Environment and Climate Change
Environmental Stewardship Division
Environmental Approvals Branch
Box 36 14 Fultz Blvd
Winnipeg, MB R3Y 0L6

February 17, 2026
Client File No.: 1071.10, 53.10, 1069.10
Our File No.: EMS
020-17-08-11-00
020-17-08-11-0N

Attention: Agnes Wittmann, Director

RE: 2025 River Crossing Asset Management Plan

As referenced in the River Crossing Annual Report for 2025, we are sending you the new River Crossing Asset Management Plan (AMP) that the City commissioned in 2025 and finalized on January 31, 2026.

This AMP will support your review of the 2025 Annual River Crossing Report. It also demonstrates the City's structured, evidence-based approach to managing the river crossing assets to maintain safe, reliable service and regulatory compliance over its lifecycle.

We trust that this AMP provides the information required to support risk-informed oversight. We would welcome the opportunity to meet with your team to walk through the report and answer any questions you may have. Please let us know your availability to meet, if you so desire.

Should you have any questions, please contact me at 204-986-5210 or by email at cwiebe@winnipeg.ca.

Sincerely,

[redacted]

Cynthia Wiebe, P. Eng., CAMP
Manager of Engineering Services

ATTACHMENTS:
2025 River Crossing Asset Management Plan – Janaury 30, 2026
Asset Inventory Spreadsheet

/jkm

c:

Y. Hawryliuk, Environment and Climate (email
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C. Carroll, Water and Waste Department (email)
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Winnipeg

AECOM

CITY OF WINNIPEG

High Risk River Crossings Asset Management Plan

FINAL | 60645745 | January 2026

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AECOM: 2015-04-13

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Revision History

Revision	Revision date	Details	Authorized	Name	Position
R0	July 11, 2025	DRAFT	MM	Marv McDonald	Project Manager
R1	August 28, 2025	DRAFT II	MM	Marv McDonald	Project Manager
R2	January 27, 2025	Final	MM	Marv McDonald	Project Manager

Distribution List

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Winnipeg is located in Treaty One Territory, the home and traditional lands of the Anishinaabe (Ojibwe), Ininew (Cree), and Dakota peoples, and in the National Homeland of the Red River Métis. Our drinking water comes from Shoal Lake 40 First Nation, in Treaty Three Territory.

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Glossary of Terms

Abbreviation	Full Term
AM	Asset Management
AMP	Asset Management Plan
ANSI	American National Standards Institute
CCME	Canadian Council of Ministers of the Environment
CMMS	Computerized Maintenance Management System (in the case of WDD this is the OWAM)
CIBI	Canadian Infrastructure Benchmarking Initiative
CIPP	Cured-in-Place Pipe
CIPS	Close Interval Potential Survey
CoF	Consequence of Failure
DFO	Fisheries and Oceans Canada
ECCC	Environment and Climate Change Canada
ECG	Erosion Condition Grade
EEMUA	Engineering Equipment and Materials Users Association
EPC	Executive Policy Committee
HDD	Horizontal Directional Drilling
HDPE	High Density Polyethylene
ISA	International Society of Automation
KPI	Key Performance Indicator
LCM	Lifecycle Management
LoS	Levels of Service
MECP	Ministry of the Environment, Conservation and Parks
NASSCO	National Association of Sewer Service Companies
NEWPCC	North End Water Pollution Control Centre
OWAM	Oracle Work Order Management
PACP	Pipeline Assessment Certification Program
PE	Polyethylene
PoF	Probability of Failure
PVC	Polyvinyl chloride
RCs	River Crossings
RFEC	Remote Field Eddy Current
SAMP	Strategic asset management plan
SCA	Sewer Condition Assessment
SCG	Slope Condition Grade
SEWPCC	South End Water Pollution Control Centre
SPG	Structural Performance Grade
UT	Ultrasonic Test
WBS	Work Breakdown Structure
WSER	Wastewater Systems Effluent Regulations

Abbreviation	Full Term
WEWPCC	West End Water Pollution Control Centre
WWD	Water and Waste Department
WWS	Wastewater Sewer

Executive Summary

Introduction

AECOM Canada ULC ("AECOM") was retained by the City of Winnipeg (the "City") to prepare a Wastewater Sewer (WWS) River Crossings (RCs) Asset Management Plan (AMP). This initiative builds on the City's ongoing commitment to infrastructure stewardship and long-term planning, as outlined in its Asset Management Policy approved in 2015. This AMP represents a critical step in advancing asset-specific management practices within the Water and Waste Department (WWD), supporting compliance with regulatory requirements, enhancing risk-based investment decision-making, and informing capital and operating budget planning over a 20-year horizon.

The purpose of this AMP is to provide a structured framework and long-term strategy for managing the City's RCs, which are critical to maintaining reliable wastewater service across watercourses and face unique operational and environmental risks. Covering all known high-risk WWS RCs under the City's jurisdiction, including bridge crossings, force mains, inverted siphons, and gravity sewers, this AMP integrates findings from prior risk assessments and condition assessment, identifies vulnerabilities and prioritizes rehabilitation and renewal, and supports capital and operational investments over the short-term and long-term funding projection window.

The City's Journey

In 2006, AECOM (formerly UMA Engineering Ltd.) completed a desktop risk assessment for the City's wastewater RCs. This initial assessment established a foundational risk framework by evaluating all known WWS RCs at the time based on likelihood and consequence of failure. Since then, several condition assessments have been performed to further evaluate the condition of the WWS RCs that had met specific age or condition criteria using a variety of condition assessment methods. As part of developing the RCs AMP, AECOM has updated the original risk matrix to reflect the most recent data and insights. This updated framework ensures that risk-informed decision-making continues to guide the City's planning, prioritization, and investment strategies for these critical linear assets.

Figure ES-1 presents a comparative risk matrix illustrating both the original 2006 assessment data and the updated 2025 data for wastewater RCs.

The 2006 data points (green circles) and the 2025 data points (blue squares) are plotted based on their Consequence of Failure (CoF) and Structure Performance Grade (SPG) respectively. The figure highlights a noticeable downward shift in SPG values for many crossings, indicating a significant reduction in assessed risk levels over time. This improvement reflects enhanced asset knowledge, more detailed condition assessments, and targeted inspections and RCs renewals completed since the original desktop study. Minor adjustments to CoF values are also evident, driven by improved understanding of the localized impacts and criticality of each crossing. Overall, the figure demonstrates the value of updated data and condition assessments in supporting more accurate and risk-informed decision-making.

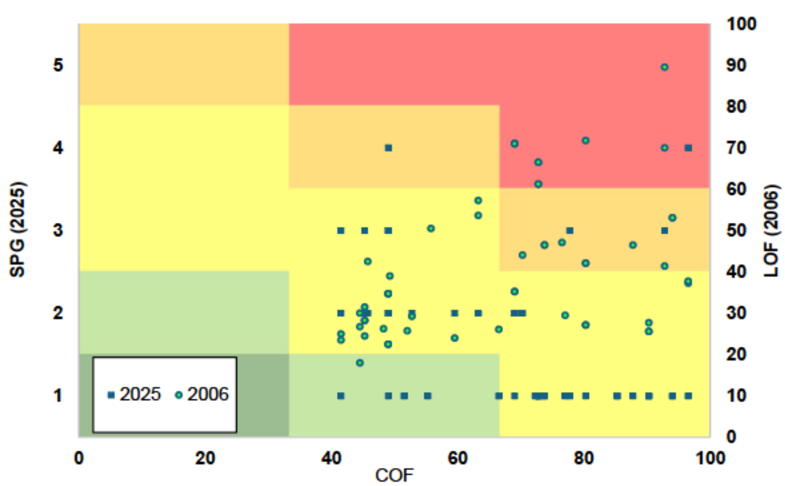


Figure ES-1: Comparative Risk Matrix – 2006 vs 2025

State of Infrastructure

The summary of the City's RCs linear assets and appurtenant assets inventory along with corresponding asset replacement values are provided in Table ES-1. The average unit replacement value was assigned to each asset based on historical cost data, budget quotations from equipment suppliers, and other data sources such as the

RSMeans Construction Cost Database (2025 edition) by Gordian. The City's RCs assets have an estimated total replacement value of approximately $263 million, with collection piping accounting for the largest portion at around $253 million.

Table ES-1: Summary of RCs Assets Inventory and Replacement Value

Asset Group	Asset Category	Asset Sub-Category	Counts of Records	Quantity (m)	Average Unit Cost	Total Replacement Values
Linear Assets	Collection Piping	Inverted Siphon	15	3,529	$35,871 / meter	$126,596,000
		Force Main	16	2,611	$23,802 / meter	$62,152,000
		Gravity	19	1,628	$30,929 / meter	$50,347,000
		Bridge Crossing	3	742	$19,140 / meter	$14,201,000
		Sub-total	**53**	**8,510**		**$253,296,000**
Appurtenant Assets	Structures	Maintenance Hole	15	N/A	$15,000 / Ea.	$225,000
		Chamber	15	N/A	$400,000 / Ea.	$6,000,000
	Pipe Works	Cured-in-Place Pipe (CIPP)	12	N/A	-*	-*
	Valves	Isolating Valves	45	N/A	$77,000 / Ea.	$3,456,000
		Air Release Valve (Reducer)	20	N/A	$15,000 / Ea.	$300,000
		Sub-total	**107**			**$9,981,000**
		Total	**160**			**$263,277,000**

*No cost is provided as the cost of the pipeline asset is retained instead of the value of the CIPP liner.

Regarding the weighted average age and remaining service life of the City's RCs linear assets (**Table ES-2**), gravity mains and inverted siphons are the oldest, with average ages of 61 and 57 years, and only 10 and 11 years of remaining life, respectively. Single and Twin Force Mains have 8 and 17 years respectively remaining, while bridge crossings are the newest, with 26 years of service life left. These findings highlight the urgent need to address aging gravity and siphon infrastructure. The impact of the installation of Class IV linings which effectively creates a new pipe are not seen in this table and therefore the full financial requirement (which does consider this installation) should be consulted.

Table ES-2: RCs Assets Weighted Average Age, ESL, and Remaining Service Life

Asset Category	Asset sub-category		Average Install Year	Weighted Avg. Age	Weighted Avg. ESL	Remaining Useful Life
Collection Piping	Inverted Siphon	Single	1988	59	73	14
		Twin	1973	80	79	0
		Twin-close Separation	1975	44	59	15
	Gravity	Single	1967	61	71	10
	Force Main	Single	1997	58	66	8
		Twin	2002	59	76	17
		Twin-close Separation	1991	55	75	20
	Bridge Crossing	Single	2023	1	60	59
		Twin-adequate Separation	2005	50	60	10

Figure ES-2 summarizes the condition grade of the City's RCs linear assets weighted by replacement value. Over 77% of the assets by value are in Fair or better condition, while around 13% are in rated Poor or Very Poor (in terms of replacement value).

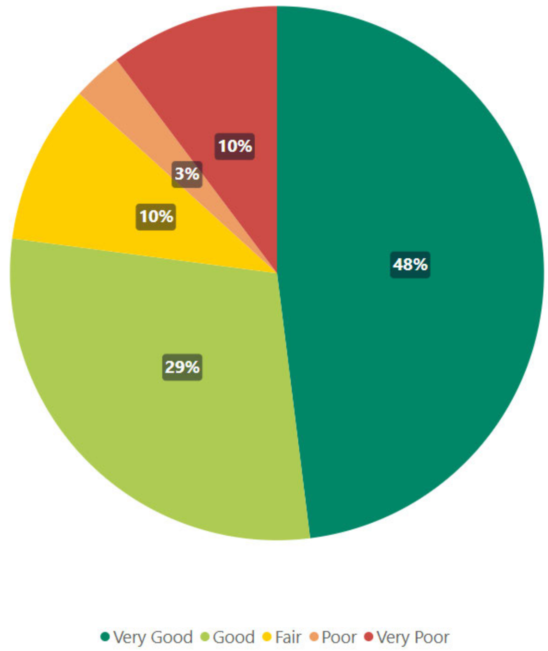


Figure ES-2: RCs Linear Assets Asset Condition Summary Weighted by Replacement Value

Figure ES-3 presents the condition summary for linear RCs assets, categorized by crossing types and asset class, shown in terms of total replacement value. The assets in Very Poor Condition are the Fort Garry crossings which are currently being replaced.

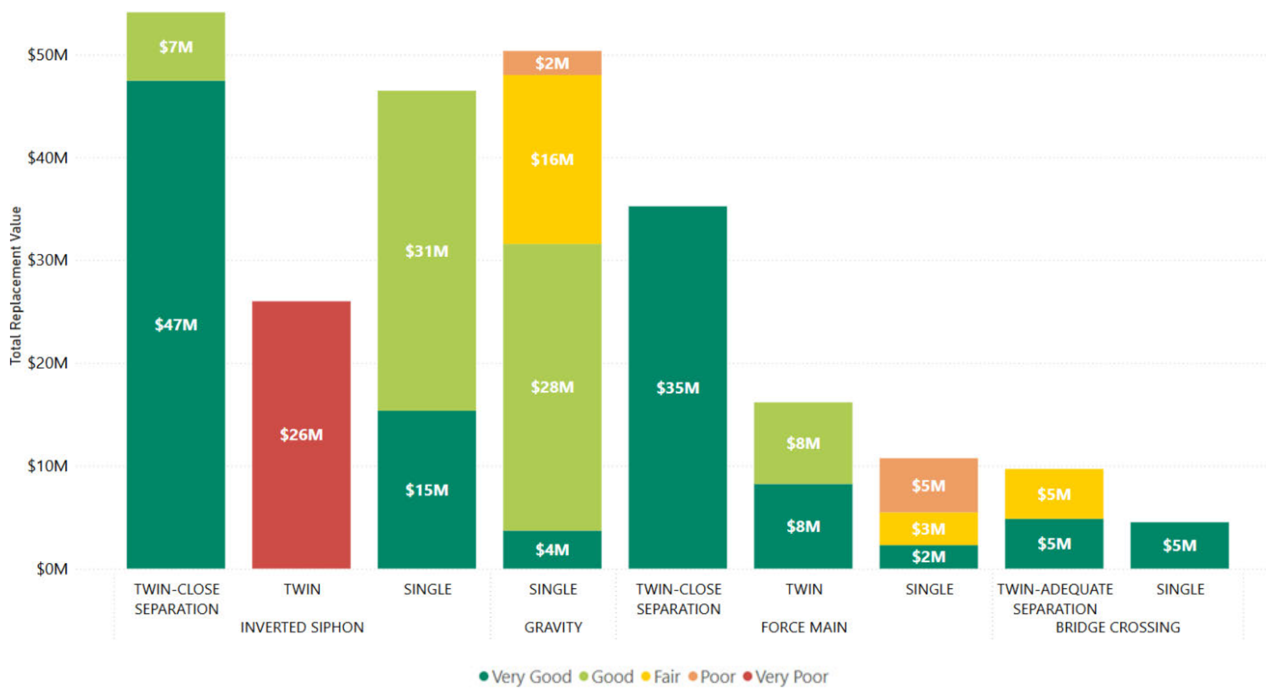


Figure ES-3: RCs Linear Assets Asset Condition Summary Weighted by Replacement Value

As asset information for RCs appurtenant assets remains incomplete—particularly installation years and condition ratings, these assets were not included in the age, remaining service life, and condition analyses presented in the following sub-sections. Additional data collection and verification in future updates will enable their inclusion.

Levels of Service

The Level of Service (LoS) framework serves as a foundational element of the City's AM system, supporting informed decision-making, service planning, and resource prioritization. It enables the City to define, monitor, and evaluate how RC assets are expected to perform historically and, in the future, across a range of strategic, regulatory, technical, and financial dimensions.

A summary of the RCs LoS measures the City is currently tracking or would like to track in the future is shown in **Table ES-3**. Also included in this table are the LoS target and lifecycle activities. More detailed information on for the current and proposed future trends, budget impact, risk of not meeting the LoS and data sources for each measure can be found in **Table 3-5**.

Table ES-3: RCs Levels of Service Measures

#	LoS Measures	Unit	LoS Target	Lifecycle Activities
1	% of crossings with sufficient or better long-term capacity	%	90%	Growth
2	# of odour complaints within 150m buffer of RC asset	#	0	O&M
3	% of RCs that meet environmental sustainability and resilience goals	%	TBD (once the City's Climate Action Plan Update is finalized)	Upgrade
4	% of RC monitoring plan complete, based on monitoring criteria	%	100%	O&M
5	% of RCs in Fair condition or better	%	100%	Renewal
6	% of total complete tasks on all RCs IDs on all work orders	%	100%	O&M
7	% of emergency repair costs relative to total capital repair costs for past 3 years	%	TBD	O&M
8	% of RC inspection costs relative to total O&M costs for past 3 years (Contracted Services + In House)	%	TBD	O&M
9	% of Capital Reinvestment / Replacement Value of RCs	%	0.80%*	Renewal

*Target excludes Fort Garry replacement costs

Wastewater infrastructure, particularly critical assets such as RCs, is influenced by a range of political, environmental, social, economic, and technological factors. Future demand drivers were identified through internal engagement and technical discussions, including:

- Aging infrastructure
- Regulatory changes
- Climate change impacts
- Population and employment growth
- Skilled labour and succession planning
- Funding availability
- Contractor and supply chain availability
- Fluctuating project costs
- City strategic goals

As these drivers evolve, it will be critical for the City to regularly review service demands, update AM strategies, and incorporate flexible planning approaches. Future service level expectations should reflect both anticipated growth and system constraints while ensuring resilience to external pressures.

Lifecycle Management

The lifecycle management section identifies and defines the full range of activities required to operate, maintain, and renew RCs assets in order to sustain the current level of service. To achieve this, the Rightsholders and stakeholders' responsibilities were identified among asset lifecycle stages, including Growth (acquisition), Upgrade (improvement and expansion), Operations and Maintenance (O&M), Renew (renewal and replacement), and Disposal (including decommissioning and disposal). A series of high-level tasks and planning tools have been developed, including a decision-making flowchart for repair and rehabilitation (**Figure 4-1**), and a flowchart for determining inspection frequencies (**Figure 4-2**). Together, these components provide a structured and proactive approach to managing asset performance over time.

Risk Management

The risk management approach has been developed based on a review of previous risk assessment studies, recent condition assessment reports, and discussions with City staff and technical experts. This process includes summarizing key findings by asset class, confirming existing mitigation measures, and validating risks through interdisciplinary input.

A structured approach is used to assess the likelihood and consequences of failure. An updated risk matrix is developed by combining Structural Performance Grade (SPG) and Consequence of Failure (CoF) scores as shown in **Figure ES-4**, and a risk map of the RCs assets is created as illustrated in **Figure ES-5**. Confidence bands, shown as circles, illustrate the range of values from the 2024 risk assessment. Smaller circles indicate higher precision, while larger circles reflect greater uncertainty, highlighting both the central estimate and its certainty.

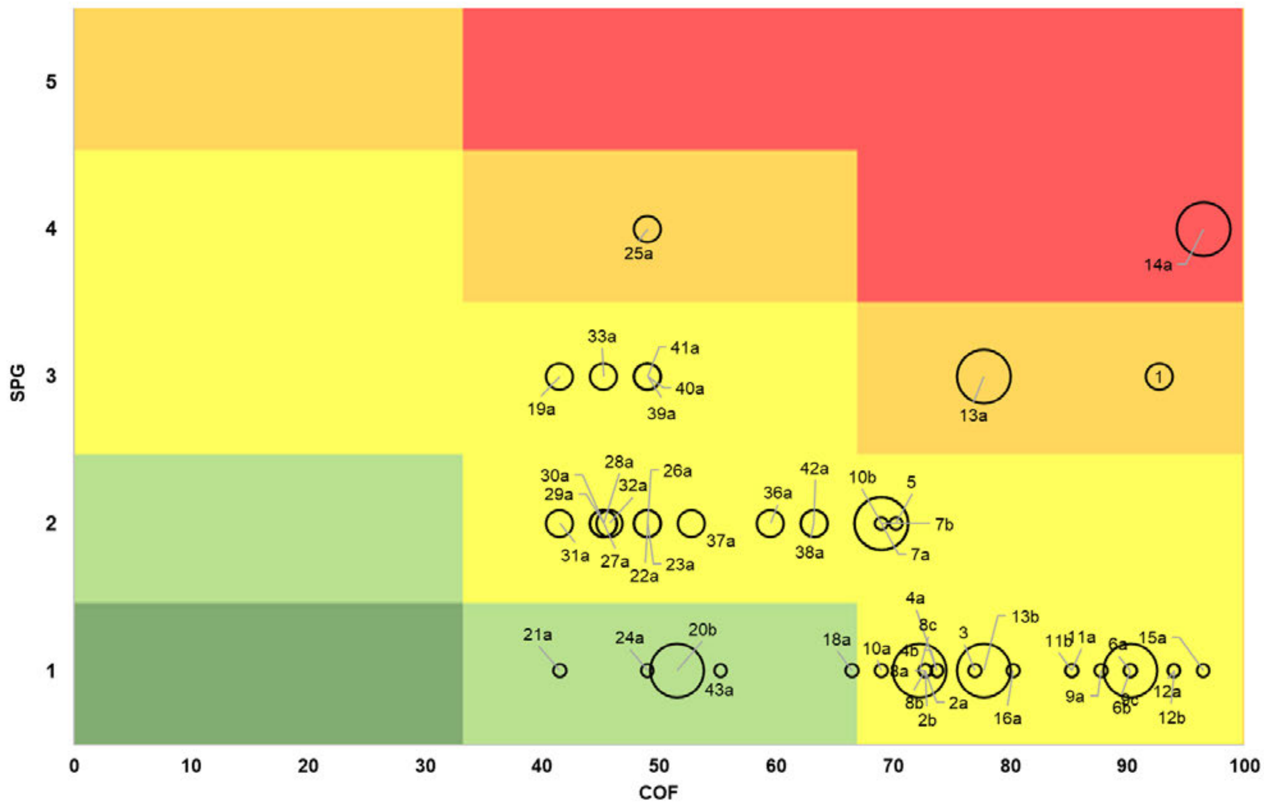


Figure ES-4: Risk Management Matrix

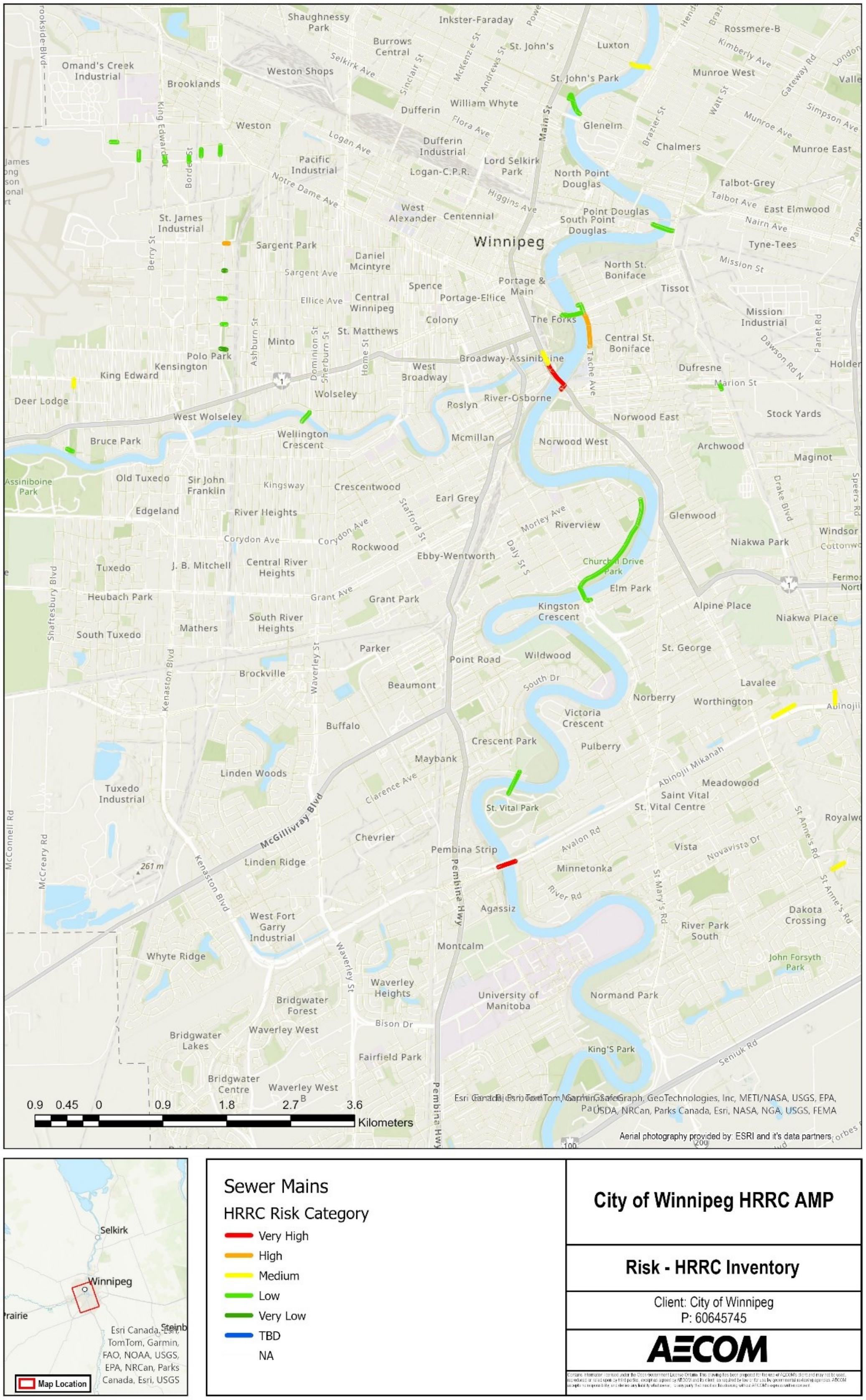


Figure ES-5: RCs Risk Map

In addition, a detailed summary of site-specific risks has been created (**Table 5-8**), which consolidates information on asset characteristics, structural condition ratings, consequence of failure, risk scores, and known or potential failure modes. It also documents historical inspections, rehabilitation work, and current operational monitoring programs. This information forms the foundation for identifying and prioritizing risk mitigation strategies as part of the overall Risk Management Plan.

Financing Strategy

Financial forecasting and capital planning are essential to ensuring the efficient and sustainable management of infrastructure. **Figure ES-6** presents the 20-year full funding (including all asset needs as defined within **Sections 4** and **5**) forecast for RCs linear assets, showing that despite year-to-year fluctuations, the average annual reinvestment is approximately $3.4 million. This forecast does not include new assets (acquired for growth or donated) within the 20-year period (with the exception of acquisitions for replacement such as Fort Garry) and should be revised accordingly as new assets are added to the City's inventory. Excluding the Fort Garry replacement the average annual reinvestment is $2.1 million.

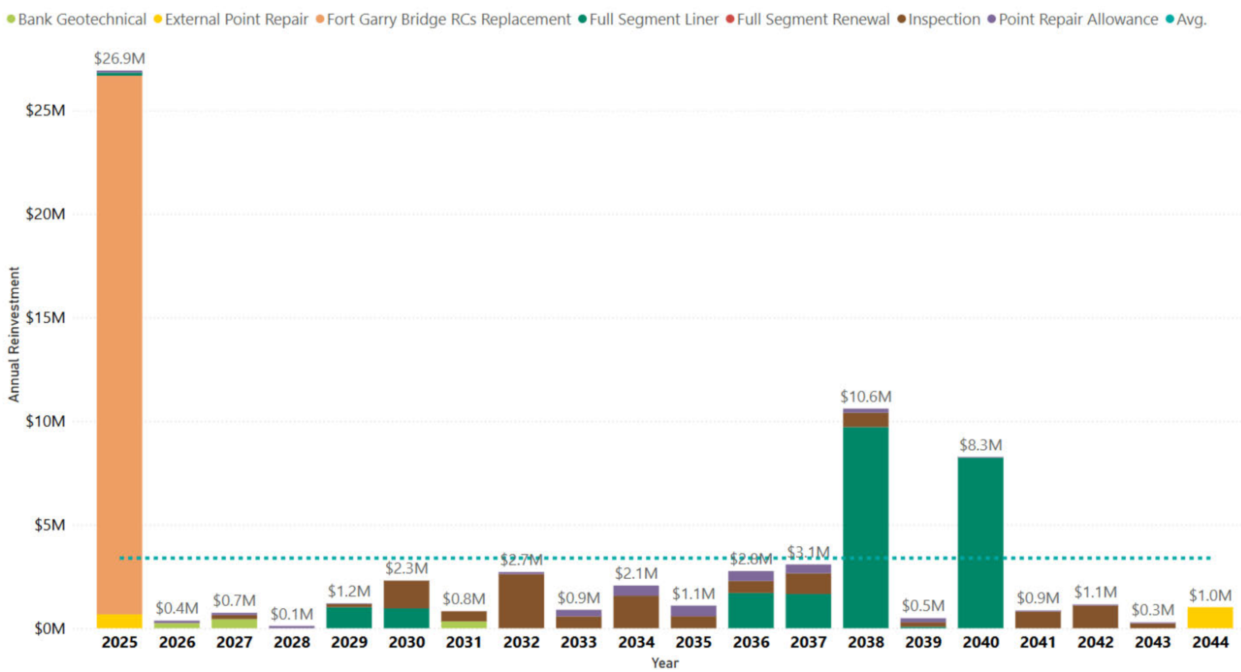


Figure ES-6: RCs Linear Assets Full Funding Needs

Table ES-4 summarizes the total 20-year funding needs and the corresponding annual averages for each funding category. Full segment liner and full segment renewal (which includes the ongoing Fort Garry Bridge RC replacement) represent the largest capital needs, with liner emerging as the dominant cost driver in the long-term investment profile. Inspection activities also require significant funding, highlighting the importance of proactive monitoring and condition assessment. While point repair allowances and bank geotechnical work contribute a smaller share of the overall investment, they play critical roles in preserving asset integrity and addressing localized risks.

Table ES-4: Funding Needs for Each Funding Category

Funding Categories	20-Year Total	20-Year Average
Bank Geotechnical	$1.02 million	$10,000 (10-year average) *
Inspection	$12.2 million	$610,000
Point Repair Allowance	$3.35 million	$160,000
External Point Repair (Expansion Joint Replacement for Provencher Bridge and Norwood Bridge RCs)	$650,000	N/A**
Full Segment Liner	$23.4 million	$1.17 million

Full Segment Renewal (Fort Garry Bridge RCs Replacement)	$26 million	N/A**

*The funding needs for bank geotechnical rehabilitation are only available for the first 10 years.

**The external point repair and full segment renewal are planned in 2025 and forecast for 2044.

Plan Improvement and Monitoring

Each section of this report highlights several gaps and opportunities to improve asset management, the next iteration of the plan and to support operations at the City. The gaps were assigned logical groups with similar themes for execution. Each gap had several opportunities identified which could improve the management of RCs. Those which had the highest impact to the management of RCs at the City are shown **Table ES-5** below.

Table ES-5: Highest Benefit Activities

Activity #	Activity Description
1	New assets for the sanitary network should be consistently added to the inventory within a fixed timeline, preferably within three months of commissioning.
2	Project closeout should be closely monitored to ensure that asset information is entered quickly, accurately, and in accordance with City standards. Preliminary data should be entered into City systems as soon as construction is complete, followed by more accurate updates once as-built drawings are available
7	Identify data gaps and supplement with targeted flow monitoring at high-risk crossings to evaluate remaining sewer capacity.
10	Create a work order type/category using an unused data field in the CMMS that can be applied to all work relating to HRRC assets.
21	Reassess and adjust the contingency fund to reflect current asset inventory and inflation.
22	Establish clearer access protocols and explore dedicated funding streams for high-priority expenditure.
25	Update unit rates for full segment lining using the most recent contractor quotes, market pricing, tender results, and third-party cost databases (e.g., RSMeans). Unit rates should be differentiated to account for variability in crossing configurations, recognizing that single-pipe crossings may require bypass pumping—representing a significant additional expense—whereas twinned crossings may not, resulting in substantially lower unit costs.
26	Incorporate site-specific cost estimation into the financial model by integrating factors such as installation type, geotechnical conditions, selected rehabilitation method, project delivery timeline, and local constraints. This will ensure that the model accurately reflects the variability of conditions across RCs and provides a more reliable basis for long-term reinvestment planning.
59	Where possible, populate missing installation dates using historical maintenance records or estimated installation windows based on nearby assets or pipe segments.
74	Work with City stakeholders to define and document acceptable risk thresholds to support consistent risk-based decisions.

All opportunities were risk ranked according to the City's integrated risk management standard. The breakdown of these opportunities and their risk ranking are shown in **Table ES-6**.

Table ES-6: Recommendations and priorities

Improvement Area	Recommendations to Improve AM Planning				Non-AMP Recommendations	TOTAL
	Minimal	Minor	Moderate	Critical		
1.Asset Inventory and Data Integration	0	4	1	0	5	10
2. Condition Assessment and Lifecycle Planning	0	4	2	0	9	15
3. Performance Monitoring and Capacity Planning	0	0	3	0	5	8
4. Operational Processes and Work Order Management	1	0	2	0	10	13
5. Risk Management and Decision-Making	1	2	2	0	2	7
6. Governance, Roles, and Stakeholder Engagement	1	1	0	0	9	11
7. Financial Tracking and Cost Attribution	7	0	3	0	3	13
TOTAL	**10**	**11**	**13**	**0**	**43**	**77**

*Note that activities are numbered up to 81 as 4 opportunities were identified as complete or no longer required.

Using high-level estimates the following internal and external resource requirements have been identified to support AM plan improvement over the next plan cycle. All groups identified are within the WWD

- Internal Resource: 1,120 hours.
  - AM Branch – 910 hours.
  - Design (Wastewater Planning and Project Delivery Branch – 50 hours.
  - GIS - 40 hours.
  - Finance – 120 hours.
- External Resource: 1,570 hours.

Conclusions

The completion of this AMP represents a major milestone in the City's asset management journey for its wastewater RC infrastructure. It consolidates available data, identifies key asset risks, and introduces a structured lifecycle and financial planning framework to guide investment over the next 20 years. The recommended improvement initiatives outlined herein provide a practical roadmap for addressing known gaps and elevating the City's overall asset management maturity. By implementing these measures and continuing to monitor progress, the City will be well-positioned to deliver reliable service, optimize capital reinvestment, and enhance long-term system resilience.

1. Introduction

AECOM Canada ULC (AECOM) was retained by the City of Winnipeg (the "City") to prepare a Wastewater Sewer (WWS) River Crossings (RCs) Asset Management Plan (AMP). This initiative builds on the City's ongoing commitment to infrastructure stewardship and long-term planning, as outlined in its Asset Management Policy approved in 2015[1]. The RCs AMP represents a critical step in advancing asset-specific management practices within the Water and Waste Department (WWD), supporting compliance with regulatory requirements, enhancing risk-based investment decision-making, and informing capital and operating budget planning over a 20-year horizon.

This project is a direct response to the recognized need for a comprehensive, structured approach to manage the City's 53 RCs assets. These assets include pressurized force mains (both underwater and bridge-supported), inverted siphons, and gravity sewers that traverse rivers and streams throughout the City. Given the critical role these assets play in maintaining service reliability and environmental protection, the AMP will provide a technical and financial roadmap for their continued safe operation, renewal, and timely replacement. It should be noted that all crossings are captured within this AMP but in practice may be assessed under the wider network Sewer Condition Assessment (SCA) program, or the HRRC program.

The plan also reflects and consolidates the findings and updates from multiple phases of condition assessment programs conducted on high-risk RCs, as well as the updated RCs risk review[2]. The AMP development is intended to complement other ongoing initiatives under the City's broader asset management (AM) program.

1.1 Background

The City owns and manages a network of combined (stormwater and wastewater) infrastructure that includes 53 RCs assets at 43 locations across its jurisdiction. These crossings are critical components of the wastewater collection system and consist of various asset types, including pressurized force mains (submerged, buried, or bridge-mounted), inverted siphons, and gravity sewers. Their locations at river and stream crossings present unique engineering, environmental, and operational challenges.

The City first undertook a system-wide assessment of these assets in 2006, when a desktop risk evaluation was completed to assess the likelihood and consequence of failure at each crossing[3]. Since then, several targeted RCs Condition Assessment programs were implemented using a combination of inspection techniques to evaluate asset condition. These efforts were necessary to satisfy regulatory requirements for continuous condition monitoring and to support timely interventions where integrity issues, such as leakage or material degradation, were identified.

Prior to this project the City had not developed a formal AMP specifically for the WWS RCs or the RCs. With increasing expectations for regulatory compliance, cost-effective service delivery, and risk-informed decision-making, the development of this AMP was identified as a priority. It builds upon the risk matrix updates completed in 2024 and serves as a foundational document to consolidate knowledge, define lifecycle strategies, and guide investment planning for this critical asset class.

1.2 Scope and Objectives

The purpose of this AMP is to provide a structured framework and long-term strategy for managing the City's RCs. These assets are essential for maintaining continuous and reliable wastewater service across watercourses and are subject to unique operational and environmental risks. The AMP aims to support effective management of these assets to meet regulatory requirements, enable risk-informed planning, and guide capital and operational investments over a 10-year (short-term) and 20-year (long-term) funding projection window.

The scope of this AMP includes all known WWS RCs classified, all of which are classified as high risk (either due to condition or consequence of failure) under the City's jurisdiction. This encompasses bridge crossings, force mains, inverted siphons, and gravity sewers. The AMP integrates findings from previous risk assessments and condition

[1] City of Winnipeg (2015) Policy No. FI-011, Asset Management Policy
[2] AECOM (2024) High Risk River Crossing – Phase 3 – Risk Matrix Update
[3] AECOM/UES (2006) High Risk River Crossing – Risk Assessment

investigations, including those completed under the RCs Condition Assessment programs. The updated risk matrix provides a foundation for identifying vulnerabilities and prioritizing rehabilitation and renewal works.

Key objectives of the AMP are to:

- Consolidate existing data to define the current state of infrastructure, including asset inventory, age, condition, and replacement value.
- Establish asset-specific levels of service in alignment with the City's 2023 Water and Waste Levels of Service (LoS) Framework.
- Identify lifecycle management strategies and required activities over the next two decades to maintain desired LoS.
- Quantify financial needs and develop a funding strategy to support long-term sustainability and resilience.
- Support regulatory reporting and enhance the City's ability to communicate infrastructure needs and priorities to internal and external stakeholders.
- Recommend actions to improve AM maturity and promote continuous improvement.

This plan serves as both a decision-making tool and a communication document, enabling the City to manage these critical assets in a proactive, transparent, and fiscally responsible manner.

1.3 Regulatory and Legislative Requirements

This AMP is a tactical plan which links "top-down" strategic objectives with "bottom-up" operational activities. **Figure 1-1** illustrates the geographical context for the City's RCs. The in-scope assets cross several vital watercourses (notably the Red and Assiniboine Rivers) as well numerous creeks and tributaries. High resolution versions of maps are contained within **Appendix A**.

Figure 1-2 further demonstrates the line-of-sight between the City's AM strategic objectives and its tactical and operational AM elements, including the relationship this AMP has to the other plans in the City's hierarchy of documents.

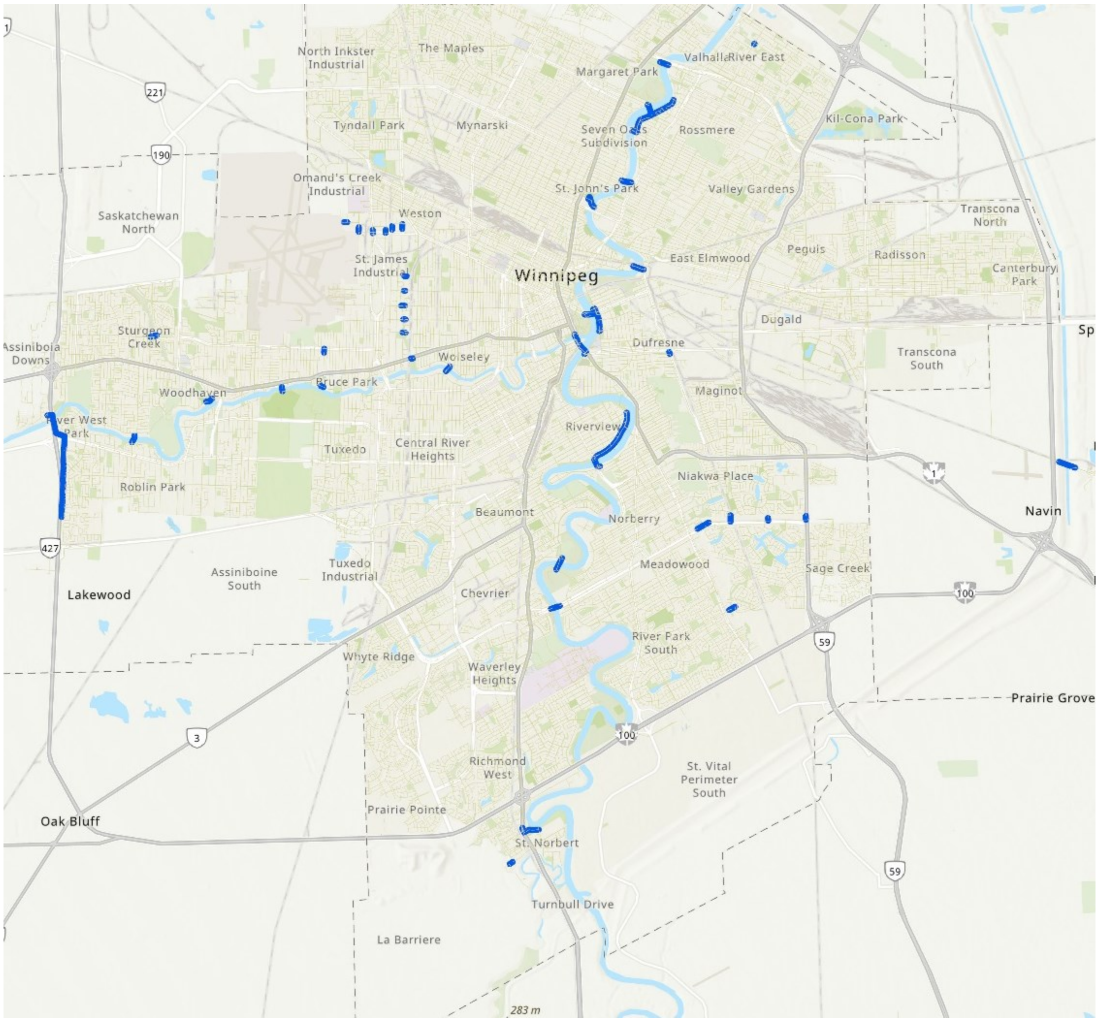


Figure 1-1: Map of the City of Winnipeg RCs

Level	AM Line of Sight	Description of AM Element	The City's WWS River Crossings AM Document Hierarchy
Strategic Level	**Corporate Objectives & Goals**	*Strategic business goals set by the organization*	• The City's Asset Management Policy • 2018 City of Winnipeg Asset Management Plan • 2021-2024 Strategic Asset Management Plan • 2018 Winnipeg Climate Action Plan
	Strategic Asset Management	*Plans and policies that outline the organization's AM guiding principles, objectives and goals*	
Tactical Level	**Asset Management Planning**	*Plans for understanding the current state of the assets, defining levels of service, managing the lifecycle of specific asset classes*	• WWD Levels of Service Project Summary Report • **High Risk River Crossings Asset Management Plan (this project)**
Operational Level	**Asset Management Implementation**	*Programs and documents that help staff carry out capital and operational activities on specific assets*	• Maintenance plans/reports, condition assessments, various other studies and reports
	Asset Portfolio	*The assets under management*	• Asset Inventory

Figure 1-2: City's RCs AM Line of Sight

2. State of Infrastructure

The inventory of the RCs assets is a comprehensive catalogue detailing the quantity, condition, and specifications of these components within the City. By analyzing the inventory and assessing the data gaps, this section presents a summary of the asset hierarchy, inventory, valuation, age, and condition, based on current information obtained from condition assessments reports, ArcGIS shapefiles, and various organizational sources and systems. The state of infrastructure (SOI) results supports strategic decision-making and resource planning by highlighting maintenance needs and financial considerations.

2.1 Asset Hierarchy

To pave the way for robust long-range AM planning of the RCs assets, the City requires a logically segmented asset breakdown structure (hierarchy) under the scope of this AMP. Achieving this requires a sufficiently granular classification of RCs assets, enabling the identification of individual assets due for renewal. Striking the right balance is also crucial, as there is a fine trade-off between supporting adequate granularity to provide essential information and avoiding excessive granularity that could make the effort to collect and manage information more burdensome than the usefulness derived from it.

The City's wastewater infrastructure includes a broad range of RC assets organized into a clear hierarchical structure that reflects functional groupings and parent-child relationships. This hierarchy aligns with how assets are represented in internal systems and data sources, supporting system accountability and analytical clarity. As shown in **Figure 2-1**, the RCs assets are divided into five primary categories: Collection Pipes, Pumps and Valves, Instrumentation & Control, Structures, and Riverbank Protection & Erosion Control. Each of these categories is further divided into specific asset types—such as force mains, air release valves, flow meters, and riprap—demonstrating the nested relationships among components.

The linear assets (conveyance pipes), along with their appurtenant components (pumps and valves, instrumentation & control, structures, and riverbank protection & erosion control assets), form a clearly defined and operationally significant segment of the RC infrastructure. The hierarchical organization enables targeted analysis and management of these high-risk components, facilitating maintenance planning, risk assessment, and cost tracking at both system and asset-specific levels. This structure provides the foundation for understanding the interdependencies among assets and ensures that the most critical infrastructure—particularly the RCs-related elements—receives prioritized attention.

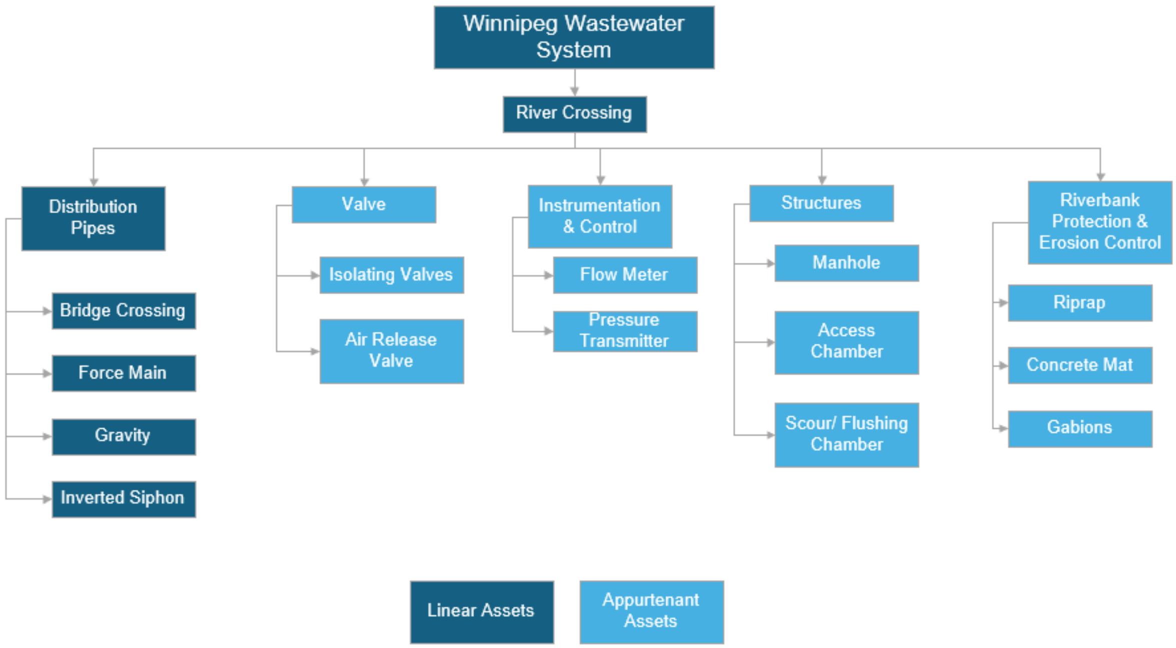


Figure 2-1: City of Winnipeg Wastewater System River Crossing Asset Hierarchy

2.2 Current State of the Assets

The following section outlines the sources used to define the inventory as well as the total replacement values, current age and remaining life, and the linear asset condition where available.

2.2.1 Asset Inventory

A completed RCs asset inventory is compiled based on the raw data provided by the City at the initial stage of the project, which was obtained from the following sources:

- 07_Sewer_Crossing_HRRC_Review (supporting file to the HRRC Risk Matrix Update in 2024).
- HRRC Master Plan.
- 2024 CAC INVENTORY.
- Yearly RC Report - Operation of gate valves.
- The City's GIS Database.
- Valve Maintenance work orders.

Note that the appurtenant assets were identified using a geo-fencing approach applied to the City's GIS database. Specifically, assets such as maintenance holes, chambers, CIPP segments, isolating valves, and air release valves (reducers) located within 60 meters of a RC pipe were captured and classified as appurtenant assets associated with that particular RC. Additional valves were captured from the Valve Maintenance work orders in the City's CMMS system. Manual confirmation was conducted to remove non-related assets from the inventory.

As shown in **Figure 2-1**, the inventory was structured to strike a balance between granularity and manageability. It is detailed enough to identify individual assets requiring renewal (refurbishment or replacement), yet not so detailed that data collection and management become overly extensive. Additional details regarding data gaps and associated methodologies are provided in **Section 2.4**. This structured asset hierarchy enables the City to organize data by asset type and adapt the inventory over time to reflect current asset condition, estimated service life, and as replacement costs evolve (increase). The summary of the City's RCs linear assets and appurtenant assets inventory is provided in **Table 2-1** below.

In total, the City owns and manages 53 RCs pipes assets spanning approximately 8.5 km, along with 107 RCs appurtenant assets, one third of which are isolating valves.

Table 2-1: RCs Assets Inventory Summary

Asset Group	Asset Category	Asset Sub-Category	Counts of Records in Inventory (Ea.)	Quantity (m)
Linear Assets	Collection Pipes	Inverted Siphon	15	3,529
		Force Main	16	2,611
		Gravity	19	1,628
		Bridge Crossing	3	742
Sub-total			**53**	**8,510**
Appurtenant Assets	Structures	Maintenance Hole	15	N/A*
		Chamber	15	N/A*
	Pipe Works	CIPP	12	N/A*
	Valves	Isolating Valves	45	N/A*
		Air Release Valve (Reducer)	20	N/A*
Sub-total			**107**	

* The RCs appurtenant assets are quantified using unit counts (Ea.) and not by length (m).

Instrumentation & Control assets (e.g., flow meters, pressure transmitters) and riverbank protection assets (e.g., riprap, concrete mats, gabions) are not currently captured as discrete inventory line items in the City's GIS, CMMS, or any supplementary inventory records. As a result, these asset groups were excluded from the state of infrastructure analysis.

The key individual asset data attributes included the following information:

- Site ID
- Asset Number
- Pipe Size
- Crossing Material
- Installation Type
- Crossing Type
- Sewer main Type
- Flow Type
- Water Course
- Isolation Length
- Crossing Length
- Asset Replacement Value
- Asset Installation Year
- Condition Scores
- Risk Score
- Risk Rating
- Asset Replacement Value

The asset inventory was competed by adding a variety of additional descriptive and calculated attributes used for evaluation of asset age, expected and estimated service lives, replacement values, consequence of failure (CoF), probability of failure (PoF), risk and replacement cycles. A detailed inventory is provided in MS Excel format in **Appendix A.**

2.2.2 Current Asset Replacement Value

The replacement value was assigned to each asset based on historical cost data, budget quotations from equipment suppliers, and other data sources such as the RSMeans Construction Cost Database (2025 edition) by Gordian. The replacement valuation for all City's RCs assets was based on the following assumptions:

- Nominal Cost – represents the cost in 2025 dollars to replace the assets to a new condition with a current / similar model of equipment / asset, as applicable. This includes supply, delivery and installation.
- Replacement Value – estimated to be the nominal cost plus a 45% allowance for construction contingency, engineering and project management.

The nominal costs for the RC collection piping were estimated based on:

$$Piping\ Crossing\ Length\ (m) \times Unit\ Replacement\ Rate\ (\$/m/mm) * Pipe\ Diameter\ (mm)$$

The unit replacement rate for RC piping, regardless of material type, is $33.4/m/mm in 2025 dollars. For collection piping with varying diameters, the unit replacement values were calculated as shown in **Table 2-2.**

Table 2-2: Unit Replacement Costs for Collection Piping in Different Diameter

Asset Category	Pipe Diameter (mm)	2025 Unit Rates ($/m)
Collection Piping	218	$7,288
	250	$8,358
	300	$10,030
	350	$11,702
	375	$12,538
	400	$13,373
	450	$15,045
	500	$16,717
	525	$17,553
	530	$17,720
	600	$20,060
	700	$23,403
	750	$25,075
	800	$26,747
	900	$30,090
	1,200	$40,120
	1,350	$45,135

Table 2-3 summarizes the average and total replacement values of RCs assets by asset category. The City's RCs assets have an estimated total replacement value of approximately $263 million, with collection piping accounting for the largest portion at around $254 million. Among the different crossing types, the 15 inverted siphon RCs represent the highest share, contributing nearly 50% of the total replacement value ($127 million) for RC collection piping. Notably, three assets in this sub-category have replacement values exceeding $1 million: Whellams Lane (New) and the two Fort Garry Bridge crossings (S-MA70087290 and S-MA70053063). It should be noted that current accurate replacement values were used for the Fort Garry crossings as recent tender information is available.

Among the appurtenant assets, structures such as maintenance holes and chambers contribute approximately $0.23 million and $6 million, respectively. In terms of valves, isolating valves have a total replacement value of $3.46 million, while air release valves (reducers) account for approximately $0.3 million.

Table 2-3: RCs Asset Replacement Value

Asset Group	Asset Category	Asset Sub-Category	Average Unit Cost	Unit	Total Replacement Values ('000s)
Linear Assets	Collection Piping	Inverted Siphon	$35,871	$/meter	$126,596
		Force Main	$23,802	$/meter	$62,152
		Gravity	$30,929	$/meter	$50,347
		Bridge Crossing	$19,140	$/meter	$14,201
Sub-total				$/meter	**$253,296**
Appurtenant Assets	Structures	Maintenance Hole	$15,000	$/Ea.	$225
		Chamber	$400,000	$/Ea.	$6,000
	Pipe Works	CIPP*	-	-	-
	Valves	Isolating Valves	$77,000	$/Ea.	$3,456
		Air Release Valve (Reducer)	$15,000	$/Ea.	$300
Sub-total					**$9,990**
Total					**$263,286**

*CIPP is a liner-based rehabilitation method used to fully restore RC pipes. Its associated replacement values are included in the lifecycle funding requirements as full-segment liner costs.

Figure 2-2 illustrates the total replacement value of RCs linear assets by installation decade. The installation profile for the City of Winnipeg's RC piping shows that the majority of assets were installed between the 1960s and 1970s, accounting for the highest total replacement values at $66.0 million and $68.7 million, respectively. These decades are dominated by inverted siphon installations, representing a substantial portion of the system's long-term renewal needs. More recent installations from 2000–2009 also show significant investment, totaling $49.8 million, with a more diversified mix including force mains and bridge crossings. Installations in the 2010s and 2020s taper off to $23.6 million and $11.3 million, respectively, indicating reduced RC construction activity in recent years. Older assets from 1950–1959 and pre-1980s contribute smaller shares but still include a mix of gravity and force mains components, underscoring the aging infrastructure's presence in the network.

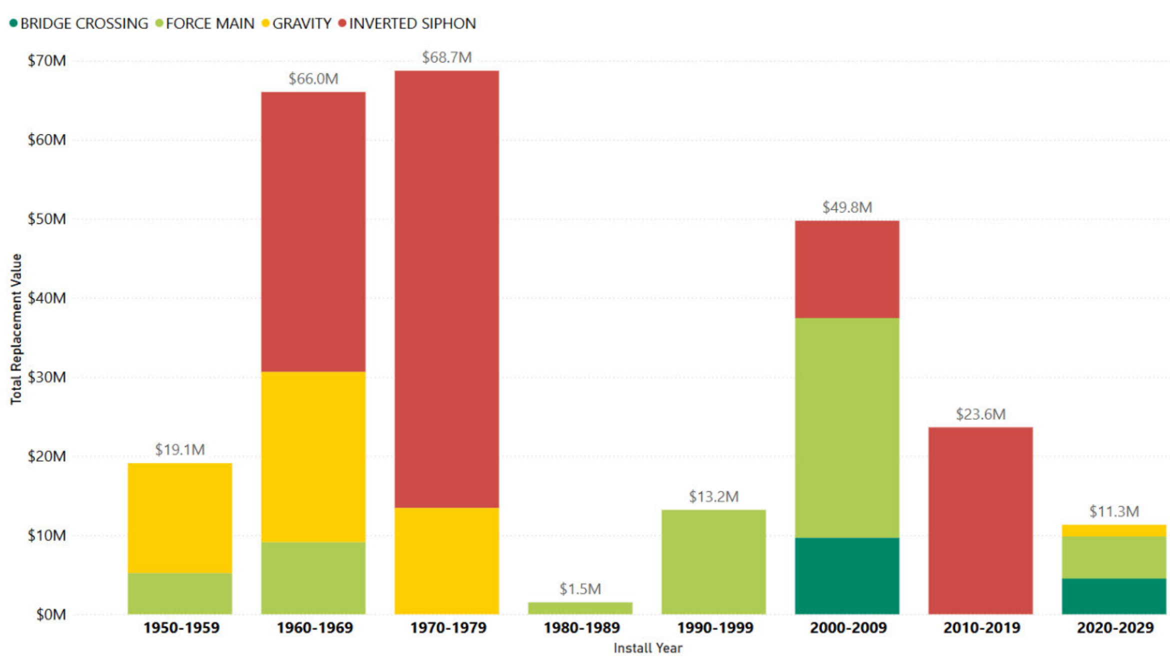


Figure 2-2: RCs Linear Assets Installation Profile

Table 2-4 indicates the breakdown of RCs appurtenant assets by the associated collection pipe. Several RCs RC sites stand out due to their high asset value and concentration of appurtenant components. Main Street Bridge (S-MA70058225) is the most complex, with five asset types including three maintenance holes, one chamber, two air release valves, and three isolating valves, totaling approximately $0.70 million in replacement value. Norwood Bridge (S-MA70057885) and Floodway (S-MA70087417) also rank among the highest-value sites, each containing multiple asset types and estimated replacement values nearing or exceeding $0.95 million. Sites with extensive valve infrastructure include Frasers Grove Park (S-MA00017639) and Montcalm (S-MA70046432), each with four isolating valves and total values exceeding $0.3 million. Fort Garry Cemetery (S-MA70093899) similarly includes four isolating valves, contributing to a total value of $0.31 million.

Table 2-4: Breakdown of RCs Appurtenant Assets by Associated Collection Pipe

RCs ID	Site Name	Asset Sub-categories in Cost (Thousands $) and Quantity (in Ea.)				
		Maintenance Hole	Chamber	Reducer (Air Release Valve)	Isolating Valves	CIPP*
S-MA70016410	WESTWOOD	$15 (1)	$400 (1)	-	-	- (4)
S-MA70028006	WEST PERIMETER BRIDGE	$15 (1)	$400 (1)	-	$385 (5)	-
S-MA70087417	FLOODWAY	$30 (2)	$800 (2)	-	$154 (2)	-
S-MA70016345	ASSINIBOINE ZOO	$15 (1)	$400 (1)	$15 (1)	$154 (2)	-
S-MA70044144	ASH	$30 (2)	-	$30 (2)	-	- (1)
S-MA70057885	NORWOOD BRIDGE	$30 (2)	$800 (2)	$15 (1)	$154 (2)	-
S-MA70058225	MAIN STREET BRIDGE	$45 (3)	$400 (1)	$30 (2)	$231 (3)	-
S-MA70046432	MONTCALM	$15 (1)	-	-	$308 (4)	- (1)
S-MA00017639	FRASERS GROVE PARK	$15 (1)	$400 (1)	$60 (4)	$308 (4)	-
S-MA70021128	FRASERS GROVE PARK	$15 (1)	$400 (1)	-	-	-
S-MA70044147	ASH	-	$800 (2)	-	-	-
S-MA70058265	MAIN STREET BRIDGE	-	$800 (2)	-	-	-
S-MA70046417	MONTCALM	-	$400 (1)	-	$231 (3)	-
S-MA70062902	HART	-	-	-	$154 (2)	-
S-MA70013886	LAGIMODIERE / ABINOJI MIKANAH	-	-	$15 (1)	-	-
S-MA70017147	MUNROE	-	-	$15 (1)	-	- (1)
S-MA70017149	MUNROE	-	-	$15 (1)	-	-
S-MA70031937	PEMBINA / DUCHARME	-	-	$15 (1)	-	-
S-MA70050831	PROVENCHER BRIDGE	-	-	$15 (1)	$231 (3)	-
S-MA50017754	ST. VITAL BRIDGE	-	-	$30 (2)	$231 (3)	-
S-MA70016408	WESTWOOD	-	-	$15 (1)	-	-
S-MA00017097	WHELLAMS LANE	-	-	$15 (1)	-	-
S-MA00017096	WHELLAMS LANE	-	-	$15 (1)	$154 (2)	-
S-MA60023233	DES TRAPPISTES	-	-	-	-	- (1)
S-MA70016531	WINDHAM	-	-	-	$77 (1)	- (1)
S-MA70016527	WINDHAM	-	-	-	$77 (1)	- (1)
S-MA20010426	WELLINGTON AVENUE	-	-	-	-	- (1)

RCs ID	Site Name	Asset Sub-categories in Cost (Thousands $) and Quantity (in Ea.)				
		Maintenance Hole	Chamber	Reducer (Air Release Valve)	Isolating Valves	CIPP*
S-MA70042549	ARCHIBALD / MARION	-	-	-	-	- (1)
S-MA70031733	HERITAGE / PARKDALE	-	-	-	$77 (1)	-
S-MA70087290	FORT GARRY BRIDGE**	-	-	-	$154 (2)	-
S-MA70053063	FORT GARRY BRIDGE**	-	-	-	$77 (1)	-
S-MA70093899	FORT GARRY CEMETERY	-	-	-	$308 (4)	-
TOTAL		**$225 (15)**	**$6,000 (15)**	**$300 (20)**	**$3,465 (45)**	**- (12)**

*CIPP is a liner-based rehabilitation method used to fully restore RC pipes. Its associated replacement values are included in the lifecycle funding requirements as full-segment liner costs.

** Two Fort Garry Bridge RCs are currently in the process of re-installation.

As asset information for RCs appurtenant assets remains incomplete—particularly installation years, and condition ratings, these assets were not included in the age, remaining service life, and condition analyses presented in the following sub-sections. Additional data collection and verification in future updates will enable their inclusion.

2.2.3 RCs Linear Asset Age and Remaining Service Life

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

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

The expected service life (ESL) of RC pipes is significantly influenced by installation type and pipe material. **Table 2-5** outlines five common installation types—ranging from fully buried to bridge-mounted and exposed river-bottom settings—and highlights their associated risks and ESL adjustment factors. Buried installations offer the highest durability with no ESL reduction, while more exposed configurations (e.g., river bottom and bridge-mounted) warrant reductions of up to 30% due to increased environmental stress.

Table 2-5: Impact of Different Installation Types on the RCs Linear Assets' ESL

Installation Type	Description	Impact on ESL	Suggested ESL Adjustment
Buried	Pipe is buried below riverbed or riverbanks. Stable and protected.	Least exposure to external damage or UV.	No change (100%)
Shallow Bury	Buried with minimal cover (<1 m). Risk of exposure, freeze/thaw, erosion.	More vulnerable to physical and environmental damage.	Reduce by ~10–15%
River Bottom (Exposed)	Laid directly on riverbed, potentially exposed to flow, UV, and debris.	High exposure to environmental and mechanical stress.	Reduce by ~20–30%
Bridge Mounted	Suspended on bridge; exposed to air, temperature swings, and UV.	Exposed to UV and thermal cycles.	Reduce by ~10–20%
Not Fully Buried	Partially exposed; risks vary based on site-specific conditions.	Similar risks to shallow or river bottom installations.	Reduce by ~15–25%

Table 2-6 applies these adjustments across various pipe materials (e.g., concrete, HDPE, PVC, steel), showing material-specific ESL values for different installation types. Notably, buried PVC and HDPE pipes retain their full 90-year ESL, while exposed steel pipes can drop to as low as 53 years. Unknown and N/A installation types are conservatively treated with the shortest ESL for each material to reflect uncertainty in asset condition and exposure.

Table 2-6: RCs Linear Assets' ESL with Different Installation Types

Crossing Pipe Material	Installation Type	ESL (Years)
Concrete Material ESL 75 Years	Buried	75
	N/A*	66
	Unknown	66
	Shallow Bury	66
HDPE Material ESL 90 Years	Buried	90
	N/A	68
	River Bottom	68
	Shallow Bury	79
PE Material ESL 90Years	N/A	90
PVC Material ESL 90 Years	Buried	90
	N/A	90
	Bridge	60
Steel Material ESL 70 Years	Buried	70
	Bridge	60
	N/A	53
	Not Fully Buried	56
	River Bottom	53
	Shallow Bury	62

* For certain RCs piping assets, the installation type is not specified in the provided inventory. In such cases, the lowest ESL associated with the known installation types will be applied to ensure a conservative estimate.

Table 2-7 and **Figure 2-3** summarize the age and remaining service life of the City's RCs linear assets by category. It should be noted that all ages used in this analysis represent apparent ages, derived from the SPG scores provided in the most recent condition assessment reports. Gravity mains are among the oldest assets, with a weighted average age of 61 years and only 10 years of remaining useful life, since most of the gravity mains were rated with SPG 3 or above. Inverted siphons are similarly aged at 61 years on average, with just 10 years remaining averagely, though some twin inverted siphon segments have already reached the end of service life (two Fort Garry Bridge RC pipes). Force Mains, installed more recently (average year 1995), show an average remaining useful life of 17 years, reflecting a moderate renewal timeline. Bridge crossings are the newest assets, with an average install year of 2011 and the longest average remaining useful life at 26 years. This indicates that while bridge crossings can be considered long-term assets, gravity mains and siphons represent the most immediate renewal pressures in the system. The impact of the installation of Class IV linings which effectively creates a new pipe are not seen in this table.

Table 2-7: RCs Linear Assets Weighted Average Age, ESL, and Remaining Service Life

Asset Category	Asset sub-category		Average Install Year	Weighted Avg. Age	Weighted Avg. ESL	Remaining Useful Life
Collection Piping	Inverted Siphon	Single	1988	59	73	14
		Twin	1973	80	79	0
		Twin-close Separation	1975	44	59	15
	Gravity	Single	1967	61	71	10
	Force Main	Single	1997	58	66	8
		Twin	2002	59	76	17
		Twin-close Separation	1991	55	75	20
	Bridge Crossing	Single	2023	1	60	59
		Twin-adequate Separation	2005	50	60	10

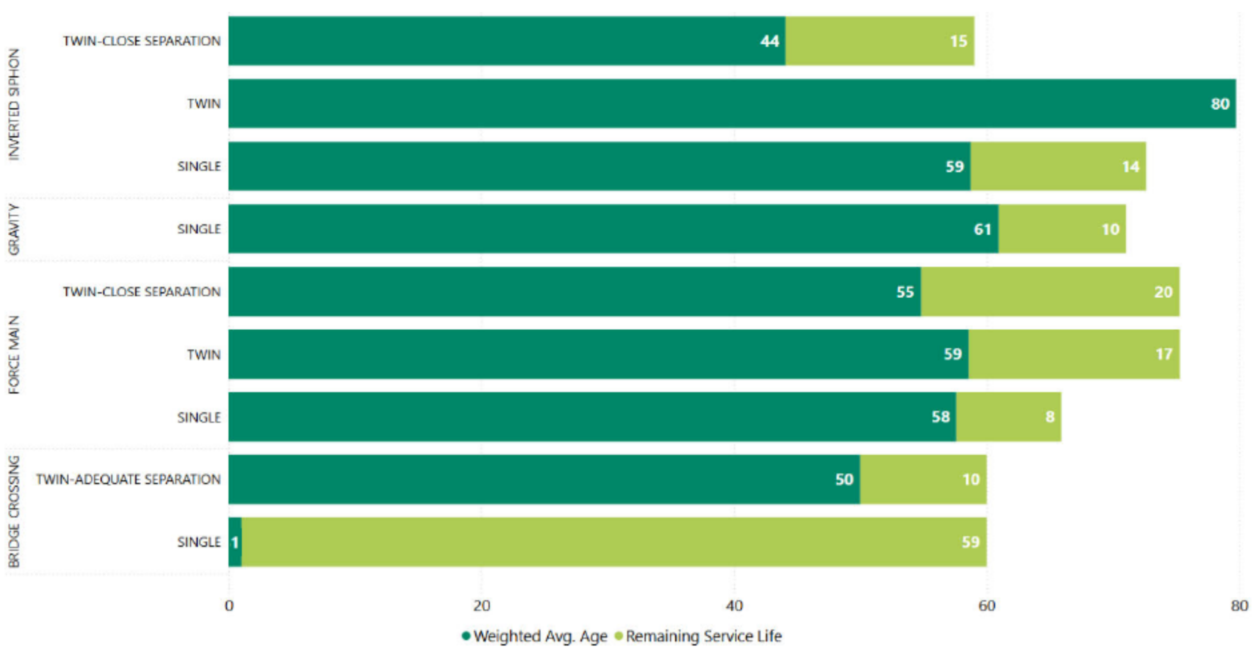


Figure 2-3: RCs Linear Assets Weighted Average Age and Remaining Service Life

2.2.4 RCs Collection Piping Materials

Table 2-8 summarizes the total length and replacement value of RC pipes in Winnipeg by material type. Concrete steel pipes are the materials with the highest replacement value being 2,351 m and 3,250 m with replacement values of $91 million and $90 million respectively. HDPE also represents a significant share of total value, totaling 2,857 m at a value of $63 million. In contrast, Polyvinyl Chloride (PVC) and Polyurethane (PE) pipes are less prevalent, accounting for only 146 m and 250 m in length, with corresponding replacement values of $3.8 million and $13 million.

This distribution highlights the dominance of concrete, HDPE and steel materials in the City's RC infrastructure portfolio.

Table 2-8: RCs Collection Piping Material Distribution by Length and Replacement Values

Pipe Material	Total Length (m)	Total Replacement Values (1000's $)	Average Unit Costs ($/m)
STEEL	3,250	$89,739	$27,615
PVC	146	$3,771	$25,762
HDPE	2,857	$62,702	$21,944
CONCRETE	2,351	$90,778	$38,616
PE	250	$13,000	$51,979

2.2.5 RCs Linear Asset Condition

The RCs Condition Assessment Program was initiated in response to regulatory changes in the mid-2000s, which mandated the inspection and assessment of pipeline crossings within the City's inventory. Early desktop studies—such as the 2006 WWS RC Assessment and the Watermain Criticality Study[3] highlighted several high-risk assets, prompting the City to launch a targeted inspection program. The Phase 1 Program (2012–2016), delivered by AECOM, involved detailed inspections of 19 pipelines across 14 locations (13 wastewater and 6 potable water), along with planning for deferred sites due to operational constraints. Phase 2 (2017–2020) assessed six additional pipelines using advanced inspection technologies. The current Phase 3 program, initiated in 2020, originally included 10 sites and 13 pipelines, with an additional non-river site (Murray Avenue) added post-award for leak verification. The RCs Condition Assessment Program continues to play a critical role in supporting the City's AM strategy by identifying failure risks, estimating remaining service life, and guiding both rehabilitation planning and capital investment prioritization.

Based on available pipe condition data, each asset is assigned a condition grade, named Structural Performance Grade (SPG), on a scale from 1 to 5, where 1 indicates a new asset and 5 represents failure. This is in alignment with the National Association of Sewer Service Companies (NASSCO) Pipeline Assessment Certification Program (PACP). Assets graded 2 or below are considered in Good condition and require no immediate action. A grade of 3 signals the need for increased monitoring and preparing for allowance for repairing, while a grade of 4 should be considered for short-term repair funding. Assets assigned a grade of 5 require immediate intervention.

Furthermore, Weibull distribution function was used to assess the current condition and to project the future condition of the City's RCs assets. The Weibull distribution has been used extensively in reliability studies and lifetime prediction models in industries ranging from automotive to oil & gas and provides a suitable distribution for this type of analysis. The underlying premise of the Weibull-shaped deterioration is that while some assets fail prematurely due to severe conditions or improper installation, other assets are very long-lived and function well beyond their theoretical ESL. In order to perform a high-order network-level analysis, it was assumed that assets would fail (and require replacement) within a deterioration envelope/curve approximated by a Weibull probability distribution. The two-parameter Weibull cumulative distribution has two parameters for scale and shape, as set out in Equation [1]:

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

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

A set of Weibull cumulative distribution functions were leveraged to simulate a set of deterioration curves for assets with different ESLs as shown in **Figure 2-4**.

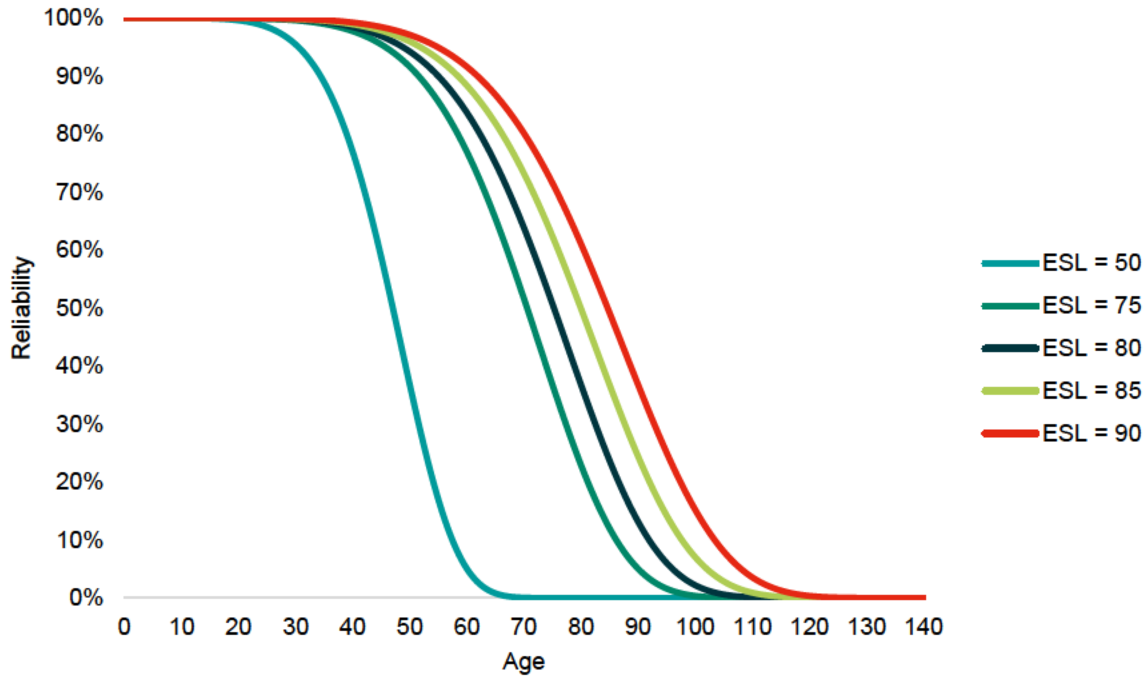


Figure 2-4: Asset Deterioration Curve Samples

Table 2-9 Summarizes the definition of the SPG scores and their conversion to Weibull condition scores

Table 2-9: RCs Linear Asset SPG Details and the Conversion to Weibull Condition Grades

SPG Grade	Weibull Grade	Gravity Sewer Implication	Pressure Pipe Implication
5	3.5	Collapsed or collapse imminent	Failed or in a state of incipient failure, hydrostatic integrity compromised
4	2.8	Collapse likely in the near future	Structural failure likely in short term, hydrostatic integrity may be compromised
3	2.2	Collapse unlikely in the near future but further deterioration likely	Deterioration processes will accelerate in near future, loss of hydrostatic integrity unlikely but elevated risk
2	1.5	Minimal collapse risk in the short term but potential for further deterioration	Deterioration processes active, minimal potential for structural failure or loss of hydrostatic integrity in short term
1	1	New asset or no active deterioration processes present	Asset is new or shows no signs of deterioration; hydrostatic integrity is fully intact and not at risk.

Table 2-10 and Figure 2-5 summarize the condition grade of the City's RCs linear assets with associated replacement values. 48% of the assets are in Very Good condition, with a total replacement value of approximately $121.6 million, and 10% of the assets are in Very Poor condition, with a total replacement value of $26 million. Good condition accounts for 29% of the existing inventory, having a replacement value of around $73.6 million. Fair and Poor condition assets make up 10% and 3%, respectively. It is expanded upon in later sections but should be noted here that all assets rated as Very Poor are currently planned for and in repair workflows.

Table 2-10: RCs Linear Asset Condition Summary

SPG Grade	Condition Rating	Replacement Value (1000's $)	% of Replacement Value
1	Very Good	$121,630	48%
2	Good	$73,598	29%
3	Fair	$24,462	10%
4	Poor	$7,606	3%
5	Very Poor	$26,000	10%
Total		$253,296	100%

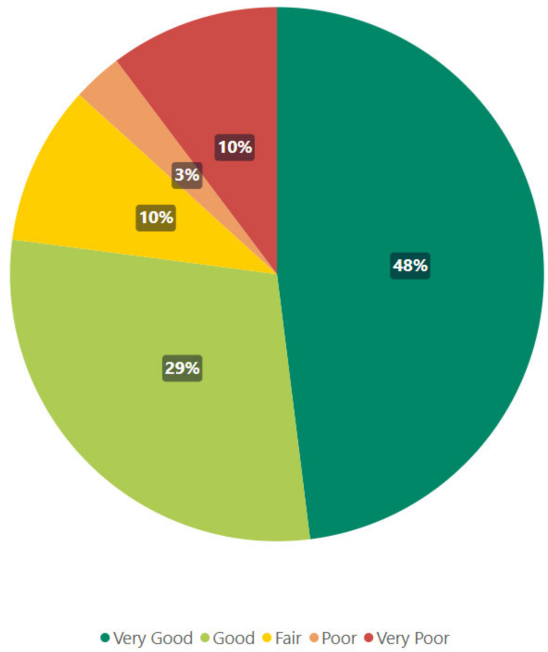


Figure 2-5: RCs Linear Assets Asset Condition Summary Weighted by Replacement Value

Figure 2-6 presents the condition summary for RC assets, categorized by crossing types and asset class, and weighted by total replacement value. For twin-close separation inverted siphons, the majority—valued at $47 million—are in Very Good condition, with an additional $7 million in Good condition. The only assets in Very Poor condition are two Fort Garry Bridge RCs ($26 million) which are decommissioned and being replaced. These are listed as twin inverted siphons in the original inventory but following their failure and planned replacement work the siphons have been removed. It is anticipated that these assets will be graded in Very Good condition in early 2026 when the replacements are commissioned. For single inverted siphons, $15 million are in Very Good condition and $31 million in Good condition.

The gravity main class shows the widest spread, with $28 million in Good condition, $16 million in Fair, $4 million in Very Good and $2 million Very Poor condition (for which repairs are currently planned with budget allocated). For twin-close separation force mains, all $35 million are in Very Good condition. Twin force mains are evenly split between Good and Fair, each valued at $8 million. For single force mains, the condition ranges from $2 million in Very Good to $5 million in Poor.

All twin-adequate separation bridge crossings, totaling $10 million, are rated Fair or better. Meanwhile, single bridge crossings, totaling $5 million, are entirely classified as Very Good. This distribution highlights significant condition variability by configuration type, with twin siphons and single force mains emerging as critical areas for renewal planning.

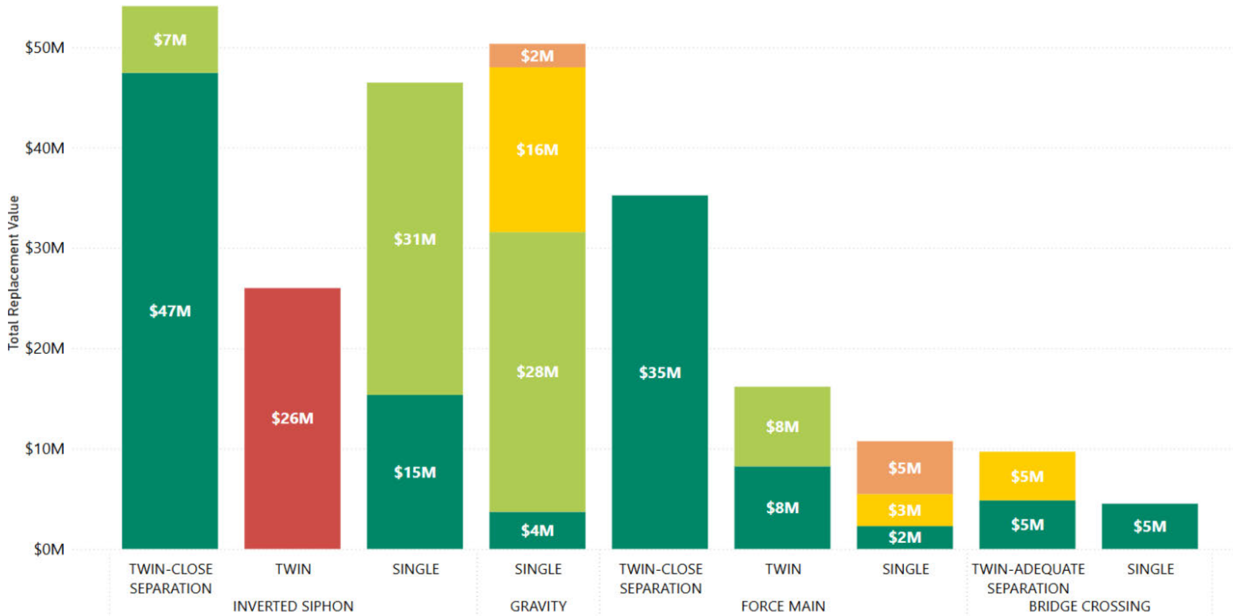


Figure 2-6: RCs Linear Assets Condition Distribution by Asset Sub-categories

2.3 Asset Data Gap Analysis

This section summarizes the current state of the City's asset data by assessing the quality of the data describing the RC asset inventory. Specifically, this section identifies existing data gaps, determines the overall confidence in the current asset data, and introduces good practices of data management.

2.3.1 Data Gap Observations

The City's RCs assets were previously stored across multiple spreadsheets and within the City's sewer management program, Innovyze's InfoAsset Manager. This project has successfully centralized the data into a single inventory. Additionally, it has addressed and filled gaps in key data, such as ESL and replacement costs, achieving a 100% completeness rate. Table 2-11 provides a summary of data completeness levels in the compiled RCs inventory across key data attributes. It is recommended that the City continue to work on filling any remaining gaps, ensuring a comprehensive and up-to-date database.

Table 2-11: Observations on Asset Data Completeness

Asset Category	Type (Material or Valve Type)	Size (Diameter, Valve Size, Spatial Area)	Location	Installation Date	Condition	ESL	Replacement Cost	ID
Linear Assets	100%	100%	100%	100%	100%	100%	100%	96%
Structures	N/A[1]	N/A[2]	100%	100%	0%	0%	100%	100%
Pipe Works	100%	100%	100%	100%	0%	0%	0%	100%
Valves	66%	100%	80%	100%	100%	100%	100%	58%

1- Structures are typically multi-material so this field has no practical application.
2- Structural size has no direct application and varies individually.

2.3.2 Data Management Practice

The asset data lifecycle is a sequence of stages that data goes through from its initial build (i.e., data capture and entry) to its eventual archival and/or deletion at the end of its useful life[4]. A clear definition and understanding of the organization's process for acquiring, storing, utilizing, assessing, improving, archiving, and deleting data (see Figure

[4] TechTarget Network (2020): Definition: Data Life Cycle

2-7) will ensure good data management practices and help to sustain levels of data quality required to support AM activities.

Figure 2-7: Asset Information Lifecycle

The seven key stages of the asset data lifecycle are described in more detail below, aligned with By-law No. 123/2020 – Records Management:

- Acquiring New Data

New asset data typically originates from asset creation, refurbishment, overhauls, or transfers from other business units, organizations, or third parties. In accordance with the Records Management By-law, processes for classification and integration must be clearly defined to maintain consistency and compliance. This includes ensuring that new sanitary network assets are added to the inventory within a fixed timeline, preferably within three months of commissioning. A minimum dataset must be clearly defined and maintained to ensure accuracy, reliability, and compliance with City records management policies. Where data is inherited or transferred, it should be properly assessed, merged, and classified within the City's records management system, considering whether it constitutes a City record, non-City record, transitory, or non-transitory information.

- Storing Data

Proper storage is essential for safeguarding the integrity and accessibility of asset data. Under the by-law, data storage systems must support the City's comprehensive records management framework by ensuring security, privacy, and backup/recovery capabilities that comply with applicable legislation. Asset records may reside in CMMS, GIS, or IAM platforms; however, duplication across systems should be minimized through integrated processes and system interoperability. The classification of data, particularly regarding whether records are transitory or archival, should guide storage design and implementation.

- Utilizing and Analyzing Data

Utilization encompasses the processing, viewing, editing, and publishing of data to support both internal decision-making and public communication. To preserve traceability and data integrity, all critical modifications must be auditable and documented in line with the retention and access policies under the City's records management framework. Furthermore, any public release of data must follow the appropriate approval process and be consistent with records access rights as established by the City Archivist and Records Committee.

- Assessing Data

Regular assessment of asset data is necessary to maintain confidence in decision-making and ensure compliance. Poor-quality data may result in incomplete maintenance records, reduced asset performance, failure to meet statutory or safety obligations, increased risks of incidents, and asset failures stemming from gaps in lifecycle planning. The Records Management By-law requires that City records be evaluated for archival value and either retained or destroyed accordingly. Assessments should therefore inform classification and guide retention scheduling to ensure accuracy and accountability.

- Improving Data

Data improvement efforts must be intentional, structured, and aligned with organizational Asset Management objectives. Clear data quality targets should be set and communicated across the organization, with a full understanding of the costs, benefits, and risks of improvement initiatives. Unnecessary data collection should be avoided, as data must always serve a clear strategic or operational purpose. All improvements should be documented, tracked, and managed within the City's records management system in compliance with retention and audit requirements.

- Archiving Data

Archiving is the process of retaining inactive data that may still hold legal, operational, or historical value. Consistent with the Records Management By-law, records with archival value, such as long-term engineering data, must be transferred to the City Archives and preserved accordingly. Engineering-specific data should be retained for at least 10 years, in line with Engineers and Geoscientists Manitoba standards. An archive strategy should clearly define what qualifies for archival and why, outline applicable legal and regulatory retention obligations, establish retention timelines, set authorized access controls, and incorporate risk assessments related to data loss. Policies must be communicated across all departments to ensure consistent application.

- Deleting Data

Finally, data destruction represents the end of the lifecycle and must be handled strictly under the Records Management By-law. City records may only be deleted with authorization from the Records Committee, the City Archivist, or under an approved retention and destruction schedule. "Squirrelling," or retaining data longer than necessary, must be avoided, as retention should always be sufficient but finite. Deletion must be irreversible and beyond any possible reconstruction, with all activities supported by prior authorization, proper audit trails, and strict compliance with retention schedules.

2.3.2.1 Current Data Management State

The City's staff are actively engaged in asset data management. Currently, the RCs asset data is maintained across multiple platforms, including Excel spreadsheets, reports, IAM and a GIS database. Updates to asset records are made in the spreadsheets; however, there can be delays in acquiring and incorporating new or revised data, which may affect data accuracy and timeliness.

The City adheres to the requirements outlined in the Retention and Disposition of Municipal Records Regulation, M.R. 53/97 under The Municipal Act (C.C.S.M. c. M225) and the Records Management Bylaw. These regulations mandates that municipalities retain asset records for "the lifetime of unit" and maintain documentation of their disposition, whether through destruction or transfer to an approved archival institution. The Byelaw increases requirements to maintaining as-builts for a further 2-years after being superseded. These practices ensure that asset data is managed in compliance with provincial standards for municipal recordkeeping and privacy.

2.3.2.2 Future Data Management State

The City recognizes that gaps in condition data—particularly for older or difficult-to-access sewer crossings—pose a challenge to effective asset management. Moving forward, the City will prioritize data collection for high-risk or data-deficient assets through targeted inspections and condition assessments. This approach will help build a complete and more reliable asset inventory, enabling better-informed decisions regarding maintenance, rehabilitation, and replacement. The implementation plan for addressing these data gaps is outlined in **Section 6**.

2.4 Gaps and Recommendations

As part of the state of infrastructure assessment, several limitations were identified related to asset inventory completeness, data consistency, and condition information for the City's RCs assets and associated appurtenances. These issues affect the reliability and consistency of asset condition grading, replacement value estimates, and lifecycle modeling, particularly for assets not fully captured in GIS or CMMS systems. The observed gaps were primarily associated with incomplete installation data, missing asset attributes, and inconsistent hierarchy or ID references across platforms.

Table 2-12 summarizes key data and inventory gaps identified in the RCs asset, along with proposed resolutions to enhance data quality, asset traceability, and future asset management practices. These gaps stem from limitations in historical records, inconsistencies across data systems (e.g., GIS, CMMS, spreadsheets), and the absence of standardized condition ratings or lifecycle data. Addressing these issues will support more accurate asset evaluation, prioritization of renewal activities, and alignment with the City of Winnipeg's broader AM objectives.

Table 2-12: SOI Gaps and Recommendations Summary

Section	Gap	Recommendations
Section 2.1 Asset Hierarchy	The asset hierarchy for RCs appurtenant assets was developed based on site observations, historical reports, and operational records rather than a structured and validated asset inventory. (Gap#1)	• Develop a standardized and comprehensive asset hierarchy aligned with the City's GIS and CMMS databases to improve inventory consistency and support future planning efforts. (Recommendation#27)
Section 2.2 Current State of Assets	The appurtenant asset inventory was established through geo-fencing (60 m buffer around RCs pipes) and manual verification but may not include all relevant assets. (Gap#2)	• The City should conduct a full confirmation of the inventory to ensure completeness and accuracy of all in-scope assets. (Recommendation#57)
	Instrumentation & control components and riverbank protection/erosion control features were not captured in the GIS database. (Gap#3)	• Perform a targeted asset capture initiative for these components using field validation and incorporate them into GIS and CMMS with appropriate asset classifications. (Recommendation#58)
	Portions of valve inventory were extracted from CMMS work orders using CMMS-specific asset IDs, which differ from the GIS database's asset IDs, resulting in traceability issues. (Gap#4)	• Harmonize CMMS and GIS asset identifiers using a cross-referencing system or unique asset ID mapping table to improve traceability and data integration across platforms. (Recommendation#28)
	Many valve records are missing installation year data, limiting lifecycle analysis and asset age profiling. (Gap#5)	• Where possible, populate missing installation dates using historical maintenance records or estimated installation windows based on nearby assets or pipe segments. (Recommendation#59)
	Some appurtenant asset installation dates are entered as default or placeholder values (e.g., 9999-09-09), affecting data reliability. (Gap#6)	• Establish data validation rules in GIS/CMMS to flag and correct placeholder values; update missing dates through field verification or engineering judgment. (Recommendation#60)
	No formal condition ratings have been assigned to RCs appurtenant assets, making it difficult to evaluate asset health or prioritize renewal. (Gap#7)	• Continue implementation of standardized condition assessment protocol (e.g., NASSCO MACP for MHs and chambers) and incorporate the results into the City's asset management systems. (Recommendation#61)
	Asset data is spread across multiple systems (GIS, CMMS, spreadsheets), leading to inconsistency and inefficiency. (Gap#8)	• Define the data contained within each asset data repository or implement automated data syncing across platforms (particularly GIS system) to ensure a single source of truth for asset records. (Recommendation#29)
	No consistent methodology exists for estimating remaining service life (RSL) based on a defined Structure Performance Grade (SPG) or condition criteria. (Gap#9)	• Establish and document a consistent RSL estimation method based on condition grade, age, material, and performance risk; align with condition assessment reports or industry best practices. (Recommendation#30)
	Assets associated with RCs appurtenant assets are not clearly identified in the GIS or CMMS for easy future reference. (Gap#10)	• Introduce a standardized data field or tagging convention (e.g., "RCs_Asset" flag) in both GIS and CMMS systems to streamline tracking and filtering of relevant assets. (Recommendation#31)
Section 2.3.2 Data	Assets are being operated for prolonged periods without entry into critical City systems such as the CMMS or GIS. (Gap#11)	• New assets for the sanitary network should be consistently added to the inventory within a fixed timeline, preferably

Section	Gap	Recommendations
Management Practice		within three months of commissioning. (**Recommendation#1**) • Project closeout should be closely monitored to ensure that asset information is entered quickly, accurately, and in accordance with City standards. Preliminary data should be entered into City systems as soon as construction is complete, followed by more accurate updates once as-built drawings are available. (**Recommendation#2**) • A minimum required dataset must be clearly defined and maintained to uphold inventory accuracy, reliability, and compliance with records management policies. (**Recommendation#3**)

3. Levels of Service

This section presents the Level of Service (LoS) framework developed for the City's WWS RCs. The LoS framework serves as a foundational element of the City's AM system, supporting informed decision-making, service planning, and resource prioritization. It enables the City to define, monitor, and evaluate how RC assets are expected to perform in the future, across a range of strategic, regulatory, technical, and financial dimensions.

The LoS framework aligns with the City's overarching AM vision and strategic objectives, as outlined in the OurWinnipeg 2045 Development Plan[5] and the Strategic Asset Management Plan (SAMP)[6]. It translates broad corporate goals into service expectations that are specific, measurable, achievable, relevant, and time bound. The framework also incorporates stakeholder input, risk considerations, and regulatory requirements, so that the City's RCs continue to provide reliable, affordable, and environmentally responsible service.

3.1 Purpose

The purpose of establishing LoS for the City's wastewater network and tailoring them specifically for the RCs is to provide a structured foundation for decision-making that supports sustainable service delivery, risk management, and long-term infrastructure performance. As critical components of the wastewater network, RCs must be managed to ensure safe, continuous conveyance under varying operational and environmental conditions.

LoS serves as a key enabler in the City's overall AM system. It helps shift the focus from simply maintaining asset condition to delivering outcomes that align with community needs, regulatory obligations, and strategic goals. The formalization of LoS expectations allows the City to clarify what services are delivered, how they are delivered, and at what cost, thereby strengthening internal accountability and external transparency.

Within this context, establishing LoS for RCs is intended to:

- Enable strategic decision-making by linking corporate objectives with asset performance targets.
- Promote transparency and accountability by documenting service expectations and resource implications.
- Support risk-based asset planning by using LoS targets to guide capital investment and maintenance.
- Facilitate cross-departmental alignment by integrating LoS into departmental plans and practices.

By defining service expectations in measurable terms, LoS will also support continuous improvement across service areas and provide a foundation for evaluating future changes in demand, performance, or risk. Ultimately, this approach helps maintain RC infrastructure so it continues to provide safe, reliable, and cost-effective service to current and future residents.

3.2 Objectives

Defining LoS objectives is a foundational step in establishing a clear connection between the City of Winnipeg's strategic goals and the management of its RCs. These crossings are essential infrastructure that enable the uninterrupted conveyance of wastewater across natural water bodies, supporting public health, environmental protection, and community resilience.

The LoS objectives for RCs are designed to reflect the City's commitment to responsible asset stewardship and sustainable service delivery, as outlined in the OurWinnipeg 2045 Development Plan and the City's Asset Management Policy. These objectives aim to ensure that investment decisions are guided by a structured, risk-based approach that supports both regulatory compliance and community expectations.

Furthermore, the City's SAMP outlines a long-term roadmap for advancing AM maturity across all service areas. One of its five core objectives is to develop clearly defined LoS frameworks that balance cost, risk, and service expectations. Establishing LoS is foundational to developing an AM program that links strategic objectives with

[5] City of Winnipeg (2022), OurWinnipeg 2045, https://www.winnipeg.ca/building-development/city-planning-design/ourwinnipeg/ourwinnipeg-2045
[6] City of Winnipeg (2021), 2021-2024 Strategic Asset Management Plan., https://legacy.winnipeg.ca/Infrastructure/asset-management-program/default.stm

technical performance and customer expectations. A defined LoS framework enables staff to use target service levels as baselines in lifecycle analysis and evaluate the impacts of any changes over time.

The aim is to establish a comprehensive LoS framework and associated tools for all City services delivered through its assets, including RCs. The City's SAMP emphasizes the importance of using consistent service attributes to guide LoS development across all asset types. In line with this, the LoS objectives for RCs reflect four core service attributes[7]:

- **Capacity and Use**: Ensuring infrastructure is available, accessible, and meets service demand.
- **Legal / Regulatory and Service Priorities**: Ensuring assets comply with legislation and deliver service at an acceptable level of risk.
- **Quality and Function**: Ensuring reliable, responsive, and fit-for-purpose performance.
- **Affordability**: Balancing service delivery with cost-effectiveness and long-term financial sustainability.

To ensure alignment between these service attributes and the City's corporate goals, the information in **Table 3-1** is based on the framework outlined in the WWD Levels of Service Project Summary Report. The table presents this framework in an organized format, showing how each OurWinnipeg 2045 goal links with its relevant service attribute(s) and corresponding LoS objective for RCs.

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

Corporate Goals	Service Attribute	LoS Objectives for RCs
Leadership and Good Governance	Legal / Regulatory and Service Priorities	Maintain asset inventories, condition assessments, and risk evaluations to support defensible and transparent decision-making for RC renewal and investment.
Environmental Resilience (ER)	Quality and Function	Protect river ecosystems and minimize risk of contamination by ensuring RCs are structurally sound and inspected/renewed to prevent leakage or failure. Incorporate climate resilience by preparing for extreme weather events and adapting infrastructure to withstand the impacts of a changing climate
Economic Prosperity (EP)	Affordability	Avoid service disruptions and emergency repairs that could result in high social and economic costs through proactive maintenance and capital planning of crossings.
Good Health and Well-Being (HW)	Quality and Function	Prevent sanitary sewer overflows and backups by maintaining the hydraulic and structural performance of the system to ensure the safe and reliable conveyance of wastewater under both normal and emergency flow conditions.
Social Equity (SE)	Capacity and Use	Provide consistent levels of wastewater service to all communities by ensuring key RCs are reliable and inclusive of all network segments, including older areas.
City Building (CB)	Capacity and Use / Legal / Regulatory and Service Priorities	Support long-term growth and intensification by preserving critical trunk connections that cross rivers, enabling capacity and resilience in the wastewater network.

3.3 Rightsholders and Stakeholders Identification

In the context of this plan, a Rightsholder is defined as an individual or group with specific, legally or morally recognized entitlements, such as Indigenous communities with rights related to land and water. A stakeholder, by contrast, refers to any individual, group, or organization that can affect, be affected by, or perceive themselves to be affected by decisions or activities related to infrastructure service delivery.

For the City of Winnipeg, engaging both Rightsholders and stakeholders is a critical component of managing wastewater infrastructure, particularly for specialized and high-risk assets such as RCs. These assets operate at the intersection of environmental, regulatory, technical, and community concerns, making inclusive engagement essential to effective asset management.

As part of the AM strategy for RCs assets, AECOM worked with the City to identify and define the roles of key internal and external groups involved throughout the asset lifecycle, from acquisition to operation, maintenance, renewal, and decommissioning. This process was informed by the City's preferred lifecycle stages, the current asset inventory, and typical lifecycle activities, and was supported by an online workshop held on May 21, 2025.

[7] SLBC Inc. (2023) City of Winnipeg WWD Levels of Service Project Summary Report.

The Rightsholder and stakeholder analysis enables the City to understand the diverse needs, expectations, and influence levels of various groups. Internally, departments and governing bodies are responsible for planning, operating, and overseeing sewer crossing assets in alignment with municipal priorities and regulatory requirements. Externally, stakeholders and Rightsholders contribute regulatory oversight, technical services, funding, and community perspectives. Their involvement ensures that infrastructure projects meet environmental standards, respect Indigenous rights, and reflect the values of the broader public.

In the context of RCs, stakeholder engagement supports the City in:

- Identifying which aspects of service (e.g., reliability, resilience, compliance) are most important to different audiences.
- Understanding tolerance for infrastructure-related risks, such as environmental release or structural failure.
- Anticipating how changes in Level of Service (LoS), regulations, or climate conditions may impact affected parties.
- Facilitating long-term planning and investment decisions that align with community values and legal obligations.

Those involved in or affected by the planning and performance of RCs include both internal departments and external parties. **Table 3-2** summarizes the key groups and their respective interests and priorities.

Table 3-2: Key Stakeholders for River Crossings and Their Interests

Type	Group	Description	Priorities / Interests
Internal	Water and Waste Department (WWD), Asset Management Branch	Primary steward of sewer crossing assets, responsible for operations, maintenance, inspections, and planning.	Clear service expectations, proactive coordination with Corporate Asset Management Office, and integration of safety, climate resilience, and lifecycle investment needs
	City Council, Committee	Elected officials responsible for setting strategic direction, approving policies and budgets, and providing oversight to ensure infrastructure investments reflect public priorities and long-term community outcomes.	Champion strategic asset renewal decisions that reflect community needs, long-term priorities, and environmental stewardship.
	Finance	Internal department responsible for financial planning, budget coordination, and alignment of capital investments with fiscal policy.	Support integration of Level of Service expectations into capital planning and funding decisions, ensuring alignment with corporate asset management goals and long-term financial sustainability.
	Public Works Department	Supports integration of sewer infrastructure with other municipal systems and provides technical input.	Supports integration of sewer infrastructure with other municipal systems by providing technical input and facilitating coordination during planning and delivery of capital works projects. This includes joint utility planning, construction phasing, and holistic right-of-way management to optimize use of public space, minimize disruption, and ensure compliance with applicable regulations.
	Water and Waste Department (WWD), Wastewater Services Division	City personnel responsible for operating and maintaining RCs.	Clear guidance on service expectations, funding for renewal and repairs, and incorporation of climate and safety considerations.
	Planning and Design Departments	Internal departments involved in infrastructure design and long-term planning.	Internal departments responsible for infrastructure design, growth planning, and alignment of projects with broader land use strategies. Support coordination of future infrastructure needs, ensure designs meet regulatory requirements, and align with long-term development and intensification plans.
External	Provincial Government of Manitoba	Regulates environmental impacts and may provide infrastructure funding.	Compliance with provincial legislation and environmental standards.
	Federal Government of Canada	Oversees national environmental laws and regulations affecting water bodies and fish habitats.	Protection of federally regulated areas and enforcement of environmental legislation.

Type	Group	Description	Priorities / Interests
	Environmental Regulatory Agencies	Includes the Ministry of the Environment, Conservation and Parks (MECP), Environment and Climate Change Canada (ECCC), and Fisheries and Oceans Canada (DFO).	Compliance with environmental protection standards, particularly related to watercourse crossings and potential effluent release.
	Indigenous Communities	Rightsholders with interests in traditional territories and culturally significant areas.	Environmental stewardship, protection of shared water bodies, and inclusion in planning and emergency response.
	Neighbouring Communities	Nearby or downstream residents potentially affected by infrastructure failure.	Notification and mitigation planning in the event of service disruption.
	Emergency Services	Fire, police, and emergency response units.	Prioritizes clear contingency plans, coordinated communication, and rapid mobilization to contain and mitigate incidents such as structural collapse, major discharge, or environmental spills.
	Public and Local Communities	End users of wastewater services and recipients of environmental protection.	Prioritizes maintaining safe, reliable service, preventing spills or pollution, ensuring transparent performance reporting, and implementing proactive measures to protect environmental and public health.
	Industrial, Commercial, and Institutional (ICI) Users	High-demand users of wastewater services, often reliant on trunk infrastructure.	Service continuity and capacity assurance, especially for facilities located near or dependent on the RCs network.
	Environmental Organizations and Advocacy Groups	Local and national organizations focused on environmental protection and sustainable infrastructure.	Protection of aquatic ecosystems, transparency, and sustainable asset management.
	Consultants, Contractors, and Suppliers	External service providers for design, inspection, and construction.	Clarity on technical specifications, timelines, and environmental constraints.

Below are the categories defined based on the influence and interest of the Rightholders and Stakeholders for the RCs infrastructure. This categorization reflects the City's understanding of which parties are most affected by, or influential in, decisions related to these assets. It provides a clear framework for assessing engagement needs across the asset lifecycle and supports targeted communication, informed decision-making, and effective collaboration. It also serves as a foundational tool for future engagement planning, ensuring that each category is appropriately involved based on its role and relevance.

The categories are divided into four groups:

- **High Influence and High Interest**: This category includes stakeholders with both strong decision-making authority and a high level of engagement in the planning, operation, and oversight of the RCs sewer infrastructure. It comprises the Water and Waste Department (WWD) – Asset Management Branch, WWD – Wastewater Services Division, and the Planning and Design Departments, all of which are directly involved in managing the infrastructure's performance and future planning. The Public Works Department is also part of this group due to its operational responsibilities for related municipal assets. External stakeholders with comparable influence and interest include the Provincial Government of Manitoba, the Federal Government of Canada, and environmental regulatory agencies, all of which establish regulations, provide oversight, and may contribute funding. Indigenous Communities are included in this group given their legal rights, environmental stewardship responsibilities, and formal role in consultation and decision-making processes that could impact the infrastructure and surrounding waterways.
- **High Influence and Low Interest:** This group comprises stakeholders with significant authority over project approvals, funding, and delivery, but who typically engage at key decision points rather than in daily operational activities. City Council and its associated Committees fall into this category, as they provide political direction, set policies, and approve budgets. Finance is also included, given its control over funding allocations and financial oversight. External stakeholders in this group include Consultants, Contractors, and Suppliers, whose influence stems from their technical expertise, cost control, and ability to affect project timelines, as well as Emergency

Services, which hold critical authority during emergencies or infrastructure failures but have limited involvement under normal operating conditions.

- **Low Influence and High Interest:** Stakeholders in this category have a strong interest in the safe and reliable operation of the RC sewer infrastructure but possess limited formal authority to influence technical or strategic decisions. This includes Neighbouring Communities, Public and Local Communities, Industrial, Commercial, and Institutional (ICI) Users, and Environmental Organizations and Advocacy Groups. Their interest stems from the potential impacts on daily life, public health, environmental quality, and economic activity. These stakeholders often play an important role in public engagement, feedback, and advocacy, ensuring community concerns and environmental considerations are reflected in decision-making.
- **Low Influence and Low Interest:** No stakeholders from the current list have been identified in this category. Most parties connected to the RC Crossing sewer infrastructure have either substantial influence, high interest, or both. If any peripheral or non-local groups are identified in a future iteration with minimal involvement and limited potential impact, they could be classified here.

3.4 Legislative and Regulatory Levels of Service Metrics

The City's wastewater sewer RCs (HRRCs and those not identified as high risk) are governed by a robust regulatory framework intended to safeguard environmental quality, protect public health, and ensure compliance with applicable standards. These legislative and regulatory requirements establish the minimum acceptable thresholds for service delivery and inform how the City defines, monitors, and maintains LoS for its critical infrastructure.

Key regulatory influences stem from Federal and Provincial legislation, in addition to specific clauses embedded in the City's wastewater treatment plant licenses. These regulations as shown in **Table 3-3** define technical performance expectations, environmental discharge limits, and operational reporting obligations. They are essential inputs into the City's LoS framework and play a pivotal role in setting compliance metrics for RCs and the broader wastewater system.

Table 3-3: Legislated and Regulatory Requirements

Federal	Provincial	City
• Fisheries Act • Canadian Environmental Protection Act • Canadian Council of Ministers of the Environment (CCME) guidelines • Wastewater Systems Effluent Regulations (WSER)	• The Environment Act (Manitoba) • Environment Act Licences (e.g., SEWPCC[9], NEWPCC[10], WEWPCC[11]) • Manitoba Water Quality Standards, Objectives, and Guidelines • Nutrient Management Regulation (62/2008) • CSO EAL No. 3042[12]	• City of Winnipeg Sewer By-law No. 106/2018

In particular, the Environment Act Licences for each of the City's three sewage treatment plants provide site-specific regulatory obligations that influence RC operations. Clauses 18 and 19 of the SEWPCC and NEWPCC licences, and Clauses 20 and 21 of the WEWPCC licence set requirements for effluent quality, operational monitoring, and contingency planning, which indirectly impact the City's LoS metrics and maintenance strategies for associated infrastructure, including RCs. In addition, Clause 7 of the City's Combined Sewer Overflow (CSO) Licence prohibits CSOs during dry weather flow, Clause 8 requires that new or upgraded infrastructure must not increase CSO frequency or volume, and Clauses 10 and 16 require that all CSO events be publicly reported and documented.

As part of the City's efforts to document compliance-oriented performance, the following legislative and regulatory LoS metrics are tracked for RCs:

[9] Province of Manitoba (2018) City of Winnipeg South End Water Pollution Control Centre (SEWPCC) – Environment Act Licence No. 2716 RR

[10] Province of Manitoba (2019) City of Winnipeg North End Water Pollution Control Centre (NEWPCC) – Environment Act Licence No. 2684 RR

[11] Province of Manitoba (2009) City of Winnipeg West End Water Pollution Control Centre (WEWPCC) – Environment Act Licence No. 2669 E RR.

[12] City of Winnipeg, Combined Sewer Overflow, No. 3042, 2013

- **% of RC monitoring plan complete, based on monitoring criteria**: This metric measures the percentage of planned inspections completed for RCs, based on age-based or condition-based criteria established in the monitoring program. At present, the City has completed all inspections for crossings that have reached the specified age threshold for condition assessment. In the future, the City may refine this metric based on the interpretation of "monitoring" as outlined in the Environment Act licences, considering whether additional monitoring activities beyond age-based inspection (e.g., hydraulic, structural, or environmental parameters) should be incorporated into the plan to meet broader regulatory expectations. It should be noted that the City in conjunction with technical experts has determined that real-time monitoring presents minimal benefit and excessive technical challenge in comparison to the proactive and rigorous condition assessment and monitoring program that is currently in place.
- **# of odour complaints within 150m buffer of RC asset**: This metric tracks the number of odour complaints received from the public within a 150-metre buffer of a RC asset. While odour data can be subjective, it may serve as a proxy indicator of potential system performance concerns. AECOM recommends that complaints within this buffer be used to flag associated RCs for desktop review—such as checking maintenance records or recent performance data—rather than triggering automatic inspections. Over time, if patterns or clusters emerge, these can inform targeted field investigations. This reactive approach supports asset management, improves responsiveness to public concerns, and helps mitigate reputational risks.
- **% of RCs that meet environmental sustainability and resilience goals (proposed)**: This is a forward-looking metric intended to align with the City's future Climate Action Plan Update. While specific resilience and sustainability criteria for RCs have not yet been finalized, this metric is proposed to support the City's long-term environmental objectives. Once targets are defined through the Climate Action Plan Update, this measure can be formalized to track the share of RCs that meet updated design or operational resilience thresholds.

These metrics serve both as performance indicators and as tools for continuous improvement. By monitoring them, the City ensures that it remains compliant with its regulatory obligations while providing transparent reporting and fostering public trust.

3.5 Levels of Service Performance Measures and Targets

A documented suite of LoS performance measures enables a common understanding of the service delivery that the City's customers currently receive, and the associated cost of maintaining infrastructure assets to provide the service. Having these performance measures set at the appropriate levels within the City supports alignment from the corporate vision to asset investment decisions, and to day-to-day operational activities. When establishing LoS performance measures it is important to keep in mind the "SMART" acronym, as follows:

Specific, easily evaluated and understood.

Measurable, quantifiable, and easily collectable to support ongoing data availability.

Attainable, so that they work to motivate as opposed to discourage.

Relevant, in that they relate and align with a specific goal.

Time-Bound, measured over a specific period, which is typically annually.

The key performance indicators (KPIs) are sourced from the Canadian Infrastructure Benchmarking Initiative (CIBI) with other KPI's obtained from the Municipal Benchmarking Network Canada, the City's WWD Levels of Service Project Summary Report[7], and other comparable municipalities that AECOM has worked with previously.

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

One of the key challenges in setting targets in a municipal environment is that they can often become biased or politically motivated. Therefore, it is crucial to engage both internal and external stakeholders when reviewing LoS targets, particularly the customers most affected by changes in service delivery.

An essential aspect of evaluating LoS targets is determining users' willingness to pay for the service. Regulatory requirements are an exception, as they establish only the minimum service standard. Cost remains a significant factor when considering service improvements. To address financial constraints and support that targets are both attainable and cost-effective, it is necessary to:

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

A summary of the City's RCs LoS metrics is presented in **Table 3-5**. Each metric was indicated with its current trend and proposed trend for the next 10 years, represented by legends, considering the nature of the measure, data availability, and whether the trend impacts positively or negatively on the proposed LoS. The LoS trend legends are described in **Table 3-4**.

For metrics where data is currently tracked, **Table 3-5** includes historical insights to highlight performance direction and assess alignment with desired outcomes. In addition, proposed trends have been formulated based on engineering judgement, risk considerations, and anticipated system needs. In such cases, it is recommended that firm LoS targets not be established until baseline performance is better understood.

In addition to trend analysis, **Table 3-5** also highlights the operational implications associated with each metric. This includes whether the metric is currently being tracked by the City, the type of lifecycle activity it influences (e.g., operations and maintenance (O&M), renewal, or growth), and the estimated budget impact required to meet the proposed LoS. This provides a financial lens through which to evaluate service objectives and prioritize investment.

Each LoS measure also includes a high-level summary of the potential risks if performance does not meet expectations. These risks range from increased service disruptions and public dissatisfaction to regulatory non-compliance and financial inefficiency.

Table 3-4: LoS Trend Legend

Symbol	Name	Description	Example
↑	Positively Increasing	The KPI is trending in a good direction, showing continuous improvement over time. This indicates progress toward desired goals and positive performance outcomes.	*The percentage of water and wastewater mains in Good condition is increasing due to proactive renewal and rehabilitation programs.*
→	Positively Stable	The KPI is at a strong and desirable level, with no expected increase or decrease. Maintaining this trend ensures consistent performance and long-term stability.	*The number of water quality violations and wastewater effluent exceedances remains at zero due to consistent operational practices.*
↓	Positively Decreasing	The KPI is trending in a good direction while decreasing over time. A lower value in this case represents an improvement, helping achieve desirable service levels.	*Energy consumption per ML treated at both water and wastewater treatment plants is decreasing due to efficiency upgrades.*
↑	Negatively Increasing	The KPI is trending in a bad direction and worsening over time. This suggests an ongoing issue that may require intervention to prevent further negative impacts.	*The number of odour complaints near sewer crossings and customer calls for low water pressure are increasing, indicating potential asset or operational issues.*
→	Negatively Stable	The KPI remains at a Poor level, with no expected improvement or further decline. While the situation is not worsening, it also means no progress is being made toward improvement.	*A cohort of aging cast iron watermains and vitrified clay sewers continues to show Poor condition, with limited reinvestment planned in the short term.*
↓	Negatively Decreasing	The KPI is trending in a bad direction while decreasing over time. A declining value in this case indicates a worsening condition, requiring attention to mitigate risks and negative consequences.	*The number of certified water and wastewater operators is declining, creating risks for regulatory compliance and operational continuity.*

Table 3-5: RCs Current and Proposed Levels of Service

#	LoS Measures	Customer LoS	Unit	Current Performance	Current Trend	LoS Target	Realistic Proposed Trend	Data Source	Currently Tracking?	Lifecycle Activities	Budget Impact to Meet Proposed LoS	Risk of Not Meeting LOS	Note
1	% of crossings with sufficient or better long-term capacity	Services are available and accessible	%	TBD	↑	90%	→	Lift station flow data; Fort Garry St Vital (FGSV) and SW Interceptor capacity data; future system modeling (recommended for long-term planning and scenario analysis, though it is recognized that system modeling is resource-intensive, both in terms of cost and time)	No	Growth	Medium (Cost of new crossing)	Not meeting capacity; increased overflow risk (for example, to basements).	• Current capacity tracking is limited due to model constraints involving siphons and force mains. • Pumping data from lift stations and capacity information from the FGSV and future Southwest Interceptor crossings can serve as partial inputs. • It is recommended to define capacity performance as follows: – Good: Future/projected peak flow is less than RC capacity – Fair: Current peak flow is less than RC capacity – Poor: Current peak flow exceeds RC capacity ** Capacity ratings are based on the most current data provided; where available, the design horizon year for each RCs (e.g., 2055 for the SW interceptor) should be specified.* • Future targets should consider a 35-year planning horizon and utilize design storm scenarios (e.g., 10-year MacLaren design). • The term "Fair" may be accepted as meeting current requirements, provided future projections confirm sufficient capacity under planned growth scenarios. • This metric highlights a current data gap; investment in flow monitoring and system modeling would enhance future tracking capabilities.
2	# of odour complaints within 150m buffer of RC asset	Services are provided at appropriate levels of risk and support City priorities	#	TBD	TBD	0	↓	Oracle Work and Asset Management (OWAM) Odour Data, Georeferenced	Yes	O&M	High	Increased public complaints, reduced satisfaction, media scrutiny; potential reputational risk.	• System-wide odour complaints in 2020 totalled 380. • It is recommended that when an odour complaint occurs within 150 metres of a RC, the asset be proactively inspected to determine any underlying operational issues. • Although odour complaint data is partially subjective, it remains a useful indicator for potential localized performance issues.
3	% of RCs that meet environmental sustainability and resilience goals	Services are provided at appropriate levels of risk and support City priorities	%	TBD	TBD	TBD (once the City's Climate Action Plan Update is finalized)	TBD	Pending development under Climate Action Plan Update	No	Upgrade	High	Bank washouts, increased exposure or deterioration of RC pipes, and misalignment with long-term climate resilience goals.	• This is a forward-looking metric proposed for alignment with the City's forthcoming Climate Action Plan Update. • Once defined, this metric will help assess the proportion of RCs designed or retrofitted to withstand climate-related stresses. • Future guidance may include flood resilience, erosion protection, and ecological impact thresholds.
4	% of RC monitoring plan complete, based on monitoring criteria	Services are provided at appropriate levels of risk and	%	100%	→	100%	→	Inspection records and crossing age thresholds	Yes	O&M	High	Unknown condition of assets, increased risk of failure, and potential regulatory non-compliance.	• All inspections are currently up to date based on age-related criteria. • Monitoring refers to age- or condition-based inspection, aligned with licence expectations. • Ongoing refinement of the monitoring framework is recommended to ensure continued compliance and proactive risk management.

#	LoS Measures	Customer LoS	Unit	Current Performance	Current Trend	LoS Target	Realistic Proposed Trend	Data Source	Currently Tracking?	Lifecycle Activities	Budget Impact to Meet Proposed LoS	Risk of Not Meeting LOS	Note
		support City priorities											
5	% of RCs in Fair condition or better	Services are reliable and responsive to customers	%	77%	↓	100%	↑	2024 Risk Assessment	Yes	Renewal	High	Increased likelihood of crossing failure, potential fines, and non-compliance with licensing conditions.	• Current performance based on **Section 2.2.5** shows 77% of RCs linear assets have Fair or better condition. • Targeting 100% in Fair or better condition aligns with risk mitigation and regulatory compliance priorities. • Continued investment in renewal planning is recommended to maintain and improve asset condition over time.
6	% of total complete tasks on all RCs IDs on all work orders	Services are reliable and responsive to customers	%	38%	↓	100%	↑	OWAM data	Yes	O&M	Moderate	Increased risk of failure going undetected, potential environmental discharge, and accelerated asset deterioration.	• The current task completion rate indicates opportunities for improved follow-through on assigned work. • Enhancing task closure rates will support early detection of issues and reduce long-term maintenance costs. • It is recommended to establish a target based on achievable operational capacity and integrate into O&M performance tracking.
7	% of emergency repair costs relative to total capital repair costs for past three years	Services are affordable and lowest cost	%	21%*	↑	10%	↓	RCs Budget Expenditures	No	O&M	Moderate to High	Uncontrolled increase in emergency spending, financial strain on sewer rates, and reactive service delivery.	• This metric reflects the balance between proactive and reactive spending over a rolling three-year window. • It is recommended to formalize tracking using consistent capital and emergency expenditure categories. • A decreasing trend will indicate improved financial planning and system resilience.
8	% of RC inspection costs relative to total O&M costs for past 3 years (Contracted Services + In House)	%	%	TBD	→	Similar range	→	RCs Budget Expenditures	Yes	O&M	Medium	Lack of cost control or overspending on inspections without value-driven return; potential inefficiency in O&M practices.	• Current CCTV inspection costs for wastewater infrastructure are estimated at approximately $10,000/km (2023 CIBI). • Although inspection cost is not a direct service-level outcome, tracking it supports financial stewardship and cost-efficiency review. • It is recommended that inspection cost trends be reviewed periodically to validate the effectiveness of O&M strategies.
9	% of Capital Reinvestment / Replacement Value of RCs	Services are affordable and lowest cost	%	0.94%	↑	0.8%	↑	RCs Budget Expenditures	Yes	Renewal	High	Financially unsustainable service delivery; increased emergency costs; capital reinvestment may not reflect true long-term needs.	• Capital reinvestment rate is a core affordability metric that reflects whether long-term funding matches asset value and aging. • Current performance is calculated using an average capital reinvestment expenditure of approximately $6.35 million from 2018 to 2024[13], divided by a total replacement value of $263 million. – This average is heavily influenced by a one-time expenditure of $35 million in 2024, which may not reflect typical annual reinvestment levels over the medium to long term. – The estimate includes capital allocations specifically under RCs monitoring and rehabilitation and the Southwest Interceptor RC project. • LoS target is based on the capital reinvestment need under the unlimited budget scenario, calculated as the twenty-year annual average from 2025 to 2044 ($28 million, $1.4 million annually), as detailed in **Section 6.3**. • Recommended to apply this metric to RCs by using planned capital budgets and updated replacement value estimates. • A consistent tracking method will support long-term financial planning and proactive risk reduction.

*21% has a low confidence due to historical reporting quality. Figure also does not include additional maintenance and operational costs associated with emergency response. The 10% target requires consideration once sufficient data is captured and the City enters a stable period of repair and replacement.

↑ Positively Increasing	→ Positively Stable	↓ Positively Decreasing	↑ Negatively Increasing	→ Negatively Stable	↓ Negatively Decreasing

[13] City of Winnipeg (2025) WW-funded 2018 to 2027.xlsx.

Table 3-6 presents the weightings assigned to each LoS performance measure, categorized by the four customer service attributes and associated corporate objectives. These weightings are being updated with input from the City and are in alignment with the process previously created. They reflect the relative importance placed on each metric in evaluating the overall service performance of the RCs assets. Measures with higher weightings represent critical priorities for service delivery, such as maintaining system capacity, regulatory compliance, and asset condition. The table serves as a foundational reference for interpreting performance results and guiding future AM planning decisions, particularly in prioritizing investment, maintenance activities, and continuous improvement initiatives.

Table 3-6: RCs KPI Weighting Summary

Customer Service Attribute	Corporate LOS Objective	Weighting	Technical LoS Measures	Unit
Capacity and Use	Services are available and accessible	100%	% of crossings with sufficient or better long-term capacity	%
Legal / Regulatory and Service Priorities	Services are provided at appropriate levels of risk and support City priorities	20%	# of odour complaints within 150m buffer of RC Asset	#
		0%*	% of RCs that meet environmental sustainability and resilience goals	%
		80%	% of RC monitoring plan complete, based on monitoring criteria	%
Quality and Function	Services are reliable and responsive to customers	50%	% of RCs in Fair condition or better	%
		50%	% of total complete tasks on all RCs IDs on all work orders	%
Affordable	Services are affordable and lowest cost	40%	% of emergency repair costs relative to total capital repair costs for past 3 years	%
		10%	% of RC inspection costs relative to total O&M costs for past 3 years (Contracted Services + In House)	%
		50%	% of Capital Reinvestment / Replacement Value of RCs	%

**To be modified once the City's Climate Action Plan Update is finalized*

3.6 Future Demand Drivers

Managing future demand is essential to ensuring that the desired LoS for all RCs are achieved in a sustainable and cost-effective manner. Identifying and understanding the various drivers of demand enables the City to proactively plan for changing service expectations and infrastructure needs, while aligning with its long-term strategic objectives.

Wastewater infrastructure, particularly critical assets such as RCs, is influenced by a range of political, environmental, social, economic, and technological factors. As part of this project, future demand drivers were identified through internal engagement and technical discussions. Key drivers anticipated to affect the City's ability to maintain and enhance LoS for RCs include, but are not limited to:

- **Aging infrastructure:** The continued use of legacy assets, including older force mains, siphons, and concrete or steel pipes, increases the need for timely rehabilitation or replacement to maintain service reliability and mitigate risk. The increased probability of asset failure with increasing service life may result in capacity constraints.
- **Regulatory changes:** Evolving Provincial and Federal environmental requirements, as well as conditions outlined in the City's wastewater treatment plant licences, may introduce new monitoring, design, or reporting obligations for RCs. Currently this has manifested in increased technical complexity for new installations (for the ability to monitor) but may impact cost should secondary containment ("pipe-within-pipe") be mandated.
- **Climate change impacts:** More frequent extreme weather events, increased precipitation, and rising river levels will place added hydraulic and physical stress on RCs, highlighting the need for climate-resilient design and condition monitoring strategies. The City is progressing sewer separation, in-line storage and offline storage to counteract increasing demand on the sewer network.

- **Population and employment growth:** Continued urban development and densification are expected to increase wastewater flows (from both sanitary and stormwater sources), potentially requiring system expansions, additional crossings, or capacity upgrades to maintain service levels.
- **Skilled labour and succession planning:** Workforce transitions, including retirements and technology-driven skills gaps, emphasize the need for strategic human resource planning, cross-training, and investment in operator and technical staff development.
- **Funding availability:** Access to sustainable capital and operating funding will be a key factor in the City's ability to deliver proactive maintenance, complete condition assessments, and renew infrastructure in alignment with desired LoS. Organizational capacity will become an issue should funding increase beyond the ability of City staff to enact projects. Currently the City can tolerate one large repair a year before being constrained (either financially or by internal resources).
- **Contractor and supply chain availability:** Limited availability of qualified contractors, construction materials, or specialized equipment may delay major rehabilitation or construction projects, particularly in a constrained capital delivery environment.
- **Fluctuating project costs:** Volatility in material, labour, and logistics pricing can create uncertainty in long-term budget planning, potentially impacting the affordability and timing of major projects. The rate of inflation experienced by municipal construction is greater than that used on a consumer basis and differs from the internal rate of inflation used for budget calculation by the City.
- **City strategic goals:** CSO Master Plan sets a control target to increase the volume of combined sewer flow that is captured and treated from a 2013 baseline of approximately 74% to 85% by 2045. This increase in captured flow is expected to result in greater throughput demands at downstream facilities such as RCs. As such, the impact on hydraulic capacity should be considered during full segment renewal and replacement to ensure the system can accommodate future flow conditions.

As these drivers evolve, it will be critical for the City to regularly review service demands, update AM strategies, and incorporate flexible planning approaches. Future LoS expectations should reflect both anticipated growth and system constraints while ensuring resilience to external pressures. This will help the City remain well-positioned to provide reliable and sustainable wastewater service for its RC assets.

3.7 Gaps and Recommendations

The gap analysis process is an essential part of developing a meaningful and actionable LoS framework. As demonstrated in **Section 3.5**, while several performance measures are already tracked by the City of Winnipeg, a number of LoS indicators for WWS RCs remain in development or require further refinement. These gaps relate to issues such as incomplete data, system modeling limitations, emerging regulatory demands, and challenges in work order tracking and reporting.

Table 3-7 summarizes key gaps in LoS development and monitoring, as well as practical recommendations to strengthen future service delivery. Each recommendation is designed to support risk-informed planning, improve data quality, and enhance alignment with the City's broader AM objectives.

Table 3-7: LoS Gaps and Recommendations Summary

Linked Section / KPI	Gap	Recommendations
KPI #1 – Capacity (% of crossings with sufficient or better long-term capacity)	• No system-wide capacity metric is currently available due to modelling limitations associated with siphons, force mains, and older infrastructure. (**Gap#12**) • Available data sources, such as lift station pumping records and design capacity for FGSV and future Southwest Interceptor crossings, are not currently integrated into a formal performance evaluation framework. (**Gap#13**) • There is no current mechanism to evaluate whether crossings meet capacity needs under current or future flow conditions. (**Gap#14**)	• Develop a fit-for-purpose hydraulic capacity assessment framework for RCs using available lift station data and crossing design information. (**Recommendation#4**) • Define clear rating thresholds using the following logic (**Recommendation#5**): – Good: Future/projected peak flow < RC capacity (35-year planning horizon) – Fair: Current peak flow < RC capacity – Poor: Current peak flow > RC capacity • Use flow projections under a 10-year MacLaren design storm for gravity siphons and maximum pumping capacity for force mains. (**Recommendation#6**) • Identify data gaps and supplement with targeted flow monitoring at high-risk crossings. (**Recommendation#7**) • Incorporate sewer capacity results into lifecycle planning and prioritize upgrades for any crossings assessed as an SPG or 4 or 5. (**Recommendation#8**) • As an interim step, initiate a RC mini-model to support risk screening until a full system-wide capacity model is feasible. (**Recommendation#9**)
KPI #2 – Odour Complaints (# of odour complaints within 150m buffer)	• Odour complaints not fully geo-referenced to RCs. (**Gap#15**)	• Update OWAM workflows to include standardized location input (address or GIS coordinates) for each odour complaint. (**Recommendation#32**) • Cross-reference complaints occurring within 150 metres of a crossing with inspection scheduling. (**Recommendation#33**) • Incorporate odour complaint investigation results into quarterly service-level reviews. (**Recommendation#34**)
KPI #3 – Environmental Resilience (% of crossings meeting sustainability goals)	• Environmental resilience metric not yet defined. (**Gap#16**)	• Once the Climate Action Plan Update is finalized, define asset-specific criteria such as bank stabilization, freeboard, scour protection, and pipe material standards. (**Recommendation#35**) • Integrate these criteria into capital project scopes and tracking dashboards. (**Recommendation#36**) • Pilot two climate-resilient renewal projects as a demonstration of best practice. (**Recommendation#37**)
KPI #4 – RC Monitoring (% of RC monitoring plan complete, based on monitoring criteria)	• Monitoring is currently defined and tracked based solely on age-related inspection thresholds. (**Gap#17**) • There is a potential gap in proactively capturing broader performance indicators (e.g., hydraulic stress, erosion, structural risk) that may impact asset reliability between inspections. (**Gap#18**)	• Activity no longer required by the City. (**Recommendation#62**) • Formalize the monitoring plan contained herein that includes condition inspections, interim screening (e.g., visual spot checks or remote flow indicators), and risk-based reinspection cycles. (**Recommendation#63**) • *Regularly review and update monitoring criteria to align with evolving regulatory expectations and asset risk profiles.* Activity updated and no longer required by the City. (**Recommendation#64**) • Ensure all monitoring activities, including inspections triggered by age, condition, or event-based thresholds, are captured consistently in the City's asset management system. (**Recommendation#65**) • Enhance documentation and reporting protocols to support compliance audits and operational transparency. (**Recommendation#66**)
KPI #5 – Asset Condition (% of crossings in Fair condition or better)	• Limited condition data coverage across all crossings. (**Gap#19**)	• Continue the condition assessment program to understand the condition of all RCs and consider integration of information from non-RCs covered under the regular gravity main condition assessment program. Consider prioritization of those still relying on age-based proxies. (**Recommendation#38**) • Use the updated 2024 risk assessment data to finalize baseline condition performance. (**Recommendation#39**)
KPI #6 – Task Completion (% of total complete tasks on all RCs IDs)	• Incomplete work order closure rates for RC-related activities. (**Gap#20**)	• Create a work order type/category using an unused data field in the CMMS that can be applied to all work relating to HRRC assets. (**Recommendation#10**) • Develop automated CMMS dashboards to flag overdue or partially closed work orders and email weekly exception reports to supervisors. (**Recommendation#11**) • Schedule and complete work orders such that superseded work orders are closed out when a more recent is completed. (**Recommendation#12**) • At completion of a work order schedule the next for the correct frequency instead of an automatic schedule at the start of the year. (**Recommendation#13**) • Provide refresher CMMS training for O&M staff to improve data entry accuracy and completion rates. (**Recommendation#14**) • Establish an interim LoS target of ≥ 75 % fully closed work orders within three years, monitored via quarterly CMMS performance reviews and reported in the annual LoS dashboard. (**Recommendation#15**) • Review individual task completion of work orders (particularly valve actuation) for consistently incomplete tasks and over actuated valves. (**Recommendation#16**)
KPI #7 – Emergency Repairs (% of emergency vs. capital repair cost)	• Emergency vs. planned capital spending not disaggregated for RCs. (**Gap#21**)	• Create unique cost codes to separate emergency repairs from planned renewals in financial systems. (**Recommendation#40**) • Report a three-year rolling average of emergency-to-capital spending ratio and use it as an indicator of risk exposure. (**Recommendation#41**) • Target a long-term ratio of ≤15% to support stable financial planning. (**Recommendation#42**)
KPI #8 – Inspection Costs ($/km)	• Inspection costs tracked but not used for decision-making. (**Gap#22**)	• Monitor cost trends over time to support decisions on inspection frequency, contract management, and bundling opportunities. (**Recommendation#43**)
Section 3.3: Rightsholders and Stakeholders Identification	• Environmental and stakeholder engagement is ad-hoc. (**Gap#23**)	• Develop a formal protocol for engaging regulatory agencies, Indigenous communities, and environmental groups during project scoping and design phases. (**Recommendation#78**) • Publish the crossing summary annually, highlighting inspection results, identified risks, and planned improvements for transparency. (**Recommendation#79**)
Section 3.6: Future demand calculation	• Future demand and capacity is not specifically calculated and known. (**Gap#24**)	• Demand drivers such as increasing population, forecast climate change and the CSO master plan will increase demand. A consistent process for determination of the hydraulic capacity over the life of a renewal or replacement should be agreed and implemented prior to future works. (**Recommendation#17**) • A full combined sewer hydraulic model should be consulted with inputs from future developments/densification, population increase forecasts and the impact of other existing City projects (see KPI#1 gap above). (**Recommendation#18**)

4. Lifecycle Management Plan

The objective of the Lifecycle Management (LCM) plan is to identify and define the full range of activities required to operate, maintain, and renew RCs assets in order to sustain the current Level of Service (LoS). This includes clarifying responsibilities for each activity and ensuring alignment with the roles of Rightsholders and Stakeholders as identified in **Section 3.3**, where the Rightsholder and stakeholder matrix is presented, showing their level of interest and influence. To support this objective, a series of high-level tasks and planning tools were developed, including a decision-making flowchart for repair and rehabilitation, and a flowchart for determining inspection frequencies. Together, these components provide a structured and proactive approach to managing asset performance over time.

4.1 Stakeholder Responsibilities

Rightsholders and stakeholders play key roles in the LCM of Winnipeg's RCs assets. Their responsibilities span five LCM stages in line with the City's 2024 Infrastructure Plan — Growth (acquisition), Upgrade (improvement and expansion), Operations and Maintenance (O&M), Renew (renewal and replacement), and Disposal (including decommissioning and disposal). The following sections outline how each group contributes to these stages, supporting effective, inclusive, and accountable AM.

4.1.1 Growth & Upgrade (Asset Acquisition, Improvement, and Expansion)

The acquisition and expansion of sewer crossing infrastructure in Winnipeg is a multi-stakeholder process led primarily by the WWD. Within the WWD, the Asset Management Branch is responsible for long-term budget planning, while the Wastewater Planning and Project Delivery Branch evaluates the need for new assets based on system performance, growth projections, and infrastructure gaps. These efforts culminate in the development of detailed business cases and 20-year investment plans, which outline projected expenditures and strategic priorities.

These plans are submitted to City Council and relevant committees for review and approval. Council holds the authority to approve capital budgets and may influence project scope through funding decisions. Oversight is provided by the Executive Policy Committee and Standing Policy Committee of Water, Waste and Environment, which ensures that WWD's planning aligns with broader municipal objectives. Budget constraints and requests for reductions during the planning phase can significantly affect the timing and scale of asset improvements or expansions.

Once funding is approved, the Design and Construction Branch is responsible for procuring the asset and coordinating construction and installation services. The Provincial Government plays a regulatory role, requiring Notices of Alteration for certain projects and ensuring compliance with environmental and planning regulations. The Federal Government may also be involved, particularly in projects that trigger national environmental legislation such as the Fisheries Act or the Canadian Environmental Protection Act (CEPA).

Indigenous communities are essential Rightsholders in this stage, especially when projects intersect with traditional territories or culturally sensitive areas. The City's Indigenous Relations Branch coordinates heritage screenings and consultation processes to ensure respectful and inclusive planning. Engineering consultants and contractors support the technical aspects of design and construction, while public and local communities contribute through engagement sessions that help shape project priorities and promote transparency.

This collaborative and structured approach ensures that asset acquisition is not only technically and financially sound but also aligned with regulatory requirements, community expectations, and long-term service goals.

4.1.2 Operations and Maintenance (O&M)

Operations and maintenances are critical components of the sewer crossing lifecycle, ensuring that infrastructure remains functional, safe, and compliant with regulatory standards. The WWD leads this phase through a coordinated effort across several internal branches. The Asset Management Branch is responsible for planning and delivering condition assessment and monitoring programs, which form the foundation for maintenance planning and lifecycle forecasting. This includes managing a structured condition assessment program for RCs that informs both short-term interventions and long-term renewal strategies.

Routine inspections and maintenance activities are carried out by various groups within the Wastewater Services Division (WWD), which includes the Operations team, Maintenance Branch, and Wastewater Collections staff. The division is responsible for valve exercising, flushing, and inspections. Within this structure, the Operations team conducts planned inspections and routine visual assessments, while the Maintenance Branch supports these efforts through valve maintenance and other corrective actions. Wastewater Collections staff also contribute to visual inspections and valve operations, ensuring that field-level observations are captured and addressed. Additionally, SCADA systems are monitored by Wastewater Services; however, workshop feedback highlighted that these systems often lack standardization and are not consistently supported by training or clear operational protocols.

The Operations team currently performs weekly drive-by visual inspections at high-risk crossings to check for signs of leakage or surface anomalies. While this practice provides a basic level of oversight, it lacks the depth needed to proactively manage aging infrastructure. To enhance system reliability and reduce reactive maintenance, it is recommended that the City alter its O&M activities to include physical interventions such as valve actuation, movement testing, and flushing routines. These activities help verify mechanical integrity, prevent seizure, and ensure operational readiness in emergency scenarios. Drive by inspections are only of use in circumstances where there is an immediate threat of release and no existing controls are in place to make Operations aware of any asset failure.

The integration of instrumentation and alarm systems into SCADA has been inconsistent, with alarms frequently installed without clear criteria or executive action plans. This has led to calls for improved practices, including the adoption of alarm rationalization standards such as ANSI/ISA-18.2[14] and EEMUA 191[15]. ANSI/ISA-18.2 provides a comprehensive framework for the design, implementation, and management of alarm systems, including guidance on alarm identification, prioritization, and classification. EEMUA 191 complements this by offering practical recommendations and performance benchmarks to ensure alarm systems are effective and manageable. An alarm rationalisation project is advised based upon City staff experience.

While public feedback during this phase tends to focus more on traffic disruptions from construction than water quality concerns, community input still plays a role in shaping operational priorities. Complaints and service requests help identify emerging issues and guide the allocation of maintenance resources. Overall, the O&M phase relies on a collaborative, cross-functional approach within WWD, supported by data-driven planning and continuous improvement in monitoring and response systems.

A key method for rehabilitating linear assets is installation of a Cured-in-Place Pipe (CIPP) liner. Key O&M requirements often include:

- Pre- and post-lining CCTV inspections to verify pipe cleanliness, liner integrity, and proper service reinstatement.
- Monitoring for defects such as delamination, blistering, or improper curing.
- Careful reinstatement of service connections to avoid damage (often included in rehabilitation contract).
- Avoidance of aggressive cleaning methods that could compromise liner integrity.

Only pre-qualified or approved installers may perform CIPP work for the City. Additionally, pre- and post-repair video documentation is required for all types of sewer rehabilitation to ensure quality control and accountability.

4.1.2.1 O&M of Appurtenant Assets

Appurtenant assets such as chambers, maintenance holes, valves, and reducers play a critical role in the overall performance and reliability of sewer systems. Regular O&M activities are essential to ensure these components function as intended and support the longevity of the broader infrastructure. This section outlines typical O&M practices for these assets, highlights key considerations for specialized components like air release valves and CIPP liners, and identifies areas where current procedures, such as manual actuation of air valves, may require revision to align with best practices.

- **Chambers and Maintenance Holes:** Routine inspections of chambers and maintenance holes are essential to assess structural integrity, check for infiltration or corrosion, and ensure safe access. Maintenance includes debris removal, sealing of leaks, and structural repairs where necessary. Maintenance holes should also be

[14] ANSI/ISA-18.2 (2016). Management of Alarm Systems for Process Industries. American National Standards Institute (ANSI) & International Society of Automation (ISA).
[15] EEMUA 191 (2024). Alarm Systems – A Guide to Design, Management, and Procurement, Publication 191, Edition 4. The Engineering Equipment and Materials Users Association (EEMUA).

checked for proper alignment with surface grades and traffic loading conditions. Inspection using NASSCO MACP grades helps to ensure consistency and a transparent intervention definition.

- **Isolation Valves (Back Water, Ball, Butterfly, and Gate Valves):** Valves require regular exercising to prevent seizing and ensure operability during emergencies. This includes:
  - Turning valves through full range of motion.
  - Lubricating moving parts.
  - Checking for leaks or corrosion at seals and joints.
- **Reducers (Air Release Valves):** Air release valves are critical for removing trapped air in pressurized systems. However, they should not be manually actuated during routine maintenance. Manual actuation can:
  - Cause sudden pressure changes or water hammer.
  - Lead to uncontrolled discharge of wastewater or air.
  - Damage internal components not designed for manual cycling.

  Despite this, current City work order structures may still include ARV actuation as a standard task. This practice should be revised to reflect industry best practices, which recommend visual inspection and leak detection only, unless manufacturer-approved procedures are in place for controlled testing.

Operations indicated that some valves are non-operational and an alternative isolation (inflatable dam) can be used instead. It is recommended that the City evaluate valve operability and possibly removal from service if assets are found to be non-operational and unnecessary.

4.1.3 Renew (Renewal and Replacement)

Renewal and replacement activities are initiated when condition assessments and SPG ratings indicate that a sewer crossing has deteriorated or is approaching the end of its service life. The WWD through its Asset Management Branch, is responsible for identifying these needs based on routine inspection data and performance trends. Once needs are identified, the branch prepares and reviews business cases to justify renewal or replacement, which are then submitted for internal and Council-level approval.

The planning and delivery of these projects involve multiple internal and external stakeholders. Within WWD, the Design and Construction Branch is responsible for executing the renewal or replacement work, including construction administration and coordination with contractors. The Operations team may also provide support during construction, particularly in managing system impacts and ensuring continuity of service.

Funding for these projects often comes from capital budget allocations. However, the current discretionary fund, an unspecified $1 million pool for which every branch competes, has not kept pace with inflation or the growing number of aging assets. This has led to increased competition for limited resources across departments. Budget approvals are managed by City Council, with larger projects, typically those exceeding $5 million, requiring additional oversight and approval.

External stakeholders also play a significant role. The Province of Manitoba is involved in licensing and permitting, particularly for projects that affect waterways or require environmental review. Both the Federal and Provincial Governments may participate in design reviews to ensure compliance with environmental and regulatory standards. Indigenous communities are engaged early in the process, especially when projects intersect with traditional lands or require heritage screening. Their level of involvement is determined on a case-by-case basis, but early consultation is essential to ensure cultural sensitivity and regulatory compliance. The City does not have a duty to consult under the Constitution Act but this requirement is evolving as is determined by the courts.

Consultants and contractors are engaged to support technical assessments, detailed design, and construction delivery. Their expertise is critical in ensuring that renewal and replacement projects are executed efficiently, safely, and in accordance with design specifications and environmental requirements.

This collaborative, multi-tiered approach ensures that renewal and replacement activities are well-planned, appropriately funded, and aligned with both municipal priorities and broader regulatory frameworks.

4.1.3.1 CIPP

CIPP liners are a key method for rehabilitating aging sewer infrastructure, offering a cost-effective alternative to full pipe replacement. They help maintain structural integrity and hydraulic performance but require proper installation and ongoing maintenance to achieve their expected service life (ESL). Types of CIPP liners include Applied Felts, Armtec, Insituform, and other Liner Products.

The City maintains its own specifications for CIPP installation and sewer maintenance, outlined in CW 2140 – Sewer Cleaning are embedded into Part E – Specifications, of each CIPP construction tender. These documents define the standards for cleaning practices, liner installation, inspection protocols, and contractor qualifications. CW 2145 specifically outlines the technical requirements for sewer and manhole inspections. Part E Specifications for CIPP defines liners, including material properties, curing methods, and structural performance criteria. CW 2140 provides guidance on acceptable cleaning methods to prevent damage to liners and ensure pipes are properly prepared prior to rehabilitation.

4.1.4 Disposal (Decommissioning and Disposal)

Decommissioning and disposal of sewer crossings are typically approached on a case-by-case basis, depending on the asset's condition, location, and potential environmental or legal implications. In many instances, crossings are abandoned in place, particularly when removal is not technically necessary or would pose greater environmental risk. However, in sensitive locations, such as riverbeds, removal may be required to prevent ecological disruption or navigational hazards.

The WWD leads the decommissioning process through a coordinated effort between its Asset Management and Design and Construction branches. The Asset Management Branch is responsible for identifying decommissioning needs based on inspection data and condition assessments. This Branch also prepares the necessary business cases to justify decommissioning activities and ensure alignment with broader asset management strategies. Once a project is approved, the Design and Construction branch oversees contract administration and the physical delivery of the work, including coordination with contractors for safe execution.

The City's engineering and legal teams may be consulted to evaluate structural risks, environmental obligations, and regulatory requirements associated with abandonment or removal. Indigenous communities are also important stakeholders in this phase, particularly when decommissioning activities may affect culturally significant areas or traditional lands. Early consultation helps determine the appropriate level of involvement and ensures that the process respects cultural and legal considerations.

Contractors are engaged to carry out the physical work, whether that involves securing abandoned infrastructure or fully removing it. Their role is critical in ensuring that decommissioning is completed safely, efficiently, and in compliance with applicable standards. This structured, multidisciplinary approach ensures that decommissioning decisions are made responsibly, balancing technical feasibility, environmental protection, and community interests.

4.2 Incorporation of Risk Matrix

The incorporation of a risk matrix into the lifecycle management of Winnipeg's sewer crossings is a critical step in ensuring that infrastructure decisions are both proactive and resilient. This activity focuses on aligning risk assessment with the previously defined lifecycle stages, such as asset acquisition, maintenance & operation, renewal, and identifying potential vulnerabilities associated with each. By doing so, the City can better anticipate challenges, prioritize interventions, and allocate resources more effectively.

The process begins with a review of existing risk assessments and mitigation strategies already in place for relevant activities. These are then evaluated in the context of the lifecycle stages to ensure alignment and identify any gaps. Each lifecycle activity is assessed for potential risks, ranging from structural failure and environmental impact to regulatory non-compliance and funding delays. Where risks are identified, additional mitigation strategies are proposed, including enhanced monitoring, design modifications, or contingency planning. This comprehensive approach results in a robust risk management plan that supports informed decision-making and long-term asset sustainability.

For details on how the risk and criticality is assessed and prioritized, refer to **Section 5 – Risk Management Plan**.

4.3 Lifecycle Activities

This section outlines the tools and strategies used to guide long-term planning, inspection, and intervention decisions for RCs assets. It begins with a Lifecycle Activity Plan that defines the types of actions required to maintain the current LoS. This is followed by a Repair, Rehabilitation, and Renewal Flowchart, which provides a structured decision-making process for selecting appropriate remedial actions based on asset condition and accessibility. Finally, the Inspection Frequency section details how inspection intervals are determined using asset characteristics, remaining useful life, and performance grades to ensure timely and effective monitoring. Together, these components form the foundation of a proactive and informed AM approach.

4.3.1 Lifecycle Activity Plan for Maintaining Current LoS

To ensure Winnipeg's RCs continue to deliver the current Level of Service (LoS) over the next two decades, a comprehensive lifecycle activity plan has been developed. This plan builds on previous work completed by AECOM and aligns with the City's asset management framework. It incorporates a balanced mix of proactive and reactive strategies designed to uphold infrastructure performance, safety, and regulatory compliance. The activities are organized into five key categories that reflect the full spectrum of asset management needs, from early monitoring to urgent interventions:

- **Monitor and Forecast:** This group includes ongoing monitoring activities such as routine inspections, SCADA data analysis, and geotechnical assessments. These efforts are led by WWD's Asset Management and Operations teams and are essential for tracking asset condition, identifying early signs of deterioration, and forecasting future maintenance or renewal needs. Monitoring also supports the refinement of SPG ratings and informs long-term planning.
- **Proactive Assessment:** Proactive condition assessments (also considered as monitoring tasks) are scheduled based on asset age, material, SPG, and risk profile. These include CCTV inspections, structural evaluations, and flow monitoring. The goal is to detect issues before they escalate, enabling timely interventions. This group also includes alarm rationalization and instrumentation reviews to improve the effectiveness of monitoring systems.
- **Repair / Replace on Failure:** This category addresses reactive maintenance, where assets are repaired or replaced following a failure or service disruption. This approach is appropriate for low-risk assets and is necessary for unforeseen events or when assets reach the end of their useful life unexpectedly. WWD's Maintenance and Construction teams are responsible for executing these activities, often under time-sensitive conditions. Capital contingency funds may be used to support emergency interventions, subject to Council approval.
- **Programmed Rehabilitation / Replacement:** This group includes planned rehabilitation and replacement projects identified through condition assessments and lifecycle modeling. Activities may involve point repair, lining, segmental replacement, or full asset renewal. These projects are prioritized based on SPG ratings, risk exposure, and available funding. Business cases are developed by WWD's Asset Management Branch and delivered by the Design and Construction branch, with oversight from Council and the Executive Policy Committee.
- **Urgent Rehabilitation / Replacement:** Urgent interventions are required when assets are found to be in critical condition during inspections or when failure is imminent. These projects are fast-tracked and may bypass standard planning timelines. Coordination across WWD branches is essential to mobilize resources quickly. Indigenous consultation, environmental permitting, and contractor engagement must also be expedited to ensure timely delivery.

4.3.2 Repair, Rehabilitation, and Renewal Flowchart

The flowchart shown in **Figure 4-1** is a decision-making tool used to determine what kind of repair, rehabilitation, or renewal is needed for a pipeline after it has been inspected and assessed structurally. It helps to inform part of the RCs Condition Assessment Program[16] and is designed to guide staff through a step-by-step process based on the condition of the asset. The start of the flowchart ties in with the previously established "WBS 7.0 – Condition Assessment, Recommendations, and Report", as part of the overall RCs Condition Assessment Program flowchart.

[16] AECOM (2024). High Risk River Crossings – Phase Three Condition Assessment Report.

The chart uses the Structural Performance Grade (SPG) to determine what kind of action is appropriate. The goal is to make sure each crossing is managed in a consistent way, based on its condition, and to extend its useful remaining life where possible. The flowchart starts by asking: Is the crossing damaged? If it is, the next steps depend on how bad the damage is, whether it's localized or extensive, if the damaged area can be accessed, and if external repairs are possible. Based on these answers, the chart helps decide whether the crossing needs any of the following repair or renewal actions:

- **Ongoing Monitoring & Routine Maintenance:** This activity includes regular inspections, cleaning, and condition assessments to ensure the sewer crossing remains functional and safe. It is a preventive approach aimed at early detection of issues before they escalate, to maintain asset performance, extend service life, and inform future rehabilitation planning. Examples of this activity include:
    - CCTV Inspections: To visually assess internal pipe conditions.
    - Flow Monitoring: To detect blockages or abnormal flow patterns.
    - Cleaning: Removal of debris, sediment, or roots using flushing or mechanical methods.
    - Maintenance Hole Inspections: Checking for structural integrity and access safety.
- **No Rehabilitation or Remedial Work Required:** Crossings with a SPG of 1 or 2 are considered to be in Good condition. These do not require any immediate rehabilitation or remedial work. Such crossings are only subject to routine maintenance and ongoing monitoring to ensure their condition does not deteriorate over time.
- **External Point Repair:** External point repair involves excavating and repairing a localized section of a pipe from the outside. This method is used when the damage is confined to a small area and is accessible without requiring full pipe replacement or lining.
- **Point Repair Contingency:** This is a budgetary allowance set aside for future point repairs or rehabilitation work. It applies to crossings with an SPG of 3, where deterioration is evident but not yet critical. The purpose is to ensure timely intervention if conditions worsen, without needing to wait for new funding or planning cycles.
- **Full Segment Lining:** Lining involves installing a new liner inside the existing pipe to restore structural integrity and extend service life. This is a trenchless technology that minimizes surface disruption. It is used for crossings with an SPG of 4, indicating significant deterioration that affects a larger portion of the pipe. Example methods include CIPP and slip lining.
- **Full Segment Renewal:** This is the complete replacement of a sewer pipe segment, typically involving excavation or trenchless techniques such as pipe bursting. It is the most invasive and costly option, reserved for pipes that are structurally unsound, and lining is deemed inappropriate. It is used for crossings with an SPG of 5, where the pipe has failed or is at imminent risk of failure. Examples include open-cut replacement or installation of a new pipe via tunneling.

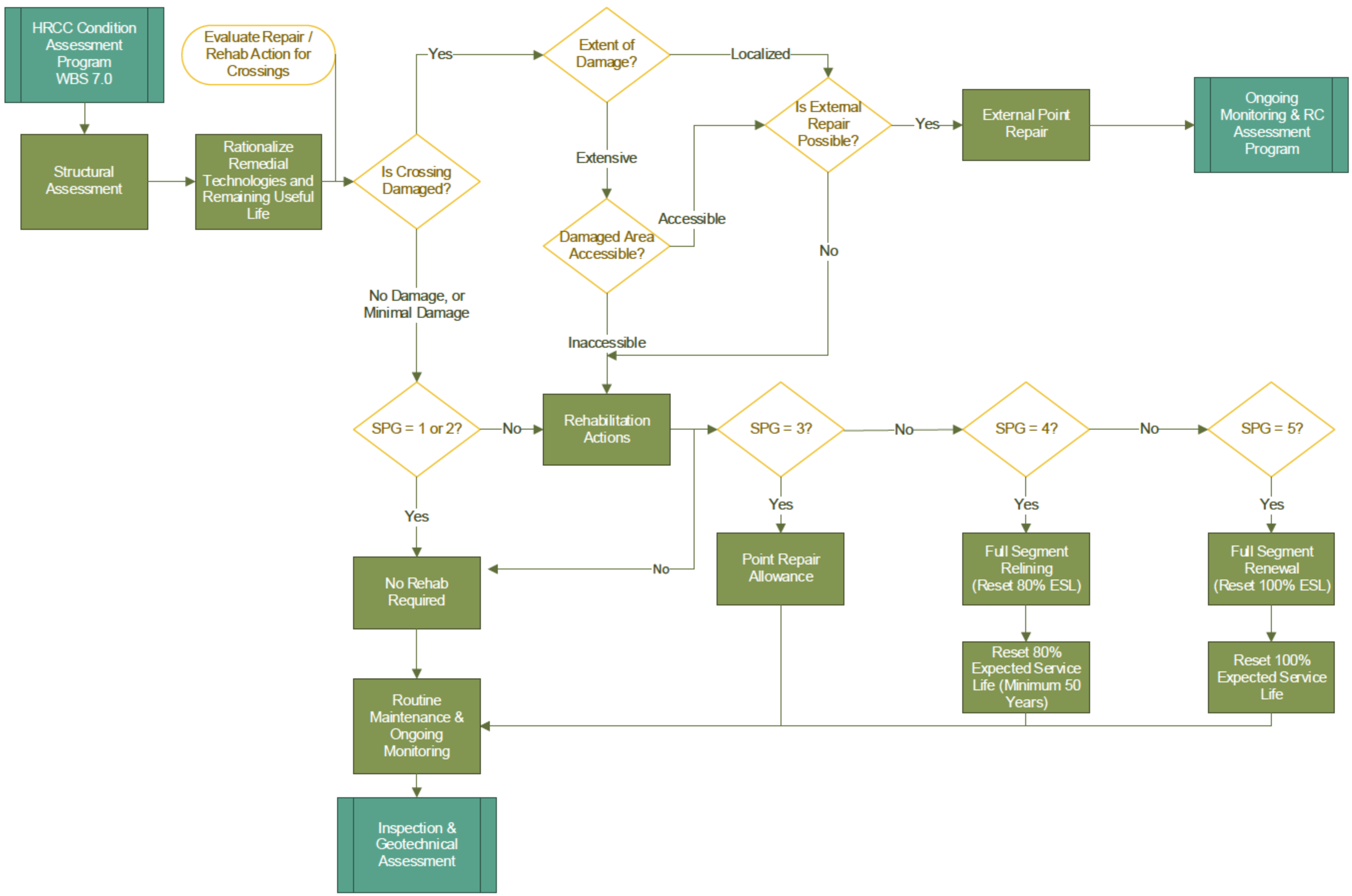


Figure 4-1: Repair, Rehab, and Renewal Flowchart

4.3.3 Inspection Frequency

The frequency of inspections and geotechnical assessments for sewer crossings is determined by several key factors, including the pipe's age, material, rehabilitation status, remaining useful life, and SPG. These criteria help ensure that inspections are both timely and cost-effective, while prioritizing asset safety and longevity.

The decision-making process is illustrated in the flowchart in **Figure 4-2**, and is guided by the following principles:

- **New Pipes (Non-Steel)**: Inspect every 30 years. These materials typically have longer service lives and lower corrosion risk.
- **New Steel Pipes:** Inspect every 20 years due to steel's higher susceptibility to corrosion and structural degradation over time. This reduced time in comparison to non steel pipe assets is due to a pipeline failure experienced by the City.
- **Fully Rehabilitated Pipes:** Treated similarly to new pipes, these should be inspected every 30 years, assuming the rehabilitation method restores full structural integrity.
- **Pipes Near End of Life:** Pipes with less than six years of remaining useful life are not re-inspected, as they are likely candidates for renewal or decommissioning.
- **Mid-Life Re-Inspections:** Pipes should be re-inspected at the midpoint of their estimated remaining service life. *Example:* If a pipe has 22 years of remaining life, it should be re-inspected in 11 years.
- **SPG-Based Maximum Intervals:** For pipes with SPG 1 or 2, the maximum interval between inspections is 20 years, even if other criteria suggest a longer interval. This ensures early detection of unexpected deterioration. As the SPG is a data-based assessment of the pipe it is only assigned once inspection data is available.

In addition to standard inspection intervals, several other factors influence the frequency and timing of LCM activities. In areas with known geotechnical concerns, such as unstable soils, high groundwater levels, or a history of settlement, geotechnical monitoring may be required more frequently, regardless of the pipe's current condition.

Risk-based adjustments are also considered, particularly for higher risk crossings located beneath major roadways or water bodies, or where previous inspections have revealed early signs of deterioration. These crossings may warrant shorter inspection intervals to proactively manage potential failures. Refer to **Section 5.5 – Risk Decision Matrix** for details on how risk is incorporated. Furthermore, inspection schedules are subject to periodic review and may be updated based on new condition data, revised SPG, or changes in environmental conditions. This data-driven approach ensures that lifecycle management remains responsive and aligned with the evolving state of the infrastructure.

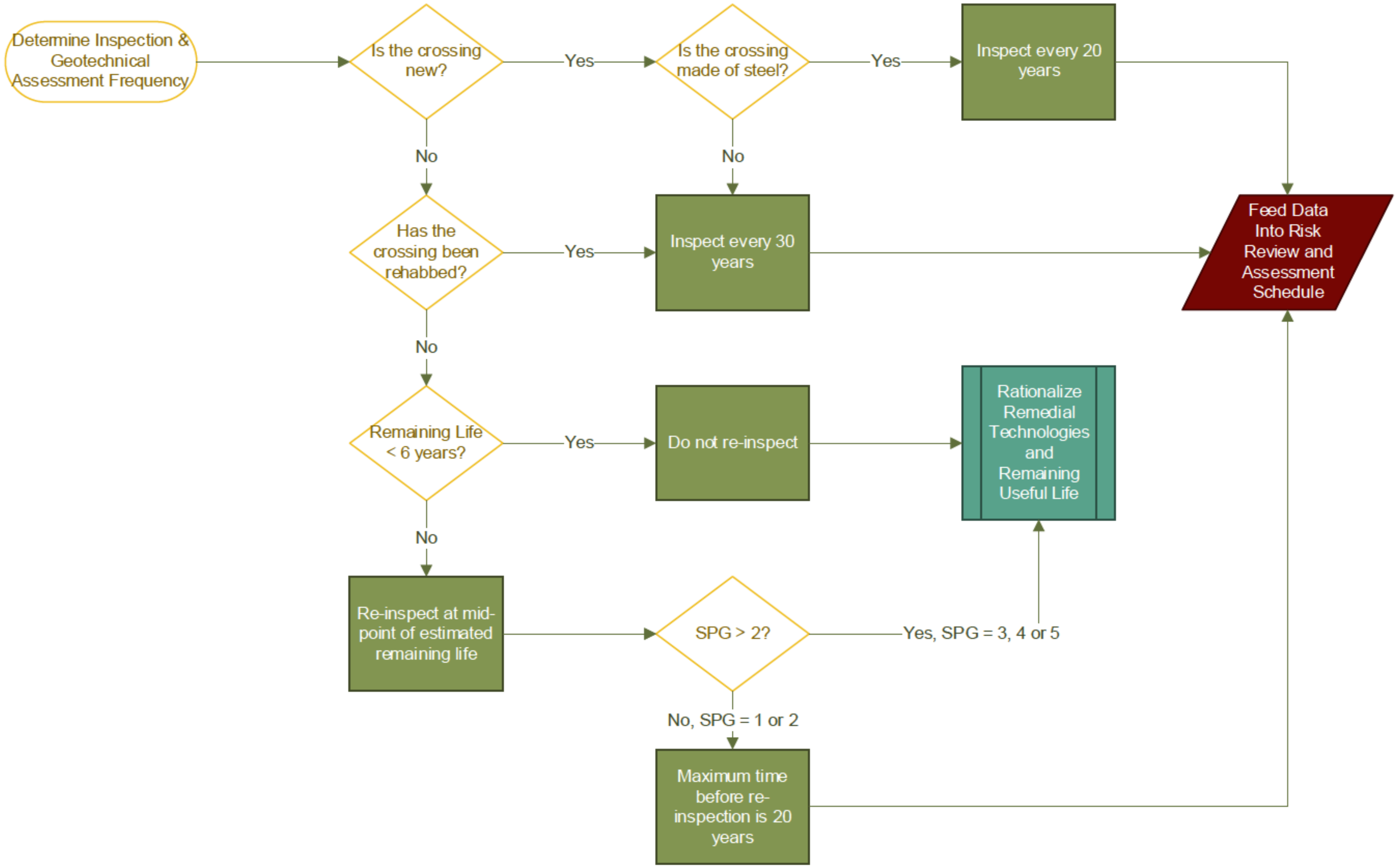


Figure 4-2: Condition Assessment Frequency Flowchart

4.4 Lifecycle Costs Analysis

Lifecycle cost analysis is a critical component in understanding the long-term financial implications of managing the RCs assets. As illustrated in **Figure 4-3**, costs are incurred at distinct stages throughout the asset's effective life, beginning with capital investment, followed by ongoing operation, mid-life refurbishment, and ultimately replacement and disposal. This progression underscores the importance of planning for both predictable and variable expenditures across the full lifecycle of each asset.

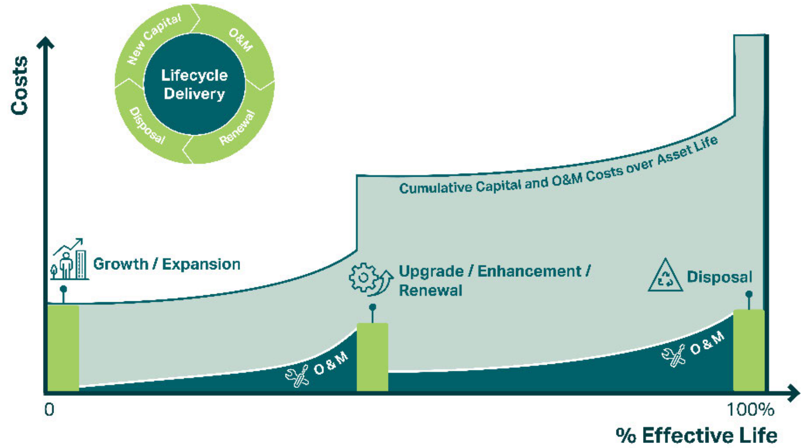


Figure 4-3: Lifecycle Cost Accumulation Over Asset Life

By integrating lifecycle cost analysis into the AM framework, the City can make informed decisions that balance performance, risk, and cost-effectiveness.

Currently in the financial plans, RC costs are often grouped within the broader category of wastewater main infrastructure, which can obscure the unique financial and operational characteristics of these critical assets. This aggregation limits the City's ability to accurately assess the lifecycle needs of sewer crossings, which typically face different environmental stressors, structural demands, and maintenance requirements compared to standard wastewater mains. To address this, it is recommended that the City establish a distinct cost tracking and forecasting framework specifically for sewer crossings. By separating these costs, the City will gain clearer insight into the timing and scale of capital, operations, maintenance, and renewal investments required for each crossing. This targeted approach will enhance the precision of lifecycle cost analysis and support more effective long-term financial planning.

AECOM's methodology will align with this lifecycle delivery model, incorporating the four key stages (Growth , Upgrade, Operations and Maintenance, Renew, and Disposal into a comprehensive cost framework. Once a full list of activities and risk mitigations has been established, it is possible to estimate associated costs to support the City's future financing strategy. These estimates will be informed by historical data, industry benchmarks, and collaboration with the City's finance team to ensure realistic forecasting of future expenditures.This collaboration will support the development of a robust financial strategy that aligns with both short-term budget constraints and long-term objective goals. The outcome will be a replicable framework that can be applied across all RCs assets, enabling consistent and transparent financial planning. For details on the financial model assumptions and forecast ouptuts, refer to **Section 6 - Financing Strategy**.

4.5 Gaps and Recommendations

As part of the lifecycle management process, several data, procedural, and planning gaps were identified that may impact the City's ability to consistently evaluate and manage sewer crossing assets. These gaps were observed across multiple technical documents, including condition assessments, lifecycle activity plans, and annual inspection summaries. Addressing these gaps will improve data reliability, prioritization of lifecycle activities, and long-term asset management decision-making. **Table 4-1** summarizes key gaps along with recommended actions to support future improvements.

Table 4-1: LCM Gaps and Recommendations Summary

Section	Gap	Recommendations
Section 4.1 Stakeholder Responsibilities	Limited documentation of stakeholder responsibilities across lifecycle stages. (**Gap#25**)	• Finalize and implement stakeholder engagement tools to clarify roles and communication pathways. (**Recommendation#74**)
	Indigenous engagement is often reactive and case-by-case. (**Gap#26**)	• Establish a proactive consultation protocol with Indigenous communities across all project stages, in collaboration with the City's Indigenous Relations Division. (**Recommendation#45**)
	Lack of clarity on roles during early planning and regulatory coordination. (**Gap#27**)	• Develop a formal acquisition workflow that defines responsibilities across WWD, Council, and regulators. (**Recommendation#46**)
	Inconsistent alarm configuration and lack of training on SCADA systems. (**Gap#28**)	• Implement alarm rationalization program/project using ANSI/ISA-18.2 and EEMUA 191 standard. (**Recommendation#19**) • Define requirements for SCADA alarms for future projects. (**Recommendation#20**)
	The unspecified, discretionary fund of $1 million has not increased with inflation or asset growth. It is shared across the department and often oversubscribed. Use of the fund requires a formal memo to Council for transfer, which can delay urgent projects. (**Gap#29**)	• Reassess and adjust the contingency fund to reflect current asset inventory and inflation. (**Recommendation#21**) • Establish clearer access protocols and explore dedicated funding streams for high-priority expenditure. (**Recommendation#22**)
	No standardized process for determining when to abandon vs. remove assets. (**Gap#30**)	• Develop a decision-making framework for decommissioning, including environmental and cultural criteria. (**Recommendation#45**)
	Existing non-functioning assets. (**Gap#50**)	• Operations indicated that some valves are non-operational and an alternative isolation (inflatable dam) can be used instead. It is recommended that the City evaluate valve operability and possibly removal from service if assets are found to be non-operational and unnecessary. (**Recommendation#81**)
Section 4.2 - Incorporation of Risk Matrix	Risk matrix not fully integrated into lifecycle planning and prioritization. (**Gap#31**)	• Embed risk scoring into lifecycle decision-making tools and project planning workflows. (**Recommendation#44**)
Section 4.3 - Lifecycle Activities	Inconsistent alignment between SPG ratings and assigned lifecycle actions. (**Gap#32**)	• Standardize decision rules linking SPG levels to specific lifecycle activities as identified in **Figure 4-1**. (**Recommendation#82**)
	Lack of clarity on inspection intervals for certain pipe types and conditions. (**Gap#33**)	• Develop a formal inspection schedule matrix based on pipe material, SPG, and remaining life, based on the **Figure 4-2** flowchart. (**Recommendation#47**)
	Gaps in condition data for older or inaccessible crossings. (**Gap#34**)	• Prioritize data collection for high-risk or data-deficient assets using targeted inspections. (**Recommendation#67**)
	Air release valves are currently included in work orders for manual actuation, which can cause damage or safety risks. (**Gap#35**)	• Revise work order protocols to exclude manual actuation of air valves; adopt visual inspection and leak detection as standard practice. (**Recommendation#23**)
	Post-installation inspections and quality assurance are inconsistently applied. (**Gap#36**)	• Consistently enact formal post-installation inspection protocols in accordance with the City of Winnipeg's specifications.. These protocols include mandatory pre- and post-installation CCTV inspections, verification of service reinstatement quality, and documentation of liner integrity. Ensuring consistent application of these standards will improve quality control, extend asset life, and support accountability across all rehabilitation projects. (**Recommendation#24**)
Section 4.4 - Lifecycle Costs Analysis	Sewer crossing costs are currently aggregated with overall wastewater main costs, obscuring their unique lifecycle and financial requirements. (**Gap#37**)	• Establish a distinct cost tracking and forecasting model specifically for RCs assets, separate from general wastewater infrastructure, to ensure accurate lifecycle analysis and targeted financial planning. (**Recommendation#48**)

5. Risk Management Plan

The risk management plan contained within this section is developed based on a review of previous risk assessment studies, recent condition assessment reports, and discussions with City staff and technical experts. This process includes summarizing key findings by asset class, confirming existing mitigation measures, and validating risks through interdisciplinary input. A structured approach is used to assess the likelihood and consequences of failure, identify risks beyond the City's tolerance, and outline potential treatment strategies. The plan also considers possible trade-offs between mitigation options and their broader implications.

5.1 Overview of Previous Risk Assessments

The 2006 risk assessment[3] focused on sewer crossings of waterways, using a desktop analysis to evaluate risk based on pipe location, type, material, age, and environmental conditions. Due to limited condition data, risk ratings relied on assumptions about material performance, particularly the vulnerability of ferrous pipes in corrosive soils. Since then, most crossings have been inspected through the HRRC and SCA programs. Newer crossings, built with modern materials, are approaching the City's 30-year inspection threshold and are being scheduled for inspection, if not already completed.

During the 2024 risk assessment[2], the approach shifted from a desktop-based methodology to a condition-based model informed by physical inspections. While material, age, and environmental factors remain relevant, the assessment now incorporates direct inspection data to evaluate pipeline deterioration and condition. The techniques used include continuous electromagnetic (EM) inspection, CCTV, LIDAR, SONAR, point ultrasonic (UT) and visual inspections, and material sampling—each offering varying levels of confidence. Assets are assigned condition grades from 1 (new) to 5 (failure), aligned with PACP SPG ratings. Grades 1–2 require no immediate action, grade 3 calls for enhanced monitoring, grade 4 triggers short-term repair planning, and grade 5 requires immediate attention. **Table 5-1** presents the SPG grading implications for sewer crossings infrastructure

Table 5-1: Condition Grade Ramifications for Gravity and Pressure Pipe

Grade	Gravity Sewer Implication	Pressure Pipe Implication
5	Collapsed or collapse imminent	Failed or in a state of incipient failure, hydrostatic integrity compromised
4	Collapse likely in the near future	Structural failure likely in short term, hydrostatic integrity may be compromised
3	Collapse unlikely in the near future but further deterioration likely	Deterioration processes will accelerate in near future, loss of hydrostatic integrity unlikely but elevated risk
2	Minimal collapse risk in the short term but potential for further deterioration	Deterioration processes active, minimal potential for structural failure or loss of hydrostatic integrity in short term
1	New asset or no active deterioration processes present	New asset or no active deterioration processes present

The 2024 risk assessment also reflects an evolution in evaluating pipeline environments, particularly riverbank slope stability. Initial assessments based on the 2000 Riverbank Stability Characterization Study have been enhanced through visual grading using Slope Condition Grade (SCG) and Erosion Condition Grade (ECG) metrics introduced in the Outfall Condition Assessment Program. Sites showing SCG ratings of 3 or higher, or other signs of instability, were subject to further geotechnical and slope stability analysis, with updated SCG values applied where appropriate. In some cases, SCG and ECG data from nearby outfall assessments were transferred to adjacent RC assets.

For this project, AECOM reviewed the consequence of failure (CoF) ratings established in the 2006 and 2024 studies. These CoF values were used to develop the updated risk matrix, which will be presented in the following sections. Since 2006, two new crossings have been added, and several others replaced in kind. A summary of all assets, along with their corresponding information and attributes, is provided in **Section 2** of this report.

Based on the 2024 risk assessment, the overall condition of RC infrastructure is generally good and shows significant improvement over the 2006 assessment. Most high-risk assets have been identified and either renewed, scheduled for renewal, or monitored through programs such as HRRC and SCA. The understanding of condition is a significant reducer of unknown risk. Since 2012, 11 crossings have been rehabilitated or replaced, three are pending renewal, and 10 are backlogged but not considered critical for immediate intervention. Rehabilitation through lining has yielded substantial cost savings in comparison to full replacement, also allowing quicker enactment. Additionally, 12 newer pipelines fall within the City's 30-year inspection window, with six ferrous metal pipes already inspected in accordance with City criteria.

Based on the 2024 risk assessment, the following assets, in **Table 5-2**, were identified as requiring immediate or short-term remediation due to their elevated Structural Performance Grade (SPG) ratings (SPG 3 or higher) and associated risks:

Table 5-2: Key Assets Requiring Remediation Based on 2024 Risk Assessment

Asset ID	Site	SPG	Remediation
S-MA70028006	West Perimeter	3	CIPP, full structural lining
S-MA70053063	Fort Garry St Vital	5	The original pipes have been abandoned, with temporary pipelines currently in place. New siphons are in the design phase and have been considered for replacement in the financial analysis. It is recommended for replacement in the current financial plan. Please refer to **Section 6**. Work has been successfully tendered at time of plan authoring with construction scheduled for late 2025 and early 2026.
S-MA70087290		5	
S-MA70050831	Provencher	3	Reset expansion joint.
S-MA70057885	Norwood	4	Inspect/replace expansion joint(s).
S-MA60023233	Des Trappiste	3	Full Segment Lining, Backlogged.
S-MA20010426	Wellington	4	Full Segment Lining, Pending 2025.
S-MA50009013	Abinojii Mikanah	3	Full Segment Lining, Backlogged.
S-MA50008068	Edgemont	3	Full Segment Lining, Backlogged.
S-MA70013886	Lagimodiere	3	Full Segment Lining, Backlogged.

5.1.1 Risk Matrix Update and Integration of CoF and SPG

This section outlines the updated risk matrix, which integrates Consequence of Failure (CoF) and SPG as core components. CoF captures the potential impact of asset failure across service delivery, environmental, safety, and financial dimensions, while SPG represents the structural condition of the asset, based on observed or assessed physical performance. During AMP creation the methodologies from the 2006 and 2024 studies were reviewed and minor refinements applied to ensure consistency with current assessment practices and decision-making requirements. The revised decision matrix provides a more robust framework for evaluating asset risk and supporting capital planning decisions.

5.2 Consequence of Failure (CoF)

CoF represents the severity of impact resulting from an asset failure and supports risk-informed prioritization. In the 2006 study, CoF was influenced by material and crossing characteristics, such as pipe diameter, material type, flow type (pressure vs. gravity), and redundancy at stream or RCs. Larger diameters and certain material types were associated with greater environmental and operational impacts due to the complexity and duration of repairs. These attributes continue to inform the updated risk matrix, ensuring that failure consequences are appropriately weighted in asset decision-making, as shown below.

- Material Characteristics
  - Diameter (**Table 5-3**) – 15%
  - Material Type (**Table 5-4**)– 5%
- Crossing Characteristics
  - Crossing Type (**Table 5-5**) – 25%
  - Stream Classification (**Table 5-6**) – 35%
  - Number of Pipes (**Table 5-7**) – 20%

Table 5-3: Material Characteristics – Diameter

Diameter	Weight
Unknown	75
500 ≤ D	100
300 ≤ D ≤ 500	75
0 < D < 300	50

Table 5-4: Material Characteristics – Material

Material	Weight
CONCRETE	20
HDPE	80
PE	80
PVC	70
STEEL	30
Unknown	80

Table 5-5: Crossing Characteristics– Crossing Type

Crossing Type	Weight
Bridge Crossing	100
Force main	100
Gravity	10
Inverted Siphon	25

Table 5-6: Crossing Characteristics – Stream Classification

Stream Classification	Weight
Intermediate	60
Large	100
Small	30
Unknown	50

Table 5-7: Crossing Characteristics – Crossing Type

Number of Pipes	Weight
Single	100
Twin	50
Twin-Adequate Separation	25
Twin-Close Separation	75

5.2.1 Final CoF Ratings

The CoF represents the potential impact of an asset's failure. Based on the methodologies outlined in the 2006 and 2024 studies, this project applies a standardized scale from 0 to 100, grouped into three categories:

- **Low Failure Consequence (0–33):** Minimal impact with limited or no disruption to service.
- **Medium Failure Consequence (34–66):** Moderate impact that may affect service levels or require intervention.
- **High Failure Consequence (67–100):** Significant impact with major service disruption, high costs, or broader consequences.

This categorization supports consistent risk evaluation and helps guide prioritization for asset management and capital planning.

5.3 Structural Performance Grade (SPG)

In addition to CoF, the SPG has been used as the condition-based input for calculating risk scores. SPG provides a standardized assessment of asset condition on a scale from 1 to 5, where higher grades indicate more severe structural deterioration. The grading system is defined as follows:

- SPG (100%):
  - 5 – Collapsed or collapse imminent.
  - 4 – Collapse likely in the near future.
  - 3 – Collapse unlikely in the near future but further deterioration likely.
  - 2 – Minimal collapse risk in the short term but potential for further deterioration.
  - 1 – New asset or no active deterioration processes present.

This SPG classification, 2024 study methodologies, enables a consistent evaluation of asset condition and supports its integration into the overall risk scoring framework.

5.4 Risk Calculations

Risk scores were calculated by combining the CoF and the SPG, consistent with methodologies from the 2006 and 2024 studies. CoF reflects the impact of asset failure, while SPG, based on Table 5-1, represents the City's condition assessment of sewer RCs.

$$\boldsymbol{Risk} = \boldsymbol{SPG} \times \boldsymbol{Consequence\ of\ Failure\ (CoF)}$$

The total risk score ranges from 0 to 500, and is categorized as follows:

Very Low: 0–62 | **Low:** 63–124 | **Medium:** 125–187 | **High:** 188–312 | **Very High:** 313–500

This scoring system enables the City to consistently prioritize assets based on both structural condition and potential consequences, supporting data-driven planning and resource allocation.

5.5 Risk Decision Matrix

The analytical approach used in this evaluation is consistent with previous methodologies, such as those applied in the assessment of RC inventories in the City of Winnipeg. In this project, the risk matrix is developed by combining SPG and COF scores as presented in Figure 5-1. This combined framework supports the development of policy guidelines and helps determine appropriate actions for each asset based on defined risk thresholds.

The 2006 study recognized that while failure consequences for stream crossings are typically high, the likelihood of failure varies depending on asset condition and environmental factors. At the time, limited condition data required reliance on indirect indicators to estimate failure probability. In the current evaluation, SPG is used to represent asset condition more directly and consistently. Accordingly, the risk matrix has been updated to reflect this improved condition information, allowing for more accurate risk evaluation and proportionate management responses. The proposed risk matrix for management of the RC inventory is presented in Figure 5-1.

SPG \ COF	Low (0-33)	Medium (34-66)	High (67-100)
5	Programmed Rehab / Replace	Urgent Rehab / Replace	Immediate Rehab / Replace
4	Proactive Assessment	Programmed Rehab / Replace	Urgent Rehab / Replace
3	Proactive Assessment	Proactive Assessment	Programmed Rehab / Replace
2	Monitor and Forecast	Proactive Assessment	Proactive Assessment
1	Do Nothing	Monitor and Forecast	Proactive Assessment

Figure 5-1: Risk Management Matrix

Given that, there are five generally accepted levels of action with respect to the appropriate management of linear infrastructure as follows:

- **Do Nothing:** No immediate action is required. These assets are in Good condition and can be deprioritized in capital planning.
- **Monitor and Forecast:** Assets require ongoing monitoring to track deterioration or external risks but are not in urgent need of intervention.
- **Proactive Assessment:** Planned and proactive assessment is recommended to better understand asset condition and refine timing for future rehabilitation.

- **Programmed Rehab / Replace:** Assets should be included in scheduled capital works programs before reaching critical failure condition.
- **Urgent / Immediate Rehab / Replace:** High-priority intervention is needed due to severe deterioration or high failure consequences.

5.6 Refined Risk Matrix

Figure 5-2 presents the updated risk matrix, developed based on the 2024 risk assessment analysis and further refined as part of this Asset Management Plan update.

Confidence bands are illustrated by circles around the data points from the 2024 risk assessment - the larger the data point the less certain the inputs are indicating a potentially higher risk. This presentation highlights both the central estimate and the associated level of certainty, supporting clear interpretation of the results.

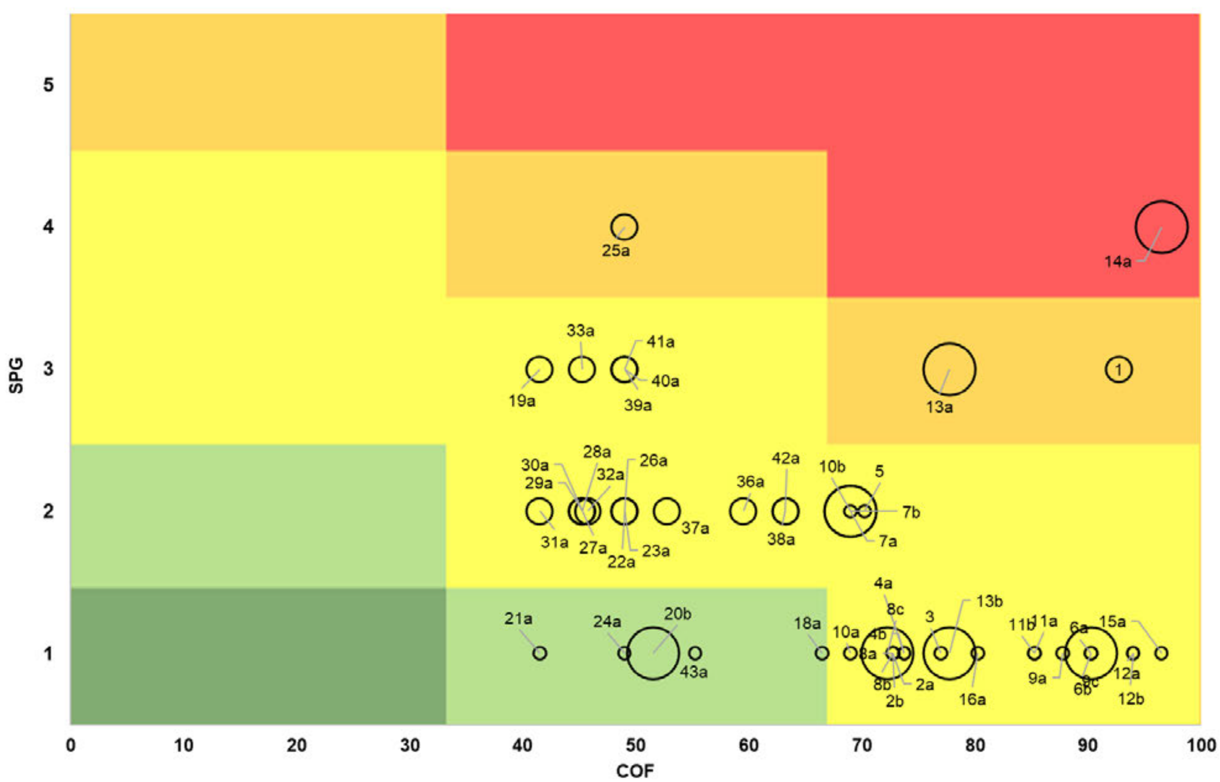


Figure 5-2: Updated Risk Matrix

For comparison purposes the original (2006) data points have been plotted along side the latest data set in Figure 5-3. As can be seen there has been a considerable reduction in risk due to an improvement in asset understanding and condition (shown by a reduction in SPG). There have been minor changes to CoF as well based upon updated understanding of each crossing.

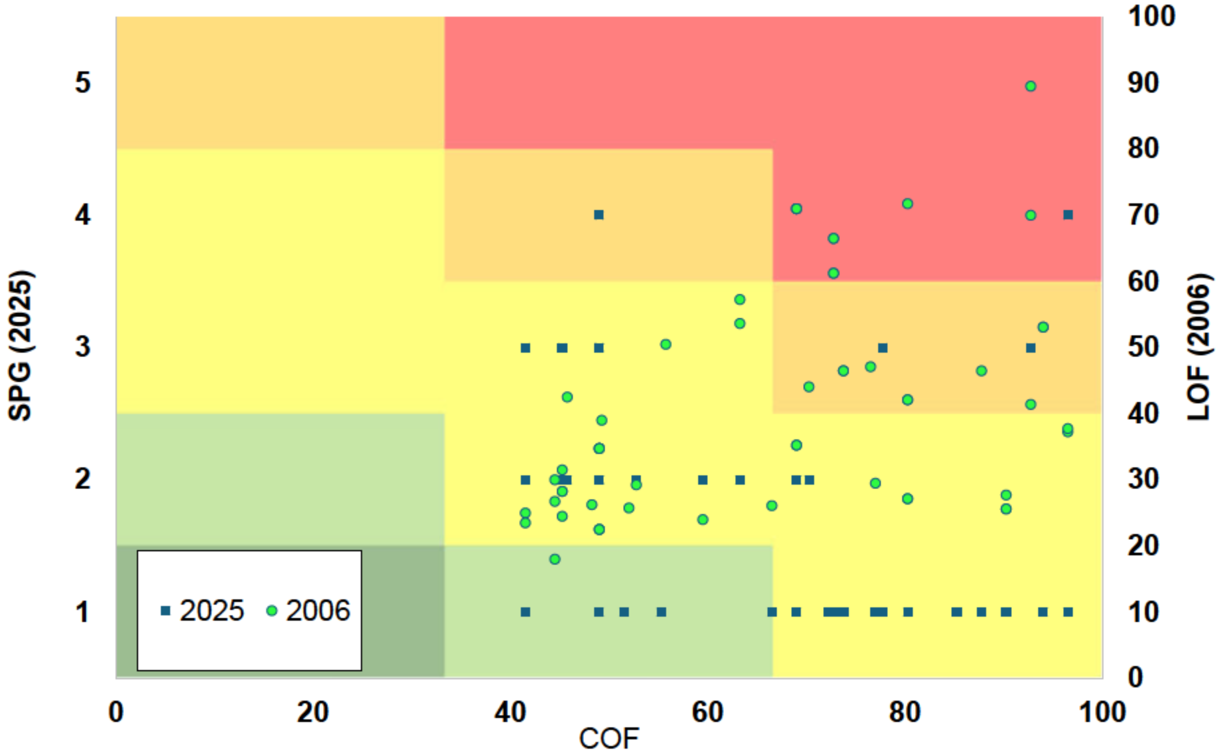


Figure 5-3: Comparative Risk Matrix – 2006 vs 2025

5.7 Risk Map of RCs Assets

Figure 5-4 shows the risk map of the RCs assets based on the updated risk scores from this assessment. Higher resolution and detailed views are supplied in Appendix B.

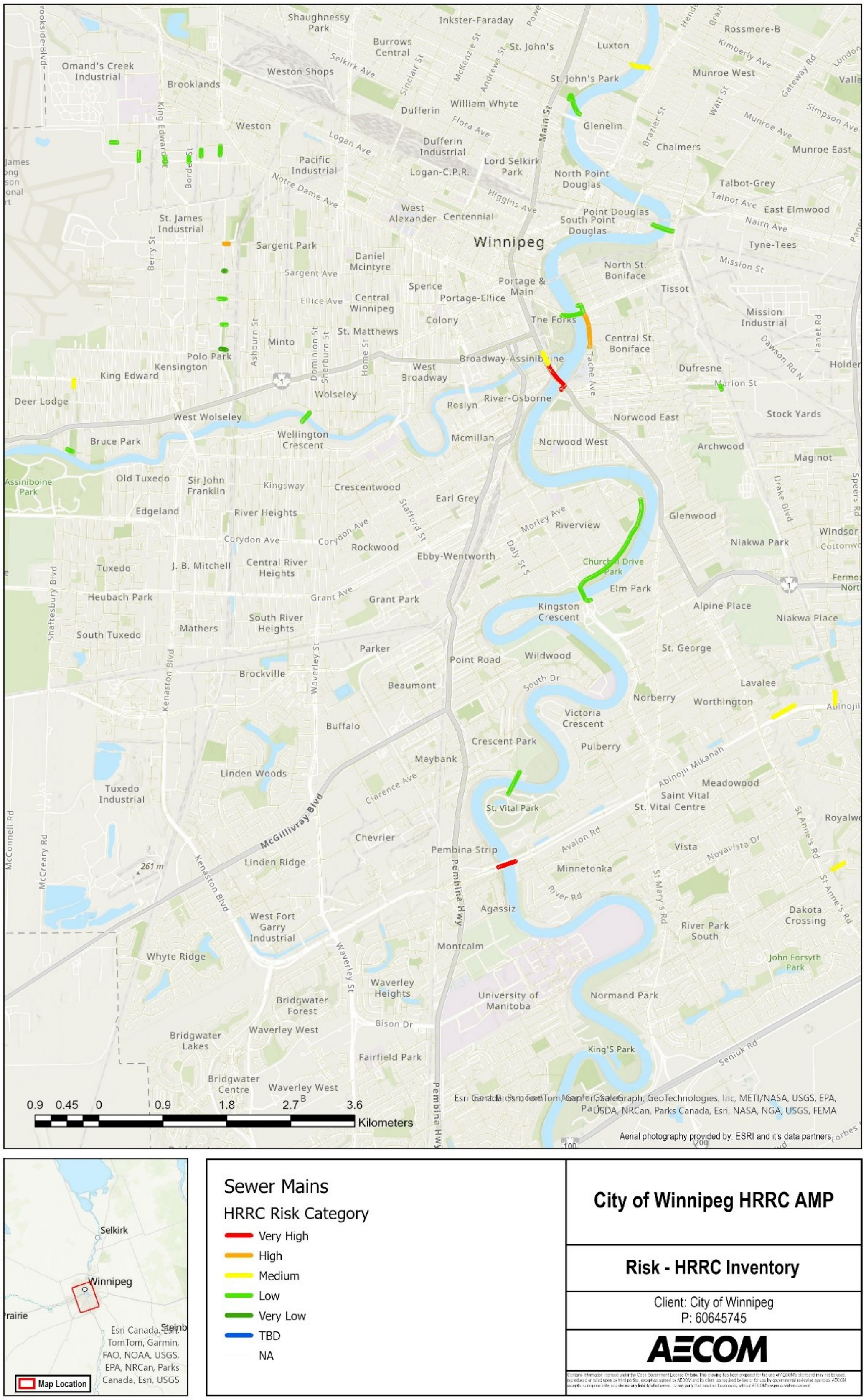


Figure 5-4: RCs Risk Map

5.8 Risk Management Plan and Site-Specific Risks

Table 5-8 provides a detailed summary of site-specific risks for RCs assets. It consolidates information on asset characteristics, structural condition ratings, consequence of failure, risk scores, and known or potential failure modes. It also documents historical inspections, rehabilitation work, and current operational monitoring programs. This information forms the foundation for identifying and prioritizing risk mitigation strategies as part of the overall Risk Management Plan.

Mitigation strategies were developed based on the most recent risk assessment, which considered both likelihood and consequence of failure. In the absence of a formal City risk tolerance framework, risk severity has been interpreted using observed risk levels and industry benchmarks. Strategies address site-specific risks such as degradation, corrosion, debris accumulation, and mechanical failure. Recommended actions include re-inspection timelines, cleaning programs, structural rehabilitation, and operational monitoring, tailored to the asset's condition and performance history.

Responsibility for managing these risks lies with several parties:

- The City's Engineering Services (including Asset Management, Capital Planning, and Design Branches) are responsible for setting inspection cycles, coordinating capital rehabilitation projects, and integrating risk information into long-term planning.
- Operations and Maintenance teams are responsible for routine inspections, valve exercising, monitoring of system performance, and response to emerging issues.
- AECOM, as the lead technical advisor, facilitated the risk assessment process, validated findings through subject matter expertise, and developed risk mitigation recommendations and implementation strategies aligned with best practices and available risk evidence.

Together, this collaborative approach ensures risks are properly identified, categorized, and addressed through coordinated planning, monitoring, and investment.

In **Table 5-8** the following fields are used to assist in the asset summary:

- **Index:** The row number.
- **Site ID:** A unique crossing ID using the location index and a sequential naming convention where there are multiple crossings.
- **Asset ID:** The S-MA number from the City's GIS to allow direct reference.

Table 5-8: Summary of Site-Specific Risks, Failure Modes, and Mitigation Measures for RCs

Index	Site ID	Asset Name	Asset ID	SPG	COF	Risk Score	Risk Category	Description	Possible Failure Mode (Hazard)	Inspection / Rehabilitation Work	Operation Monitoring Program / Preventative Maintenance	Mitigation Strategies
1	1	West Perimeter Bridge (Assiniboine RC)	S-MA70028006	3	92.75	278.25	High	1- 400 mm steel force main installed in 2001 using horizontal directional drilling (HDD) through riverbank and riverbed. 2- Damaged during installation and repaired with a specialized sleeve.	1- Mechanical stress from slope instability and pressure fluctuations. 2- Debris buildup. 3- Corrosion.	1- Steel pipe installed in 2001. Initial Remote Field Eddy Current (RFEC) inspection conducted in 2021 (20 years old); follow-up frequency to be based on results. 2- RFEC or magnetic flux leakage inspection planned for 2023. 3- In 2023, two access maintenance holes installed, but RFEC was deemed to high a risk. Pipe was dewatered, CCTV and low-head leakage tests completed—no leakage detected. 4- CIPP, full structural lining (based on 2024 risk assessment recommendation).	1- Visual Inspections: Conducted weekly (March–November) and monthly (December–February). 2- Quarterly isolation valve exercising.	• Enhanced monitoring. • Valve exercising scheduled quarterly. • Risk-Based inspection planning. • Lining program. • Slope stabilization review. • Inspection cycle review. • Evaluate redundancy options.
2	2a 2b	Westwood / Community Row (Assiniboine RC)	S-MA70016410 S-MA70016408	1 1	72.75 72.75	72.75 72.75	Low Low	600 mm and 500 mm steel inverted siphons installed in 1971 through riverbank and riverbed.	1- Mechanical stress from slope instability. 2- Debris buildup. 3- Corrosion.	1- 2012: SONAR inspection showed Good condition with <10% debris. 2- 2014: RFEC inspection identified Poor condition in some areas. 3- 2015: Rehabilitated with CIPP liners; SPG of 1 (excellent condition). 4- 2045: CCTV re-inspection planned. 5- 2019: Toe armoring identified as needed within 5–10 years. 6- 2023: Slope regrading and armoring planned for 2025.	1- Visual Inspections: Conducted weekly (March–November) and monthly (December–February) 2- Isolation Valves: Found inoperable and removed during 2015 lining project; no replacement planned. Alternative isolation methods will be used if needed in the future.	• Continue visual inspections (weekly/monthly). • Complete slope regrading and toe armoring (2025). • CCTV re-inspection planned for 2045. • Monitor performance of 2015 CIPP lining. • Confirm alternative isolation methods in place. • Sonar inspection as needed
3	3	Heritage Park (Sturgeon Creek Crossing)	S-MA70031733	1	77	77	Low	250 mm C900 PVC force main installed in 1989 through creek bank and bottom.	1- Mechanical stress from slope instability and pressure fluctuations. 2- Debris buildup. 3- Isolation valve failure.	1- 2017: Planned internal SONAR inspection; follow-up schedule to depend on results. 2- 2019: Low-pressure leakage test and pipe material testing conducted. 3- 2020: Condition assessment recommended toe armoring by 2025. 4- 2023: Slope regrading and armoring scheduled for completion in 2025.	Visual Inspections: Conducted weekly (March–November) and monthly (December–February).	• Complete slope regrading and toe armoring (2025). • Continue visual inspections (weekly/monthly). • Review need for follow-up internal inspection post-2025. • Monitor for debris and isolation valve performance. • Sonar inspection as needed
4	4a 4b	Windham Road (Sturgeon Creek Crossing)	S-MA70016531 S-MA70016527	1 1	73.75 73.75	73.75 73.75	Low Low	Two 450 mm steel force mains, concrete-encased, installed in 1964 through creek bank and bottom.	1- Mechanical stress from slope instability. 2- Debris buildup. 3- Isolation valve failure. 4- Corrosion.	1- 2014: RFEC inspection found pipes with 5–6 years of remaining life; rehab recommended in 2–5 years. 2- 2014: Geotechnical study indicated south bank slope stabilization needed; can align with pipe rehab. 3- 2018: Acoustic leak detection found no leaks. 4- 2019: CIPP lining of both pipes began in December. 5- 2020: CIPP lining completed. 6- 2050: CCTV re-inspection planned to confirm condition.	1- Visual Inspections: Conducted weekly (March–November) and monthly (December–February). 2- Quarterly isolation valve exercising.	• Monitor post-CIPP performance; re-inspect with CCTV in 2050. • Complete south bank slope stabilization if not yet done. • Continue visual inspections (weekly/monthly). • Maintain annual isolation valve exercising.
5	5	Assiniboine Park Zoo (Assiniboine RC)	S-MA70016345	2	70.25	140.5	Medium	200 mm steel inverted siphon installed in 1967 through riverbank and riverbed.	1- Mechanical stress from slope instability. 2- Debris accumulation. 3- Isolation valve failure. 4- Corrosion.	1- 2012: RFEC inspection estimated 57 years of remaining life; re-inspection recommended in 22 years (2034). 2- 2021: River bottom scan showed a visible pipe trench; ~20 m may be exposed. Trench alignment suggests no significant lateral movement.	1- Visual Inspections: Conducted weekly (March–November) and monthly (December–February). 2- Quarterly isolation valve exercising.	• Continue visual inspections (weekly/monthly). • Valve exercising scheduled quarterly. • Re-inspect pipe in 2034 as planned. • Monitor exposed pipe trench for erosion or movement.
6	6a 6b	Ash Street	S-MA70044144 S-MA70044147	1 1	90.25 90.25	90.25 90.25	Low Low	Two 300mm diameter HDPE force mains installed in 2003. Pipes were installed through riverbank and riverbed using horizontal directional drilling (HDD).	1- Debris accumulation. 2- Isolation valve failure. 3- Mechanical stress from slope instability and pressure fluctuations.	HDPE pipe installed in 2003. Initial inspection planned for 2033; follow-up frequency to be based on findings.	1- Visual Inspections: Conducted weekly (March–November) and monthly (December–February). 2- Quarterly isolation valve exercising.	• Conduct initial inspection in 2033; adjust future frequency as needed. • Continue visual inspections (weekly/monthly). • Valve exercising scheduled quarterly. • Monitor for debris accumulation and slope stability.
7	7a 7b	Main Street Bridge (Bridge of the Old Forks)	S-MA70058225 S-MA70058265	2 2	69 69	138 138	Medium Medium	500 mm and 600 mm steel force mains installed in 1996, suspended within the northbound span of the Old Forks Bridge.	1- Corrosion. 2- Freezing. 3- Mechanical stress from pressure fluctuations. 4- Isolation valve failure.	1- 2021: Planned detailed inspection using magnetic flux leakage or RFEC at 25 years old; follow-up based on findings. 2- 2022: Targeted EM bracelet probe and ultrasonic testing (UT) conducted in November; follow-up frequency to be based on results. 3- 2024: Inspection and condition assessment of the Old Forts Bridge force mains suggests that the pipes are in Good condition. The lowest reported wall thickness was 88% of the original wall thickness.	1- Visual Inspections: Conducted weekly (March–November) and monthly (December–February). 2- Quarterly isolation valve exercising.	• Review 2024 condition results; adjust inspection frequency as needed. • Continue visual inspections (weekly/monthly). • Valve exercising scheduled quarterly. • Monitor for corrosion and freezing risks.

Index	Site ID	Asset Name	Asset ID	SPG	COF	Risk Score	Risk Category	Description	Possible Failure Mode (Hazard)	Inspection / Rehabilitation Work	Operation Monitoring Program / Preventative Maintenance	Mitigation Strategies
8	8a 8b 8c	Whellams Lane	S-MA00017097 S-MA00017096 TBD	1 1 1	72.75 72.75 72.25	72.75 72.75 72.25	Low Low Low	1- 500 mm and 800 mm steel siphons installed in 1970, laid on riverbed and secured with concrete anchors. 2- New 1200 mm pipe crossing completed with isolation valves on both east and west sides.	1- Mechanical stress from slope instability and pipe flotation. 2- Debris accumulation. 3- Environmental degradation. 4- Corrosion.	1- 2013: SONAR inspection identified significant debris in the 500 mm pipe. 2- 2014: SONAR and RFEC inspections confirmed pipes are supported by the riverbed; 800 mm pipe had 13 years remaining life, 500 mm had 10 years. Rehabilitation recommended by 2022. 3- 2019: 1200 mm third pipe crossing substantially completed. 4- 2021: Leak detection flow monitoring equipment installed. 5- 2022: RFP awarded for CIPP rehabilitation of 500 mm and 800 mm pipes; construction tendered mid-year. 6- 2024: Construction delayed, completed in 2024. 7- 2025: Slope regrading and armoring scheduled for completion.	1- Visual Inspections: Conducted weekly (March–November) and monthly (December–February); no issues observed to date. 2- Isolation Valves: 500 mm and 800 mm valves remain inoperable with no plans for repair. The 1200 mm valve continues to be exercised quarterly.	• Monitor condition of 1200 mm pipe (completed 2024). • Monitor performance of recently completed CIPP lining (500/800 mm pipes). • Complete slope regrading and armoring (2025). • Continue visual inspections (weekly/monthly). • Exercise 1200 mm valve quarterly; 500/800 mm valves remain inoperable. • Perform sonar inspection as needed
9	9a 9b 9c	Frasers Grove Park	S-MA00017639 S-MA70021128 TBD	1 - 1	87.75 - 90.25	87.75 - 90.25	Low - Low	1- 350 mm steel force main installed in 1959 through riverbank and riverbed in a shallow trench. 2- 1979 HDPE pipe abandoned in 2023. 3- 375 mm HDPE force main installed in 2023 through bedrock, outside the riverbank failure zone.	1- Mechanical stress from slope instability, pipe flotation, and pressure fluctuations. 2- Debris accumulation. 3- Corrosion (steel force main). 4- Slow crack growth (HDPE).	1- 2014: RFEC inspection of 350 mm steel pipe estimated 132 years of remaining life; re-inspection recommended in 2034. Material testing sample taken from 350 mm HDPE pipe. 2- 2017: Material testing indicated increasing risk of brittle failure in HDPE due to reduced ductility (linked to slow crack growth). 3- 2018: Acoustic testing found no leaks; SONAR inspection showed HDPE pipe nearing end of life. 4- 2019: Condition assessment recommended HDPE rehabilitation by 2025. Toe armoring required by 2028. CIPP point repair installed at a non-river leak location. 5- 2020: RFP prepared for rehabilitation/replacement of both 350 mm force mains. 6- 2021–2022: Preliminary and detailed design completed; construction contract awarded with 2023 target. 7- 2023: Construction of new RC completed in late 2023.	1- Visual Inspections: Conducted weekly (March–November) and monthly (December–February) 2- Quarterly isolation valve exercising.	• Monitor condition of new 375 mm HDPE pipe (installed 2023). • Complete re-inspection of 350 mm steel pipe by 2034 • Monitor for toe armoring needs by 2028. • Continue visual inspections (weekly/monthly). • Valve exercising scheduled quarterly. • Perform sonar inspection as needed
10	10a 10b	Munroe Avenue	S-MA70017147 S-MA70017149	1 2	69 69	69 138	Low Medium	300 mm and 450 mm steel inverted siphons installed in 1964 in a concrete-filled trench.	1- Mechanical stress from slope instability, pipe flotation, and pressure fluctuations. 2- Debris accumulation. 3- Isolation valve failure. 4- Corrosion.	1- 2012: RFEC inspection of 300 mm pipe estimated 16 years of life; re-inspection recommended by 2022 and rehab within 10–15 years. 2- 2014: RFEC inspection of 450 mm pipe estimated 55 years of life; re-inspection planned for 2034. 3- 2016: External point repair completed on 300 mm pipe. 4- 2020: Geotechnical analysis indicated need for west bank slope stabilization by 2023. 5- 2022: RFP awarded for CIPP lining of 300 mm siphon; construction tendered in June. 6- 2024: Construction completed in 2024.	1- Visual Inspections: Conducted weekly (March–November) and monthly (December–February). 2- Isolation Valves: 300 mm and 450 mm siphon valves remain inoperable; no repairs planned. Alternative isolation methods will be used if needed.	• Re-inspect 300 mm and 450 mm pipes as needed based on recommendations. • Address west bank slope stabilization as recommended. • Continue visual inspections (weekly/monthly). • Use alternative isolation methods (valves inoperable).
11	11a 11b	Hart Avenue (Red RC	S-MA70062902 S-MA70062897	1 1	85.25 85.25	85.25 85.25	Low Low	Two 300 mm HDPE force mains installed in 2007 using HDD through riverbank and riverbed.	1- Debris accumulation. 2- Isolation valve failure. 3- Mechanical stress from slope instability and pressure fluctuations.	HDPE pipe installed in 2007. Initial inspection planned for 2037 (at 30 years); follow-up frequency to be based on findings.	1- Visual Inspections: Conducted weekly (March–November) and monthly (December–February). 2- Quarterly isolation valve exercising.	• Conduct initial inspection in 2037; adjust follow-up based on findings. • Continue visual inspections (weekly/monthly). • Maintain annual valve exercising. • Monitor for debris and slope-related stress.
12	12a 12b	Montcalm Avenue (Red RC	S-MA70046432 S-MA70046417	1 1	94 94	94 94	Low Low	Two 600 mm HDPE force mains installed in 2004 using HDD through riverbank and riverbed.	1- Debris accumulation. 2- Isolation valve failure. 3- Mechanical stress from slope instability and pressure fluctuations.	HDPE pipe installed in 2004. Initial inspection planned for 2034 (at 30 years); follow-up frequency to be based on findings.	1- Visual Inspections: Conducted weekly (March–November) and monthly (December–February). 2- Quarterly isolation valve exercising.	• Conduct initial inspection in 2034; adjust follow-up based on findings. • Continue visual inspections (weekly/monthly). • Valve exercising scheduled quarterly. • Monitor for debris and slope-related stresses
13	13a 13b	Provencher Bridge (Red RC)	S-MA70050831 S-MA70050829	3 1	77.75 77.75	233.25 77.75	High Low	Two 300 mm steel force mains installed in 2005, suspended within the eastbound span of the Provencher Bridge.	1- Mechanical stress from pressure fluctuations. 2- Corrosion. 3- Freezing.	1- 2005: Steel pipes installed; detailed inspection planned at 20 years (2021) using magnetic flux leakage or RFEC. 2- 2021: Visual inspection of pipe hanger supports completed; report expected early 2022. 3- 2022: Targeted EM bracelet probe and ultrasonic testing (UT) conducted in November; follow-up frequency to be based on findings. 4- 2024: Inspection and condition assessment of the Provencher Bridge force mains indicate the pipes are in Good condition. The lowest recorded wall thickness was 95% of the wall thickness. 5- Asset S-MA70050831 is planned to reset the expansion joint.	1- Visual Inspections: Conducted weekly (March–November) and monthly (December–February). 2- Quarterly isolation valve exercising.	• Monitor findings from recent UT/EM inspections (2022–2024). • Reset expansion joint for asset S-MA70050831 (planned). • Continue visual inspections (weekly/monthly). • Valve exercising

Index	Site ID	Asset Name	Asset ID	SPG	COF	Risk Score	Risk Category	Description	Possible Failure Mode (Hazard)	Inspection / Rehabilitation Work	Operation Monitoring Program / Preventative Maintenance	Mitigation Strategies
14	14a	Norwood Bridge (Red RC	S-MA70057885	4	96.5	386	Very High	500 mm steel force main installed in 1997, suspended within the northbound span of the Norwood Bridge.	1- Mechanical stress from pressure fluctuations. 2- Corrosion. 3- Freezing.	1- 1997: Steel pipe installed; detailed inspection planned at 25 years (2021) using magnetic flux leakage or RFEC. 2- 2022: Targeted EM bracelet probe and ultrasonic testing (UT) conducted in November; follow-up inspection frequency to be based on results. 3- 2024: Inspection and condition assessment of the Norwood Bridge force main indicate the pipe is in Good condition. The lowest reported wall thickness was 86% of the wall thickness. 4- 2042: Next inspection is recommended to be done. 5- It is recommended to replace the expansion joints.	1- Visual Inspections: Conducted weekly (March–November) and monthly (December–February). 2- Quarterly isolation valve exercising.	• Monitor results from 2022 UT/EM inspections and 2024 condition assessment. • Replace expansion joints and conduct a full EM inspection during the replacement period while the asset is bypassed. • Plan next inspection in 2042, or earlier if new risk indicators emerge. • Continue visual inspections (weekly/monthly). • Maintain valve exercising.
15	15a	St Vital Bridge (Red RC)	S-MA50017754	1	96.5	96.5	Low	500 mm insulated steel force main installed in 2023, suspended beneath the northbound span of the St. Vital Bridge.	1- Corrosion. 2- Freezing.	1- 2007: Flow monitoring (mag-meters) installed as a pilot for leak detection; pilot unsuccessful—only effective for catastrophic failures. Not suitable for leak before break scenario. 2- 2015: Risk assessment ruled out internal inspection due to pipe layout and lack of redundancy. 3- 2018: External wall thickness testing indicated the pipe was at end-of-life. 4- 2020: Replacement project initiated; construction and material procurement underway. 5- 2021–2022: Pipe replacement completed in December 2021; final restoration finished in fall 2022.	1- Visual Inspections: Conducted weekly (March–November) and monthly (December–February). 2- Quarterly isolation valve exercising.	• Pipe was fully replaced in 2021–2022 — no further immediate rehabilitation needed. • Continue visual inspections (weekly/monthly). • Maintain annual isolation valve exercising. • Monitor for signs of corrosion or freezing, especially given insulated steel pipe.
16	16a	Fort Garry Cemetery-Crescent Drive (Red RC)	S-MA70093899	1	80.25	80.25	Low	600 mm dual-encased HDPE siphon installed in 2010, cored through limestone bedrock and located well outside the riverbank failure zone.	1- Debris accumulation. 2- Isolation valve failure. 3- Mechanical stress from slope instability and pressure fluctuations.	HDPE pipe installed in 2010. Initial inspection planned for 2040; follow-up frequency to be based on findings.	1- Visual Inspections: Conducted weekly (March–November) and monthly (December–February). 2- Isolation Valve Exercising: Valves are operated annually to ensure proper function. - South gate operates as scheduled. - North slide gate is damaged, not required, and considered abandoned.	• Continue annual valve exercising; north slide gate is abandoned and not required. • Perform initial inspection in 2040 as planned; adjust future inspection frequency based on results. • Maintain regular visual inspections (weekly/monthly). • Monitor for debris accumulation and stress-related concerns despite the secure location (outside failure zone).
17	17a 17b	Fort Garry Bridge (Red RC)	S-MA70087290 S-MA70053063	5 5	70.25 45.75	351.25 228.75	Very High High	700 mm and 800 mm Series 60 HDPE siphons installed in 1973; trenched through riverbank, laid on riverbed, and secured with concrete anchors every 6 m.	1- Mechanical stress from slope instability, pipe flotation, and pressure fluctuations. 2- Debris accumulation. 3- Upstream valve failure. 4- Slow crack growth.	1- 2011: SONAR inspections identified deformation in the 800 mm pipe. 2- 2014: 8 m of deformed 800 mm pipe replaced. 3- 2017: Material testing showed increasing risk of brittle failure in the 800 mm pipe due to reduced ductility (linked to slow crack growth). 4- 2021: Internal and river bottom SONAR re-inspection completed. 5- 2023: Low-pressure test confirmed leakage in 700 mm pipe; partial CCTV inspections found defects in both pipes. Emergency bypass system installation began, and planning for rehabilitation/replacement of both siphons is underway. 6- 2025: Scheduled for replacement and removed from service.	1- Visual Inspections: Conducted weekly (March–November) and monthly (December–February). 2- Isolation Valves: Operated annually to ensure function. West-side gates remain operable; east-side gates are seized with no plans for repair. Alternative isolation methods will be used if needed.	• Leak confirmed in 700 mm pipe; full replacement scheduled for 2025. • Emergency bypass system in place. • Continue visual inspections and annual valve exercising. • West valves operable; east valves seized—alternative isolation in use. • Perform sonar inspection as needed
18	18a	Pembina / Ducharme	S-MA70031937	1	66.5	66.5	Low	250 mm PVC force main installed in 2000	1- Debris accumulation. 2- Isolation valve failure. 3- Mechanical stress from slope instability and pressure fluctuations.	PVC pipe installed in 2000. Initial inspection planned for 2030; follow-up frequency to be based on findings.	1- Visual Inspections: Conducted weekly (March–November) and monthly (December–February). 2- Quarterly isolation valve exercising.	• Initial inspection planned for 2030; follow-up as needed. • Continue weekly/monthly visual inspections. • Annual valve exercising to ensure operability.
19	19a	Des Trappistes	S-MA60023233	3	14.5	124.5	Medium	250 mm concrete gravity main installed in 1975	1- Mechanical stress from slope instability and pipe floatation. 2- Debris accumulation. 3- Environmental degradation 4- Corrosion	1- Concrete gravity main installed in 1975. Next inspection is scheduled for 2036. 2- Full segment lining is recommended to be carried out.	1- Visual Inspections: Conducted weekly (March–November) and monthly (December–February).	• Next inspection scheduled for 2036. • Segment lining recommended. • Continue weekly/monthly visual inspections.

Index	Site ID	Asset Name	Asset ID	SPG	COF	Risk Score	Risk Category	Description	Possible Failure Mode (Hazard)	Inspection / Rehabilitation Work	Operation Monitoring Program / Preventative Maintenance	Mitigation Strategies
20	20a 20b	Portage Avenue (Omand's Creek Crossing)	S-MA70031433 N/A	- 1	- 51.5	- 51.5	- Very Low	600 mm PVC interceptor siphon installed in 2022 through the creek bottom.	1- Mechanical stress from slope instability and pipe flotation. 2- Debris accumulation. 3- Corrosion.	1- 2012: SONAR inspection showed no restrictions (e.g., debris or tuberculation); re-inspection recommended for 2022. 2- 2014: RFEC inspection was considered but removed due to cost and failure risk. 3- 2019: Engineering study initiated to replace the crossing within 2–4 years. 4- 2020: RFP prepared for rehab/replacement of the 600 mm interceptor at Omand's Creek. 5- 2022: Construction of new 600 mm siphon interceptor completed in summer. 6- 2052: Next inspection is planned for 2052	1- Visual Inspections: Conducted weekly (March–November) and monthly (December–February). 2- Quarterly isolation valve exercising. 3- Annual cleaning completed in 2023.	• Next inspection scheduled for 2036. • Segment lining recommended. • Continue weekly/monthly visual inspections. • Annual valve exercising. • Perform sonar inspection as needed
21	*21a*	*Maroons*	*S-MA20010800*	*1*	*41.5*	*41.5*	*Very Low*	*Private Connection*	*1- Mechanical stress from slope instability and pipe flotation* *2- Debris accumulation* *3- Environmental degradation* *4- Corrosion*	*This pipe is a private connection*	*This pipe is a private connection*	-
22	22a	St Matthews Avenue (Omand's Creek Crossing)	S-MA20009764	2	49	98	Low	750 mm concrete gravity sewer installed in 1954 through the creek bottom.	1- Degradation due to environmental stresses. 2- Debris accumulation and blockage. 3- Corrosion. 4- Cracking and Fracture.	1- 2009: The gravity sewer crossing was inspected via CCTV. It received an SPG of 2, indicating it was in Good condition. 2- 2029: Recommendation - Based on its condition, a follow-up CCTV inspection is recommended in 20 years, around 2029, to reassess the asset's condition.	This is a low-risk gravity flow asset; therefore, active monitoring by Operations is not required.	• CCTV reinspection recommended for 2029 to reassess condition. • Monitor for signs of environmental degradation and corrosion during inspections. • No active monitoring required (low-risk gravity flow asset).
23	23a	Ellice Avenue (Omand's Creek Crossing)	S-MA20009857	2	49	98	Low	750 mm concrete gravity sewer installed in 1953 through the creek bottom.	1- Degradation due to environmental stresses. 2- Debris accumulation and blockage. 3- Corrosion. 4- Cracking and Fracture.	1- 2003: CCTV inspection assigned SPG 2 (Good condition). 2- 2014: Re-inspection confirmed SPG 2. 3- 2034: Next CCTV inspection recommended to confirm condition.	This is a low-risk gravity flow asset; therefore, active monitoring by Operations is not required.	• Reinspection by CCTV planned for 2034 to confirm condition. • Monitor for environmental degradation and corrosion during future inspections. • No active monitoring required (low-risk gravity flow asset).
24	24a	Sargent Avenue (Omand's Creek Crossing)	S-MA20009956	1	49	49	Very Low	750 mm concrete gravity sewer installed in 1953 through the creek bottom.	1- Degradation due to environmental stresses. 2- Debris accumulation and blockage. 3- Corrosion. 4- Cracking and Fracture.	1- 2012: CCTV inspection rated the sewer main with an SPG of 1 (excellent condition). 2- 2032: Recommendation: Re-inspect by CCTV in ~20 years (2032) to confirm condition.	This is a low-risk gravity flow asset; therefore, active monitoring by Operations is not required.	• Reinspection by CCTV planned for 2032 to confirm condition. • Monitor for signs of environmental degradation and corrosion during future inspections. • No active monitoring required (low-risk gravity flow asset).
25	25a	Wellington Avenue (Omand's Creek Crossing)	S-MA20010426	4	49	196	High	750 mm concrete gravity sewer installed in 1956 through the creek bottom.	1- Degradation due to environmental stresses. 2- Debris accumulation and blockage. 3- Corrosion. 4- Cracking and Fracture.	1- 2012: CCTV inspection assigned SPG 3 (Fair condition). 2- 2022: CCTV re-inspection planned for December. 3- 2023: CCTV completed; SPG 4 assigned. Full segment liner added to 2024 Capital Sewer Rehabilitation program. 4- 2025: Rehabilitation work expected to be completed. 5- 2043: Next inspection is planned for 2043. 6- Full segment lining is recommended to be done based on 2024 risk assessment.	This is a low-risk gravity flow asset; therefore, active monitoring by Operations is not required.	• Full segment lining included in 2024 Capital Program; rehabilitation expected in 2025. • Reinspection planned for 2043. • Ongoing monitoring for degradation and corrosion to guide future risk reassessment. • No active monitoring required (gravity flow asset).
26	26a	McCrossen Street (Omand's Creek Crossing)	S-MA20011761	2	49	98	Low	1350 mm concrete gravity sewer installed in 1964.	1- Degradation due to environmental stresses. 2- Debris accumulation and blockage. 3- Corrosion. 4- Cracking and Fracture.	1- 2012: CCTV inspection assigned SPG 2 (Good condition). 2- 2032: Re-inspection recommended to confirm asset condition.	This is a low-risk gravity flow asset; therefore, active monitoring by Operations is not required.	• Re-inspection recommended for 2032 to confirm condition. • Monitor for potential degradation and corrosion over time. • No active monitoring required (gravity flow asset).
27	27a	St James Street (Omand's Creek Crossing)	S-MA20011765	2	45.25	90.5	Low	450 mm concrete gravity sewer installed through the creek bottom.	1- Degradation due to environmental stresses. 2- Debris accumulation and blockage. 3- Corrosion. 4- Cracking and Fracture.	1- 2012: CCTV inspection assigned SPG 2 (Good condition). 2- 2032: Re-inspection recommended to confirm condition.	This is a low-risk gravity flow asset; therefore, active monitoring by Operations is not required.	• Re-inspection recommended for 2032 to confirm condition. • Monitor for potential degradation and corrosion over time. • No active monitoring required (gravity flow asset).

Index	Site ID	Asset Name	Asset ID	SPG	COF	Risk Score	Risk Category	Description	Possible Failure Mode (Hazard)	Inspection / Rehabilitation Work	Operation Monitoring Program / Preventative Maintenance	Mitigation Strategies
28	28a	Border Street (Omand's Creek Crossing)	S-MA20011649	2	45.25	90.5	Low	375 mm concrete gravity sewer installed through the creek bottom.	1- Degradation due to environmental stresses. 2- Debris accumulation and blockage. 3- Corrosion. 4- Cracking and Fracture.	1- 2012: CCTV inspection assigned SPG 2 (Good condition). 2- 2032: Re-inspection recommended to confirm asset condition.	This is a low-risk gravity flow asset; therefore, active monitoring by Operations is not required.	• Re-inspection recommended for 2032 to confirm condition. • Monitor for potential degradation and corrosion over time. • No active monitoring required (gravity flow asset).
29	29a	King Edward Street (Omand's Creek Crossing)	S-MA20007212	2	45.25	90.5	Low	450 mm concrete gravity sewer installed in 1959.	1- Degradation due to environmental stresses. 2- Debris accumulation and blockage. 3- Corrosion. 4- Cracking and Fracture.	1- 2012: CCTV inspection assigned SPG 2 (Good condition). 2- 2032: Re-inspection recommended to confirm condition.	This is a low-risk gravity flow asset; therefore, active monitoring by Operations is not required.	• Re-inspection recommended for 2032 to confirm condition. • Monitor for potential degradation and corrosion over time. • No active monitoring required (gravity flow asset).
30	30a	Sherwin Road (Omand's Creek Crossing)	S-MA20007078	2	45.25	90.5	Low	450 mm concrete gravity sewer installed in 1964 through the creek bottom.	1- Degradation due to environmental stresses. 2- Debris accumulation and blockage. 3- Corrosion. 4- Cracking and Fracture.	1- 2012: CCTV inspection assigned SPG 2 (Good condition). 2- 2032: Re-inspection recommended to confirm asset condition.	This is a low-risk gravity flow asset; therefore, active monitoring by Operations is not required.	• Re-inspection recommended for 2032 to confirm condition. • Monitor for potential degradation and corrosion over time. • No active monitoring required (gravity flow asset).
31	31a	Stevenson Road (Omand's Creek Crossing)	S-MA20007112	2	41.5	83	Low	250 mm concrete gravity sewer installed in 1965 through the creek bottom.	1- Degradation due to environmental stresses. 2- Debris accumulation and blockage. 3- Corrosion. 4- Cracking and Fracture.	1- 2012: CCTV inspection assigned SPG 2 (Good condition). 2- 2032: Re-inspection recommended to confirm asset condition.	This is a low-risk gravity flow asset; therefore, active monitoring by Operations is not required.	• Re-inspection recommended for 2032 to confirm condition. • Monitor for potential degradation and corrosion over time. • No active monitoring required (gravity flow asset).
32	32a	Deer Lodge Place (Truro Creek Crossing)	S-MA70016729	2	45.75	91.5	Low	300 mm steel secondary gravity sewer installed in 1961 through the creek bottom.	1- Mechanical stress from slope instability. 2- Debris accumulation. 3- Corrosion.	1- 2012: Dry sections inspected by CCTV; SPG 2 (Good condition) assigned. 2- 2013: SONAR inspection showed low debris levels. 3- 2014: Partial RFEC inspection estimated 36 years remaining life; re-inspection recommended in 2034. 4- 2015: Full CCTV inspection assigned SPG 3 (Fair condition); high debris removed. 5- 2019: Slope regrading and armoring identified as needed within 5–10 years. 6- 2023: Slope regrading and armoring planned for completion in 2025. 7- 2024: CCTV inspection completed; SPG 2 assigned (improved condition). 8- 2036: Next inspection planned to confirm condition and reassess performance.	1- Cleaning completed in October 2023. 2- Low-risk gravity flow asset; ongoing monitoring by Operations not required.	• Cleaning completed in October 2023. • Next CCTV inspection recommended in 2036 to confirm condition and reassess performance. • Ongoing monitoring not required (low-risk gravity flow asset). • Slope regrading and armoring planned for 2025, as identified in previous inspections. • Perform sonar inspection as needed
33	33a	Albany Street (Truro Creek Crossing	S-MA20007887	3	45.25	135.75	Medium	450 mm concrete gravity sewer installed through the creek bottom.	1- Degradation due to environmental stresses. 2- Debris accumulation and blockage. 3- Corrosion. 4- Cracking and Fracture.	1- 2013: CCTV inspection assigned SPG 3 (Fair condition). 2- 2023: Re-inspection confirmed SPG 3. 3- 2032: Next CCTV inspection recommended to confirm condition.	This is a low-risk gravity flow asset; therefore, active monitoring by Operations is not required.	• CCTV inspection completed in 2023; next inspection recommended in 2032 to confirm condition. • Asset is considered low risk; active monitoring by Operations is not required. • Degradation and corrosion mitigation may include periodic inspections and future lining if condition worsens.
36	36a	Archibald Street (Seine RC)	S-MA70042549	2	59.5	119	Low	900 mm concrete gravity sewer installed in 1958.	1- Degradation due to environmental stresses. 2- Debris accumulation and blockage. 3- Corrosion. 4- Cracking and Fracture.	1- 2017: CCTV inspection assigned SPG 2 (Good condition). 2- 2037: Re-inspection recommended to confirm condition.	This is a low-risk gravity flow asset; therefore, active monitoring by Operations is not required.	• CCTV inspection completed in 2017; re-inspection recommended for 2037 to confirm asset condition. • Given the degradation and corrosion risks, lining or targeted repairs may be considered if future inspections indicate deterioration. • Asset is classified as low risk; active monitoring by Operations is not required.

Index	Site ID	Asset Name	Asset ID	SPG	COF	Risk Score	Risk Category	Description	Possible Failure Mode (Hazard)	Inspection / Rehabilitation Work	Operation Monitoring Program / Preventative Maintenance	Mitigation Strategies
37	37a	Rothesay Street (Bunn's Creek Crossing)	S-MA70032063	2	52.75	105.5	Low	525 mm concrete interceptor siphon installed in 1974 through the creek bottom.	1- Degradation due to environmental stresses. 2- Debris accumulation and blockage. 3- Corrosion. 4- Cracking and Fracture.	1- 2015: CCTV inspection assigned SPG 2 (Good condition). 2- 2035: Re-inspection recommended to confirm asset condition.	1- Annual cleaning completed in October 2023. 2- Asset is currently stable with low operational concerns. Included in the routine O&M program for periodic cleaning; no additional active monitoring by Operations is required at this time.	• CCTV inspection completed in 2015; re-inspection recommended for 2035 to reassess asset condition. • Given potential for degradation and corrosion, lining or structural rehabilitation may be considered based on future inspection findings. • Annual cleaning was completed in October 2023 to address debris accumulation. • Given the asset's low operational risk and maintenance history, no additional mitigation strategies are required beyond routine cleaning and periodic condition reviews.
38	38a	Abinoji Mikanah (Seine RC)	S-MA50009027	2	63.25	126.5	Medium	1350 mm concrete interceptor sewer installed in 1967.	Cracks and deformation from environmental stresses.	1- 2010: CCTV inspection assigned SPG 2 (Good condition). 2- 2021: Last condition assessment completed. 3- 2041: Next CCTV inspection recommended to confirm asset condition.	This is a low-risk gravity flow asset; therefore, active monitoring by Operations is not required.	• CCTV inspection completed in 2010; re-inspection recommended for 2041 to confirm asset condition. • Given potential for environmental degradation and corrosion, lining may be considered based on future inspection results. • As this is a low-risk gravity flow asset, active monitoring by Operations is not required.
39	39a	Abinoji Mikanah / CPR Tracks (Navin Drain)	S-MA50009013	3	49	147	Medium	750 mm concrete interceptor sewer installed in 1967.	Cracks and deformation from environmental stresses.	1- 2021: Last condition assessment completed. 2- 2041: Next CCTV inspection recommended to confirm asset condition. 3- Full segment lining is recommended to be done based on the 2024 risk assessment.	This is a low-risk gravity flow asset; therefore, active monitoring by Operations is not required.	• Last condition assessment completed in 2021; re-inspection recommended for 2041. • Full segment lining recommended based on 2024 risk assessment. • As this is a low-risk gravity flow asset, active monitoring by Operations is not required.
40	40a	Edgemont / Abinoji Mikanah	S-MA50008068	3	49	147	Medium	530mm gravity sewer installed in 1973	1- Mechanical stress from slope instability. 2- Debris buildup. 3- Corrosion.	1- 2015: CCTV inspection assigned SPG 3. 2- 2035: Re-inspection recommended to confirm asset condition. 3- Full segment lining is recommended to be done based on 2024 risk assessment.	1- Visual Inspections: Conducted weekly (March–November) and monthly (December–February).	• CCTV inspection completed in 2015; re-inspection recommended for 2035. • Full segment lining recommended based on 2024 risk assessment. • Visual inspections conducted weekly (March–November) and monthly (December–February).
41	41a	Lagimodiere / Abinoji Mikanah	S-MA70013886	3	49	147	Medium	900 mm Interceptor sewer gravity installed in 1976	1- Mechanical stress from slope instability. 2- Debris buildup. 3- Corrosion.	1- 2019: CCTV inspection assigned SPG 3. 2- 2039: Re-inspection recommended to confirm asset condition. 3- Full segment lining is recommended to be done based on 2024 risk assessment	1- Visual Inspections: Conducted weekly (March–November) and monthly (December–February)..	• CCTV inspection completed in 2019; re-inspection recommended for 2039. • Full segment lining recommended based on 2024 risk assessment. • Visual inspections conducted weekly (March–November) and monthly (December–February).
42	42a	Warde Avenue (Seine RC)	S-MA70045660	2	63.25	126.5	Medium	750 mm concrete gravity secondary sewer installed in 2003.	Cracking and deformation from environmental stresses.	1- 2003: CCTV inspection assigned SPG 1 (excellent condition). 2- 2015: CCTV inspection assigned SPG 2 (Good condition). 3- 2035: Re-inspection recommended to confirm asset condition.	This is a low-risk gravity flow asset; therefore, active monitoring by Operations is not required.	• CCTV inspections completed in 2003 (SPG 1) and 2015 (SPG 2). • Re-inspection recommended for 2035 to reassess asset condition. • As this is a low-risk gravity flow asset, active monitoring by Operations is not required.
43	43a	Floodway	S-MA70087417	1	55.25	55.25	Very Low	250 mm inverted siphon installed in 2007	1- Mechanical stress from slope instability. 2- Debris buildup. 3- Isolation valve failure. 4- Corrosion.	1- 2037: Re-inspection recommended to confirm asset condition. 2- Cleaning and CCTV inspection to take place in Fall 2025	1- Visual Inspections: Conducted weekly (March–November) and monthly (December–February). 2- Quarterly isolation valve exercising.	• Re-inspection recommended for 2037 to confirm asset condition. • Ongoing visual inspections (weekly March–November, monthly December–February). • Annual isolation valve exercising.

5.9 Risk Trade-Off Considerations

Although the RCs condition assessments and risk matrix update (AECOM, 2012–2025) do not explicitly document risk trade-offs, certain recommended actions imply consideration of such effects. For example, in HRRC3 (2024), full segment lining is recommended for several crossings to address structural degradation; however, such interventions may reduce hydraulic capacity or complicate future maintenance. Similarly, as noted in the updated HRRC report[17], the abandonment of inoperable gates may simplify operations but reduce system redundancy in emergency scenarios. These examples highlight that mitigation strategies can, in some cases, introduce new operational or performance risks. While not systematically categorized in the source documents, these potential impacts were considered when summarizing site-specific mitigation recommendations. Where applicable, the City is encouraged to evaluate each action not only for its direct risk-reduction benefits but also for any secondary impacts on service levels, operability, or long-term maintenance requirements.

5.10 Gaps and Recommendations

As part of the risk assessment process, several data, procedural, and planning gaps were identified that may impact the City's ability to consistently evaluate and manage RC risks. These gaps were observed across multiple technical documents, including condition assessments, the updated risk matrix, and annual inspection summaries. Addressing these gaps will improve data reliability, risk prioritization, and long-term asset management decision-making. **Table 5-9** summarizes key gaps along with recommended actions to support future improvements.

Table 5-9: Risk Management Gaps and Recommendations Summary

Section	Gap	Recommendations
Section 5: Risk Management Plan	Missing asset IDs and some other information like stream classification in registry and condition reports. (**Gap#38**)	• Update asset inventory to ensure each crossing has a unique ID and confirmed stream classification type. Use inspection reports and field verification where needed. (**Recommendation#69**)
	Inconsistent inspection schedules across RCs. (**Gap#39**)	• *Resolved during AMP project.*
	No formal risk tolerance threshold. (**Gap#40**)	• Work with City stakeholders to define and document acceptable risk thresholds to support consistent risk-based decisions. (**Recommendation#73**)
	Outdated or assumed condition ratings in older assessments. (**Gap#41**)	• *Resolved during AMP project.*
	No formal process for evaluating risk trade-offs. (**Gap#42**)	• Include a standard step in future planning to identify and document any unintended consequences from proposed mitigation strategies. (**Recommendation#53**)

[17] AECOM (2022) HRRC2

6. Financing Strategy

Financial forecasting and capital planning are essential for the efficient and sustainable management of infrastructure. This process involves projecting future financial needs and developing a strategic approach to secure funding for the maintenance, renewal, and expansion of assets. By accurately anticipating financial requirements and implementing a robust capital plan, the City can ensure the long-term resilience of its infrastructure systems. Moreover, this proactive approach helps manage costs effectively, mitigate environmental risks, and safeguard public health. The subsequent sections are structured as follows:

- **Section 6.1** discusses the estimated project costs related to each repair, rehab, or renewal strategy.
- **Section 6.2** outlines the methodologies and assumptions used in the financial model to guide reinvestment and replacement decisions.
- **Section 6.3** presents the capital reinvestment needs for the next 20 years under an Unconstrained Budget Scenario. The forecasted 20-year LoS trend and the benchmarking for capital reinvestment needs are also included.
- **Section 6.4** presents the full funding needs for the next 20 years, including bank geotechnical, inspection, point repair allowance, external point repair, full segment liner, and full segment renewal.
- **Section 6.5** summarizes the gaps and recommendations for this section.

6.1 Basis of Estimate

This section outlines the estimated project costs (in current 2025 values) associated with each rehabilitation, renewal strategy (refer to **Section 4.3.2**), and the inspection and riverbank geotechnical work required (refer to **Section 4.3.3**). These cost projections are based on current unit rates, scope of work, and the condition assessment outcomes (SPG ratings) assigned to each crossing. By aligning intervention types with asset condition, the cost estimates help support strategic capital planning, prioritize high-risk assets, and ensure that funding allocations reflect both immediate and future infrastructure needs.

6.1.1 RCs Collection Piping Repair, Rehab, and Renewal Cost

Table 6-1 presents the estimated costs associated with various intervention strategies for the RCs linear assets, along with the corresponding age reset values upon completion of each intervention.

Table 6-1: Estimated Project Costs for Different Intervention Types

Intervention Types	Description	Applicable Condition (SPG)	Application Examples	Estimated Capital Costs	Asset age reset
No Rehabilitation Required	Crossings in Good condition that require no immediate action. These are subject to routine monitoring and maintenance to track future changes.	SPG 1–2	• All low-risk assets are monitored for deterioration	• N/A	N/A
Point Repair Allowance	Budget provision for potential future repairs on crossings with early signs of deterioration. Enables timely action without delaying for new funding.	SPG 3	• Not location-specific; allocated as a risk and condition-based financial provision	• 0.5% of the asset full replacement value	0
External Point Repair	Localized repair through external excavation to fix specific defects (e.g., at expansion joints). Used where damage is minor and accessible.	Targeted, typically SPG 3–4,	• Provencher Bridge (S-MA70050831) • Norwood Bridge (S-MA70057885)	• Costs are based on the estimation from the RCs condition assessment reports • \$90,000 for Provencher Bridge (S-MA70050831) • \$562,500 for Norwood Bridge (S-MA70057885)	0
Full Segment Liner	Trenchless rehabilitation method (e.g., CIPP, slip lining) used to structurally restore deteriorated pipes without excavation.	SPG 4	• Applied where significant but contained deterioration is observed • Deer Lodge (S-MA70016729) • Albany (S-MA20007887)	• \$10/mm/m unit rate is applied for all the RCs linear assets, except the following 6 assets, using a reduced rate at \$3/mm/m, due to site access, location and pipe size: • Des Trappistes (S-MA60023233) • Wellington Avenue (S-MA20010426) • Albany (S-MA20007887) • Abinoji Mikanah / CPR Tracks (S-MA50009013) • Edgemont / Abinoji Mikanah (S-MA50008068) • Lagimodiere / Abinoji Mikanah (S-MA70013886)	80% of Asset ESL
Full Segment Renewal	Complete replacement of the pipe via excavation or tunneling. Applied when structural integrity is compromised beyond repair.	SPG 5	• Reserved for assets in critical or failed condition • Fort Gary Bridge (S-MA70087290 and S-MA70053063)	• Full asset replacement value	100% of Asset ESL

6.1.2 RCs Collection Piping Inspection Cost

The inspection costs for RCs pipes are calculated by combining a basic inspection fee with length-based unit rates, depending on the type of inspection conducted. **Table 6-2** summarizes the unit costs for various RC inspection activities, based on figures from the City's RCs Master Plan and adjusted to 2025 dollars using the rate of inflation experienced by the City.

Table 6-2: RCs Pipe Inspection Costs Breakdown

Inspection Items	Unit Cost	Unit or Measure	Cost Basis	2025 Unit Cost
Basic Inspection Fee	$136,000	/inspection	2014 Estimate	$233,000
Basic Re-inspection Fee	$74,000	/inspection	2014 Estimate	$127,000
Inspection Fee	$265	/m	2014 Estimate	$453
Re-inspection Fee	$105	/m	2014 Estimate	$180
RBS (River-bottom Sonar)	$40	/m	2013 Estimate	$72
Sonar	$24	/m	2012 Estimate	$45
Basic Leak Detection Fee	$29,900	/inspection	2017 Estimate	$45,000
Leak Detection Inspection Fee	$15	/m	2017 Estimate	$22

6.1.3 RCs Riverbank Geotechnical Rehabilitation Cost

Riverbank geotechnical rehabilitation funding needs are derived from the RCs Condition Assessment and Annual Reports, based on key findings related to site-specific geotechnical conditions, soil characteristics, and riverbank structural stability. The site-specific funding needs for the next 3-5 years and 5-10 years are currently based on the most up-to-date available information, as indicated in **Table 6-3.**

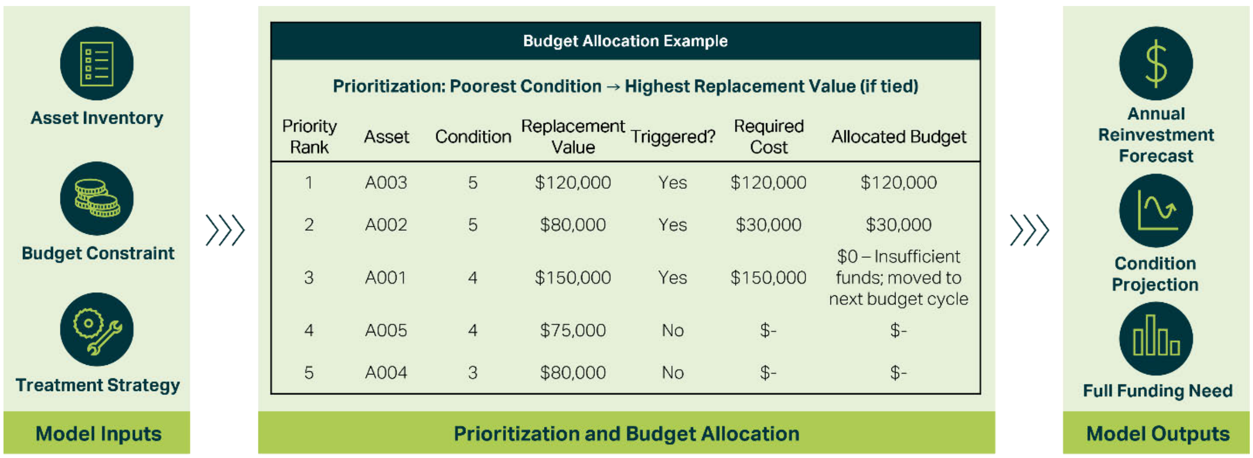
Table 6-3: Site Specific Riverbank Geotechnical Rehabilitation Cost Needs

Site Name	Asset Number	Planned Capital Work (3–5 Years)	Cost (3–5 Years)	Planned Capital Work (5–10 Years)	Cost (5–10 Years)
Westwood	S-MA70016410	Slope regrading and armoring	$15,000	-	-
Westwood	S-MA70016408	Slope regrading and armoring	$15,000	-	-
Heritage / Parkdale	S-MA70031733	Slope regrading and armoring	$66,000	-	-
Windham	S-MA70016531	Slope regrading and armoring	$40,000	-	-
Windham	S-MA70016527	Slope regrading and armoring	$40,000	-	-
Assiniboine Zoo	S-MA70016345	-	-	Remote Field Technology	$278,000
Whellams Lane	S-MA00017097	Slope regrading and armoring	$77,000	-	-
Whellams Lane	S-MA00017096	Slope regrading and armoring	$77,000	-	-
Whellams Lane	N/A	Slope regrading and armoring	$77,000	-	-
Frasers Grove Park	S-MA00017639	Toe armoring	$33,000	Remote Field Technology	$402,000
Frasers Grove Park	S-MA70021128	Toe armoring	$33,000	-	-
Munroe	S-MA70017147	Slope regrading and armoring	$40,000	-	-
Munroe	S-MA70017149	Slope regrading and armoring	$40,000	Remote Field Technology	$383,000
Fort Garry Bridge	S-MA70053063	Toe armoring	$16,000	-	-
Deer Lodge	S-MA70016729	Slope regrading and armoring	$80,000	Remote Field Technology	$252,000

6.2 Reinvestment Forecast and Lifecycle Modeling

6.2.1 Prioritization Methodology

A lifecycle model was developed to forecast and prioritize the City's RCs asset reinvestment needs over 20-year planning horizons. As presented in **Figure 6-1**, the core logic of this lifecycle model is to prioritize asset replacement based on condition scores, which are derived from SPG data and projected using the Weibull distribution. Assets are first ranked by condition, with those in the poorest condition receiving the highest priority. When multiple assets share the same condition rating, the model uses replacement value as a tiebreaker, giving precedence to assets with higher replacement costs. Only assets that are "triggered" for action based on the pre-defined treatment strategy are considered for funding. The allocated budget is distributed starting from the highest-priority asset until the available budget is exhausted. Assets that are triggered but cannot be funded within the current budget cycle are deferred to the next cycle. This approach enables the City to systematically prioritize capital work by aligning limited financial resources with the most urgent infrastructure needs.



Priority Rank	Asset	Condition	Replacement Value	Triggered?	Required Cost	Allocated Budget
1	A003	5	$120,000	Yes	$120,000	$120,000
2	A002	5	$80,000	Yes	$30,000	$30,000
3	A001	4	$150,000	Yes	$150,000	$0 – Insufficient funds; moved to next budget cycle
4	A005	4	$75,000	No	$-	$-
5	A004	3	$80,000	No	$-	$-

Figure 6-1: Lifecycle Model Prioritization Methodology

The results of the lifecycle model are presented as Power BI dashboards. Power BI is a robust business analytics tool that allows for data visualization and flexible exploration to support deeper analysis. Its user-friendly interface, robust data connectivity, and interactive reporting capabilities make it an ideal solution for transforming raw asset data into meaningful insights. By using Power BI, the user can explore reinvestment and full funding needs for RCs assets, monitor changes in risk profiles over time, and communicate findings clearly to stakeholders, supporting more informed and strategic AM decisions.

6.2.2 Key Assumptions and Parameters

Before interpreting the results of the asset lifecycle model, it is important to review the underlying assumptions. These assumptions define how asset performance, deterioration, and reinvestment needs are estimated. Ensuring a shared understanding of these inputs helps align expectations, supports transparency, and strengthens confidence in the model's outputs for decision-making.

The key assumptions and parameters adopted in the lifecycle model are listed below:

- **Base Year**: The base year for the financial model is set to 2025.
- **Analysis Period**: The financial model is designed to provide a 20-year forecast, covering the period from 2025 to 2044. It also has the capability to focus on any specific year within this range.
- **Inflation Rate**: The current and future inflation rates adopted for the financial model is 3% annually from 2025 to 2044.
- **Markup**: As mentioned in **Section 2.2.2**, the markup value adopted in the analysis is 45%, accounting for construction contingency, engineering and project management.
- **SPG, Asset Condition and Apparent Age**: A key assumption of this lifecycle model is that asset condition scores (derived from SPG data and projected using a Weibull distribution, refer to **Section 2.2.5** for details)

provide a more reliable indicator of asset health than real age. Therefore, condition scores are used to estimate the apparent age, which reflects the asset's actual physical and functional state. By prioritizing based on apparent age rather than real age, the model assumes that condition-driven decisions lead to more accurate identification of reinvestment needs and better alignment with asset performance over time.

- **Asset Reinvestment Types**: This model includes four types of asset reinvestment: Point Repair, External Point Repair, Full Segment Liner, and Full Segment Renewal. Refer to **Section 4.1** for the detailed decision tree and the associated outcomes of each reinvestment strategy.

6.3 Capital Reinvestment Need Analysis

As mentioned in the previous section, the capital reinvestment needs for the RCs assets are estimated based on asset condition, without regard to funding limitations. This Unlimited Budget Scenario reflects the theoretical funding needed to proactively manage asset condition and service levels without deferral or backlog accumulation. Note that the RCs appurtenant assets are excluded from the funding needs analysis.

6.3.1 20-Year Reinvestment Need Analysis

Under the Unlimited Budget Scenario, the total estimated reinvestment need for the City's RCs assets over the next 20 years are approximately **$28 million**, which translates to an average of around **$1.4 million per year**. As illustrated in **Figure 6-2**, In 2025, a projected reinvestment of $0.92 million is planned, primarily driven by the scheduled replacement of expansion joints on Provencher Bridge (S-MA70050831) and Norwood Bridge (S-MA70057885) at a combined cost of $0.65 million.

After 2025, annual reinvestment levels vary, until the first two peaks occur in 2029 and 2030, with total funding needs of $1 million annually, driven primarily by gravity (funding requirement of $1.2 million) and force main (funding requirement of $0.79 million) RCs pipes. A significant portion of the 2030 reinvestment is attributed to the full segment liner of the West Perimeter Bridge crossing (S-MA70028006), accounting for approximately $0.79 million. In 2036 and 2037, reinvestment needs rise to over $2 million. These increases are primarily driven by aging and deteriorated inverted siphon and force main assets. Specifically, the Munroe (S-MA70017149) are expected to require averagely $1.7 million for a full segment liner.

In 2038, reinvestment needs are projected to reach their highest peak at approximately $10.0 million. This surge is largely driven by the planned lining of inverted siphons and gravity crossing pipes approaching the end of their service life. Significant contributors include the Abinoji Mikanah / St. Annes crossing (S-MA50009027) at $7.0 million and the Mccrossen crossing (S-MA20011761) at $2.7 million for full segment lining. A secondary peak is anticipated in 2040, with total reinvestment needs estimated at $8.2 million, again primarily due to aging inverted siphons and gravity crossing pipes. Key projects include the Waterton / St. Annes crossing (S-MA70015660) requiring $2.3 million and the Ellice crossing (S-MA20009857) requiring $1.2 million for full segment lining. Bridge crossings generally require smaller, periodic investments throughout the planning horizon. Overall, the reinvestment pattern reflects condition-based triggers addressing both the backlog and ongoing asset deterioration.

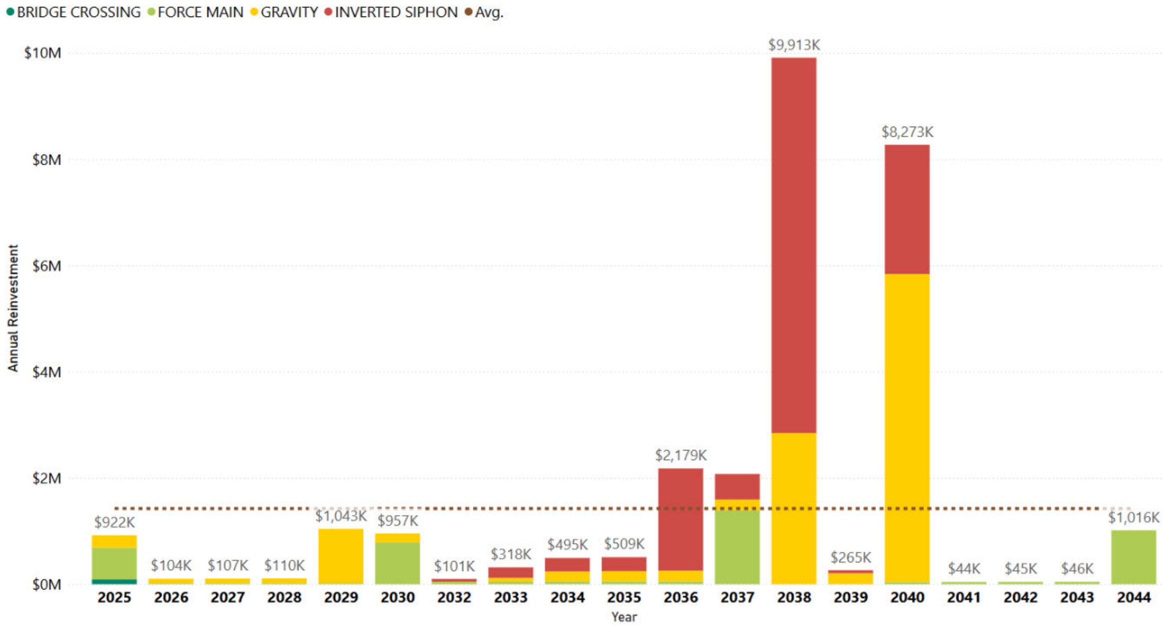


Figure 6-2: 20-Year Reinvestment Needs for the RCs Assets Under the Unlimited Budget Scenario

6.3.2 RCs Assets 20-Year LoS Trend Forecast

Figure 6-3 illustrates the long-term condition outlook for RC assets under two scenarios: Do Nothing and Unlimited Budget (see **Figure 6-2**). Under the Do-Nothing scenario, the percentage of assets in Fair or better condition declines sharply from approximately 86% in 2025 to just over 48% by 2044, indicating widespread deterioration in the absence of timely intervention. In contrast, the Unlimited Budget scenario maintains LoS near 98% throughout the 20-year period, demonstrating the effectiveness of timely reinvestment. This stark contrast highlights the critical need for sustained capital investment to preserve asset condition and avoid significant service degradation over time.

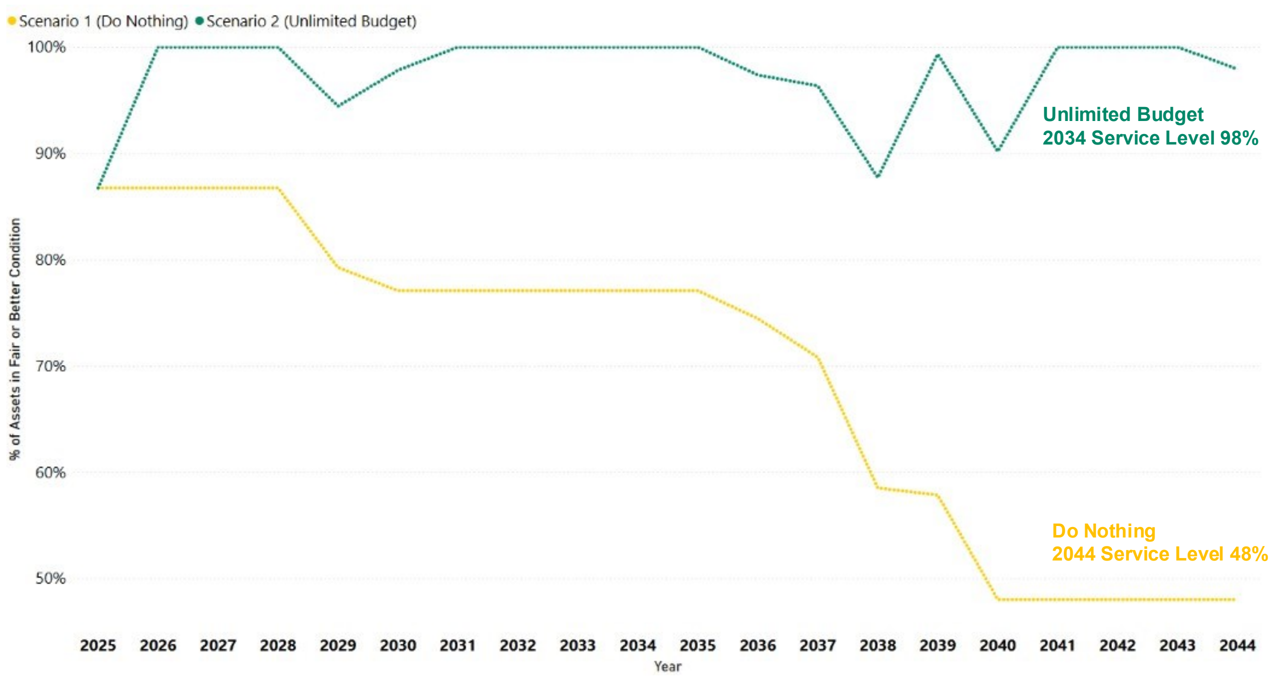


Figure 6-3: RCs Linear Assets Levels of Service Trend for All Budget Scenarios

Figure 6-4 demonstrates a progressive improvement in asset condition over the 20-year period under the Unlimited Budget Scenario. In 2025, only 48% of assets (by replacement value) are in Very Good condition while 10% are already in Very Poor condition. By 2037, the share of assets in Very Good condition rises to 70%, reflecting steady reinvestment efforts. From 2039 to 2040, 86% of assets remain in Very Good condition, with the balance in Fair or Good categories. By 2041, 96% of assets are consistently maintained in Very Good condition, a level that continues through 2044. This trajectory highlights the success of sustained reinvestment in virtually eliminating assets in Poor and Very Poor condition, ensuring long-term reliability of the system.

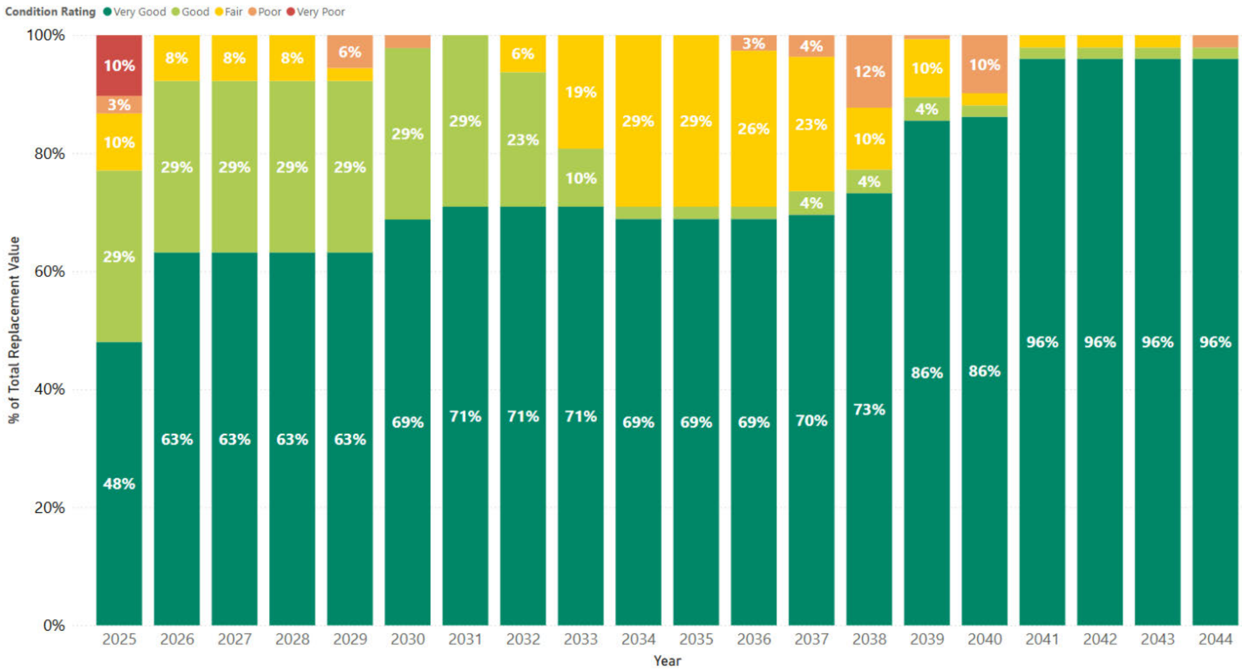


Figure 6-4: RCs Linear Assets Condition Projection

6.3.3 Benchmarking for Capital Reinvestment Needs

When interpreting the City's reinvestment needs, it is beneficial to compare the estimated needs with those of peer municipalities. AECOM's Canadian Infrastructure Benchmarking Initiative (the CIBI, see https://www.nationalbenchmarking.com/) provides valuable context for such comparisons. The CIBI is a partnership of over 40 Canadian municipalities, stretching from coast to coast, that annually collects and reports on water, wastewater, stormwater, and transportation LoS across operational, financial, environmental, and social "bottom lines". The findings from the CIBI serve as key inputs into establishing what constitutes industry best practice for asset management activities across Canadian municipalities. Comparing the City's capital reinvestment needs against CIBI data helps determine whether the City is investing appropriately to effectively maintain its RCs infrastructure and support long-term service delivery.

Figure 6-5 presents the City's capital expenditures benchmarked against 2024 CIBI data, where expenditures are normalized by the total replacement value of the wastewater collection system to calculate the capital reinvestment rate. A reinvestment rate of 1% indicates that the entire system would be replaced over a 100-year period. The CIBI wastewater collection system group median reinvestment rate is 0.60%, with the 25th and 75th percentiles at 0.21% and 0.89%, respectively. The City's current wastewater collection system reinvestment rate (0.94%) falls just above the 75th percentile, indicating an already relatively strong level of reinvestment compared to the broader peer group. For RCs assets specifically, the suggested annual reinvestment of $3.4 million would result in a reinvestment rate of 1.29%, positioning the City well above the sector benchmark and supporting a more proactive infrastructure renewal strategy. This higher reinvestment rate is particularly important for high criticality assets, where failures can lead to significant service disruptions, risks, costly emergency repairs and significant reputational damage. By investing at an elevated rate, the City can better manage risk, extend asset life, and ensure continued service reliability for critical wastewater infrastructure. Note that this reinvestment rate includes the Fort Garry Replacement. An equivalent figure without Fort Garry is $2.1 million per year and a reinvestment rate of 0.8% (which is used in the LoS targets).

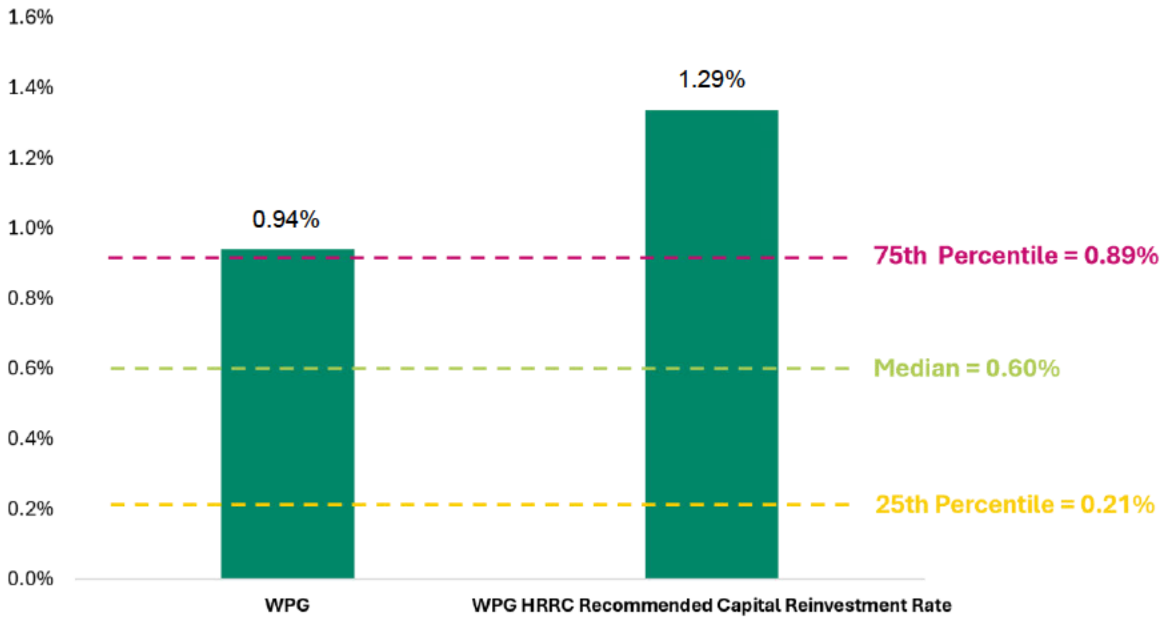


Figure 6-5: Wastewater Capital Expenditures Benchmarking – Capital Reinvestment Rate

6.4 Full Funding Need Profile

As indicated in Figure 6-6, the 20-year full funding forecast for RCs linear assets show a highly variable funding profile, with several pronounced peaks. The most significant spike occurs in 2025, with an estimated need of $26.9 million, primarily driven by the committed replacement project for the Fort Garry Bridge RCs. Smaller reinvestment years follow, with notable peaks in 2032 ($2.7 million), 2037 ($3.1 million), a second major peak in 2038 ($10.6 million) and a third major peak in 2040 ($8.3 million), largely due to full segment liner. Bank geotechnical work, inspections, point repair allowances, and external point repairs contribute to annual baseline costs. Despite fluctuations, the average annual reinvestment level hovers around $3.4 million, indicating a need for sustained capital allocation and proactive long-term planning to maintain the functionality and safety of these critical assets.

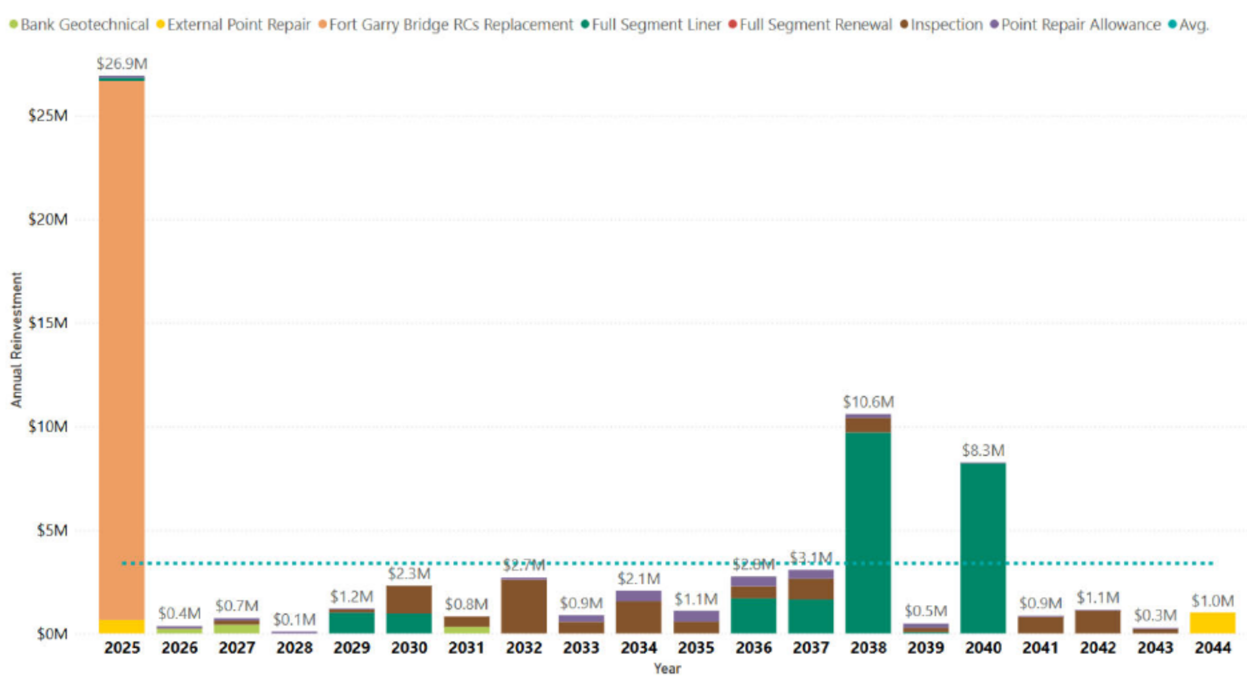


Figure 6-6: RCs Linear Assets Full Funding Needs

As indicated in Table 6-4, the 20-year funding analysis highlights that full segment liner and full segment renewal represent the largest capital needs, accounting for $57 million and $30.32 million, respectively. Full segment liner alone averages $2.85 million per year, making it the dominant cost driver in the long-term investment profile. Inspection activities also require significant funding, totaling $12.2 million over the planning horizon, with an average annual need of $0.61 million, underscoring the importance of proactive monitoring. Point repair allowances and bank geotechnical work contribute modestly to the total but play critical roles in maintaining asset integrity and mitigating localized risks. These findings reinforce the need for a balanced funding strategy that prioritizes structural rehabilitation while supporting routine condition assessments and minor repairs.

Table 6-4: Funding Needs for Each Funding Category

Funding Categories	20-Year Total	20-Year Average
Bank Geotechnical	$1.02 million	$10,000 (10-year average) *
Inspection	$12.2 million	$0.61 million
Point Repair Allowance	$3.35 million	$0.16 million
External Point Repair (Expansion Joint Replacement for Provencher Bridge and Norwood Bridge RCs)	$0.65 million	N/A**
Full Segment Liner	$23.4 million	$1.17 million
Full Segment Renewal (Fort Garry Bridge RCs Replacement)	$26 million	N/A**

*The funding needs for bank geotechnical rehabilitation are only available for the first 10 years.

**The external point repair and full segment renewal are planned in 2025 only.

6.5 Gaps and Recommendations

As part of the financial needs analysis, several gaps were identified related to cost estimation methods, inspection frequency assumptions, and the completeness of financial modeling inputs for the City's RCs assets. These limitations could affect the accuracy and reliability of long-term reinvestment forecasts, particularly for rehabilitation and renewal strategies involving external point repairs, full segment liners, riverbank geotechnical work, and inspection programs. The current financial model relies on generalized unit rates, broad cost assumptions, and non-standardized age reset values, which may not fully reflect site-specific conditions, updated market pricing, or evolving asset performance data.

Table 6-5 summarizes the key gaps identified during the development of the capital funding model, along with recommended actions to enhance accuracy, cost transparency, and alignment with industry best practices. These issues stem from outdated cost assumptions, conservative lifecycle parameters, and the absence of proactive funding needs forecasting. Addressing these limitations will improve the City's ability to prioritize investments, refine lifecycle projections, and support defensible capital planning under the broader asset management framework.

Table 6-5: Financial Analysis Gaps and Recommendations Summary

Section	Identified Gap	Recommendations
6.1 Basis of Estimate	External point repair funding estimates for RCs pipes are currently based on findings from condition assessment reports or field-identified service issues. These estimates rely on report recommendations but are not systematically updated in the financial model. (**Gap#44**)	• Establish a formal process to periodically review and integrate the most recent condition assessment reports and field findings into the financial model. (**Recommendation#76**) • Ensure all identified external point repair needs are incorporated as discrete items in future budget forecasts. (**Recommendation#52**)
	Full segment liner costs in the financial model are currently estimated using generalized unit rates (e.g., $10/mm/m or $3/mm/m), serving only as high-level placeholders. The City's detailed project cost estimating framework, however, uses a more refined method that combines base costs with length-based unit rates depending on the liner type. (**Gap#45**)	• Update unit rates for full segment lining using the most recent contractor quotes, market pricing, tender results, and third-party cost databases (e.g., RSMeans). Unit rates should be differentiated to account for variability in crossing configurations, recognizing that single-pipe crossings may require bypass pumping—representing a significant additional expense—whereas twinned crossings may not, resulting in substantially lower unit costs. (**Recommendation#25**)

Section	Identified Gap	Recommendations
		• Incorporate site-specific cost estimation into the financial model by integrating factors such as installation type, geotechnical conditions, selected rehabilitation method, project delivery timeline, and local constraints. This will ensure that the model accurately reflects the variability of conditions across RCs and provides a more reliable basis for long-term reinvestment planning. (**Recommendation#26**)
	Riverbank geotechnical rehabilitation needs are identified on a site-specific basis within RCs condition assessments and annual reports. However, there is currently no systematic or recurring geotechnical assessment program across all RCs sites. Additionally, the funding needs are reported within broad timeframes (e.g., 3–5 years or 5–10 years) without precise delivery years, reducing forecasting precision. (**Gap#46**)	• Implement a recurring geotechnical inspection program for riverbank conditions at all RCs crossings, with risk-based prioritization. (**Recommendation#70**) • Define clear timelines for recommended rehabilitation work and align funding forecasts with specific delivery years in the financial model. (**Recommendation#71**) • Periodically update rehabilitation needs as part of the City's AM planning cycle. (**Recommendation#72**)
	Full segment renewal needs are documented in City-issued condition assessments and RCs annual reports but may not be consistently reflected in the financial model if timely updates are absent in the future. (**Gap#47**)	• Ensure that all renewal needs identified in technical reports are systematically reviewed and integrated into the capital planning model, with adjustments made as asset knowledge evolves. (**Recommendation#80**)
6.2 Reinvestment Forecast and Lifecycle Modeling & 6.3 Capital Reinvestment Need Analysis	The RCs appurtenant assets were excluded from the funding needs analysis due to the absence of key information, including asset condition, installation year, and validation from the City. (**Gap#49**)	• It is recommended that these data gaps be addressed by validating the site-specific relationship between the appurtenant assets and the RCs Collection Piping. Once verified, these assets should be incorporated into the funding needs analysis in the next iteration. (**Recommendation#56**)
	The financial model assumes a default service life of 50 years for Class IV structural liners used in full segment repairs. While this is a conservative assumption, it may underestimate the actual performance potential of these materials under certain conditions. (**Gap#43**)	• Conduct a literature review and consult available performance testing data to determine whether a longer expected service life (e.g., 60–75 years) can be justified. (**Recommendation#75**) • If applicable, update lifecycle parameters in the financial model to reflect a more representative lifespan, thereby optimizing long-term planning. (**Recommendation#77**)
	Upon completion of full segment lining, the model currently resets asset age to 80% of the liner's theoretical expected service life. This conservative approach may understate the remaining useful life restored through rehabilitation. (**Gap#48**)	• Reassess the age reset assumption based on empirical data, industry best practices, and site-specific performance monitoring. (**Recommendation#54**) • Consider adjusting the reset factor upward where warranted to better reflect the full structural benefit of rehabilitation work. (**Recommendation#55**)

7. Plan Improvement and Monitoring

Each section of this report highlights several gaps and recommended activities to improve asset management, the next iteration of the plan and to support operations at the City. The gaps were assigned logical groups with similar themes for execution. Each gap found was assigned an impact and this impact was used to assign a priority to each recommendation (high, medium, and low). These groups along with the total number of recommendations and their priority are described in this section. The high-level areas of improvement found were:

1. Asset Inventory and Data Integration.
2. Condition Assessment and Lifecycle Planning.
3. Performance Monitoring and Capacity Planning.
4. Operational Processes and Work Order Management.
5. Risk Management and Decision-Making.
6. Governance, Roles, and Stakeholder Engagement.
7. Financial Tracking and Cost Attribution.

The following activities (**Table 7-1**) within these areas have been identified by the City as the highest benefit to the City and are recommended to be progressed.

Table 7-1: Highest Benefit Activities

Activity #	Activity Description
1	New assets for the sanitary network should be consistently added to the inventory within a fixed timeline, preferably within three months of commissioning.
2	Project closeout should be closely monitored to ensure that asset information is entered quickly, accurately, and in accordance with City standards. Preliminary data should be entered into City systems as soon as construction is complete, followed by more accurate updates once as-built drawings are available.
7	Identify data gaps and supplement with targeted flow monitoring at high-risk crossings to evaluate remaining sewer capacity.
10	Create a work order type/category using an unused data field in the CMMS that can be applied to all work relating to HRRC assets.
21	Reassess and adjust the contingency fund to reflect current asset inventory and inflation.
22	Establish clearer access protocols and explore dedicated funding streams for high-priority expenditure.
25	Update unit rates for full segment lining using the most recent contractor quotes, market pricing, tender results, and third-party cost databases (e.g., RSMeans). Unit rates should be differentiated to account for variability in crossing configurations, recognizing that single-pipe crossings may require bypass pumping—representing a significant additional expense—whereas twinned crossings may not, resulting in substantially lower unit costs.
26	Incorporate site-specific cost estimation into the financial model by integrating factors such as installation type, geotechnical conditions, selected rehabilitation method, project delivery timeline, and local constraints. This will ensure that the model accurately reflects the variability of conditions across RCs and provides a more reliable basis for long-term reinvestment planning.
59	Where possible, populate missing installation dates using historical maintenance records or estimated installation windows based on nearby assets or pipe segments.
74	Work with City stakeholders to define and document acceptable risk thresholds to support consistent risk-based decisions.

7.1 Summary & Gaps

All gaps identified within the AMP have been reviewed and grouped by similarity to identify seven core areas to address at the City specifically focussing on RCs. These are listed below and the corresponding gaps referenced as per **Table 7-2**.

Table 7-2: Total Gaps and Recommendations Summary

Gap #	Gap Description	Area
1	The asset hierarchy for RCs appurtenant assets was developed based on site observations, historical reports, and operational records rather than a structured and validated asset inventory.	1
2	The appurtenant asset inventory was established through geo-fencing (60 m buffer around RCs pipes) and manual verification but may not include all relevant assets.	1
3	Instrumentation & control components and riverbank protection/erosion control features were not captured in the GIS database.	1
4	Portions of valve inventory were extracted from CMMS work orders using CMMS-specific asset IDs, which differ from the GIS database's asset IDs, resulting in traceability issues.	1
5	Many valve records are missing installation year data, limiting lifecycle analysis and asset age profiling.	1
6	Some appurtenant asset installation dates are entered as default or placeholder values (e.g., 9999-09-09), affecting data reliability.	1
7	No formal condition ratings have been assigned to RCs appurtenant assets, making it difficult to evaluate asset health or prioritize renewal.	2
8	Asset data is spread across multiple systems (GIS, CMMS, spreadsheets), leading to inconsistency and inefficiency.	1
9	No consistent methodology exists for estimating remaining service life (RSL) based on a defined Structure Performance Grade (SPG) or condition criteria.	2
10	Assets associated with RCs appurtenant assets are not clearly identified in the GIS or CMMS for easy future reference.	1
11	Assets are being operated for prolonged periods without entry into critical City systems such as the CMMS or GIS.	4
12	No system-wide capacity metric is currently available due to modelling limitations associated with siphons, force mains, and older infrastructure.	3
13	Available data sources, such as lift station pumping records and design capacity for FGSV and future Southwest Interceptor crossings, are not currently integrated into a formal performance evaluation framework.	3
14	There is no current mechanism to evaluate whether crossings meet capacity needs under current or future flow conditions.	3
15	Odour complaints not fully geo-referenced to RCs	6
16	Environmental resilience metric not yet defined	6
17	Monitoring is currently defined and tracked based solely on age-related inspection thresholds.	2
18	There is a potential gap in proactively capturing broader performance indicators (e.g., hydraulic stress, erosion, structural risk) that may impact asset reliability between inspections.	2
19	Limited condition data coverage across all crossings	2
20	Incomplete work order closure rates for RC-related activities	4
21	Emergency vs. planned capital spending not disaggregated for RCs	5
22	Inspection costs tracked but not used for decision-making	4
23	Environmental and stakeholder engagement is ad-hoc	6
24	Future demand and capacity is not specifically calculated and known.	3

Gap #	Gap Description	Area
25	Limited documentation of stakeholder responsibilities across lifecycle stages.	6
26	Indigenous engagement is often reactive and case-by-case.	6
27	Lack of clarity on roles during early planning and regulatory coordination.	6
28	Inconsistent alarm configuration and lack of training on SCADA systems.	4
29	The unspecified, discretionary fund of $1 million has not increased with inflation or asset growth. It is shared across the department and often oversubscribed. Use of the fund requires a formal memo to Council for transfer, which can delay urgent projects.	7
30	No standardized process for determining when to abandon vs. remove assets.	5
31	Risk matrix not fully integrated into lifecycle planning and prioritization.	5
32	Inconsistent alignment between SPG ratings and assigned lifecycle actions.	5
33	Lack of clarity on inspection intervals for certain pipe types and conditions.	2
34	Gaps in condition data for older or inaccessible crossings.	2
35	Air release valves are currently included in work orders for manual actuation, which can cause damage or safety risks.	2
36	Post-installation inspections and quality assurance are inconsistently applied.	2
37	Sewer crossing costs are currently aggregated with overall wastewater main costs, obscuring their unique lifecycle and financial requirements.	7
38	Missing asset IDs and some other information like stream classification in registry and condition reports.	1
40	No formal risk tolerance threshold.	5
42	No formal process for evaluating risk trade-offs.	5
43	The financial model assumes a default service life of 50 years for Class IV structural liners used in full segment repairs. While this is a conservative assumption, it may underestimate the actual performance potential of these materials under certain conditions.	2
44	External point repair funding estimates for RCs pipes are currently based on findings from condition assessment reports or field-identified service issues. These estimates rely on report recommendations but are not systematically updated in the financial model.	7
45	Full segment liner costs in the financial model are currently estimated using generalized unit rates (e.g., $10/mm/m or $3/mm/m), serving only as high-level placeholders. The City's detailed project cost estimating framework, however, uses a more refined method that combines base costs with length-based unit rates depending on the liner type.	7
46	Riverbank geotechnical rehabilitation needs are identified on a site-specific basis within RCs condition assessments and annual reports. However, there is currently no systematic or recurring geotechnical assessment program across all RCs sites. Additionally, the funding needs are reported within broad timeframes (e.g., 3–5 years or 5–10 years) without precise delivery years, reducing forecasting precision.	7
47	Full segment renewal needs are documented in City-issued condition assessments and RCs annual reports but may not be consistently reflected in the financial model if timely updates are absent in the future.	7
48	Upon completion of full segment lining, the model currently resets asset age to 80% of the liner’s theoretical expected service life. This conservative approach may understate the remaining useful life restored through rehabilitation.	7

Gap #	Gap Description	Area
49	The RCs appurtenant assets were excluded from the funding needs analysis due to the absence of key information, including asset condition, installation year, and validation from the City.	1
50	Operations indicated that some valves are non-operational.	2

*Gaps 39 and 41 identified during the course of the AMP and reported at draft stages were found to have been previously resolved and have been removed from this gap analysis.

7.1.1 Area 1 - Asset Inventory and Data Integration

The RCs appurtenant assets have had an asset inventory created within this AMP but this may not correspond directly to the overarching hierarchy within the City. The asset hierarchy was initially developed based on site observations, historical reports, and operational records, which resulted in an incomplete and non-validated inventory (Gap #1). Although geo-fencing was used to identify assets, there is a risk that not all relevant assets were captured (Gap #2). Additionally, instrumentation, control components, and riverbank protection features are missing from the GIS database (Gap #3). Traceability issues also arise from differences between asset identifiers in CMMS and GIS, leading to data inconsistencies (Gap #4). Missing installation year data for many valves limits lifecycle analysis and asset age profiling (Gap #5), and some installation dates have been entered as placeholder values (Gap #6), further affecting data reliability. Also, there is no clear identification of RC appurtenant assets in GIS or CMMS systems (Gap #10, Gap #49) to assist in tracking, and the asset data is spread across multiple systems, leading to inefficiencies and inconsistency (Gap #8). Missing or incomplete asset IDs and other information, such as stream classification, also contribute to a lack of clarity in asset management (Gap #38).

The impact of these gaps is determined to be low to medium with no immediate impact to safety, budgets or performance.

7.1.2 Area 2 - Condition Assessment and Lifecycle Planning

A key issue in the management of RC appurtenant assets is the lack of formal condition ratings, which hinders the ability to evaluate asset health and prioritize necessary repairs or replacements (Gap #7). No consistent methodology for estimating the remaining service life (RSL) of assets existed, which leaves significant gaps in lifecycle planning (Gap #9) which have been partially addressed by this plan but should be validated by the City. Condition assessment has been primarily based on age-related inspection thresholds, which fail to capture broader performance indicators like hydraulic stress or erosion that may affect asset reliability (Gap #17, Gap #18) but this should be addressed now that the majority of assets have had an inspection. There is also limited coverage of condition data across all RCs assets (Gap #19), and gaps in the condition data for older or inaccessible crossings have made it difficult to conduct accurate assessments (Gap #34). The inconsistently applied inspection intervals for certain types of pipes and conditions (Gap #33, Gap #50) is indicative of the financial constraints the City has to work within and is compounded by inconsistent post-installation inspections (Gap #36) which further complicates lifecycle planning. Additionally, air release valves are often included in work orders for manual actuation, posing safety risks (Gap #35). The default assumption that Class IV structural liners have a service life of 50 years may underestimate their longevity and affect repair decision-making (Gap #43) but can be easily addressed.

In addition to existing issues, condition assessment is further limited by the absence of a recurring geotechnical evaluation program for riverbanks and by overly conservative post-lining asset age resets, which may underrepresent the actual service life restored through rehabilitation efforts (Gap #46).

The impact of these gaps is determined to be low to medium with no immediate impact to budgets or performance with the exception of Gap #35 and Gap #36 which should be addressed in the short term.

7.1.3 Area 3 - Performance Monitoring and Capacity Planning

The RCs system is currently lacking a system-wide capacity metric, particularly for older infrastructure like siphons and force mains, due to a lack of detailed available modeling (Gap #12). There is also no integration of available data sources, such as lift station records or design capacity for critical crossings which should be used in a formal performance evaluation framework (Gap #13). This lack of integration makes it difficult to assess whether crossings meet capacity needs under current or future flow conditions (Gap #14, Gap #24).

The impact of these gaps is determined to be medium to high as the mitigation and options to address may take considerable time to enact.

7.1.4 Area 4 - Operational Processes and Work Order Management

Several gaps in operational processes have led to inefficiencies and data inconsistencies in work order management. For example, some RC assets have been operated for extended periods without being entered into critical City systems like CMMS or GIS (Gap #11), and work orders related to RCs often have incomplete closure rates (Gap #20). Inspection costs are tracked but not effectively used in decision-making (Gap #22), and inconsistent alarm configuration and lack of SCADA training (Gap #28) has created operational risks.

The impact of these gaps is determined to be high as the City is not enacting work that has been defined and cannot easily track this risk.

7.1.5 Area 5 - Risk Management and Decision-Making

Risk management processes have been created and input data updated but are not fully integrated into lifecycle planning or decision-making, and there is no clear process for determining when to abandon versus remove assets (Gap #30). The risk matrix was not fully aligned with lifecycle planning or prioritization, but this AMP has attempted to address this along with SPG ratings that are now matched with lifecycle actions (Gap #31, Gap #32). Additionally, the absence of a formal risk tolerance threshold (Gap #40) and the lack of a formal process for evaluating risk trade-offs (Gap #42) have contributed to difficulty in making informed, risk-based decisions. Financial decisions also suffer from the absence of clear emergency versus planned capital spending breakdowns, especially for RCs (Gap #21).

The impact of these gaps is determined to be low to medium with no immediate impact to safety, budgets or performance. Two gaps (#31 and #32) are addressed by the plan.

7.1.6 Area 6 - Governance, Roles, and Stakeholder Engagement

Stakeholder engagement is fragmented and often reactive. There is a lack of clarity about stakeholder responsibilities across lifecycle stages, and indigenous engagement is typically handled on a case-by-case basis (Gap #25, Gap #26). Regulatory coordination is unclear during early planning stages (Gap #27), and environmental and stakeholder engagement processes are ad-hoc, making it harder to manage projects effectively (Gap #23). Furthermore, the absence of a defined environmental resilience metric further complicates decision-making for climate-sensitive projects (Gap #16) as the requirement to align with City objectives is not quantified. Odour complaints are also not fully geo-referenced to RCs, making it difficult to track performance or implement corrective actions (Gap #15).

The impact of these gaps is determined to be low to medium with no immediate impact to safety, budgets or performance.

7.1.7 Area 7 - Financial Tracking and Cost Attribution

A significant gap exists in tracking and categorizing costs, particularly related to RCs. Sewer crossing costs are currently aggregated with overall wastewater main costs, obscuring their unique lifecycle and financial requirements (Gap #37). The unspecified, discretionary fund has not increased to reflect inflation or asset growth, and the fund is often oversubscribed, which can delay urgent projects (Gap #29). The financial model lacks integration with detailed condition assessments and relies on generalized unit rates and static assumptions, resulting in funding estimates that may not reflect true renewal needs, project scope, or current cost estimating standards (Gap #44, #45, #46, #47, and #48). The impact of these gaps is determined to be medium to high due to substantial, longer-term impact to budgets and the accuracy of this plan.

7.2 Improvement Opportunities

The improvement opportunities listed in this plan have been reviewed to identify the gap area they work towards addressing and if they are tactical (improve the AMP) or strategic (support other business processes) in nature. A full list of the improvement activities is shown in **Appendix D** alongside their assessed risk severity (in line with the City's integrated risk management process).

It should be noted that this list is **not a list of required improvements** and is only identified as a list of opportunities that the City can select from when looking to improve AM further.

7.2.1 AM Plan Improvements

AMP improvement initiatives are listed per gap area in **Table 7-3** to **Table 7-9** with approximate durations estimated along with additional or external resources required to support a high-level funding requirement (note that each activity would need to be fully defined to allow a full estimate to be calculated).

The tables below also give approximate timelines to execute (the projected calendar duration of a task), the relative importance based upon the impact of the gap area previously discussed (low, medium, high) and the estimated internal branch responsible for delivery at the City. When a task is recurring the suggested frequency is listed (monthly, quarterly, yearly, etc.)

Table 7-3: RC AMP Improvements Recommendations – Area 1 Asset Inventory

#	Activity	Priority	Timeline	Team	Resource
57	Conduct a full review and validation of the inventory with City staff to ensure completeness and accuracy of all in-scope assets.	Medium	6 months	AM	Internal (80 hours)
58	Perform a targeted asset capture initiative for these components using field validation and incorporate them into GIS and CMMS with appropriate asset classifications.	Medium	12 months	AM	Internal and External (approx. 80 hours each)
59	Where possible, populate missing installation dates using historical maintenance records or estimated installation windows based on nearby assets or pipe segments.	Medium	3 months	GIS	Internal (40 hours)
69	Update asset inventory to ensure each crossing has a unique ID and confirmed stream classification type. Use inspection reports and field verification where needed.	Medium	3 months	AM	Internal (20 hours)
56	It is recommended that these data gaps be addressed by validating the site-specific relationship between the appurtenant assets and the RCs Collection Piping. Once verified, these assets should be incorporated into the funding needs analysis in the next iteration.	Low	2 years	AM	Internal (80 hours)
				Total	**Internal – 300 hours** **External – 80 hours**

Table 7-4: RC AMP Improvements Recommendations – Area 2 Condition Assessment

#	Activity	Priority	Timeline	Team	Resource
30	Establish and document a consistent RSL estimation method based on condition grade, age, material, and performance risk; align with condition assessment reports or industry best practices.	Low	3 months	AM	External (80 hours)
63	Formalize the monitoring plan contained herein that includes condition inspections, interim screening (e.g., visual spot checks or remote flow indicators), and risk-based reinspection cycles.	Medium	12 months	AM	Internal (80 hours) External (200 hours)
38	Continue the condition assessment program to understand the condition of all RCs and consider integration of information from non-RCs covered under the regular gravity main condition assessment program. Consider prioritization of those still relying on age-based proxies.	Low	2 years	AM	Internal (120 hours) External (400 hours)
47	Develop a formal inspection schedule matrix based on pipe material, SPG, and remaining life, (flowchart in **Section 4.3**)	Low	6 months	AM	Complete
71	Define clear timelines for recommended rehabilitation work and align funding forecasts with specific delivery years in the financial model.	Medium	2 years	AM	Internal (80 hours) External (80 hours)
72	Periodically update rehabilitation needs as part of the City's AM planning cycle.	Medium	Annual Task	AM	Internal (20 hours) External (100 hours)
				Total	**Internal – 300 hours** **External – 860 hours**

Table 7-5: RC AMP Improvements Recommendations – Area 3 Performance Monitoring

#	Activity	Priority	Timeline	Team	Resource
5	Define clear rating thresholds using the following logic: – Good: Future/projected peak flow < RC capacity (35-year planning horizon) – Fair: Current peak flow < RC capacity – Poor: Current peak flow > RC capacity	Medium	12 months	AM	Internal (20 hours)
7	Identify data gaps and supplement with targeted flow monitoring at high-risk crossings to evaluate remaining sewer capacity.	High	12 months	Design	Internal (40 hours)
8	Incorporate sewer capacity results into lifecycle planning and prioritize upgrades for any crossings assessed as an SPG or 4 or 5.	High	2 years	AM	Internal (20 hours)

#	Activity	Priority	Timeline	Team	Resource
				Total	**Internal – 80 hours**

Table 7-6: RC AMP Improvements Recommendations – Area 4 Operational Processes

#	Activity	Priority	Timeline	Team	Resource
3	A minimum required dataset must be clearly defined and maintained to uphold inventory accuracy, reliability, and compliance with records management policies.	High	6 months	AM	Internal (20 hours) External (40 hours)
15	Establish an interim LoS target of ≥ 75 % fully closed work orders within three years, monitored via quarterly CMMS performance reviews and reported in the annual LoS dashboard.	High	3 months	AM	Internal (20 hours)
43	Monitor cost trends over time to support decisions on inspection frequency, contract management, and bundling opportunities.	Low	Annually	Finance	Internal (20 hours)
				Total	**Internal – 60 hours** **External – 40 hours**

Table 7-7: RC AMP Improvements Recommendations – Area 5 Risk Management

#	Activity	Priority	Timeline	Team	Resource
41	Report a three-year rolling average of emergency-to-capital spending ratio and use it as an indicator of risk exposure.	Low	Annually	Finance	Internal (10 hours)
42	Target a long-term ratio of ≤15% to support stable financial planning.	Low	2 years	Finance	Internal (10 hours)
44	Embed risk scoring into lifecycle decision-making tools and project planning workflows.	Medium	12 months	AM	Internal (20 hours)
73	Work with City stakeholders to define and document acceptable risk thresholds to support consistent risk-based decisions.	Medium	12 months	AM	Internal (40 hours) External (80 hours)
53	Include a standard step in future planning to identify and document any consequential risks from proposed mitigation strategies.	Medium	3 months	Design	Internal (10 hours) External (10 hours)
				Total	**Internal – 90 hours** **External – 90 hours**

Table 7-8: RC AMP Improvements Recommendations – Area 6 Governance, Roles and Stakeholder Engagement

#	Activity	Priority	Timeline	Team	Resource
34	Incorporate odour complaint investigation results into quarterly service-level reviews.	Low	Quarterly	AM	Internal (10 hours)
46	Develop a formal acquisition workflow that defines responsibilities across WWD, Council, and regulators.	Medium	2 years	AM	Internal (40 hours)
				Total	**Internal – 50 hours**

Table 7-9: RC AMP Improvements Recommendations – Area 7 Financial Tracking

#	Activity	Priority	Timeline	Team	Resource
45	Develop a decision-making framework for decommissioning, including environmental and cultural criteria.	Low	12 months	AM	Internal (40 hours) External (120 hours)

#	Activity	Priority	Timeline	Team	Resource
48	Establish a distinct cost tracking and forecasting model specifically for RCs assets, separate from general wastewater infrastructure, to ensure accurate lifecycle analysis and targeted financial planning.	Low	12 months	Finance	Internal (80 hours) External (40 hours)
75	Conduct a literature review and consult available performance testing data to determine whether a longer expected service life of CIPP (e.g., 60–75 years) can be justified.	Low	3 months	AM	Internal (20 hours) External (80 hours)
76	Establish a formal process to periodically review and integrate the most recent condition assessment reports and field findings into the financial model.	Low	12 months	AM	Internal (10 hours) External (40 hours)
25	Update unit rates for full segment lining using the most recent contractor quotes, market pricing, tender results, and third-party cost databases (e.g., RSMeans). Unit rates should be differentiated to account for variability in crossing configurations, recognizing that single-pipe crossings may require bypass pumping—representing a significant additional expense—whereas twinned crossings may not, resulting in substantially lower unit costs.	High	2 years	AM	Internal (10 hours) External (10 hours)
26	Incorporate site-specific cost estimation into the financial model by integrating factors such as installation type, geotechnical conditions, selected rehabilitation method, project delivery timeline, and local constraints. This will ensure that the model accurately reflects the variability of conditions across RCs and provides a more reliable basis for long-term reinvestment planning.	High	2 years	AM	Internal (10 hours) External (100 hours)
80	Ensure that all renewal needs identified in technical reports are systematically reviewed and integrated into the capital planning model, with adjustments made as asset conditions evolve.	Medium	2 years	AM	Internal (40 hours) External (80 hours)
77	If applicable, update lifecycle parameters in the financial model to reflect a more representative lifespan, thereby optimizing long-term planning.	Low	2 years	AM	Internal (10 hours) External (10 hours)
54	Reassess the age reset assumption based on empirical data, industry best practices, and site-specific performance monitoring	Low	12 months	AM	Internal (10 hours) External (10 hours)
55	Consider adjusting the reset factor upward where warranted to better reflect the full structural benefit of rehabilitation work.	Low	12 months	AM	Internal (10 hours) External (10 hours)
				Total	**Internal – 240 hours** **External – 500 hours**

7.2.1.1 Resource Requirements

Using the high-level estimates presented previously the following internal and external resource requirements have been identified to support AM plan improvement over the next plan cycle. All groups identified are within the WWD

- Internal Resource: 1,120 hours.
  - AM Branch – 910 hours.
  - Design (Wastewater Planning and Project Delivery Branch – 50 hours.
  - GIS - 40 hours.
  - Finance – 120 hours.
- External Resource: 1,570 hours.

7.2.2 Non Plan Related Improvement Opportunities

Table 7-10 contains the improvement opportunities identified which are not directly related to the AMP but may further management of RCs at the City. They are supported by the relative importance according to the identified gap.

Table 7-10: Non-AMP Improvement Activities

#	Recommendation	Risk
1	New assets for the sanitary network should be consistently added to the inventory within a fixed timeline, preferably within three months of commissioning.	Critical
2	Project closeout should be closely monitored to ensure that asset information is entered quickly, accurately, and in accordance with City standards. Preliminary data should be entered into City systems as soon as construction is complete, followed by more accurate updates once as-built drawings are available	Critical
4	Develop a fit-for-purpose hydraulic capacity assessment framework for RCs using available lift station data and crossing design information.	Moderate
6	Use flow projections under a 10-year MacLaren design storm for gravity siphons and maximum pumping capacity for force mains to determine future capacity requirements for non separated sewers.	Moderate
9	As an interim step to full future capacity demand analysis, initiate a RC mini-model to support risk screening until a full system-wide capacity model is feasible.	Moderate
13	At completion of a work order, schedule the next for the correct frequency instead of an automatic schedule at the start of the year.	Critical
14	Provide refresher CMMS training for O&M staff to improve data entry accuracy and completion rates.	Moderate
16	Review individual task completion of work orders (particularly valve actuation) for consistently incomplete tasks and over actuated valves.	Critical
17	Demand drivers such as increasing population, forecast climate change and the CSO master plan will increase demand. A consistent process for determination of the hydraulic capacity over the life of a renewal or replacement should be agreed and implemented prior to future works.	Minor
18	A full combined sewer hydraulic model should be consulted with inputs from future developments/densification, population increase forecasts and the impact of other existing City projects (see KPI#1 gap above).	Minor
19	Implement alarm rationalization program/project using ANSI/ISA-18.2 and EEMUA 191 standard.	Moderate
20	Define requirements for SCADA alarms for future projects.	Moderate
21	Reassess and adjust the contingency fund to reflect current asset inventory and inflation.	Moderate
22	Establish clearer access protocols and explore dedicated funding streams for high-priority expenditure.	Moderate
23	Revise work order protocols to exclude manual actuation of air valves; adopt visual inspection and leak detection as standard practice.	Moderate
24	Consistently enact formal post-installation inspection protocols in accordance with the City of Winnipeg's specifications. These protocols include mandatory pre- and post-installation CCTV inspections, verification of service reinstatement quality, and documentation of liner integrity. Ensuring consistent application of these standards will improve quality control, extend asset life, and support accountability across all rehabilitation projects.	Critical
27	Develop a standardized and comprehensive asset hierarchy aligned with the City's GIS and CMMS databases to improve inventory consistency and support future planning efforts.	Minimal
28	Harmonize CMMS and GIS asset identifiers using a cross-referencing system or unique asset ID mapping table to improve traceability and data integration across platforms.	Minimal
29	Define the data contained within each asset data repository or implement automated data syncing across platforms (particularly GIS system) to ensure a single source of truth for asset records.	Minor
31	Introduce a standardized data field or tagging convention (e.g., "RCs_Asset" flag) in both GIS and CMMS systems to streamline tracking and filtering of relevant assets.	Minimal
32	Update OWAM workflows to include standardized location input (address or GIS coordinates) for each odour complaint.	Minor
33	Cross-reference odour and other resident complaints occurring within 150 metres of a crossing with inspection scheduling to assist in work order prioritisation.	Minimal
34	Incorporate odour complaint investigation results into quarterly service-level reviews.	Minimal
35	Once the Climate Action Plan Update is finalized, define asset-specific criteria such as bank stabilization, freeboard, scour protection, and pipe material standards.	Minimal
37	Pilot two climate-resilient renewal projects as a demonstration of best practice.	Minimal

#	Recommendation	Risk
39	Use the updated 2024 risk assessment data to finalize baseline condition performance.	Minor
40	Create unique cost codes to separate emergency repairs from planned renewals in financial systems.	Minor
49	Activity updated - not required by the City.	#N/A
51	Establish a proactive consultation protocol with Indigenous communities across all project stages, in collaboration with the City's Indigenous Relations Division.	Minor
52	Ensure all identified external point repair needs are incorporated as discrete items in future budget forecasts.	Minor
60	Establish data validation rules in GIS/CMMS to flag and correct placeholder values; update missing dates through field verification or engineering judgment.	Minor
61	Continue implementation of standardized condition assessment protocol (e.g., NASSCO MACP for MHs and chambers) and incorporate the results into the City's asset management systems.	Moderate
62	Activity updated - not required by the City.	N/A
64	Activity updated - not required by the City.	N/A
65	Ensure all monitoring activities, including inspections triggered by age, condition, or event-based thresholds, are captured consistently in the City's asset management system.	Moderate
66	Enhance documentation and reporting protocols to support compliance audits and operational transparency.	Minor
67	Prioritize data collection for high-risk or data-deficient assets using targeted inspections.	Minor
70	Implement a recurring geotechnical inspection program for riverbank conditions at all RCs crossings, with risk-based prioritization.	Moderate
74	Finalize and implement stakeholder engagement tools to clarify roles and communication pathways.	Minimal
78	Develop a formal protocol for engaging regulatory agencies, Indigenous communities, and environmental groups during project scoping and design phases.	Minor
79	Publish the crossing summary annually, highlighting inspection results, identified risks, and planned improvements for transparency.	Minor
81	Operations indicated that some valves are non-operational and an alternative isolation (inflatable dam) can be used instead. It is recommended that the City evaluate valve operability and possibly removal from service if assets are found to be non-operational and unnecessary.	Minor
82	Standardize decision rules linking SPG levels to specific lifecycle activities as identified in **Figure 4-1**.	Minor
83	Activity updated - not required by the City.	N/A

8. Lessons Learned and Conclusion

The following final lessons learned and conclusions are summarized for the City's consideration. They are integral to ensuring that this AMP functions not only as a comprehensive and strategic planning document, but also as a living tool to guide continuous improvement and support data-driven decision-making. This section supports two core purposes:

- Stakeholder Communication: The summary serves as a mechanism for communicating the outcomes of the asset management process to key stakeholders, including senior management, City departments, regulatory bodies, and external partners. It provides transparency regarding the City's current challenges, actions taken, and future direction for managing high-risk RCs.
- Support for Decision-Making: The lessons learned from the development of this AMP help inform future decision-making by reinforcing effective strategies and highlighting areas where improvements are needed. They ensure the AMP remains responsive to emerging needs and adaptable to future updates in policy, data, and infrastructure conditions.

8.1.1 Key Lessons Learned

The process of developing this AMP has offered valuable insights into both the strengths of the current asset management approach and areas requiring further attention. It emphasized the importance of consistent data, clear governance, and proactive reinvestment planning to manage aging infrastructure and associated risks effectively. The following lessons have emerged as critical to supporting future iterations of this AMP and advancing the City's overall asset management maturity:

- **Asset Management is an Iterative Process:** The development of this AMP demonstrated that asset management maturity and improvement depend on periodic review and refinement. Gaps identified across asset inventory, condition data, and financial forecasting demonstrate the need for ongoing updates and integration of new information into the AMP to advance. There is no single activity that solves the City's challenges.
- **Data Gaps Must Be Systematically Addressed:** Several limitations were identified in historical data, particularly related to installation years, condition ratings, geotechnical risks, and inspection frequency. Structured data improvement initiatives (for capturing, maintaining and updating) are required to enhance the reliability of future lifecycle modeling and reinvestment planning.
- **Defined Roles and Interdepartmental Collaboration are Critical:** Effective asset management relies on coordination across departments including Water and Waste, Engineering, GIS, and Finance. Clarity in governance and responsibility increases the likelihood that AM tasks are completed consistently and information is shared across functional areas.
- **Monitoring and Reporting Drive Accountability:** Establishing performance measures, update cycles, and AM review processes—such as the 5-year AMP update interval—enables the City to track progress, reassess priorities, and ensure alignment with service expectations and fiscal realities.

8.1.2 Conclusion

The completion of this AMP represents a major milestone in the City's asset management journey for its wastewater RC infrastructure. It consolidates available data, identifies key asset risks, and introduces a structured lifecycle and financial planning framework to guide investment over the next 20 years. The recommended improvement initiatives outlined in **Section 7** provide a practical roadmap for addressing known gaps and elevating the City's overall asset management maturity. By implementing these measures and continuing to monitor progress, the City will be well-positioned to deliver reliable service, optimize capital reinvestment, and enhance long-term system resilience.

APPENDIX A

Asset Inventory

A

Appendix A - Asset Inventory

The Asset Inventory is supplied in a separate MS Excel File.

APPENDIX B

Crossing Maps

B

Appendix B - Crossing Maps

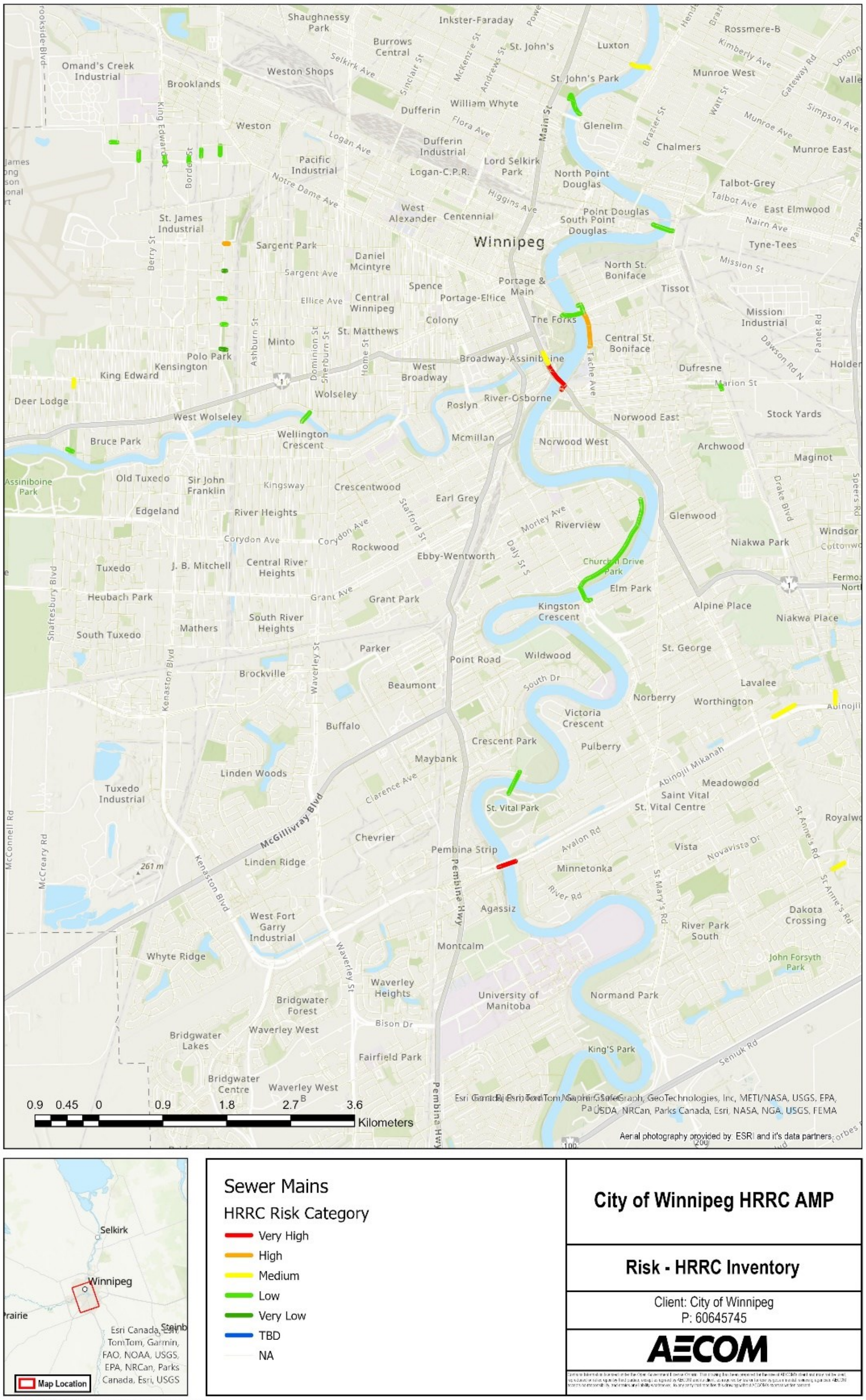


Figure B-1: Risk – RCs Inventory

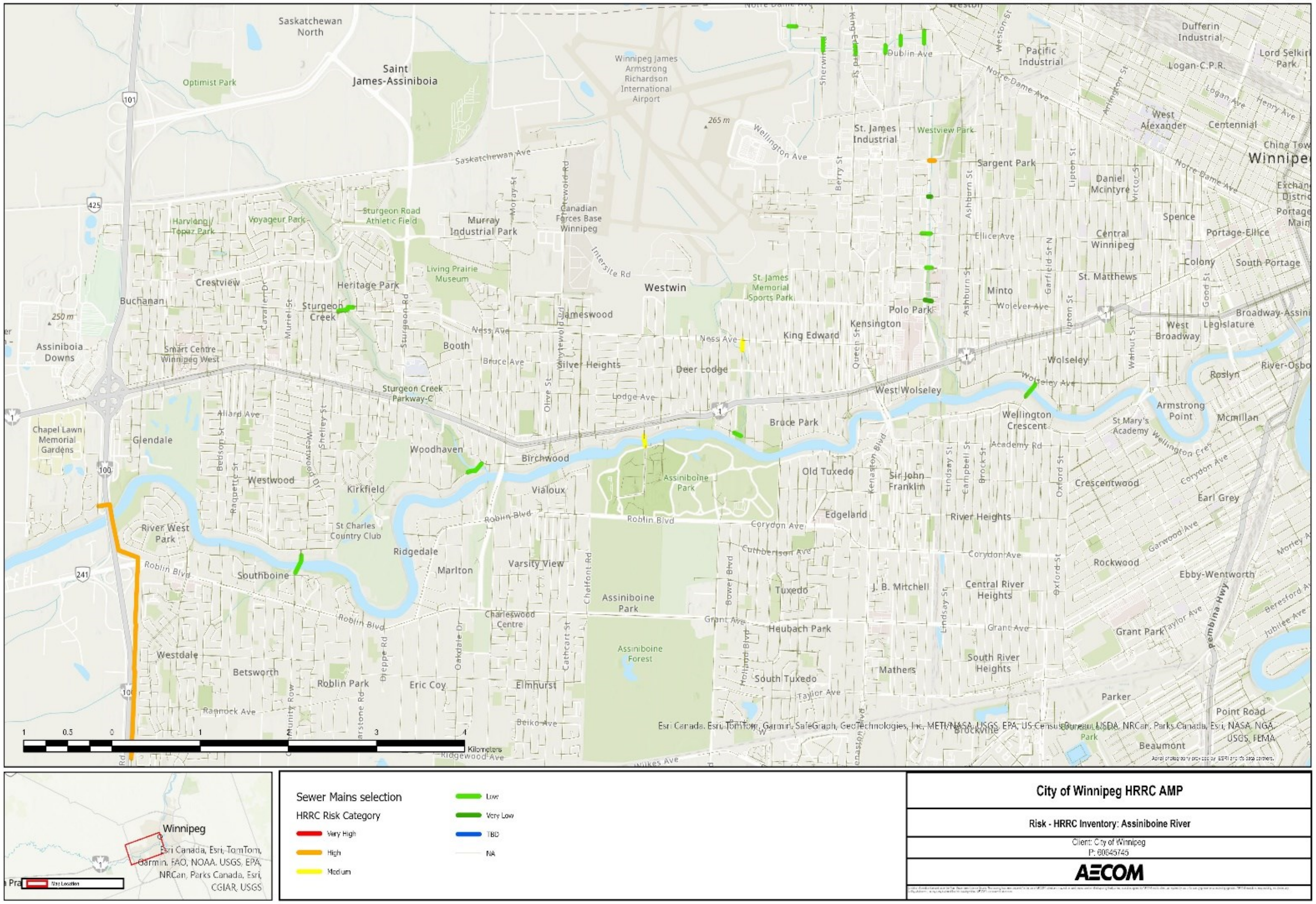


Figure B-2: Risk – RCs Inventory – Assiniboine River

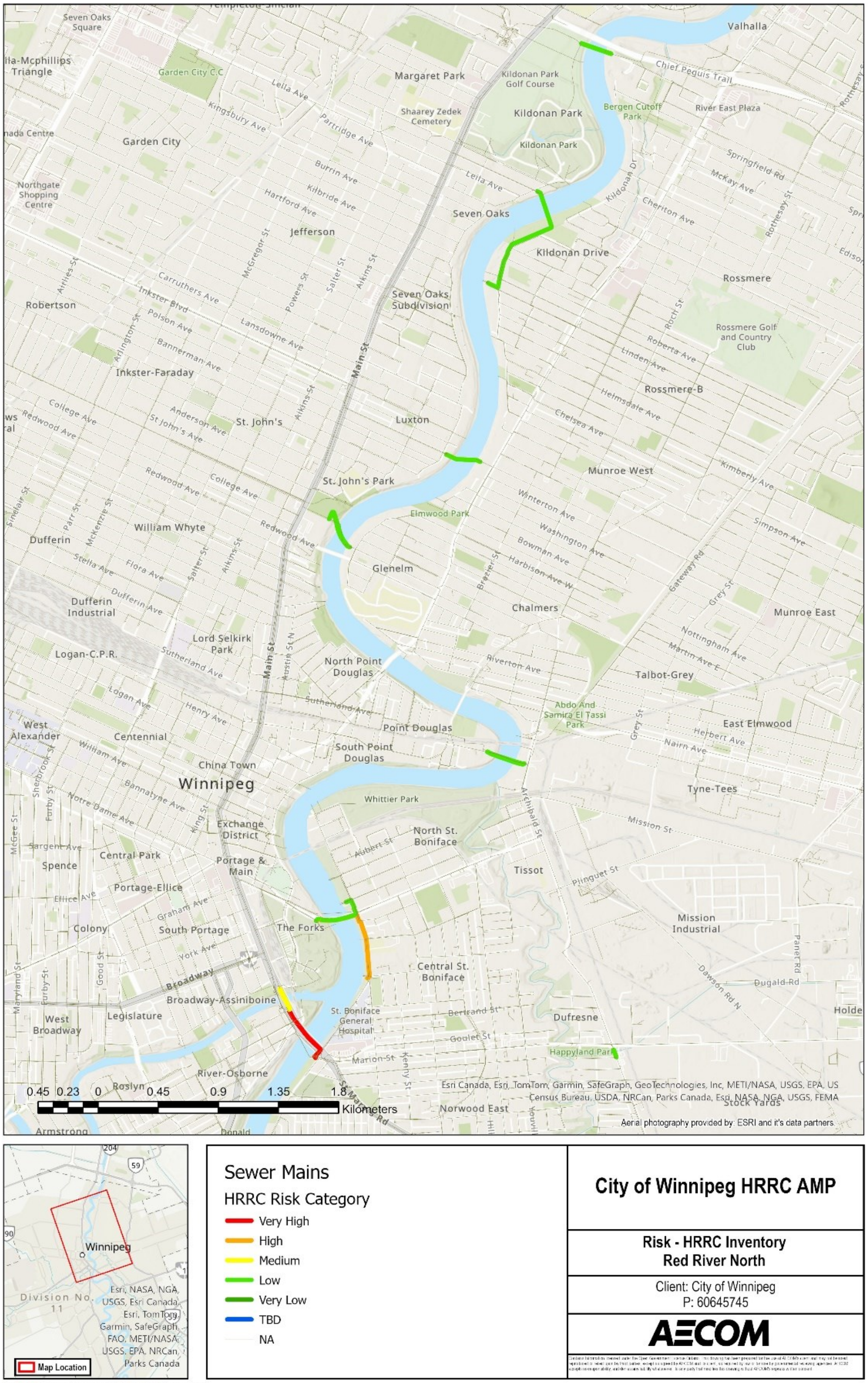


Figure B-3: Risk – RCs Inventory – Red River North

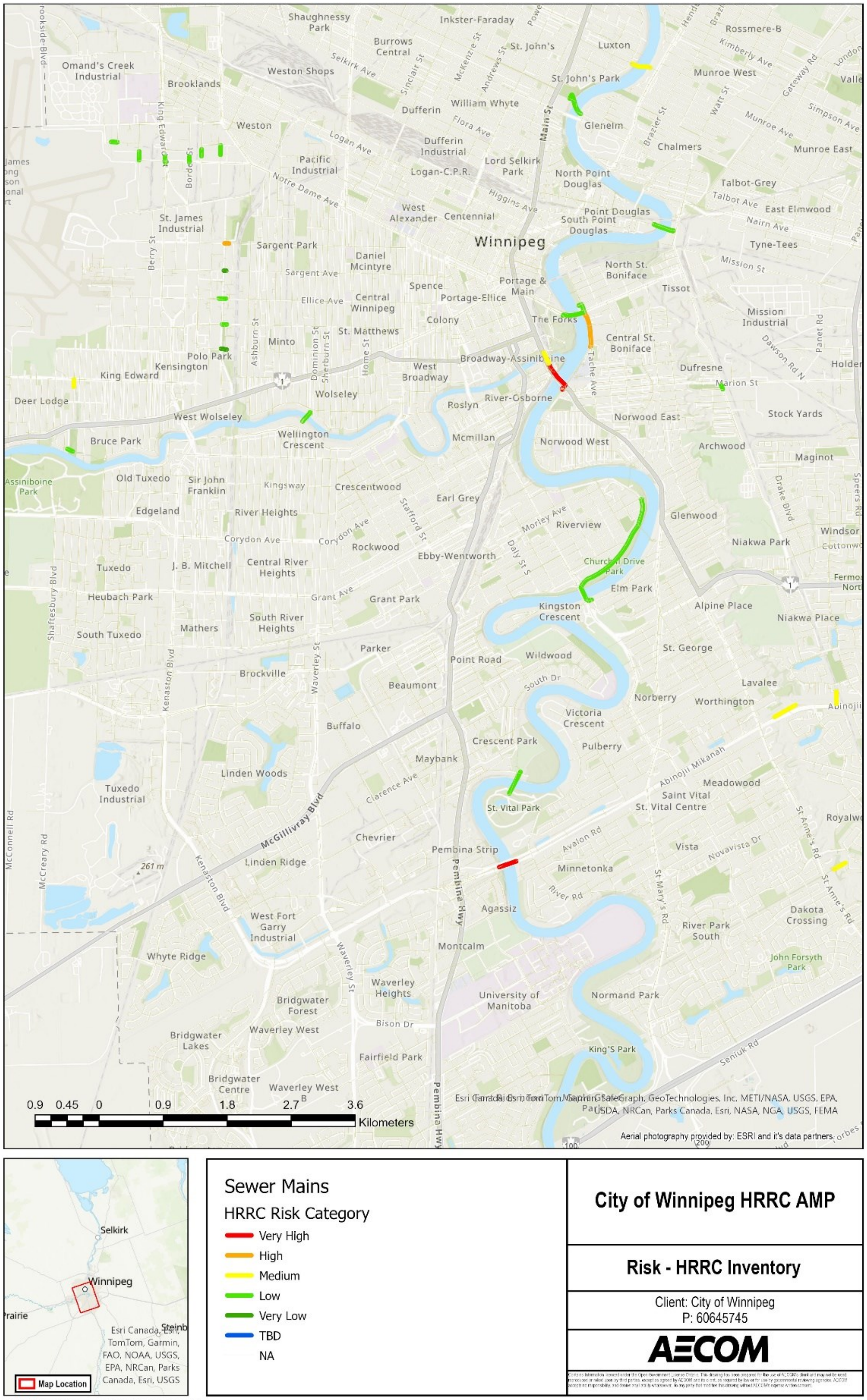


Figure B-4: Risk – RCs Inventory – Red River South

APPENDIX C

Utilized Risk Scores

C

Appendix C - Utilized SPG and COF

Table C-1: Utilized Risk Scores

SITE_ID	Asset ID	Site Name	SPG	COF
1	S-MA70028006	WEST PERIMETER BRIDGE	3	92.75
2a	S-MA70016410	WESTWOOD	1	72.75
2b	S-MA70016408	WESTWOOD	1	72.75
3	S-MA70031733	HERITAGE / PARKDALE	1	77
4a	S-MA70016531	WINDHAM	1	73.75
4b	S-MA70016527	WINDHAM	1	73.75
5	S-MA70016345	ASSINIBOINE ZOO	2	70.25
6a	S-MA70044144	ASH	1	90.25
6b	S-MA70044147	ASH	1	90.25
7a	S-MA70058225	MAIN STREET BRIDGE	2	69
7b	S-MA70058265	MAIN STREET BRIDGE	2	69
8a	S-MA00017097	WHELLAMS LANE	1	72.75
8b	S-MA00017096	WHELLAMS LANE	1	72.75
8c	N/A	WHELLAMS LANE	1	72.25
9a	S-MA00017639	FRASERS GROVE PARK	1	87.75
9c	N/A	FRASERS GROVE PARK	1	90.25
10a	S-MA70017147	MUNROE	1	69
10b	S-MA70017149	MUNROE	2	69
11a	S-MA70062902	HART	1	85.25
11b	S-MA70062897	HART	1	85.25
12a	S-MA70046432	MONTCALM	1	94
12b	S-MA70046417	MONTCALM	1	94
13a	S-MA70050831	PROVENCHER BRIDGE	3	77.75
13b	S-MA70050829	PROVENCHER BRIDGE	1	77.75
14a	S-MA70057885	NORWOOD BRIDGE	4	96.5
15a	S-MA50017754	ST. VITAL BRIDGE	1	96.5
16a	S-MA70093899	FORT GARRY CEMETERY	1	80.25
18a	S-MA70031937	PEMBINA / DUCHARME	1	66.5
19a	S-MA60023233	DES TRAPPISTES	3	41.5
20b	N/A	PORTAGE / EMPRESS	1	51.5
21a	S-MA20010800	MAROONS	1	41.5
22a	S-MA20009764	ST. MATTHEWS	2	49
23a	S-MA20009857	ELLICE	2	49
24a	S-MA20009956	SARGENT	1	49
25a	S-MA20010426	WELLINGTON AVENUE	4	49
26a	S-MA20011761	MCCROSSEN	2	49
27a	S-MA20011765	ST. JAMES STREET	2	45.25
28a	S-MA20011649	BORDER	2	45.25

SITE_ID	Asset ID	Site Name	SPG	COF
29a	S-MA20007212	KING EDWARD	2	45.25
30a	S-MA20007078	SHERWIN	2	45.25
31a	S-MA20007112	STEVENSON	2	41.5
32a	S-MA70016729	DEER LODGE	2	45.75
33a	S-MA20007887	ALBANY	3	45.25
36a	S-MA70042549	ARCHIBALD / MARION	2	59.5
37a	S-MA70032063	ROTHESAY / BONNER	2	52.75
38a	S-MA50009027	ABINOJI MIKANAH / ST. ANNES	2	63.25
39a	S-MA50009013	ABINOJI MIKANAH / CPR TRACKS	3	49
40a	S-MA50008068	EDGEMONT / ABINOJI MIKANAH	3	49
41a	S-MA70013886	LAGIMODIERE / ABINOJI MIKANAH	3	49
42a	S-MA70045660	WATERTON / ST. ANNES	2	63.25
43a	S-MA70087417	FLOODWAY	1	55.25

APPENDIX D

Full List of Improvement Activities

D

Appendix D - Full List of Improvement Activities

The following risk analysis and assessment tool was provided by the City and the activities in Table D-1 assessed accordingly.

Risk Severity Options and Chart

Opportunities						Threats				
5 Extreme	4 Major	3 Moderate	2 Minor	1 Insignificant		1 Insignificant	2 Minor	3 Moderate	4 Major	5 Extreme
25	20	15	10	5	95-100% Almost Certain	5	10	15	20	25
20	16	12	8	4	65-95% Likely	4	8	12	16	20
15	12	9	6	3	35-65% Possible	3	6	9	12	15
10	8	6	4	2	5-35% Unlikely	2	4	6	8	10
5	4	3	2	1	0-5% Rare	1	2	3	4	5

Figure D.1: Winnipeg Integrated Risk Management Process

Table D-1: Full Activity List

#	Recommendation	Identified Gap	Gap Area	City Priority	Risk Ranking	AMP Action
1	New assets for the sanitary network should be consistently added to the inventory within a fixed timeline, preferably within three months of commissioning.	11	4	Yes	Critical	
2	Project closeout should be closely monitored to ensure that asset information is entered quickly, accurately, and in accordance with City standards. Preliminary data should be entered into City systems as soon as construction is complete, followed by more accurate updates once as-built drawings are available	11	4	Yes	Critical	
3	A minimum required dataset must be clearly defined and maintained to uphold inventory accuracy, reliability, and compliance with records management policies.	11	4		Moderate	Area 4
4	Develop a fit-for-purpose hydraulic capacity assessment framework for RCs using available lift station data and crossing design information.	12,13,14	3		Moderate	
5	Define clear rating thresholds using the following logic: — Good: Future/projected peak flow < RC capacity (35-year planning horizon) — Fair: Current peak flow < RC capacity — Poor: Current peak flow > RC capacity	12,13,14	3		Moderate	Area 3
6	Use flow projections under a 10-year MacLaren design storm for gravity siphons and maximum pumping capacity for force mains to determine future capacity requirements for non separated sewers.	12,13,14	3		Moderate	
7	Identify data gaps and supplement with targeted flow monitoring at high-risk crossings to evaluate remaining sewer capacity.	12,13,14	3	Yes	Moderate	Area 3
8	Incorporate sewer capacity results into lifecycle planning and prioritize upgrades for any crossings assessed as an SPG or 4 or 5.	12,13,14	3		Moderate	Area 3
9	As an interim step to full future capacity demand analysis, initiate a RC mini-model to support risk screening until a full system-wide capacity model is feasible.	12,13,14	3		Moderate	
10	Create a work order type/category that can be applied to all work relating to HRRC assets.	20	4	Yes	Moderate	
11	Develop automated CMMS dashboards to flag overdue or partially-closed work orders and email weekly exception reports to supervisors.	20	4		Critical	
12	Schedule and complete work orders such that superseded work orders are closed out when a more recent is completed.	20	4		Moderate	
13	At completion of a work order, schedule the next for the correct frequency instead of an automatic schedule at the start of the year.	20	4		Critical	
14	Provide refresher CMMS training for O&M staff to improve data entry accuracy and completion rates.	20	4		Moderate	
15	Establish an interim LoS target of ≥ 75 % fully-closed work orders within three years, monitored via quarterly CMMS performance reviews and reported in the annual LoS dashboard.	20	4		Moderate	Area 4
16	Review individual task completion of work orders (particularly valve actuation) for consistently incomplete tasks and over actuated valves.	20	4		Critical	

#	Recommendation	Identified Gap	Gap Area	City Priority	Risk Ranking	AMP Action
17	Demand drivers such as increasing population, forecast climate change and the CSO master plan will increase demand. A consistent process for determination of the hydraulic capacity over the life of a renewal or replacement should be agreed and implemented prior to future works.	24	3		Minor	
18	A full combined sewer hydraulic model should be consulted with inputs from future developments/densification, population increase forecasts and the impact of other existing City projects (see KPI#1 gap above).	24	3		Minor	
19	Implement alarm rationalization program/project using ANSI/ISA-18.2 and EEMUA 191 standard.	28	4		Moderate	
20	Define requirements for SCADA alarms for future projects.	28	4		Moderate	
21	Reassess and adjust the contingency fund to reflect current asset inventory and inflation.	29	7	Yes	Moderate	
22	Establish clearer access protocols and explore dedicated funding streams for high-priority expenditure.	29	7	Yes	Moderate	
23	Revise work order protocols to exclude manual actuation of air valves; adopt visual inspection and leak detection as standard practice.	35	2		Moderate	
24	Consistently enact formal post-installation inspection protocols in accordance with the City of Winnipeg's specifications. These protocols include mandatory pre- and post-installation CCTV inspections, verification of service reinstatement quality, and documentation of liner integrity. Ensuring consistent application of these standards will improve quality control, extend asset life, and support accountability across all rehabilitation projects.	36	2		Critical	
25	Update unit rates for full segment lining using the most recent contractor quotes, market pricing, tender results, and third-party cost databases (e.g., RSMeans). Unit rates should be differentiated to account for variability in crossing configurations, recognizing that single-pipe crossings may require bypass pumping—representing a significant additional expense—whereas twinned crossings may not, resulting in substantially lower unit costs.	45	7	Yes	Moderate	Area 7
26	Incorporate site-specific cost estimation into the financial model by integrating factors such as installation type, geotechnical conditions, selected rehabilitation method, project delivery timeline, and local constraints. This will ensure that the model accurately reflects the variability of conditions across RCs and provides a more reliable basis for long-term reinvestment planning.	45	7	Yes	Moderate	Area 7
27	Develop a standardized and comprehensive asset hierarchy aligned with the City's GIS and CMMS databases to improve inventory consistency and support future planning efforts.	1	1		Minimal	
28	Harmonize CMMS and GIS asset identifiers using a cross-referencing system or unique asset ID mapping table to improve traceability and data integration across platforms.	4	1		Minimal	
29	Define the data contained within each asset data repository or implement automated data syncing across platforms (particularly GIS system) to ensure a single source of truth for asset records.	8	1		Minor	
30	Establish and document a consistent RSL estimation method based on condition grade, age, material, and performance risk; align with condition assessment reports or industry best practices.	9	2		Minor	Area 2
31	Introduce a standardized data field or tagging convention (e.g., "RCs_Asset" flag) in both GIS and CMMS systems to streamline tracking and filtering of relevant assets.	10	1		Minimal	
32	Update OWAM workflows to include standardized location input (address or GIS coordinates) for each odour complaint.	15	6		Minor	

#	Recommendation	Identified Gap	Gap Area	City Priority	Risk Ranking	AMP Action
33	Cross-reference odour and other resident complaints occurring within 150 metres of a crossing with inspection scheduling to assist in work order prioritisation.	15	6		Minimal	
34	Incorporate odour complaint investigation results into quarterly service-level reviews.	15	6		Minimal	
35	Once the Climate Action Plan Update is finalized, define asset-specific criteria such as bank stabilization, freeboard, scour protection, and pipe material standards.	16	6		Minimal	
36	Integrate environmental resilience criteria into capital project scopes and tracking dashboards.	16	6		Minimal	Area 6
37	Pilot two climate-resilient renewal projects as a demonstration of best practice.	16	6		Minimal	
38	Continue the condition assessment program to understand the condition of all RCs and consider integration of information from non-RCs covered under the regular gravity main condition assessment program. Consider prioritization of those still relying on age-based proxies.	19	2		Minor	Area 2
39	Use the updated 2024 risk assessment data to finalize baseline condition performance.	19	2		Minor	
40	Create unique cost codes to separate emergency repairs from planned renewals in financial systems.	21	5		Minor	
41	Report a three-year rolling average of emergency-to-capital spending ratio and use it as an indicator of risk exposure.	21	5		Minimal	Area 5
42	Target a long-term ratio of ≤15% to support stable financial planning.	21	5		Minor	Area 5
43	Monitor cost trends over time to support decisions on inspection frequency, contract management, and bundling opportunities.	22	4		Minimal	Area 4
44	Embed risk scoring into lifecycle decision-making tools and project planning workflows.	31	5		Minor	Area 5
45	Develop a decision-making framework for decommissioning, including environmental and cultural criteria.	30	7		Minimal	Area 7
46	Develop a formal acquisition workflow that defines responsibilities across WWD, Council, and regulators.	27	6		Minor	Area 6
47	Develop a formal inspection schedule matrix based on pipe material, SPG, and remaining life, based on the Figure 4-2 flowchart.	33	2		Minor	Area 2
48	Establish a distinct cost tracking and forecasting model specifically for RCs assets, separate from general wastewater infrastructure, to ensure accurate lifecycle analysis and targeted financial planning.	37	7		Minimal	Area 7
51	Establish a proactive consultation protocol with Indigenous communities across all project stages, in collaboration with the City's Indigenous Relations Division.	26	6		Minor	
52	Ensure all identified external point repair needs are incorporated as discrete items in future budget forecasts.	44	7		Minor	
53	Include a standard step in future planning to identify and document any unintended consequences from proposed mitigation strategies.	42	5		Moderate	Area 5
54	Reassess the age reset assumption based on empirical data, industry best practices, and site-specific performance monitoring	48	7		Minimal	Area 7
55	Consider adjusting the reset factor upward where warranted to better reflect the full structural benefit of rehabilitation work.	48	7		Minimal	Area 7

#	Recommendation	Identified Gap	Gap Area	City Priority	Risk Ranking	AMP Action
56	It is recommended that these data gaps be addressed by validating the site-specific relationship between the appurtenant assets and the RCs Collection Piping. Once verified, these assets should be incorporated into the funding needs analysis in the next iteration.	49	1		Minor	Area 1
57	The City should conduct a full confirmation of the inventory to ensure completeness and accuracy of all in-scope assets.	2	1		Minor	Area 1
58	Perform a targeted asset capture initiative for these components using field validation and incorporate them into GIS and CMMS with appropriate asset classifications.	3	1		Minor	Area 1
59	Where possible, populate missing installation dates using historical maintenance records or estimated installation windows based on nearby assets or pipe segments.	5	1	Yes	Moderate	Area 1
60	Establish data validation rules in GIS/CMMS to flag and correct placeholder values; update missing dates through field verification or engineering judgment.	6	1		Minor	
61	Continue implementation of standardized condition assessment protocol (e.g., NASSCO MACP for MHs and chambers) and incorporate the results into the City's asset management systems.	7	2		Moderate	
63	Formalize the monitoring plan contained herein that includes condition inspections, interim screening (e.g., visual spot checks or remote flow indicators), and risk-based reinspection cycles.	17,18	2		Minor	Area 2
65	Ensure all monitoring activities, including inspections triggered by age, condition, or event-based thresholds, are captured consistently in the City's asset management system.	17,18	2		Moderate	
66	Enhance documentation and reporting protocols to support compliance audits and operational transparency.	17,18	2		Minor	
67	Prioritize data collection for high-risk or data-deficient assets using targeted inspections.	34	2		Minor	
69	Update asset inventory to ensure each crossing has a unique ID and confirmed stream classification type. Use inspection reports and field verification where needed.	38	1		Minor	Area 1
70	Implement a recurring geotechnical inspection program for riverbank conditions at all RCs crossings, with risk-based prioritization.	46	2		Moderate	
71	Define clear timelines for recommended rehabilitation work and align funding forecasts with specific delivery years in the financial model.	46	2		Moderate	Area 2
72	Periodically update rehabilitation needs as part of the City's AM planning cycle.	46	2		Moderate	Area 2
73	Work with City stakeholders to define and document acceptable risk thresholds to support consistent risk-based decisions.	40	5	Yes	Moderate	Area 5
74	Finalize and implement stakeholder engagement tools to clarify roles and communication pathways.	25	6		Minimal	
75	Conduct a literature review and consult available performance testing data to determine whether a longer expected service life (e.g., 60–75 years) can be justified.	43	7		Minimal	Area 7
76	Establish a formal process to periodically review and integrate the most recent condition assessment reports and field findings into the financial model.	44	7		Minimal	Area 7

#	Recommendation	Identified Gap	Gap Area	City Priority	Risk Ranking	AMP Action
77	If applicable, update lifecycle parameters in the financial model to reflect a more representative lifespan, thereby optimizing long-term planning.	43	7		Minimal	Area 7
78	Develop a formal protocol for engaging regulatory agencies, Indigenous communities, and environmental groups during project scoping and design phases.	23	6		Minor	
79	Publish the crossing summary annually, highlighting inspection results, identified risks, and planned improvements for transparency.	23	6		Minor	
80	Ensure that all renewal needs identified in technical reports are systematically reviewed and integrated into the capital planning model, with adjustments made as asset knowledge evolves.	47	7		Moderate	Area 7
81	Operations indicated that some valves are non-operational and an alternative isolation (inflatable dam) can be used instead. It is recommended that the City evaluate valve operability and possibly removal from service if assets are found to be non-operational and unnecessary.	50	2		Minor	
82	Standardize decision rules linking SPG levels to specific lifecycle activities as identified in Figure 4-1.	32	5		Minor	

Note – activities 49,50, 62,64 and 83 are no longer required by the City as they have been completed within this AMP or were found to be duplicated. These have been removed from the above list.

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