Municipal Water Use Pricing Structure Options

Report prepared for the Town of Middleton, as part of the
Green Heart of the Valley Project

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Executive Summary

As part of the Green Heart of the Valley project, the Town of Middleton is planning to replace their current sewage treatment plant and upgrade beyond what is required by government standards. This document is an exploration of water pricing structures, evaluating pros and cons of each, to allow the Town of Middleton to make the best choice possible in financing the upgrade and providing high quality water for human consumption.

There is increasing concern about the quantity and quality of water that we consume (Meakin, 1993). Average Canadian water use is second only to Americans (Jane Goodall Institute of Canada, 2009) with the average Canadian household using more than 300L each day (Real Estate Institute of Canada, 2002). Part of this consumption trend is perpetuated through misconceptions about the true price of water. This is true of municipal water systems. Many pricing structures do not cover the full cost of water, encourage conservation or provide funds for upgrades and repairs of existing infrastructure.

Volume based charges are essentially user pay pricing structures. Pricing structures such as universal monitoring, increasing block rate, sewer surcharge and seasonal peak load are much better conservation tools than flat rate structures. As nearly every human use of water degrades the quality in some aspect, removing less water from the natural environment not only protects the ecosystems it, but also reduces the volume of poorer quality water re-entering the system (Meakin, 1993). There is also the financial benefit on the part of the utility commission. By reducing the volume of water consumed, the amount of water that needs to be treated also reduces. Therefore, if the volume of water treated by a plant decreases by 30% and all else being equal, the life of that treatment plant has also been extended by 30%. As well there are additional savings in terms of substances used in the treatment process such as chloride. This can mean savings in terms of hundreds of thousands of dollars by deferring upgrades or replacements.

Four case studies are included within the report of communities that implemented user pay pricing systems. Savings realized through conservation range from $12,000 to $53,000 each year in reduced costs. One community was able to defer finding a new water supply, which is a $50,000,000 expense. These are significant savings. However as there is a disconnect between the actual cost of water and the price the public is willing to pay there needs to be a reconciliation between the two. Educating the public about the actual cost of providing potable water, as well as making the transition easy and positive should alleviate resistance. As the Town of Middleton has already had great success in working with its citizens to reduce water consumption, an environmental ethic is already present within the community.

Introduction

Freshwater resources are perceived by most Canadians to be in abundant supply (Real Estate Institute of Canada, 2002). It is also considered a renewable source because it is continually moving through the hydrologic cycle. Canadian water usage certainly does not appear to contest this theory of abundance. In 2004 the average Canadian used 329 L per capita (Real Estate Institute of Canada, 2002), in 1999 the average Canadian used 343 L and 335 L in 2001 (Water Governance, 2009b). These figures are significantly higher than many European countries (Figure 1). Despite the fact that Canada holds 20% of the world's freshwater, we possess only 6.5% of the world's renewable supply (Water Governance, 2009a). Over half of the Canadian freshwater supply flows north, away from our most populated regions (Water Governance, 2009a). By 2011 Canadian municipal water use will be double what it was in the early nineties if growth and consumption patterns remain the same (Meakin, 1993). This rapidly escalating water use could mean water shortages for Canada (Meakin, 1993).

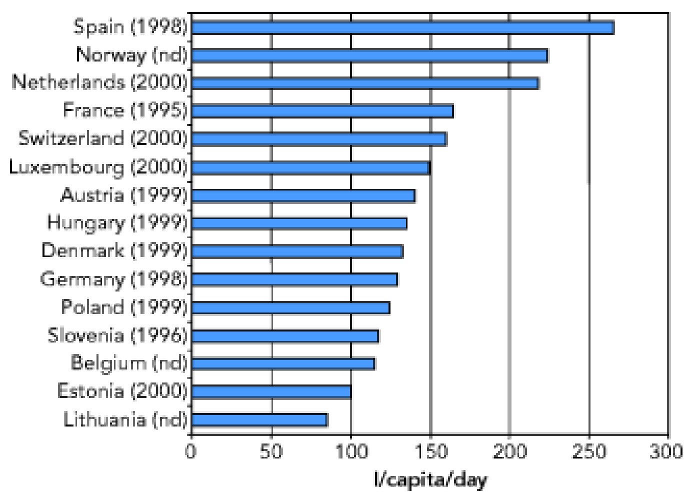

Figure 1. Water consumption in L/capita/day for selected European countries*.

How do Canadians consume such large volumes of water? The answer may be in the value that we assign water. At a conference, a PhD economy student with the University of Chicago stated: "We need to put costs for water and wastewater in context; people are willing to pay far more for soft drinks and other beverages than for tap water." He went on to state that Americans tend to have a greater understanding of global scale problems, such as global warming but knowledge of more local problems, such as producing and providing resources eluded them. As well "people generally also have no sense of how much water costs; even examining local utility bills, it can be difficult to understand. The prices of other resources (e.g., gas) are far more obvious and visible." (Coursey, 2006) Although this is a commentary on the

* Source: European Environment Agency, http://themes.eea.europa.eu/Specific_media/water/indicators/WQ02e,2003.1001/Figure05_11.png/view

American perspective, based on similarities between the countries it is safe to assume that it is also valid for many Canadians.

The price we pay for municipal water and wastewater may be another significant factor. There is a concern among water experts that provincial and municipal water prices rarely reflect the true value of water. This skewed view can result in "over consumption, water use conflicts, deteriorating infrastructure, declining water quality, and stifled innovation in water-conserving technologies" (Water Governance, 2009c). A significant fault to these inaccurate water prices is that insufficient revenue is generated to meet water utility capital and operating costs (Water Governance, 2009c). In addition, water providers must look to other sources of funding to finance repair and replacement of aging water infrastructure. Canadian overuse of water costs billions of dollars in supply and wastewater infrastructure (Meakin, 1993). Although water itself is free, producing potable water is a very costly enterprise.

Aside from social and economic affects of water use, there is a suite of environmental impacts. There are two main types of usage: instream and withdrawal but for the purposes of this paper, withdrawal is the more relevant. Withdrawal use often returns less water than it removed and the water it returns is usually of a lower quality (Meakin, 1993). Meakin (1993) identifies suspended solids (TSS – total suspended solids), organic material (BOD – biochemical oxygen demand), toxic contaminants, and nutrients are the major pollutants affecting water quality.

Suspended solids reduce instream visibility, clog gills and in some instances abrade organisms that live within the water body. Biochemical oxygen demand is essentially a measure of the rate at which organisms use oxygen. The introduction of organic content can increase the BOD. For example, the decomposition of organic material consumes oxygen, reducing the amount available for organisms within the water system. Toxic contaminants can produce a suite of problems for organisms. Examples include reducing oxygen content in the blood, organ deterioration, mutations and/or increase genetic defects in young. Excess nutrients can cause similar effects of increased BOD. Excess nutrients can cause an increase in aquatic populations, which can reach such levels that they cannot be supported within the system. These organisms die and decompose and remove oxygen from the water.

A series of problems arise because Canadians do not really understand the true cost of providing potable water:

1. Our water supply is limited
2. The price charged for water utilities often does not pay for operating and maintenance costs
3. Revenue from providing water utility services does not cover the cost of repairs, upgrades, expansions and replacements to existing water infrastructure
4. Negative environmental impacts of water use

The fact that water is essential to many of our daily activities is undeniable. However, water can be used in a responsible way. The rest of this paper will explore water-pricing options, how water-pricing structures exist in Canada and ways that other communities have found ways to charge accurate prices for water and encourage conservation.

Water Pricing Options

Metering

Using a water metering based pricing system is essentially a 'user pays' system. A user is charged based on the volume of water they use, sometimes with a fix base charge. Water metering can be an effective way to encourage conservation by residential users. Often there is an initial decline in use, with a following rebound period (Loudon, 1994). As long as the pricing structure encourages conservation (or penalizes excessive use) metering will be an effective conservation measure (Loudon, 1994).

Sewer Surcharge

A sewer surcharge is generally a straight percentage add-on to the bill (Loudon, 1994). While this is often used to help recover the cost of treating wastewater it can also be an effective tool in encouraging conservation (Loudon, 1994). A sewer surcharge raises the user's bill by being added on top of the rate the user is charged. If the surcharge is a significant addition users may seek to offset that additional cost by reducing water use.

Increasing Block Rates

This is a 'class-based' charging system. The first block of each class is designed to encompass the average water consumption of a customer in that class (ex. a family). Consumption beyond the initial block is charged at a higher rate. This can be an effective way of encouraging water conservation, as long as the price difference between subsequent blocks is significant (Kitchener, 2007).

Declining Block Rates

A declining block rate is also a 'class-based' model. Often accompanied by constant service or basic fee charge, the cost per unit decreases as consumption increases. The amount of the constant charge is often dependent upon the size of the connection (Kitchener, 2007). Often the initial block rate is based on the expected consumption for a family, the second block rate is designed for the consumption for most middle-sized commercial customers and the third block is based on consumption for larger commercial customers (Kitchener, 2007). This method is thought to discourage water conservation, as cost decreases with increasing volume.

Constant Unit Charge

This is a very simple, volumetric based pricing option. A constant unit rate is constant rate per unit consumed. However, this pricing option is unlikely to cover the cost of providing water because the marginal cost is not constant (Kitchener, 2007). The marginal cost is dependent upon the quantity of water consumed. Kitchener (2007) states that this form of water pricing does not encourage water conservation in that it can conceal the true price of water production.

Flat Rate Charge

A flat rate system charges each user the same amount regardless of volume of water used. This rate system does not give users any real sense of the true value of water. It also does not directly encourage conservation or thoughtful usage. It is easily understood by the users and presents stability for the utility managers in providing a predictable income per user (Source, 2005).

Property Tax (Ad valorem taxes)

In this charging system the costs of operating and maintaining a wastewater plant based on the assessed value of the user's property. The logic behind this system is the higher the value of the property, the greater the ability to pay for services (Myers, 1998). However the relationship between usage and property value is not necessarily strong or even present. To address this disparity some utility providers include a significant fixed charge to moderate the variability in charges due to different property values.

Seasonal Rates

This charging system takes into accountant that water usage varies throughout the year. For the peak season (time of year when water use is at its highest) users are charged at a higher rate. This is implemented to cover the increased cost of providing additional water (Kitchener, 2007). Generally, in Canada, peak season is the summer due to residential lawn watering. The summer rate is applied to all users and based on the user's winter usage patterns. By charging a seasonal rate, the variable capital costs are covered by peak season water use and marginal operating costs are covered by off peak usage (Harris, 1994). This type of pricing mechanism is generally well understood by users and can be effective in encouraging conservation during the peak season.

Peak load Pricing

This pricing system is similar to that of seasonal pricing in that it seeks to charge extra during times of maximum usage. However the theory of peak load pricing recognizes that water demand varies not only seasonally but daily and hourly. This variation in demand influences capital costs of water utilities, in that the infrastructure must be able to support peak demands (Harris, 1994). However daily or hourly peak load rates is not a practical solution because water meters are not read with that sort of frequency.

Water Pricing in Canadian Municipalities

The 2004 Environment Canada Municipal Water and Wastewater Survey report (previously Municipal Water Use and Pricing Survey) presented how municipalities charged for water:

- 37% of Canadian households pay a flat rate for water
- 62% are charged based on the volume of water consumed. Volumetric pricing breaks down into three general categories:
    - 39% are charged at a constant unit price
    - 13% are charged at a declining block rate
    - 10% are charged at an increasing block rate

The results of this survey indicate that users who pay a flat rate use 70% more water than users who are charged on a volume based system. Based on this, it seems correct to assume that volume based charges (essentially user pay) are much better conservation tools than flat rate structures. Aside from the environmental benefits of conservation, there is also the financial benefit on the part of the utility commission. By reducing the volume of water consumed, the amount of water that needs to be treated also reduces. Therefore, if the volume of water treated by a plant decreases by 30% and all else being equal, the life of that treatment plant has also been extended by 30%. This can mean savings in terms of hundreds of thousands of dollars by deferring upgrades or replacements.

By adopting water pricing structures that are more representative of the true cost of water (generally through user pay structures) conservation can be encouraged, as long as there is a financial advantage to consuming less water. There are obvious advantages to infrastructure with water conservation. However, changing and often increasing the price of water to better reflect its true cost can be a struggle for the public. How can the true cost of water be reconciled with the public perception of the cost of water? Below are case studies of towns, cities and municipalities that introduced water-pricing systems that were more representative of the true cost of water and often encouraged water conservation.

Pricing structure	Brief description	Pros	Cons	Examples
Metering	User is charged based on the volume of water they use	- Sufficiently covers cost of producing potable water - May encourage water conservation which can increase the life of water infrastructure - Easily understood by public	- Public opposition to changes in water bill - Cost of meters	Port Alberni, BC Saugeen Shore, ON Vernon, BC Kelowna, BC Savings range from 2 million $50 million
Sewer surcharge	Straight percentage add-on to the bill	- Can be an effective water conservation tool which can increase the life of water infrastructure	- Public opposition to changes in water bill	Sarnia, ON Region of Peel, ON
Increasing block rate	Rate blocks are developed based on volumes of water used. As the amount of water increases, so does the price	- Can encourage conservation which can increase the life of water infrastructure	- May not cover the cost of producing potable water	Cochrane, AB Okanogan Valley, BC
Declining block rate	Rate blocks are developed based on volumes of water used. As the amount of water increases, the price decreases	- Can encourage/support commercial and industrial operations	- Does not represent true cost of water - May encourage wasteful water use which could lead to premature wear on water infrastructure	Winnipeg, MB
Constant unit charge	Constant unit rate is constant rate per unit consumed	- Easily understood by public	- Does not represent true cost of water - May encourage wasteful water use	Niagara, ON Unable to cover costs, therefore had to

				implement volume based structure
Flat rate charge	Each user the same amount regardless of volume of water used	- Easily understood by public - Constant income for water provider	- Does not represent true cost of water - May encourage wasteful water use which could lead to premature wear on water infrastructure	Fort Frances, ON Prince George, BC
Property tax	Fee is based on the assessed value of the user's property	- Easily understood by public	- Does not represent true cost of water - May encourage wasteful water use which could lead to premature wear on water infrastructure - Public opposition to obvious inequalities in individual charges	Corner Brook, NL
Seasonal rate	Users are charged a higher rate during peak season	- Easily understood by public - May encourage water conservation which can increase the life of water infrastructure - Sufficiently cover costs of extra water	- Public opposition to changes in water bill	Windsor, ON Columbia, MO, USA
Peak load pricing	Users are charged a higher rate for weekly/daily peaks	- Represents true cost of water	- Impractical	No examples found

Community Case Studies

The CWWA has a database of water efficiency case studies that is called "Water Efficiency Experiences Database". The case studies described here are examples taken from that database.

Port Alberni, BC: Metering

Population Size: 18468
Timeframe Start: 1/1/1998
Timeframe End: Ongoing

In 1998 the City of Port Alberni installed approximately 6,000 meters as part of a universal metering study and pilot program with the plan to implement a metered rate plan in 1999. The cost of the activities includes: metering study $40,000; installation of residential meters $2.1 million; and installation of commercial and industrial meters $500,000. As a result of the metering and rate structure Port Alberni deferred the cost of finding a new water source, which they estimated to be $50,000,000.

Saugeen Shores, ON: Water Meter Installation and Retrofits to Postpone a Water Plant Expansion

Population Size: 6500
Timeframe Start: 7/1/1991
Timeframe End: 7/31/1992

To avoid a water plant expansion, the Town installed meters and encouraged a voluntary water conservation retrofit program. 2400 residential and commercial meters were installed and paid for by instituting a 2-year levy on taxes. Over 70% of residents voluntarily installed water efficient showers and faucet aerators during meter installation. As a result water and wastewater plant operating costs declined by $12,000 per year and the water plant expansion has been deferred for 8 years. It is apparent that it has been deferred indefinitely.

Vernon, BC: Universal Water Metering

Population Size: 32500
Timeframe Start: 1/6/1992
Timeframe End: 1/31/1993

January 1993 water meters and conservation installed devices for all residential municipal water users. As well a new rate structure was implemented. Based on 6 years of data, the residential savings are 34% as compared to consumption prior to metering.192 million gallons of water are saved per year. This is

34% water savings in a year, and additionally there is a 5% wastewater savings per year. Financially low water users save up to $60 per year. As a result of the project and the lower pumpage that resulted, the utility saved about $50,000 per year in electricity costs and $3,000 per year in chlorine costs.

Kelowna, BC : Meter Installation and Water Conservation Educational

Population Size: 94000
Start: 3/1/1996
Timeframe End: 3/1/2011

A private company was engaged to supply and install 11,200 residential meters and refurbish/replace 1200 commercial meters. This resulted in 100% metering of all user's between April and November 1996. Rates were changed from a flat rate to billing based on metered consumption. Since 1997 when the water meter rates were introduced there has been a 21% increase in water savings. The city calculates that it will save at least $600,000 over a 20-year period in reduced water pumping costs.

Convincing the Public

When it came to convincing the public that implementing a 'user pay' pricing structure there were a variety of methods. In Vernon they paired the installation of meters with water conservation devices and quadrupled flat rates for homeowners who refused to have a water meter installed. Kelowna launched an educational program in conjunction with the metering program to explain new rates and the impact of seasonal water use on the bill.

Education seems to be the key. Citizens need to know the true cost of water and understand that our water supply is not boundless. Also important is providing clean examples of how citizens can reduce their water bills by taking advantage of water saving tools such as toilet dams, faucet aerators and low flow shower heads.

There is a variety of material available on introducing water efficiency to your community. A list of these resources is provided here.

- Canadian Council of Ministers of the Environment, Q&A the Benefits of Water Efficiency http://www.ccme.ca/assets/pdf/pn_1188_e.pdf
- Water Efficiency, Region of Durham Program, http://www.durham.ca/waterefficiency/
- Toronto's WaterSaver Program, http://www.toronto.ca/watereff/index.htm
- City of Prince George, Universal Metering, http://www.cwwa.ca/WEED/Record_e.asp?ID=250

- City of Vernon, Universal Metering, http://www.cwwa.ca/WEED/Record_e.asp?ID=57
- Kelowna, Universal Metering and Water Conservation Education Program, http://www.cwwa.ca/WEED/Record_e.asp?ID=155

Conclusion

"Water management must effect changes in demand, not supply. This approach is necessary as untapped sources of water are becoming rarer, and the depletion and contamination of groundwater sources are further limiting supplies" (Meakin, 1993). Implementing a user pay charging system can reduce water consumption and also more accurately represent the true cost of water.

References

Coursey, D. (2006). An Economist's First Impressions of the Water Industry. Expert Workshop on Full Cost Pricing of Water and Wastewater Service conference summary notes. Michigan State University. November 1-3, 2006. Retrieved on January 28, 2009 from
http://www.epa.gov/waterinfrastructure/pdfs/workshop_si_fullcostpricing.pdf

Harris, J. (1994). Practical Modifications to the Theory of Marginal Cost Pricing in Municipal Rate Setting for Water Utilities. Presentation article from Every Drop Counts. Ontario. Pp. 239-248.

Jane Goodall Institute of Canada (2009). Water in Canada. Retrieved February 27, 2009 from: http://www.janegoodall.ca/project-blue/WaterinCanada.html

Loudon, R.M. (1994). The Influence of Water/Wastewater Rates on Water Use. Presentation article from Every Drop Counts. Ontario. Pp 249-268.

Kitchener, H. (2007). Financing Water and Sewer Systems in the GTA: What Should Be Done? Residential and Civic Construction Alliance of Ontario. Retrieved on November 13, 2008 from:
http://www.rccao.com/research/files/HarryKitchenerfinalreport-july9-2007.pdf

Meakin, S. (1993) Municipal water issues in Canada. Retrieved on February 5, 2009 from: http://dsp-psd.pwgsc.gc.ca/Collection-R/LoPBdP/BP/bp333-e.htm#(57)end

Myers, S. (1998). Urban Wastewater Projects – A Layperson's Guide. European Water Pollution Control Association. Hennef. Retrievied January 29, 2009 from:
http://nzdl.sadl.uleth.ca/cgi-bin/library?e=d-00000-00---off-0cdl--00-0--0-10-0---0---0prompt-10---4-------0-1l--11-en-50---20-about---00-0-1-00-0-0-11-1-0utfZz-8-00&a=d&c=cdl&cl=CL4.55&d=HASH015a066b1e5b431e61cba19e.10.5

Real Estate Institute of Canada (2002). Water Conservation Every Drop Counts. Retrieved January 29, 2009 from:
http://www.ec.gc.ca/water/en/info/pubs/FS/e_FSA6.htm Last updated: July 23, 2008.

Source, The. (2005). Utility Rate Structures – What is Right for You? A publication of Advanced Engineering and Environmental Sciences, Inc. Retrieved on January 29, 2009 from: http://www.ae2s.com/pdf/Source/1stQuarter05.pdf.

Water Governance. Canada's Myth of Water Abundance. Retrieved January 29, 2009 from:
http://www.watergovernance.ca/factsheets/pdf/FS_Myth_of_Water_Abundance.pdf

Water Governance. Water Use and Consumption in Canada. Retrieved January 29, 2009 from: http://www.watergovernance.ca/factsheets/pdf/FS_Water_Use.pdf

Water Governance. Water Pricing. Retrieved January 29, 2009 from: http://www.watergovernance.ca/factsheets/pdf/FS_Water_Pricing.pdf