportunities Matrix*.

F. Summary and Moving Forward

F.1 Summary

Asset Management has been the core function of UK since its inception, corporately responsible for ensuring that utilities are operated effectively, efficiently, safely, and reliably. It is intended that the asset management capabilities of UK will be expanded and refined in the coming years, and the AMP will incorporate the improvements, recommendations and strategies, evolving and documenting the process to maximize the benefits of Asset Management.

An effective Asset Management Plan is current best practice and if utilized properly is a tool that is expected to assist in stronger accountability, sustainable decision-making, enhanced customer service, effective risk management, and improved financial efficiency. However, Asset Management within UK does not begin or end with these documents and moving forward, and an asset management roadmap has been developed.

F.2 Moving Forward

The AMPs sections contain indices that provide an indicator of the maturity level of that portion of the AMP. The indices are not intended to be a rating of the AMP, but to describe different levels that an organization should strive towards. Overall Asset Management within UK is currently considered to be in the “minimum” Maturity Index for the water and wastewater AMPs. The AMP sections provide recommendations on moving forward and improving the manner in which UK manages the Water and Wastewater Infrastructure. Implementation of the following recommendations will not directly relate to improvements within the Maturity Indices but will improve the overall asset management programs within UK striving towards an overall “Core” Maturity Index.

F.2.1 State of the Local Infrastructure

Moving forward the asset inventories will be continually updated, tracking new assets, rehabilitation dates and repairs to assets. The water and wastewater linear asset inventories are being expanded to include new services as they are installed. An effort will be made to incorporate the various operational tracking sheets for the linear assets (water and wastewater) into the Enterprise GIS inventory, with consideration to add data such as material manufacturer, installation contractor, soil conditions, maintenance history, predictive maintenance scheduling, operational history, maintenance costs, condition, valuation, performance, risk and lifecycle data. UK should determine an appropriate formal asset inventory for Plants and Facilities and construct a hierarchy of information with Process, Component and Subcomponent levels. In addition, UK will consider a review of the data collection and condition assessment process for the distribution system watermains when conducting repairs or connections, i.e., hydrant/valve/break repairs or tapping connections and inclusion of the data in the asset inventory.

It is recommended that the data for any future Condition Assessment consulting assignments for Plants and Facilities should be stored within an appropriate asset registry. The condition and risk assessment data should be included in the asset inventory data.

Table 105: Summary of Asset Management Improvement Items

Asset Group	Asset Class	Description	Time and Effort
Linear Infrastructure	Services	Include in Enterprise GIS with pertinent attribute data. Consider the ability or need to include operational data.	Minimal, moving forward
Linear Infrastructure	Water Meters	Consider the ability or need to link to CIS Billing data for operational tracking.	Minimal, moving forward
Linear Infrastructure	Gravity Mains, Force mains, and Watermains	Consider the ability or need to include operational and additional data such as classifying the assets with additional sub-classes.	Minimal, moving forward
Linear Infrastructure	Wastewater Force mains and Large Critical Watermains	A process to determine the state of the assets for force mains and large diameter watermains should be developed and the results stored in GIS.	Moderate
Linear Infrastructure	Wastewater Junctions	Expand on this feature set to differentiate between valves that require maintenance and static fittings that do not.	Minimal to Moderate
Linear Infrastructure	ALL	Incorporate (link) Operational tracking sheets into Enterprise GIS, including maintenance history.	Moderate
Plants and Facilities	ALL	Research, select and implement a suitable asset management tool (Asset Registry) for Plants and Facilities.	Substantial - Substantial in terms of time, effort and cost.
Plants and Facilities	ALL	Determine appropriate Replacement Costs for all Plants and Facilities to eliminate uncertainty. Conduct an engineering valuation study or implement into next Master Plan update.	Moderate.
Plants and Facilities	ALL	Consider breaking the Assets into Component Sub-Component Processes for purposes of facility management.	Minimal to Moderate, moving Forward
Plants and Facilities	ALL	Include all Asset Classes and Sub- classes for Condition, Criticality and Risk Assessments.	Moderate.
ALL	ALL	Include estimated end-of-life dates and replacement costs for each asset and any relevant asset components for both linear and non-linear assets in the new Asset Management Software.	Minimal to Moderate, moving Forward

F.2.2 Expected Levels of Service

Each Level of Service Statement is supported by a suite of KPIs that are primarily quantitative facets of the Utility that are rated against standards developed by staff. It is not only the current value of the KPI that is important, but the trend demonstrated by the KPI's change over time. These will evolve over time as will the KPI's to ensure that there are benefits to calculating and tracking them. Moving forward UK will track and review the trends in the KPI reporting, as well as modifying the LOS, respective KPI and target values as required to improve asset management within the Utility over time. The KPI's should be monitored throughout the year and updated annually. Additional KPI's should continue to be considered for future iterations of the Asset Management Plans.

F.2.3 Asset Management Strategy

UK currently manages the water and wastewater utilities through a series of Infrastructure Planning, Demand Management, Risk Management, Lifecycle Evaluation, Cost-Benefit Analysis and Maintenance Management processes. Several of these processes are formalized through; the Growth/Planning and Municipal Environmental Assessment processes, Standard Operating Procedures, or Routine maintenance procedures while others are conducted through informal evaluations and assessments.

Moving forward UK should strive to formalize and document the internal risk evaluation and prioritization strategies for the assets such that they are transparent, clear and concise, and understood by the entire organization. The risk evaluation and prioritization strategies should include all asset and sub-asset classes. A Capacity Assurance Program should also be conducted for the other asset classes, including watermains, sewer mains, Pump and Booster Stations – this will utilize the current design parameters to estimate the flow commitment for collection, distribution and conveyance infrastructure.

Asset Management Software is deemed to be essential to take the UK Water and Wastewater Utilities' Asset Management plan to a more advanced level. Tracking all assets for condition, risk, expenditures, lifecycles and works within a dedicated software tool will improve the evaluation and prioritization strategies and project reviews, resulting in better decision making.

UK is currently entering the implementation phase of new Enterprise Asset Management (EAM) System, following the completion of vendor selection and procurement. The EAM system will strengthen the asset management processes by centralizing data, improving work and lifecycle management, and supporting greater consistency, coordination, and long-term planning - ultimately advancing overall asset management maturity.

F.3 O. Reg. 588/17 Compliance Review

Table 106 identifies the requirements outlined in O. Reg. 588/17 that municipalities must meet. Next to each requirement, a section reference is provided. For this AMP, UK has met all the requirements due by July 1, 2025.

Table 106: O. Reg. 588/17 Compliance Review

Requirement	O. Reg. Section	Water Section Reference	Wastewater Section Reference	Status
Summary of assets in each category	S.5(2), 3(i)	C.1.1	C.1.1	Complete
Replacement cost of assets in each category	S.5(2), 3(ii)	C.1.2	C.1.2	Complete
Average age of assets in each category	S.5(2), 3(iii)	C.1.3	C.1.3	Complete
Condition of all assets in each category	S.5(2), 3(iv)	C.1.3	C.1.3	Complete
Description of UK's approach to assessing the condition of assets in each category	S.5(2), 3(v)	C.1.3	C.1.3	Complete
Current levels of service in each category	S.5(2), 1(i-ii)	C.2.1	C.2.1	Complete
Current performance measures in each category	S.5(2), 2	C.2.1	C.2.1	Complete
Lifecycle activities needed to maintain current levels of service for 10 years	S.5(2), 4	C.3.3	C.3.3	Complete
Costs of providing lifecycle activities for 10 years	S.5(2), 4	E.2.1	E.2.1	Complete
Growth assumptions	S.5(2), 5(i-ii) S.5(2), 6(i-vi)	C.3.1.1	C.3.1.1	Complete
Specify the proposed levels of service and explain why they are appropriate.	S.6(1),1-2	C.2.2	C.2.2	Complete
Proposed Performance for Each Asset Category	S. 6(1), 3	C.2.2	C.2.2	Complete
Lifecycle management and financial strategy for the 10-year period	S. 6(1), 4	C.3.3	C.3.3	Complete

Appendix A: Utilities Kingston Asset Management Policy

BACKGROUND

Asset Management is a framework of practices, actions, and policies under which an organization can consistently manage its infrastructure to meet broader corporate priorities and policies. The Infrastructure for Jobs and Prosperity Act, 2015 ("IJPA") in section 6(2) sets out principles for the provincial government to regulate asset management planning for municipalities in Ontario and under IJPA there is a requirement to have an Asset Management Policy. The electric asset management planning process is regulated by the Ontario Energy Board (OEB) and is described in the OEB Chapter 5 Consolidated Distribution System Plan.

Utilities Kingston manages a diverse inventory of Assets (sewer, water, gas, electric, telecommunications (fibre), and hot water tanks) that must be in good working order to provide the level and quality of services Stakeholders expect. This policy is intended to formalize Asset Management activities with the intent of achieving the following benefits:

- strong governance and accountability
- sustainable decisions
- enhanced customer service
- effective risk management
- improved financial efficiency
- meeting regulatory requirements

PURPOSE

The purpose of the Asset Management Policy is:

- to provide leadership and commitment to Asset Management;
- to establish principles and requirements for implementing consistent Asset Management processes throughout Utilities Kingston; and,
- to formally link Asset Management to organizational strategic objectives and plans.

POLICY

1.0 Scope/Exceptions

1.1 Scope
This policy, at a minimum, applies to those departments or business units within Utilities Kingston that manages, operates, or maintains tangible capital assets or asset systems to deliver services to Stakeholders in the City of Kingston or stakeholders of Kingston Hydro or Utilities Kingston.

1.2 Exceptions
Asset Management does not replace existing corporate strategy, business planning and budget management systems and existing processes. Rather, Asset Management aligns to these existing initiatives, by providing a perspective that supports corporate strategies, plans and objectives.

2.0 Consequences of Non – Compliance

Failure to adhere to this policy may result in:

2.1 The Risk that Utilities Kingston is not investing in the asset infrastructure it manages at the most optimal times in the Assets life cycle. This Risk potentially compromises the safety and service delivery provided by the infrastructure managed, operated or maintained by Utilities Kingston.

2.2 The Risk of sub-optimal planning for growth, operations, maintenance, and replacement of existing Assets and the development of new Assets. This Risk potentially compromises Utilities Kingston’s ability to meet expected Levels of Service.

2.3 The Risk of regulatory non-compliance and exposure to litigation for failing to adhere to or provide for the core elements of this policy.

2.4 Sub-optimal or conflicting service area investment priorities, issues with the coordination of delivery of service, corporate inefficiencies, and lack of expenditure optimization.

2.5 Capital plans that are inconsistent with the needs identified in Asset Management Plans may exacerbate the Infrastructure Gap. This Risk potentially compromises the alignment of financial, infrastructure and land-use goals and objectives.

3.0 Commitment and Accountability

3.1 The Senior Leadership Team (SLT) within Utilities Kingston is accountable for the Asset Management Policy as well as the Asset Management System and committed to the following:

a. Implementing management review and continuous improvement of the Asset Management Plans, Systems, processes and practices that support the achievement of Utilities Kingston's organizational strategic plan and objectives.
b. Recommending the necessary financial resources and maintaining the necessary corporate capacity (such as resourcing, staff competencies, business processes data and integrated information systems) to support Asset Management activities.
c. Supporting an Asset Management methodology that utilizes best practices and industry standards as a means of delivering value to Stakeholders.
d. Ensuring coordinated planning, collaboration, and implementation, of capital work with other utilities and City of Kingston departments, where practical.

3.2 The executive lead for Asset Management planning is the Director of Utilities Engineering.

3.3 This Policy will be endorsed by the Council for the City of Kingston Council for Municipal Assets and provided as Information to the Utilities Kingston and Kingston Hydro Boards.

4.0 Policy on Key Principles of Asset Management

Utilities Kingston manages, operates, maintains and, in some instances owns, a number of infrastructure assets. The Asset Management Policy ensures that as Assets age and deteriorate they will continue to meet acceptable Levels of Service over time and are managed for present and future users in a sustainable manner. In order to effectively use Asset Management to support the achievement of Utilities Kingston's organizational goals and objectives the following principles are applied:

4.1 Ensure Assets are managed in a manner that provide the greatest value, minimal risk for a desired performance and at the required Levels of Service.

4.2 Develop, maintain, and implement appropriate Asset Management practices designed to ensure Asset reliability and maximize Asset life cycle.

4.3 Create Asset Management Plans, Systems and processes for Assets managed, operated, and maintained by Utilities Kingston while complying with appropriate regulations and best practices.

4.4 Define and continue to evolve Levels of Service that balance Stakeholders' expectations, compliance and legislative requirements, technological, environmental, and financial considerations.

4.5 Ensure Asset investment decisions are made considering all stages of an Asset life cycle.

a. Asset investment decisions should be considered within the context of an Asset system and not just to optimize the individual asset itself.
b. A long-term, life cycle based approach in determining Asset investments and activities is needed to develop effective Asset Management decisions for the long term.
c. Asset Management decisions are to be made on the basis of trade-offs between the competing factors of Levels of Service (including asset performance), risk and cost.

4.6 Manage risks and opportunities through a risk-based decision making process to minimize the probability and/or consequence of Asset failure with consideration for the following:

a. Actions that may be required to address risk and vulnerabilities associated with climate change such as operational issues; changes to Levels of Service; life cycle management, etc.
b. Anticipated costs that could arise, including disaster planning and contingency funding.
c. Adaptation and mitigation opportunities or approaches to climate change such as greenhouse gas emissions (GHG) reduction goals and targets that assist in managing vulnerabilities.

4.7 Monitor and evaluate the performance of Assets and associated programs, and track the effectiveness of the Asset Management principles, plan, and systems with a view to ensuring best practices and continuous improvements.

4.8 Ensure asset management planning is aligned with financial plans or any other legislative requirement.

a. Specifically for the water infrastructure, that asset management planning aligns with the financial plans prepared under the Safe Drinking Water Act, 2002.

4.9 As current and long-term capital budgets and financial plans are developed in an Assets life cycle, Asset Management Plans are to be considered including performance, corporate risk, financial requirements and impacts on Levels of Service.

4.10 Ensure various strategic objectives and plans as noted in documents such as the City of Kingston's Official Plan, Provincial Regulation or Policy Statement, City of Kingston's Strategic Plan, Utilities Kingston Strategic Plan and Kingston Hydro's Strategic Plan, are considered in the Asset Management System.

4.11 Asset Capitalization Thresholds will be based on thresholds identified in the City of Kingston's Tangible Capital Assets policy for municipal Assets or as indicated in the Utilities Kingston Capital Guideline for other Assets.

4.12 Provide opportunities for stakeholders to provide input into Asset Management planning.

4.13 Establish once a year update reporting by the SLT to the Board of Directors for Utilities Kingston and Kingston Hydro; and City of Kingston Council, for municipal Assets, on the status and performance of Assets and work related to Asset Management.

5.0 Review Period

This policy will be reviewed at a minimum every five (5) years from its effective date.

6.0 Definitions

Capitalized words in this document have their meaning defined below

“Asset” - An item, thing, or entity that has potential or actual value to an organization.
“Asset Management” - The planned actions and coordinated activities of an organization to optimally and sustainably manage its assets that will enable the assets to provide the desired Levels of Service in a sustainable way, while managing risk at the lowest life cycle cost. It encompasses all asset types, tangible or intangible, individual components or complex systems and all activities involved in the Assets life cycle from acquisition/creation, through maintenance to renewal or disposition.
“Asset Management Policy” - A high-level statement of the organization’s principles and approach to asset management.
“Asset Management Plan” – is a long-term plan that outlines the asset activities and programs for each asset type and the resources applied to provide a defined Levels of Service in the most cost-effective way.
“Asset Management System” - Is a management system or framework for asset management. It is a standard management approach outlining the linkages between key elements and practices of an effective asset management program. A set of interrelated or interacting practices and techniques of an organization enabling the management of assets at various levels from the operational level up to where integration across asset systems or networks are required.
“Capitalization Threshold” - Is the value of the infrastructure asset at or above which the City of Kingston or Utilities Kingston will capitalize the value of it and below which it will expense the value of it.
“Infrastructure Gap” - The difference between the amounts of funding required maintaining the assets in a reasonable state of repair compared to the current available capital funding.
“Levels of Service” - The parameters or combination of parameters that reflect social, political, economic, and environmental outcomes the organization delivers.
“OEB Chapter 5 Consolidated Distribution System Plan” - means the most current version of the Ontario Energy Board (OEB) filing requirements for electricity distribution rate applications by local distribution companies which is available for download from the OEB website.

"Risk": - The effect of uncertainty on objectives. Risk events are events which may compromise the delivery of the organization's strategic objectives.
"Stakeholder" - person or organization that can affect, be affected by, or perceive themselves to be affected by a decision or activity (ISO55001).

Asset Management Policy

Approved:

	Kingston Hydro Board	Utilities Kingston Board	City of Kingston Council
Version 1.0	April 16, 2018	April 23, 2018	August 7, 2018
Version 2.0			July 11, 2023

David Fell (signature) — July 11, 2023

David Fell, President & CEO, Utilities Kingston — Date

Stantec is a global leader in sustainable engineering, architecture, and environmental consulting. The diverse perspectives of our partners and interested parties drive us to think beyond what's previously been done on critical issues like climate change, digital transformation, and future-proofing our cities and infrastructure. We innovate at the intersection of community, creativity, and client relationships to advance communities everywhere, so that together we can redefine what's possible.

Stantec Consulting Ltd.
300 - 1331 Clyde Avenue
Ottawa ON K2C 3G4
stantec.com

Exhibit B
Report Number 25-237

Natural Gas Utilities Asset Management Plan 2025 to 2034

Updated Asset Management Plan for Natural Gas Utilities

Prepared for:
UK

Prepared by:
Stantec

September 23, 2025

Project/File: 165900005 /
UK-24-28 Water, Wastewater and Natural Gas Asset Management Plan Updates

Stantec Consulting Ltd.

Exhibit B
Report Number 25-237

Revision Schedule

Revision	Description	Author	Date	Quality Check	Date	Independent Review	Date
0	Initial Draft	C. Vunvulea A. Kondic-Radu	April 9, 2025	J. Ferguson	April 21, 2025	L. Alfaqih	April 22, 2025
1	Revised Draft	K. Bohaichuk.	June 3, 2025	J. Ferguson	June 3, 2025	L. Alfaqih	June 3, 2025
2	Final	K. Bohaichuk.	July 25, 2025	J. Ferguson	July 25, 2025	L. Alfaqih	July 25, 2025
3	Revised Final	K. Bohaichuk.	Sept 18, 2025	J. Ferguson	Sept 22, 2025	L. Alfaqih	Sept. 22, 2025

Disclaimer

The conclusions in the Report titled Natural Gas Utilities Asset Management Plans 2025 to 2034 are Stantec's professional opinion, as of the time of the Report, and concerning the scope described in the Report. The opinions in the document are based on conditions and information existing at the time the scope of work was conducted and do not take into account any subsequent changes. The Report relates solely to the specific project for which Stantec was retained and the stated purpose for which the Report was prepared. The Report is not to be used or relied on for any variation or extension of the project, or for any other project or purpose, and any unauthorized use or reliance is at the recipient's own risk.

Stantec has assumed all information received from UK (the "Client") and third parties in the preparation of the Report to be correct. While Stantec has exercised a customary level of judgment or due diligence in the use of such information, Stantec assumes no responsibility for the consequences of any error or omission contained therein.

This Report is intended solely for use by the Client in accordance with Stantec's contract with the Client. While the Report may be provided by the Client to applicable authorities having jurisdiction and to other third parties in connection with the project, Stantec disclaims any legal duty based upon warranty, reliance or any other theory to any third party, and will not be liable to such third party for any damages or losses of any kind that may result.

Prepared by: Bohaichuk, Katarina — Digitally signed by Bohaichuk, Katarina Date: 2025.09.23 10:06:13-06'00'

Katarina Bohaichuk, P.Eng.
Team Lead - Facilities Integrity

Reviewed by: Ferguson, James — Digitally signed by Ferguson, James Date: 2025.09.23 10:54:29 -06'00'

James Ferguson, P.Eng.
Manager, Integrity Business Development/Technology

Approved by: Alfaqih, Laith — Digitally signed by Alfaqih, Laith Date: 2025.09.23 13:39:49 -04'00'

Laith Alfaqih, PhD, PE, CRL, MIAM, SDRM
Senior Principal

Table of Contents

List of Tables

List of Figures

List of Appendices

Acronyms / Abbreviations

Acronym / Abbreviation	Full Name
AG	Above Grade
AIM TF	Asset and Integrity Management Task Force
AMP	Asset Management Plan
BG	Below Grade
CGA	Canadian Gas Association
CP	Cathodic Protection
CSA	Canadian Standards Association
DSIMP	Distribution System Integrity Management Program
EVC	Electronic Volume Corrector
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GIS	Geographic Information System
HP	High Pressure
ILI	In-Line-Inspection
IP	Intermediate Pressure
KM	Kilometers
KPI	Key Performance Indicator
LE	Life Expectancy
LP	Low Pressure
LOS	Level of Service
MDPE	Medium Density Polyethylene
MIP	Medium Intermediate Pressure
MOP	Maximum Operating Pressure
NG	Natural Gas
NPS	Nominal Pipe Size
PE	Polyethylene
psig	Pound per square inch gauge
ORCGA	Ontario Regional Common Ground Alliance
SOP	Standard Operating Procedure
TCP	TransCanada Pipelines, now known as TC Energy
TSSA	Technical Standard and Safety Authority
UK	Utilities Kingston
XHP	Extra High Pressure

Glossary

Term	Definition
Downtime	Any expected or unexpected shutdown of specific assets
Level of Service	A concept used to measure the quality of a service crucial for development infrastructure management plans
Lifecycle Activities	Activities undertaken with respect to a municipal infrastructure asset over its service life, including constructing, maintaining, renewing, operating and decommissioning, and all engineering and design work associated with those activities (O. Reg 588/17)
Low Pressure (GIS table)	Includes linear inventory for TCP, IP, MIP, and LP pressure ratings
LP (pressure rating)	Pressure downstream of the service meter, not regulated
Gas Main	UK type designation for TCP, XHP, HP, IP, MIP, LP (pressure)
Performance Measures	A process of quantifying and assessing the effectiveness of the system
Outages	See Downtime above

1 Introduction

For over 150 years, Utilities Kingston (UK) has provided the Kingston community with safe and reliable utility services. UK is an asset management corporation responsible for ensuring that the City's Gas, Water, Wastewater, and Electric Utilities are operated and maintained effectively, efficiently, safely, and reliably. These goals are reflected in the UK Mission, Vision, and Values:

- Mission: Our mission is to manage, operate, and maintain community infrastructure to deliver safe, reliable services and a personal customer experience.
- Vision: Our vision is to advance the unique multi-utility model to benefit our customers and build better communities.
- Values: Our values are safety, integrity, innovation, and reliability.

As an Asset Management System is formalized, adopted, improved, and entrenched in the organization, it is expected to provide:

- Strong governance and accountability;
- Sustainable decision-making;
- Enhanced customer service;
- Effective risk management; and
- Improved financial efficiency.

UK identifies Asset Management, including Natural Gas Asset Management, as a corporate priority and it has been an essential function of UK since its inception. As part of its services, UK aims to provide safe and reliable gas distribution to nearly 16,000 customers.

The Natural Gas Asset Management Plan is intended to meet the requirements of Ontario Regulation 588/17 Asset Management Planning for Municipal Infrastructure. As regulated and as part of its continuous improvement, the Plan shall be reviewed and updated as necessary at least every five years.

2 State of Local Infrastructure – Natural Gas Utility

As required by the Ontario Regulation 588/17, the following sections address:

- a summary of the assets;
- the replacement costs of the assets;
- the average age of the assets;
- the information available on the condition of the assets; and
- a description of the approach to assessing the condition of the assets (assessment methodologies).

2.1 Asset Inventory

The Kingston Natural Gas (NG) Distribution system serves nearly 16,000 customers in Central Kingston, Ontario and is comprised of both linear and non-linear assets, specified in **Subsections 2.1.1 and 2.1.2**. The inventory information is obtained from the City of Kingston's administered Enterprise Geographic Information System (GIS).

The major NG assets are regulating stations and the extra-high pressure (XHP) / high-pressure (HP) pipeline system. UK receives NG products from TransCanada Pipelines (TCP), now known as TC Energy. The NG enters the Kingston Gas Distribution system at the City Gate located between Unity Road and Perth Road in the City of Kingston.

From the City Gate regulating station, the product is transported via two parallel XHP/HP main lines of diameters NPS 8 and NPS 12 along Perth Road. The two mainlines, Queen Line and City Line, split their trajectory before crossing Highway 401. From there, the two mainlines travel to 10 other regulating stations and transport products to customers via HP and intermediate pressure (IP) pipelines. The IP lines transport product directly to customers via service lines. The 10 regulating stations further reduce the gas pressure to a non-regulated pressure of 55 psig for distribution throughout the system.

The XHP/HP steel pipe system is 27 km in length and IP system comprises 232 km of steel and polyethylene pipe. The service system is 231 km in length.

2.1.1 Linear Assets

UK Linear Assets include all NG distribution mains and service pipelines. **Table 1** and **Figure 1** provide information on pipe size range, Maximum Operating Pressure (MOP), and length of pipe by pressure class.

Table 1: Summary of Natural Gas Linear Assets by Pressure Class[1]

Pressure Class	Pipe Size (in)	MOP (psig)	Typical Operating Pressure (psig)	Length (km)
XHP	4 to 12	475	425	16.00
HP	2 to 8	375	325	11.119
MIP/IP	1/2 to 8	60	55	232.49
SERVICES	3/4 to 8	60	55	231.30

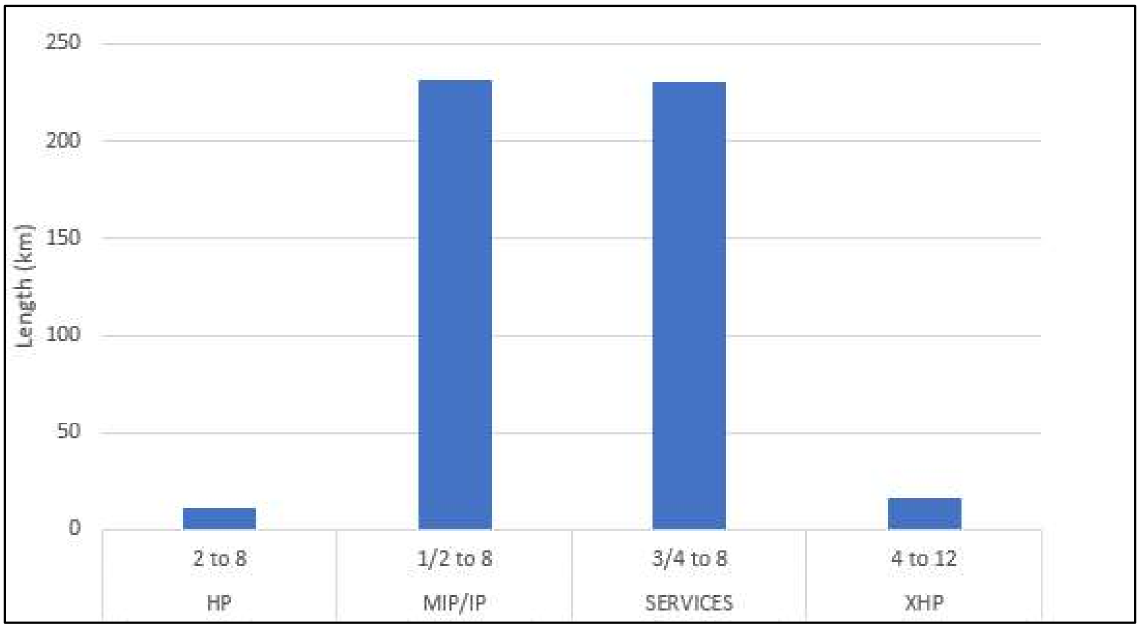

Figure 1: Summary of Linear Assets by Pressure Class[2]

Table 2 and **Figure 2** summarize the length of NG Linear Assets by material, with approximately 94 km of pipe made of steel, and 396 km pipe made of polyethylene (PE). The PE pipe represents approximately 80.7% of NG linear infrastructure while steel pipe represents approximately 19.2%.

In addition, **Table 2** and **Figure 2** summarize the distribution of the NG Linear Assets length by decades of installation. The majority (59%) of the steel pipe was installed from the 1950's to 1980's and the majority (81%) of the PE pipe was installed post 1980's to current date. The date of installation of approximately 12 km of steel pipe, and 76 km of PE pipe is not known.

[1] Source data: Gas_Mains_High_Pressure.xls, Gas_Mains_Low_Pressure.xls, Gas_Services.xls., with corrections from UK
[2] Source data: Gas_Mains_High_Pressure.xls, Gas_Mains_Low_Pressure.xls, Gas_Services.xls., with corrections from UK

The total length of black iron pipe is approximately 0.3 km and it is mostly installed in the 1960’s and 1970’s. From the data available, 0.14 km of this type of pipe has unknown date of installation.

Table 2: All Natural Gas Linear Assets – Installation Date and Materials[3]

Decade of Installation	Length of Steel Pipe (km)	Length of PE Pipe (km)	Length of Black Iron (km)
1950's	10.23	0.00	-
1960's	16.73	0.30	0.16
1970's	10.53	0.18	0.01
1980's	17.81	57.35	-
1990's	6.98	139.89	-
2000"s	15.28	59.03	-
2010"s	3.72	53.74	-
2020"s	1.31	9.53	-
Unknown	11.66	76.20	0.14
Subtotal	**94.25**	**396.22**	**0.31**
% Steel/PE	**19.2%**	**80.7%**	**<0.1%**
Total	**490.9 km**		

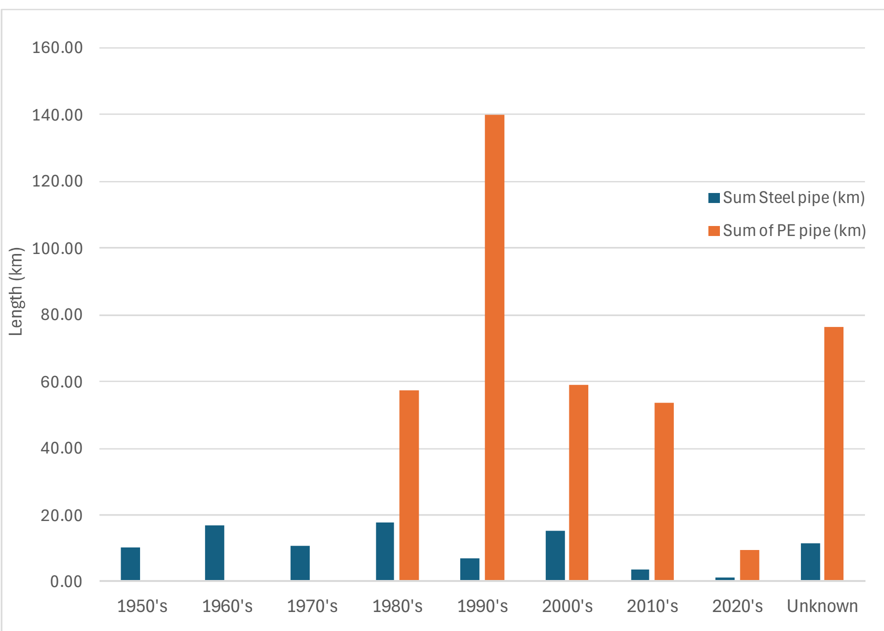

Figure 2: Summary of Natural Gas Linear Assets – Installation Date and Materials[4]

[3] Source data: Gas_Mains_High_Pressure.xls, Gas_Mains_Low_Pressure.xls, Gas_Services.xls. No copper remaining in system as per UK.
[4] Source data: Gas_Mains_High_Pressure.xls, Gas_Mains_Low_Pressure.xls, Gas_Services.xls.

The material information on the Linear Assets is generally complete in the GIS Asset Inventory; however, approximately 12% of the steel pipe and 19% of the PE pipe have an unknown year of installation.

2.1.2 Non-Linear Assets

Table 3 includes a summary of the non-linear assets grouped by asset category including total quantity of each item by size:

- Regulating Stations – eleven regulating stations, including 10 that serve as a transition from the XHP and HP pipelines to the intermediate pressure distribution piping network.
- Valves - serve as connectors between HP, IP, and service lines, and includes mainline valves, grasshopper valves which are assumed to be located above grade (AG) and excess flow valves and curb stops or shut-off valves which are assumed to be located below grade (BG).
- Meters – per UK records, there are 15,776 meter services to end customers.
- Cathodic Protection (CP) assets - include test points, anodes, locate stations, and insulators. The number of anodes (60) is likely to represent the anodes installed recently.

Table 3: Summary of Natural Gas Non- Linear Assets [5,6,7 8]

Group	Asset Description	Sizes (in)	Number of the Assets
Valves	Service Valves- including Excess Flow Valves and Shut-off (curb stop) Valves	1/2 to 8	2,745
	Grasshopper Valves	2 to 6	4
	Mainline Valves	1 1/4 to 12	1,401
Commercial - Meters	Intelis 250	n/a	1,085
	Intelis 425	n/a	324
	D800	n/a	357
	1.5M TCI	n/a	226
	3M TCI	n/a	175
	5M PTZ (AA)	n/a	38
	7M PTZ(AA)	n/a	18
	11M PTZ (AA)	n/a	4

[5] Source data: Gas_Node.xls, Gas_Valve.xls, Gas_Station.xls., with corrections from UK
[6] GIS data for Pipe fittings such as tees, elbows, transitions, junctions, reducers are available but not included in the analysis.
[7] GIS files are not structured by above and below grades, the summary of non-linear assets reflect the structure presented in GIS files.
[8] Meters are not represented in GIS files; it was assumed that 'Service Tees' are associated with each of the Customer Meters. UK has provided an updated number of meters.

Group	Asset Description	Sizes (in)	Number of the Assets
Residential - Meters	Intelis 250	n/a	13,367
	Intelis 425	n/a	124
	D800	n/a	45
	1.5M TCI	n/a	7
	3M TCI	n/a	6
Regulating Stations	No.1 City Gate	n/a	1
	No.2 Railway St	n/a	1
	No.3 Division/Weller	n/a	1
	No.4 Dalton Ave	n/a	1
	No.5 John Counter	n/a	1
	No.6 Division St	n/a	1
	No.7 Elliot Ave	n/a	1
	No.8 Sir John A. MacDonald	n/a	1
	No.9 Novelis	n/a	1
	No.10 P4W	n/a	1
	No.11 JCB	n/a	1
Cathodic Protection			
	Locate Stations	n/a	70
	Cathodic Test Points	n/a	271
	Anodes	n/a	60
	Insulators	n/a	24

2.2 Replacement Costs

This section of the report summarizes the replacement costs for the Natural Gas utilities asset classes.

The Main Line Pipe system has the highest replacement value in the portfolio (69%) as shown in **Figure 3**. The remainder of the assets correspond to 31% of the value associated with the total portfolio of assets. The replacement monetary values can be found in **Table 4 through Table 7**.

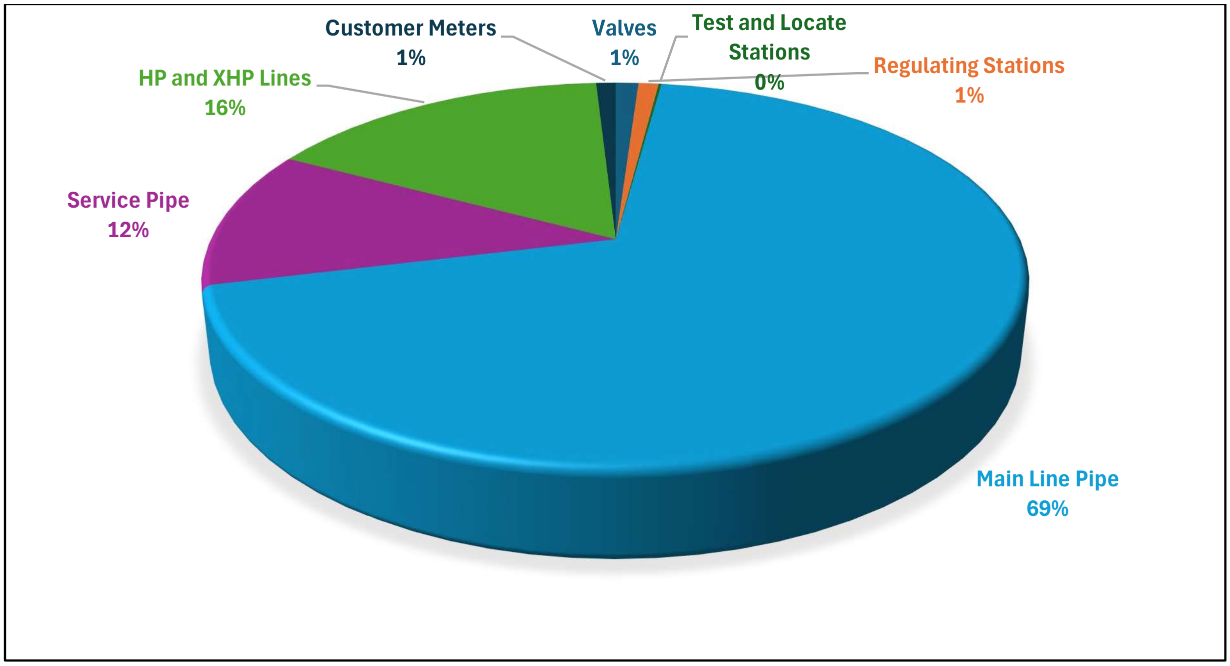

Figure 3: Asset Replacement Value for Natural Gas Assets,[9]

As per the 2024 AMP, replacement costs were based on the most recently available data sources and include the most-recent rates seen in the open market tender results[10]. It was noted in the 2024 AMP that cost data for some items such as regulating stations and high-pressure piping were based on certain assumptions and historic rates as available[11].

Further information on Linear and Non-Linear Assets replacement cost is provided in **Sub-sections 2.2.1 and 2.2.2**.

2.2.1 Linear Assets[12]

Table 4 summarizes the total replacement cost of each linear asset class in UK's gas services distribution inventory for 2024 as well for 2025. Note that the asset replacement cost in 2025 represents a 2% increase for linear assets when compared with 2024.

[9] Source data: Gas_Node.xls, Gas_Valve.xls, Gas_Station.xls. Customer meter data provided by UK.
[10] Market data used in 2024 AMP for asset replacement cost not available
[11] Asset replacement value for historical rates not available
[12] Some of the linear and non-linear replacement values are missing from the 2024 AMP. This information is unknown and requires market research. Assumed values have been used and noted in the appropriate tables in this section.

Table 4: Summary of Linear Assets Replacement Cost[13]

Type of Asset	Number of assets	Length of Pipe (km)	2024 Cost of Replacement of each Asset	2025 Cost of Replacement of each Asset
Main Line Pipe (MIP, IP and TCP)		232.5	$463,718,123	$472,992,485
Service Pipe [14]	15,896		$78,035,210	$79,595,914
Main HP and XHP Lines[15]		27.1	$109,333,415	$111,520,083
Total			$651,086,748	**$664,108,483**

Table 5 provides a detailed breakdown of the replacement cost valuations for Linear Assets infrastructure in 2024.

Table 5: Detailed Linear Assets Replacement Value Summary in 2024[16]

Linear	Type of Asset	No of Assets/ Quantity (each)	Length of Pipe/ Quantity(m)	Unit Rate	2024 Total Cost of Asset
Service Pipe only (no Tee Off service)	1/2"	12,177		$4,600	$56,014,200
	3/4"	883		$5,200	$4,591,600
	1"	500		$5,500	$2,750,000
	1 1/4"	1,834		$5,900	$10,820,600
	1 1/2"	3		$6,500[17]	$19,500
	2"	430		$6,500	$2,795,000
	3"	16		$12,500	$200,000
	4"	21		$15,000	$315,000
	6"	8		$28,000	$224,000
	8"	1		$30,000	$30,000
	Unknown	23		$11,970[18]	$275,310
	Subtotal	**15,896**			**$78,035,210**

Table continues on next page

[13]Source data: 2024 AMP, "GA2 - AMP asset calculations & rough work for 2024_ok.xls".
[14] Service pipe count does not include Tee Off Service length count that adds additional 10.4 km.
[15] The count for steel pipes is only the high-pressure system, and was used as it aligns with 2024 AMP count for linear assets table.
[16] Source data: 2024 AMP, 2024 AMP, "GA2 - AMP asset calculations & rough work for 2024_ok.xls".
[17] assumed $ value per unit as value of next highest diameter asset.
[18] assumed $ value as an average of all units' rates.

Linear	Type of Asset	No of Assets/ Quantity (each)	Length of Pipe/ Quantity(m)	Unit Rate	2024 Total Cost of Asset
IP Mains Pipe					
	1/2"	2	11.8	$1,500	$17,664
	3/4"	1	2.5	$1,500	$3,804
	1"	8	167.8	$1,500	$251,651
	1 1/4"	247	13,441.0	$1,600	$21,505,520
	2"	2,724	154,118.9	$1,800	$277,414,051
	3"	184	12,537.8	$2,250	$28,210,050
	4"	520	29,653.4	$2,250	$66,720,150
	6"	296	15,222.9	$2,700	$41,101,830
	8"	237	7,244.6	$3,900	$28,254,011
	12"	10	9.1	$4,500[19]	$40,912
	Unknown	13	84.5	$2,350	$198,481
	Subtotal	**4,242**	**232,494.3**		**$463,718,123**
HP (City Line)	2"	5	909.1	$3,000	$2,727,271
	3"	1	7.0	$3,000	$20,982
	6"	50	153.0	$3,300	$505,022
	8"	80	10,050.6	$3,900	$39,197,391
	Subtotal	**136**	**11,119.7**		**$42,450,666**
XHP (Queen Line)	4"	11	1,069.5	$3,000	$3,208,516
	6"	2	16.8	$3,300	$55,487
	8"	16	5,822.2	$3,900	$22,706,689
	12"	10	9,091.6	$4,500	$40,912,056
	Subtotal	**39**	**16,000.1**		**$66,882,749**
Liner Assets	**Total**				**$651,086,748**

[19] assumed $ value per unit as similar value of 12” XHP Line

2.2.2 Non-Linear Assets[20,21]

Table 6 summarizes the total replacement cost for each non-linear asset in UK's gas services distribution inventory for 2024 as well as for 2025. Note that the asset replacement costs in 2025 represents a 4% increase for non-linear assets when compared to 2024.

Table 6: Summary of Non-Linear Assets Replacement Cost

Type of Asset	No of Assets	2024 Estimated Asset Replacement Cost	2025 Estimated Asset Replacement Cost
Valves	4,150	$7,012,125	$7,292,610
Regulating Stations	11	$6,279,000	$6,530,160
Test and Locate Stations	341	$824,500	$857,480
Customer Meters	15,776	$6,324,756	$6,577,746
Total		**$20,440,381**	**$21,257,996**

Table 7 provides a detailed breakdown of the replacement costs of the Non-Linear Assets/ Facilities in 2024.

Table 7: Detailed Non-Linear Assets Replacement Value Summary - 2024[22]

Non-Linear	Type of Asset	Number of Assets	2024 Cost of Replacement of Each Asset	2024 Total Cost of Asset
Above Grade (Main Line Shut-off Valves Grasshopper Valves)				
(IP, MIP)	2”	1	$15,000	$15,000
(IP, MIP)	4"	2	$18,000	$36,000
(IP, MIP)	6"	1	$20,000	$20,000
	Subtotal	**4**		**$71,000**
Below Grade Service Shut-off Valves (curb stops) and Excess Flow Valves	1/2"	1295	$1,200	$1,554,000
	3/4"	414	$1,300	$538,200

[20] Some of the linear and non-linear replacement values are missing from the 2024 AMP. This information is unknown and requires market research. Assumed values have been used and noted in the appropriate tables in this section.
[21] Estimated current value is unknown, UK estimated the estimated replacement cost based on historical values.
[22] Source: 2024 AMP; “2024 AMP, “GA2 - AMP asset calculations & rough work for 2024_ok.xls”, with corrections from UK. Commercial and Residential Meter data is provided by UK.

Non-Linear	Type of Asset	Number of Assets	2024 Cost of Replacement of Each Asset	2024 Total Cost of Asset
	1"	150	$1,500	$225,000
	1 1/4"	615	$1,500	$922,500
	1 1/2"	3	$1,800[23]	$5,400
	2"	188	$1,800	$338,400
	3"	8	$3,000	$24,000
	4"	4	$3,500	$14,000
	6"	2	$4,375	$8,750
	8”	1	$4,375[24]	$4,375
	Unknowns	65	$1,800	$117,000
	Subtotal	**2745**		**$3,751,625**
Main Line Valves / Gate Valves	1 1/4"	68	$1,500	$102,000
	2"	1025	$1,800	$1,845,000
	3"	45	$3,000	$135,000
	4"	128	$3,500	$448,000
	6"	88	$4,000	$352,000
	8"	36	$6,500	$234,000
	12"	7	$8,500	$59,500
	Unknowns	4	$3,500	$14,000
	Subtotal	**1401**		**$3,189,500**
Total Valves		**4150**		**$7,012,125**
Regulating Stations	Gate Station No.1	1	$2,500,000	$2,500,000
	Railway St No.6	1	$1,250,000	$1,250,000
	District St No.3- No.11	9	$281,000	$2,529,000
	Subtotal	**11**		**$6,279,000**
Test and Locate Stations	Test Stations	271	$2,500	$677,500
	Locate Stations	70	$2,100	$147,000
	Subtotal	**341**		**$824,500**
Commercial - Meters	Intelis 425	1085	$300	$325,500
	Intelis 425	324	$485	$157,140
	D800	357	$1,663	$593,691
	1.5M TCI	226	$2,102	$475,052

[23] Assumed similar value as 2” Below Grade Service Valve.
[24] Assumed similar value as 6” Below Grade Service Valve

Non-Linear	Type of Asset	Number of Assets	2024 Cost of Replacement of Each Asset	2024 Total Cost of Asset
	3M TCI	175	$2,324	$406,700
	5M PTZ (AA)	38	$3,044	$115,672
	7M PTZ(AA)	18	$3,430	$61,740
	11M PTZ (AA)	4	$3,882	$15,528
Residential - Meters	Intelis 250	13,367	$300	$4,010,100
	Intelis 425	124	$485	$60,140
	D800	45	$1,663	$74,835
	1.5M TCI	7	$2,102	$14,714
	3M TCI	6	$2,324	$13,944
	Subtotal	**15,776**		**$ 6,324,756**
Non-Linear Total				**$ 20,440,381**

The replacement costs for Regulating Stations #1 and #6 include significant uncertainty due to the insufficient comparable cost information available for large regulating stations of similar nature since they are replaced infrequently.

2.3 Asset Age and Condition Assessment

The average asset age and condition information is directly related to the remaining life of the asset, which is key for developing capital projects and maintenance programs. Understanding the remaining service life of individual assets enables the development of long-term capital planning for asset replacement, prioritization of investments, evaluation of life-cycle decisions, and refinement of UK's maintenance programs. In alignment with Ontario Regulations 588/17, this section addresses the age and condition of Linear and Non-Linear Assets within UK's NG Utility system.

2.3.1 Asset Age Assessment

2.3.1.1 Linear Assets Age

Table 8 and **Figure 4** summarize the life expectancy (LE) of each asset material category, the length of assets currently past their LE, and those that will reach the end of their service life in the next five and ten years. The LE of each asset category is primarily obtained from GIS data.

There are approximately 21 km of steel pipes which are currently past their LE, and 33 km of steel pipe with up to 10 years of remaining life, based on a 60-year life cycle. Additionally, there are approximately 0.3 km of PE pipe which is past due for replacement, and 0.5 km of PE pipe with up to 10 years of remaining life based on a 60-year life cycle.

Replacement rates presently are approximately 1.0 km / year which is much less than the 'break-even' replacement rate which corresponds to 3.75 km per year.[25]

Table 8: Linear Asset Age and Life Expectancy (LE)[26]

Asset	LE[27]	Past LE Current (km)	LE in Next 5 Years (km)[28]	LE in Next 10 Years (km)[29]
Gas Steel	60 years	20.9	27.0	32.6
Gas PE	60 years	0.26	0.3	0.47

Figure 4 shows a graphical representation the gas main age life expectancy by steel /PE asset type.

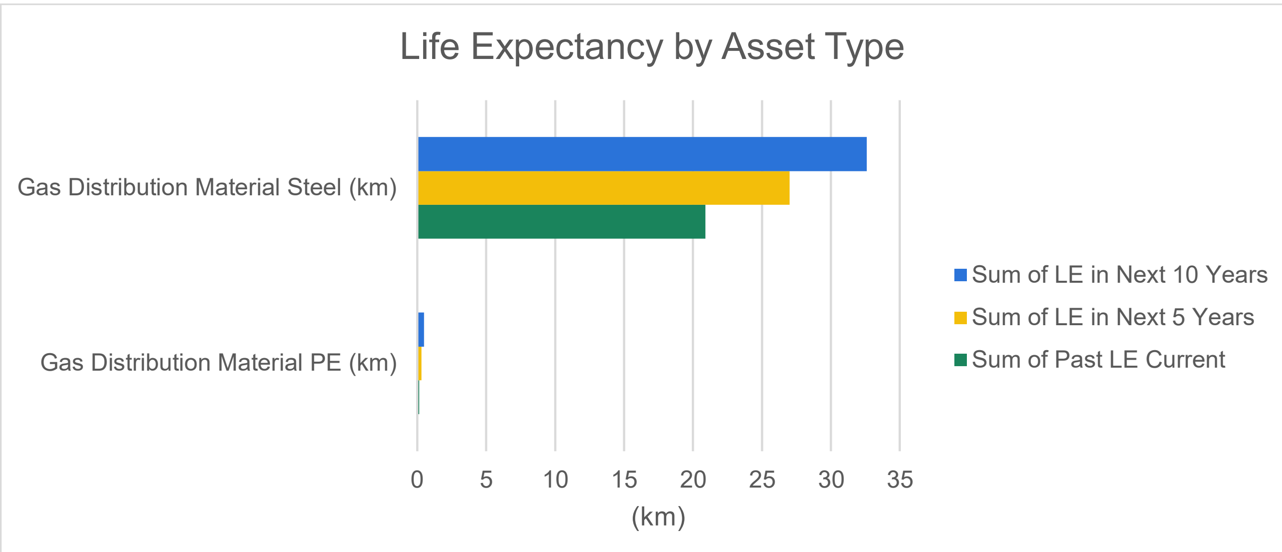

Figure 4: Average Life Expectancy by Asset Type[30]

As previously noted, the majority of steel pipe was installed from the 1950's to 1980's and most of the PE pipe was installed post 1980's to current date. The date of installation of approximately 12 km of steel pipe, and 76 km of PE pipe is not known. For more information refer to **Section 2.1.1** of this document.

---

[25] Source: 2024 NG AMP for replacement rate/km and the assumption of 1km/year
[26] Source data: Gas_Mains_High_Pressure.xls, Gas_Mains_Low_Pressure.xls, Gas_Services.xls
[27] Source: 2024 AMP
[28] Next 5 years contains the cumulative total beyond LE.
[29] Next 10 years contains the cumulative total beyond LE.
[30] Source data: Gas_Mains_High_Pressure.xls, Gas_Mains_Low_Pressure.xls, Gas_Services.xls

As determined by industry standards and anticipated material performance, the estimated useful life of NG Linear Assets is approximately 60 years. However, it is important to note that the life-expectancy may vary considerably based on, but not limited to:

- in situ conditions such as, but not limited to temperature, soil pH, soil conductivity;
- material properties and installation practices; and
- third-party damage.

The factors above can significantly influence the useful life of the pipelines.

The steel mains require more maintenance due to the continual need for adequate CP; however, the steel mains can last longer than PE lines which lose strength over time with the rate of deterioration being a function of residual stresses and ground temperature. The medium density PE pipe used within UK's NG pipe network is a relatively new material and the overall lifespan is still being understood industry wide.

Table 9 and **Figure 5** provide the age distribution and percentage of expected life for the NG Linear Assets. The actual installation years are not documented in the GIS Asset Inventory for many linear assets; as a result, the age distribution is presented per decade. Approximately 18% of the gas system pipe length has unknown age.

Table 9: Natural Gas Linear Assets Age Distribution and Percentage of Expected Useful Life[31]

Decade of Installation	Steel pipe (km)	PE pipe (km)	Average Remaining Life (%)
1950's	10.23	0.00	-11.9%
1960's	16.73	0.30	-1.4%
1970's	10.53	0.18	16.5%
1980's	17.81	57.35	35.4%
1990's	6.98	139.89	47.4%
2000''s	15.28	59.03	66.4%
2010''s	3.72	53.74	81.5%
2020''s	1.31	9.53	94.6%
Unknown	11.66	76.2	
Total km	94.25	396.22	
% Main Steel/PE pipe	**19.2%**	**80.8%**	
Exceed lifetime expectation	**7.75%**	**0.06%**	
Total Mains (km's)	**490.9**		

[31] Source data: Gas_Mains_High_Pressure.xls, Gas_Mains_Low_Pressure.xls, Gas_Services.xls.

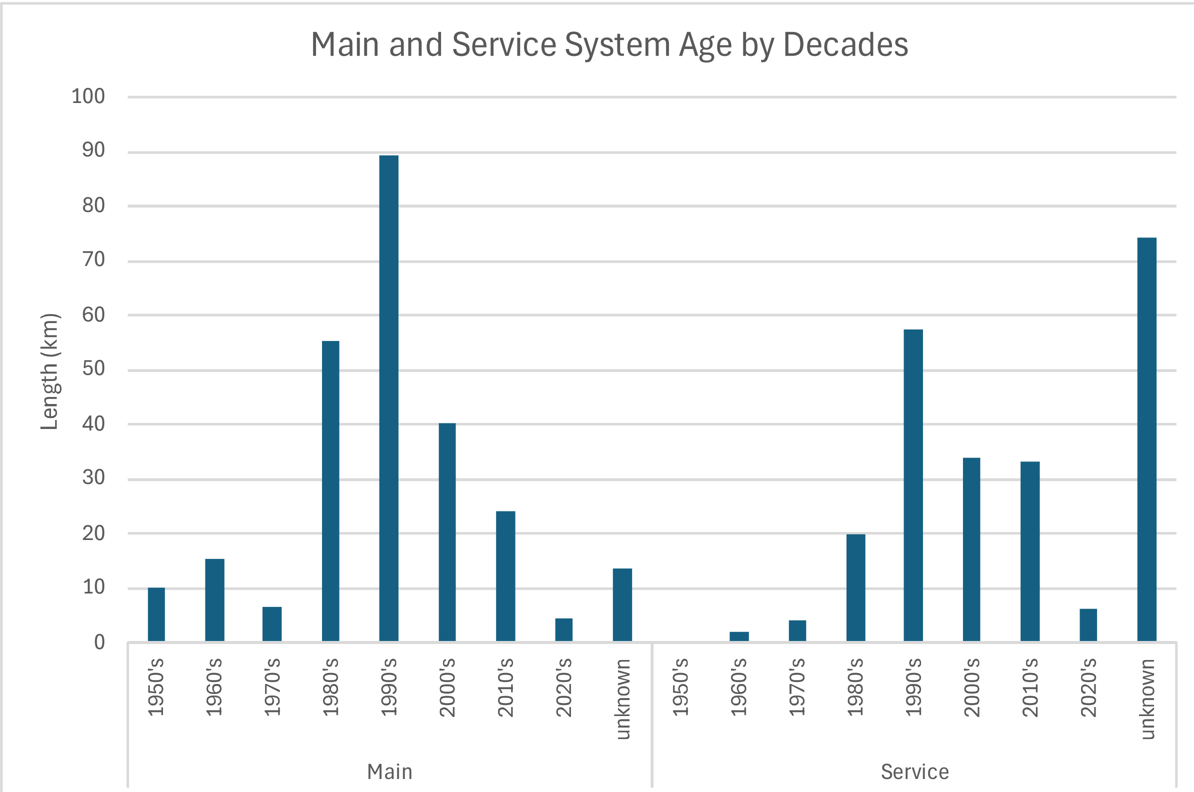

Figure 5: Gas Main: HP and Low Pressure (GIS table) and Service Age by Decades[32]

Figure 5 shows both the main pipe system and the service pipe system length in kilometers (km) by decade of installation. It is noted that the number of pipes with unknown year of installation in the service system is 32% for PE pipe as compared to 6% for steel pipe.

[32] Source data: Gas_Mains_High_Pressure.xls, Gas_Mains_Low_Pressure.xls, Gas_Services.xls

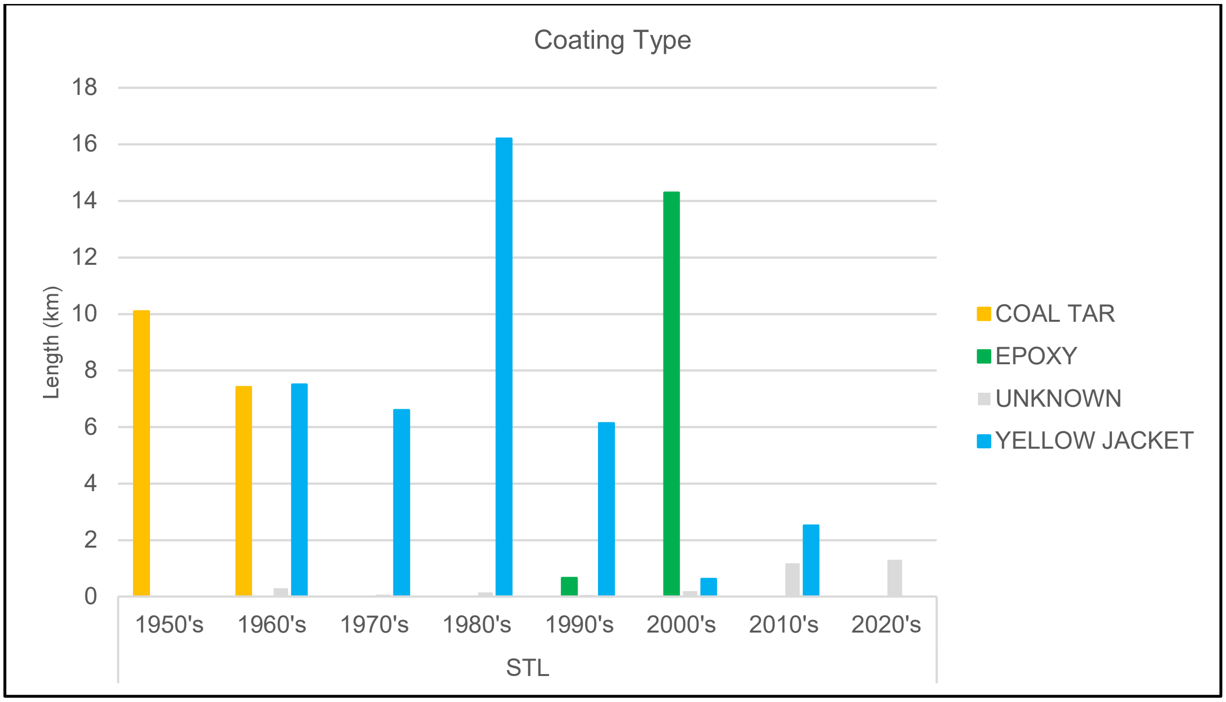

Figure 6: Gas Main and Service Steel Pipe Coating[33]

Figure 6 summarizes the type of coating used on the steel pipe assets. There are 17.5 km of various pipe diameter with coal tar coating built in the 1950's-1960's. Also, 3 km of the steel pipe coating is unknown.

2.3.1.2 Non-Linear Assets Age[34,35]

Table 10 and **Figure 7** indicate the age profile of non-linear assets and upgrades. They provide the average number of consumed years since installation, the percentage of average remaining life, and the percentage of assets with unknown age. The average life expectancy for non-linear assets was assumed at 50 years with the exception of customer meters with an assumed average life expectancy of 15 years[36]. The life expectancy for test and locate stations was not provided in the source indicated table, thus was not updated in **Table 10.**

As presented in **Table 10**, and in alignment with available GIS data, the valves are grouped by mains, service and grasshoppers.

[33] Source data: Gas_Mains_High_Pressure.xls, Gas_Mains_Low_Pressure.xls, Gas_Services.xls
[34] The source of age of the regulating stations was not available, the number are maintained from the 2024 AMP
[35] The life expectancy for test and locate stations is unknown, the data shown in the table is summarized from previous 2024 AMP report
[36] The average life expectancy of 50 years was deduced from the 2024 AMP Table 4.3.2. The life expectancy of customer meters was provided by UK as 15 years.

Table 10: Natural Gas Non-Linear Assets Age and Life Remaining[37]

Non - Linear Asset	Average Age to 2025 (years)	Average Life Remaining (%)	Unknown Age (%)
Main Valve	29	42	
Service - curb stop only	32	36	20
Grasshopper Valves	43	15	
Test and Locate Stations	14.5	-	81
Customer Meters	5.5	-	13
Regulating station- City Gate	10	80	
Regulating station- Railway St.	40	10	
Regulating station- District (typical)	5-15	67-88	89

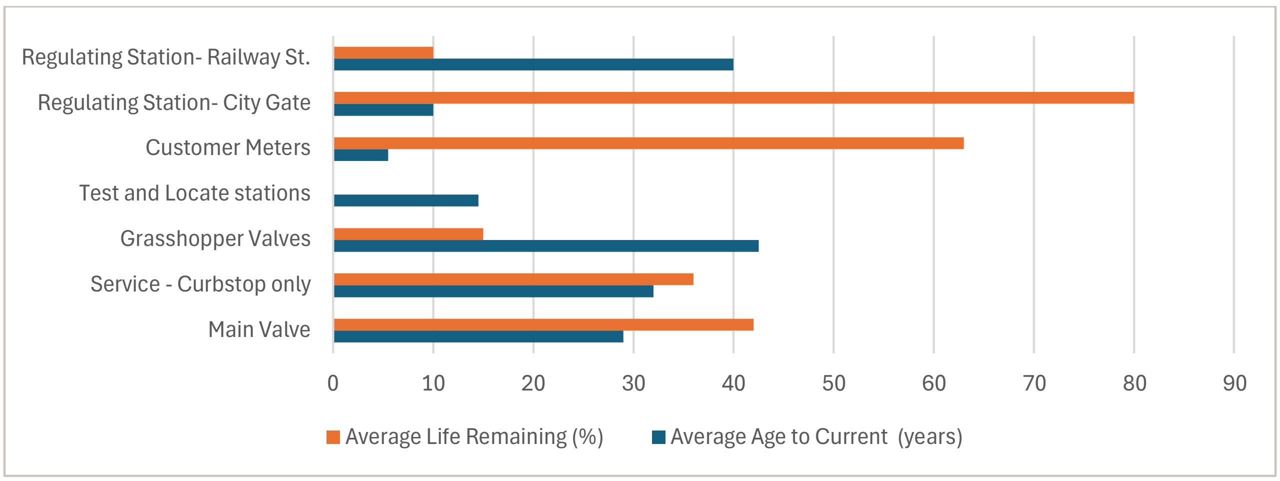

Figure 7: Natural Gas Non- Linear Assets Age and Life Remaining [38]

As part of current UK practices, the non-linear assets are often replaced when the adjacent linear infrastructure is replaced on a life cycle basis. Regulating stations of all sizes are treated separately and have been replaced or upgraded as dictated by the ability of the infrastructure to meet the utility's operational needs.

Note: Railway St. Regulating Station has the lowest average remaining life of 10%. The age was calculated assuming a life expectancy of 50 years from 1984 when the Station was likely built.

---

37 Source data: Gas_Node.xls, Gas_Valve.xls, Gas_Station.xls, 2024 AMP Table 4.3.2
38 Source data: Gas_Node.xls, Gas_Valve.xls, Gas_Station.xls, 2024 AMP Table 4.3.2

2.3.2 Asset Condition Assessment

Asset condition assessments were generated based on interviews and reviews of the major assets by UK Operational staff. **Table 11** defines the asset criticality grades and the conditions scores used in the assessment. Assets were criticality graded as high, moderate and low (A, B, and C, respectively) and the asset condition was scored from <2.0 to ≥ 4, with ≥4 assigned to excellent condition.

Table 11: Criticality Grade and Condition Scoring[39]

Criticality Grade	Description
A	Highly Critical: significant facility and/or substantial consequence of failure
B	Moderately Critical: moderately sized facilities with moderate consequence of failure
C	Low Criticality: Small or very small facilities, often with redundancy or minimal consequence of failure
Condition Score	**Description**
≥4.0	Excellent condition
3.5-4.0	Good condition
3.0-3.5	Satisfactory condition
2.0-3.0	Poor condition

2.3.2.1 Linear Asset Condition Assessment and Methodology[40]

Several condition assessment parameters are tracked relating to the condition of distribution gas mains and services, including but not limited to asset age, CP, and leak history.

The methodology used to track these parameters are the Leak Surveys and CP Surveys. See **Section 2.3.2.3** for the description of these methodologies.

As mentioned in **Section 2.3.1.1**, there are 17.5 km of various pipe diameters with coal tar coating built in 1950’s-1960’s. The Medium Density Polyethylene (MDPE) linear assets comprise of 81% of the distribution network and are among the most recently installed gas assets, post 1980’s. For the MDPE piping, age is a primary indicator of condition. In addition to the asset age, incidents are tracked to help identify systemic material or installation issues.

[39] Source: 2024 AMP.

[40] The year of construction for the regulated stations is an estimate, gathered from various sources through the AMP reports.

To better understand the condition of the high-pressure linear assets, consideration has been given to in-line-inspection (ILI) methods; however, both the City and Queens lines are not currently constructed to facilitate this type of inspection. Alterations to both lines would be required to implement ILI technologies.

2.3.2.2 Non-Linear Asset Condition Assessment and Methodology

The condition assessment information for the non-linear infrastructure is based on interviews with UK Operations staff. Routine maintenance is performed on the stations in accordance with UK Standard Operating Procedures as required by the Safety Regulations.

The District Regulating Stations are relatively new additions to the NG Distribution system with most of them installed within the past 10-20 years, except the No.2 Railway St. Station that was installed in 1984. The installation dates were deduced from the '2024 AMP Table 4.3.2 Summary of Non-Linear Asset Age and Remaining Life'.

Table 12 shows the results of the condition assessment. The regulating stations No.1 City Gate and No.10 P4W were ranked by UK with the highest condition score of four (4). The table also include the estimated year of construction for the regulating stations as well as any stations with history of upgrades.

Table 12: Regulating Station Condition Assessment Summary

Asset Class	Asset Name	Condition Scores[41]	Constructed[42]	Upgrades[43]
Regulating Stations	No.1 City Gate	4.0	2015	Some upgrades are planned, such as an upgraded odorant tank
	No.2 Railway St	2.5	1985	Some upgrades conducted, some planned
	No.3 Division/Weller	3.0	2010-2020	
	No.4 Dalton Ave	3.5	2010-2020	
	No.5 John Counter	3.5	2010	
	No.6 Division St	3.5	2010-2020	Some upgrades conducted, some planned
	No.7 Elliot Ave	3.5	2010-2020	
	No.8 Sir John A. MacDonald	3.5	2010-2020	
	No.9 Novelis	3.5	2014	
	No.10 P4W	4.0	2023	
	No.11 JCB	4.0[44]	2023[45]	

41 Source: 2024 AMP.
42 Source data: 2024 AMP Table 4.3.2 Summary of Non-Linear Asset Age and Remaining Life, and Gas_Regulating_Station.xls
43 Qualitative assessment based on review of historical capital replacements. Data Source: 'E3_2019 - 2022 & 2023-40 Capital Plan 2018 v.17- FINAL.xlsx'
44 Assumed excellent condition as station was recently built
45 Source: UK communication

The criticality scores are primarily attributed to an asset's redundancy in the system. The assets which are required to be in operation for the NG Distribution System to operate are assigned the highest criticality score. Conversely, the assets which can be temporarily taken off service without negatively impacting the level of service provided to customers are assigned a lower criticality score.

City Gate Station #1 includes redundancy within its design in accordance with Gas Safety Codes; however, the station itself has no back-up; therefore, a Criticality score of A was assigned to the station. All regulating stations in UK NG Distribution system rely on supply from City Gate; thus, if City Gate Station #1 is shut down, levels of service to all customers would be compromised, and the incident would trigger a safety critical incident response until the station returns to operation.

Railway Regulating Station #2 is the largest regulating station to feed the Intermediate Pressure Network. During the heating season, November to March, the capacity offered by this station is essential to maintain sufficient system pressure and NG supply. However, during the lower system demand, the Railway Regulating Station #2 could be taken offline without consequence; therefore, a Criticality Grade of B has been assigned to the station.

District Regulating Station #8, located at Sir John A MacDonald Boulevard and Johnson Street, has a Criticality Grade of B because its flow rate exceeds the flow of other District Regulating Stations. The condition assessment for this station included physical observations of the internal surfaces which has shown some metal loss within the body of the regulator. The location of the metal loss and wear pattern appears to be consistent with scour caused by high flow rates. While the installation of District Regulating Station #10 in 2023 helps to reduce the overloading, due to the relatively higher criticality and low asset condition score, Sir John A. MacDonald Station #8 should be considered for remediation.

The remaining District Regulating Stations (Division/Weller Station #3, Dalton Ave Station #4, John Counter Station #5, Division St. Station #6, Elliot Ave Station #7, Novelis Station #9, P4W Station #10, and JCB Station #11) have been assigned a Criticality Grade of C, as they have full redundancy in the system and can be turned off for maintenance purposes without compromising system performance.

2.3.2.3 Condition Assessment Methodologies

The following sections contain information about the various condition assessment methodologies utilized on the NG Distribution assets.

2.3.2.3.1 GIS Based Data Gathering System

Figure 8 is a screenshot of UK's GIS interface that shows the various fields that can be captured within the system and various other information relating to asset condition, including visual condition assessment determined through survey results and leak history, as described in the next sections.

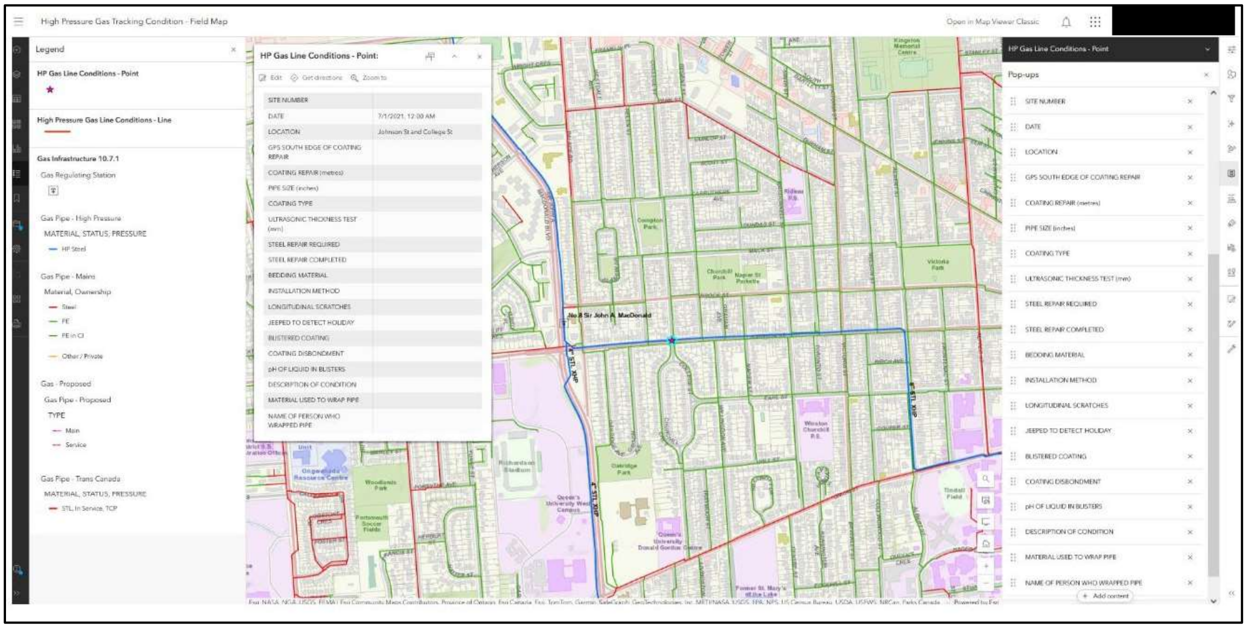

Figure 8: GIS Based Data Gathering System

UK's Natural Gas System Operational Plan and Standard Operating Procedures outline eleven procedures to inspect, test, and monitor the distribution system. These procedures are shown in **Table 13** and some of these are detailed in the next sections.

Table 13: Natural Gas System Operational Plan and Standard Operating Procedures[46]

Natural Gas System Operational Plan and Standard Operating Procedures	
1. Leak Survey	GD-01-07
2. Damage Survey	GD-01-08
3. Mains Testing	GD-02-04
4. Valve Maintenance	GD-03-02
5. Service Cleaning and Testing	GD-04-02
6. Meters Light and inspect	GD-05-07
7. Corrosion Coating Repair	GD-11-02
8. Corrosion Cathodic Survey	GD-11-03
9. Regulator Stations Maintenance Inspections	GR-01-01
10. Alarm Response	GR-01-03
11. Pressure Relief Valves Operations Checks	GR-03-01

[46] Source: Distribution System Integrity Management Program.pdf.

2.3.2.3.2 Leak Survey

As a control response to the potential hazards, a leak survey is performed at regular intervals in accordance with the GG-01-07 Leakage Survey Program. The procedure summarizes and describes the leak detection elements, methods, and frequency. The program is held annually or event driven, except the IP Mains and service/distribution pipe system that is systematically surveyed every 5 years.

In compliance with UK standard practice, all XHP and HP assets are surveyed annually in addition to 20% of the distribution system as well as any special zones, new construction projects, events, etc. In the last two years (2023 and 2024), new installations, distribution system Zones 2 and 6, commercial Zone 1, and all XHP/HP lines including TCP to Railroad St. Station and TCP to Queen's University as well from Sir John A McDonald Blvd. to Division St underwent leak surveys. Service valves and tees corresponding to the survey locations were also surveyed. A laser spectroscopy instrument was used to conduct the leakage surveys, as well as a Gazoscan Remote Methane Detector was utilized on non-passable areas of the XHP line. Supplementary instrumentation, such as Combustible Gas Indicators, Odorators, and Ethane Identifiers were available and utilized as required. In 2024, a total of 64 km of distribution lines were surveyed and all (27km) of XHP/HP lines. According to the GTel report, 0.06 below grade leakage per km (or 6.8 leaks per 100 km) were found and reported back to the Operator for the distribution system and 0 below grade leaks for the XHP/HP system.

All identified leaks are reported and the records kept on file record. Repair work is performed within a specific timeline depending on the severity of the leak and its subsequent leak classification (A, B, or C), as prescribed by the Program.

2.3.2.3.3 Cathodic Protection

The CP system is a passive system relying on sacrificial anodes distributed throughout the network of steel mains to ensure that the pipelines are protected. The current system relies on direct measurement of the pipe-to-soil potential difference at each test station, performed on an annual basis. These measurements are reviewed and areas which need additional protection have additional anodes installed.

2.4 Maturity and Moving Forward

2.4.1 Asset Inventory and Replacement Cost Maturity

The Linear Assets inventory information is available through the City of Kingston's GIS with varying levels of detail. The inventory is well structured by main lines that are HP, IP, and LP as well as service pipes. The inventory has detailed information on asset attributes, such as geographical location, pipe ID, diameter size, type of material, type of pressure system, coating, and year of installation. For some 1950's pipes, the year of replacement was added in the Comments column. The NG leak incident information stored has a geographical representation mapped to the GIS inventory.

Linear Assets have a good data inventory in terms of location, type and size of assets. Only 0.1% of the assets are missing diameter size. Some areas for improvement were identified below:

- Pipe coating is missing for 3 km of steel pipes in the GIS inventory.
- The NG leak incident information is stored in GIS inventory, but it does not tie with the pipe ID in the GIS inventory.
- Overall, the liner assets inventory is considered to meet the minimum maturity level requirements as per the IIMM (NAMS, 2011) guidelines (refer to **Table 14***: Current Maturity of Asset Inventory and Valuation*).

Linear Assets replacement costs were determined by UK in the 2024 AMP. HP and IP system replacement costs were assessed by pipe length in meters, while the Gas Service system valuation was switched from a per meter basis to a per service basis in better alignment with industry pricing. A minimum cost replacement per length of each pipe was completed by UK, with some 1 ¼” and 12” pipe diameters missing the cost replacement. Per **Section 2.2.1**, it is concluded that the 2025 value of the Linear assets is approximatively $664 million.

Overall, the Linear Assets valuation has sufficient information to meet the ‘Minimum’ criteria. The replacement cost for applicable asset age/life is considered to meet the criteria for Core Maturity level.

The Non- Linear Assets inventory information is available through the City of Kingston's GIS. Similar to the Linear Assets, the Non- Linear Assets are also included in the GIS inventory with varying levels of detail. The inventory is structured by stations, valves, and nodes. The non- linear assets inventory has detailed information on asset attributes, such as northing and easting geographical location, asset ID, type of service, valve diameter size, type of valves or other fittings, and year of installation.

Valves are divided by types such as main valves, service valves, and grasshoppers. The type of valve is classified in the GIS. Valves are mainly classified as Excess Flow and Curb Stop and some of the valves are associated with type of pipe pressure (e.g., HP/TCP, IP).

The Non-linear Assets inventory was noted to have some limited information summarized below:

- Major equipment within a regulating station such as boilers and heaters, some of which is risk ranked the highest score, is not represented in the GIS inventory.
- The valve inventory is relatively complete, with 1% of valve diameter sizes unknown, of which, four (4) are main valves. Only four (4) grasshopper valves are present in the GIS inventory. Some grasshopper valves appear to not be represented.
- CP assets - including test points, anodes, locate stations, and insulators are present in the inventory. However, the ground beds are missing and the number of anodes is likely to represent only those that are recently installed.

Considering these factors, the overall non-linear asset inventory is in a minimal state as per the IIMM (NAMS, 2011) guidelines (refer to **Table 14***: Current Maturity of Asset Inventory and Valuation*). Some assets such as Test and Locate Stations are at a core maturity level.

Non-Linear assets replacement costs – valves, stations, test and locate systems - were evaluated as individual assets. The replacement cost value conducted by UK provides a detailed breakdown of the replacement costs of the assets in a structure that could not be exactly related with the GIS inventory. For example, valves were divided between above and below grade valves with Curb Stops considered as below grade valves and Line Shut-off Valves (Grasshopper) considered as above grade valves. When UK's valve characterization was compared with the GIS inventory, the above grade /below grade category was not present in the GIS inventory. Therefore, the number of valves could not be compared. The GIS Inventory also listed 4,150 valves while the 2024 AMP listed 3,529 valves. **Section 2.2.2** details a best fit in terms of valve characterization and number of valves.

The replacement costs for Regulating Stations #1 and #6 include significant uncertainty, due to the insufficient comparable cost information available for large regulating stations of similar nature, since they are replaced infrequently. It is noted that the Non-Linear Assets were valued in year 2025 to approximatively $14.7 million.

Some Non-Linear Assets have insufficient information to complete the valuation for all applicable asset age/life. Therefore, it is concluded that not all the Non-Linear Assets meet the Core Maturity level.

Table 14: Current Maturity of Asset Inventory and Valuation

Maturity Level[47]	Description	Status of Current Plan
Minimum	Basic physical information recorded in a spreadsheet or similar (e.g. location, size, type), but may be based on broad assumptions or not complete.	Currently meeting the Minimum Maturity Level
Core	Sufficient information to complete asset valuation – as for 'minimum' plus replacement cost and asset age/life. Asset hierarchy, asset identification and asset attribute systems documented.	Majority of the Linear assets meet the Core Maturity. Short-Term Target: advance maturity of non-linear assets
Intermediate	A reliable register of physical and financial attributes recorded in an information system with data analysis and reporting functionality. Systematic and documented data collection process in place. High level of confidence in critical asset data.	
Advanced	Information on work history type and cost, condition, performance, etc. recorded at asset component level. Systematic and fully optimized data collection program. Complete database for critical assets; minimal assumptions for non-critical assets	

[47] Levels defined in 2024 AMP

2.4.2 Asset Age and Condition Assessment Maturity

To summarize, the condition of the Linear Assets is assessed based on the installation date, leak surveys, CP surveys, and the asset's life expectancy. The LE of NG Linear Assets is estimated taking into consideration the pipe material (steel, PE), while an average LE is assumed for Non-Linear Assets. Additionally, for assets with missing installation dates, the LE should be further estimated based on other available data and/ or through the best judgement of UK staff.

Considering these factors, the overall asset inventory is in a minimal state per the IIMM (NAMS, 2011) guidelines (refer to **Table 14** in the section above). Likewise, the maturity of the Facilities condition assessment can be considered at a Minimum Maturity level**.**

Stantec recommends the following actions regarding the asset inventory:

1. Include all condition assessment attributes of assets in the inventory such as coating condition, pipe accessibility, proximity to other utilities, over pressurization, over utilization, third party damage, geotechnical, and capability to line locate.
2. Include assets such as boilers and heaters in the GIS data that are ranked high in criticality for further tracking of the maintenance timelines.
3. Update and correct information missing in GIS (e.g., PE lines have coating, customer meters and installation dates missing) using other available data sources. A complete list of CP assets should be included in the inventory for tracking and recording evidence of inspection and maintenance.
4. Include the pipe steel and valve material grades and wall thickness in the asset inventory for further assessing the condition of the underground assets.
5. Valves should be updated to indicate whether they are above or below grade. Historically, opportunity for valve maintenance was used as a measure of pipe replacements, however, a record of the valve's latest maintenance should be kept.
6. The LE of the assets should be studied and added to the inventory.
7. Conduct a formal condition assessment for the linear assets and major equipment installed at non-linear asset sites, including the City Gate and Railway Stations.
8. The capacity of the main and intermediate stations should be monitored and upgraded to avoid overutilization.

3 Levels of Service

3.1 Current Level of Service

The Ontario Regulation 588/17 requires a description of the current Level of Service (LOS) for all asset categories. In the case of non-core assets such as the NG Distribution System, the LOS is based on qualitative descriptions and quantitative defined metrics.

The LOS indicates the quality of service provided and it is helpful to guide UK in their management of infrastructure to meet specific service quality targets. This version of the AMP, in addition to the number of leaks as the primary indicator of the LOS, considers other risk, sustainability, growth and reliability metrics. **Table 15** below summarizes the performance and reliability metrics for LOS of below grade assets.

3.1.1 Performance and Reliability

Table 15: Performance and Reliability

Key Performance Indicator	**Past Period** (2018-2022) *Average per Year*	**Current Period** (2023-2024)[48] *Average per Year*	**Target (2025 to 2034)**	**Notes**
Unplanned Downtime/ Outages that Affect Active Customers[49]	18	12	<12	Unplanned outages due to line strikes
Planned Downtime/ Outages that Affect Active Customers[50]	4	Unknown	<5	Outages due to planned repairs

3.1.1.1 Current Level of Service Metrics – Downtime Related to Unplanned Line Strikes

Downtime related to unplanned line strikes is tracked as an indicator of both operational performance within the utility and overall infrastructure health. An increased number of line strikes may be correlated to higher amounts of unplanned, reactive work or a reduction in safety and quality of work being undertaken on the system.

[48] Source data: UK - CP Data for 2021 due March 31 with Comments, GasLeaks_BelowGrade.xlsx.

[49] Recent Downtime/ Outages that Affect Active Customers- data not available. Downtime that affects active customers was made available for 2018-2021 only

[50] Recent Downtime/ Outages that Affect Active Customers- data not available. Downtime that affects active customers was made available for 2018-2021 only

Figure 9 and **Table 16** show a summary of the 2023-2024 third-party damage (unplanned line strikes) recorded for the assets with or without release of the gas product.

Table 16: Gas Damage/Release Incidents from 2023-2024 due to Third-Party Damage[51]

Year	No. of Gas Incidents	Above Grade	Below Grade	Damage with Gas Release (Underground)	Cause
2023	12	2	10	8	Third party damage
2024	12	0	12	12	Third party damage

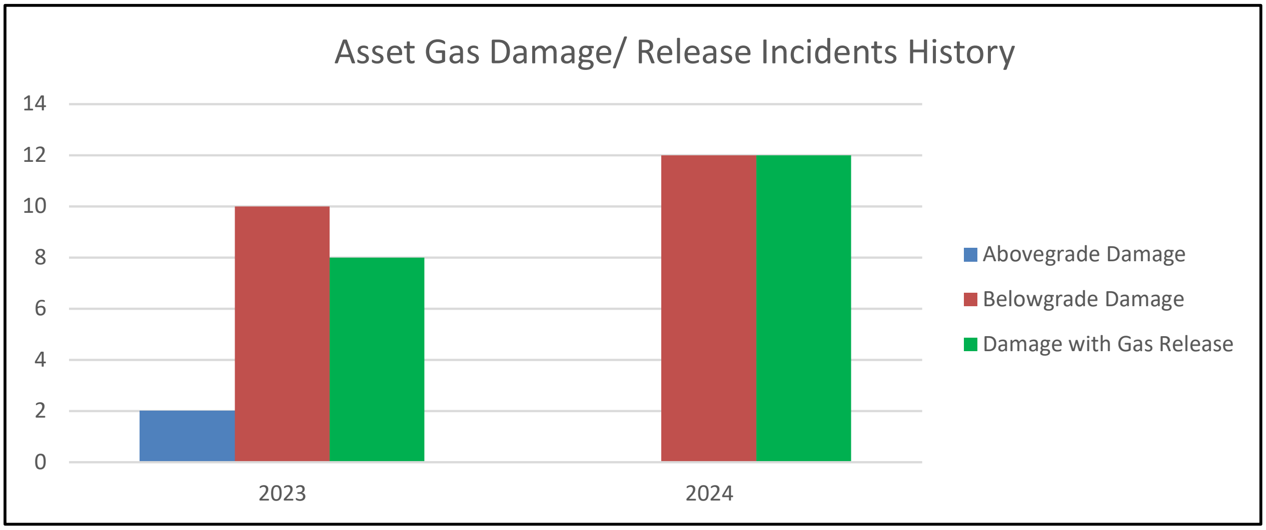

Figure 9: Gas Asset Third-Party Damage/ Release Incidents[52]

3.1.1.2 Current Level of Service Metrics – Downtime Related to Planned Repairs[53]

UK tracks the number of outages due to planned repairs as both an indicator of infrastructure health as well as quality and reliability of service delivery to customers. UK aims to continually reduce the number of outages resulting from planned work to maximize system uptime.

According to ORCGA statistics published for 2019-2021, 2-5 outage/year occur due to planned repairs in the gas distribution pipe system.[54] Outage data for planned repairs in 2023-2024 was not available at the time of preparing this report.

[51] Source data: Gas Pipeline Incident Spreadsheet.xls.
[52] Source data: Gas Pipeline Incident Spreadsheet.xls.
[53] Source: The GIS data available for downtime due to planned repairs.
[54] Source: UK – CP Data for 2021 due March 31 with Comments

3.1.2 Risk Management

3.1.2.1 Current Level of Service Metrics: Number of Leaks

Leak data is tracked as a prime indicator of infrastructure health with the yearly goal of reducing occurrences of leaks and increasing monitoring to reduce duration of leaks. Leaks tracked in these key performance indicators (KPIs) do not necessarily result in system downtime and are often located via annual leak surveys and subsequent repaired without service interruption. **Table 17** presents a summary of below-grade leak performance by primary cause.

Table 17: Risk Management

Key Performance Indicator	Past Period (2018-2022) *Average per Year*	Current Period (2023-2024)[55] *Average per Year*	Target (2025 to 2034)
Number of Leaks: Mains and Services due to Excavation Damage	6	11	10
Number of Leaks: Mains and Services due to Materials or Welds	1.4	1.5	1.5

Figure 10 and ***Figure 11*** address the number of below grade leaks per year over defined periods of time observed in UK's distribution network. The leak data addressed in ***Figure 10*** and ***Figure 11*** present the number of below grade leaks of pipelines surveyed between 2018-2024 by material pipe and by cause of the leak.

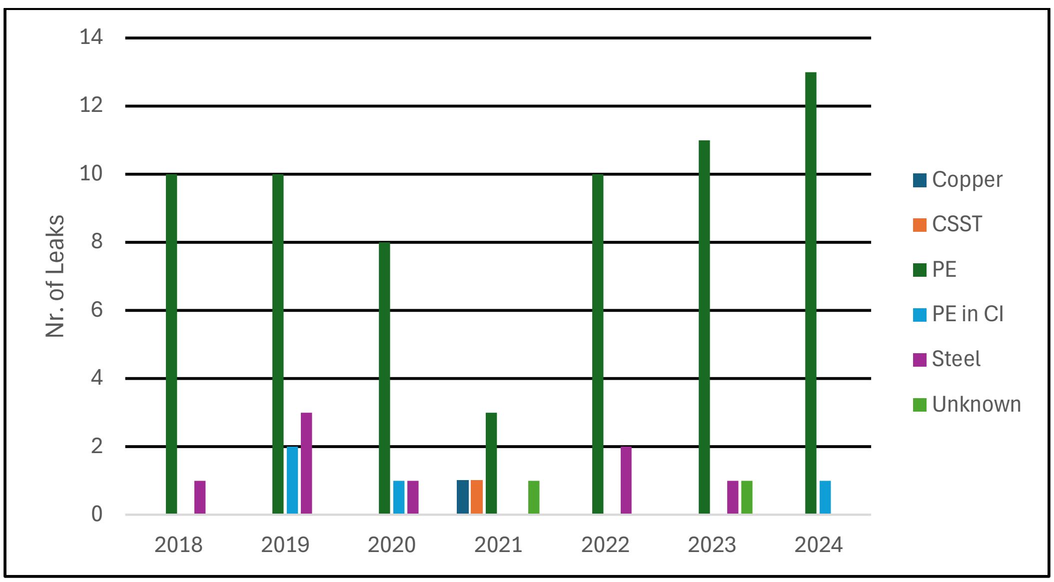

Figure 10: 2018-2024 Below Grade Leak by Material[56]

[55] Source data: UK - CP Data for 2021 due March 31 with Comments, GasLeaks_BelowGrade.xlsx.
[56] Source data: 'GasLeaks_BelowGrade.xls'.

It is noted that the major cause of below grade leaks is excavation damage followed by material and welds. There was an increase in the number of leaks from an average of 11 below grade leaks per year in 2018-2022 to 13 leaks in 2023 and 14 leaks in 2024.

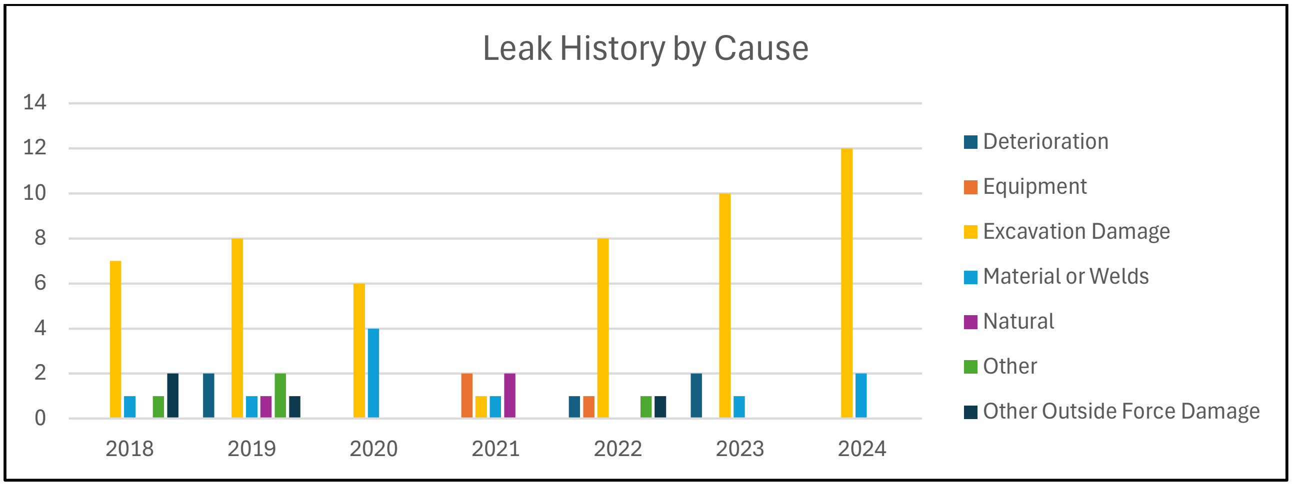

Figure 11: Below Grade Leak since 2018 to Date by Cause[57]

Pipes made of PE material are most prone to leaks when located underground due to excavation damage.

3.1.3 Current Asset Performance

Asset performance of the NG System at UK is presently addressed by the hydraulic conveyance of an asset relative to its maximum capacity, with the intention to indicate remaining capacity in the asset system.

The following sections address the relative capacity of the Linear Assets including the high-pressure and intermediate networks, as well as the non-linear regulating station assets, and represent the current performance of NG assets in accordance with the Ontario Regulation 588/17.

3.1.3.1 Linear Assets

The current performance of the Linear Assets is inferred by comparing the upstream pressure to the downstream pressure for the given asset, using data obtained through pressure monitoring programs. The performance of the assets is further measured by using knowledge of pipeline system capacity and comparison of the mentioned pressure data points.

Figure 12 illustrates the industry standard curve used to determine utilized capacity and performance of linear assets. It should be noted that as a system approaches its maximum capacity, the pressure ratio decreases steeply in a non-linear fashion. The shape of the curve suggests that for pressure drop ratios

[57] Source data: Gas Pipeline Incident Spreadsheet.xls.

less than 0.5, the risk of exceeding available capacity would increase sharply. To manage the risk, it is suggested that a pressure drop ratio of 0.5 be used as a limit to trigger the capacity upgrades, which corresponds to approximately 80% of a pipeline system's utilized capacity.

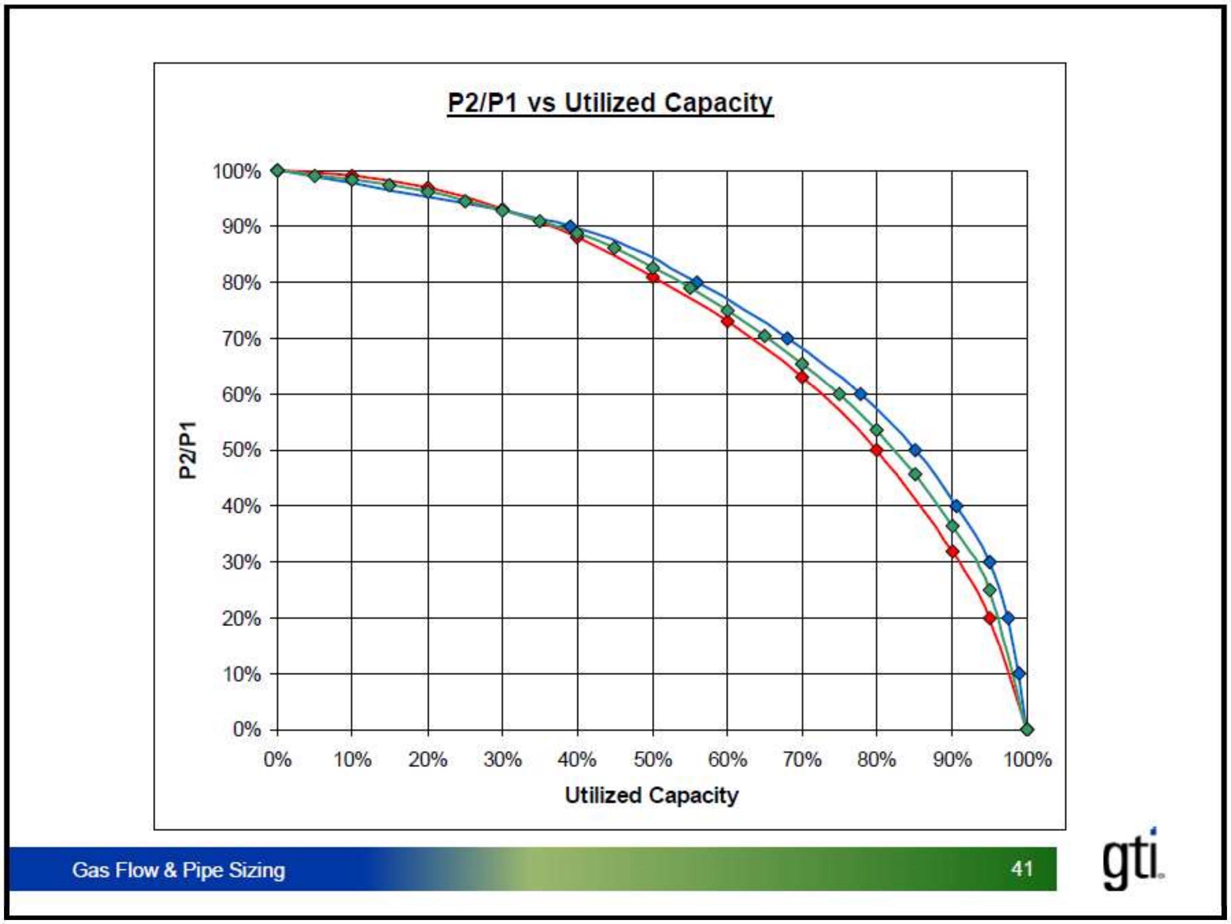

Figure 12: *Pressure Drop vs Utilized Capacity*[58]

3.1.3.2 High Pressure Pipeline System

Instantaneous pressure and flow data from 2024 was analyzed, and a graphical representation of the high-pressure pipe system, for City Line and Queen's Line, is shown in **Figure 13** and **Figure 14**, respectively.

As presented in **Figure 13***,* City Line pressures includes data from pressure sensors located at the most upstream location (City Gate City Outgoing Line Pressure (CityGate_AIPT11) and the most downstream locations on the pipeline (Railway St. Incoming Gas Pressure (RAILRTU.PT01)). The outlier datapoints appear within the data set as a brief drop in pressure. These anomalies in the data are generated when

[58] Source: 2024 AMP

sections of the pipeline containing the sensor have been subject to maintenance work/procedures. The data anomalies have been excluded from the analysis.

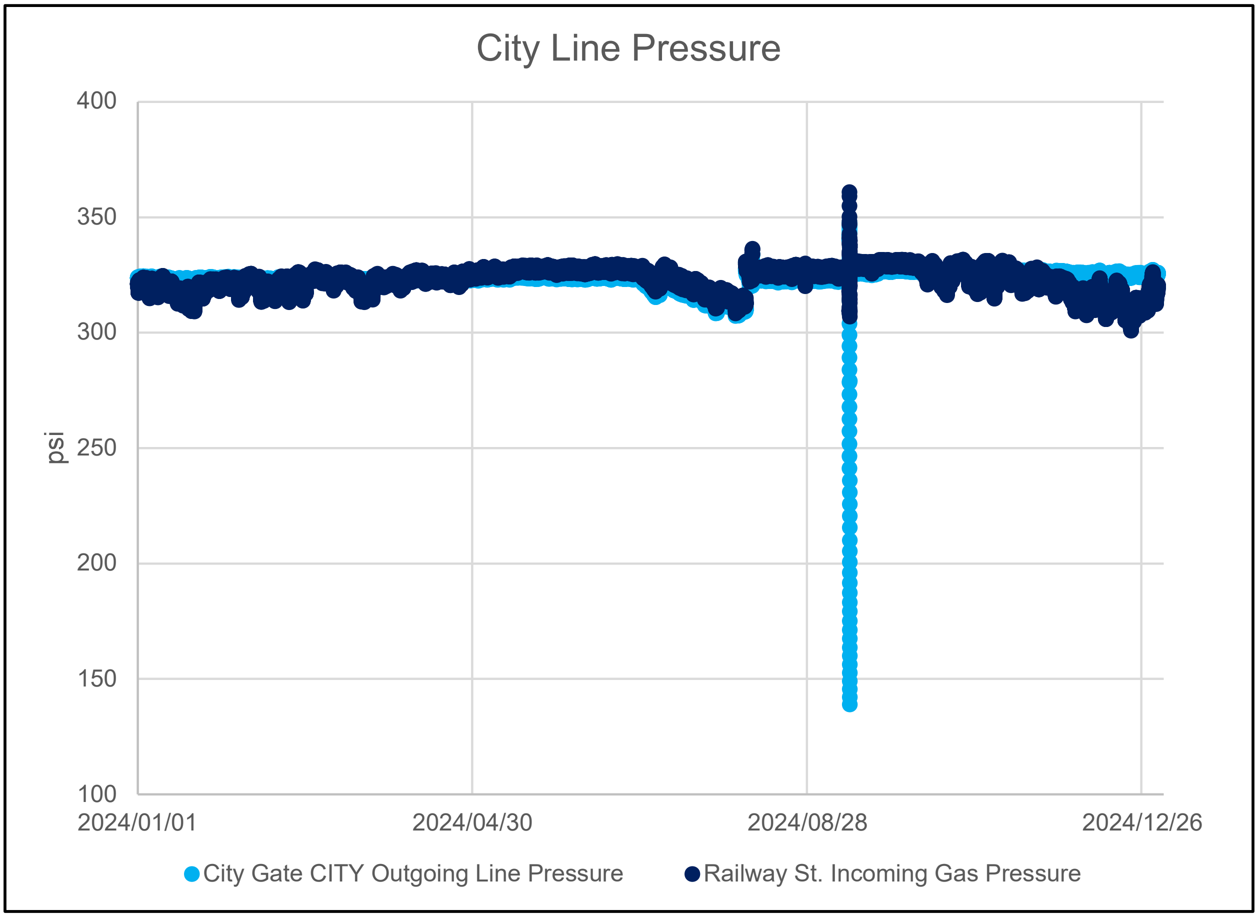

Figure 13: City Line Input and Output Pressure[59]

As presented in **Figure 14,** Queen's Line pressures include data collected from the sensors installed at the most upstream location (City Gate Queen's Line Pressure (CityGate_AIPT06) and the most downstream location (CHP High Pressure Incoming (CHPGAS.HPIN)). A few of the extraneous data points above and below the trendline are believed to be caused by readings taken at the time when the power plant downstream switches instantaneously off. The system quickly compensates this brief imbalance, but a reading per on/off event shows in the data. These data anomalies have been also excluded from the analysis.

[59] Source data: 3.a,b,c Citygate.xlsx, 3.a,b,c Railway.xlsx, 3.a,b,c CHP.xlsx.

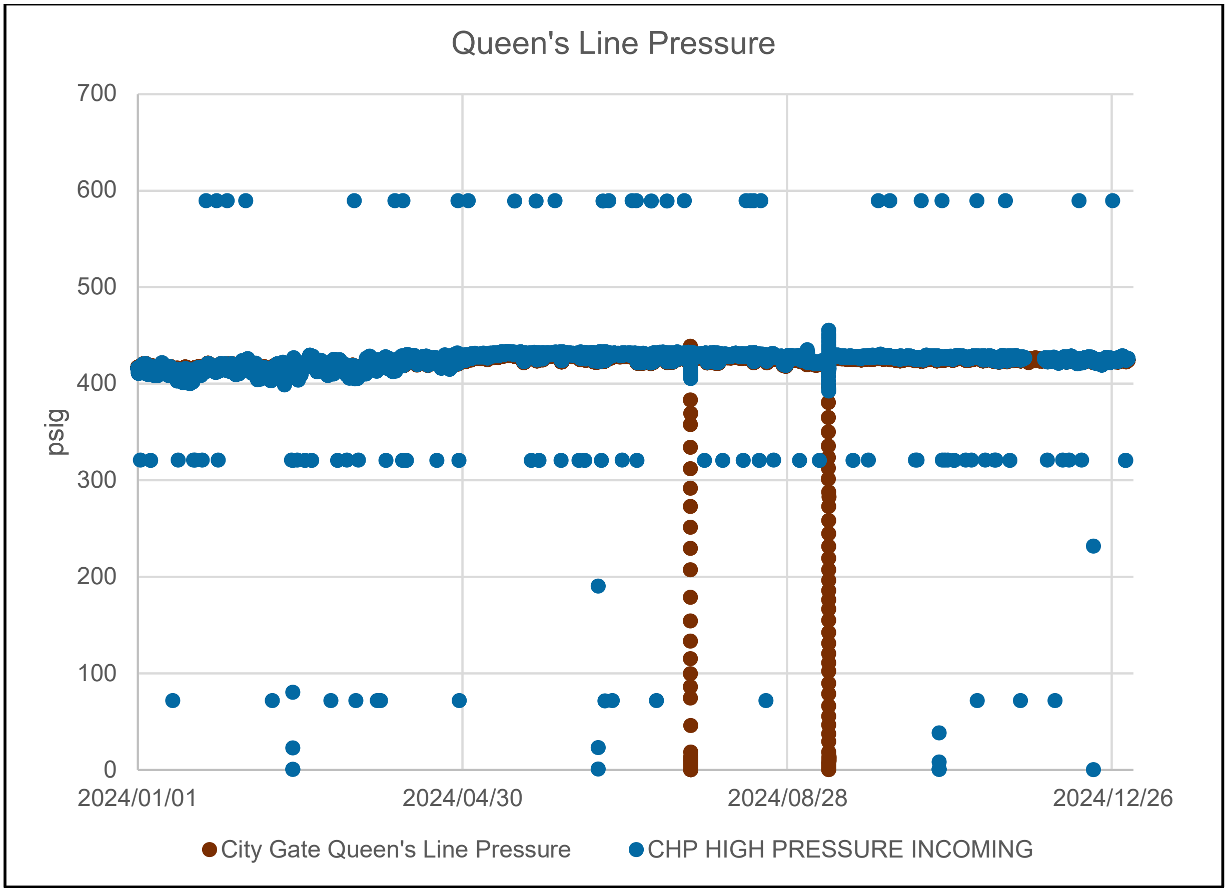

Figure 14: Queen's Line Input and Output Pressure

Table 18 summarizes the current asset performance for this asset class and shows roughly a 25% utilization of the City Line in 2024.

Table 18: Actual Capacity of Regulated High-Pressure Linear Assets

Linear Asset	P1[60] (psig)	P2 (psig)	P2/P1	Flow Rate (m3/h)	Utilized Capacity (%)
City Line	324	309[61]	0.95	14,364	25
Queen's Line	424	398[62]	0.94	16,420	100

It should be noted that the minimum acceptable downstream pressure for the Queen's Line is 400 psi due to the sales agreement in place with Queen's University. Therefore, with this constraint, the Queen's Line

[60] P1 taken as average outgoing pressure from City Gate
[61] P2 taken from minimum pressure reading during demand period on January 20-21, 2024. Flow rate taken from City Gate City Line at corresponding timeframe.
[62] P2 taken from minimum pressure reading during demand period on February 24, 2024. Flow rate taken from City Gate Queen's Line corresponding timeframe.

is at 100% of its available capacity. If it is assumed that the minimum acceptable downstream stream pressure for the City Line is 60 psi, this line may be assessed to be utilized at ~30% of its available capacity.

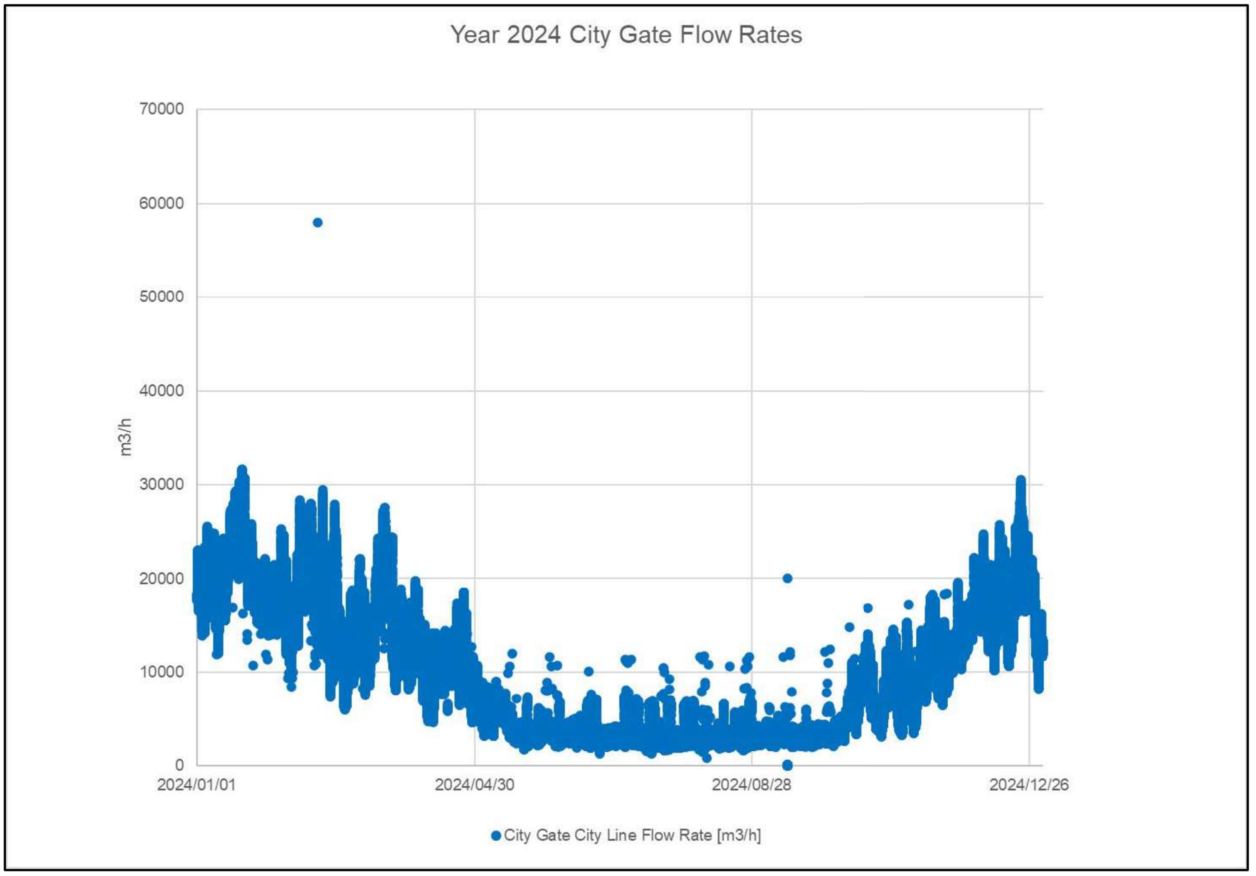

Figure 15: Summation of City Gate City Line and City Gate Queen's Line Daily Flow Rates[63]

Flow rate data received taken in 2024 from City Gate City Line and Queen's Line in general do not exceed the City Gate peak historical flow rates[64] of 40,000 m^3/h from 2014 and 2016. Assuming that the February 2024 flowrate of 58,000 m^3/h is a reading error, the peak 2024 flowrate is 31,580 cubic meters per hour, as per the **Figure 15.**

3.1.3.3 Intermediate Pressure Network

Four (4) large volume meters are selected for measuring pressures at the far end of the intermediate pressure systems. These are 1000 King W., 7 Earl St., 8 River St, and 100 Portsmouth Ave.

---

[63] Source data: 3.a,b,c Citygate.xlsx.
[64] Historical flow rate data is taken from the 2024 AMP.

Downstream pressure within the Intermediate Pressure network is the limiting factor in available system capacity and is a highly critical performance indicator. This data informs UK about excess capacity available to connect new customers without investing in capital expansion projects. To gather this data, Electronic Volume Corrector (EVC) meters are utilized. The EVC meters use real-time pressure data to perform the volumetric metering calculations. The program began collecting this data at specific locations in November 2020.

Figure 16 shows a map of the Intermediate Pressure Monitoring Locations.

Figure 16: *Map of Intermediate Pressure Monitoring Locations*[65]

Table 19 recaps the data provided in the 2024 AMP and summarizes the upstream and downstream pressures at the end of Intermediate Pressure network.

65 Data Source:2024 AMP.

Table 19: Meters Capacity for End of Intermediate Pressure Assets[66]

Linear Asset	P1 (psig)	P2 (psig)	P2/P1	Utilized Capacity (%)
1000 King St. W.	48.8	34.4	0.70	65
7 Earl St.	48.8	36.5	0.75	55
8 River St.	50	41.6	0.83	50
100 Portsmouth Ave.	48.8	33.5	0.69	65

Recent capacity pressure data received from partial readings taken in 2024-2025 show the minimum and maximum pressure recorded daily. The maximum and minimum pressures incoming into the volume meters was analyzed based on the recent 2024 data. The pressure was made available at the locations ‘8 River St.’ and ‘7 Earl St.’ and ‘1000 King St. W’ and is presented in **Table 20.**

Table 20: Volume Meters Capacity for Intermediate Pressure Assets based on Pressure – 2024[67]

Non- Linear Asset	P1[68] (MOP) (psig)	P2 (Min. Pressure Incoming) (psig)	P2/P1	Utilized Capacity (%)
1000 King St. W.	60	41.1	0.69	65
7 Earl St. In	60	39.9	0.67	65
8 River St. In	60	43.7	0.73	60

It is concluded that in recent (2024) statistics the volume capacity of the volume meters is maximized, and the pressure capacity of the volume meters is at 60-65% utilization. The minimum service pressures of these meters were not provided, so the utilization based on service constraints cannot be reported.

[66] Data Source: 2024 AMP, Table 3.1.1.1. It is assumed these pressures are representative of the capacity at end-2023.

[67] Data Source: Natural Gas - Spare Capacity.zip. It is assumed the data provided is in absolute pressure

[68] Pressure data from upstream regulating district stations not made available. It is assumed that the outlet pressure of the regulating stations is MOP pressure.

3.1.3.4 Non-Linear Assets/ Facilities

Figure 17 provides expected NG flow rates at the different pressure regulating stations.

When gas is received into the UK NG System, the flow is divided at City Gate Regulating Station #1 into two high-pressure distribution mains. The expected flow rates for these two lines are included in the figures below.

The City Line was originally installed in 1958, and its primary purpose is to feed Regulating Station No. #2 Railway St. and customers on the east side of the distribution system, based on demand and the resulting relative pressures within the related intermediate pressure network. The Queen's Line was installed in 2006 in order to provide high-pressure and high-volume gas supply to the Queen's University Combined Heat and Power Plant.

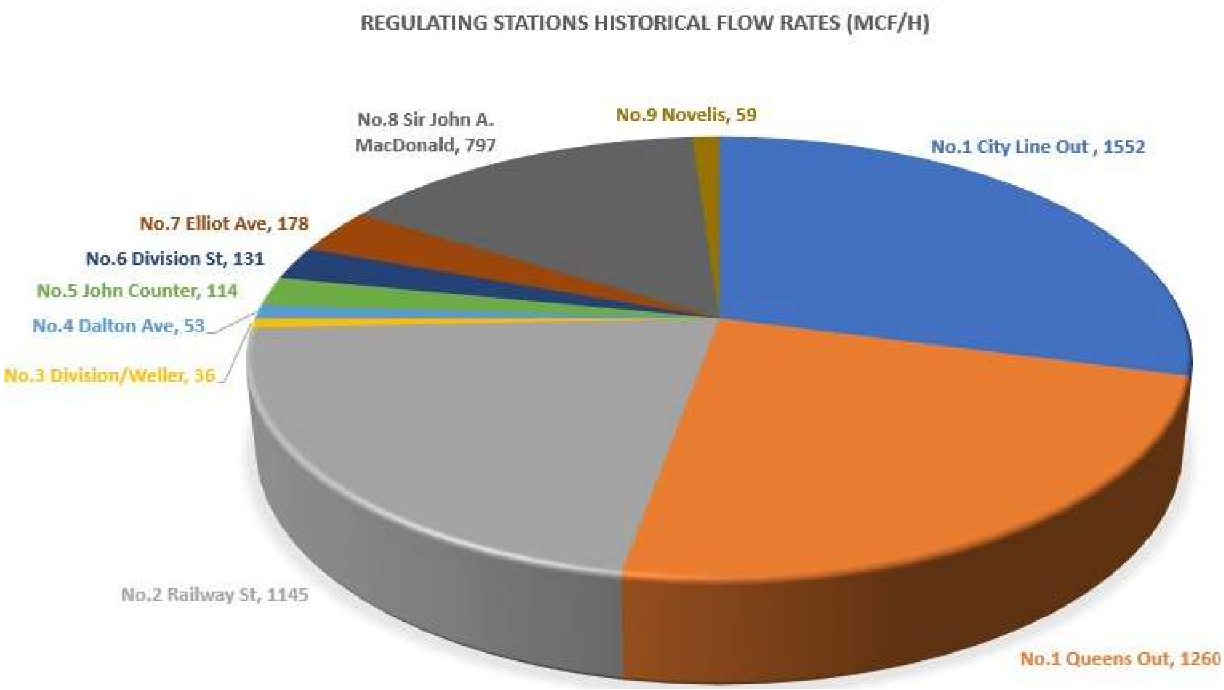

Figure 17: Gas Model Rates at High and Intermediate Pressure Regulating Stations (Mcfh)[69]

[69] Data Source: GA2 - District Station Report_ok.xls.

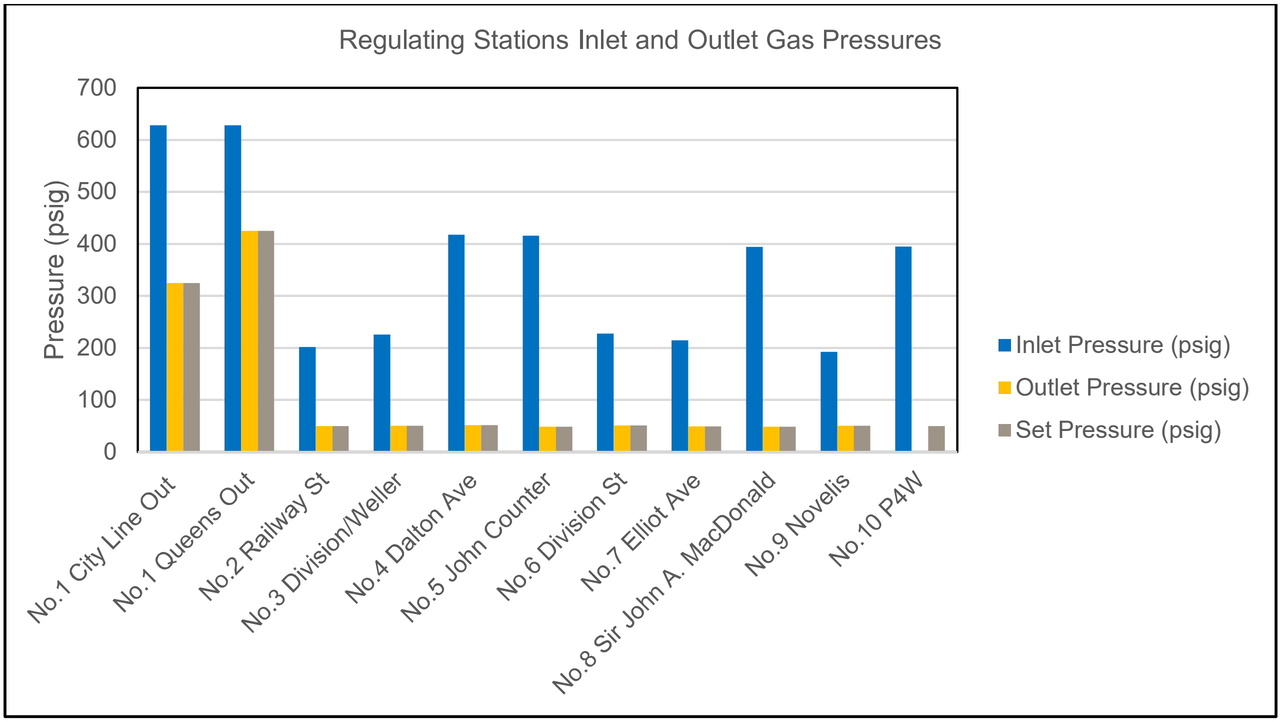

Figure 18: Historical Regulating Stations Inlet and Outlet Pressure[70]

The second level in gas distribution is the transition from the high-pressure lines to the intermediate pressure distribution piping network. At the transition locations, metering data is not available because these stations are not equipped with meters. Instead, flow rate estimates provided by hydraulic modelling software can be utilized. The pressures for each of these intermediate regulating stations is also presented in **Figure 18** above.

Table 21 refers to historical gas flow rates capacity while **Table 22** provides information on current (2024) gas capacity utilization, which is used to measure the performance capacity of the assets.

[70] Data Source: GA2 - District Station Report_ok.xls.

Table 21: Historical Regulating Station Capacity Utilization[71]

Station	Estimated Flow Rate (Sm3/hr)	Capacity (Sm3/hr)	% Utilized
No.2 Railway St	18,661	40,000	47%
No.3 Division/Weller	588	6,800	9%
No.4 Dalton Ave	867	8,500	10%
No.5 John Counter	1,864	8,500	22%
No.6 Division St	2,141	6,800	31%
No.7 Elliot Ave	2,903	6,800	43%
No.8 Sir John A. MacDonald	12,977	8,500	153%

In conclusion, based on the historical provided data (GA2 - District Station Report), the Non-Linear system has some level of surplus capacity which varies depending on the Station, except for the No. 8 Sir John A. MacDonald Station that shows as over utilized. More recent data was not made available for No.8 Sir John A. MacDonald, however, it is expected that since the installation of the No. 10 P4W Regulating Station and associated P4W line, the utilization of No.8 Sir John A. MacDonald Station will have reduced.

Table 22: Current Regulating Station Capacity Utilization using SCADA data for 2024

Station	Maximum Flow Rate (Sm3/hr)[72]	Stated Capacity (Sm3/hr)[73]	% Utilized
No. 1 City Gate City Line	16,615	50,000	68%
No. 1 City Gate Queens Line	17,608[74]		

3.2 Proposed Levels of Service

In general, UK is not proposing any significant changes or enhancements to its current lifecycle activities or existing operational service levels over the next 10 years. This decision reflects a balanced approach to service delivery, financial sustainability, and risk management. The current levels of service are considered both achievable and appropriate within UK's existing financial and operational capacity.

Several factors support the decision to maintain existing service levels. The operating budget, funded through stable and predictable revenue sources, is sufficient to support ongoing maintenance and operations. The current service levels align with community expectations and have proven to be both

[71] Data Source: 2024 AMP, Table 3.2.1. It is assumed that this data is representative of the capacity at end-2023.
[72] Data Source: 3.a,b,c Citygate_CV.xls.
[73] Data Source: 2024 AMP, Table 3.2.1
[74] Excluding unrealistically high datapoints that are assumed to be data errors.

effective and affordable. Furthermore, the condition of existing assets and the associated risks are being actively managed through planned maintenance and renewal activities.

A number of new KPIs, outlined in **Table 23** have been added to allow the municipality to better predict future growth-related infrastructure needs, increase resilience and align with the City's and UK sustainability objectives.

3.2.1 Performance and Reliability

Table 23: Performance and Reliability (Proposed)

Key Performance Indicator	Past Period (2018-2022) *Average per Year*	Current Period (2023-2024)[75] *Average per Year*	Target (2025 to 2034)	Notes
Unplanned Downtime/ Outages that Affect Active Customers[76]	18	12	Good: < 10, Acceptable: 10-18, Unacceptable: > 18	Unplanned outages due to line strikes
Planned Downtime/ Outages that Affect Active Customers[77]	4	Unknown	Good: < 3, Acceptable: 3-5, Unacceptable: > 5	Outages due to planned repairs
NEW Below Grade Leaks per 100km per year	Unknown	6.8[78]	<31[79]	

3.2.1.1 Proposed Level of Service – Downtime Due to Planned Repairs

UK proposes to maintain the existing level of service with respect to downtime/outages related to planned repairs. Further data related to downtime needs to be gathered and tracked to establish an appropriate target metric and funding required.

[75] Source data: UK - CP Data for 2021 due March 31 with Comments, GasLeaks_BelowGrade.xlsx.

[76] Recent Downtime/ Outages that Affect Active Customers- data not available. Downtime that affects active customers was made available for 2018-2021 only

[77] Recent Downtime/ Outages that Affect Active Customers- data not available. Downtime that affects active customers was made available for 2018-2021 only

[78] Data Source: 2024 GTel Leakage Survey Report

[79] Based on estimated US national average of 0.5 leaks per mile of pipeline reported in Cheptonui, F.; Riddick, S.N.; Hodshire, A.L.; Mbua, M.; Smits,K.M.; Zimmerle, D.J. Estimating the Below-Ground Leak Rate of a Natural Gas Pipeline Using Above-Ground Downwind Measurements: The ESCAPE1 Model. Sensors 2023, 23, 8417. And reference Weller, Z.D.; Hamburg, S.P.; Von Fischer, J.C. A National Estimate of Methane Leakage from Pipeline Mains in Natural Gas Local Distribution Systems. Environ. Sci. Technol. 2020, 54, 8958–8967.

3.2.1.2 Proposed Level of Service – Below Grade Leak Rates per 100 km

UK proposes to add a new KPI to track the number of below grade leaks per 100 km, with a target of less than 31 leaks per 100 kilometers per year, which is based on US national averages.

Data will be gathered through the existing leakage survey program. The leakage survey program divides the distribution gas grid into sections and inspects based on a 5-year maximum inspection interval and annually for XHP/HP assets and selected areas of interest. It is important to note that in any given year only 20% of the distribution grid is surveyed.

It should be noted that leak rate data for above grade piping is tracked separately as it is not considered an indicator of pipeline condition. It is tracked separately as an important data set relating to the greenhouse gas (GHG) emission management and reduction.

3.2.1.3 Proposed Level of Service - Downtime Related to Line Strikes

UK proposes to maintain the existing level of service with respect to downtime/outages related to line strikes. Information on the number of line strikes is currently tracked, however, information regarding associated downtime needs to be better tracked going forward.

3.2.2 Risk Management

Table 24: Risk Management (Proposed)

Key Performance Indicator	Past Period (2018-2022) *Average per Year*	Current Period (2023-2024)[80] *Average per Year*	Upcoming Period (2025 to 2034)[81]	**Target (2025 to 2034)**
NEW Linear Assets Exceeding Life Expectancy	Unknown	IP Mains: 6% HP Mains: 27% Service Pipe: 1%	IP Mains: 6% HP Mains: 27% Service Pipe: 1%	Good: < 5%, Acceptable: 5 - 25 %, Unacceptable: > 25%
NEW Non-Linear Assets Exceeding Life Expectancy	Unknown	Unknown	Customer Meters: 50%	Good: < 5%, Acceptable: 5 - 10 %, Unacceptable: > 10%
Number of Leaks: Mains and Services due to Excavation Damage	6	11	-	Good: < 6, Acceptable: 6-12, Unacceptable: > 12
Number of Leaks: Mains and Services due to Material or Welds	1.4	1.5	-	Good: < 2, Unacceptable: > 2

[80] Source data: UK - CP Data for 2021 due March 31 with Comments, GasLeaks_BelowGrade.xlsx., Gas_Mains_High_Pressure.xlsx, Gas_Mains_Low_Pressure.xlsx, Gas_Services.xlsx

[81] Source data: Gas_Mains_High_Pressure.xlsx, Gas_Mains_Low_Pressure.xlsx, Gas_Services.xls. Customer meter data provided by UK.

Exhibit B
Report Number 25-237

3.2.2.1 Proposed Level of Service – Linear Assets Exceeding Life Expectancy

UK proposes to add a new KPI to track the number of linear assets exceeding their life expectancy with the target of less than 25% of linear assets (IP Mains, HP Mains, and Service Pipes) to be exceeding their life expectancy and to maintain the 25% over the next 10 years. **Figure 19** depicts the percentage of assets exceeding their service life in the next 10-years, assuming no replacements are undertaken. Currently, 27% of the HP assets are exceeding their LE in 2025. Taking an average 2025 replacement cost of the end-of-life HP assets to be $3,866 per meter, approximately $2.1 million is required in 2025 to bring the HP assets within the proposed LOS target[82]. The funding required for 2025 HP Replacements can be spread and indexed over the next 10-years to meet this proposed LOS, provided UK assesses that the assets are safe for continued operations and has appropriate risk mitigations and monitoring in place. **Section 5.2** details the 10-year funding available and shows that the utility is in deficit with this proposed LOS.

Currently, 6% of IP Mains, 0.2% of HP Mains, and 33% of Service Pipes have an unknown installation date in the GIS inventory. Accurate installation dates should be obtained for these assets to ensure reliable tracking of this KPI and to support the proposed LOS.

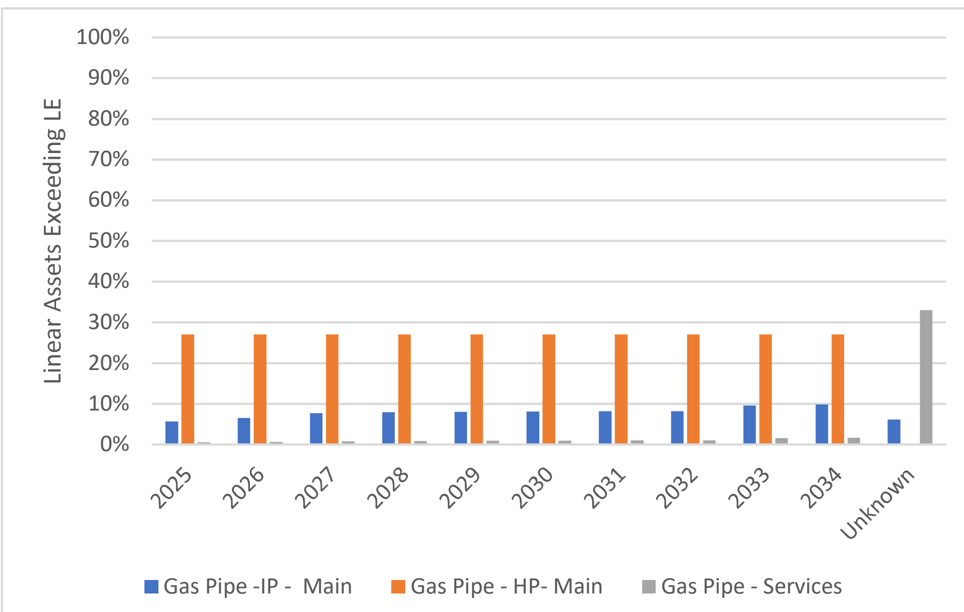

Figure 19: Linear Assets Exceeding 60-year LE

[82] Source: 2024 AMP replacement costs, indexed to 2% for linear assets

3.2.2.2 Proposed Level of Service – Non-Linear Assets Exceeding Life Expectancy

UK proposes to add a new KPI to track the number of non-linear assets exceeding their life expectancy. This KPI currently only applies to customer meters. Further information needs to be gathered on facility assets to track a similar KPI in future revisions.

With an estimated life expectancy of 15 years, approximately 50% of the customer meters will reach their end of useful life within the next 10-year period. The 2025 replacement costs for the customer meters can be used to determine the additional funding required to keep the customer meters within the proposed LOS target. This results in an additional $3.1 million to meet the proposed target. This cost can be spread and indexed over the next 10-years. **Section 5.2** details the 10-year funding available and shows that the utility is in deficit with this proposed LOS.

3.2.2.3 Proposed Level of Service – Leaks Due to Line Strikes and Material Failures

UK proposes to maintain the existing level of service with respect to leaks occurring from excavation damage (e.g. line strikes) and material or weld failure. Additional information related to this KPI can be found in **Section 3.1.2.1**.

3.2.3 Growth and Planning

3.2.3.1 Proposed Level of Service – Capacity Utilized

As shown in **Table 25**, UK proposes to add three new KPIs to track the capacity utilized for HP linear assets, IP linear assets and City Gate station in order to plan for growth and development in the service area, allowing for enhanced, forward looking distribution system planning. A detailed overview of the systems current capacity used to inform these KPIs is included in **Section 3.1.3**.

Table 25: Growth and Planning (Proposed)

Key Performance Indicator	2023[83]	Current (2024)	Target (2025 to 2034)	Notes
NEW Capacity Utilized: HP Linear Assets	N/A	City Line: 25% Queens Line: 100%	City Line: <80% Queens Line: 100%	Based on the inlet and outlet pressures of the subject pipelines. (City Line and Queen's Line) *Note: Queen's Line is at 100% of its sales agreement constrained (400 psig) pipeline pressure*

[83] Data Source: 2024 AMP. It is assumed that this data is representative of the capacity at end-2023.

Key Performance Indicator	2023[83]	Current (2024)	Target (2025 to 2034)	Notes
NEW Capacity Utilized: IP Linear Assets	1000 King St. W: 65% 7 Earl St: 55% 8 River St: 50% 100 Portsmouth Ave: 65%	1000 King St. W: 65% 7 Earl St: 65% 8 River St: 60% 100 Portsmouth Ave: 65%	Good: <75% Acceptable: 75-85% Unacceptable: >85%	Based on the pressure at regulating stations and the furthest downstream meters, as represented by 1000 King St. W, 7 Earl St., 8 River St.., and 100 Portsmouth Ave.
NEW Capacity Utilized: City Gate Station	N/A	68	Good: <75% Acceptable: 75-85% Unacceptable: >85%	Based on flowrate.

3.2.4 Sustainability

3.2.4.1 Proposed Level of Service – Sustainability

As shown in **Table 26**, UK proposes a new KPI to track site energy use and total greenhouse gas emissions (GHG) of key gas facilities relative to 2018 baseline values to align with climate action targets and ongoing reduction of emissions.

UK also recognizes that fugitive methane emissions can occur from the natural gas system through several pathways, including pipeline leaks, third-party damage, pressure regulation activities and venting during flaring or pipeline blowdowns. Emissions associated with these activities are difficult to measure or quantify with precision. UK is exploring the development of a fugitive emissions management program, beginning with improved monitoring and data collection to better quantify this emission contribution. Once complete, a future fugitive emissions KPI may also be considered to track progress.

Table 26: Sustainability (Proposed)

Key Performance Indicator	2023	Current (2024)	Target (2025 to 2034)	Notes
NEW Total GHG Emissions (kgCO2e) from Utility Energy Usage reduction compared to 2018 baseline values (as a %)[84]	a) City Gate: n/a b) Railway: -66.6%	a) City Gate: n/a b) Railway: -75.5%	Good: < or = -50% Acceptable: >-50% to +10% Unacceptable: >+10%	The reported greenhouse gas emissions reflect only energy-related emissions from utility-supplied natural gas and electricity. Data for City Gate is currently under review by UK.

[84] Source: as provided by UK

Exhibit B
Report Number 25-237

4 Asset Management Strategy

The Asset Management Strategy for the NG Distribution Utility utilizes the following principles:

- Risk Management is a primary trigger for asset replacement or major system upgrade.
- Growth is the primary trigger for new asset construction as well as facility and system expansion/upgrades.
- Maintenance activities are related to maintaining the condition of the assets with the purpose to provide the lowest lifecycle cost.

UK's asset management strategy is based on four key categories:

1. Infrastructure Planning: focuses on addressing UK's growth-related needs, ensuring that infrastructure meets the growth-driven needs of the city
2. Risk Management: supports decision-making by evaluating the risks associated with the assets. This includes assessment of condition and criticality.
3. Lifecycle Decision-Making: helps to determine the asset interventions required based on the information obtained from infrastructure planning and risk assessments.
4. Maintenance Management: focuses on maintaining assets when there are no immediate triggers for replacement or upgrades. Maintenance management includes both preventive and reactive maintenance activities.

Together these categories ensure effective asset management and support the long-term development of the UK NG system. Each category is further discussed in the following sections.

4.1 Infrastructure Planning

The purpose of infrastructure planning is to ensure that the NG system can meet both current and future customer demands. Currently, The City of Kingston only plans to increase density of housing in the natural gas service territory, and UK has deemed that no system expansion is needed to support this level of growth.

4.1.1 Growth Estimation[85]

As part of the Population, Housing and Employment Growth Analysis Study, a Technical Memorandum prepared by Watson was presented to Council on December 5, 2023, that identified low, medium and

[85] Commentary and Data sourced from: E9_Planning-Committee_Meeting-17-2024_Report-PC-24-051 _Growth-Analysis.pdf.

high population, housing and employment growth scenarios for the city to the year 2051 (Report Number 24-016).

Near-term provincial gross domestic product (GDP) growth slowed notably in 2023 and has continued to slow in 2024 due to the high cost of borrowing and persistent inflation at levels above target by the Bank of Canada. While national and provincial GDP is anticipated to rebound by 2025/2026 in response to recent and anticipated interest rate cuts by the Bank of Canada, it should be noted that macro-economic conditions across Canada and Ontario have softened within the past year. As a result, the national housing market recently started to show signs of cooling with respect to sales and price appreciation. Canada's federal government increased its immigration targets, which are now set at 500,000 new permanent residents in 2025 and 2026. Recent data indicates that a growing share of new Canadians are choosing to reside in the Kingston census metropolitan area and the City of Kingston.

Council endorsed the Medium Population, Housing and Employment Growth Scenario for the 2021-2051 time period. Based on this scenario, the city is projected to grow from 154,100 people in 2021 to 220,900 people by 2051, representing 66,800 new residents, with approximate 29,300 new housing units for the entire City of Kingston.

Currently, the city does not have enough land within the current urban boundary to accommodate the city's growth forecast to 2051. The land assessment for residential use takes into consideration a higher residential intensification target of 60% within the city's existing urban boundary (as compared to the existing intensification target of 40%).

The 29,300 new housing units anticipated in the city between 2021 and 2051 include both permanent as well as student households, with the permanent households being approximately 24,600.

The growth allocations by sub-area are as follows and are summarized in **Table 27**. The table may not represent the same number as presented above as the data throughout the gross analysis report varies.

Table 27: Growth Allocations by Sub-Area in the City of Kingston

Sub-Area	Population growth (2021-2051)	Population growth share	Housing growth (2021-2051)	Housing growth share	Employment growth (2023-2051)	Employment growth share
Kingston West	24,900	41%	10,610	39%	13,420	40%
Kingston Central	20,500	34%	10,100	37%	11,850	36%
Kingston East	14,100	23%	6,000	22%	7,640	23%
Kingston North	900	1%	270	1%	480	1%
City of Kingston	**60,400**	**100%**	**26,980**	**100%**	**33,390**	**100%**

As noted in Report Number 24-172, the actual development of any urban boundary expansion lands will depend on the outcomes of the Integrated Mobility Plan and the Water and Wastewater Master Plan and it is likely that these lands will not be developed for a number of years until they can be supported by the necessary infrastructure.

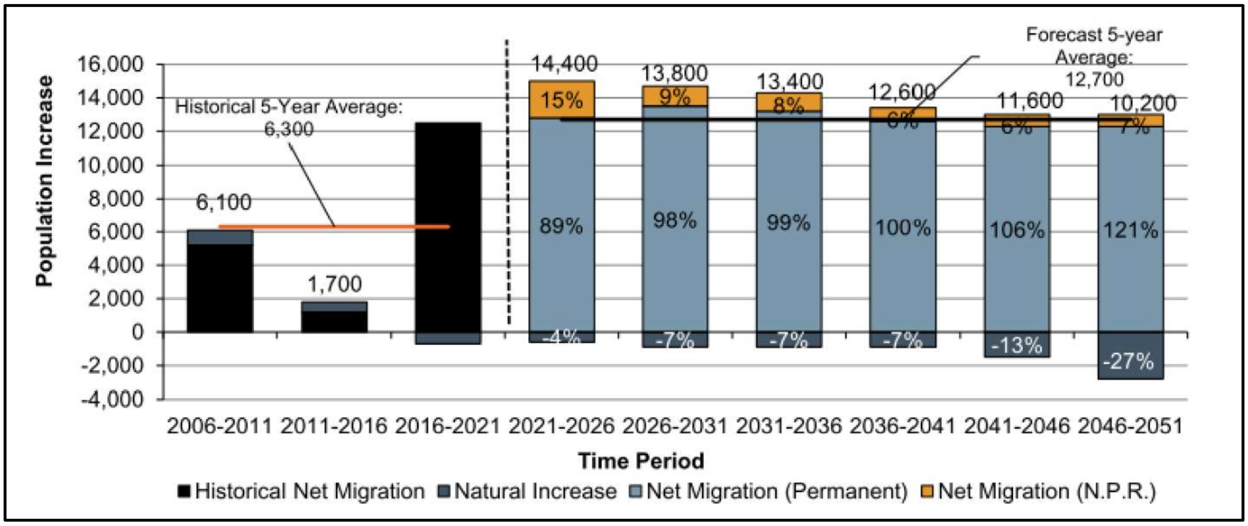

Figure 20: Kingston Census Metropolitan Area Components of Population Growth[86]

Figure 20 highlights that a 100% growth is expected for the City of Kingston in the next 30 years with an 89% growth until 2026. The 5-year average forecast shows a 12,700 population increase per year.

The current number of customer meters is estimated at 16,000 that is assumed one meter per household/ customer.

According to the growth study, demand is anticipated to increase more significantly in the next 5 years rather than over a 10-year horizon. This projected increase in natural gas customer demand could represent over a 100% increase in capacity requirements over the next 26 years. Accommodating this level of growth may involve urban boundary expansion, particularly in areas with proximity and access to Highway 401, where future development may include industrial uses. However, while these projections indicate potential demand, growth-related projects must be carefully evaluated in light of broader utility considerations, including Hydro infrastructure and long-term integrated energy planning. Additionally, any changes to the City's strategic direction, including updates to existing plans or the development of a new strategic growth plan, could influence how and where growth is accommodated, which in turn may affect future infrastructure investment decisions for the natural gas distribution system.

UK plans for growth through infrastructure planning studies (in progress) that will provide guidance for identifying projects, such as the potential for expansion of the gas distribution system, new regulating stations and intermediate stations, or any new high pressure and intermediate capacity pipelines that may required to meet both current and future customer demands while adhering to gas CSA Z662 standards and Ontario Regulation 588/17.

---

[86] Source: E9_Planning-Committee_Meeting-17-2024_Report-PC-24-051 _Growth-Analysis.pdf.

Although the natural gas demand management strategies may not have an immediate impact on the budget, they can provide long-term benefits by slowing down upgrades to the distribution system and lowering operating expenses through decreased gas usage and losses.

4.1.2 Electrification and Climate Change

A number of corporate plans and activities are currently underway or expected to be developed in the next couple of years that will have implications on UK's natural gas system, including:

- Kingston Hydro Strategic Plan (2025)
- UK's Strategic Plan (2026)
- Climate Action Leadership Plan (2025)

Strategic priorities may include:

- Reducing energy usage
- Reducing unwanted gas losses
- Renewable Natural Gas (RNG)
- Green Hydrogen production and utilization
- Integrated Energy opportunities
- Demand side management and other conservation initiatives

While population growth in the city is anticipated to grow the demand for energy and natural gas, decarbonization is expected to simultaneously reduce demand for natural gas. The net effect of these competing factors will be a key priority in upcoming years.

4.2 Risk Management

Risk management strategy is often used to prioritize capital investments and to help companies to define asset criticality and condition grades. The following sections describe UK's Risk Assessment process and methodology used to support the NG Utility Capital Plan development.

Following the 2020 Technical Standards and Safety Authority (TSSA) regulatory audit, UK updated its Risk Assessment process in 2022 to align it with the requirements of CSA Z662 Annex N. Taking in consideration data maturity, UK will continue improving its Risk Assessment process as part of the continuous improvement process as addressed within the UK NG Distribution System Integrity Management Program.

4.2.1 Risk Assessment Process

After the comparison and assessment of different risk methodologies used by various local gas distribution companies and taking into consideration the type and size of the UK organization and gas network, as well as the maturity level of current data, UK based its NG Risk Assessment methodology on an observation-based approach that would provide the best leverages of the company's strengths. The meeting- based format previously used was replaced by a staff-survey format. This new approach, that relies on Operations Lead's observation inputs, was adopted based on the success demonstrated by other local distribution companies during UK's participation in CGA Distribution Risk Management Sub-Committee of the Asset and Integrity Management Task Force (AIM TF).

The staff-survey questionnaire enabled the identification of all hazards/ potential hazards and their related risks. The assets are usually grouped into the following asset classes:

- High Pressure Distribution
- Intermediate Pressure Distribution
- Facilities: City Gate, Railway, and District Stations

UK's Risk Assessment Model follows a score-based relative ranking system. The scores are used to compare the various assets against each other.

The risk rankings are calculated for each asset class/ area as an average of all the relative rankings received from Operations. The highest risk ranked items are selected for actionable work in the coming years. A criticality threshold of 3.75 out of 5.00 is used to define the highest priority risk items to allow for a manageable number of projects to be selected for further action. The goal of the risk assessment process is to identify and mitigate the highest risks within the system. The risk assessment results are considered for integrity and asset management planning,

In addition, in the last risk assessment (2023), all items identified in the comments within the following sections were also included in the NG Capital Plan.

4.2.2 Risk Assessment Survey Results and Prioritization[87]

Table 28 through Table 32 summarize the risk assessment survey results and risk prioritization. The numbers under the 'Average' column, represent the average of all the eleven independent SME's risk ranking for the same condition.

[87] Data Source: GC1 - 2023 - 2026 Capital Plan Summary Document 4stantec.docx.

Table 28: Risk Ranking - Linear Assets, High Pressure

High Pressure (XHP & HP)	Risk Rank (1-5)											Average
Condition of the Queen's Line	5	-	4	5	4	4	3	-	4	5	2	**4.00**
Third Party Damage	4	5	2	4	3	3	4	-	3	4	5	**3.70**
Condition of the City Line	3	3	4	4	4	4	4	-	3	3	4	**3.60**
Cathodic Protection	2	3	3	4	3	4	3	-	5	3	3	**3.30**
Line Marking and Identification	3	3	3	4	2	3	1	-	2	1	5	**2.70**
Inoperable/Inaccessible Valves	2	1	3	3	2	3	1	-	2	4	5	**2.60**
Proximity to Other Utilities	4	2	2	2	2	2	1	-	3	1	3	**2.20**
Over Pressurization	2	2	2	3	2	2	1	-	3	2	-	**2.11**
Geotechnical	2	1	2	1	2	1	1	-	2	3	1	**1.60**

High Pressure Comments	Freq (#)
Queens Line	**5**
Pipeline Accessibility	**2**
Age of City Line	**2**
Third Party Damage	**1**
Pipeline Marking	**1**

Table 29: Risk Ranking- Linear Assets Intermediate Pressure Linear

Distribution (IP/MIP Network)	**Risk Rank (1-5)**											**Average**
Steel Islands	2	5	4	4	4	4	3	4	3	3	5	**3.73**
Steel Services and Risers Corrosion	4	3	4	5	3	3	3	3	4	4	5	**3.73**
Material Degradation & Corrosion	3	3	3	5	3	3	3	3	4	-	5	**3.50**
Coating Issues	2	5	3	4	3	3	3	4	3	-	5	**3.50**
Untraceable Assets	3	4	3	3	2	3	4	4	2	2	5	**3.15**
Third Party Damage	4	5	2	3	2	2	4	2	2	3	4	**3.00**
Inoperable/Inaccessible Valves	2	2	3	4	3	3	3	2	2	3	5	**2.91**
Materials (issue/improper use)	2	1	4	3	3	3	2	4	1	3	5	**2.82**
Over Pressurization	3	2	2	2	2	3	2	2	2	2	4	**2.36**
Meter Sets	2	2	2	3	1	2	2	1	1	2	5	**2.18**

Distribution Comments	Freq (#)
Steel Island Mains	**2**
Steel Island Services	**2**
Risers	**1**
Compton Wilson Weller Risers	**1**
Materials: “Plexco” Tapping Tee Caps	**1**
Aging Infrastructure	**1**
Un-tracible Assets	**1**
Coating Holidays	**1**
Meter Protection	**1**
Contractor Management (materials)	**1**
Cathodic Protection Program - transparency & training	**1**
Risers in the Compton Wilson Weller area	**1**

Table 30: Risk Ranking- Facility Assets City Gate

City Gate	Risk Rank (1-5)									Average
Boiler System (vacuum loss, redundancy)	5	4	5	4	4	5	4	5	5	5	4.60
Mercaptan System Building & Safety	3	4	4	3	3	3	3	3	4	4	3.40
Bypass Valves & Procedures	3	3	4	3	4	4	3	3	-	3	3.33
Grasshopper Valves	-	4	3	3	3	3	4	2	2	4	3.33
Overpressurization downstream	4	3	4	2	3	3	3	2	3	5	3.10
Regulating Runs	3	3	3	3	2	3	2	3	4	3	3.00
UG Piping at the Station	2	3	3	3	2	4	3	2	3	3	2.80
Instrumentation & Monitoring Failure	4	1	3	2	2	2	4	2	3	2	2.50
TC Incoming Line	2	-	3	3	2	2	3	1	5	1	2.44
Security (3rd Party Tampering)	4	1	2	2	2	2	2	2	4	3	2.40
Build Grounds (access/ roads)	2	1	2	2	2	2	1	2	2	2	1.80
Building Issues	2	1	2	2	2	2	1	2	2	1	1.70

City Gate Comments	Freq. (#)
Heater	5
Valve Repair	**1**
Mercaptan Building Roof Maintenance	**1**

Table 31: Risk Ranking- Facility Assets Railway Regulating Station No 2

Railway Regulating Stn. No 2	Risk Rank (1-5)										Average
Boiler System (vacuum loss, redundancy)	4	3	5	4	3	5	-	4	5	5	**4.22**
Grasshopper Valves	1	5	5	4	4	4	-	3	3	5	**3.78**
Bypass Valves & Procedures	2	3	5	4	4	5	-	2	3	5	**3.67**
Building Envelope	3	3	4	4	2	2	-	4	5	4	**3.67**
UG piping at the Station	2	4	3	3	2	3	-	2	3	3	**2.78**
Security (3rd Party Tampering)	4	2	2	2	2	3	-	2	4	3	**2.67**
Overpressurization Downstream	4	2	2	2	2	3	-	2	3	3	**2.56**
Instrument. & Monitoring Failure	2	2	2	2	2	2	-	2	5	1	**2.22**
Regulating Runs	2	1	2	2	2	3	-	2	4	1	**2.11**

Railway Regulating Station Comments	Freq. (#)
Bypass Valve	**3**
Building Issues (walls, roof, etc.)	**3**
Heater	**2**
Relief Reg Venting Location	**1**
Training on Relief Operation	**1**

Table 32: Risk Ranking- Facility Assets District Regulating Stations

District Regulating Stations	Risk Rank (1-5)										Average
Relief Valves	3	3	3	3	3	3	-	2	5	2	3.00
UG Piping & Valves to the Station	2	2	4	4	3	3	-	1	3	4	2.89
Regulator Ice Over	2	3	3	3	2	2	-	2	5	3	2.78
Security (3rd Party Tampering)	4	3	2	2	3	3	-	1	4	2	2.67
Enclosures	2	1	3	3	3	3	-	1	4	1	2.33
Overpressurization Downstream	2	2	2	2	3	3	-	1	3	2	2.22

District Regulating Stations Comments	Freq. (#)
Risers Need to be Re-coated	1
Geotechnical Movement at RS #5	1
Palace Rd Showing Excessive Wear	1
Filter Maintenance	1
Gas Contamination	1

4.2.3 Risk Assessment Results Implementation and Moving Forward

The outcomes from the above addressed risk assessment are summarized in **Table 33**.

The investment summary includes specific linear projects until the year 2030. It is assumed that additional projects will be required until 2034 but have not yet been defined. **Table 33** addresses near term investments. Investments made further into the future will be subject to additional analysis, risk assessments, and managerial direction. Operations and Maintenance activities are not included in this table, but continuation of the existing programs is appropriate. **Section 4.5** discusses Operations and Maintenance Activities in more detail.

Table 33: Capital Investment Summary [88]

Year	Stations	IP Mains	HP Mains	Services
2025	Recoating	Fraser & Joseph	-	New as req'd
2026	Railway Design	Bath Rd & Armstrong	HP Line Survey	New as req'd
2027	Railway Rebuild	Kingscourt	-	New as req'd
2028	Palace Rd Upsizing	Raglan	HP Line Survey	New as req'd
2029	TBA	Rideau St (lower)	-	New as req'd
2030	TBA	Rideau St (upper)	HP Line Survey	New as req'd
2031	TBA	TBA	-	New as req'd
2032	TBA	TBA	HP Line Survey	New as req'd
2033	TBA	TBA	-	New as req'd
2034	TBA	TBA	HP Line Survey	New as req'd

Capital investment plans are subject to City Council approval and the project list is revisited at regular intervals to keep this approval current. This approach should be maintained going forward, with adjustments to the investment program made as new asset condition and risk information becomes available.

4.3 Integrity Management

To achieve a safe and reliable delivery/ supply of NG within the UK distribution area, UK developed a Distribution System Integrity Management Program (DSIMP) in alignment with the most current version of CSA Z662 Oil and Gas Pipeline Systems industry standard. The purpose of the DSIMP is to provide the framework for UK to collect, integrate, and analyze information related to design and construction, condition monitoring, maintenance and repair, operating conditions, failure/ damage incidents, damage/ deterioration/ manufacturing imperfections, environmental protection, and safety.

4.4 Lifecycle Decision Making

In accordance with Ontario Regulations 588/17, the following section includes a description of lifecycle activities to maintain the current Level of Service.

The infrastructure planning and risk management are used to identify assets that require new/ increased/accelerated maintenance, rehabilitation/ major upgrades or replacement. Once these assets

[88] Data Source: 2024 AMP, Communications with UK

are identified, decisions are made on how they should be addressed through the Lifecycle Decision Making process.

4.4.1 Linear Infrastructure

Lifecycle decisions relating to the Linear Assets are based on the planning and the risk assessment processes:

- An asset should typically be maintained through digging and repairs if it shows minor maintenance requirement(s) and/ or a lower risk of failure.
- The planning process identifies the need for capacity improvements, the upgrades should be prioritized within the planned timeframe, or UK may address the replacement as a separate, one-off project.
- If the assets are identified as high-risk, where maintenance activities will not be cost-effective in reducing the risk, the following should be considered:
    - Replacement of an asset and its dependents
    - Rehabilitation, with consideration to the condition of dependent assets and appropriate rehabilitation, cathodic protection, or replacement of dependent assets.

4.4.2 Non-Linear Assets/ Facilities

The Non-Linear Assets are primarily managed through maintenance and minor upgrades or coincidental with the need to replace non-linear assets (e.g. valves), rather than major upgrades/ replacements. However, if the planning processes identifies the need for a significant increase in capacity and/or significant improvement of the assets, the assets are managed through major upgrades or facility replacements.

4.5 Operations and Maintenance Management

In the absence of triggers for replacement, upgrades, or capacity increase, a routine maintenance program should be completed to ensure the NG system operates effectively.

The Gas Pipeline Systems Safety Code requires that various maintenance activities be conducted at prescribed or performance-based intervals. The Standard Operating Procedures contain a detailed response to the maintenance work that is required by both policy and by code.

Table 34 addresses maintenance intervals of the selected key components of this Plan.

Table 34: Major Maintenance Item Intervals[89]

Asset Category	Maintenance Item	Frequency
Linear	Leak Survey	High Pressure: Annual Other Linear Assets: 1 in 5 years
Linear	Cathodic Protection Survey	Annual
Linear	Priority Shut-off Valves	As per SOP
Facilities	Regulator Rebuild	Annual
Facilities	Relief Valve Verification	Annual
Facilities	Odorant System	As Req'd
Facilities	Boiler Maintenance	As Req'd

All maintenance activities should be documented, tracked by asset, and accessible to UK staff.

Existing tracking methods include:

- Various tracking sheets maintained by Operations for linear infrastructure, relating to maintenance.
- The GIS Asset Inventory can track work on the Linear Infrastructure, but maintenance activities are currently tracked on individual sheets. It is recommended to track and catalog all maintenance work completed in GIS or other asset management software.

4.6 New Assets

In general, UK adds new assets through acquisition from developers (due to growth) and in-house construction (driven by growth, reassessed capacity needs, or internal risk assessments). The new assets should be documented in the Asset Inventory and incorporated into the financial summaries as required.

A recent growth study completed for the City of Kingston showed an increase in population with approximate permanent households to increase by approximately 26,980 in the next 26 years, with a respective more than double increase in the Capacity demand[90]. The majority of the population growth is expected in the next 5 years and with 60% concentrated on the core and around Hwy 401, according to the statistics, see **Section 4.1.1** for details.

The current NG Distribution capacity provides for the 2024 demand. Downstream pressure at the end of Intermediate Pressure network is the limiting factor in available system capacity and will limit growth in

[89] Data Source: 2024 AMP.

[90] Data Source: According to the document "E9_Planning-Committee_Meeting-17-2024_Report-PC-24-051 _Growth-Analysis", the count of permanent households is 24,570. However, the count of Services from UK's GIS is 16,806.

NG services. The analysis conducted through 2024 considers measured pressure and flow rates and presented in this 2025 AMP shows:

- Actual Capacity of Regulated High-Pressure Assets (City Line, Queens Line) shows that the current pressure on the XHP system (Queens Line) is maximized and there is excess capacity on the City Line to deliver additional volumes to the IP system.
- Queens Line average pressure readings are at 100% of its downstream sales agreement constraint (400 psig) for pipeline pressure.
- The volume capacity of the IP regulating stations ranges from 9-153%.
- Volume capacity data from the volume meters located at the end of the Intermediate pressure system ranges from 12-66%.
- The pressure capacity of the volume meters located at the end of the Intermediate pressure system ranges from 60-65%.

Based on the 2024 data, the current system has capacity to deliver additional volumes to support the planned densification in the Central area.

4.7 Decommissioning

When an asset is no longer providing value, it should be decommissioned or repurposed as applicable. The process of formally removing an asset from service and operation includes steps like physical removal, data sanitization, decontamination, dismantling, and responsible disposal or repurposing to ensure the safety, compliance, and recovery of value at the end of an asset's lifecycle. It is a crucial, complex, and potentially costly final phase of an asset's management, requiring careful planning to address potential hazards, environmental concerns, and regulatory requirements. This process should include carrying out the necessary studies and procedures to properly decommission/ repurpose assets that are no longer required.

4.8 Maturity and Moving Forward

Linear assets have sufficient information to complete asset valuation for ‘minimum’ maturity level plus replacement cost for applicable asset age/life which is considered that meet the criteria Core Maturity level.

Non - Linear assets have minimum information to complete asset valuation cost for all applicable asset age/life. Some assets such as Test and Locate Stations are at a core maturity level. It was concluded that not all the non-linear assets meet the criteria Core Maturity level.

5 Financial Strategy

5.1 Overview

This section summarizes the cost and budget figures as well as projects that are planned for the next 10 years. Maintenance is not included in these totals.

5.2 Operating Costs

Figure 21 summarizes significant operating expenses from 2020 to 2035. Historically, approved budgets have adequately covered actual operating costs. The rising trend in operating budgets reflects UK's ongoing commitment to efficiently manage existing operations while preparing for future expansions. For 2024, the approved operating budget is $5,282,481. The proposed operating budget for 2025 is $5,841,680, marking an increase of $559,199 (or 10.6%). An additional increase of $417,005 (or 7.1%) is anticipated for 2026, bringing the proposed operating budget to $6,258,685.

These increases are primarily driven by rising costs for contracted services, supplies (e.g., materials, tools, equipment, and parts), and utilities necessary to maintain current service levels. The budget also reflects the need for additional resources to support the inspection, operation, and maintenance of the City's inventory of natural gas assets, including facilities and underground infrastructure.

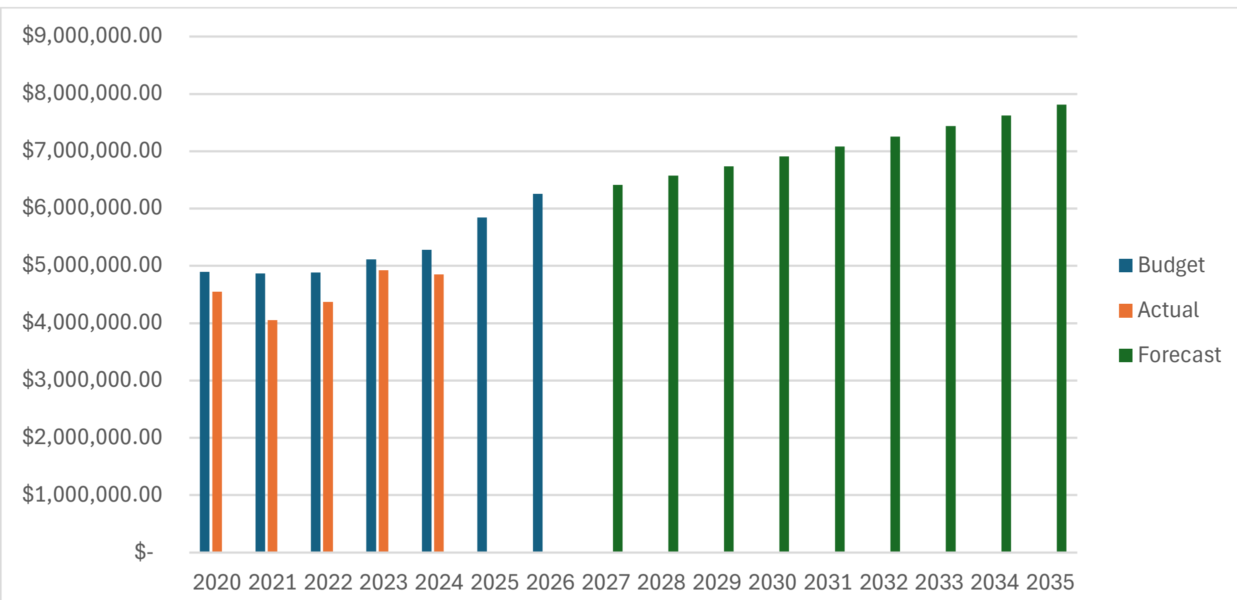

Figure 21: Significant Operating Costs for Natural Gas[91]

[91] Source: E5-E7. Municipal Utilities Budget to Actuals - 2020-2035

5.3 Capital Cost and Budget Forecast

Existing budgets were based on the previous 2024 Asset Management Plan (AMP) and as provided by UK[92].

Milestone projects are those items previously identified as important priorities and have been funded, such as the 2027 Railway St. Regulating Station Rebuild which is reaching end of life. Additional funds required to meet the proposed levels of service outlined in **Sections 3.2.2.1 and 3.2.2.2** have been added to the 2025-2034 Capital Plan presented in detail in **Appendix A.2**.

Table 35 and **Appendix A** summarizes the 10-year budget forecast required to continue operate the gas utility at the current levels of service, the proposed levels of services and the available capital. Based on this forecast, the gas utility infrastructure is in a deficit.

Table 35: 2025-2034 Breakdown of UK Financial Strategy for the Gas Utility

Year	UK Capital Funding Available	Funding Required for Current LOS	Funding Required for Proposed LOS	Funding Available vs. Required – Proposed LOS
2025	$8,441,210	$7,615,760	$7,992,498	$448,712
2026	$7,630,210	$7,617,425	$8,060,150	-$429,940
2027	$7,520,892	$ 6,992,500	$7,451,497	$69,395
2028	$6,884,754	$ 6,975,000	$7,425,562	-$540,808
2029	$6,893,148	$ 5,865,400	$6,308,329	$584,819
2030	$6,335,941	$ 5,835,400	$6,296,007	$39,934
2031	$6,171,912	$ 5,892,670	$6,371,775	-$199,863
2032	$5,937,725	$ 5,856,600	$6,354,533	-$416,808
2033	$6,040,150	$6,036,600	$6,553,701	-$513,551
2034	$6,171,397	$ 5,849,925	$6,363,044	-$191,647
Total	**$68,027,339**	**$64,537,280**	**$69,177,094**	**-$1,149,755**

5.4 Infrastructure Deficit

Table 35 presents the capital budget forecast and projected capital funding availability for the Gas Utility, highlighting the difference between the capital expenditures in the financial plan and the asset management projections over the 10-year period, which results in an infrastructure deficit of $1.1 million. The funding requirements to achieve the proposed Levels of Service incorporate an assumed annual inflation rate of 3%. Financial plans are reviewed and updated annually to reflect current priorities, funding availability, and market conditions. All financing options are carefully assessed to maximize the asset management work achievable within available resources. For projects involving the replacement of

[92] Source: E2_2025-2045 UKCapPlan W-WW-G

existing infrastructure, additional funding may be accessed from rate-based sources to ensure essential renewal proceeds. Ongoing monitoring, proactive financial planning, and the pursuit of sustainable funding strategies remain critical to managing these risks and ensuring reliable service delivery.

It should be noted that persistent underfunding increases the risk of service disruption, higher lifecycle costs, and reduced capacity to maintain desired Levels of Service. Addressing the projected 10-yr infrastructure deficit requires a focused set of lifecycle activities, including rehabilitation, upgrades, replacement, and maintenance. Deferring these activities risks accelerated asset failure, reductions in levels of service and reduced service reliability. To manage these risks, a risk-based prioritization framework will be employed to focus resources where they are most needed. Additionally, cost-effective strategies such as routine maintenance programs, the implementation of the new Enterprise Asset Management, and the use of asset condition monitoring technologies will be implemented to maintain existing levels of service while minimizing expenditures.

Exhibit B
Report Number 25-237

Appendix A – 2025-2034 Capital Plan

A.1 UK Gas 10-Year Capital Budget

	Total 2025	Total 2026	Total 2027	Total 2028	Total 2029	Total 2030	Total 2031	Total 2032	Total 2033	Total 2034	Sum of WIP	Sum of Total
⊟General												
⊟**Business Systems**												
Business Systems City Transfers	$ 321,460.00	$ 388,625.00	$ 390,000.00	$ 390,000.00	$ 200,000.00	$ 200,000.00	$ 221,970.00	$ 221,000.00	$ 221,000.00	$ 225,000.00	$ 556,410.00	$ 3,335,465.00
Business Systems UK	$ 350,000.00	$ 487,500.00	$ 1,280,000.00	$ 1,130,000.00	$ 250,000.00	$ 255,000.00	$ 260,100.00	$ 260,000.00	$ 260,000.00	$ 265,200.00	$ 1,499,531.00	$ 6,297,331.00
SCADA	$ 100,000.00	$ 110,000.00	$ 40,000.00	$ 40,000.00	$ 10,400.00	$ 10,400.00	$ 10,600.00	$ 10,600.00	$ 10,600.00	$ 10,600.00	$ 120,000.00	$ 473,200.00
⊟**Construction and Office Equipment**												
City Restoration Costs	$ 250,000.00	$ 240,000.00	$ 220,000.00	$ 220,000.00	$ 210,000.00	$ 200,000.00	$ 200,000.00	$ 180,000.00	$ 150,000.00	$ 150,000.00		$ 2,020,000.00
Office Equipment	$ 17,500.00	$ 5,000.00	$ 7,500.00	$ -	$ -	$ -	$ -	$ 10,000.00	$ -	$ -	$ 7,500.00	$ 47,500.00
Tools, Locating Equipment, Radios	$ 303,800.00	$ 253,800.00	$ 125,000.00	$ 120,000.00	$ 120,000.00	$ 125,000.00	$ 125,000.00	$ 100,000.00	$ 90,000.00	$ 100,000.00	$ 209,334.00	$ 1,671,934.00
⊟**Property**												
Land		$ -	$ -	$ -	$ -	$ 20,000.00	$ -	$ -	$ -	$ 10,000.00	$ 10,000.00	$ 40,000.00
Office Building Improvements		$ -	$ -	$ -	$ -	$ 20,000.00	$ -	$ -	$ -	$ 20,000.00	$ 49,615.00	$ 89,615.00
⊟**Vehicles**												
New	$ 25,000.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 455,000.00	$ 480,000.00
Upgrades	$ 10,000.00	$ 7,500.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 16,000.00	$ 33,500.00
⊟G-Pipes												
⊟**Appurtenance Upgrades or Replacement**												
												$ -
Meters	$ 2,273,000.00	$ 3,000,000.00	$ 1,100,000.00	$ 1,200,000.00	$ 1,200,000.00	$ 1,200,000.00	$ 1,225,000.00	$ 1,100,000.00	$ 1,200,000.00	$ 1,224,000.00		$ 14,722,000.00
Pipe	$ 400,000.00	$ 200,000.00	$ 200,000.00	$ 225,000.00	$ 200,000.00	$ 200,000.00	$ 225,000.00	$ 200,000.00	$ 200,000.00	$ 225,000.00		$ 2,275,000.00
Services	$ 50,000.00	$ 450,000.00	$ 200,000.00	$ 200,000.00	$ 150,000.00	$ 250,000.00	$ 250,000.00	$ 250,000.00	$ 170,000.00	$ 250,000.00		$ 2,220,000.00
Valves	$ 110,000.00	$ 175,000.00	$ 175,000.00	$ 200,000.00	$ 300,000.00	$ 300,000.00	$ 275,000.00	$ 250,000.00	$ 250,000.00	$ 275,000.00		$ 2,310,000.00
⊟**Construction**												
Main Expansion IP	$ 25,000.00	$ 100,000.00	$ -	$ -	$ 50,000.00	$ 50,000.00	$ 50,000.00	$ 50,000.00	$ 50,000.00	$ 75,000.00		$ 450,000.00
Main Replacement HP	$ 150,000.00	$ 100,000.00	$ 100,000.00	$ 125,000.00	$ 150,000.00	$ 150,000.00	$ 150,000.00	$ 150,000.00	$ 150,000.00	$ 175,000.00		$ 1,400,000.00
Main Replacement IP	$ 2,600,000.00	$ 1,500,000.00	$ 2,500,000.00	$ 2,500,000.00	$ 2,800,000.00	$ 2,600,000.00	$ 2,600,000.00	$ 2,600,000.00	$ 2,600,000.00	$ 2,600,000.00		$ 24,900,000.00
New Services	$ 450,000.00	$ 200,000.00	$ 185,000.00	$ 185,000.00	$ 175,000.00	$ 175,000.00	$ 175,000.00	$ 175,000.00	$ 175,000.00	$ 185,000.00	$ 778.00	$ 2,080,778.00
⊟**Planning & Design**												
	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
⊟Regulating Stations												
⊟**Construction**												
	$ -	$ -	$ 385,000.00	$ 375,000.00	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,550,000.00	$ 3,310,000.00
⊟**Equipment Upgrades or Replacement**												
											$ 265,000.00	$ 265,000.00
Building Fixtures	$ 10,000.00	$ 10,000.00	$ 10,000.00	$ 15,000.00	$ 15,000.00	$ 10,000.00	$ 10,000.00	$ 15,000.00	$ 5,000.00	$ 5,125.00		$ 105,125.00
Building Structure	$ 25,000.00	$ 20,000.00	$ 10,000.00	$ 15,000.00	$ 15,000.00	$ 10,000.00	$ 10,000.00	$ -	$ 5,000.00	$ 20,000.00		$ 130,000.00
Electrical Equipment	$ 35,000.00	$ 20,000.00	$ 20,000.00	$ 10,000.00	$ 10,000.00	$ 30,000.00	$ 30,000.00	$ 15,000.00	$ 5,000.00	$ 10,000.00		$ 185,000.00
Mechanical Equipment	$ 110,000.00	$ 100,000.00	$ 40,000.00	$ 25,000.00	$ 10,000.00	$ 30,000.00	$ 75,000.00	$ 270,000.00	$ 450,000.00	$ 25,000.00		$ 1,135,000.00
⊟**Planning & Design**												
	$ -	$ 250,000.00	$ 5,000.00	$ -	$ -	$ -	$ -	$ -	$ 45,000.00	$ -	$ 6,000.00	$ 306,000.00
Grand Total	$ 7,615,760.00	$ 7,617,425.00	$ 6,992,500.00	$ 6,975,000.00	$ 5,865,400.00	$ 5,835,400.00	$ 5,892,670.00	$ 5,856,600.00	$ 6,036,600.00	$ 5,849,925.00	$ 5,745,168.00	$ 70,282,448.00

Natural Gas Utilities Asset Management Plans 2025 to 2034

A.2 Proposed UK Gas 10-Year Capital Budget[93,94]

	Total 2025	Total 2026	Total 2027	Total 2028	Total 2029	Total 2030	Total 2031	Total 2032	Total 2033	Total 2034	Sum of WIP	Sum of Total
General												
Business Systems												
Business Systems City Transfers	$ 321,460.00	$ 388,625.00	$ 390,000.00	$ 390,000.00	$ 200,000.00	$ 200,000.00	$ 221,970.00	$ 221,000.00	$ 221,000.00	$ 225,000.00	$ 556,410.00	$ 3,335,465.00
Business Systems UK	$ 350,000.00	$ 487,500.00	$ 1,280,000.00	$ 1,130,000.00	$ 250,000.00	$ 255,000.00	$ 260,100.00	$ 260,000.00	$ 260,000.00	$ 265,200.00	$ 1,499,531.00	$ 6,297,331.00
SCADA	$ 100,000.00	$ 110,000.00	$ 40,000.00	$ 40,000.00	$ 10,400.00	$ 10,400.00	$ 10,600.00	$ 10,600.00	$ 10,600.00	$ 10,600.00	$ 120,000.00	$ 473,200.00
Construction and Office Equipment												
City Restoration Costs	$ 250,000.00	$ 240,000.00	$ 220,000.00	$ 220,000.00	$ 210,000.00	$ 200,000.00	$ 200,000.00	$ 180,000.00	$ 150,000.00	$ 150,000.00		$ 2,020,000.00
Office Equipment	$ 17,500.00	$ 5,000.00	$ 7,500.00	$ -	$ -	$ -	$ -	$ 10,000.00	$ -	$ -	$ 7,500.00	$ 47,500.00
Tools, Locating Equipment, Radios	$ 303,800.00	$ 253,800.00	$ 125,000.00	$ 120,000.00	$ 120,000.00	$ 125,000.00	$ 125,000.00	$ 100,000.00	$ 90,000.00	$ 100,000.00	$ 209,334.00	$ 1,671,934.00
Property												
Land		$ -	$ -	$ -	$ -	$ 20,000.00	$ -	$ -	$ -	$ 10,000.00	$ 10,000.00	$ 40,000.00
Office Building Improvements		$ -	$ -	$ -	$ -	$ 20,000.00	$ -	$ -	$ -	$ 20,000.00	$ 49,615.00	$ 89,615.00
Vehicles												
New	$ 25,000.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 455,000.00	$ 480,000.00
Upgrades	$ 10,000.00	$ 7,500.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 16,000.00	$ 33,500.00
Customer Meters												
Commercial	$ 107,551.15	$ 110,777.68	$ 114,101.02	$ 117,524.05	$ 121,049.77	$ 124,681.26	$ 128,421.70	$ 132,274.35	$ 136,242.58	$ 140,329.86	$ -	$ 1,232,953.40
Residential	$ 208,686.65	$ 214,947.25	$ 221,395.67	$ 228,037.54	$ 234,878.66	$ 241,925.02	$ 249,182.77	$ 256,658.26	$ 264,358.00	$ 272,288.74	$ -	$ 2,392,358.57
G-Pipes												
Appurtenance Upgrades or Replacement												
Meters	$ 2,273,000.00	$ 3,000,000.00	$ 1,100,000.00	$ 1,200,000.00	$ 1,200,000.00	$ 1,200,000.00	$ 1,225,000.00	$ 1,100,000.00	$ 1,200,000.00	$ 1,224,000.00		$ 14,722,000.00
Pipe	$ 400,000.00	$ 200,000.00	$ 200,000.00	$ 225,000.00	$ 200,000.00	$ 200,000.00	$ 225,000.00	$ 200,000.00	$ 200,000.00	$ 225,000.00		$ 2,275,000.00
Services	$ 50,000.00	$ 450,000.00	$ 200,000.00	$ 200,000.00	$ 150,000.00	$ 250,000.00	$ 250,000.00	$ 250,000.00	$ 170,000.00	$ 250,000.00		$ 2,220,000.00
Valves	$ 110,000.00	$ 175,000.00	$ 175,000.00	$ 200,000.00	$ 300,000.00	$ 300,000.00	$ 275,000.00	$ 250,000.00	$ 250,000.00	$ 275,000.00		$ 2,310,000.00
Construction												
Main Expansion IP	$ 25,000.00	$ 100,000.00	$ -	$ -	$ 50,000.00	$ 50,000.00	$ 50,000.00	$ 50,000.00	$ 50,000.00	$ 75,000.00		$ 450,000.00
Main Replacement HP	$ 210,500.00	$ 217,000.00	$ 223,500.00	$ 230,000.00	$ 237,000.00	$ 244,000.00	$ 251,500.00	$ 259,000.00	$ 266,500.00	$ 275,500.00		$ 2,414,500.00
Main Replacement IP	$ 2,600,000.00	$ 1,500,000.00	$ 2,500,000.00	$ 2,500,000.00	$ 2,800,000.00	$ 2,600,000.00	$ 2,600,000.00	$ 2,600,000.00	$ 2,600,000.00	$ 2,600,000.00		$ 24,900,000.00
New Services	$ 450,000.00	$ 200,000.00	$ 185,000.00	$ 185,000.00	$ 175,000.00	$ 175,000.00	$ 175,000.00	$ 175,000.00	$ 175,000.00	$ 185,000.00	$ 778.00	$ 2,080,778.00
Planning & Design												$ -
	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -		$ -
Regulating Stations												
Construction												$ -
	$ -	$ -	$ 385,000.00	$ 375,000.00	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,550,000.00	$ 3,310,000.00
Equipment Upgrades or Replacement												$ -
											$ 265,000.00	$ 265,000.00
Building Fixtures	$ 10,000.00	$ 10,000.00	$ 10,000.00	$ 15,000.00	$ 15,000.00	$ 10,000.00	$ 10,000.00	$ 15,000.00	$ 5,000.00	$ 5,125.00		$ 105,125.00
Building Structure	$ 25,000.00	$ 20,000.00	$ 10,000.00	$ 15,000.00	$ 15,000.00	$ 10,000.00	$ 10,000.00	$ -	$ 5,000.00	$ 20,000.00		$ 130,000.00
Electrical Equipment	$ 35,000.00	$ 20,000.00	$ 20,000.00	$ 10,000.00	$ 10,000.00	$ 30,000.00	$ 30,000.00	$ 15,000.00	$ 5,000.00	$ 10,000.00		$ 185,000.00
Mechanical Equipment	$ 110,000.00	$ 100,000.00	$ 40,000.00	$ 25,000.00	$ 10,000.00	$ 30,000.00	$ 75,000.00	$ 270,000.00	$ 450,000.00	$ 25,000.00		$ 1,135,000.00
Planning & Design												$ -
	$ -	$ 250,000.00	$ 5,000.00	$ -	$ -	$ -	$ -	$ -	$ 45,000.00	$ -	$ 6,000.00	$ 306,000.00
Grand Total	**$ 7,992,497.80**	**$ 8,060,149.93**	**$ 7,451,496.68**	**$ 7,425,561.58**	**$ 6,308,328.43**	**$ 6,296,006.28**	**$ 6,371,774.47**	**$ 6,354,532.61**	**$ 6,553,700.58**	**$ 6,363,043.60**	**$ 5,745,168.00**	**$ 74,922,259.97**

93 As outlined in **Section 3.2.2.1**, an average 2025 replacement cost of HP assets at their LE was determined to be $3,866 per meter resulting in $2.1 million required in 2025 to bring the HP assets within the proposed LOS target. The $2.1 million for HP Main Replacements was spread over 10-years and indexed to 3% inflation per year.

94 As outlined in **Section 3.2.2.2**, the replacement cost for customer meters reaching their LE in the next 10-years was determined to be $3.1 million required to bring the customer meters within the proposed LOS target. This cost was averaged over 10-years and indexed to 3% inflation per year.

Stantec is a global leader in sustainable engineering, architecture, and environmental consulting. The diverse perspectives of our partners and interested parties drive us to think beyond what's previously been done on critical issues like climate change, digital transformation, and future-proofing our cities and infrastructure. We innovate at the intersection of community, creativity, and client relationships to advance communities everywhere, so that together we can redefine what's possible.

Stantec Consulting Ltd.
300 - 1331 Clyde Avenue
Ottawa ON K2C 3G4
stantec.com

Exhibit C
Report Number 25-237

Utilities Kingston

Water Heater Asset Management Plan

2 June 2025

Contents

Introduction

The practice of asset management aims to minimize the lifecycle costs of delivering infrastructure services and manage the associated risks while maximizing the value customers receive from the asset portfolio. Utilities Kingston has an Asset Management Policy which directs staff on the roles and responsibilities regarding asset management.

This document provides details on the specific asset management plan for the assets managed by Utilities Kingston in the water heater rental business.

The water heater rental business consists of municipally owned assets managed by Utilities Kingston. The business is competitive with private companies.

Asset Category Details

Summary of Assets in the Category

The water heater rental business consists of different types of water heaters, varying in capacity and fuel type. These assets are grouped into a single asset category called "Water Heaters."

Replacement Cost of the Assets in the Category

Table 1: Replacement Cost of the Assets as of Dec 31, 2024

Asset Category	Quantity in Service	Replacement Cost
Water Heaters	10,412	$21,530,152

Replacement cost is determined using data from the last full calendar year of new install data.

Table 2: Quantity and Cost of New Heaters 2024, as of Dec 31, 2024

Number of Heaters Installed	Cost to Install Heaters	Cost per Heater
690	$1,429,882	$2,072

Therefore, to determine the replacement cost:
10,412 X $2,072 = $21,573,664 as per the table above.

Average Age of Assets in the Category

Table 3: Average Age of Water Heaters as of Dec 31, 2024

Asset Category	Average Age
Water Heaters	7 years 10 months

Condition Assessment Methodology

Assessing the condition of the water heater assets is completed by analyzing the number of calls per in-service heater per year and the age of the water heater.

Service calls reflect the volume of customer problems with water heaters operating as expected.

Table 4: Water Heater Performance Matrix

Number of Service Calls Per In-service Heater per Year	Performance Measure	Value Assigned to Performance
0.05 or less	Very Good	5
0.051 to 0.1	Good	4
0.11 to 0.15	Fair	3
0.16 to 0.20	Poor	2
0.21 or greater	Very Poor	1

The age of the assets is also used to determine the condition. Newer water heaters are expected to require fewer service calls and have fewer operational issues than older heaters.

Table 5: Water Heater Age Evaluation Matrix

Age of Asset	Condition Contribution	Number of Assets	Value Assigned to Age
0-5 Years	Very Good	4,585	5
6-10 Years	Good	3,480	4
11-15 Years	Fair	1,378	3
16-20 Years	Poor	579	2
20+ Years	Very Poor	369	1

To establish the contribution of age toward the asset condition, the following formula is used:

Sum of (Value Assigned to Condition Contribution * Number of assets at each level) divided by total number of assets.

To establish the water heater asset category condition, the value assigned to performance is multiplied by the value assigned to age to yield a total condition rating.

Table 6: Asset Age Condition Contribution

Age of Asset	Number of Assets	Value Assigned to Age	Number of Assets * Value Assigned to Age
0-5 Years	4,606	5	23,030
6-10 Years	3,480	4	13,920
11-15 Years	1,378	3	4,134
16-20 Years	579	2	1,158
20+ Years	369	1	369

Table 7: Asset Age Condition

Total Value Assigned to Age	42,611
Total Number of Assets	10,412
Asset Age Condition (Total Value Assigned to Age / Total Number of Assets)	4.1

Utilities Kingston has developed the following table to yield the overall condition assessment of the asset category.

Table 8: Overall Asset Condition Assessment

Value Assigned to Performance	5	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15
	2	2	4	6	8	10
	1	1	2	3	4	5
		1	2	3	4	5
		Asset Category Age Condition				

16 to 25 is Good Condition – low risk for adverse asset behaviour
8 to 15 is Fair Condition – continue to monitor
1 to 7 is Poor Condition – action required

Current Levels of Service

The water heater rental business operates within the regulatory requirements of the Consumer Protection Act, 2002, S.O.2002, c.30, Sched. A and the Sale of Goods Act R.S.O. 1990, c.S.1. As per O.Reg. 588/17 5.1.ii Utilities Kingston defines the level of service for the assets managed under this plan using a qualitative description and a technical metric.

Qualitative Description

Utilities Kingston water heater rentals will provide hot water to customers when called upon and operate as per the manufacturer's specifications.

Technical Metric

The number of after-hours service calls per in-service heater per year indicates the number of service calls while accounting for changing customer numbers. Service calls are defined as customer contacts when a water heater does not operate as expected. Service calls are used to measure the overall health of the water heater fleet. Utilities Kingston has established the following table to evaluate the technical metric.

Table 9: Technical Metric Measures

Number of Service Calls Per In-service Heater per Year	Performance Measure
0.05 or less	Very Good
0.051 to 0.1	Good
0.11 to 0.15	Fair
0.16 to 0.20	Poor
0.21 or greater	Very Poor

Current Condition Assessment

The most recent performance measure is 0.071 service calls per water heater per year, yielding a performance measure of good (4).

The most recent snapshot of asset age condition is good (4.1).

Combining the performance measure with the Asset Category age condition yields an overall condition assessment of good (16.4).

Table 10: Overall Condition Assessment

Performance Measure	Age condition	Overall Condition Assessment
Good (4)	Good (4.1)	Good (16.4)

Proposed Level of Service

The following table describes the proposed level of service for 10 years.

Table 11: Proposed Level of Service by Year

	Age Condition	Performance	Level of Service
2025	3.82	4.0	15.27
2026	4.00	5.0	20.02
2027	4.11	5.0	20.57
2028	4.18	5.0	20.89
2029	4.26	5.0	21.29
2030	4.36	5.0	21.79
2031	4.36	5.0	21.81
2032	4.38	5.0	21.92
2033	4.41	5.0	22.03
2034	4.44	5.0	22.19
2035	4.52	5.0	22.62
2036	4.55	5.0	22.73

Appropriateness of the proposed level of service

In determining the level of service to propose, staff looked to balance customer satisfaction with the financial sustainability of the business. In preparing this asset management plan, three scenarios were considered and are detailed below. Ultimatley, the third scenario is what has been chosen to proceed with.

Scenario 1 – Status Quo Option

In this scenario, the assets continue to be managed as they have historically been, and heaters are replaced when they fail or when requested by customers after a heater reaches 10 years of age.

Currently, the age distribution of water heaters is weighted considerably less than 10 years.

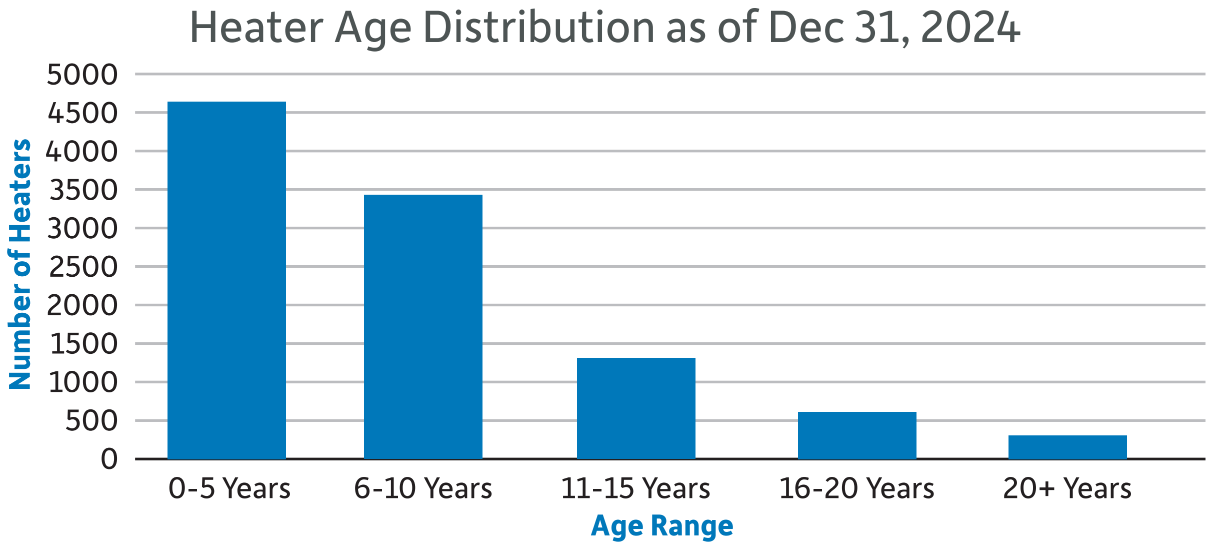

Figure 1: Heater Age Distribution as of 31 Dec 2024

In a status quo scenario, it is expected that the age distribution of the heaters will start moving to the right. Aging of assets is expected to cause a corresponding increase in the number of service calls per heater per year as the heaters get older. Increasing age, and increasing service calls will result in a lower level of service than currently available. Industry data indicates that water heaters have an estimated life of 8-15 years. Consequently, an increased number of customer service calls should be expected as more of the asset fleet ages into this range. Forecasting the performance measure and the age of the assets into the future yields the following level of service forecast.

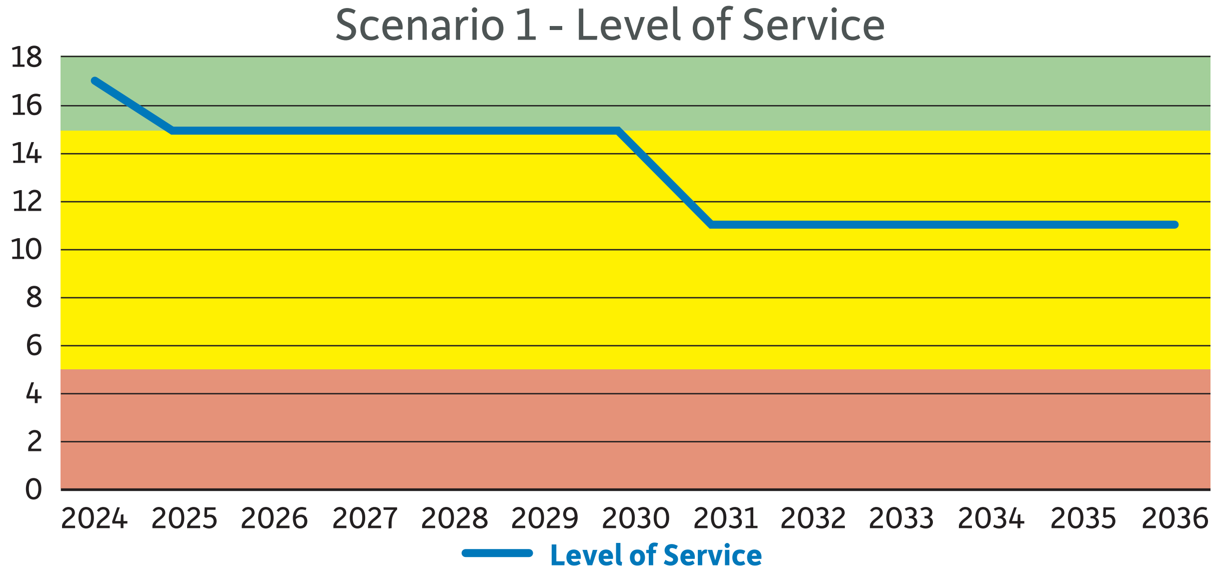

Figure 2: Projected Level of Service Over Time for Scenario 1

Scenario 1 does not maintain the desired level of service (good) over the life of the asset management plan.

Scenario 2 – Replace heaters when they reach 15 years of age

In this scenario, heaters are proactively replaced when they reach 15 years of age. This results in a significant increase in heaters replaced in year one, along with a corresponding decrease in service calls. This scenario then proceeds to continue with removing water heaters as they reach 15 years over the course of the plan. This generally results in a steady increase in the number of required replacements over the life of the plan as the asset fleet ages.

As would be expected in the first year of this scenario, there is a significant capital expense increase to replace all of the heaters greater than 15 years old immediately. Forecasting the performance measure and the age of the assets into the future yields the following level of service forecast.

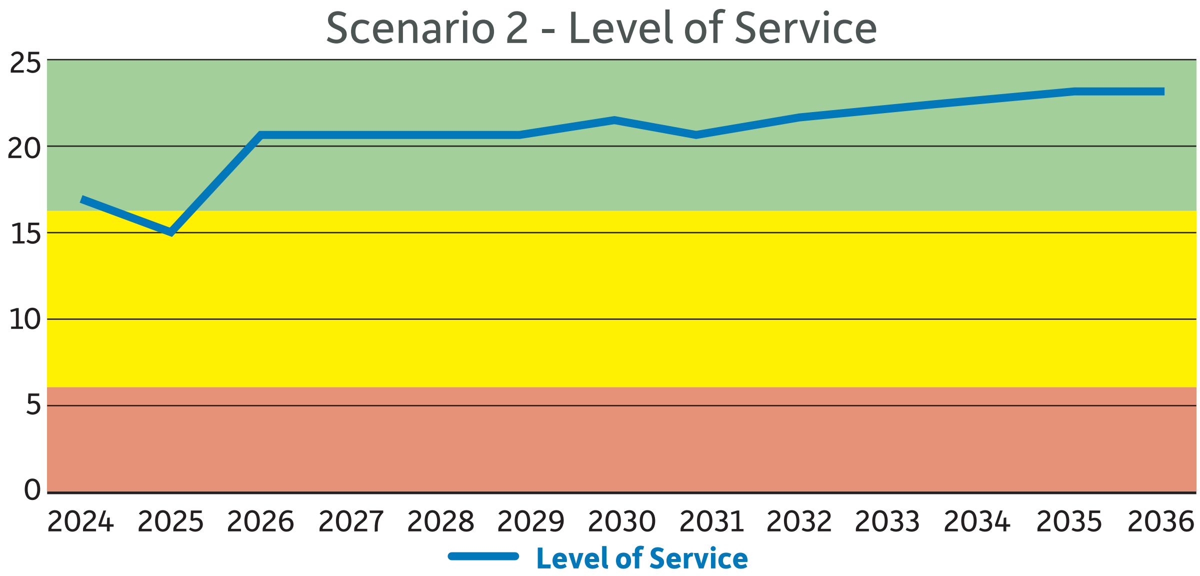

Figure 3: Projected Level of Service Over Time for Scenario 2

This scenario does maintain the level of service in the good range.

Scenario 3 – Replace Backlog over four Years

In this scenario, water heaters are replaced when they reach 15 years of age. To avoid a significant first-year increase in captial expenses, the initial backlog of assets greater than 15 years old is replaced over four years instead of one.

Forecasting the performance measure and the age of the assets into the future yields the following level of service forecast.

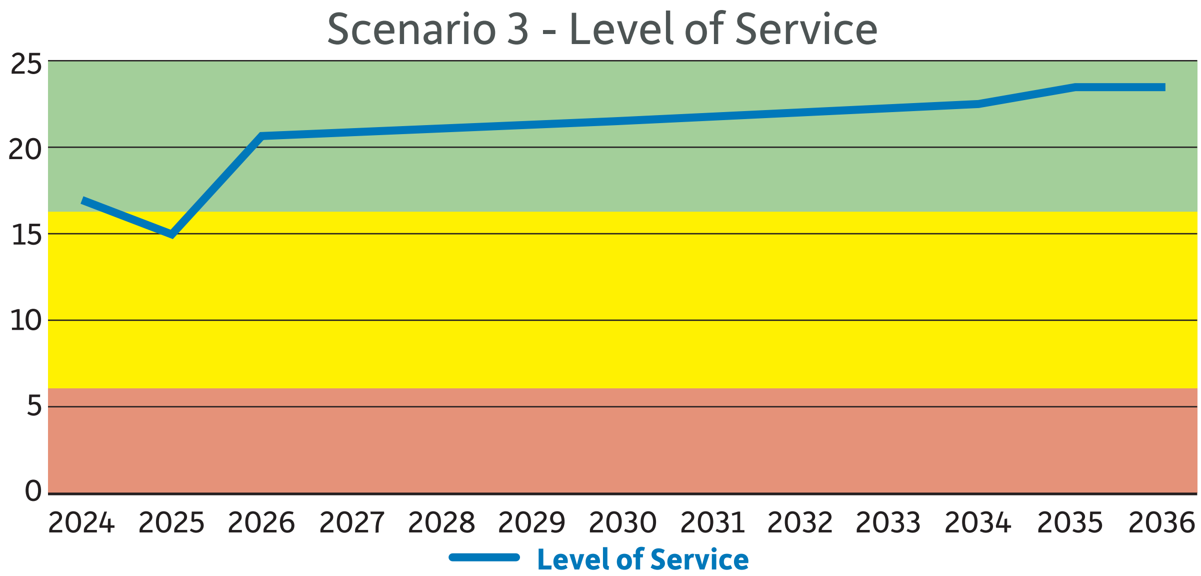

Figure 4: Projected Level of Service over Time for Scenario 3

Scenario 3 also maintains a level of service in the desired good range.

Difference from Current Level of Service

The proposed level of service maintains the current level of service. However, to maintain the level of service in the good range requires proactive asset replacement as the asset fleet ages which is different from the current handling.

Achievability of the Proposed Level of Service

Staff believe that the proposed level of service is achievable.

Affordability of the Proposed Level of Service

Modeling of the proposed level of service and the corresponding lifecycle activities indicate that the proposed level of service is affordable.

Current Performance

As these assets perform an important role in a competitive business, one of the most relevant performance measures is the number of times a customer calls with a problem. The more customers call us with problems, we can infer greater problems with the assets in the field. To properly evaluate this over time, we need to account for a changing number of water heaters installed. The metric we monitor for this performance is the number of service calls per in-service water heater per year.

Number of service calls per in-service heater (last three years)

- 2024 – 0.0711 service calls per in-service heater per year – Good performance
- 2023 – 0.0658 service calls per in-service heater per year – Good performance
- 2022 – 0.0824 service calls per in-service heater per year – Good performance

Lifecycle Activities to Maintain Current Level of Service

Utilities Kingston operates the water heater rental business in a competitive market. The company operates in the same manner as its competitors, using a run-to-fail model. Water heaters are replaced when they fail to operate, and technicians cannot repair them.

There is no planned maintenance program for water heaters, which are treated in financial reporting as having an estimated useful life of 10 years.

Water heaters are serviced when a customer reports they are not working.

When a service technician determines that a water heater is not repairable, the heater is replaced with a new one.

Risk in the water heater business is managed based on the impact of an asset's failure. The company faces financial risk from water heater failures that damage customer properties. Insurance claim totals have varied from $6,000 to $41,000 annually over the most recent five-year period. These numbers are monitored to determine patterns and trends in the data.

Options for Lifecycle Activities

Run to Failure

This business operates in a competitive industry with a run-to-failure model. Utilities Kingston strives to maintain service levels and rental rates available in the rental business's market. The company has run this model since its inception and is most familiar with it.

Proactive Replacement of Assets based on Age

A new option for asset lifecycle contemplated during this asset management plan development was the proactive replacement of assets based on their age. The largest factor that has an impact on the health of the asset base is age. By proactively replacing heaters, we are eliminating the assets which generate the most service calls.

Two scenarios were analyzed for lifecycle management to meet the proposed levels of service. The first scenario analyzed was to replace all of the heaters that are 15+ years old in the first year of the plan. This scenario achieved the desired goal of improving the level of service over time, however it was not financially achievable.

The second scenario analyzed replacing tanks older than 15 years over a four-year period instead of one. This scenario achieved the same result of leading to an improved level of service while also ensuring financial sustainability.

Expected Growth

The water heater business does not grow as a direct function of population or economic growth in the service territory. Growth in the water heater business is tracked with three data points. The number of new customers that get a new heater installed represents net new assets to the company. The number of customers that exchange a heater represents existing customers with new heater assets installed due to failure. The number of customers that remove a heater represents the customers that the business loses in a year, and no longer has an asset installed. Growth is forecasted based on three years of trending historical data (2022 to 2024).

- New Customer Installs 3-year average = 222 heaters
- Customer Exchanges 3-year average = 456 heaters
- Customer Removals 3-year average = 211 heaters

This represents an average of 678 new heaters installed per year and 211 heaters removed from service per year.

Financial Strategy

Revenues from the water heater rental business are received as customers pay for their individual heaters via monthly rental charges. The operating and capital budgets for the water heater business are included in the operating and capital budgets prepared by Utilities Kingston and approved by the City of Kingston Municipal Council. The most recent financial forecast approved by the City of Kingston Council for operating expenses and capital investments is included. This comes from report 25-048 dated January 20, 2025.

Table 12: Operating and Capital Budget Approved by City of Kingston Council in January 2025.

	Operating Budget	Capital Budget
2025	$892,000	$1,505,000
2026	$884,000	$1,685,000
2027	$906,000	$1,996,000
2028	$929,000	$2,085,000
2029	$952,000	$2,179,000
2030	Not forecasted in Council Report	$2,277,000
2031		$2,380,000
2032		$2,487,000
2033		$2,599,000
2034		$2,716,000

This forecast will be updated again in late 2025 for the 2026 to 2040 time period.

The operating budget is used for sales, marketing, triage and repairs to water heaters that are not working.

The capital budget is used for water heater asset replacements and growth in the number of assets installed.

Increases in operating costs and capital costs due to inflation and material availability are monitored. Rental rates are adjusted annually to ensure Utilities Kingston collects sufficient revenue to ensure sufficient financial resources to manage, operate and maintain the water heater business. For the purposes of this asset management plan, the impact of tariffs has not been considered, as they are as of yet not fully known. Future updates to this plan will reflect the reality of tariffs.

For the purposes of this asset management plan, a financial model has been developed. The financial model has been developed after the budget approved by the City of Kingston Council in report 25-048 was developed, and as such, the projections below are slightly different than the approved budget documents. This will be reconciled going into future budget years. The financial projections included here are the result of proactively replacing water heaters that are 15 years or older and replacing the initial backlog over the first four years of the plan.

Table 13: Operating and Capital projections for the selected approach to asset management

	Operating Expense	Capital Expense
2025	$ 759,195.29	$1,550,241.16
2026	$526,981.07	$2,350,949.69
2027	$542,790.50	$2,523,176.90
2028	$559,074.21	$2,705,052.66
2029	$432,220.38	$2,179,470.02
2030	$445,186.99	$2,360,768.24
2031	$458,542.60	$2,552,792.69
2032	$472,298.88	$2,756,171.30
2033	$486,467.85	$2,971,572.01
2034	$501,061.88	$3,199,705.64
2035	$516,093.74	$3,441,821.60
2036	$531,576.55	$3,697,049.84

In the selected path forward, there is a larger than a status quo capital expense, but it is spread out over four years. However, once that period is over, operating expenses are forecast to be lower than the status quo scenario.

The benefits associated with lower operating costs of the selected lifecycle management plan is the result of a predicted drop in service calls associated with eliminating older assets from the fleet. Newer heaters, which are proactively replaced, are forecast to reduce the number of customers looking to other rental suppliers or otherwise leaving the program.

Data Sources

- Utilities Kingston Asset Management Policy
- All Asset Export from CityWide 2023
- Hot Water Tanks Analysis 2024
- 2024 HWT service orders in CIS
- Insurance claims history
- Alliance After Hours Call Categories 2022, 2023, 2024
- O.Reg. 588/17
- O.Reg. 193/21
- City of Kingston Council Report 25-048