

Infrastructure Services Report to
Infrastructure and Planning Committee
2024 December 11

ISC: UNRESTRICTED
IP2024-1237

Bearspaw South Feeder Main Pipe Investigation Findings

PURPOSE

The purpose of this report is to:

- a) Provide the final, detailed results from Associated Engineering's report on the Bearspaw South Feeder Main pipe investigation, including cause of the 2024 June 5 failure; and
- b) Identify the process for prioritizing asset condition assessments and managing risk.

PREVIOUS COUNCIL DIRECTION

Council has received verbal updates regarding the Bearspaw South Feeder Main since the original break on 2024 June 5 (Attachment 1).

RECOMMENDATIONS:

That Infrastructure and Planning Committee recommend that Council:

1. Receive this report for the Corporate Record.

That Infrastructure and Planning Committee:

1. Forward this report to the 2024 December 17 Regular Meeting of Council.

CHIEF ADMINISTRATIVE OFFICER/GENERAL MANAGER COMMENTS

Acting General Manager, Ryan Vanderputten, supports this report provided by Associated Engineering that outlines the final, detailed results of the investigation into what led to the 2024 June 5 failure of the Bearspaw South Feeder Main. These findings have and will continue to contribute to our overall asset management practices and risk management of our utility infrastructure.

HIGHLIGHTS

Key highlights are as follows:

- The final report for the pipe investigation from Associated Engineering, *the Investigation into the Bearspaw South Feeder Main Rupture*, has been received (Attachment 2), with the following conclusions:
 - The design and operations of the feeder main were not factors that contributed to the deterioration of the feeder main.
 - Several failure mechanisms and well as soil conditions contributed to deterioration of the feeder main and ultimately the June 5th failure.
- With the twenty-nine repairs complete, the feeder main is operating within acceptable structural integrity limits and is stable.
- Acoustic fibre optic and temporary acoustic monitoring equipment have also been installed on the feeder main to provide continuous condition monitoring.

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- The Utility asset management program has a data driven decision-making method that directs its feeder main condition assessment program.
- An enhanced emergency response plan has been developed, and an expanded spare parts inventory is on hand to respond to any further urgent repairs.

DISCUSSION

Administration engaged with external consultants Associated Engineering and Pure Technologies, to support the response to the 2024 June 5 pipe failure and the subsequent repairs, as well as undertake a pipe investigation. The purpose of the investigation is to understand the factors that led to the deterioration of the feeder main and its failure.

Pipe Investigation Report

The final report of the pipe investigation, in its entirety, is provided in Attachment 2.

The cause of the June 5 failure was the breakage of a sufficient number of prestress wires in a pipe segment causing a loss of pressure resisting capability in the pipe. The prestress wires are wrapped under significant tension around the pipe's outer concrete core. The wires are protected with cement mortar. Upon their exposure after the event, approximately 200 wires were observed to have failed.

Based on the information available to date, we believe that the ruptured pipe experienced microcracking or previous mortar damage allowing soil interaction with the prestress wires. The compromised mortar allowed Stress Corrosion Cracking and/or Hydrogen Embrittlement of the prestress wires resulting in brittle wire failures/fractures. The lack of chloride penetration and simultaneous corrosion occurring on some pipes suggests microcracking of the cement mortar coating may have occurred.

Pipe Performance after the Repairs

Pure Technologies was tasked with evaluating the structural integrity of the feeder main. This evaluation is based on finite element analysis of the pipe, and the development of a statistical model to estimate the number of repairs required in the next 5 to 30 years. The results have been used to confirm the operational parameters for the feeder main, in terms of acceptable operational flows and pressures. Further system testing is planned for Spring 2025 to confirm the findings.

Pipe Monitoring and Condition Assessment

An acoustic fibre optic monitoring system has been installed along the majority of the 1950 mm diameter Prestressed Concrete Cylindrical Pipe (PCCP) segment of the feeder main. This monitoring system will be extended to include the 1500 mm diameter segment in Q1 2025. Until the acoustic fibre optics are installed along the 1500 mm segment, temporary acoustic monitors will be used along this segment of the feeder main. This system enables continuous monitoring of wire snaps (breaks), therefore, allowing for the tracking of the pipe condition over time.

Pure Technologies will continue to monitor and analyze the condition of the feeder main going forward. This monitoring will provide advance warning by observing the frequency and location of wire snaps. If the pipe deterioration advances, Administration will have adequate time to plan and execute a safe repair.

Bearspaw South Feeder Main Pipe Investigation Findings

The City's utility asset management program uses data-driven decision-making processes. The program is based on recognized practices that assess risk and prioritize asset lifecycle activities, including feeder main condition assessments. These processes were established in or around 2008 and are based on experience stemming from previous feeder main breaks and soil conditions. This assessment supports the prioritization and order of current and future asset condition assessments (see Attachment 3).

EXTERNAL ENGAGEMENT AND COMMUNICATION

- | | |
|--|---|
| <input type="checkbox"/> Public engagement was undertaken | <input type="checkbox"/> Dialogue with interested parties was undertaken |
| <input type="checkbox"/> Public/interested parties were informed | <input checked="" type="checkbox"/> Public communication or engagement was not required |

The technical engineering investigation did not include public engagement. The final report from Associated Engineering is being shared publicly at <https://www.calgary.ca/emergencies/feeder-main-repair.html>

IMPLICATIONS

Social

Administration recognizes the significant impact of the Bearspaw South Feeder Main Incident and the long-term residual effects of the emergency on Calgarians and the surrounding communities. The findings of this analysis will be used to update the City's asset management practices, including the City's risk appetite and tolerance for critical infrastructure failure and the consideration for the consequence of failure to the social well-being of Calgarians, its businesses, the Calgary region, and its visitors.

Environmental

Administration recognizes the broader environmental impacts of the Bearspaw South Feeder Main Incident. The findings of this analysis will provide a foundation for further study regarding increased chloride levels in localized areas, including investigation as to potential sources and risks to the feeder main. Additionally, Administration will apply these findings to other segments of the feeder main network to reevaluate at-risk assets, including those that are made of the same pipe material.

Economic

Administration recognizes the significant economic impact of the Bearspaw South Feeder Main Incident to the community, including individuals and businesses alike. The findings of this analysis will be used to update the City's asset management practices, including the City's risk appetite for critical infrastructure failure and the consideration for the consequence of failure on the city and regional economy.

Bears paw South Feeder Main Pipe Investigation Findings

Service and Financial Implications

Increase in rates or fees

The final cost of the twenty-nine repairs, including the repair of the original pipe break, is being finalized. The current estimate is \$20-25 million for the original repair plus the five hot spots. The estimate for the subsequent twenty-one repairs is \$15-20 million. The cost of the recently completed repairs to the 1500 mm segment of the feeder main is also being finalized. These costs were included in the increase to the Water Services budget as part of the 2024 Mid-Cycle Adjustment process. Administration will return to the Infrastructure and Planning Committee in 2025 with a plan, and related costs, related to the implementation of redundancy and rehabilitation investments as related to this feeder main.

RISK

The findings of the pipe investigation will inform the management of water feeder main assets, and the inherent risks of aging infrastructure. Additionally, Administration will reconsider its risk appetite and tolerance regarding the management of risk related to its water service infrastructure, as well as other critical infrastructure and services.

ATTACHMENTS

1. Previous Council Direction, Background
2. Bears paw South Feeder Main Investigation Report
3. Bears paw South Feeder Main Pipe Investigation Findings Presentation
4. Public Submission

Department Circulation

General Manager/Director	Department	Approve/Consult/Inform
Michael Thompson	Infrastructure Services	Approve
Ryan Vanderputten	Infrastructure Services	Approve
David Duckworth	Chief Administrative Officer	Inform
Stuart Dalgleish	Chief Operating Officer	Consult
Doug Morgan	Operational Services	Consult
Katie Black	Community Services	Consult
Deb Hamilton	Planning and Development Services	Inform
Jill Floen	City Solicitor	Inform
Chris Arthurs	People Innovation and Collaboration Services	Inform
Les Tochor	Acting Chief Financial Officer	Inform