Canadian Water Network

BALANCING THE BOOKS

Financial Sustainability for Canadian Water Systems

Utility
For the purposes of this report, utility may refer to a municipally-owned, or privately-owned, or publicly-owned but privately operated water utility or department.

Water systems
Water systems refers to drinking water, wastewater and stormwater systems, unless specified otherwise.

Data Analysis
Data on the financial practices of a subset of Canadian utilities are analysed in this report. The data were collected from participating municipalities by the National Water and Wastewater Benchmarking Initiative (NWWBI) between 1999 and 2016 and are presented in aggregate. Not all data were available or analysed from all utilities for all years. Where appropriate, the subset of the database that was used is indicated.

March 2018

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The information in this report does not necessarily represent the views of the experts or their employers.

PREFACE

The Canadian Municipal Water Consortium is a national network of progressive water leaders who are working together to advance water, wastewater and stormwater management. In addition to sharing peer knowledge with each other, members co-invest in projects and partnerships that generate new insights on critical challenges.

This report has been prepared by Canadian Water Network on behalf of the Consortium to:

- Discuss the elements involved in full cost recovery
- Provide a snapshot of typical financial practices of Canadian utilities
- Highlight the challenges to achieving financially sustainable water systems
- Identify a menu of opportunities to advance financial sustainability

Canadian Water Network's
Canadian Municipal Water Consortium

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EXECUTIVE SUMMARY

Canadians expect consistent, high quality water services, with operations that are fiscally, environmentally and socially responsible. However, substantial financial challenges have been inherited, and billions of dollars will be needed to repair or upgrade aging infrastructure across the country. The costs of running our systems, as well as the ability to generate revenues to pay for them, are impacted by fluctuations in system demand due to factors like population change, new developments and water conservation initiatives. Additionally, the potential impacts from climate change extremes — such as flooding, freezing, wildfire or drought — add uncertainty and can carry huge price tags for recovery, repair and rebuilding.

Achieving financial sustainability requires that water utilities balance the books for the long term, securing sufficient revenue to recover the system costs, buffer against unexpected circumstances, service debts and save for future capital needs (Figure 1). To balance this cost-revenue equation, utilities must consider what their systems need to achieve now and in the future; account for the full costs (including risk and uncertainty); and factor fairness, affordability and intergenerational equity into cost recovery approaches.

Doing more with less has long been a given for municipalities, but optimization alone will not cover future costs — revenues will also need to increase. However, these increases must also include a realistic view of customers' ability to pay. As the expectations and costs of managing water systems rise, the socioeconomic consequences of decisions are becoming more central in the search for sustainable options. Decision makers also need to know what options are available and how they can be tailored to work within a local context. This report provides a window into the current state-of-the-practice in Canada, highlights the challenges that utilities are encountering and includes a list of opportunities to advance toward greater financial sustainability.

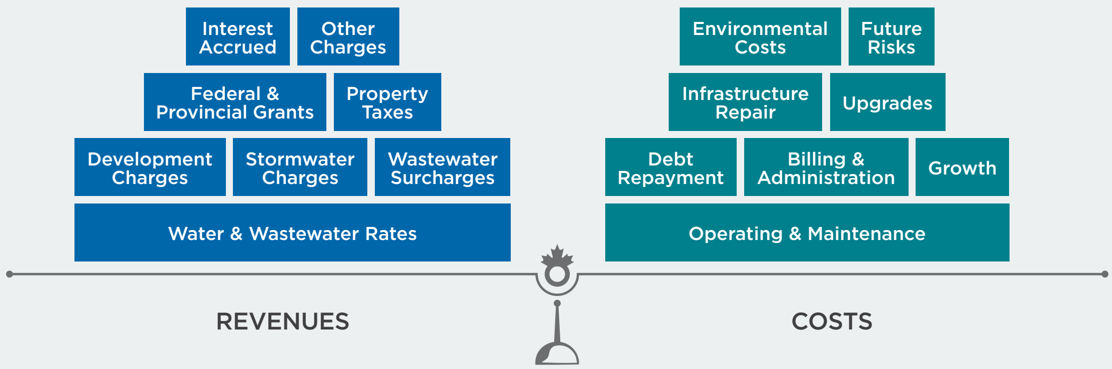


FIGURE 1: **The principle of full cost recovery is a process of balancing utility revenues and costs**

Revenues and costs may vary from one community to another.

State-of-the-Practice of Full Cost Recovery in Canada

Currently, there isn't a national snapshot of how Canadian water utilities are using funding sources, financial tools and practices available to them. This report provides some insight by examining data from a subset of Canadian utilities participating in the National Water and Wastewater Benchmarking Initiative, as well as additional research. In addition, there are ten case studies which highlight innovative approaches to these practices.

Accounting for the Full Costs

National discussions about full cost recovery have focused on just how broadly the costs of water systems should be considered (Figure 2). Full cost accounting strives to identify and capture as many discernible costs as accurately as possible, including elements that have historically been outside the mandate of utilities, such as source water protection or long-term environmental impacts. Quantifying environmental and resource costs and future risks is very difficult, and as a result, most utilities in Canada are either underestimating or not accounting for these costs. A few utilities have started to explore how they can be brought into accounting practices.

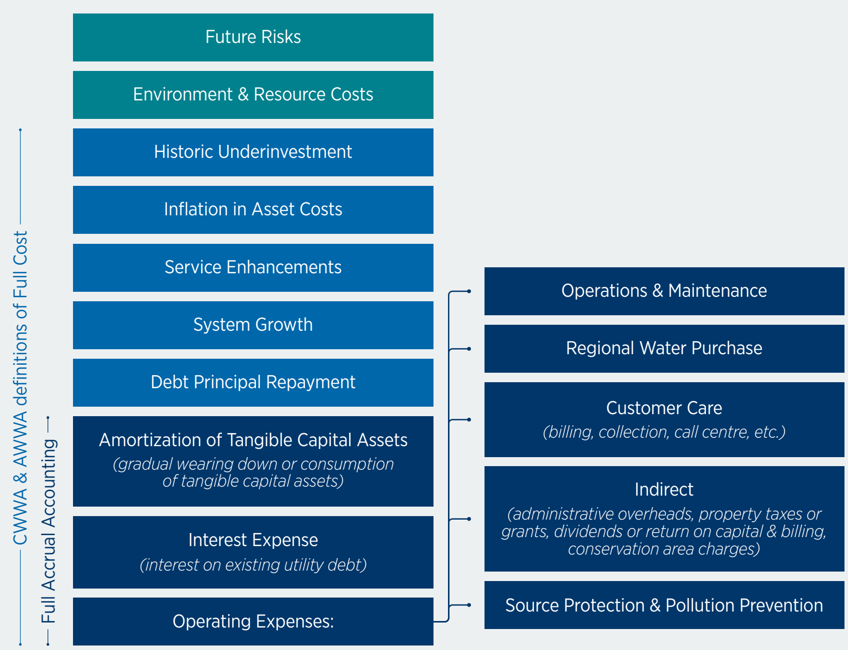


FIGURE 2: **Full cost accounting — typical utility practices + costs that are not typically captured**

Generating Revenue

Historically, funding water services through property taxes was common practice in Canada. Although this is still practiced in Quebec and for stormwater services in many municipalities, the majority of water and wastewater utilities in Canada collect the bulk of their revenues directly from service users and a growing number of municipalities are implementing dedicated separate stormwater charges. Water sales and wastewater fees, on average, account for approximately 80% of the revenues of utilities reporting to the National Water and Wastewater Benchmarking Initiative (NWWBI) and the remaining 20% is generated from a combination of service charges, grants, development charges and other sources (Figure 3).

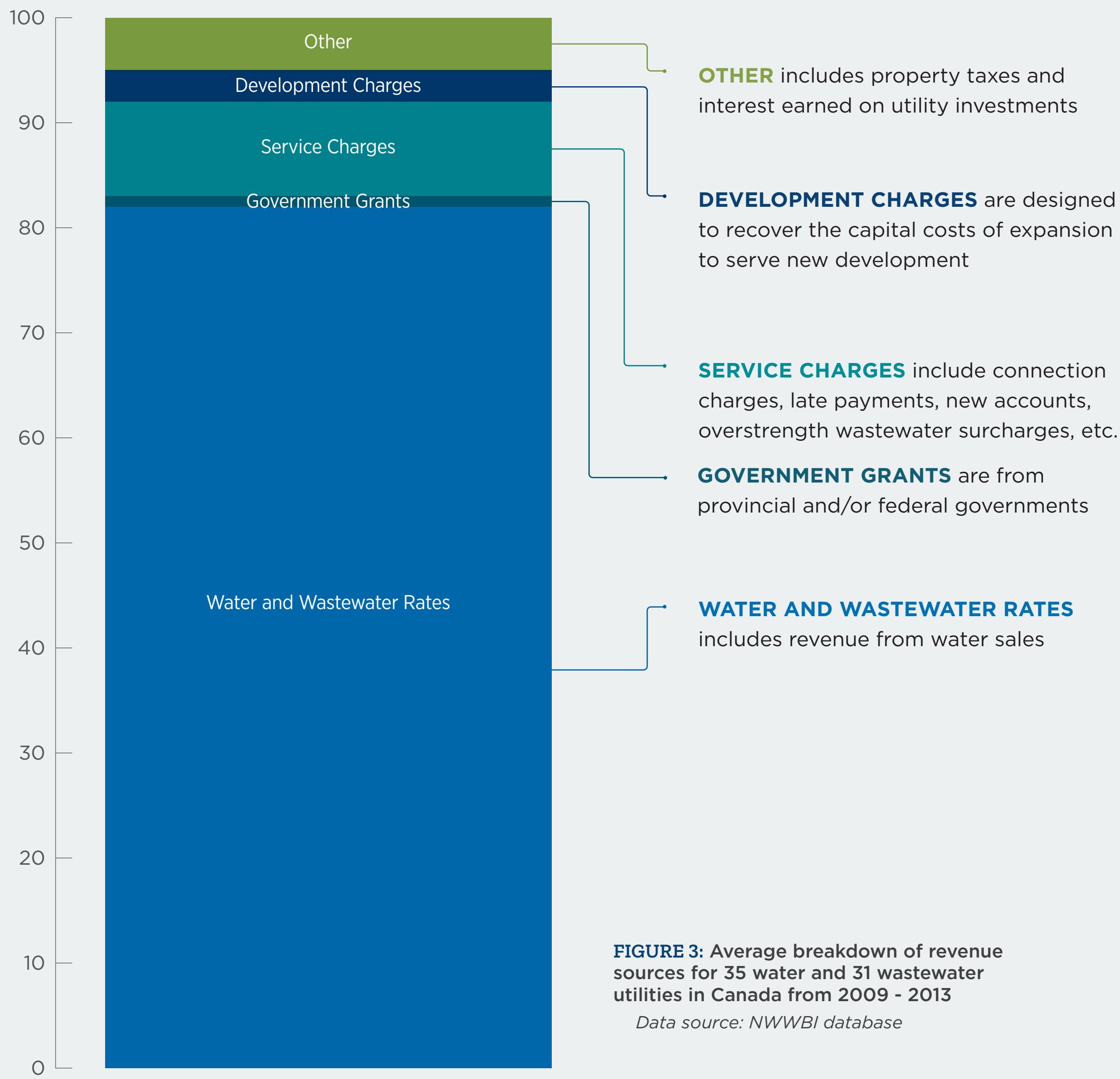


FIGURE 3: Average breakdown of revenue sources for 35 water and 31 wastewater utilities in Canada from 2009 - 2013

Data source: NWWBI database

Data on the financial practices of a subset of Canadian utilities are analysed in the report. The data were collected from participating municipalities by the National Water and Wastewater Benchmarking Initiative between 1999 and 2016 and are presented in aggregate. Where appropriate, the subset of the database that was used is indicated.

Water and Wastewater Rates

Water and wastewater rates are the fees charged to household residents, industries and institutions for water services. Utilities use different types of rate structures with fixed rates, volumetric rates or a combination of the two to recoup costs and achieve objectives like fairness and conservation. The different rate structures (Figure 5) include flat rates, which don't require metering, because a set rate is charged monthly regardless of how much water is used; uniform rates that are based on a unit volumetric charge, where those who use more, pay more; and block rates that apply varying rates for specific volumes of water use and can increase or decrease as more water is consumed to encourage conservation or economic development.

Fifty-six percent of water utilities and 61% of wastewater utilities reporting to the NWWBI apply a uniform volumetric rate, while 44% of water and 27% of wastewater utilities use fixed fees along with a uniform rate structure. NWWBI utilities who use an increasing block volumetric rate also charge a fixed fee in conjunction with the rate. In Nova Scotia, a base rate for fixed costs and a consumption or discharge rate for variable costs is common.

Development Charges

Development charges are a one-time fee assessed for new developments or re-development so that the costs of system expansion are paid for by the developer (or final occupants) instead of existing users or taxpayers. The charges are designed to recover new capital costs but do not recover lifecycle costs like operation and maintenance, repairs and upgrades, which are covered through water and wastewater rates.

Stormwater Charges

Canadian utilities have started to link the recovery of stormwater costs to use or benefit from the services. Twenty-four municipalities reporting to the NWWBI have introduced separate stormwater charges, including three of Canada's top ten cities by population. Fifty-four percent of these utilities apply tiered flat fees based on property type, and 32% have opted for more complex structures based on property size, impervious area and/or runoff coefficients.

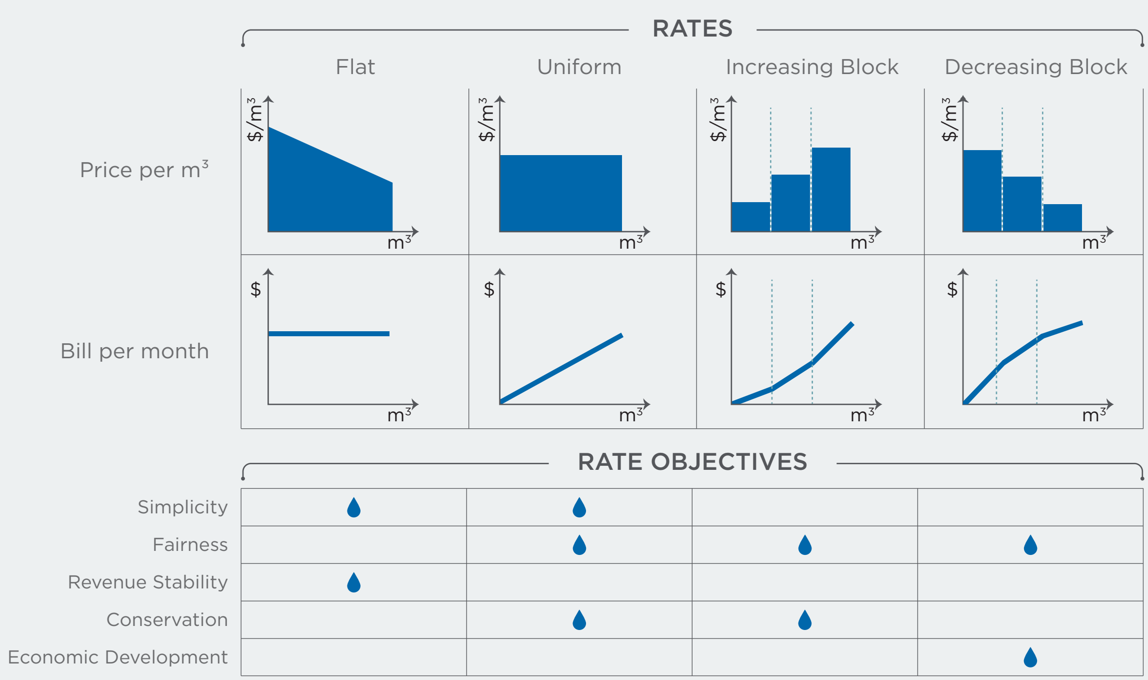


FIGURE 5: Common rate structures employed by water and wastewater utilities and the objectives they support

Wastewater Surcharges

Many utilities have a wastewater surcharge by-law to recover additional treatment costs or infrastructure degradation resulting from commercial, industrial and institutional over-strength discharges (i.e., discharges that exceed standard concentrations of wastewater constituents or contaminants). Sixty-three percent of 36 utilities reporting to the NWWBI in 2014 applied this type of surcharge.

Federal or Provincial Grants

Federal or provincial grants play an important role in enabling capital water and wastewater projects for many municipalities. However, the majority of these grants are one-time offers that have tended to favour shovel-ready or near-term projects rather than long-term strategies that lead to improved financial sustainability.

Financing Approaches

Reserves and Debt

Water utilities have three options when planning for large future expenditures: save now (create cash reserves), pay as you go, or borrow now and pay back over time (debt financing). Reserve funds can help mitigate risk, manage debt levels, cover unexpected expenses or liabilities and provide contingency funds. On the other hand, debt financing can be a fair and justifiable approach, because future users — who are the primary beneficiaries of new or upgraded infrastructure — contribute to repayment.

Public-Private Partnerships

Public-private partnerships (P3s) are collaborations between a government agency and a private sector entity to deliver public infrastructure or public services. Some of the benefits include access to expertise, potential cost savings, transferred risk and clear lines of accountability. P3s for water and wastewater systems have included contracts for short-term operation and maintenance, leases and concessions for long-term operation and management, and design-build-finance-operate-maintain contracts for infrastructure projects.

Equity and Affordability

There are many different dimensions of equity, including equity between customers, generations and income groups (OECD, 2003). In this report, equity refers to the fair allocation of costs based on system use, while affordability refers to paying the same proportion of income on basic water services.

In the short-term, customers can be charged based on their actual use of services or costs to the system, ensuring that they pay their fair share, but longer-term costs like infrastructure investment and renewal must be distributed across generations. The American Water Works Association's manual, *Principles of Water Rates, Fees and Charges* (AWWA, 2012), recommends that utilities determine the cost of service for different customer classes (residential, commercial and industrial) to support equity and revenue stability. However, distinguishing and charging different classes requires more complex monitoring, tracking and administration, and the majority of Canadian utilities in the NWWBI database do not differentiate customer classes for billing.

Increasing rates can have significant impacts on low-income households, particularly where flat or uniform rates are employed. Water-related costs can represent more than 4% of expenditures in low-income households earning under $20,000 per year, which is ten times the impact for high-income families (Bodimeade & Renzetti, 2013). Some municipalities choose to subsidize specific water users by setting a low-cost minimum volume charge for basic household needs or lower industrial rates to promote economic development (Alliance for Water Efficiency [AWE], 2014a).

CHALLENGES TO ACHIEVING FINANCIALLY SUSTAINABLE WATER SYSTEMS

Given the state of practice in Canada, there are some critical challenges to achieving financial sustainability.

Impact of changing water use on utility revenue

Canadian utilities are largely dependent on water use to generate revenue, but water sales can fluctuate and conservation results in lower revenues. Nevertheless, the utility's core costs are fixed, irrespective of the amount of water consumed or disposed of on a daily basis. For 31 water and wastewater utilities reporting to the NWWBI, more than 50% of revenue is derived from volumetric rates, while only 9% of costs are related to volumetric use (Figure 9). Data from 12 NWWBI utilities indicated an average decrease in single-family household water use of 12% from 2009 to 2013. Conservation by high volume industrial users can also significantly impact a utility's revenue. Utilities in the NWWBI database list loss of revenue due to declining usage as a top economic concern.

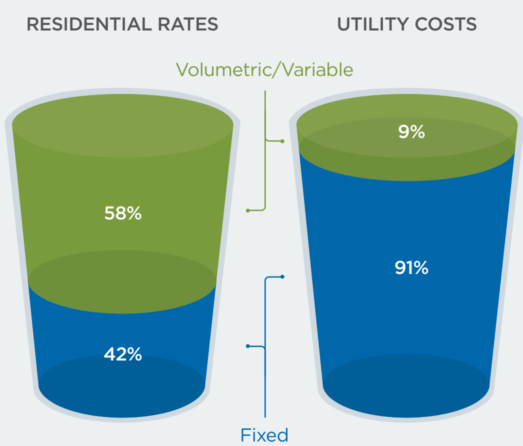


FIGURE 9: Comparison of single-family household rates to utility costs for 31 utilities in 2013

Calculated assuming:

Single family homes: 20m³/month, 16mm meter

Utility costs: Variable costs – chemicals and energy

Fixed costs: Total annual expenditure minus variable costs

Data source: NWWBI database

Historic underinvestment in infrastructure

Much of Canada's infrastructure was built shortly after World War II and is approaching the end of its lifecycle. The 2016 Canadian Infrastructure Report Card reports that approximately 29%, 35% and 23% of potable water, wastewater and stormwater assets are in a condition that warrants attention and that full replacement would cost approximately $173 billion (Canadian Construction Association [CCA] et al, 2016). Canadian reinvestment rates on average for water and wastewater infrastructure are below the targets recommended by asset management practitioners (CCA et al, 2016). System breaks and failure are a consequence of this state of affairs, and of the 22 utilities reporting to the NWWBI in 2014, the majority spent more than 50% of maintenance hours on emergency and urgent repairs. Studies show that the longer investment is delayed, the costlier it becomes to upgrade or replace assets (Alliance for Water Efficiency [AWE], 2014a; Fenn & Kitchen, 2016).

The high cost of unpredictable events

The capacity of Canada's aging infrastructure is further stressed by the more frequent and intense rainfall, flooding, drought, wildfires, ice storms and extreme temperatures that accompany climate change. The Insurance Bureau of Canada has reported that insurance pay-outs due to catastrophic events reached $602 million for 2015, and topped $1 billion for each of the six preceding years, with a record pay-out of $3.6 billion for 2013 (Insurance Bureau of Canada [IBC], 2016). Responding to extreme events and building more resilient infrastructure will be very costly. There is limited regulatory guidance on best practices or requirements for adapting to climate change, despite the potentially high consequences for municipalities.

Rising energy costs

Municipal water and wastewater systems are energy-intensive and are typically a municipality's largest single energy user. Energy prices can have a substantial impact on utility costs and fluctuations can make accurate cost forecasting challenging. For example, from 2006 to 2016, residential electricity rates increased between 71 and 149% in Ontario (Ontario Energy Board, n.d.-a) and Alberta's electricity rate is recalculated monthly and can fluctuate dramatically ("Regulated Rate Option (RRO)," n.d.). Future energy costs are also expected to rise due to the energy requirements of meeting increasingly stringent treatment standards, decreased quality of water sources as a result of urbanization and potential changes in water quality due to climate change.

Limited system information and asset management planning

Good data, combined with accurate replacement costs and risk assessment are needed to empower utilities to do the right thing, to the right asset, at the right time — which ultimately reduces costs. Asset management planning is becoming more widespread among larger utilities, but only 35% of smaller municipalities surveyed in the 2016 Canadian Infrastructure Report Card employ a formal program (Canadian Construction Association [CCA] et al., 2016). Accurately measuring system usage is a fundamental component in designing and implementing appropriate user rates, assessing the impact of interventions and programs, ensuring pricing equity and ultimately recovering the costs of service. While there are still utilities in Canada that do not meter water and system use, overall, utilities reporting to the NWWBI steadily increased their metered connections over the last decade.

Gaps in provincial legislation

Provincial legislation in some parts of Canada encourages financial viability through elements of full cost recovery, but generally there is little legislation that mandates full cost recovery for all three of drinking water, wastewater and stormwater services. In comparison, the European Water Framework Directive (Council Directive 2000/60/EC, 2000) contains specific clauses that mandate full cost recovery. However, implementation by the member states has varied, which suggests that legislation is only one piece of the puzzle.

Public resistance to rate changes

Municipal water management has occupied limited bandwidth in public discourse in Canada, except in times of crisis like contamination, flooding, drought or wildfire. There is low public awareness of the complexity of considerations, decisions and practices, or the nature and consequences of financial underinvestment. Consequently, resistance to rate or tax increases to support additional system investments and more complete cost recovery is common. Utilities are increasingly recognizing a strong need to connect the public's desire for high-quality water with an understanding of the costs involved in its delivery and the implications of underinvestment.

OPPORTUNITIES TO MOVE TOWARD FINANCIAL SUSTAINABILITY

Although water utilities across Canada face many of the same core challenges, they have diverse systems, regional and regulatory settings, and socio-economic realities in the communities they support. As a result, achieving success will necessitate a customized approach. This report presents a menu of opportunities from which each community can select the most appropriate options to move toward greater financial sustainability.

Design adaptive rate structures to achieve revenue stability

Combine volumetric rates + fixed fees to achieve multiple objectives such as revenue stability, equity and conservation. A sufficient fixed component provides predictable revenue that enables better revenue forecasting, while a volumetric component ensures that price signals and customer control are maintained.

Introduce tiered stormwater charges based on property size and the amount of impervious surface. Incentive programs can also be developed that encourage on-site stormwater management.

Customize pricing models to better reflect different users and uses.

Implement automatic rate adjustments based on multi-year budget forecasts to minimize political uncertainty, with periodic reviews to ensure that revenue and costs are aligned, particularly following economic downturn, extreme weather and other changes.

Link automatic rate adjustments to a specific index (e.g., the Consumer Price Index) when appropriate to the local context.

Consider pass-through charges that adjust customer rates in proportion to actual changes in the costs of operation (e.g., electricity, raw water and capital costs).

Use temporary surcharges where appropriate to address time-limited costs or needs like disaster recovery, paying for a major capital project, or influencing customer behaviour during a drought.

Build climate change resiliency into financial planning

Establish targets for operating and contingency reserve funds that consider risks like extreme weather more explicitly.

Secure municipal insurance for climate risks, particularly for property damage and legal liability caused by infrastructure failure.

Use financial derivatives to manage weather-related risks where the value is based on an agreed-upon asset, index or security, similar to those used in the energy and agricultural sector.

Issue green bonds (where possible) to fund climate change adaptation to expand funding of activities that achieve long-term environmental goals.

Adjust financial forecasting for extreme events, rather than relying on historical data to inform projections, placing more weight on worst-case scenarios that support the need for larger reserves or financing abilities.

Develop new risk management strategies that better reflect change and explicitly consider how to manage increased uncertainty.

Identify cost-effective and proactive risk-reduction investments like green infrastructure or low-impact development.

Optimize energy use and recover resources

Increase energy efficiency by reducing leakage, inflow and infiltration, managing demand, modifying operations, optimizing treatment protocols and implementing energy-efficient technologies.

Implement resource recovery to lower overall costs through the reuse or sale of recovered resources (e.g., biogas or phosphorous), or cost savings as a result of reduced maintenance, less intense treatment requirements and delayed tertiary upgrades (e.g., through struvite recovery or water reuse).

Increase system knowledge

Improve asset management practices and link increased understanding of system performance to asset management planning to enable better estimates of the short- and long-term costs for sustainable financial planning. This is an active area of research, technology development and practice in Canada.

Broaden the consideration of assets to include natural assets and determine the value of the ecosystem and socio-economic services provided by rivers, wetlands and aquifers on system outcomes. This is challenging but also critical to a broader discussion of risk and resiliency.

Increase data mining and the use of existing data to reap significant benefits for financial sustainability. For example, by using district metered areas, the location of leaks can be detected much earlier, helping to reduce non-revenue water loss and minimize more extensive repair and maintenance costs.

Adopt advanced metering infrastructure to enable system optimization and adaptive rate design and to improve customer understanding of service use.

Create a culture of communication

Focus on building relationships and gather valuable insights about customer needs and motivations. Utilities need to move from a "top-down just-the-facts" approach to a communications model that is more responsive to customer feedback.

Use targeted communications to reach a broader audience. Customer needs and motivations can vary widely, depending on the customer class (household, commercial or industrial) and demographics like income level, business size, etc.

Relate communications to external events. For example, communicating about stormwater management following a wet spring may increase uptake and retention. Effective communication during crisis events can provide an opportunity to educate and build momentum for change.

Given the thousands of municipal water systems in Canada, the wide variability in the state of repair of those systems and the socio-economic realities of the communities they support, balancing the books to achieve financial sustainability will be less about applying an "industry standard" and more about selecting the best approach from a menu of options. Recognition of the urgent need to address water management is growing. Utilities, government, industry and the public all have a role in responding to that need. For Canadian utilities on the front lines of water management, the opportunity exists to select and implement the best options to achieve financially sustainable systems and improve Canadians' connection to shaping and supporting those systems.

INTRODUCTION

In Canada, a culture shift is happening in municipal water management. Utilities are moving from a more reactive operational approach driven by regulatory compliance to a more proactive, customer-focused approach, which ultimately begins with two fundamental questions:

What do customers want from their systems? What are they willing to support?

Regulations are fundamental to ensuring safe and effective operations. However, progressive utilities increasingly view regulatory compliance as a foundation to build upon, rather than an end goal. Determining what makes the most sense to do and how that is best achieved and paid for occupies much of the attention of those leading water management today. A realistic view of consumers' ability to pay must also be considered. As the costs of managing water systems rise, the socio-economic consequences of decisions are becoming more central in the search for sustainable options.

Water systems are predominantly a public enterprise in Canada. The owners, investors and customers are the public, and they set the bar for what municipal water managers must achieve. Canadians expect high quality from their water systems and assume they will be operated in a fiscally, environmentally and socially responsible manner. In meeting these expectations, utilities are contending with a number of significant financial challenges. Across the country, urgent repairs or upgrades to aging infrastructure will require billions of dollars of investment to avoid system failures and maintain high quality. Fluctuating demands for water due to population growth, demographic changes, development and conservation all directly affect utility costs and revenue generation. The potential impacts from large and unpredictable events as a result of climate change — such as flooding, freezing, wildfire or drought — are clear risks that can carry huge price tags for recovery, repair and rebuilding.

WHAT DO CANADIANS WANT FROM THEIR WATER SYSTEMS?

- Safe, up-to-date, efficient systems
- Consistent and reliable service
- Financial, environmental and social sustainability
- Fair and equitable cost distribution
- Affordability

All of this is happening at a time when water systems are undergoing significant changes, including operational innovation, the ability to monitor systems in real-time and increased expectations of transparency and public engagement. Given all of this, there is a compelling case for embracing opportunities to achieve more effective and resilient water systems through financially sustainable water management. Decision makers need to know what options are available to them for effective full cost planning and recovery, particularly those that will work within a local context. This report delves into the spectrum of costs and recovery options to ensure effective water systems in Canada, provides a window into the current state of the practice regarding funding, financing and full cost recovery and suggests how to implement change.

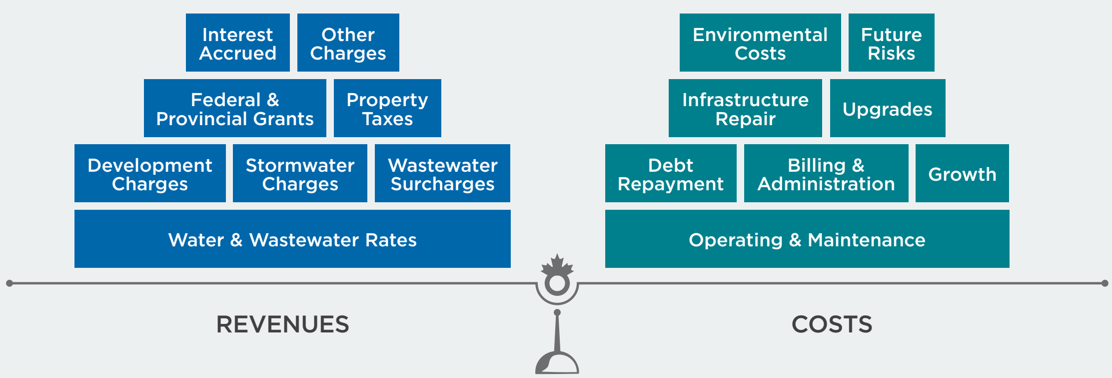
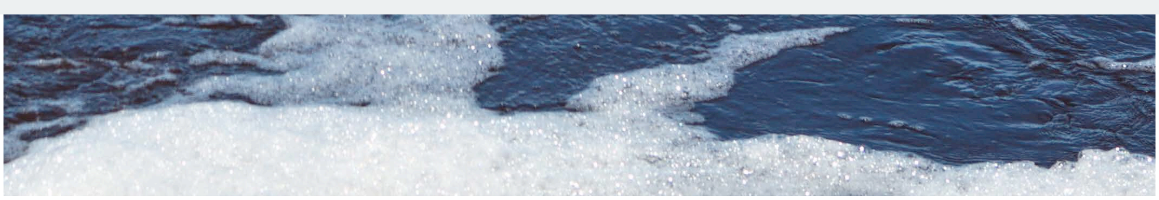


FIGURE 1: The principle of full cost recovery is a process of balancing utility revenues and costs
Revenues and costs may vary from one community to another.

To be financially sustainable, water utilities must be able to: 1) secure enough revenue to recover costs and service debts, 2) buffer against unexpected circumstances, and 3) save for future capital needs. This task is a matter of ensuring that financial outputs (costs) equal financial inputs (revenues). However, balancing this seemingly simple equation is enormously challenging. It requires clarity on what the system has to achieve now and in the future, an accurate representation of the actual costs — including risks and uncertainties — and cost recovery approaches that fit with other municipal objectives like fairness and affordability. Balancing annual budgets through financial tools such as reserves, loans and public-private partnerships adds further complexity to the equation. Reducing costs or "doing more with less" is a given for municipalities, but optimization alone will only get you so far — revenues will also need to increase.



STATE-OF-THE-PRACTICE OF FULL COST RECOVERY IN CANADA

Generating a better understanding of how to advance utilities' progress toward financial sustainability and full cost recovery requires consideration of current practices within Canadian utilities. Analysis of available data from the National Water and Wastewater Benchmarking Initiative and other studies provide valuable insights on Canadian water utilities' use of funding sources, financial tools and practices, as well as equity and affordability considerations.

RESEARCH METHODOLOGY

The primary data referenced in this section was provided by the National Water and Wastewater Benchmarking Intiative (NWWBI).

The NWWBI collects operational and financial data annually from its members to identify best practices and performance improvement opportunities. There are currently 55 utilities, municipalities and regions participating in the NWWBI from British Columbia, Alberta, Manitoba, Saskatchewan, Ontario, Quebec and Nova Scotia, with populations ranging from 15,000 to 3 million.

The report analyses data on the financial practices of a subset of these utilities. Each figure notes the number of utilities whose data is included and when a subset of data was used. The data, collected between 1999 and 2016, are presented in aggregate (i.e., no individual utility data are provided).

The NWWBI represents a subset of utilities across Canada and does not include any First Nations communities. In some cases, incomplete data were eliminated.

Accounting for the full costs

A great deal of the discussion around full cost recovery has focused on how broadly the costs of operating water systems should be considered — i.e., how wide to cast the net. Full cost accounting strives to identify and capture as many known and discernible costs as accurately as possible, including elements that have historically been outside the mandate of utilities, such as source water protection or long-term environmental impacts. Figure 2 illustrates how our thinking about what to include has been widening, and the subsequent discussion highlights the limitations of accounting practices to accurately capture those costs.

Figure 2 on the next page shows the costs included in standard practice full accrual accounting, as well as broader considerations recommended by national and international water and wastewater associations, and costs associated with environmental and future risks.

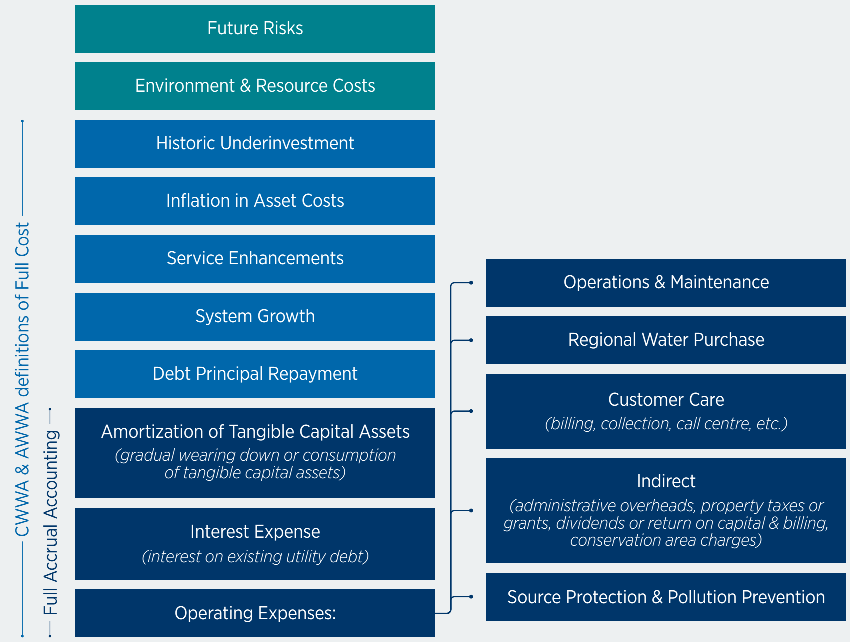


FIGURE 2: **Full cost accounting — typical utility practices, plus costs that are not typically captured**

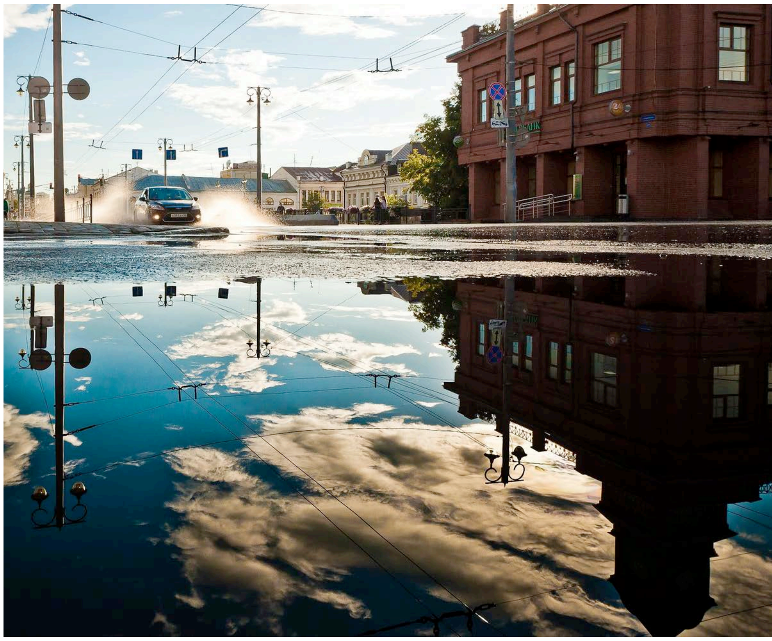
Assessing annual costs

The first tier in Figure 2 (navy blue) — operating expenses, interest expense and amortization of tangible capital assets — represents expenses under full accrual accounting (Ontario Ministry of the Environment [MOE], 2007; Public Sector Accounting Board [PSAB] & Canadian Institute of Chartered Accountants [CICA], 2003). Full accrual accounting assumes that there will be an accounting surplus if a utility is generating more revenue than the sum of the layers in this tier (PSAB & CICA, 2003). Operating expenses, however, are often underestimated due to deferred maintenance and may be further understated when based solely on historical costs (Ontario Ministry of the Environment [MOE], 2007). As a result, an accounting surplus may not be adequate to support current and future operations. The full accrual approach accounts annually for costs which span multiple years through amortization or depreciation of capital assets (e.g., treatment plants, pump stations, transmission mains, etc.). Although the capital cost of a new treatment plant or transmission main is noted in the year of expenditure, the use of capital assets over their full lifecycle is accounted for annually, painting a more complete picture of assets that are used for many years (PSAB & CICA, 2003). Additionally, while this approach can include operating expenses related to source protection and pollution prevention, it does not include green or natural infrastructure as capital assets (Canada's Ecofiscal Commission, 2017). It also doesn't take into account future needs or the uncertainty of those needs.

Full accrual accounting is an accounting method adopted by the Public Sector Accounting Board of the Canadian Institute of Chartered Accountants. It was adopted for municipal accounting in 2009. It attempts to match revenues collected with the expenses that produced those revenues. Thus, revenues are recognized and recorded when goods or services are provided, not when the money is collected. Expenses are recorded when they are incurred (i.e., when goods or services are received), not when they are paid for.

Capturing a more complete view

The second tier in Figure 2 (royal blue) — debt repayment, system growth requiring new or upgraded infrastructure, system enhancements, inflation and the consequences of historic underinvestment in asset renewal and replacement — adds consideration of additional costs associated with changes that take place over time. Both the Canadian Water and Wastewater Association (CWWA) and American Water Works Association (AWWA) have recommended that utilities account for these additional costs (American Water Works Association [AWWA], 2015; Canadian Water and Wastewater Association [CWWA], n.d.). However, accurately accounting for multi-year costs is complicated by changing needs and market conditions like inflation and interest rates. Amortization used in full accrual accounting does not account for higher asset replacement costs, the impact of inflation and other asset management-related costs (The Regional Municipality of York, 2015). Quantifying the funding gap from historic underinvestment is a challenge for many utilities that requires new or expanded asset management programs.



Including environmental and resource costs and future risks

The third tier in Figure 2 (blue-green) represents longer-term costs not typically accounted for under existing accounting standards. These include:

- Environmental costs associated with adverse ecosystem impacts, such as aquatic habitat contamination, soil salination, reduction in biodiversity or loss of species, bank erosion or greenhouse gas emissions.
- Resource costs, which are lost benefits or services resulting from the depletion or degradation of water sources or natural hydrologic features (e.g., aquifers, wetlands, etc.) beyond their natural state of recharge or recovery, or through loss of recreational or cultural value.
- Future risks, including unidentified or difficult to quantify elements such as weather-related impacts (e.g., drought, flood, wildfire and extreme temperatures), emerging contaminants (e.g., pharmaceuticals, personal care products and microplastics), revised regulations, rapid development due to population growth or urbanization and others.

Environmental and resource costs and future risks are difficult to quantify (OECD, 2010) and are typically underestimated or not explicitly taken into account. Historically, they may have been considered beyond a utility's scope. These costs are viewed as negative externalities, and the services provided by natural assets like water storage, filtration and flood protection are considered free (Canada's Ecofiscal Commission, 2017). Determining what component of clean-up or restoration costs should be borne by utility customers is also challenging. Assessing environmental and resource costs depends on having adequate information on the physical condition of the ecosystem and a clear understanding of the extent to which the natural recovery process was affected. Additional uncertainty regarding cause and effect (temporally and spatially) and a lack of environmental standards or established ecological norms adds to the difficulty (Andrews et al., 2004). Some examples include increased costs associated with the need for more advanced water treatment facilities to manage degraded water supplies, or flood mitigation infrastructure to prevent more frequent flooding (Canada's Ecofiscal Commission, 2017).

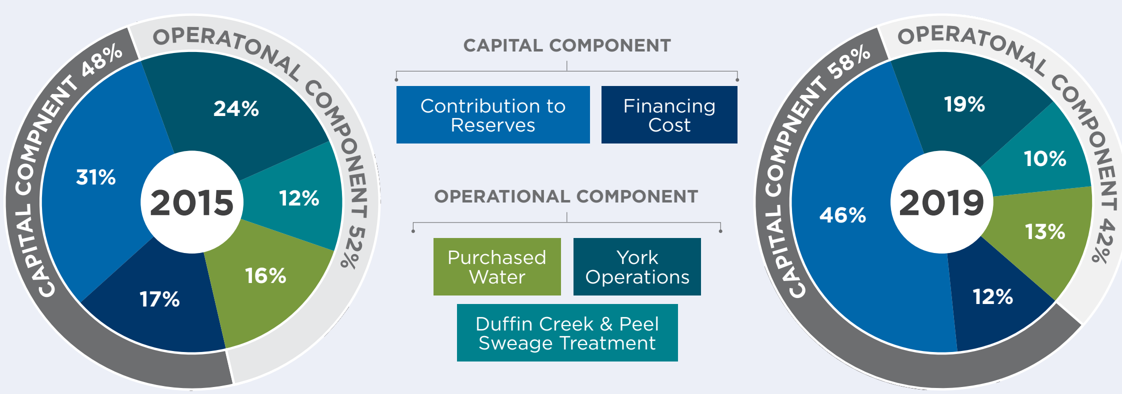
Some jurisdictions in Canada have started to explore how previously unaccounted for environmental services can be brought into accounting practices. Regulators looking at broader goals within the overall watershed have also been moving toward an expanded definition of full cost accounting. For example, the European Water Framework Directive requires utilities to account for environmental and resource costs associated with water use (Council Directive 2000/60/EC, 2000; European Environment Agency [EEA], 2013).

York Region's Water and Wastewater Financial Sustainability Plan

York Region provides water services for more than one million people in nine different municipalities. It is one of the fastest growing regions in Canada, with a projected population of 1.79 million by 2031. Unlike other municipalities in the Greater Toronto Area, York Region lacks direct access to Lake Ontario and must purchase water and wastewater services from neighbouring municipalities. The Region's long-range strategic plan has set a target of no new water supplies by 2051, which will be achieved by leveraging innovative technology for wastewater reuse and water conservation, and the adoption of a One Water approach. Within this context, balancing costs and revenues is vital. In October 2015, Council approved a Water and Wastewater Financial Sustainability Plan to achieve full cost recovery in 2021. There was extensive analysis on potential rate changes, affordability, intergenerational equity, projected flows and infrastructure costs during the development of the plan, which now includes the following steps:

- Establish water and wastewater service goals that align with the region's strategic plan.
- Identify full costs, including capital enhancements, upgrades, rehabilitation and replacement, payments to other municipalities for water and wastewater services, funding Conservation Authorities, growth-related expansions funded by development charges, regulatory costs, environmental costs (source water protection), research and development, and financing debt repayment.
- Conduct a more thorough review of asset replacement value and the complexity of replacing assets to better understand cost drivers and identify future investment needs.
- Develop future demand projections that take into account population growth, new technology, weather, changes in housing density, shifting customer behaviour and future operating costs.
- Manage the mismatch between timing of asset management related costs and revenue generation through use of financial tools, such as reserves.
- Review new rate structures, informed by customer research.
- Review revenues, costs, cash flows and other results annually, and adjust the plan as needed. This is an important step which recognizes the challenge of predicting future behaviour and cost escalation due to inflation, changes in the building code, labour, energy and weather.

The implementation of full cost recovery pricing will help to ensure that adequate reserves are in place to adequately fund current and future capital and eliminate the need for debt financing of rehabilitation and replacement projects. This will result in a shift in the proportion of user fees contributing to the reserve for asset replacement and rehabilitation, as shown in the figure below.



Allocation of User Fees to Capital and Operating Cost Components in York Region

Source: The Regional Municipality of York (2015)

Generating revenue

Full cost recovery is the process of securing sufficient funds to offset all the costs of service. Once the costs are known, revenue targets can be established, along with appropriate ways to generate the revenue. How this happens varies from one community to another, and from year to year, because what is best and workable will be unique to each community, and because costs and conditions are always changing.

Water, wastewater and stormwater financing occurs within the context of provincial legislation, as well as local municipality and utility governance. Options exist to draw financial support for water management from the shared tax base or operate as a self-standing entity that recovers costs more-or-less independently. Most utilities, although part of (or owned by) local governments, are structured to generate their own revenue for operations, maintenance and upgrades. They employ a number of funding methods and financing tools to generate revenue and manage variable year-over-year accounting (Canada's Ecofiscal Commission, 2017; Doumani et al., 2006).

The primary revenue source for Canadian water utilities are the fees collected for providing water services. Water sales and wastewater fees account for approximately 80% of NWWBI utility total revenues, with the remaining 20% generated from a combination of other service charges, grants, development charges and other sources (Figure 3). Most utility costs are fixed, yet revenues are based on water use that fluctuates. Therefore, it is critical that rate structures are well-designed to ensure a stable and predictable source of funding (Canada's Ecofiscal Commission, 2017; Spang et al., 2015).

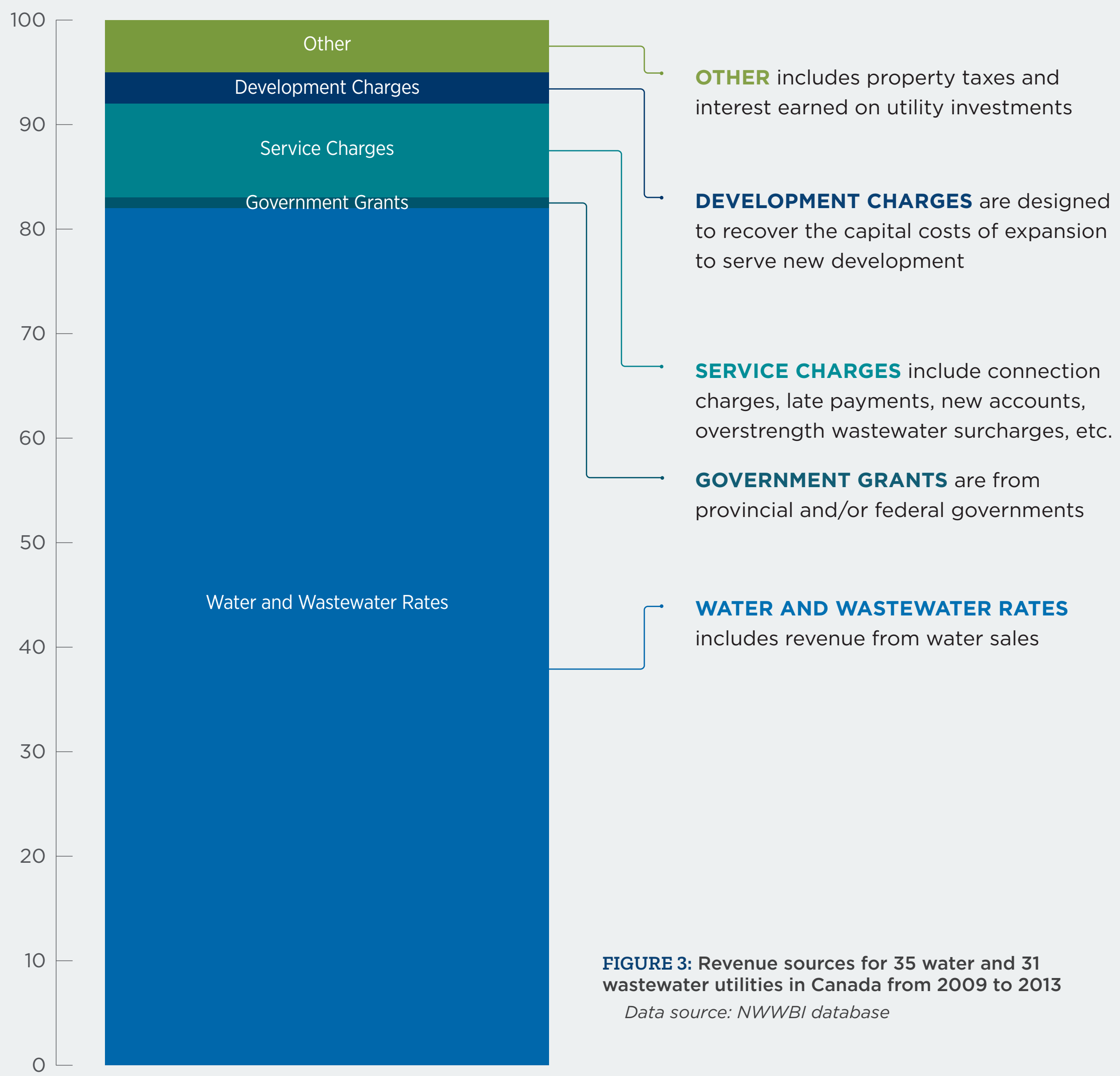
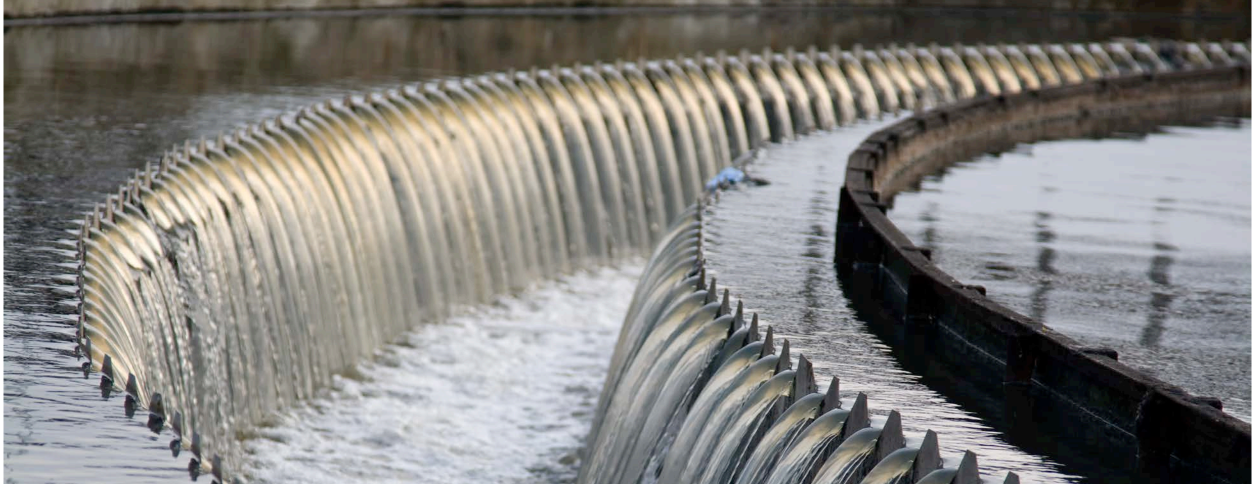


FIGURE 3: Revenue sources for 35 water and 31 wastewater utilities in Canada from 2009 to 2013

Data source: NWWBI database



Water and wastewater rates

Water and wastewater rates are the fees charged to customers for providing safe and reliable service to homes, businesses and institutions. As they generate the largest proportion of utility revenue, an effective structuring of these rates is key. The rate structure must allow the utility to achieve several objectives, including revenue and rate stability, affordability, fairness, water demand management (total and peak), accurate costing and simplicity (Bonbright et al., 1988). Water and wastewater rates can be fixed, volumetric or a combination of both. They can be the same for all customers, or vary based on customer categories such as residential or non-residential.

Wastewater discharge is not metered, but the general assumption is that what goes in must come out, so a ratio of the volume of drinking water consumed is used to bill for wastewater. Seventy-one percent of the NWWBI member utilities set their wastewater rates at 80 to 100% of drinking water usage. Just over half of those utilities use 100% of the volume of water consumed as their wastewater rate, and two utilities apply percentages in excess of 100% to account for the higher proportional cost of their wastewater services. For effective cost recovery, water and wastewater rates should be designed to correspond with the actual costs to provide each service, which means that if providing wastewater service costs more than drinking water, user fees should be higher. The NWWBI data shows close alignment between the average ratio of water to wastewater rates (1.04) and the average ratio of water to wastewater costs (1.05), which suggests that the water and wastewater rates employed reflect an appropriate cost distribution for each service.

FIXED RATES

Fixed rates, also known as fixed fees or fixed charges, account for fixed service costs like billing and meter reading and fixed infrastructure costs like piping, treatment plants and the provision of water for firefighting. Although they comprise a smaller percentage of revenue for most utilities, fixed fees typically provide a predictable and stable revenue source regardless of the volume of water consumed. There are four kinds of fixed rates that are typically employed (AWWA, 2012; Chicago Metropolitan Agency for Planning et al., 2012):

- *Service charges* are related to billing and meter readings and are usually the same for all customers unless a utility has created different classes of customers.
- *Meter charges* recover the costs associated with meter repair and replacement and generally increase based on the size of the meter.
- *Fire protection* charges are common, and can be determined by meter size, property frontage or assigned as a fixed charge for all customers.
- *Minimum charges* are base fees that typically include a portion of service charges, plus a charge for a minimum volume of water.

Seventy-three percent of NWWBI water utilities employ fixed rates as a component of the monthly residential bill, compared to 42% of NWWBI wastewater utilities. Five percent of wastewater utilities used a fixed rate exclusively for monthly residential bills. Figure 4 shows the percentage contribution of fixed fees to the monthly bill (where applicable) for residential water and wastewater services assuming 20 m^3/month consumption. Of those water utilities which employ fixed rates, most employ a fixed rate between approximately 30 – 40% of the monthly water bill, while the majority of wastewater utilities which employ fixed rates use a rate that is between 20 – 50% of the monthly bill (ratio assumes 20 m^3/month consumption).

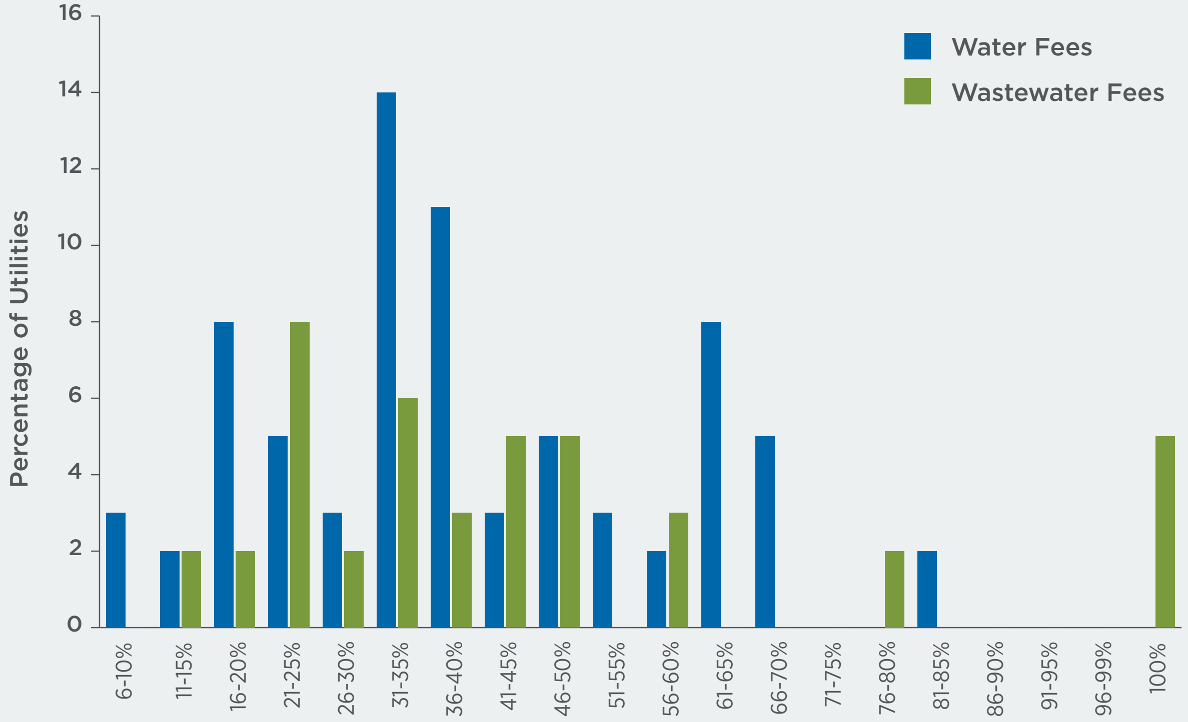


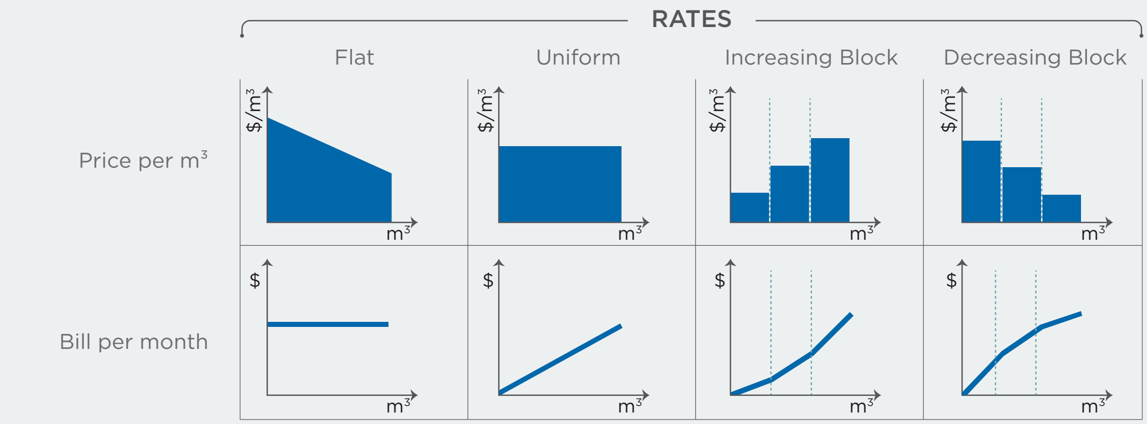
FIGURE 4: **The contribution of fixed fees to monthly residential bills in 63 water utilities and 62 wastewater utilities in 2015 and 2016**

Bill calculations were based on a volumetric rate of 20 m³/month with meter sizes ranging from 16 to 25 mm.
Data source: NWWBI database

VOLUMETRIC RATES

There are four main types of rate structures that are employed by Canadian utilities to recover costs for water consumption: flat, uniform, increasing blocks and decreasing blocks. Each structure has advantages and disadvantages for addressing different objectives, depending on local circumstances.

Flat rates are a set rate that is charged on a monthly basis regardless of the volume of water used. These rates do not require the use of meters, are straightforward and inexpensive to administer, and deliver a reasonably steady and predictable revenue. Flat rates do not distinguish between high and low volume users, which can result in a disproportionate share of the cost of service being borne by lower volume users. Since flat rates typically do not track usage, they are not sensitive to changes in use and there is little incentive for users to conserve water (Federation of Canadian Municipalities [FCM], 2006; Vander Ploeg, 2011).



RATE OBJECTIVES

	Flat	Uniform	Increasing Block	Decreasing Block
Simplicity	●	●		
Fairness		●	●	●
Revenue Stability	●			
Conservation		●	●	
Economic Development				●

FIGURE 5: Common rate structures employed by water and wastewater utilities and the objectives they support

Uniform rates are based on a unit charge for water or wastewater that does not vary depending on the amount used. This is a user-pay approach where meters are used to monitor usage, and those who use more, pay more. Users can decrease their total monthly bill through conservation, but the rate does not change with increased volume, as compared to block rates which change the size of the incentive. As a result, while these rates support conservation, they are not seen as an effective pricing model to actively encourage conservation (FCM, 2006). This rate structure can also lead to some revenue instability for utilities.

Block rates apply specified and varying rates for set volumes of water usage (i.e., blocks) and are more complicated to implement. There are two common types of block rates: increasing block and decreasing block. With **increasing block rates**, the rate increases as more water is consumed, which encourages conservation by large users. However, those who consume larger volumes of water in their operations may be impacted significantly to the point of discouraging industrial or commercial activity. With **decreasing block rates**, the rate decreases as more water is consumed. These rates are more representative of economies-of-scale, and while sometimes perceived as a quantity discount, can be used as a strategy to encourage economic development (FCM, 2006). However, decreasing block rates do not provide a conservation incentive for low volume users.

The complexity of block structures can make predicting future revenue challenging, as usage can fluctuate. However, block structures provide utilities with the flexibility to customize rates to achieve multiple objectives if their design is well-informed on usage and price elasticities. For example, the lowest block in an increasing block rate can be set intentionally low to maintain a level of affordability, particularly for low-income users. After this first block, subsequent blocks can apply higher rates to achieve cost recovery across the range of use beyond basic personal necessity. Upper blocks can implement even higher pricing to discourage increased usage to support conservation and help minimize total water demand.

In 2013, the City of London implemented a hybrid block structure that comprised both increasing and decreasing blocks (see case study on page 21). By incorporating this "humpback" model, the City was able to benefit from the advantages that each rate structure provided. This example highlights the importance of clearly establishing objectives that take into account the local context and needs of different sectors of the population and implementing an appropriate structure that achieves multiple objectives. A potential downside of this approach is that it may be difficult to forecast revenues, impacting planning for revenue stability.

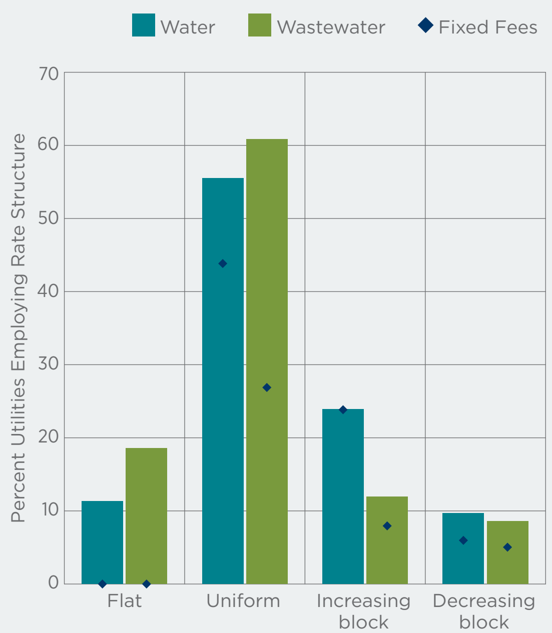


FIGURE 6: Rate structures employed by 63 water and 59 wastewater utilities in 2015 and 2016

Data source: NWWBI database

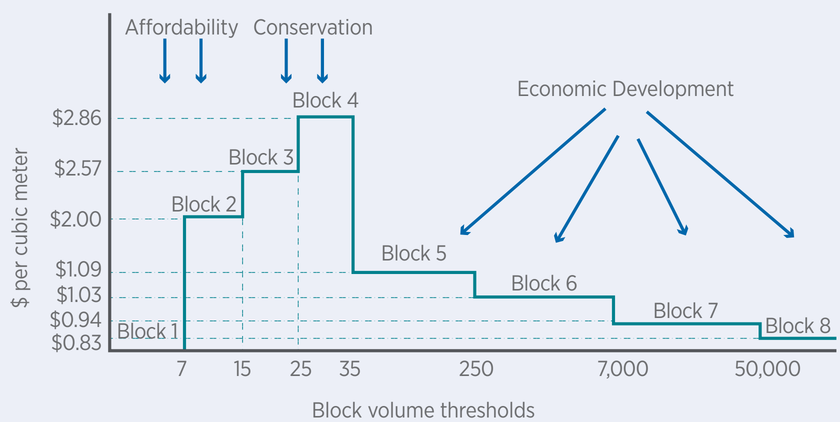
Figure 6 highlights the combinations of rate structures employed by water and wastewater utilities in the NWWBI database. Fifty-six percent of water and 61% of wastewater utilities employ uniform rates. It is common for utilities to combine their volumetric rates with fixed fees. Forty-four percent of water utilities and 27% of wastewater utilities use fixed fees, along with a uniform rate structure. Notably, when an increasing block rate is employed by an NWWBI utility, it does not depend solely on the volumetric charge, but always charges a fixed fee in conjunction with the rate. A common structure in Nova Scotia is a two-part structure with a base rate as a surrogate for fixed costs, and a consumption/discharge rate as a surrogate for variable costs (e.g. Halifax Water, n.d.-c). Balancing utility objectives through the design of rate structures is challenging, and depends on geographic, economic and social conditions, as well as user preferences. A municipality's particular pricing structure is usually the result of historical practice, local politics, adherence to industry rate-setting principles and circumstance, among other factors (Renzetti, 2009).

Customer class groupings based on common characteristics and usage patterns are used to design rate structures that reflect cost-of-service responsibility (AWWA, 2012). Common customer classes include single-family residential, multiple family residential, commercial, industrial, institutional, irrigation-only, and wholesale (Alliance for Water Efficiency [AWE], 2014a). For example, a utility may apply a low uniform rate for their non-residential customer class and an increasing block rate for their residential customer class, with fixed fees based on meter size. Of the 65 utilities that reported to the NWWBI, 62% do not differentiate between customer classes and bill all customers under the same water rate structure; 23% have two classes (residential and non-residential); 12% have more than two classes; and 3% combine multi-family rates with some combination of industrial, commercial, or institutional rates in one class and single-family user rates in a separate class (NWWBI, 2016).

London's hybrid rate structure targets multiple objectives

In 2013, the City of London's water department was facing a $600,000 annual deficit. Until this point in time, the department had been billing customers based on water consumption. A hybrid rate was introduced to provide more reliable revenue, encourage conservation, build reserves and invest in a 20-year lifecycle plan. The new structure combines a fixed rate and increasing and decreasing block components. Fixed rates, which account for approximately 30% of revenue, include system costs, fire protection and a 25¢ fixed monthly fee that generates funds to assist low-income customers with bill payments, purchasing water-efficient fixtures and emergency plumbing.

In addition to the fixed rates, an increasing block structure comprised of four block volumes helps achieve affordability and promote conservation. Recognizing that small industries and other commercial establishments might be impacted by the higher block rates, a decreasing block structure is applied to volumes in excess of the fourth block. The decreasing block is similarly divided into four blocks to promote economic development in the manufacturing sector, who generally have high consumption volumes.



2015 Water rate structure for the City of London's water and wastewater services

Source: Canadian Water Network (2015)

Rates are increased annually based on inflation. The City anticipates that this rate structure will enable it to move towards financial sustainability and generate adequate funding to reduce its infrastructure deficit. Before the new rate structure was implemented, an extensive public awareness campaign was undertaken to communicate the value of clean, safe water and about intergenerational equity (i.e., distributing costs among the generations that will benefit). This example highlights the importance of clearly establishing objectives that take into account the local context and needs of the different sectors of the population, and implementing an appropriate structure that allows multiple objectives to be achieved.

Municipal taxes

Although municipal property taxes were not assessed as a separate revenue source for the 2014 NWWBI survey, they can be assumed to fall under the 'other' category in Figure 3, which makes up approximately 5% of total utility revenues. Historically, funding water through property taxes was common practice in Canada, and is still common in Quebec and for stormwater services in many municipalities, although water and wastewater services cannot be funded by property taxes in Ontario (Canada's Ecofiscal Commission, 2017; Fenn & Kitchen, 2016).

There may be advantages to using taxes for services that are provided for the benefit of the property, like stormwater management and fire protection (United States Environmental Protection Agency [USEPA], 2007). However, from the viewpoint of operating a utility, shared tax revenue is generally not seen as a reliable funding source, as other municipal services compete for the same revenue. Increasing property taxes to cover increased costs is also unpopular publically and politically. Also, taxes do not provide direct feedback to customers or connection to operations (Aquije, 2016; Canada's Ecofiscal Commission, 2017). As a result, there has been a growing movement in Canada toward dedicated user-pay approaches, including property-related charges such as stormwater management and fire protection (Fenn & Kitchen, 2016; Ministry of Public Infrastructure Renewal, 2005).

Other user charges

DEVELOPMENT CHARGES

Development charges provide approximately 3% of revenue for utilities in the NWWBI database (Figure 3). These charges are based on the principle that growth should pay for growth and are focused on recovering the capital costs of expansion from serving new developments. They are a one-time fee for new development or re-development, where the costs are borne by the developers (or final occupants) rather than by the existing system users or taxpayers. The charges are based on a contributing area or number of new dwelling units instead of property value, and include the costs of infrastructure design and construction, plus water and sewer mains, roads, fire and policing (e.g., City of Ottawa, n.d.-a; City of Toronto, n.d.; Halifax Water, n.d.-b).

Provincial legislation typically governs development charges. For example, Ontario's Development Charges Act (Development Charges Act, 1997) permits municipalities to pass by-laws that impose fees to cover the increased capital costs associated with providing services to an area of development. When developing these by-laws, a background study must be conducted that includes an asset management plan and estimates of the anticipated amounts and type of developments, the need for service to the anticipated developments and the capital costs necessary to provide the service. These by-laws are renewed every five years, prompting a new background study and review of the charges.

Development charges are designed to recover the capital costs for new developments, but not to recoup other infrastructure lifecycle costs like operation and maintenance (O&M) costs, which will greatly exceed the initial capital investments over the lifetime of the infrastructure and eventual replacement costs. Typically, property taxes and user fees generated in newly developed areas provide revenues that can offset the majority of the O&M costs for these new areas. However, water demand and long-term service enhancements, repairs and upgrades are difficult to predict for new areas, and unless accounted for in a utility's long-term financial planning, can require additional revenues through increased user fees (e.g., rate increases) or property taxes for full recovery.

Fluctuations in development may impact a utility's annual budget. For example, new development in the City of Calgary fell to a 33-year low in 2016 due to the slumping energy sector, which resulted in a $47-million budget shortfall for its water utility (City of Calgary, 2016). The utility plans to partially offset this deficit through rate increases, reduced levels of service and deferred work. The Regional Municipality of Durham relies on development charge receipts from the previous year instead of growth forecasts to minimize potential funding shortfalls due to volatility in the development industry.

STORMWATER CHARGES

Stormwater management in Canada has historically been funded using property taxes based on property value, as well as development charges. Limited funding has typically been available for stormwater system upgrades, and a result, many utilities' stormwater assets are under-capacity and ill-equipped to withstand the increasing frequency and intensity of storms. Over the last twenty years, there has been a trend toward linking the recovery of stormwater costs to use or benefit from the services.

Twenty-four municipalities reporting to the NWWBI have introduced separate stormwater charges since 1996 (Figure 7), including three of Canada's top ten cities by population. The City of Mississauga employs a 5-tiered rate structure correlated to impervious surface coverage for single family residences; the City of Edmonton's stormwater charge, which is managed by EPCOR, is based on property size and land zoning (EPCOR, n.d.); and the City of Calgary charges a flat fee (City of Calgary, n.d.).

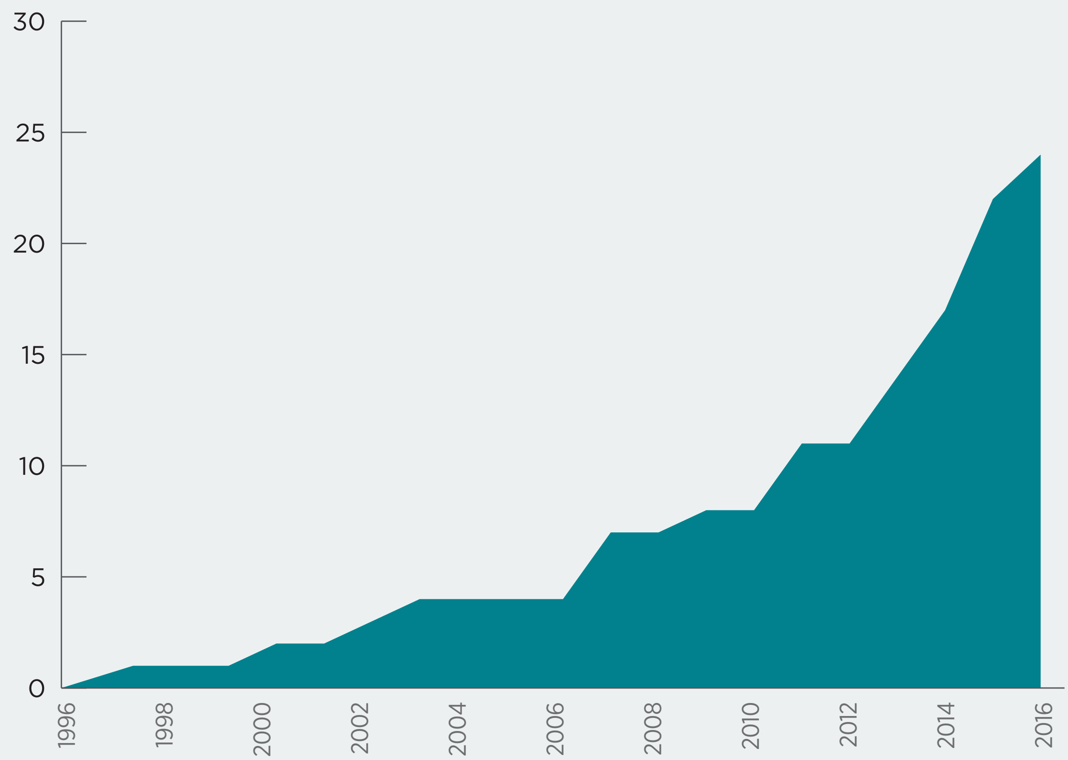


FIGURE 7: Cumulative number of utilities that introduced a dedicated stormwater charge between 1996 and 2016
Data source: NWWBI database

Rates based on property characteristics like size and impervious area and tiered flat fees based on property type/size are more equitable than property taxes, in that they more closely correlate to the volume of stormwater runoff generated from a property. Some utilities are also using incentives like a stormwater credit to encourage property owners to reduce runoff (Aquije, 2016). The approach taken by a water utility depends largely on local need and resources. For example, data for individual properties, such as geographic information systems data and aerial mapping may not be readily available. According to the NWWBI database, 54% of the 24 utilities using stormwater fees apply tiered flat fees based on property type (e.g., single-family residential or industrial), whereas 32% of utilities opt for more complex structures based on property size, impervious area and a runoff coefficient. The remaining municipalities base their stormwater fees on tax-assessed property value. Regardless of the structure adopted, a dedicated stormwater charge provides utilities with the revenues necessary to better account for system costs, improve resilience and mitigate risk to the environment, public health and property.

Separate stormwater charges in Kitchener and Mississauga provide dedicated funding

A sizeable funding gap led the City of Kitchener to introduce a separate stormwater charge on customers' water bills in 2011. It was estimated that 12% of the City's portion of property taxes per year would be needed to provide a sustainable level of stormwater service that would meet regulatory requirements. The actual average stormwater expenditures had been 5.1% of the property tax budget since 2007, resulting in an almost $5.5 million per year difference between needed and allocated funding (TSH & CDM, 2008). A stormwater charge based on impervious surface area was introduced as a necessary and more equitable measure to offset this difference in funding (TSH & CDM, 2008). The City also implemented a credit program whereby property owners taking steps to reduce stormwater runoff receive a credit for up to 45% of their stormwater charge (City of Kitchener, n.d.; Gollan, 2012). This is especially relevant for non-residential property owners who pay proportionally more under this stormwater user charge program, due to their higher impervious surfaces and run-off to city stormwater management infrastructure.

In 2016, the City of Mississauga became the largest municipality in Ontario to add a stormwater charge to customers' water bills. Previously its stormwater management was funded primarily through property taxes, which amounted to $14.7 million in 2012. The City's stormwater system had an estimated replacement value of approximately $2.06 billion in 2017 (City of Mississauga, 2017). Mississauga has implemented a tiered flat rate similar to Kitchener for single-family residences, with credit programs available to non-residential and multi-residential properties and a subsidy program for places of worship, veterans' organization properties, working farms and households with low-income seniors or people with disabilities (City of Mississauga, n.d.-a, n.d.-b).

In both Kitchener and Mississauga, separate stormwater rates were seen as necessities to help offset the cost of operating, maintaining and upgrading the stormwater systems sustainably for the long term.

Surcharges

Many Canadian utilities have a wastewater surcharge by-law to recover some of the additional treatment costs or infrastructure degradation that can result from overstrength discharges. Overstrength discharges exceed the utility-determined and industry standard concentration of wastewater constituents or contaminants and may negatively impact wastewater treatment processes, collection system infrastructure or worker health and safety. The NWWBI database reported that 63% of 36 utilities in 2014 applied a surcharge to commercial, industrial and institutional over-strength discharges. The surcharges may be volume- or concentration-based or fixed, and require annual monitoring and agreements between the dischargers and the utility. No other individual surcharges were called out in the annual NWWBI survey, such as those related to a specific capital works project or drought.

Federal or Provincial Grants

Government grants are external sources of funding that can reduce, to some degree, a utility's dependence on rate-based revenue. However, the majority of federal and provincial grants are one-time offers. Therefore, while the injection of needed capital is important, it is also difficult to build these sources into longer-term planning that ensure financial sustainability. Previous programs, like the federal Infrastructure Stimulus Fund, were intended to provide economic stimulus during a recession by allocating funding to shovel-ready projects, which spurred municipalities to prioritize capital projects based on readiness rather than long-term needs. These programs often require matching investment from municipalities, which may also influence local decisions, in part because municipalities do not want to miss out.

The federal Gas Tax Fund is currently the only permanent ongoing infrastructure program in Canada with no definitive end date. It provides over $2 billion annually to a range of municipal infrastructure projects, including water, wastewater and stormwater projects. Funding is allocated to provinces and territories on a per capita basis and distributed to municipalities according to allocation formulas in provincial-municipal funding agreements. Other past programs include the $8.8 billion Building Canada Fund (2007-2014) (Infrastructure Canada, 2011), $4 billion Infrastructure Stimulus Fund (2009-2010) (Infrastructure Canada, 2009) and $14 billion New Building Canada Fund (2014-2024) (Infrastructure Canada, 2016). More recently, the Government of Canada announced $2 billion for water and wastewater projects through the Clean Water and Wastewater Fund and over $20 billion in funding for green infrastructure initiatives (Government of Canada, 2017; Infrastructure Canada, 2017). Utilities can also apply to the $550 million Green Municipal Fund administered by the Federation of Canadian Municipalities, which provides a combination of grants and low-interest loans to support initiatives that improve air, water and soil or mitigate the impacts of climate change (see Reserves and Debts on page 26).

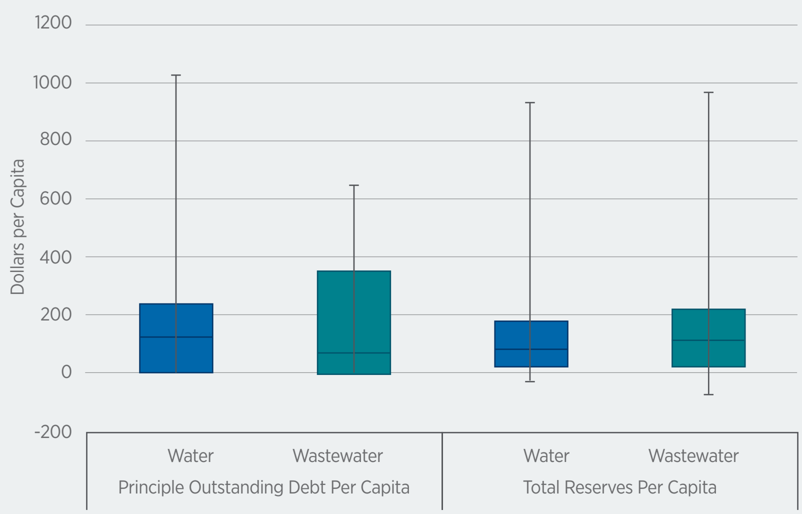
Government grant programs provide an important source of capital to accelerate the ability of utilities to improve their operations and move to more sustainable systems. However, an over-reliance on these programs in the past as a way to make financial ends meet may have impeded the structural changes needed to achieve full cost recovery (Ministry of Public Infrastructure Renewal, 2005, p. 50). For those utilities with the capacity to develop more financially sustainable systems, there is a desire to see more predictable and reliable government funding, as well as grant programs that reward movement towards more sustainable operations rather than perpetuating unsustainable ones. There are certain instances, such as small, rural and remote communities where the cost of services exceed users' capacity to pay, where there is a need for government subsidies, at least in the short-term (Canada's Ecofiscal Commission, 2017). There may also be a need to restructure or regionalize services (Ministry of Public Infrastructure Renewal, 2005).

Financing Approaches

Reserves and debt

Revenue is generated annually through a variety of means to support costs, but utilities also use other financial tools to manage the inevitable variability in year-over-year spending, particularly with regard to large capital expenditures. Water utilities have three options when it comes to planning for future expenditures: save now (i.e., create cash reserves from user fees), pay as you go (using cash reserves and other revenue sources), or borrow and pay back over time (i.e., debt financing). Depending on its financial state and the type and terms of a capital project, the utility will need to determine whether financing through debt or use of cash reserves provides the most benefit for financial sustainability and intergenerational equity.

Figure 8, which compares the per capita debt of NWWBI water and wastewater utilities versus the total amount of reserves held, illustrates the range of per capita debt and monies held in reserve by Canadian utilities. When a utility decides to save for future expenditures, then a portion of that year's revenue is held in reserve to cover future costs. If the funds held in reserve are insufficient to cover large or unexpected expenses, additional resources are borrowed, which requires debt servicing and repayment in subsequent years. Debt financing can be a fair, efficient and justifiable approach because future users (who are the primary beneficiaries of the infrastructure and service enhancements) can contribute to covering the repayment through taxes and/or user fees (Slack, 2008). Ultimately, how financing is structured is a question of who will pay: the customer of today, the customer of tomorrow, or a combination of the two.



Boxes bound the 25th to 75th percentiles. The line in the middle of the boxes represents the median value. Whiskers span the full range of the data.

FIGURE 8: Boxplots of principal outstanding debt per capita and total reserves per capita for 41 water and 42 wastewater utilities from 2011-2013

Data source: NWWBI Database

Debt financing is used for large capital investment projects where costs are spread over many years. Funding for these large, multi-year projects is typically obtained through financial institutions at negotiated interest rates or through federal or provincial loans. The terms are usually aligned with the lifecycle of the asset to ensure that repayment is spread out over the life of the asset and current taxpayers are not bearing the majority of costs (Hanniman, 2013). Utilities derive benefit from financing when interest rates are low, but the amount and type of borrowing and the conditions governing the process are usually directed by provincial rules (FCM, 2006). Utilities are exposed to risk if they borrow too much and undertake too many initiatives, which could become financially unmanageable if economic conditions change and interest rates rise (Hughes et al., 2014). However, the interest costs and risk should be weighed against the cost of delaying infrastructure investments (e.g., higher O&M costs or lower level of service) while building up reserves (Ministry of Public Infrastructure Renewal, 2005).

Unlike debt, when reserves are collected and applied to future infrastructure, the project is financed by current (and past) users, despite the fact that they may not benefit from this investment for most of the new asset's lifecycle. Nevertheless, reserve funds can help mitigate risk, manage debt levels, stabilize rates, cover unexpected expenses or liabilities and provide contingency funds when revenues fluctuate (BMA Management Consulting, n.d.; Hanniman, 2013). The most common types of reserve funds used by water utilities are operating/contingency funds, capital project funds and those that are created through the accumulation of development charges. Rate stabilization and debt service are other potential reserve fund options (BMA Management Consulting, n.d.; Hanniman, 2013). It can take many years to accumulate sufficient funds for large capital projects such as a new water treatment plant. Some municipalities have found that the perception that reserves are "overly healthy" has led to funds being allocated for other purposes, or has made it difficult to justify rate increases (Ministry of Public Infrastructure Renewal, 2005).

Utility Financial Health

The financial health of a utility is an important consideration when determining the most appropriate financing strategy for new infrastructure projects (i.e., debt servicing, building reserves or pay-as-you-go). There are a number of accepted measurements that indicate a utility's financial health, including targets and performance ratios, reserve targets, total reserves/total O&M cost ratio, total reserves/total asset replacement value, debt service coverage ratio and operating ratio.

The Government Finance Officers Association recommends that utilities maintain a minimum level of reserves, which should be determined based on existing financial commitments and the level of financial risk the utility can manage (Government Finance Officers Association [GFOA], n.d.). Most of the utilities reporting to the NWWBI maintain some form of reserve. For example, over 70% of 49 water and 48 wastewater utilities between 2011 and 2013 had some kind of reserve (i.e., an operating reserve, capital reserve, "other" reserve or a combination of the three). In NWWBI survey results from 18 utilities in 2016, all utilities except one reported that they maintained separate reserve funds specifically for water or wastewater systems that were separate from other municipal reserves. Defined reserve targets such as those identified by the AWWA (Table 1) can help utilities allocate or reallocate funds as needed. The number of water and wastewater utilities who reported reserves to the NWWBI that were above or below typical operating or capital reserve targets is presented in Table 2.

Type of Reserve	*Typical Practice*
Operating/Working Capital	Target dependent on the utility's financial status and cash flow. However, many utilities try to maintain sufficient cash on hand to cover 45-days operating and maintenance expenses (i.e., 12.5% of annual operating and maintenance costs).
Capital	Minimum balance of 1 - 2% of the value of assets or a rolling average of planned capital expenses.
Contingency Fund	Target the replacement cost of the most expensive asset (less any potential insurance payments), or develop a reserve target based on previous experience with unexpected events.
Debt Reserves	Targets can be set based on an amount equal to the lesser of the maximum annual debt service on outstanding bonds, or 120% of the total annual debt service or 10% of the bond issue amount.

TABLE 1: Typical industry targets for maintaining reserves

Source: AWWA (2016a)

Type of Reserve	*Reserve Amount*[1]	*# of Water Utilities*[2]			*# of Wastewater Utilities*[2]		
		Year			**Year**		
		2011	**2012**	**2013**	**2011**	**2012**	**2013**
Operating Reserve	≥12.5% of annual operating and maintenance expenses[3]	12	11	9	8	11	8
	<12.5% of annual operating and maintenance expenses[3]	2	1	2	7	10	14
Capital Reserve	≥1% of the total replacement value of assets[4]	0	14	17	12	15	15
	<1% of the total replacement value of assets[4]	0	8	4	5	11	13

TABLE 2: **Number of water and wastewater utilities above and below suggested AWWA operating and capital reserve targets**

1. *Target value based from AWWA (2016a)*
2. *Data source: NWWBI Database*
3. *Calculated from reported operating reserve values and the total water/wastewater operating cost. Targets could only be calculated for the subset of reporting utilities that provided both these values.*
4. *Calculated from reported capital reserve values and the total replacement value of the distribution and treatment system (water) or the total replacement value of the collection and treatment plant (wastewater). Targets could only be calculated for the subset of reporting utilities that provided these values.*

Despite the widespread practice of maintaining reserves, not all utilities have clearly defined targets for their reserves. In the 2016 survey results, for example, only 11 of 18 utilities reported that they had established reserve targets. Nevertheless, a majority of drinking water utilities who reported reserves to NWWBI between 2011 and 2013 had operating and capital reserves at or above typical target levels. While utility-specific considerations contribute to what the ideal target reserve level might be for a given utility, this generally suggests that these water utilities had the ability to buffer against fluctuations in revenues or expenditures and capital project costs or needs. However, trends for wastewater utilities were different: mixed numbers of wastewater utilities had operating and capital reserves above and below AWWA targets, implying that reserves were either being actively drawn upon or that there may be additional opportunities to consider increasing reserves at some utilities to buffer against unanticipated costs.

Debt servicing is another indicator of financial health and refers to having sufficient funds to cover payment of the interest and principal on debt over a given period. Debt service coverage ratio is a comprehensive indicator of financial sustainability, as it is used to gauge a utility's ability to cover debt payments on time using existing annual revenue. This is calculated as the ratio of annual net revenue (i.e., revenue minus essential operating costs like salaries, energy and chemicals) divided by debt service payments (AWWA, 2016a). Minimum debt service coverage ratios are often specified when debt is taken on, with minimum ratios typically between 1.1 and 1.3. The AWWA recommends that utilities consider targeting ratios above the minimum to ensure financial stability (AWWA, 2016a). For most of the utilities reporting to the NWWBI from 2011 - 2013, the debt service coverage ratio was well above 1.5, which suggests that they are in a good financial position to make debt payments.

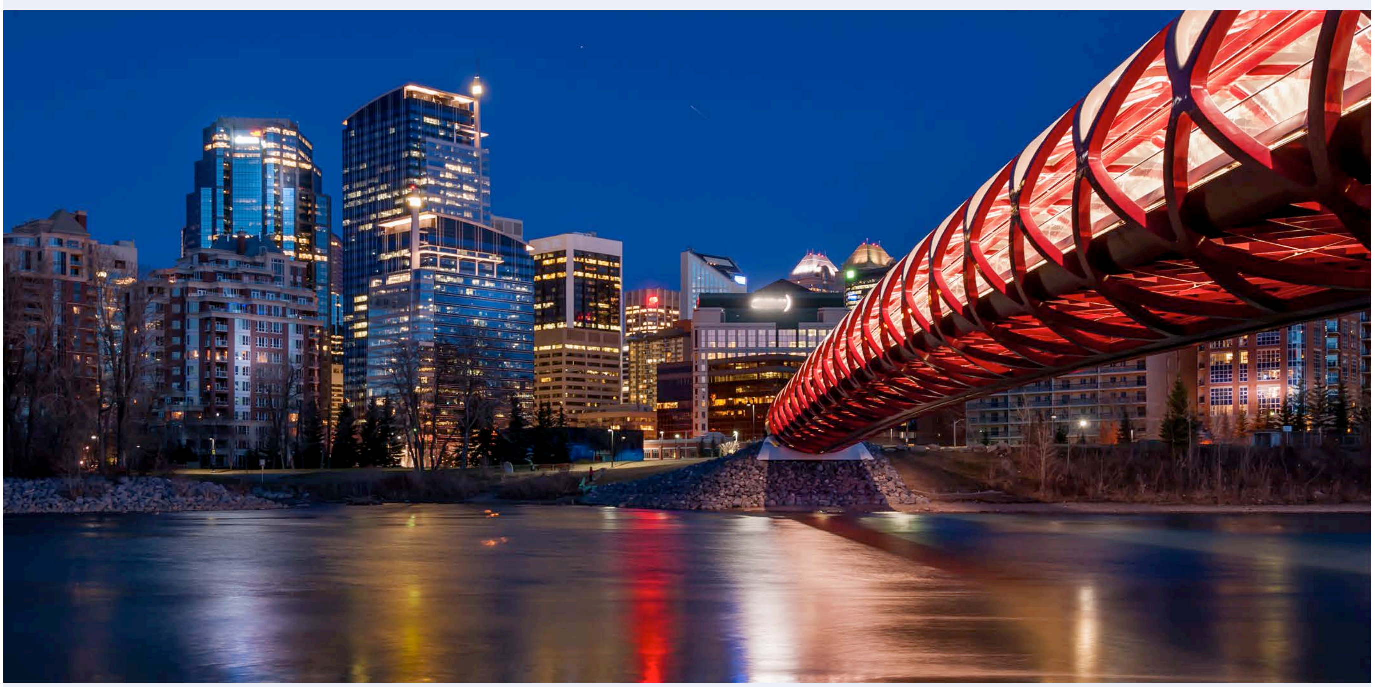
Operating ratio compares annual costs versus revenue. Operating ratios less than one indicate that a utility's current revenue is sufficient to cover operating expenses, contribute to reserves and service debt. Ratios very close to one indicate limited latitude to incur higher costs or buffer against revenue losses, and ratios above one indicate unsustainability. The median values reported for utilities reporting to the NWWBI from 2011-2013 are below 0.5, and the vast majority of water and wastewater utilities had values less than 1, which suggests that the majority are collecting sufficient revenues to offset their annual operating costs. However, like other indicators that measure annual spending, the operating ratio by itself is not a good predictor of longer-term financial performance and does not assess whether preventative maintenance and capital upgrades are occurring. Healthy operating ratios in the absence of appropriate reinvestment may be misleading since actions that would contribute to greater financial stability are deferred into the future.

Calgary's risk management approach to debt financing of capital intensive projects

Having a financial plan and maintaining compliance for Calgary's water and wastewater lines of service will ensure a financially sustainable future for the services they provide, while also mitigating financial risks due to unexpected economic changes and financial pressure due to changes in the pace of growth.

To support the utilities' goals of financial sustainability, as well as fairness and equity to customers, debt financing is used for capital projects that are substantial in cost and size and where the benefits will extend over a relatively long period. Debt financing achieves intergenerational equity for the rate payers who benefit from these capital assets. The debt from capital-intensive water and wastewater services contributes to the City debt levels and includes subject limits for the utilities specifically, as well as The City of Calgary, as a corporation.

Committed to appropriate measures for mitigating financial risk, a financial review of the water and wastewater utilities was completed by a utility sector financial consultant. The review focused on the magnitude of financial risk in the business, and examined the business financial plan — a series of policies, measures and targets for adequacy and consistency with utility best practices. The current proposed financial plan responds to recommended changes, including the replacement of a fixed debt ceiling with a debt service coverage ratio and associated target to effectively manage the utility's level of debt. A new target tied to days of annual operating expenditures for the sustainment reserve has also been proposed. This reserve balance will provide the utilities with cash reserves for normal operating expenditure and help manage contingencies in revenue fluctuation. Coupling that with managing debt capacity through debt service coverage ratio means that these services will be better able to sustain short-term increases in operating and capital requirements.



Public-Private Partnerships

Public-private partnerships (also known as PPP or P3s) are collaborations between a government agency and a private sector entity to deliver public infrastructure or public services. The structure of a P3 depends on the type of project, the requirements of the government agency and the expertise of the private sector entity. In the water industry, P3s have included design-build-finance (DBF), design-build-finance-operate (DBFO) and design-build-finance-operate-maintain (DBFOM) contracts for infrastructure projects (PPP Canada, 2013). The length of these partnerships can range from a few years for DBF projects, to as long as 20 to 30 years for DBFOM agreements. The ownership of assets is not transferred to the private entity and remains with the government agency.

There are numerous reasons why P3s may be of interest to municipalities in the context of financial sustainability (e.g., The Canadian Council for Public Private Partnerships, 2001; PPP Canada, 2013), including:

- Access to global private sector expertise and efficiency
- Potential cost savings and increased value for money (e.g., via lifecycle analyses)
- Transfer of financial, technical and operational risks and accountabilities
- Opportunities to implement new technologies and innovation
- Ability to establish clear milestones and lines of accountability

Given some of these benefits, P3s can also be used to help provide project delivery, operations and maintenance for utilities that may lack human and financial resources, such as small or First Nations communities.

A number of municipalities across Canada are involved in P3 arrangements. Table 3 highlights some examples.

Owner	Project	Procurement Model	Current Status
City of Regina	Upgrade to wastewater treatment plant	Design-Build-Finance-Operate-Maintain (DBFOM)	in service
City of Saint John	New water treatment plant and water system improvements	DBFOM	under construction
Alberta Infrastructure	New water and wastewater treatment plants	DBFOM	in service
City of Hamilton	New biosolids processing facility	DBFOM	under construction
Capital Regional District (Victoria)	New biosolids processing facility	DBFOM	design
Metro Vancouver	New wastewater treatment plant	Design-Build-Finance	under construction
Capital Regional District	New wastewater treatment plant	Design-Build	under construction
City of Sudbury	New biosolids processing facility	DBFOM	in service
City of Calgary	New organic waste and biosolids composting facility	DBFOM	in service

TABLE 3: Examples of P3s in Canada

Source: C. Baisley, Director, Infrastructure Advisory, Deloitte, personal communication, February 9, 2018

According to PPP Canada, projects that are best suited to a public-private partnership have significant value for money, long-term demand for the asset (at least 20 – 30 years), opportunities to minimize lifecycle costs through improved or innovative operations, and the ability to quantitatively assess performance. The terms, expectations and costs of the project are predetermined for the length of the contract. Responsibilities for operation and maintenance are also transferred to a third party under pre-established performance metrics, which may be attractive for utilities looking to add greater certainty to their annual and long-term financial forecasting and for transferring some of the operational risks to a third party. Current challenges with P3s in Canada revolve around limited clarity in public accounting practices — including who controls the infrastructure asset, who accrues benefits and takes on liability, and how asset revenues and liability are measured. PSAB is working to fill this gap and establish accounting requirements for P3s (PSAB, 2017).

Public utilities generally have access to more affordable financing (i.e., low-interest rate loans) than private companies (Hamel, 2007); however, although a private entity's borrowing rates may exceed those of the public sector, a P3 may still provide better value because borrowing costs are only one of the cost components of an infrastructure project. For example, if design and construction costs are lower in a P3, total borrowing costs may still be lower than the public approach, even though the financing rate is higher and further savings may be realized in operations, maintenance and renewal costs. When considering a P3, the value for money assessment typically done by procuring agencies assesses long-term all-in costs and explores whether a P3 would, on balance, offer value. The vested interest of the private entity, investor monitoring, clear lines of accountability and payment based on project milestones also help to ensure that projects stay on time and on budget (InterVISTAS, 2014; PPP Canada, 2013; The Canadian Council for Public Private Partnerships, n.d.-b). When comparing P3 and traditional approaches in Ontario, a risk premium is included for the risks of exceeding costs, construction delays and fluctuations in future revenue. Accurately pricing these risks is difficult, which means that there is the potential to overestimate how much risk is actually transferred (Siemiatycki & Farooqi, 2012).

Photo Credit: AECOM

The terms of a P3 arrangement are critical for maximizing benefits for all partners (Deloitte, 2014). Structured agreements that can be properly executed (Deloitte, 2014) and retention of a level of oversight and control by municipalities are critical, particularly on key aspects such as user fees and coordination of services. Other factors for success include clearly stipulated performance requirements (Public-Private-Partnership in Infrastructure Resource Center [PPIRC], 2011), a comprehensive and competitive procurement process, and contract terms where risks are shared rather than fully transferred. P3 Canada has developed a Business Case Development Guide to help minimize project risks and increase the likelihood of success. In developing a business case, applicants consider a range of infrastructure project delivery models to arrive at the model which provides optimal value for money and public benefit for taxpayers and stakeholders (PPP Canada, 2016).

Public-Private Partnerships in Saskatchewan

A number of projects have recently been delivered in Saskatchewan using public-private partnerships (P3s), including one in the water sector in the City of Regina. A City by-law identifies key criteria that must be considered when determining suitability, the type of assessments required, and a procurement and decision-making process (The Regina Administration By-law, 2016). The assessments include screening to ensure the proposed project aligns with City principles and priorities, as well as considering the value in transferring or sharing risks, costs, innovation, quality, affordability and transparency. A strategic assessment of lifecycle risks and lifecycle costs is also be carried out, as well as a value for money assessment which compares the risk-adjusted P3 costs to the risk-adjusted costs of a traditional approach.

In 2016, the City unveiled its upgraded Regina Wastewater Treatment Plant, which was completed under-budget and on time (Water Canada, 2016). This upgrade increased plant capacity, updated areas of the plant that had reached the end of their service life, and included the construction of a new advanced treatment process that significantly reduced ammonia, nitrogen and phosphorus. The project proceeded using the design-build-finance-operate-maintain (DBFOM) P3 model. Following a competitive bidding process, a contract was executed between the City of Regina and EPCOR in July, 2014. The contract was for a 30-year term and required that EPCOR be responsible for operation, maintenance and reinvestment for asset renewal of the facility, both during the initial construction and commissioning phase, as well as for the rest of the term. This approach provides the City with cost certainty for the duration of the term. At the end of the 30-year term, EPCOR will hand back the running of the plant to the City in accordance with stringent handback criteria, which dictate the minimum acceptable condition of the assets using agreed protocols. The City of Regina remains the owner of the facility throughout the term and is responsible for establishing sewer rates and billing water customers.

The P3 approach and DBFOM model were selected following an initial screening and a strategic assessment to identify objectives, risks and project constraints. Rather than simply focus on the design and construction aspects of the project, the assessment was more holistic and included up-front planning and procurement risks and long-term operation and maintenance risks, including those related to the attraction and retention of qualified treatment plant operations staff. A value for money assessment was also conducted to quantify risks and compare the costs with a traditional design-bid-build (DBB) approach. The overall assessment found that the P3 approach would result in savings of $138 million, based on the net present value as compared to a traditional DBB (Deloitte, 2014). Furthermore, due to the scale and complexity of the upgrades, the alternative to the traditional DBB would allow for better use of the City's resources on other projects and reduce potential delays.

The City's capital cost budget (design and construction costs plus City costs) was $224.3 million, with a grant of up to $58.5 million from PPP Canada. The DBFOM procurement was highly competitive, and savings were even greater than anticipated in the value for money business case evaluation. The actual capital cost was reduced to $180.8 million, saving $43.5 million. A consequence of this capital cost reduction was that the grant from PPP Canada was reduced to $48.2 million (Sjorberg & Davies, 2014). An additional $6 million of savings were realized at the end of the construction phase from unused City risk contingency (City of Regina, 2016).

Although the City paid a premium for capital financing costs and risk transfer, other expenses were reduced due to a competitive procurement process, efficient construction, the transfer of risks to the private sector and external financial support (City of Regina, n.d.-b). The City also benefited from the private sector partners' expertise for the design of the treatment system. Financial penalties were established to ensure that milestones and performance standards were being achieved and that any cost overruns due to construction delays were shouldered by the contractor. This model was the most cost-effective option available at the time and would have realized savings even without contributed funding from PPP Canada.

Equity and Affordability

There are many different dimensions of equity, including equity between customers, generations and income groups (OECD, 2003). In this report, equity refers to the fair allocation of costs based on system use, while affordability refers to paying the same proportion of income on basic water services. Achieving equity is ultimately about transferring the proportionate cost to those who use or benefit from the service. Charging customers based on their use of services or costs to the system ensures that they pay their fair share. However, longer-term costs like infrastructure investment and renewal need to be distributed across generations, and current system users and managers will impact the future economic landscape through environmental and fiscal sustainability practices. Most utilities are not required to consider equity in cost recovery, but it is viewed as an industry best practice and some provincial legislation exists (AWE, 2014a; AWWA, 2012; Bonbright et al., 1988). For example, Halifax Water, in conformance with the Public Utilities Act of Nova Scotia, must adhere to cost causation principles and the rule of intergenerational equity to cover its capital and operating costs (Yates, 2015).

EQUITY AMONG CUSTOMER CLASSES

AWWA's M1 manual, *Principles of Water Rates, Fees and Charges*, recommends an approach for determining the cost of services for different customer classes to support equity and revenue stability (AWWA, 2012). The Bonbright principles for rate design state that similar users should be treated similarly (horizontal equity) and dissimilar users should be treated differently (vertical equity) (AWE, 2014a; Bonbright et al., 1988). Because the cost responsibility for individual customers is generally not available, utilities establish classes of customers based on similar water use characteristics or unique service requirements (AWWA, 2012; Hughes et al., 2014). Residential, commercial and industrial classes can be further customized based on unique usage characteristics (e.g., large industrial users with low wastewater discharge, universities or hospitals, or low-income households) (AWWA, 2012). In Canada, however, utilities have typically not evolved to billing a sophisticated breakdown of customer classes, and the majority of utilities in the NWWBI database do not differentiate between customer classes for billing.

In addition to identifying and assigning different fees and charges to customer classes, equitable pricing can also be achieved through rate structures where different blocks target specific user groups based on their usage (see City of London case study on page 21). Rate design using cost causation principles supports equity among users, but some municipalities may also choose to subsidize specific water users (e.g., a low-cost minimum volume charge to meet basic household needs or low rates for industrial users to promote economic development) (AWE, 2014a).

INTERGENERATIONAL EQUITY

It is also important to consider which generation is receiving the service and which is paying. Full cost recovery includes future asset renewal (e.g., lifecycle costs), system upgrades, growth, environmental and resource protection, and future uncertainty which may happen over multiple decades. Capturing some of the anticipated future costs in rates and building up reserves means that future users will benefit from past investment. Incurring debt to pay for upgrades used by current users better aligns with cost of service principles if this practice is used consistently. Balancing who pays for debt servicing can also be used to achieve intergenerational equity by distributing the costs of infrastructure renewals and new investments over multiple decades (see Reserves and Debts on page 26).

The predominant practice in growing municipalities is that growth pays for growth, and existing users do not pay for infrastructure that will be used in the future by the users of growth areas (see Development Charges on page 22). However, in practice, it can be difficult to recover all costs associated with growth, such as required incremental upgrades elsewhere in the system and interim operating and maintenance costs (Watson & Associates Economists Limited & Dillon Consulting, 2012). Alternatively, another dimension of intergenerational equity is ensuring that an economic burden is not being unduly placed on future generations. Examples include the depletion of water sources in quality or quantity (OECD, 2003) or making infrastructure investment decisions that will negatively impact future generations.

AFFORDABILITY PROGRAMS

Increasing rates to achieve cost of service equity can have significant impacts on low-income households. This is particularly true where flat or uniform rates are employed, as low-income households ultimately shoulder a higher proportion of rate increase relative to their household income. Water-related costs can represent more than 4% of expenditures in low-income households earning less than $20,000 per year, which is ten times the amount for high-income families in Canada earning more than $100,000 per year (Bodimeade & Renzetti, 2013). Low-income households may also have a higher number of residents per household, leading to water use that exceeds the average consumption of a residential home. They are also generally not able to afford the installation of water-efficient fixtures that could lower water use.

Currently, there is no standard measure in Canada for determining whether water rates are affordable for all segments of the population (Strategic Alternatives, 2006). Affordability can be calculated or defined in different ways, but most often it is calculated as a ratio of cost to median household income (MHI). For water services, the threshold of a community's relative affordability is 2.5% of the MHI, and for combined water and wastewater services it is 4.5% of MHI (EUM Utility Leadership Group, 2017; Hughes et al., 2014; Stratus Consulting, 2013).

An NWWBI survey of 18 utilities in 2016 investigated what actions were being taken to address affordability. The survey found that the most common response was to extend the timeline of bill payment, which does not fundamentally address the root issue of affordability. Other actions the utilities reported include a one-time bill credit, special billing arrangements and referral to social agencies. Options that may be available to utilities are income-related discounts, subsidizing the installation of water-efficient fixtures in low-income households (Hughes et al., 2014) or using rate design to achieve affordability, like offering a lifeline rate (i.e., minimum volume at low cost). An important consideration for utilities is whether to subsidize the use of water or the user (Fenn & Kitchen, 2016). It should also be noted that some jurisdictions in Canada prohibit affordability programs in rate design. This does not mean that there is no role for the utility to play in supporting low-income households, but it would require discussion with other levels of government and social agencies.

Water Affordability Programs in Halifax, London and Philadelphia

Halifax Water, which is a regulated utility, does not have an explicit social mandate to fund affordability programs, but their Help to Others (H2O) program taps into an unregulated revenue stream funded by Halifax Water and its employees. The program, which is administered by the Salvation Army, provides up to $250 to low-income homeowners every two years for water, wastewater and stormwater payments (Halifax Water, n.d.-a).

The City of London adds a 25¢ fee to all single-family residential customer bills to fund its customer assistance program, which assists with bill payments and funds to install water-efficient fixtures (City of London, n.d.).

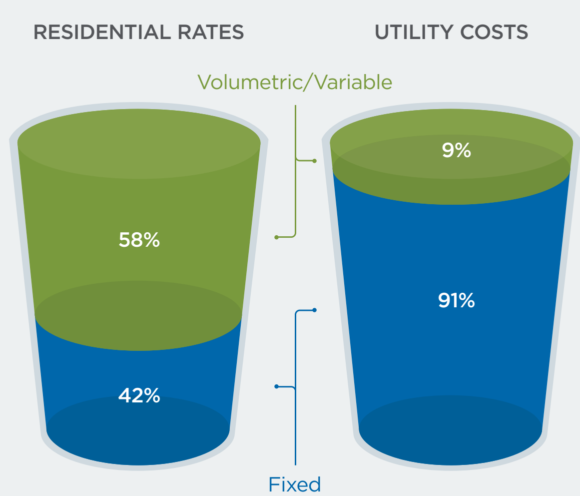
The City of Philadelphia has developed an income-based water rate based on U.S. federal poverty line guidelines. Qualifying households are not billed based on consumption, but as a percentage of their monthly income (2-3%), where the minimum bill is $12 US/month (Walton, 2017). A notable feature of this program is that households do not have to be the home-owner, enabling greater participation.

CHALLENGES TO ACHIEVING FINANCIALLY SUSTAINABLE WATER SYSTEMS

Impact of changing water use on utility revenue

In Canada, as elsewhere, there is a mismatch between fixed water system costs and rates based predominantly on variable (volumetric) water use. The core costs for providing water and wastewater services are fixed in the 'short-term' — requiring investment in basic infrastructure and customer service (e.g. pipes, pumps, treatment plants, billing, etc.), irrespective of the amount of water consumed or disposed of on a daily basis. For most utilities, the bulk of revenue is generated through water sales, so if usage decreases, revenues also drop. Encouraging conservation to reduce environmental impacts and utility costs can result in an overall decline in revenues (CWN, 2014). For 31 water and wastewater utilities reporting to the NWWBI, more than 50% of revenue is from volumetric rates, while only 10% of costs are related to volumetric use (Figure 9). Any drop in water use causes a decline in revenue, and with certain rate structures, conservation by high volume industrial users can significantly impact revenue. Rates that rely too heavily on usage can result in revenue instability if potential declines are not accounted for adequately. Not surprisingly, utilities in the NWWBI database list loss of revenue due to declining usage as their top economic concern.

Despite a popular narrative of wasteful water use in Canada, household water consumption has steadily declined over the last decade. There was an average decrease in single-family household water use of 12% between 2009 to 2013 for the 12 utilities that provided this data to NWWBI at the beginning and end of this time period. The annual cost per household increased over this same period, in part due to inflation and increased energy costs, but also due to rates being raised to offset revenue loss. However, simply relying on fixed rates to solve this problem can weaken price signals and customer control of household expenses and also impact equity and affordability (Beecher, 2017). Despite the fact that short-term impacts of reduced revenues resulting from effective conservation and peak flow management will likely be mitigated in the long-run by reduced capital expenditures on capacity expansions, a period of financial mismatch needs to be managed (AWE, 2014a). It is likely that this declining usage trend will continue and that adjustments will be needed when forecasting demand, planning infrastructure and designing rates.



Calculated assuming:

Single-family homes: 20m³/ month, 16mm meter

Utility costs: Variable costs – chemicals and energy use

Fixed costs: Total annual expenditure minus variable costs

FIGURE 9: Comparison of single-family household rates to utility costs for 31 utilities in 2013

Data source: NWWBI database

Historic underinvestment in infrastructure

A significant challenge to full cost recovery and financial sustainability continues to be the substantial investment needed for repairs and upgrades to Canada's infrastructure. Much of our current infrastructure was built shortly after World War II and is approaching the end of its lifecycle. Several studies have sought to define the scope of this problem and estimate the financial implications. For example, the 2016 Canadian Infrastructure Report Card reports that nearly 29%, 35% and 23% of potable water, wastewater and stormwater assets are in a condition that warrants attention, with a replacement cost of approximately $173 billion (Canadian Construction Association [CCA] et al., 2016).

The Canadian Infrastructure Report Card also reports that reinvestment rates (on average) for linear and non-linear water and wastewater infrastructure are below targets recommended by asset management practitioners (CCA et al., 2016). An analysis of the NWWBI database supports this finding (Figure 10). Of 22 utilities reporting to the NWWBI in 2014, a majority spent more than half of all maintenance hours performing emergency and urgent repairs. The practice of deferring preventative maintenance, repairs and upgrades is often used to limit short-term costs but has contributed to escalating costs over the long-term and more frequent infrastructure failure. Reactively addressing repairs and replacements is more expensive than maintaining infrastructure proactively, and studies show that the longer investment is delayed, the costlier it becomes to upgrade or replace assets (AWE, 2014a; Fenn & Kitchen, 2016). According to the 2016 Canadian Infrastructure Report Card, every $1 spent on preventative or routine maintenance done on assets in "fair" condition could eliminate or defer approximately $6 to $10 of future spending on rehabilitation/reconstruction.

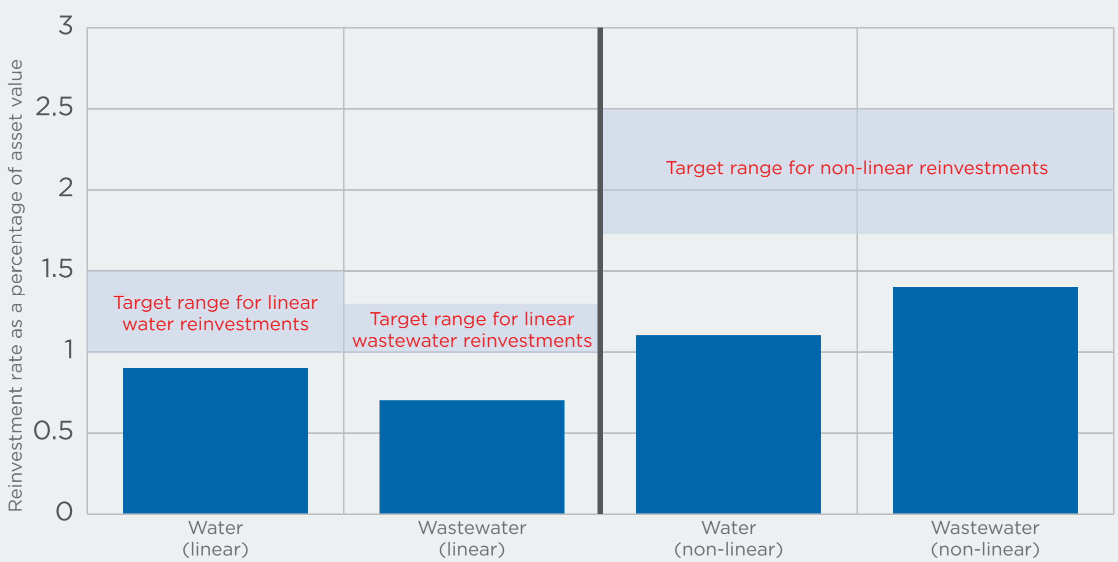


FIGURE 10: Reinvestment rates in 2016 for water and wastewater assets in 22 utilities are below targets recommended by the Canadian Infrastructure Report Card

Data sources: NWWBI database and CCA et al. (2016)

The high cost of unpredictable events

Costs associated with unexpected events or events that exceed typical contingencies are difficult to predict and quantify. Most of Canada's current infrastructure was not designed for the more frequent and intense rainfall, flooding, drought, wildfires, ice storms and fluctuating temperatures we have been experiencing in the last decade. The Insurance Bureau of Canada (IBC) has reported that insurance claim pay-outs due to catastrophic events reached $602 million for 2015, and topped $1 billion for each of the six preceding years, with a record of $3.6 billion for 2013 (IBC, 2016). It is clear that responding to extreme events and building more resilient infrastructure will be very costly. However, the relative roles and responsibilities of utilities, homeowners, the insurance industry, and federal and provincial governments are much less clear.

Basement flooding is one of the leading reasons for insurance pay-outs, with an estimated value of $1.7 billion per year across Canada (Zizzo Allan Demarco et al., n.d.). Municipalities are authorized to manage urban water infrastructure and service delivery. This authority, however, brings with it the risk of potential liability for infrastructure failure that impacts private property and public health due to flooding, contamination, etc. For example, the City of Thunder Bay received a court order to provide compensation due to negligence in their standard of care because they did not enforce downspout disconnections, which contributed to basement flooding (Credit Valley Conservation [CVC], n.d.). Upcoming regulation requiring asset management in Ontario will likely help mitigate some liability risks for municipalities associated with the failure of aging infrastructure. However, there is currently limited regulatory guidance on best practices or requirements for adapting to climate change, despite the potentially high consequences for municipalities.

Rising energy costs

Water and wastewater systems are energy-intensive and are typically a municipality's largest single energy user. For example, energy use for water and wastewater systems in Ontario in 2011 was 38% of total municipal energy consumption (Environmental Commissioner of Ontario [ECO], 2017). The City of Toronto used 2,365,751 Gigajoules of energy in 2014 for its water and wastewater processes, which represented more than 41% of the total energy consumed by all City facilities that year (City of Toronto, 2014). This energy use is equivalent to 10% of the energy demand for the entire province of Prince Edward Island in 2016 (Statistics Canada, 2017). In many American municipalities, energy use accounts for as much as 40% of the operating costs of drinking water treatment plants (United States Environmental Protection Agency [USEPA], n.d.). It has further been estimated that 25% to 60% of wastewater treatment operating costs are related to energy consumption (Wallis-Lage, 2013). Canadian utilities are likely similar in their energy use, depending on local topography and treatment technologies.

Changes in energy prices can have a substantial impact on utility costs. In Ontario, residential electricity rates from 2006 to 2016 increased between 71 and 149%, depending on time-of-day usage (TOU) (Figure 12) (Ontario Energy Board, n.d.). In Alberta, a regulated electricity rate is recalculated and set monthly by the Alberta Utility Commission (AUC), which can result in dramatic fluctuations on a monthly basis (Figure 12) ("Regulated Rate Option (RRO)," n.d.). Unpredictable energy costs make it challenging to set annual water rates to recoup costs.

Future energy costs are also expected to rise due to increasingly stringent treatment standards and decreased quality of water sources as a result of urbanization and changing water quality due to climate change. The new federal Wastewater Systems Effluent Regulations require wastewater effluent to meet standards equivalent to secondary treatment (Environment and Climate Change Canada [ECCC], 2017). Activated sludge aeration, which conventionally is part of this treatment, is an energy-intensive process that may represent more than 50% of a treatment plant's total energy use (Tchobanoglous et al., 2014).

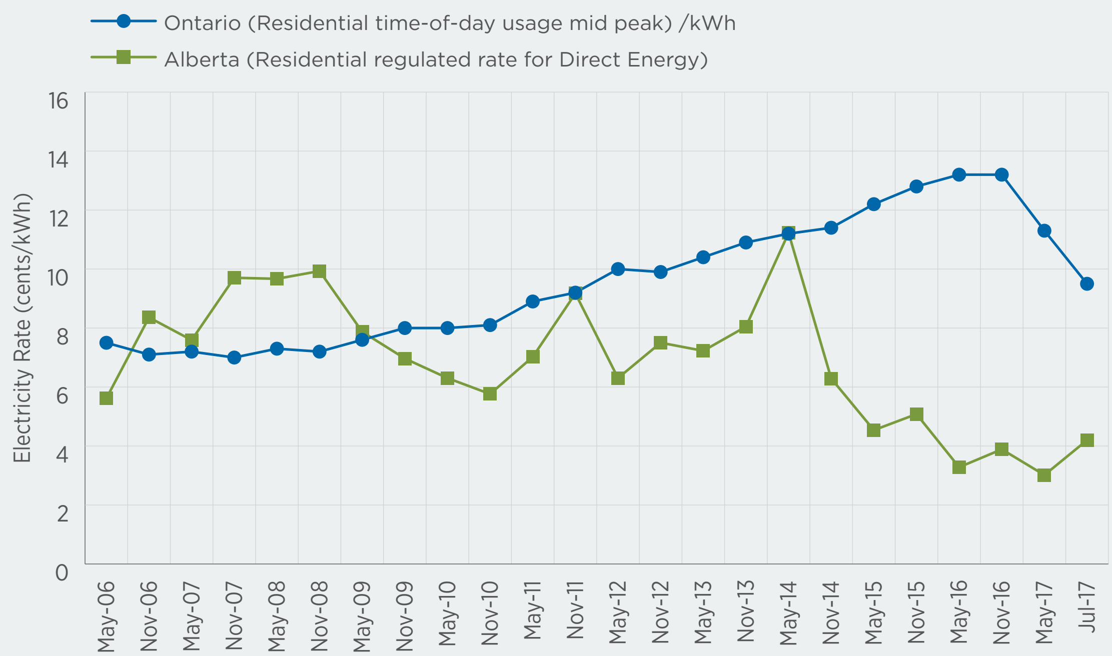


FIGURE 12: **Fluctuating electricity rates in Ontario and Alberta from 2006 to 2017**
Source: Ontario Energy Board historical electricity rates (Ontario Energy Board, n.d.) and (Alberta Utility Commission, n.d.-a, n.d.-b)

Limited system information and asset management planning

With the vast network of pipes, pumps and treatment facilities required for water and wastewater systems, a significant amount of infrastructure needs to be monitored, maintained and replaced. Without good data feeding back into financial planning, utilities are limited in the actions they can take to ensure safe, consistent and sustainable operations. Proper management of any asset is critical to ensure infrastructure is able to function efficiently and effectively over its lifecycle. However, in the case of water management, the majority of infrastructure is buried underground and hidden from sight. Early detection of issues may not always be possible, and system vulnerabilities are often brought to light after failure has occurred.

Good data, combined with accurate replacement costs and risk assessment, empowers utilities to do the right thing, to the right asset, at the right time — which ultimately reduces costs. Moving away from corrective or reactive maintenance toward preventative and proactive maintenance, a legacy challenge given historic underinvestment, requires adequate system information and asset management plans. Asset management plans aim to define and maintain levels of service, identify and minimize lifecycle costs, and make plans for asset replacement. However, Canadian utilities are not using asset management planning and system usage data to full advantage. Asset management planning is becoming more widespread among larger utilities, but only 35% of smaller municipalities surveyed in the 2016 Canadian Infrastructure Report Card employ a formal program (CCA et al., 2016). Ontario is regulating and increasing standardization of asset management plans, which has brought the number of municipalities with some form of asset management plans up to 95% (Ontario Ministry of Infrastructure, 2016). However, it is still unclear how climate change and resiliency will be incorporated to identify and capture costs for full cost recovery.

Canadian utilities collect a wide range of data and apply this information in a variety of ways. However, one of the key barriers to developing reliable asset management plans remains a lack of accurate, current and relevant data in sufficient quantities (PSD, CWN, & CWWA, 2018; CVC, n.d.). In many cases, the application of asset data to improve utility operations, financing and long-term planning is still maturing. Organizations like the International Standards Organization have established some best practices, but there is currently no consistent set of Canadian performance benchmarks for comparison (Canada's Ecofiscal Commission, 2017). CWN has partnered with Public Sector Digest (PSD) to investigate the application of asset data in local decision-making and understand how Canadian utilities are using this data for long-term financial planning. Results from this study are available at cwn-rce.ca/asset-management.

Accurately measuring system usage is fundamental in designing and implementing appropriate user rates, ensuring pricing equity and ultimately recovering the costs of service. However, there are still utilities in Canada that do not meter water and system use. In 2011, Environment and Climate Change Canada reported that 72% of single-family households and 87% of commercial connections were metered, with a higher proportion of metering in larger urban centres compared to smaller communities (ECCC, 2011). Data from the 2014 NWWBI database also mirrors these statistics, with 82% of utilities metering multi-family, industrial and institutional connections, and 68% metering single-family connections. Overall, utilities are moving toward fully metered systems, and utilities reporting to the NWWBI steadily increased their metered connections over the last decade.

Gaps in provincial legislation

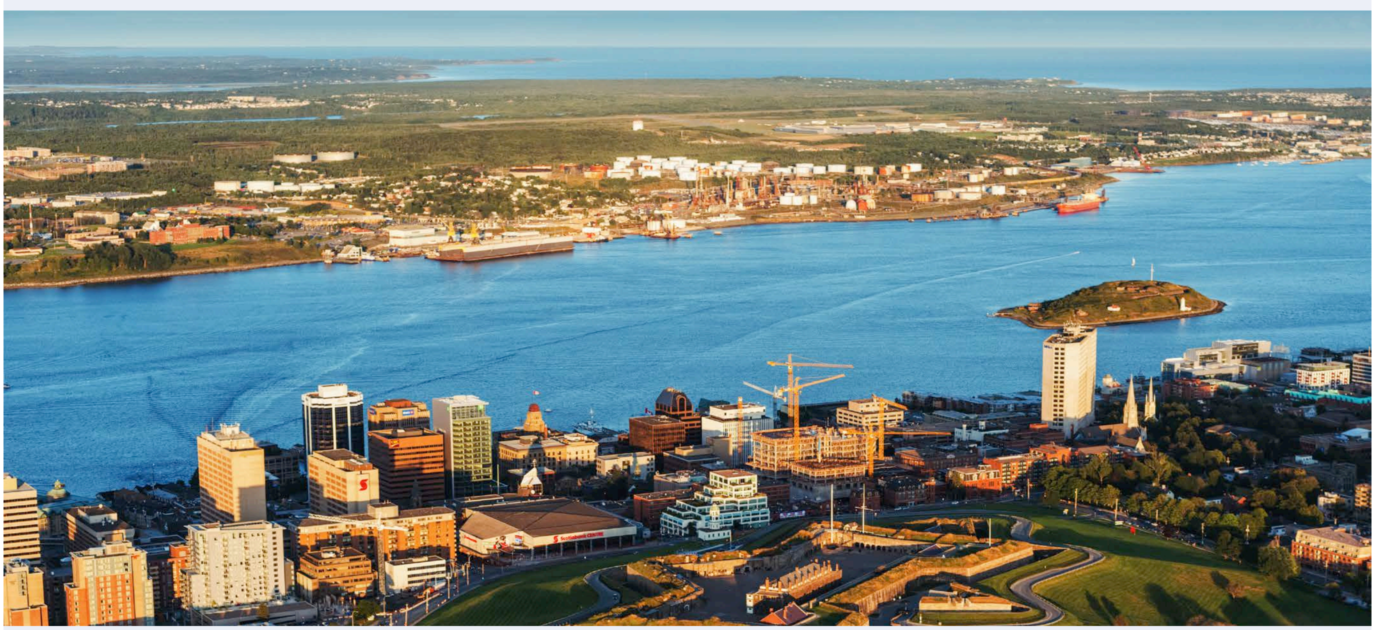
In Canada, much of the relevant legislation that sets out the requirements — and frames the opportunities — for water utilities occurs at the provincial level, although federal legislation also plays a role. In addition to protecting public and environmental health and ensuring safe operations, legislation can support the financial viability of utilities by ensuring that sufficient funding is available for the provision of water, wastewater and stormwater services. Provincial legislation in some parts of Canada encourages or supports financial viability through elements of full cost recovery, but generally there is little provincial legislation that mandates full cost recovery for drinking water, wastewater and stormwater services. Examples of related provincial legislation include:

- In Ontario, regulations under the Safe Drinking Water Act 2002 (Safe Drinking Water Act: O. Reg. 453/07, 2008) require financial plans that detail and project total revenues, total expenses, financial position, operations, surpluses/deficits and gross cash receipts of drinking water systems.
- Alberta Environment and Parks established a voluntary full cost accounting and reporting program for municipal drinking water facilities and provides several supporting documents to aid in the process (Alberta Environment and Parks [AEP], 2015).
- Saskatchewan indicates that utilities should base their fees on full cost recovery models (Government of Saskatchewan, n.d.). As a result, rates in Saskatoon and Regina are set to cover operations, capital projects and regulatory requirements (City of Regina, n.d.-a; City of Saskatoon, n.d.).
- Nova Scotia, Prince Edward Island, Manitoba, Saskatchewan and Alberta have regulatory agencies which approve rate adjustments, (see Halifax case study on page 40) (Canada's Ecofiscal Commission, 2017; CWN, 2015).

In comparison, the European Water Framework Directive (Council Directive 2000/60/EC, 2000) contains specific clauses that mandate cost recovery. Water prices must reflect operation, maintenance and investment costs, and also take into account environmental and resource costs associated with water use. Pricing must also encourage efficient water use and different water uses must contribute to the recovery of costs for water services to ensure that different sectors like agriculture and industry pay their fair share (Council Directive 2000/60/EC, 2000; EEA, 2013). However, although the Water Framework Directive was introduced in 2000, the degree of cost recovery has varied and "there is a lack of harmonized and operational concepts of cost recovery, and environmental and resource costs" among member states (EEA, 2013, p. 9), which suggests that legislated cost recovery is only one piece of the puzzle.

Halifax Water's legislated mandate for full cost recovery

The Halifax Regional Water Commission (Halifax Water) must address the relevant environmental and public health regulations pertaining to its delivery of water, wastewater and stormwater services, but it also has a financial regulator. It is regulated by the Nova Scotia Utility and Review Board (NSUARB) and is mandated by the Nova Scotia Public Utilities Act to ensure that full cost recovery is achieved. This includes the recovery of capital and operating costs through the establishment of appropriate and equitable rates and user fees (Nova Scotia Utility and Review Board [NSUARB], n.d.). In fulfilling the requirements of the Act, Halifax Water has demonstrated successful integration of its water, wastewater and stormwater services, operating the utility as a business corporation with oversight from a board of directors. With this structure, the utility finances all of its operating and capital budgets through user fees without using a tax subsidy (Campbell, 2014). Rates are approved by the Halifax Water Board and the NSUARB, which differs from practices in most public municipal water systems, where elected officials and Councils provide these approvals.



Public resistance to rate changes

In Canada, municipal water management has occupied limited public bandwidth, except in times of crisis (e.g., contamination, flooding, drought or wildfires). Generally, there is low public awareness of the complexity of considerations, decisions and practices involved in water utility management, or the costs involved. This has led to resistance to rate or tax increases when investment is needed and low overall support for complete cost recovery. In many cases, utility budget requests must be approved by elected city councils, which means that unpopular decisions are difficult to pass. Utilities are increasingly recognizing a strong need to connect the public's desire for high-quality water services with an understanding of the costs involved and the implications of underinvestment.

According to the OECD, the average cost of water and wastewater in Canada represents just 0.3% of Canadians' average disposable income, which is amongst the lowest water tariffs of the 35 member OECD countries (OECD, 2010). Based on 2017 rates, a single-family household pays $47/month in Vancouver, $72/month in Toronto and $102/month in Winnipeg for water and wastewater services (assuming 20m^3 usage). In contrast, the average Canadian household spends over $200/month on telecommunications services, such as mobile phone and home internet access (Canadian Radio-Television and Telecommunications Commission [CRTC], 2016).

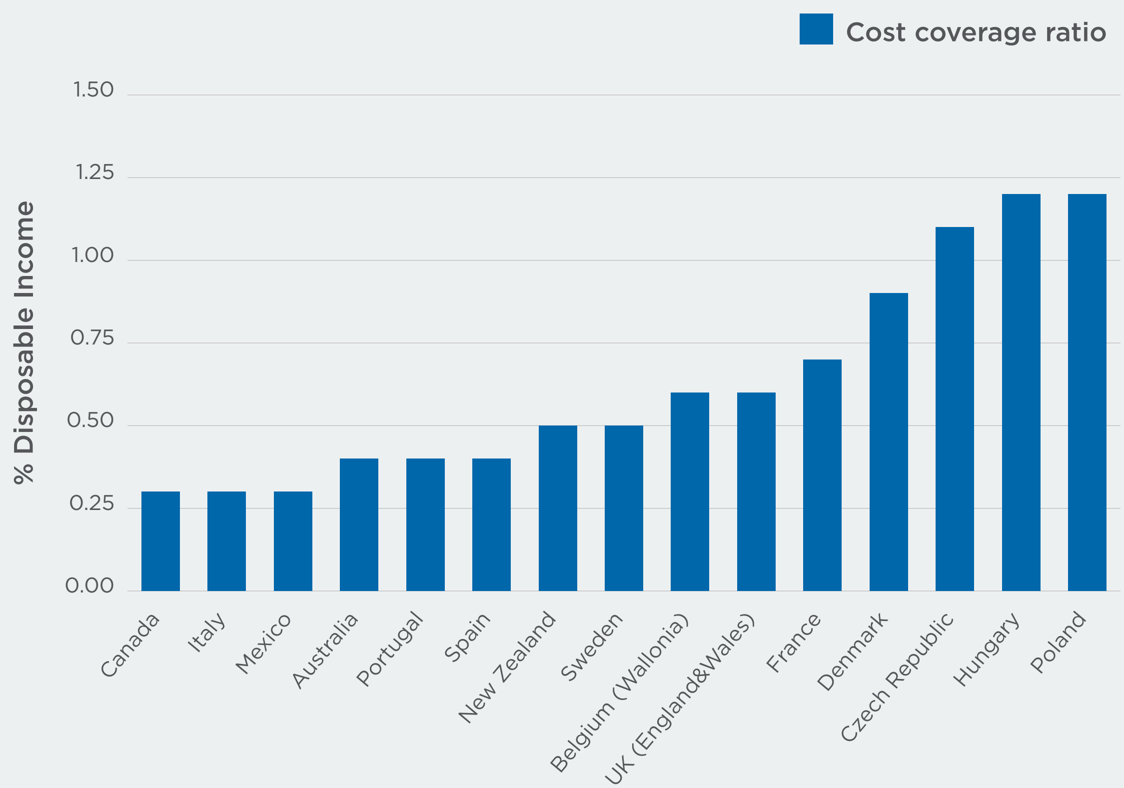


FIGURE 11: Comparison of consumer spending on water as a percentage of average net disposable income

Source: Adapted from OECD (2010)

OPPORTUNITIES TO MOVE TOWARD FINANCIAL SUSTAINABILITY

Although water utilities across Canada face many of the same core challenges, they have diverse regional settings, community needs and systems. It is this diversity, more than the commonality of the challenges that will dictate what solutions are applied. The key to structuring effective solutions is to apply the best combination of options that are workable in the local context to achieve community and utility goals. This section provides a summary of various opportunities that can be used and customized for different settings by utilities looking to improve their full cost practices and increase financial sustainability.

Design adaptive rate structures to achieve revenue stability

There has been a great deal of focus over the past few years on designing more effective rate structures. Rate structures must generate sufficient revenue to cover a "full" accounting of the costs. The revenue must be generated in a way that meets utility goals (including conservation), without penalizing utility performance. However, change is to be expected and rate structures need to be intentionally adaptive, anticipating that demand, costs and other factors will fluctuate and change over time. Opportunities to achieve this include the following options and elements:

COMBINE VOLUMETRIC RATES + FIXED FEES

Using an effective combination of volumetric and fixed rates can help a utility achieve multiple objectives such as revenue stability, equity and conservation and can be employed for both drinking water and wastewater systems. The inclusion of a sufficient fixed rate component, which is typically set by a utility based on meter size, ensures a more predictable element of revenue that enables better revenue forecasting. Maintaining a volumetric portion to the rate ensures that price signals are maintained, as well as customer control (AWE, 2014a; Beecher, 2017). In setting the fixed portion of the rates, caution is warranted to ensure that equity and affordability aren't compromised.

INTRODUCE TIERED STORMWATER CHARGES

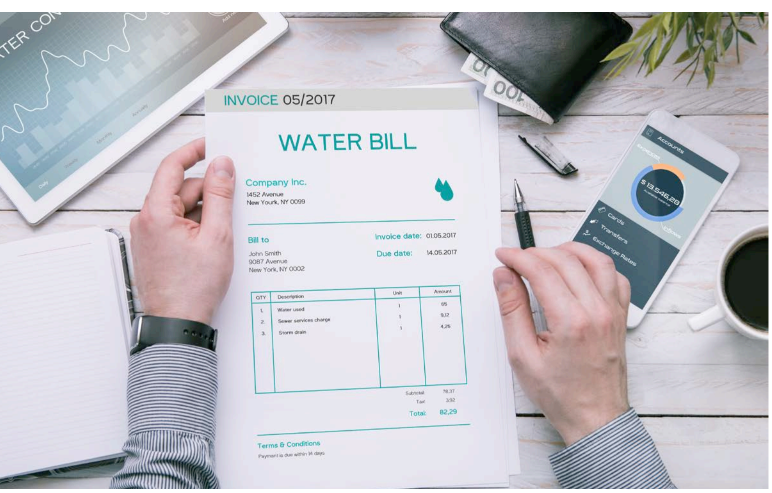
The addition of a stormwater charge to billing structures is increasingly being used to better align revenues with costs. These charges provide a dedicated revenue source tied to the cost of service for the customer and the municipality as a whole (Aquije, 2016). Creating tiered systems for stormwater charges, which take into account property size, the amount of impervious surface and other factors, further advances the concept of aligning costs to impacts on the system and provides the ability to allocate costs more equitably. Incentive programs can also be developed in concert with stormwater charges that encourage on-site stormwater management.

CUSTOMIZE PRICING MODELS

Innovating through customized rate design schemes reflecting different users and uses (see Highlighted Research on page 44) can improve revenue generation and stability while enabling utilities to adjust to changing conditions and costs. Customized pricing models can be an effective means to achieve greater revenue stability, fairness and more sustainable operations. A transparent, adaptive management approach to rate design, whereby rate changes are monitored, evaluated and revisited periodically, provides feedback on their effectiveness in achieving objectives and minimizes shocks to customers and businesses. These customized approaches may be more achievable once advanced metering is in place.

ADJUST RATES AUTOMATICALLY

Predictability for the utility and its customers is a significant concern, particularly for planning purposes. This can be improved by establishing a process for more frequent and regular rate adjustments. Pre-approving a schedule for rate increases within a set period, based on multi-year budget forecasts, eliminates the need to consult municipal council or utility boards annually. This can reduce the financial risks associated with political uncertainty for utilities, and improve understanding, expectations and acceptance of future changes for customers. However, it should be noted that this approach does not explicitly account for changes that may occur during the multi-year budget period. For this reason, automatic rate adjustments may reduce utilities' ability to rapidly adapt to factors such as economic downturn, unforeseen weather events or changes in demand due to conservation. Some balancing of the pros and cons of this approach can be achieved through a periodic review of the impact of automatic rate adjustments to help ensure alignment of revenue and costs and avoid complacency around cost control.



LINK AUTOMATIC RATE ADJUSTMENTS TO A SPECIFIC INDEX

One option to better ensure that pre-approved rate adjustments are more closely linked to future changes, such as inflation, is to base the increases on a specific cost index (e.g., Consumer Price Index). However, a utility's cost increases may exceed the rate of inflation, for example, when additional infrastructure investments are needed. Therefore, in using this approach, it is critical that the selection of cost index aligns well with the local context (AWWA, 2012).

CONSIDER PASS-THROUGH CHARGES

Another way to build adaptability into rate structures is to tie rate changes more directly to changes in costs. Pass-through charges adjust customer rates in proportion to actual changes in the costs of operation (e.g., electricity, raw water and capital costs). As such, the changes in costs are "passed" directly to users. For example, if a utility purchases water in bulk and resells it, then pass-through charges will be more effective in recovering varying costs. The utility EPCOR uses pass-through charges to make non-routine adjustments in rates if municipal franchise fees are increased (Hughes et al., 2014). It should be noted that pass-through commodity charges are generally a small percentage of total utility costs.

USE TEMPORARY SURCHARGES WHERE APPROPRIATE

Some costs or needs are time-limited, but are significant and can be more effectively addressed by applying temporary surcharges, which are time-limited fees charged in addition to the usual water and wastewater rates. Surcharges are used to generate revenue for specific purposes, such as natural disaster recovery, rate stabilization, paying for a major capital project or influencing customer behaviour during a drought. They may be fixed, volumetric or a simple percentage, and are relatively straightforward to implement. For example, Halton Region added a $40 special surcharge to residential bills in 2015 to fund a basement flooding program that provides homeowner financial assistance for flood-related clean-up and preventative actions (Henstra & Thistlethwaite, 2017). In these cases, effective public communication regarding the amount, purpose and duration of the surcharge is critical for broad acceptance (AWWA, 2012).

HIGHLIGHTED RESEARCH

Future possibilities for rate design

Researchers from the University of North Carolina have proposed three alternative pricing models that could be used to adapt to new customer usage trends and to improve fairness and revenue stability (Hughes et al., 2014):

CustomerSelect would allow customers to select a water plan with a monthly allotment of water for a fixed fee. In this model, customers budget their monthly water consumption. If the monthly allotment is exceeded, the customer pays an overage fee, similar to a mobile phone plan. Since customers are on fixed plans, the *CustomerSelect* model could support greater revenue stability for the utility, as base monthly revenues can be more easily predicted, and plans, if structured appropriately, can be designed to better align fees with the fixed costs of the service. However, as plans are defined by volumetric thresholds, the *CustomerSelect* pricing model would require utility metering and may further require utilities to implement smart meters and real-time notification tools to inform customers of their real-time usage. Also, as the *CustomerSelect* model places greater responsibility on the consumer to budget their water use, water utilities would need to find ways to guide customers on appropriate plan selection.

The **WaterWise Dividend** model would provide dividends or rebates to customers under specific conditions and could be used to incentivize behaviour. Thresholds for returns would need to be set by the utility but could be based on water usage (i.e., consumption that is less than the budget or historical averages) or financial considerations (i.e., the way customers use water has resulted in cost savings for the utility). However, where the *WaterWise Dividend* model might be most effective is in facilitating communication with customers regarding the value of water, the services provided and the financial investments needed to provide continual service quality. For example, utilities might offer a rebate after annual financial goals are successfully met, and in doing so, signal to customers that the objective of water rates is to cover costs and manage services rather than make a profit. Alternatively, any surplus revenues may be returned to the user as credits. The *WaterWise Dividend* model could be an effective way of gaining support for utility pricing structures and for providing assurances to customers that they are not overpaying for their services.

PeakSet Base Rate charges would be based on a three-year rolling average of the customer's peak month of demand, which encourages consistent use of the water by customers to minimise excessive peaks in a given month. A volumetric charge would still be included, but the base charge would constitute a larger portion of the bill. This approach would provide a more consistent and predictable revenue source because the utility could recover most costs through the base rate charges. Successfully implementing this method would require extensive metering and accurate tracking to calculate the three-year average base rate.

Build climate change resiliency into financial planning

There is widespread recognition by Canadian utilities of the significant risks and potentially enormous costs that can be imposed on water systems as a result of climate change. Given both the magnitude of the potential impacts, as well as the uncertainties about the nature and timing of those impacts, utilities are in need of ways to build such considerations into long-term thinking, planning and financing. Ultimately, managing long-term risks requires employing decisions and strategies in the short-term that will help utilities achieve greater resiliency, leading to long-term sustainability. Funding and financing water systems with future uncertainty in mind will likely require a combination of strategies to react to crises, buffer against financial uncertainty and to prevent or minimize impacts through more fully capturing costs and proactively adapting and upgrading systems. Some strategies that could be employed include:

ESTABLISH TARGETS FOR OPERATING AND CONTINGENCY RESERVE FUNDS

Most of the utilities reporting to the NWWBI maintain reserves, but some do not set targets for these reserves (see Utility Financial Health on page 27). Financial risks can be more explicitly considered and addressed by setting reserve targets and considering cumulative revenue exposure annually (i.e., whether the reserve is adequate to cover changes in revenue) (Ceres & UNC Environmental Finance Center, 2014). For example, the City of Toronto maintains a reserve to absorb unanticipated financial impacts from extreme weather. Similarly, developing clear guidelines on when and how reserve or contingency funds can be used can better protect these funding sources from unintended use. Where utilities are regulated by external provincial agencies, a framework could be put in place to ensure accountability.

SECURE MUNICIPAL INSURANCE FOR CLIMATE RISKS

Insurance is an important risk management tool to manage financial risk, particularly for property damage and legal liability caused by infrastructure failure (Henstra & Thistlethwaite, 2017). There are a small number of specialty insurers who offer coverage to Canadian municipalities. The policies can be customized (e.g., size of deductible, which catastrophic events will be covered and limiting protection to critical infrastructure) (Henstra & Thistlethwaite, 2017). For example, the City of Toronto paid an insurance premium of $5.1 million with a $5 million deductible for $100 million in liability coverage and $1.8 billion for property damage in 2015 (Henstra & Thistlethwaite, 2017, p. 12). A particular opportunity in this area is for municipalities to work more extensively with the insurance industry to ensure that reduced risks are reflected in the insurance premiums and policies for private homeowners.

USE FINANCIAL DERIVATIVES TO MANAGE WEATHER-RELATED RISKS

Financial derivatives are weather-related risk-sharing financial tools that have been used successfully in the energy and agricultural sectors, and could potentially be used by the water sector to manage risks associated with weather-related revenue loss or additional costs (AWE, 2014b). Financial derivatives are a contract between parties whose value is based on an agreed-upon underlying financial asset, index or security. The index can be selected to manage a volumetric risk like precipitation or stream flow, a price risk such as operating and maintenance costs related to energy consumption, or a combination of both. These would most likely be easier to settle than insurance claims (AWE, 2014b).

ISSUE GREEN BONDS

Green bonds may become a potential financial instrument in Canada to fund climate change adaptation. They are structured identically to conventional bonds, but their proceeds fund projects with environmental benefits. Green bonds are issued by the same types of organizations that offer traditional bonds and are usually backed by the balance sheet of the issuer (Climate Bonds Initiative, n.d.; Smart Prosperity Institute, n.d.; United Nations Development Programme, n.d.). They are generally Triple-B rated or higher (Climate Bonds Initiative, 2015). The proceeds are typically used to fund projects with anticipated returns, so lower risk projects such as the deployment of existing technologies and new infrastructure are appropriate choices (Brownlee & Kidney, 2016). There are a growing number of players in the United States issuing and purchasing green bonds and it is an increasingly feasible option for financing water and wastewater utilities. In 2014, the District of Columbia Water and Sewer Authority sold green bonds for $350 million, which was billed as the first-ever green bond to carry a 100-year maturity. The proceeds of these green bonds will be invested in construction of an upgraded drainage system to protect local rivers. The investors will be paid back from revenue of the water and sewer system, similar to typical municipal bonds (Cherney, 2014). As of 2017, the City of Ottawa became the first Canadian municipality to issue a green bond, the proceeds of which are to fund its light rail transit capital work (Critchley, 2017). The City of Ottawa has developed a green debenture framework under which it can issue green bonds. This has been deemed to be a clear and transparent process for project evaluation and selection, which includes water management related projects (City of Ottawa, n.d.-c).

ADJUST FINANCIAL FORECASTING FOR EXTREME EVENTS

Utilities typically base cost and revenue projections on past experience and the expectations of a normal operating year. However, a fundamental characteristic of climate change is that we can't rely on the past to make accurate predictions for the future. The increasing uncertainty and costs from extreme events require an alternative approach to forecasting. One approach is to shift the emphasis within financial projections from the use of average conditions to placing more weight on the worst-case scenario. Using this approach, generating revenue for preventative and proactive maintenance could be better justified, and larger reserves could be accumulated. This pricing approach could be combined with a WaterWise Dividend model (see text box on page 44) where rebates are offered if revenues exceed annual targets. It should be noted that the ability to make changes in this area are dependent on a utility's governance model.

DEVELOP NEW RISK MANAGEMENT STRATEGIES

Achieving financial sustainability while addressing climate change requires new risk management strategies that better reflect change and increased uncertainty. Updated risk management approaches that acknowledge new realities are needed to inform infrastructure investment priority-setting and decision-making. Examples of this evolution to a more updated risk approach are already occurring. The Insurance Bureau of Canada (IBC) and Engineers Canada both supported the development of critical infrastructure risk identification tools to help support strategic investments to reduce high-cost risks associated with extreme weather (Zizzo Allan Demarco et al., n.d.).

Optimize energy use and recover resources

IDENTIFY COST-EFFECTIVE AND PROACTIVE RISK-REDUCTION INVESTMENTS

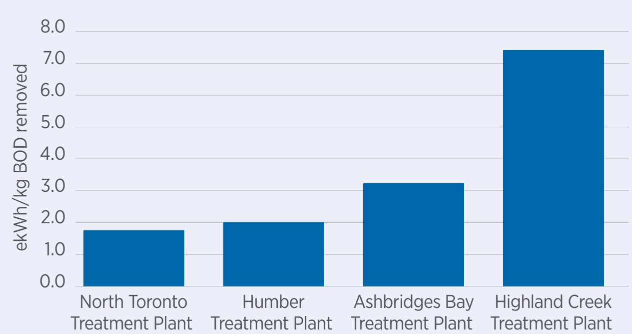
Financial sustainability can be improved by identifying opportunities to reduce the risk of system failure and adopt a more proactive approach that focuses on resiliency. Preventative actions like planned maintenance, infrastructure improvements and flood protection are more cost-effective than reactive actions. Conservation Ontario estimates that flood management programs delivered by Ontario's Conservation Authorities prevent over $100 million in annual flood damages (Conservation Ontario, 2009). Municipalities can also incentivize risk-reducing customer behaviour by subsidizing green infrastructure or low-impact development (LID) on private property, or subsidize backflow preventers to reduce the risk of basement flooding from sewer backups (Henstra & Thistlethwaite, 2017). Incentivising water conservation or enforcing sewer-use by-laws are other means to manage water and wastewater systems more cost-effectively. Increasing system knowledge and having comprehensive asset management plans that include both conventional and green infrastructure supports proactive planning for resiliency, as well as financial justification for the work. Ensuring that both grey and green stormwater assets and their lifecycle costs are incorporated into asset management plans will support greater investments in these assets and improve resiliency.

INCREASE ENERGY EFFICIENCY

Municipal utilities have a significant opportunity to decrease costs and reduce greenhouse gas emissions through greater energy efficiency. Potential savings are particularly relevant in provinces where energy costs have climbed (ECO, 2017). The recent commitment in Canada to apply carbon-pricing schemes nationally is likely to elevate the importance of energy efficiency by sending a clear market signal through energy pricing. Progressive utilities are participating in energy audits and taking action to reduce leakage, inflow and infiltration, manage demand, modify operations (e.g., off-electrical peak pumping to fill reservoirs, use of gravity systems and pump optimization), optimize treatment protocols and/or implement system upgrades. Upgrades may require substantial capital investments but can result in significant cost savings when considered over the lifecycle of the infrastructure (see case study below). Reducing water wastage in the drinking water distribution system saves money by minimizing the loss of highly treated water and its embedded energy and chemical costs. Leaks also result in higher pumping requirements to maintain system water pressure (ECO, 2017). Halifax Water (see case study on page 52) has demonstrated that energy efficiency upgrades do not necessarily require significant capital costs, and can also be accomplished through adjustments to operations and maintenance.

Toronto's audit of energy consumption at four wastewater treatment plants

Three years ago, the City of Toronto compared energy totals for its four wastewater treatment plants using the equivalent energy consumption per kg of biological oxygen demand (BOD) removed as a measure of the efficiency of treatment (City of Toronto, 2014). Results revealed that the Highland Creek Treatment Plant used more than twice the amount of energy per kg of BOD treated than the next highest plant, and almost four times more energy than the most energy efficient treatment plant. While many factors contribute to plant efficiency (e.g., the strength of raw wastewater, treatment technology and effluent quality), the data suggested that performing targeted upgrades to the Highland Creek Treatment plant could result in substantial energy and cost savings.



Energy consumption at four wastewater treatment plants in the City of Toronto in 2014

Source: Adapted from the 2014 City of Toronto Annual Report (City of Toronto, 2014)

For conventional secondary wastewater treatment as currently practiced across much of Canada, the most energy-consumptive process is aeration in biological processes (XCG Consultants Ltd, 2011). Opportunities exist to optimize energy use in these processes through approaches such as monitoring dissolved oxygen levels and adjusting requirements, upgrading to high-efficiency blowers or retrofitting with new technologies such as membrane aerated bioreactors (MABR) (ECO, 2017; Peeters et al., 2017; Stantec, 2017). MABR can result in a reduction in energy requirements and is being piloted in the City of London (Southern Ontario Water Consortium, 2017; Stantec, 2017). The applicability of innovative technologies to significantly reduce aeration energy inputs for wastewater treatment is an active area of technology research and innovation.

IMPLEMENT RESOURCE RECOVERY TO LOWER OVERALL COSTS

The recovery of wastewater resources like nutrients, energy and biosolids is becoming more feasible due to technological advances. While important and desirable for environmental and economic reasons, resource recovery can also play a role in achieving more financially stable systems. Although the sale of recovered resources may not constitute a significant revenue stream (Humphries et al., 2012), the associated process changes could offer direct savings through less intense treatment requirements (Worthen, 2015), reduced pipe maintenance and delayed tertiary upgrades (British Columbia Ministry of Community Development, 2009). Recovery of energy sources such as biogas (i.e., methane and carbon dioxide) from the anaerobic digestion process can produce energy which can be used to offset other electricity and heating needs or generate revenue (USEPA, 2011; Wan et al., 2016).

Canadian wastewater utilities are using co-generation and heat recovery to reduce energy needs, generate revenue and reduce greenhouse gas emissions

All five of Metro Vancouver's wastewater treatment plants recover and use biogas to generate heat to meet plant needs. Two of the plants also co-generate enough electricity to meet roughly half of the plants' needs. One treatment plant is also planning to sell excess biomethane to a local natural gas utility (Metro Vancouver, n.d.). Metro Vancouver has also established a Liquid Waste Heat Recovery Policy to enable municipalities and businesses to use the heat from sewers to heat nearby buildings (Metro Vancouver, n.d.). The first project enabled by the policy is an effluent heat recovery project that will be built at the new wastewater treatment plant serving the North Shore of the region, opening in 2021. It will sell 5 megawatts of heat to the district energy system of the Lonsdale Energy Corporation, providing heat for approximately 3,000 homes. The renewably-sourced heat will displace natural gas, reducing greenhouse gas emissions.

Multiple examples of co-generation facilities using wastewater treatment plant biogas exist or are planned for across the country. The City of Hamilton has a 1.6 megawatt capacity cogeneration plant at its Woodward Wastewater Treatment Plant as well as a biogas purification unit. Having both facilities allows Hamilton to choose between selling electricity or natural gas to energy distributors based on current market rates. The City of Ottawa's Robert O. Pickard Environmental Centre's cogeneration facility produces 5 megawatts of heat and electricity, which provides 50% of the treatment plant's annual energy needs (City of Ottawa, n.d.-b) and in 2006 was saving approximately $1.565 million per year (Hewitt, 2006). The Regional District of Nanaimo's Greater Nanaimo Pollution Control Centre is a smaller system, with a cogeneration system that produces 0.3 megawatts, which are sold to BC Hydro and powers 325 homes (Regional District of Nanaimo, n.d.). The Region of Waterloo has plans to add cogeneration facilities at three of its wastewater treatment facilities, with a combined electrical capacity of 1.4 megawatts that is expected to offset electrical demands by 30-60% (Canadian Consulting Engineer, 2016).

Depending on the situation, the recovery of water from wastewater treatment processes (i.e., water reuse) also represents a potential source of cost savings. Water reuse is less common in Canada than in regions with more water scarcity. However, there are some areas in Canada that do experience water scarcity or could benefit from improvements to the security of supply. It is likely that water reuse will become increasingly relevant as stressors on existing natural water sources increase due to climate change and urbanization, and as utilities face the need to reduce energy costs as discussed above. Many advanced wastewater treatment technologies (e.g., advanced oxidation processes, membrane filtration and reverse osmosis) have higher energy requirements than conventional technologies, but are becoming more energy-efficient and could potentially result in net energy savings when considering the opportunities for local water reuse and reduced pumping requirements. When accommodating the needs of growing cities, a decentralized approach to water management also potentially provides opportunities for less energy intensive treatment systems and local reuse (Libralato et al., 2012). The discussion of the applicability, benefits and potential drawbacks of decentralized approaches are an area of further research for Canadian municipalities.

Increase system knowledge

A strong understanding of system condition and behaviour is fundamental to better forecasting issues and costs. Taking a "know-your-system" approach to all processes in water management is likely one of the most effective things a utility can do to achieve best possible outcomes for any size or location of water systems. In addition to the increased focus on the importance of more rigorous asset management for water systems over the past few years, there has also been an increase in the availability of tools and approaches to achieve better system knowledge.

The rapid evolution of system monitoring technologies, including for asset condition monitoring, has increased the potential to underpin financial and investment strategies with a better understanding of systems. Many of the more sophisticated planning and rate structure approaches depend on expanded metering and system monitoring, such as advanced metering and more automated systems. In many cases, utilities' ability to implement these systems comes down to cost. This includes who bears the burden of these costs in complex governance settings, how the business case is made for the benefit and the period required for cost recovery. Approaches to system monitoring at Canadian utilities currently span a very wide range, from simple to complex. Reductions in technology costs and a more sophisticated understanding of the payback associated with implementing new monitoring and metering technologies are key to increasing uptake in Canada.

IMPROVE ASSET MANAGEMENT PRACTICES

Asset management is focused on strategically investing in people and processes. A number of organizations are actively supporting this growing field in municipal water management in Canada as it cuts across administrative, engineering, accounting, planning and political spheres of a water utility (Canadian Network of Asset Managers, n.d.).

As highlighted previously, historic practices of underinvestment in infrastructure assets and limited use of asset management planning have hindered the ability to fully recover costs. Part of the need for increases in annual and future spending is a result of this fact. While historic underinvestment cannot be rectified overnight, using asset management planning to gather and maintain relevant data (e.g., level of service, condition, useful life, operating and maintenance costs, rehabilitation and/or replacement costs) enables better estimates of the short- and long-term costs (The Regional Municipality of York, 2015). By gathering and using data on future repair needs and objectives related to lifecycle costs such as energy usage and resilience to changing conditions, asset management plans can be used to guide decision making in Canada. Increasing understanding of system performance and linking this to improved asset management planning is currently a very active area of research, technology development and practice. This is particularly relevant as the Government of Canada is making investments in Canadian water infrastructure. This federal investment provides an opportunity to assess the adequacy of existing infrastructure to meet future needs and multiple objectives before defaulting to like-for-like replacements, and to maximize the utility of new infrastructure (Maas, 2017; Ontario Ministry of Infrastructure, 2016).

BROADEN THE CONSIDERATION OF RELEVANT ASSETS

A key opportunity in achieving more financially sustainable systems is to broaden the understanding of what should be included as "assets" in asset management, including the value and importance of natural assets like trees, rivers, wetlands and aquifers to goals. This is an important trend that builds on the earlier discussion on ecosystem goods and services and is gaining momentum. It is an important consideration in the broader look at overall risk and system resiliency approaches needed going forward. Natural hydrologic features play a key role in regulating flows and water quality. Work continues in this area to build the business case on the importance of natural/non-engineered and engineered green infrastructure from a full cost recovery perspective. Valuing natural assets and incorporating associated services into utility accounting is being explored in Canada by different organizations, including the Smart Prosperity Institute through its Municipal Natural Assets Initiative (O'Neill & Cairns, 2017). In their recent report, they define municipal natural assets as natural features owned or managed by a municipality that provide services that otherwise would be achieved by an engineered solution (O'Neill & Cairns, 2017). With this definition, natural assets can be integrated into traditional infrastructure asset management and associated financial processes, more fully accounting for risks, benefits, and the costs of maintaining service levels.

Determining the value of the ecosystem and socio-economic services provided by natural assets is challenging, but not without precedent. Ecosystem services of a wetland could include wildlife habitat and stormwater retention, and at a minimum, costs associated with monitoring, research and development. The basis for cost of service could be derived from maintaining and protecting these features, such as through monitoring, research and development, or the cost to replace the same service provided by the natural feature with an engineered solution (O'Neill & Cairns, 2017). The Town of Gibsons in British Columbia is a leader in incorporating natural assets into their existing financial processes and has identified their primary drinking water aquifer as a natural asset. Identifying this critical feature has enabled them to allocate funds to monitor the aquifer (Town of Gibsons, 2015). Socio-economic services associated with natural assets are more difficult to quantify but could include public health and impact on property value. Urban green space, for example, has been found to be associated with measurably improved health outcomes (Alcock et al., 2014; Crouse et al., 2017).

INCREASE DATA MINING AND THE USE OF EXISTING DATA

A significant amount of information is collected from water systems in Canada using commonly employed tools and processes (e.g., conventional water metering, district metering, supervisory control and data acquisition (SCADA), computerized maintenance management systems (CMMS), geographic information systems (GIS) and performance measurement/reporting). The various types of data are collected for a variety of purposes (e.g., regulatory reporting requirements, treatment systems operations, etc.). One of the frequent concerns expressed, particularly by smaller municipalities, is the challenge of being able to access and proactively use that existing data to better inform system understanding and overall strategic decisions. Better use of existing data is a core element of current recommendations for asset management practices and requires a commitment to prioritizing this task in system operations. Where the capacity exists, innovative ways to inform utility operations can be employed that reap significant benefits for financial sustainability. For example, using district metered areas, the location of leaks can be detected much earlier, helping to reduce non-revenue water loss and minimize more extensive repair and maintenance costs (see case study on page 51).

Cost savings through leakage reduction in Halifax

In 1999, Halifax Water was the first utility in North America to adopt an international best practice in leakage reduction of its water distribution system, developed by the International Water Association (IWA) and American Water Works Association (AWWA) (more fully described in the AWWA Manual M36, *Water Audits and Loss Control Programs* [AWWA, 2016b]). Like many utilities looking to manage system pressure and leakage, Halifax Water had to tackle topography and the legacies of how the water distribution system was implemented and how development occurred over time. Seventy-five district metered areas were created in a water distribution system with 55 pressure zones serving approximately 350,000 people. Over 110 pressure-control and meter stations were incorporated, and $1.5 million was invested in new software and metering equipment in support of the water loss control program. Halifax Water relies heavily on its SCADA system to monitor real-time flows and analyse trends to help narrow down the location of leaks. Once a leak is detected, a skilled crew uses sound-based leak-detection equipment to pinpoint and repair the leaks, generally within a matter of days.

From 1999 to 2013, Halifax Water reduced its Infrastructure Leakage Index from 9.0 to 2.5, a reduction in real losses ranging from 540 litres to 165 litres per service connection. By reducing leakage and non-revenue water, Halifax Water was able to reduce water treatment by 40 million litres per day. This has resulted in an annual savings of approximately $650,000 per year in electricity and chemical costs. In addition to operations savings and reduced carbon footprint, addressing leaks proactively improves customer relations, reduces liability and is generally more cost-effective than managing sinkholes and property damage from larger leaks or pipe bursts.

Halifax Water is building on its initial success by developing an enhanced pressure management strategy — one of the four strategies recommended by IWA and AWWA. Pressure reduction reduces leakage through decreased pipe bursts and losses from background and active distribution leaks. A 2005 study piloting the use of flow-modulating pressure control valves determined that approximately 80% of water main breaks happen at night when pressure creeps up due to low demand. Reducing pressure overnight in residential and commercial areas during the 1-year pilot study resulted in approximately 50% reduction in main breaks and service leaks (Yates & Campbell, 2016).

ADOPT ADVANCED METERING INFRASTRUCTURE

Metering system use is a core component of operations for most — but not yet all — systems across Canada. Many of the opportunities identified for improving full cost recovery rely on metering to help facilitate accurate billing, promote equity, and improve system operation. Advanced metering infrastructure (AMI), which automatically collects and communicates more frequent data on water consumption (Moore & Hughes, 2008), helps enable adaptive rate design options by providing feedback to customers and influencing usage, and also allows the utility to have a more detailed and real-time understanding of how their system is responding. The decision on whether or not to adopt AMI is not necessarily linked directly to the size of the utility. It has been suggested that the benefits of metering can outweigh the costs of installation and maintenance, even for smaller systems (Watson & Associates Economists Limited & Dillon Consulting, 2012).

AMI data analysis can be used to optimize the system (e.g. decrease peak demands). Traditional meters collect information on water usage once a month, which does not provide granularity on different uses or enable direct feedback to customers on the impact of specific actions, like washing a car or watering the lawn. AMI provides an opportunity to access more timely data through continuous collection and real-time analysis. It also enables more timely communication with customers, which facilitates greater understanding of individual use and may lead to lower demand. Some utilities have also introduced mobile apps that alert customers about potential leaks and open taps when their usage is outside of normal patterns (Clayton et al., 2017). Other utilities, like the City of Guelph and City of London, have developed online billing applications which provide customers with social comparison information, allowing them to see how their usage and/or conservation efforts measure up to the average for their demographic or neighbourhood (Clayton et al., 2017).

Create a culture of communication

Achieving public support for the investments needed to achieve financial sustainability is critical. It requires transparency and effective communication with customers about the choices being made, the significance of those choices to customer goals and needs, and the costs involved. Utilities are evolving in a way that incorporates a more customer-focused approach that recognizes the need to engage and understand customers better. There are many resources and case studies available on how to communicate well with customers (E.g., Eckl & Huisman, 2017; Goetz, 2014; Means et al., 2008; Ruetten, 2008; Texas Water Development Board, 2010; Tiger, 2014; Tools of Change, n.d.; United States Environmental Protection Agency Office of Water, 2015). While the local context will ultimately influence the approach taken, successful campaigns are often based on a few key principles:

FOCUS ON BUILDING RELATIONSHIPS AND GATHER VALUABLE INSIGHTS

A “top-down” approach to communication — i.e., providing customers with facts about utility services — does not motivate behavioural change (Kollmuss & Agyeman, 2010; Singal, 2014; The World Bank, n.d.). Building a relationship with customers and learning about their needs and motivations is vital to success. Establishing customer rapport is an integral part of building this relationship. For example, York Region’s Water Is campaign “puts a face to the name” of staff service providers through a series of YouTube videos that highlights their role in the organization (York Region, n.d.). There are numerous other Canadian utilities, large and small, who are using social media platforms like YouTube, Facebook and Twitter to foster community relationships.

A success story that has attracted widespread attention is the District of Columbia Water and Sewer Authority's "Communications Comes First" approach. Since rebranding as DC Water in 2010, the utility has provided regular customer updates, better access to information and new conduits for feedback. This improved relationship has led to more responsive solutions. For example, a new residential drinking water system replacement fixed fee was amended to apply only to residences with a specific meter size, in response to the feedback that new homes (which have larger water lines for fire suppression) would be unfairly affected (DC Water, n.d.).

USE TARGETED COMMUNICATIONS TO REACH A BROADER AUDIENCE

Customer needs and motivations can vary widely, depending on the customer class (household, commercial or industrial) and demographics like income level, business size, etc. There are a variety of tools that can be used, and marketing studies have shown that the two most effective platforms for message delivery are still traditional mail and email to subscribers (MarketingSherpa, 2016). There may be barriers to participation in social media for some utilities due to lack of expertise or time, or because the municipality or region does not allow individual departments to run their own accounts. For utilities who are using social media, messages can be customized for the different audience demographics that are participating on a particular platform (Chaffey, 2017). Targeting youth can also be effective in modifying overall household behaviour (Damerell et al., 2013; Duvall & Zint, 2007; Vaughan et al., 2003) and has been used in other sectors (e.g., blue box recycling and impaired driving).

RELATE COMMUNICATIONS TO EXTERNAL EVENTS

Campaigns that coincide with related events can be highly effective. For example, communicating about stormwater management following a wet spring may increase uptake and retention. Crisis events like flooding, sinkholes and stormwater overflow are valuable opportunities to educate and build momentum for change.

CONCLUSION

Sustainable financing of Canada's municipal water services is fundamentally about deciding what we want from our systems, now and in the future, and ensuring that we have a sound financial plan to get there. It requires that we are fully aware of where we stand, as well as what is needed going forward to structure our systems to deliver on those expectations. A core part of achieving that goal is ensuring that Canada's systems recover the full costs involved.

Full cost recovery is a balancing act between costs incurred and revenues received. However, achieving this balance is far from straightforward, as we must spend wisely today and plan well for tomorrow. Overall, Canadian municipalities are doing a good job at paying the monthly bills, but they are playing catch-up on past decisions. Considerable investment in infrastructure will be needed, and transitioning from a reactive approach to maintenance and spending to one that is more proactive and cost-effective will be critical. Current accounting practices do not broadly include future considerations like environmental and resource costs, and given the changes in weather and population patterns that many utilities are experiencing, forecasting what will be needed to save or plan for large expenditures has become increasingly difficult.

Given the magnitude of the costs and challenges facing Canadian water systems, and the need to consider fairness and affordability for current and future generations, the task of achieving financial sustainability is a daunting one. But, it is a task that must be faced, which will require political and public support. It is not a task that can be "legislated away," but governance and legislation can play an important role in enabling municipalities to adopt and implement opportunities that move them toward financial sustainability.

Cost control and system optimization are an ongoing focus for utilities, and interest in resource recovery is beginning to take hold in Canada. However, revenues will also need to increase. A critical dilemma for Canadian utilities is declining revenues as a result of decreased water use. This continuing trend will require utilities to reconsider their reliance on revenues that are based on the volume of water consumed (or wastewater generated) when the majority of costs to provide services are independent of those volumes. Utilities will need to develop new rate structures that strike the right balance of maintaining price signals that incentivise conservation with generating reliable and adequate revenue in an equitable manner.

Utilities will also need to structure financial planning for future uncertainties. Resiliency to climate change is an increasing priority for communities across the country, and building this into financial planning is an area of innovation that should be extended to water management. An improved understanding of the state and behaviour of Canadian municipal systems is also a key need. Investing in "knowing our systems better" provides a basis for making better decisions, including: optimizing operations; selecting and applying the most appropriate policies or technologies; and proactively identifying priorities and opportunities. Better understanding our systems includes not just the physical systems, but also user interaction. This interaction is also the most direct opportunity for utilities to connect with customers, which is fundamental to setting appropriate goals and building public support.

Given the thousands of municipal water systems in Canada and the wide variability in the state of repair of those systems and the socio-economic realities of the communities they support, balancing the books to achieve financial sustainability will be less about applying an "industry standard" and more about selecting the best approach from a menu of options. Recognition of the urgent need to address water management is growing. Utilities, government, industry and the public all have a role in responding to that need. For Canadian utilities on the front lines of water management, the opportunity exists to select and implement the best options to achieve financially sustainable systems and improve Canadians' connection to shaping and supporting those systems.

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At Canadian Water Network, we've learned that informed decisions result from addressing the right questions. When decision makers ask, 'What does the science say about this?' we frame what is known and unknown in a way that usefully informs the choices being made.

For more information on the case studies provided in this report or other projects undertaken by the Canadian Municipal Water Consortium, contact Bernadette Conant at *bconant@cwn-rce.ca*.

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