Peel Region Pipeline Risk Assessment

2019 ACEC CCE Engineering Excellence Awards | Category C | Water Resources

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Pre construction pipes close-up view (large diameter)

Project summary

In an effort to support its rapidly growing population, the Region of Peel (the Region) retained GHD Ltd. to conduct a risk assessment for its water and wastewater linear pipe systems. A process was developed to **identify critical pipes and monetize risk liability and associated mitigation strategies**, establishing a consistent and transparent business case justification for short, medium, and long-term resource allocations.

Innovation

Growth projections indicated that the Regional Municipality of Peel (the Region) needs to **supply over 2.5-million residential and commercial customers with reliable and high-quality drinking water** over the next twenty years. To meet the demands of a growing population, the Region undertook a risk assessment to formulate a plan for taking future decisions related to maintenance, renewal, and capital programming activities.

For many renewal and capital planning programs, risk management is typically conducted as an independent activity and implemented through ***qualitative*** assessments for understanding of the potential consequences of infrastructure failure. However, one powerful aspect of risk management that is often not explored is ***quantitative*** risk monetization which supports prioritization and business case justification for the allocation of resources.

GHD's team followed the ISO 31000 Standard for Risk Management, a globally accepted standard for risk analysis and risk assessment. In addition, the American Water Works Association (AWWA) J-100 Risk Analysis and Management for Critical Asset Protection (RAMCAP) seven-step process was used, **making the Region one of the first regions in Canada to adopt this framework**.

Closed Circuit Television (CCTV) Inspection

The seven-step analysis and project breakdown included the following tasks:

1. Trunk sewer system assets were identified and noted.
2. Threat events were defined that may occur if the trunk sewer system failed.
3. An assessment was conducted to determine the consequence and impact of the threat events.
4. An assessment was conducted to determine to what extent the trunk sewer system assets can withstand the impact of the threat events.
5. The likelihood of occurrence of relevant threat events were determined.
6. A risk profile was developed with the Region to define high, medium, and low-risk assets.
7. Treatment strategies were created for all high risk and critical assets identified in the risk profile.

The final strategies included are:

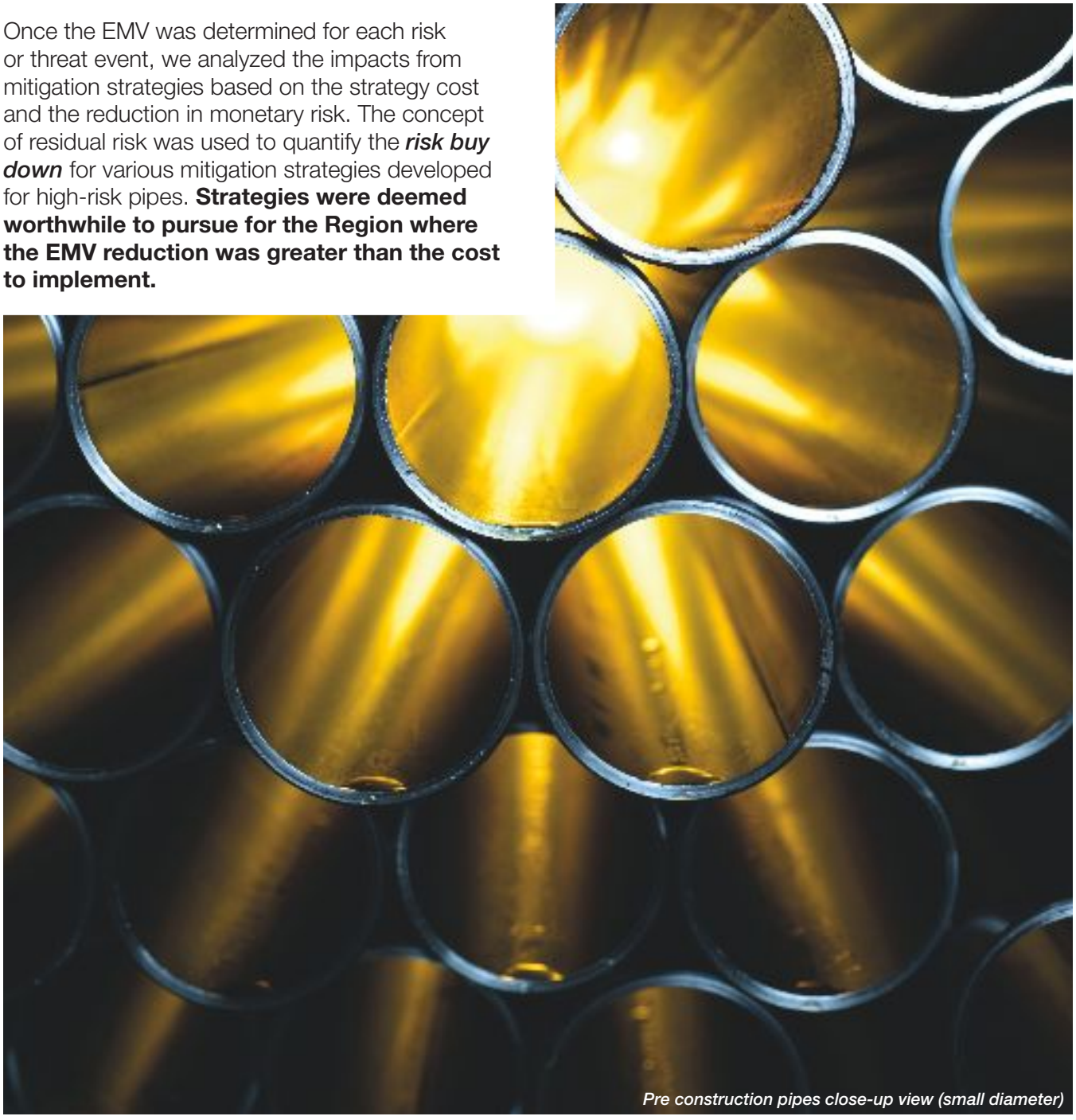
- the identification of critical pipes and practical lifecycle management strategies based on economic analysis, based on the cost-of-risk liability, versus mitigation strategy costs; and
- program strategies consisting of maintenance, renewal, and capital interventions to minimize the risks of the Region's future trunk sewer water and wastewater system pipes.

Complexity

Monetizing risk liability and the cost of associated mitigation strategies was a key challenge the GHD team faced. The approach used for monetizing risk was Expected Monetary Value (EMV) analysis. Algebraically in terms of risk management, EMV is defined as the product of the financial impact of the threat event, and the probability of occurrence.

Once the EMV was determined for each risk or threat event, we analyzed the impacts from mitigation strategies based on the strategy cost and the reduction in monetary risk. The concept of residual risk was used to quantify the ***risk buy down*** for various mitigation strategies developed for high-risk pipes. **Strategies were deemed worthwhile to pursue for the Region where the EMV reduction was greater than the cost to implement.**

The EMV was used to support business case justification for investments related to maintenance, renewal, and capital expenditures by comparing the risks of each threat event to determine how to gain the greatest value from invested dollars in the short, medium, and long term.



Pre construction pipes close-up view (small diameter)

Economic benefits

Net Present Value (NPV) is the difference between the present value of cash inflows and the present value of cash outflows over a period of time. NPV is used in capital budgeting and investment planning to analyze the profitability of a projected investment or project. In this project, **NPV analysis was conducted to identify mitigation strategies that provide the greatest overall risk reduction for the lowest cost**.

Overall, if all recommended mitigation strategies derived from the NPV analysis are implemented, the Region can realize a potential monetary risk reduction of millions of dollars per year while reducing impacts from structural pipe failures, pipe blockages and reduced pipe capacity.

In addition, the Region's *State of Good Repair and Capital Planning Programs* will integrate the results of the risk assessment which will allow the Region to:

- support decision making related to maintenance, renewal and capital investments;
- inform the balance between levels of service, costs of service and risk;
- identify both risks and opportunities that can be realized from avoiding unforeseen and/or costly infrastructure works;
- identify potential areas of improvement; and,
- improve the rigor and transparency in business processes and decision making.

Providing substantial outcomes for the client

Environmental benefits

In accordance with the AWWA J-100 Standard / RAMCAP process, threat events were derived from six general threat event categories including:

1. Natural disasters
2. Third-party damage
3. Proximity to dangerous sites
4. Operation process/methods
5. Physical impacts
6. Design and construction

To evaluate the risk of each threat event, the GHD team provided a measure for the consequence of an asset failure. From an organizational perspective, consequence of failure encompasses failure to meet considerations in regards to established customer and technical levels of service related to capacity, health and safety, and financial and asset integrity. The impacts in these areas are typically measured against triple bottom line impacts, such as social, environmental, and financial.

Manhole surcharging at the Region

The proposed mitigation strategies reduce the risk of extreme or high-threat events, including potential intangible risks, such as risks that have not been formally monetized, such as:

- health and safety related illnesses, injuries, disabilities and lost time;
- asset failures;
- service disruptions or down time of the trunk sewer system;
- regulatory charges, compliance orders, notices of violation, written warnings and notices; and
- spills and damage to the natural environment.

Meeting client's needs

The risk assessment has identified that 31% of the threat events to the pipes in the Region's trunk sewer system result in high or extreme risk pipe segments.

Overall, the Region accomplished the following key outcomes from the assessment through the development of:

- a full-scale risk assessment of the Region's trunk sewer system consistent with the ISO 31000 and AWWA J-100 (RAMCAP) risk standards;
- extreme and high-risk pipes in anticipation of population growth;
- mitigation strategies for extreme and high-risk trunk sewer pipes supported by sound business case justification and economic analysis;
- Asset Management Plans (AMP) in accordance with the Ministry of Infrastructure guidelines for Municipal AMPs; and
- consistent and transparent risk-based approach that informs maintenance, state of good repair, renewal, and capital programming.

As The Region's water planning group continues to develop and implement risk management practices across other assets in its portfolio, there is an opportunity to integrate the outcomes of the risk assessment to more effectively allocate the Region's limited resources to high-risk areas and mitigation strategies in the programs. This will **support the Region's overall asset management objective of providing levels of services to its residents at the lowest cost of asset ownership.**

Interactive collaboration and engagement

By implementing the mitigation strategies and recommendations to these high/extreme risk pipe segments, **the Region can realize a total monetary risk reduction of millions of dollars per year** while reducing impacts from structural pipe failures, pipe blockages and reduced pipe capacity.

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