Municipal Asset Management Planning in Ontario:

An Analysis of Water, Wastewater and Stormwater Asset Management Planning in Selected Ontario Municipalities

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Introduction

Infrastructure systems (such as roads, bridges, water, wastewater, and stormwater,) are essential to modern society as they deliver essential services to the public, helps sustain economic growth and development, and allows for our current standard of living. Municipalities in Canada operate, maintain and own 60% of these core infrastructure systems (CIRC, 2019). Water infrastructure construction increased across Canada in the post WWII period due to economic growth, urbanization, and modernization resulting in the construction of a lot of water distribution, wastewater treatment roads and bridges, (CNAM, 2018). However, since the 1970s an "investment gap" in core infrastructure has emerged, which has negatively impacted the performance and maintenance of many municipal infrastructure systems. In Canada, many municipal infrastructure assets are ageing and reaching the end of their expected service life.

In the 2019 Canada Infrastructure Report Card, approximately a third of Canada's water infrastructure was rated as being between "fair" and "very poor" condition (CIRC, 2019). Water, wastewater and stormwater infrastructure faces chronic investment gaps and management challenges. Municipalities face the challenge of having to make decisions in managing and maintaining their infrastructure assets while having scarce resources to do so. At the same time, many municipalities also face the challenge of having to accommodate for future population growth which will cause increased stress and expected levels of service from the general public (CNAM, 2018) and climate change is causing additional stress on aging water assets. Policy makers face important investment challenges related to water infrastructure. Asset management planning can aid municipalities in having to make these difficult decisions, as municipalities can provide stewardship of their infrastructure through these plans.

The Policy Context

In 2011, the province of Ontario released *Building Together*, a long-term infrastructure plan for the province, which aimed to: make asset management planning and public reporting universal, make optimal use of the full range of budgeting and infrastructure financing tools, address the structural challenges that are confronting small municipalities, and stated that any municipality seeking provincial infrastructure funding must demonstrate how its proposed project fits within a detailed asset management plan (Ontario,2016). The goal was to make improved asset and financial management practices a precondition for provincial infrastructure grants and makes the development of an Asset Management Plan a requirement for municipalities requesting provincial infrastructure funding. (Harvey, 2015).

In December 2017, Ontario Regulation 588/17 (O.Reg.588/17), known as the *Asset Management Planning for Municipal Infrastructure* regulation was adopted by the provincial government to promote standardization and consistency in municipal asset management (Ontario, 2018). As of January 2018, this regulation required any municipality that is seeking provincial funding for projects to demonstrate how projects fit within an asset management plan in order to ensure that resources are allocated to projects that are of critical importance to the long-term planning of the municipality (Ontario, 2019). This also ensures that provincial infrastructure funding will be conditional on if municipalities have already explored all available financing and revenue generation options and that municipal infrastructure is following all relevant legislative requirements.

What is Asset Management Planning and Why is it Important?

Ontario Regulation 588/17: Asset Management Planning for Municipal Infrastructure defines asset management as: "The process of making the optimal decisions regarding the building, operating, maintaining, renewing, replacing and disposing of infrastructure assets" (Ontario,2018). Municipal asset management planning requires a condition assessment of the infrastructure assets of interest, along with the levels of service this infrastructure provides to the public. It also requires the prioritization of infrastructure investments and the development of a long-term financial plan, in order to optimize decision making and maximize returns on investments (Ontario, 2018). The OREG 588/17 requires asset management plans to contain executive summary, an introduction, the state of local infrastructure, the expected levels of service, an asset management strategy and a financing strategy (CNAM, 2014).

Municipal infrastructure asset management can have far reaching impacts and consequences, as it requires significant environmental, economic and social responsibilities through having to manage such critical infrastructure assets. For drinking water asset management, asset managers are responsible for the municipality's assets being able to provide an abundance of clean drinking water to their customers. In wastewater asset management, asset managers are responsible for treatment and collection of wastewater, while protecting its customers and public from the possible risks of wastewater. Finally, with stormwater asset management, asset managers are responsible for their stormwater assets being able to prevent flooding in the streets of their respective municipalities.

Ontario REG 588/17 requires municipal asset management plans to include:

- The current levels of service being provided by each asset class, including qualitative and technical
- Performance measures for each asset category including: a summary of the assets in the asset category, replacement cost of the assets, average age of the assets, information about the condition of the assets and the municipality's approach to condition assessment of the assets
- The future lifecycle activities that are needed to maintain the current levels of service for the following 10 years, which include a lifecycle analysis of the assets and the lifecycle activities that are required to maintain the current levels of service
- Population and employment forecasts for the municipality
- The proposed levels of service the infrastructure will provide to the municipality in the 10 years following the current levels of service
- The proposed performance of each asset category for the following 10 years after the current performance of the infrastructure assets, which are established by the municipality through performance measures.
- A financial strategy that includes: lifecycle management of the infrastructure assets over a 10 year period, a full lifecycle evaluation of the assets, an estimate of the annual costs for each of the 10 years of the lifecycle evaluation, the annual funding projected and a funding strategy for the lifecycle activities and the capital expenditure and operating costs of achieving the proposed levels of service
- the asset management plan must be endorsed by the executive lead of the municipality, approved by the municipal council reviewed and updated every five years.

The phase-in schedule for the implementation of the 588/17 regulation is set across the following timeline:

July 1, 2019: Deadline for municipalities to have completed a strategic asset management policy, which implements asset management planning in the budgeting, operations, maintenance and other municipal planning activities (Ontario, 2018).

July 1, 2022: Deadline for municipalities to have a finalized and approved asset management plan for core assets (roads, bridges, water, wastewater and stormwater management systems) (Ontario, 2018).

July 1, 2024: Deadline for municipalities to have an approved asset management plan for all municipal infrastructure assets (Ontario, 2018).

Municipalities face significant challenges related to implementing this regulation and assessing the condition of water infrastructure assets. There are both technical and implementation capacity issues. An important challenge related to water assets relates to the fact that a majority of water, wastewater and stormwater assets are buried underground. This often leads to low percentages of infrastructure assets having undergone physical inspections, rather their condition is estimated through age-based inspections (Esmaili,2012). Insufficient asset condition data can also lead to inaccurate maintenance and rehabilitation programs, which often lead to already scarce financial resources being misused (Esmaili,2012). There are many implementation challenges and these challenges vary across Ontario's 444 municipalities.

Research Purpose, Scope and Methods

This study investigates water, wastewater and stormwater asset management planning in selected Ontario municipalities, in order to investigate how municipalities in Ontario are adhering to the guidelines provided in the Ontario Regulation 588/17: Asset Management Planning for Municipal Infrastructure, specifically related to water, wastewater and stormwater infrastructure asset management planning best practices. The central purpose of this research is to assess implementation and understand why and how implementation challenges vary across municipalities.

The first stage involved a literature review of water, wastewater and stormwater infrastructure asset management in the scholarly literature and documents from national, provincial and international non-profit organizations to determine the state of knowledge and best practices related to municipal water, wastewater and stormwater infrastructure and asset management.

The second stage of research involved a collection and review of available municipal asset management plans in Ontario and analyzing the water, wastewater and stormwater sections of these plans. Analysis focused on comparing the water, wastewater and storm water sections of these plans to the asset management requirements found in the 588/17 Ontario Regulation: Asset Management Planning for Municipal Infrastructure and the best practices of water, wastewater and stormwater infrastructure asset management provided by national, provincial and international non-profit organizations that provide best practices guidelines for local infrastructure management.

The third stage involved in-depth case studies of selected municipalities in Ontario. Municipal Asset Management Plans were chosen as case studies based on public availability of the plan itself, as well as population demographics of the municipality. Medium-sized local municipalities in Ontario that had publicly available asset management plans that contained water, wastewater and stormwater infrastructure sections were prioritized, as municipalities with less than a 25,000 population had differing levels of service requirements in the Ontario Regulation 588/17. Municipalities were identified as medium-sized using the 2016 Canadian census, which categorized municipalities based on population. The Cities of Richmond Hill, Waterloo and Guelph were chosen as the case studies, as their asset management plans and population demographics fit the inclusion criteria previously identified.

In each case, the performance of these asset management plans were compared and analyzed against the best management practices from the literature and as outlined in Ontario Regulation 588/17. The performance of each asset category (water, wastewater or stormwater) for each municipality were analyzed using a grading system based on the inclusion of the Ontario Regulation requirements and the best practices identified in these sections of the respective asset management plans. For example, the City of Waterloo's water infrastructure section will receive a best practices grading based on how many best practices of each asset management section (state of local infrastructure, levels of service, etc.) are identified in this section of the City of Waterloo's Asset Management Plan.

Research Findings

The best practices of water, wastewater and stormwater infrastructure asset management were identified through scholarly literature on infrastructure asset management, and publicly-available asset management best practices developed and published by national and international nonprofit organizations. These organizations provided reports, guides and documents aimed at helping to improve the integration of asset management practices into local water, wastewater and stormwater utility management. These organizations include: the Federation of Canadian Municipalities (FCM), American Water Works Association (AWWA), The National Guide to Sustainable Municipal Infrastructure (Infraguide), The Northwest Territories Association of Communities, and the Canadian Network of Asset Managers (CNAM).

Best practices in infrastructure asset management can be summarized by several key principles, which include: asset value, life cycle management, sustainability, risk management, performance measurement, operational plans, and financial planning (FCM, 2005). These principles can be achieved by municipalities by examining the following for each of their water, wastewater and stormwater assets in the asset management plan:

- Asset Inventory: A comprehensive inventory for each asset category (water, wastewater, and stormwater), including characteristics of each asset such as pipe length, material, and year of installation (FCM, 2005).
- Asset Valuation: Asset valuation techniques for municipal infrastructure generally use replacement value as the chosen method for identifying an assets value.
- Condition and Asset Age Assessment: Best practices in infrastructure asset infrastructure include physical inspection, CCTV camera inspection or zoom camera inspection. When

inspection methods are not feasible, municipalities will then rely on age-based condition assessment, which compares the age of the infrastructure assets to their expected useful service life (NWTAC, 2018).

- Level of service expected and levels of service targets: Municipalities should include the levels of service for each asset category by providing the performance measures of these asset categories. Performance measures for levels of service are demonstrated through technical metrics and customer metrics (Ontario, 2018). These metrics include data such as number of pipe breaks per year and number of households connected to wastewater collection infrastructure.
- Lifecycle analysis: A lifecycle analysis should be conducted for every asset type, which determines the remaining service life of an asset aids in the decision-making process of managing an asset. This analysis estimates the remaining service life of an asset based on its age, current condition and a deterioration rate model. The asset can then be replaced, rehabilitated or left alone based on the lifecycle analysis of the asset.
- Risk Management: A risk rating system is essential in managing the risks associated with asset failure. Risk identification is the first step in developing a risk rating system, followed by determining severity of the risk and the probability of the risk occurring. The risk rating of an asset failure is determined numerically through the relationship between risk probability and risk severity, which is usually determined by adding the two together (FCM, 2006).
- Short and long-term Financial Plan: Best practices of asset management financial planning include identifying current costs of maintaining current levels of service, 10-25 year projections of operating and maintenance costs, identifying revenue sources, and projections of costs increased from population and employment projections of the municipality (FCM, 2006).

The components of an asset management plan that follows the best practices identified in this study contain the following sections:

- State of Local Infrastructure
- Levels of Service
- Asset Management Strategy
- Risk Management
- Financial Strategy

Findings from Case Studies

The results of the case studies of the municipal asset management plans reveal that the selected municipalities are successfully implementing Ontario Reg. 588/17 asset management guidelines into their asset management planning of their water, wastewater and stormwater infrastructure. The success of the implementation of O.Reg.588/17 was measured by the inclusions of the regulatory requirements in the municipal asset management plan case studies.Most of the requirements for each asset management category were included in each municipality, with only a few exceptions. These exceptions were the City of Guelph's and the City of Richmond Hill's Levels of Service category for all assets, including water assets, not including proposed future levels of service. This research suggests

that municipalities have a clear understanding of the O.Reg.588/17 related to water, wastewater and storm water infrastructure.

The results of the case study comparisons to the best practices of asset management planning revealed differing results compared to the Ontario Regulation 588/17 comparison. The selected municipalities implemented most of the best practices identified for the State of Local Infrastructure and Financial Strategy asset management categories, suggesting a thorough understanding of the condition of their infrastructure assets and the long-term financial planning of these assets. The Asset Management Strategy and Risk Management categories had similar results across the case study municipalities and infrastructure types, as approximately 50-70% of the best practices identified in the categories were included across each municipality's water, wastewater and stormwater infrastructure sections of its asset management plan.

The Levels of Service asset management category was the worst performing category for each municipality aside from the City of Waterloo. The majority of the municipality's infrastructure categories contained approximately 25-50% of the best practices identified for the Levels of Service category, which was the lowest performance across all asset management categories.

Although the selected case studies reveal challenges, this research reveals that Ontario's municipalities have made significant progress in better understanding the current state of their water infrastructure assets over the last decade. The findings of this research suggest that medium-sized municipalities in Ontario successfully implemented the O.Reg.588/17 requirements into their asset management planning for their water, wastewater, and stormwater infrastructure systems. However, there is still much to be done to establish a more complete integration of water asset management planning in municipal infrastructure management, in order to aid municipalities in managing the increased stress on infrastructure from a growing population and aging infrastructure assets.

Recommendations

The key findings from this research suggest that although the O.Reg.588/17 requirements were successfully implemented by the selected asset management plans, the Best Practices of infrastructure asset management planning should also be implemented in the regulation as well as in municipal asset management planning. In addition, the results of this research can be used as a preliminary assessment of the current state of water, wastewater and storm water infrastructure asset management planning in medium-sized municipalities in Ontario. These evaluations can be used by the municipalities to improve upon future iterations of AMP of these municipalities, as they specifically indicate in which fields these municipalities may be lacking in their implementation of asset management planning. Future iterations of the O.Reg. 588/17 can also be improved by implementing the asset management planning Best Practices that were not included in the current iteration of the regulation, into asset management planning requirements in the following iterations of the regulation.

Recommendations for Municipalities:

Recommendations for municipalities are based on the performance of the specific infrastructure sections in the Ontario Regulation Guidelines and Best Practices case study comparisons. The key

findings of the research suggest that the inclusion of asset management planning Best Practices missing from the municipal asset management plan case studies can improve the implementation of asset management planning in the management of the municipalities' water, wastewater, and stormwater infrastructure systems.

1) Across all municipalities and infrastructure types, the Levels of Service category can be improved upon by including the proposed future levels of services for all infrastructure assets, along with a justification of the proposed levels of services.
2) An addition of a Risk Management category for each infrastructure type in the Cities asset management plans is also recommended. A Risk Management category will include a comprehensive risk analysis, comprising of a risk identification, probability analysis, severity analysis and development of a risk rating system. The inclusion of a risk analysis in the municipalities' asset management plans will provide a more comprehensive risk identification and mitigation strategy for their infrastructure assets and will allow for industry experts and risk manager participation in the asset management plans.
3) A full cost recovery strategy for water infrastructure funding was not included in any of the municipal asset management plans, which is understandable as the current rate structure of infrastructure funding cannot support the full costs of infrastructure operations and maintenance. However, municipalities can work towards a full cost recovery for infrastructure assets by revising the rate structure of its infrastructure systems and increase the funding for their water, wastewater and stormwater systems, in order to eliminate the infrastructure funding gaps associated with the infrastructure assets in these systems.
4) Municipalities can also improve their Asset Management Strategy sections by implementing preventative maintenance strategies that focus on building resilience in their infrastructure assets, rather than implementing reactive maintenance programs that are implemented when water assets are damaged or broken.

This research can also be used by the province of Ontario to improve upon O.Reg.588/17 by including industry standard water asset management best practices and recommendations from asset management literature and other governing bodies to the requirements for municipal infrastructure to receive provincial funding.

Recommendations for Province of Ontario:

The recommendations for the Province of Ontario are based on asset management planning practices that are identified in the best practices literature review, but are not included in the Ontario Asset Management Regulation. The requirements of the Ontario Regulation 588/17 were appropriate for the development of the first iteration of the required municipal asset management plans and should be improved upon for the following iterations of these municipal asset management plans. Based on the findings of this research, it is recommended that the Ontario Ministry of Environment Conservation and Parks should implement the Best Practices identified in this research into the requirements of future updates of O.Reg.588/17.

1) Improvements to the requirements of the Regulation's State of Local Infrastructure category can be made by requiring physical infrastructure asset condition data from the

municipalities. This requirement will push municipalities towards physical inspections and CCTV inspections of its infrastructure assets over age-based condition assessments, resulting in more accurate asset condition data.

2) The Levels of Service category can be improved upon by requiring city-defined performance metrics along with the performance metrics defined in the Ontario Regulation. This requirement will allow for municipalities to be proactive in obtaining customer service and asset performance data from its infrastructure services, and result in further community engagement in developing the asset management plan.

3) An addition of a Risk Management category in the required asset management categories will result in improved risk identification and mitigation strategies implemented by Ontario's municipalities. A requirement of a risk analysis program for each infrastructure type will allow for risk identification, severity analysis, probability analysis and the development of a risk rating system in the municipal asset management planning process.

4) The inclusion of climate change adaptation strategies to the Asset Management Strategy category will allow for an official climate change impact section in each infrastructure category of the municipal asset management plans. This section will focus on how the municipality is preparing for the impacts of climate change on its specific infrastructure assets, which will include identifying the risks associated with climate change on each infrastructure asset and the potential preventative strategies that can prepare these assets to mitigate the associated impacts.

5) Each infrastructure category and municipality included every best practice identified in the Financial Strategy category, except a full cost recovery plan. This is attributed to the rate structure of the infrastructure services, which will not allow for infrastructure rates to cover the costs of infrastructure maintenance and operations. However, municipalities can still work towards achieving full cost recovery for its infrastructure systems through revising the rate structure and identifying methods and strategies that aim to lower the costs of infrastructure operations and maintenance.

Recommendations for Other Jurisdictions/Policy Makers:

Other provincial governments and policy makers across Canada should take inspiration from and implement similar regulation as Ontario's Regulation 588/17. Other provincial governments should implement a regulation that seeks to standardize asset management planning practices in municipal water infrastructure management, in order to ensure the long-term sustainability of Canada's municipal infrastructure systems.

1) Provincial regulations should be developed and require by all municipalities within the province's jurisdiction to provide an asset management plans that contains each municipal infrastructure system that the municipality is responsible for.

2) Best practices of asset management planning identified in this study that are not present in the O.Reg.588/17 should also be implemented within these regulations, such as the inclusion of a Risk Management category.
3) Best practices for physical asset condition assessment or CCTV camera inspections of asset condition should be adopted for water asset management planning.

Bruce Fellowship Support

The Bruce Fellowship has allowed me the financial independence to be able to focus on my thesis research and work towards completing Ryerson's Environmental Applied Science and Management Program. Through the Fellowship, I was also given the unique opportunity of an internship with a local municipality in the development of their Waste Water Environmental System. This opportunity was made through the connection of Dr.Carolyn Johns and a former recipient of the Bruce Fellowship. This experience greatly helped me in the understanding of policy development and implementation in local municipalities in Ontario, which directly related to my thesis research. The financial aid of the Bruce Fellowship has allowed me not to rely on student loans to pay for the last few semesters of my master's program, which will reduce the total amount of student debt loan that I will inevitably have to pay back. This financial support has been crucial to my Masters program, as my internship required my continued enrollment in the program, which has extended my expected date of graduation of the program and resulted in additional tuition costs.

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