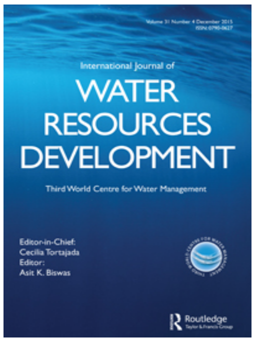


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# Applying water soft path analysis in small urban areas: four Canadian case studies

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Water soft paths begin from the vision that future water management has more to gain from reducing demand than from increasing supply. This article reviews three case studies of water soft path analysis in small urban areas in Canada, and one study of an urban planning process incorporating soft path concepts. The analytical studies indicate how communities can avoid the need for expansion of water infrastructure with negligible impacts on lifestyles or livelihoods. The planning study demonstrates that it is possible to introduce water soft paths early in a review, and that this will stimulate more ecologically sensitive thinking among citizens, officials and political leaders. Similar conclusions can be expected from soft path studies in urban areas elsewhere in the developed world.

**Keywords:** Canada; water soft paths; water demand management; urban water management; urban water planning



## Introduction

Water soft paths seek to resolve water supply–demand disequilibria by reducing demand rather than by increasing supply. More specifically, the soft path approach seeks alternative designs for water withdrawal, use, recycling and disposal in ways that supply the appropriate quantity and quality of water for human needs while ensuring that ecosystems retain the quantity and quality of water they need for viability (Brooks, 2005; Brooks & Brandes, 2011; Brooks, Brandes, & Gurman, 2009; Gleick, 2000, 2003).

Though the vision of water soft paths has been fairly well developed in the studies cited above, application of that vision to specific areas has been limited to studies in Canada (Brooks et al., 2009). Application of water soft paths to urban areas was pioneered by a study of a generalized urban area based on characteristics from a number of communities across Canada to create a 'typical' Canadian urban area (Brandes & Maas, 2009). This initial study suggested that applying water soft path measures could reduce urban water use by nearly half over a 30-year period, despite significant population growth. The purpose of this article is to test that tentative conclusion by review of four small urban areas in Canada where additional soft path analyses and pilot projects have occurred:

(1) Fergus and Elora, Township of Centre Wellington, Ontario
(2) Morden and Winkler, southeast Manitoba
(3) Abbotsford and Mission, suburbs of Vancouver, British Columbia
(4) York Region, north of Toronto, Ontario

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The first three case studies are restricted to the analytics of water soft paths. They demonstrate *what could be* if soft path recommendations are implemented. The fourth describes how soft path concepts and principles have been introduced into a planning process that is part of York Region's long-term water strategy.

The article is divided into five main sections. The Materials and Methods section reviews the differences between water demand management (WDM) and water soft path (WSP) approaches, and explains the focus on small urban areas rather than large cities or rural areas. The Analytical Results section presents the three analytical studies, and the Planning Process section, York Region's water planning process. The Discussion section compares water soft path results with alternative conventional approaches, and is followed by the Conclusions section, including comments on extending the work to urban areas outside Canada. The appendix provides reference material for the four case studies, each of which is itself a summary of reports submitted to urban or regional authorities.



## Materials and methods

### *Differences between water demand management and water soft paths*

WDM has long been in the tool kit of water managers as a way to economize on the use of water during peak-use periods or to 'buy time' until the next major supply project comes on line (Brandes & Ferguson, 2004; de Loë, Moraru, Kreutzwiser, Schaefer, & Mills, 2002; Furlong & Bakker, 2007). Furlong and Bakker (2007) suggest that demand-side management is motivated by scarcity rather than management philosophy, and as a result programmes tend to be limited and temporary. Even when a part of management philosophy, WDM is still limited in scope because the key criterion for acceptability of a demand management measure is economic efficiency – most commonly equated to cost-effectiveness. WDM is therefore an extension of environmental economics to include water use and water disposal. While a significant improvement, it still continues to view the economy as outside both society and the ecosystem.

In WSP analysis, WDM is not ignored; it is just the starting point. While WDM focuses largely on how to deliver and use water more efficiently, WSP questions why we use water at all, particularly for such uses as moving wastes or growing lawns. It also asks to what extent high-quality water can be replaced by lower-quality water, such as reused water, as part of cascading or recirculating systems. Because it seeks a balance among economic efficiency, social equity and ecological sustainability, and because it sees the economy as a subset of both human society and the ecosystem, WSP approaches are appropriately seen as a form of ecological economics (Daly, 1977; Victor, 2008).

Whereas most WDM measures of water efficiency are easily quantifiable, the same is not true for WSP measures. Compendia of water demand measures are available with quantitative examples of savings from best practices and more efficient appliances in North America (Alliance for Water Efficiency, 2010; Brandes, Maas, & Reynolds, 2006; Vickers, 2001). Nothing comparable exists for WSP measures, and even tentative measurement is complicated because the effort to achieve a triple bottom line brings human values and choices to the fore. As a result, WSP measures may not always be cost-effective in the common sense of the term. To complicate things still further, implementation of most WSP measures depends to some extent on changes in water-use habits and practices, which are ruled out in WDM analysis (Brooks, 2006). Indeed, this characteristic is a major reason why WSP approaches must be coupled with active outreach and political engagement.

The conceptual differences between WDM and WSP lead to different analytical approaches. Most importantly:

- WDM analysis generally aggregates water-saving measures that are economically efficient to determine potential savings; it moves from action to goal, and primarily employs a projection or forecasting approach.
- WSP analysis starts by identifying the water savings needed to achieve ecological sustainability and then selects a suite of measures adequate to achieve the goal; it moves from goal to action, and primarily employs a scenarios or backcasting approach.

### *Why start in small urban areas?*

Though there is potential for major gains in both water-use efficiency and water conservation throughout society, initial work in urban, rather than rural, areas offers the advantage of analytical simplicity.

- Almost all urban water is delivered at potable levels, and almost all wastewater is collected and treated. This simplifies water balances in urban areas.
- Almost all urban water is priced, though not necessarily per unit of withdrawal or use. This permits simple calculations of cost-effectiveness in urban areas.
- Few urban commercial or industrial operations exhibit a strong direct relationship between rates of water use and corporate income. (Breweries and soft drink bottlers are among the exceptions.) Therefore, WDM and WSP measures can be examined in urban areas without concern for significant income loss to commercial operations.

Finally, why focus on *small* urban areas? Simply, being smaller in size, they are less expensive to study. Among other reasons, they also have fewer industrial or agricultural facilities that require on-site visits to judge the nature and extent of soft path opportunities. Finally, because one commonly finds closer (almost communal) linkages amongst water suppliers, water users, and relevant government agencies in smaller cities, our experience suggests that it is easier to move from research to action in these areas. As analysts, we are confident that the methodological approach would hold, but do suspect that adjustments would be needed to address the greater complexity of larger cities.

### *Methodology: three case studies of urban WSP analysis*

The three analytical studies reviewed in this article use a common methodology, as described by Brooks and Holtz (2009). Specifically, they are built around one projection and two scenarios:

- business-as-usual (BAU) projection
- water demand management scenario
- water soft path scenario

Each of these studies incorporates projected rates of population growth and some economic growth, but also maintains high quality of life for residents and enough water to attract new business. Some have agricultural components in the peri-urban areas of the city; others do not. The BAU projection is based on extending current water-use rates forward for 20 years or more on the basis of population and economic forecasts for the area under study without any change in water-use patterns or deployment of new technologies.

To develop the WDM and WSP scenarios, different packages or 'suites' of water-saving measures and practices were applied to the BAU projection. Because we lacked good information on ecosystem viability, we assumed that existing withdrawals do allow adequate flows and stocks of water in the ecosystem. By adopting an interim goal of no increase in water supply ('no new water'), no greater volume of fresh water would be needed in the final year of the study than is being delivered today, and therefore no greater environmental damage.

The summaries of the three analytical studies all have a similar internal organization. After a brief geographic introduction, three subsections follow: water sources and uses; water demand management scenario; and water soft path scenario. In most cases, the scenarios were developed using the WaterSmart Scenario Builder (Maas & Maas, 2009). All three analytical studies are truncated. They do not incorporate the planning and public consultation necessary to choose which specific water soft path is the most appropriate to the area being studied. These steps are illustrated in the York Region planning case study.

## Analysis of soft path potentials

### *Fergus and Elora, Ontario*

This section summarizes the report prepared by Maas and Porter-Bopp (2011, see appendix) in response to the request by the Grand River Conservation Authority, in partnership with other groups, for an assessment of the potential to improve water sustainability planning in the region.

The Township of Centre Wellington (TCW), including the small cities of Fergus and Elora, is located in the Grand River watershed in Ontario. The proximity of Fergus and Elora to the universities and high-tech industries of the region of Waterloo and to the city of Guelph, combined with the area's natural beauty, is attracting new residents. Population is expected to double by about 2040, which leads to a perceived need for costly infrastructure to supply more water.

#### *Water sources and uses*

The TCW region is dependent on groundwater, and the existing supply system is projected to require expansion by 2028 (Grand River Conservation Authority, 2000). The residential sector in Fergus-Elora consumes 61% of average daily water deliveries. Mainly because of outdoor uses, daily water use rises significantly in summer. Non-residential sectors account for close to one-quarter of total annual average daily water use, and the remaining 15% is non-revenue water, including water losses. The highest-volume water users in TCW are the hospital, two adult care facilities, and an industrial plant that manufactures polymers.

Fergus-Elora has an average per capita residential use rate of 191 litres per capita per day, which is low by North American standards. This low rate probably stems from earlier programmes to encourage conservation, including changes to the Ontario Building Code in 1996. TCW also has universal metering. More than 70% of homes have low-flow toilets; nearly half have low-flow showerheads and faucets; and 30% have front-load clothes washers.

Based on a BAU projection, annual average daily water use for the combined system of Fergus and Elora would rise from about 5200 cubic metres per day ($m^3$/d) in 2008 to 8300 $m^3$/d in 2028 and 10,500 $m^3$/d in 2040. Maximum daily use is projected to rise from nearly 7900 $m^3$/d in 2008 to 12,800 $m^3$/d in 2028 and 16,000 $m^3$/d in 2040. TCW will be approaching system capacity in 2028 based on maximum daily use.

Table 1. Summary of scenario results for water use in the Township of Centre Wellington.

| | Current | BAU projections | | WDM scenario | WSP scenario |
|---|---|---|---|---|---|
| Year | 2008 | 2028 | 2040 | 2028 | 2040 |
| Population served | 16,581 | 26,924 | 33,804 | 26,924 | 33,804 |
| Maximum daily use ($m^3$/d) | 7,868 | 12,776 | 16,041 | 11,041 | 7,868 |
| Annual average daily use ($m^3$/d) | 5,159 | 8,377 | 10,518 | 7,443 | 5,159 |
| Reduction in average daily use | | | | 11% | 51% |

Source: Maas and Porter-Bopp (2011).

The BAU projection and the WDM and WSP scenarios for Fergus and Elora appear in Table 1; as indicated, the WDM scenario is emphasized in the near term, and the WSP scenario in the longer term.



### *Water demand management scenario*

The WDM scenario aims to defer the need to expand water infrastructure capacity (i.e. 'no new water' until 2028 or beyond), something that can be accomplished by a reduction of 14% in maximum daily use and 11% in average daily use. This goal is sufficiently modest to be readily achievable from an economic perspective. Looking for the largest opportunities suggests a focus on summer water use. A major option would be to discourage automatic irrigation systems in new homes. An additional 20% of outdoor water use could be saved by converting manual watering practices to xeriscaping or letting lawns 'go golden' in dry years. A 5% reduction in non-residential sectors would require a focus on water-intensive establishments, notably the hospital and adult care facilities as well as the polymer plant.

### *Water soft path scenario*

The WSP scenario requires that the community reduce average daily water use by 51% and maximum daily use by 51%, as compared with the BAU projection.

The WSP goal of 'no new water' would require hundreds of fixture retrofits and the most efficient technology in all new institutional and commercial buildings. The largest commercial, institutional and industrial users would have to achieve about a 40% reduction in water use, mainly by eliminating once-through cooling, using non-potable water for toilets, and adopting best management practices in other activities.

The WSP target for per capita residential use by 2040 is a little more than half the target in 2028, and therefore can only be achieved by aggressive measures, including highly efficient technology, significant use of non-potable sources, and behavioural changes – all stimulated by conservation pricing. Water used outdoors would need to be non-potable, or eliminated, by 2040. Use of non-potable water in residences is little tried in Ontario; social acceptance and regulatory measures are unknown. Even so, with appropriate local and provincial leadership, and increases in freshwater prices, the WSP target is considered challenging but feasible.

## ***Morden and Winkler, Manitoba***

This section summarizes the urban portion of a report on the Pembina Valley Conservation District (PVCD) that was prepared for the Manitoba Ministry of Water Stewardship (Forsyth & Brooks, 2011, see appendix).

Along with the rest of prairie Canada, the PVCD, in southeast Manitoba, experiences a wide range of hydrological conditions over the course of a year. It is subject to both spring floods and summer droughts. Two cities, Morden and Winkler (respectively 10,000 and 7400 in population), include about half the population of the PVCD and provide services for the surrounding farms and livestock operations. In recent years, they have also become attractive retirement communities.

Though they are formally voluntary and subject to the wishes of members, experience shows that conservation districts in Manitoba have considerable power to influence decisions. The PVCD was selected for soft path analysis because it has shown itself to be innovative and thus more likely to consider soft path solutions. Though not discussed here, the full study was coupled with outreach programmes to schools, groups of farmers, and community associations.

The BAU projection and the WDM and WSP scenarios for Morden and Winkler appear in Table 2.



### *Water sources and uses*

In contrast to much of the Canadian prairies, southeast Manitoba is relatively well provided with water. There are a number of small rivers and several aquifers, one of which has served the city of Winkler for many years. Despite saline layers at depth, its usefulness for domestic water has been extended for many years thanks to a reverse-osmosis desalination plant. Each of the two cities has its own water and sanitation utility, and, in the near term, is more limited by sanitation capacity than lack of fresh water. The agricultural sector is by far the biggest water user in the PVCD, but its use is negligible within the boundaries of Morden and Winkler.

In recent years, the population in Morden and Winkler has grown at about 1.7% per year. This rate was used for the BAU projection from 2010 to 2030, and 1% was used from 2030 to 2040. Water use grows more slowly because of the ongoing shift toward retirement living, with its lower water use per household. For industry, projected economic growth throughout the PVCD was set at 2.5% per year from 2010 to 2030, and 1.5% per year from 2030 to 2040.

Projected residential water use was based primarily on utility data on household water use. Typical use rates are around 200 litres per capita per day, which is well below the Canadian average. This is probably because the available data ignore water from private wells, which are common in the area. Data on commercial, institutional and industrial water use come from meters; interviews at the more water-intensive establishments; and inferred values based on reports of water-use rates and indicators of size, such as number of employees or number of beds.

Table 2. Summary of scenario results for water use in Morden and Winkler.

| | Current | BAU projections | WDM scenario | WSP scenario |
|---|---|---|---|---|
| Year | 2010 | 2040 | 2040 | 2040 |
| Population served | 17,400 | 26,970 | 26,970 | 26,970 |
| Annual average daily use ($m^3$/d) | 5,253 | 9,120 | 7,291 | 3,779 |
| Reduction in average daily use | | | 20% | 59% |

Source: Forsyth and Brooks (2011).

*Water demand management scenario*

Calculations for WDM measures were based on savings from implementing the measure (technology), and the proportion of the public or of water managers expected to adopt the measure (uptake). Figures for the gains from technical changes are quite robust. This is not the case for uptake. Estimates are based on experience in other parts of North America. We calculate that WDM measures alone could achieve a 20% reduction in average daily use in Morden and Winkler by 2040.

Water use in the commercial sector and in most of the institutional sector is similar to that in the residential sector, but proportions of use differ. For example, toilets account for 40–50% of total water use in schools, compared with 30% in residences. In some cases, establishment-specific information was obtained. For example, the largest water load at the Morden Agricultural Research Station is water-based cooling in greenhouses. The station has plans to replace its existing once-through cooling system with recirculation, which should cut water use by 90–95%. Industrial water use in the PVCD occurs mainly in small operations where process water is only a small increment above water used for washrooms and cafeterias.

*Water soft path scenario*

A wide range of possible soft path measures were considered. However, only the three considered the most likely to be accepted were selected for the WSP scenario. Together with WDM measures, these could achieve a 59% reduction in average daily use in Morden and Winkler by 2040:

- xeriscaping of all lawns in the residential sector
- rooftop rainwater harvesting in all sectors, with a 10% saving from WDM levels by 2030 and 40% by 2040
- greywater toilets in the commercial sector, with 10% savings from WDM levels by 2030 and 25% by 2040

Though uncommon in the region, all three have been implemented elsewhere. For example, Tucson, Arizona, requires all new commercial developments to have a rainwater harvesting plan (City of Tucson, 2008). WDM savings are not enough to meet the ‘no new water’ goal, but adding several WSP measures in the residential sector, and only greywater collection and rainwater harvesting in the commercial and institutional sectors, brings water use in Morden and Winkler well below the 2010 baseline. No WSP measures were applied to the industrial sector because, in the absence of detailed information about demand for the products, there is little difference between WDM and WSP results.

***Abbotsford and Mission, British Columbia***

This section is summarized from a study by Maas and Porter-Bopp (2009, see appendix) that was prepared in response to the request by the Abbotsford/Mission Water and Sewer Commission (AMWSC) for alternative solutions to the region’s growing water problems.

The city of Abbotsford and the district of Mission are found in the lower mainland of British Columbia. The area has experienced considerable growth over the past 20 years. With a population of more than 100,000, Abbotsford is already the fifth-largest city in British Columbia, and its population is expected to reach nearly 200,000 by 2031. Mission expects more moderate growth.

Urban growth in Abbotsford is limited by its geographic setting close to mountains and by the Agricultural Land Reserve that encompasses over 74% of the city's land area. However, existing rates of water use already put stress on the region's water system. The AMWSC currently provides up to 156,000 $m^3$/d, but can comfortably handle only 140,000 $m^3$/d, which means that the system is already working 'beyond capacity' on hot summer days.

The BAU projection and the WDM and WSP scenarios for Abbotsford and Mission appear in Table 3.

### *Water sources and uses*

Water for Abbotsford and Mission comes from local streams and lakes, as well as the transnational Abbotsford-Sumas aquifer. The primary source of water is Norrish Creek, with backup provided by Cannell Lake and 18 wells. Backup is typically needed to meet summer peak use, and for when storms cause high turbidity in Norrish Creek.

Abbotsford is fully metered, but Mission is not metered at all – a difference that explains much of why per capita daily residential use is more than 50% higher in Mission than in Abbotsford. Water use almost doubles during the summer months. Residential use constitutes approximately 50% of the total water use in Abbotsford and 60% in Mission. Indoor water use in residences is about three-fourths of total annual use in both communities.

Potable water supplied by the AMWSC may not be used for irrigation. However, the production and processing of food is important to the region, and municipally supplied agricultural (non-potable) water is allocated approximately 36% to livestock, poultry and dairy operations, 10% to greenhouse operations, and 54% to fruit and other agri-food processing. Collectively, they consume large volumes of water and contribute significantly to the summer peak water use.

The BAU projection assumes the historical per capita use of 285 litres per capita per day and 440 litres per capita per day for Abbotsford and Mission, respectively. Annual average daily water use for the combined system is projected to reach 162,000 $m^3$/d, and peak day use 291,000 $m^3$/d, in 2031.

### *Water demand management scenario*

The AMWSC commissioned a Drought Management and Water Conservation Study in 2006 (Kerr Wood Leidl, 2006) that identified potential water savings of 6–48% of total average daily water use through a series of best management practices such as volume-based pricing, leak detection, and bylaws requiring efficient fixtures for new homes. However, the AMWSC did not begin to implement recommendations until 2010, and even then only adopted some of them. The WDM scenario, which was developed independently

Table 3. Summary of scenario results for water use in Abbotsford-Mission.

| | Current | BAU projection | WDM scenario | WSP scenario |
|---|---|---|---|---|
| Year | 2007 | 2031 | 2031 | 2031 |
| Population served | 132,391 | 254,186 | 254,179 | 254,179 |
| Maximum daily use ($m^3$/d) | 141,600 | 291,800 | 193,000 | 147,000 |
| Annual average daily use ($m^3$/d) | 78,200 | 162,200 | 132,200 | 97,800 |
| Reduction in average daily use | | | 18% | 40% |

Source: Maas and Porter-Bopp (2009).

of the Kerr Wood Leidl study, yields average day reductions from BAU of 18% by 2031, which is in line with targets established by similarly sized municipalities. This value represents a reduction in peak daily use of about 100,000 $m^3$/d from BAU. The techniques involve more efficient toilets and other appliances in homes and other buildings, more efficient lawn and garden watering, and other well-known measures.

*Water soft path scenario*

The WSP scenario requires an absolute reduction of approximately 40% in annual average daily water use over 24 years to meet the target of 'no new water'. The main efforts focus on achieving a 50% reduction in peak daily use through actions that curb outdoor water use for non-essential applications such as lawn watering. The soft path approach was built on the WDM measures by extending them to include rainwater harvesting, grey-water recirculation, and composting toilets. Given the high rate of growth, there is also a heavy focus on ensuring that all new homes have highly efficient landscaping. Some of these options have the further benefit of reducing pollutants flowing into the Fraser River.

Greater attention to the agricultural sector is justified for Abbotsford-Mission, but analysis is limited because data are available only on an annual basis. Even so, water audits of the larger farms should enable municipal staff to recommend water-efficient technologies and practices. In addition, better irrigation systems on farms and recycling systems in greenhouses and food processing plants should improve water-use efficiency by 20%.

The results of both WDM and WSP scenarios are summarized in Table 3. Recently, the two communities have recognized the gains that have been made through water efficiency in recent years; as a result of this downward trend in water use, the communities now believe that development of a new water source can be deferred for the foreseeable future (See the media release dated 26 October 2012: www.mission.ca/wp-content/uploads/Regional-water-and-sewer-press-release.pdf).

## Planning with a water soft path approach

### *York Region, Ontario*

This section reviews York Region's unique planning process to involve the public in an evaluation of the region's alternatives for future water management, as described by Gilbride and Maas (2012, see appendix).

York Region is an upper-tier municipality in Ontario, just north of Toronto. It comprises nine local municipalities and serves as their wholesale supplier of drinking water. Water conservation staff wanted to explore the soft path approach during the 5-year review of their 10-year Water for Tomorrow efficiency and conservation plan. As further incentive, the Province of Ontario required York Region to develop a long-term water conservation strategy before being allowed to expand sewage capacity or increase withdrawals from Lake Ontario.

In response to these pressures, York Region became the first community in Canada to formally set a target of 'no new water' and to base its planning on soft path principles. It also brought its water conservation planning into alignment with its 40-year water and wastewater master plans, which is something that few other communities in Ontario have done. The 40-year planning horizon provides sufficient time to reform management and promote the societal and structural changes necessary to achieve the 'no new water' goal. The following discussion focuses on the public portion of the process, as opposed to the results of the scenarios, which do not differ materially from those described in the

Table 4. Summary of scenario results for water use in York Region.

| | Current | BAU projection | WDM scenario | WSP scenario |
|---|---|---|---|---|
| Year | 2011 | 2051 | 2051 | 2051 |
| Population served | 1,071,100 | 1,800,000 | 1,800,000 | 1,800,000 |
| Annual average daily use ($m^3$/d) | Not available | 400,000 | 350,900 | 155,700 |
| Reduction in average daily use | | | 12% | 61% |

Source: York Region (2011).

analytical case studies in the previous section. Table 4 summarizes scenario results for water use in York Region.

York Region began by asking its project team to review hundreds of water efficiency and water conservation practices from around the world. With this information, York then prepared a high-level, qualitative screen of those practices to develop a suite of potential options for its long-term water conservation strategy (York Region, 2011). The scenario planning also considered provincial initiatives, such as changes to the Ontario Building Code, and incorporated innovations in Ontario's new Water Opportunities Act.

From the start, York Region accepted that stakeholders needed to be become involved. However, a history of adversarial public consultation and public weariness of excessive environmental messaging indicated that a new approach was needed. This new approach revolved around creating a group of individuals who could serve as change agents to engage with the wider public. Notably, rather than merely asking people for their opinions about water conservation, they presented open-ended, value-laden questions, such as 'How do you want to live in the future?'

Insights from public events started a public discourse and set the stage for deeper dialogue. A diverse group of stakeholders were invited to participate in a series of Water Cafés to examine the value of water from various perspectives, including attitudes towards the value of water, and how people will live and work in 2051. Woven throughout was the theme of selecting a water strategy to help achieve a vibrant, sustainable future for the region. Suggestions from the Water Cafés were linked with those from the construction, business, research, and technology communities, all of which were seen as strategic partners if the region was to achieve the vision of 'no new water' (York Region, 2011).

The Water Cafés ultimately led to the assembly of a "complex set of ideas for water management and a water future for York Region" (York Region, 2011, p. 43). Collectively, that set of ideas represents the view of stakeholders that, despite population and economic growth in the region, a combination of regulations, outreach and education, new technology and financial incentives would achieve the goal of 'no new water'. These results support the conclusion of Wutich et al. (2013) that people living in relatively water-rich areas are more open to water soft path solutions than are those in water-scarce areas, even if the plans require financial expenditure. York Region appears to have created a model that is robust enough to meet the forthcoming challenges and that will be of value elsewhere.

## Discussion of results

As could be expected, WDM measures dominate the scenarios in early years whereas WSP measures play the greater role in later years. All scenarios depend upon wide implementation of proven, cost-effective WDM measures, such as more efficient fixtures, metering, and leak detection. The WSP scenarios build upon the WDM scenarios, partly by increasing the uptake rate of efficient technologies, and partly by introducing measures that require changes in water-use habits or that are not cost-effective. WSP scenarios also require matching the water quality required for the service with the water quality supplied, for example by use of non-potable water for toilet flushing and lawn watering. Some practices nearly eliminate water use, as by xeriscaping planting or composting toilets.

### *Comparisons with other Canadian cities*

*Table 5* compares the reduction in average daily use (ADU) and percentage reductions per year in each case study for both the WDM and WSP scenarios.[1]

As shown in Table 5, average WSP reductions range from 40% to 60% of ADU over 24 to 40 years, which implies annual reductions between 1.5% and 2.0%. Certainly these reductions require aggressive efficiency and conservation measures. Are they so aggressive that they are politically infeasible? To answer this question, it is useful to compare them with water demand reduction targets proposed by some other cities (large and small) in Canada (Maas & Porter-Bopp, 2009, see appendix):

- York Region, Ontario, has a long-term water conservation strategy that sets goals of using 'no new water' out to 2051 (1.5%/y) and of using less than 150 litres per capita per day by 2051 in the residential sector.
- Peel Region, Ontario, is committed to a 10% reduction in water use between 2003 and 2015 (0.8%/y).
- Guelph, Ontario, is aiming for a 20% (10,600 $m^3$/day) water reduction by 2025 (1.1%/y), with an explicit goal to use less water per capita than other comparable Canadian cities.
- Calgary, Alberta, has a '30-in-30 by 2030' (1%/y) target aimed at accommodating Calgary's future population growth with the same amount of water as was removed from the Bow River in 2003 (Kevinsen, Patrick, & Bharadwaj, 2014). A number of smaller communities in Alberta are following Calgary's example (Strathcona County Utilities, n.d.).
- Dawson Creek, British Columbia, has committed to a volumetric reduction in water use of 20% by 2020 (1.8%/y).
- Vancouver, British Columbia, will reduce per capita water consumption by 33% from 2006 levels by 2020 (2.3%/y) (City of Vancouver, 2012).

Annual reductions targeted today through water efficiency and conservation plans in these Canadian municipalities range from 0.8%/y to 2.3%/y. The reductions required to achieve WSP targets in the four case studies are therefore within the range that is considered feasible in other cities. Of course, each progressive reduction in ADU will

Table 5. Summary of reductions in average daily use (ADU).

| | | ADU reduction | | Annual ADU reduction | |
|---|---|---|---|---|---|
| City/region | Time span (y) | WDM | WSP | WDM | WSP |
| Centre Wellington | 32 | 11%* | 51% | 0.6% | 1.6% |
| Morden and Winkler | 30 | 20% | 59% | 0.7% | 2.0% |
| Abbotsford-Mission | 24 | 18% | 40% | 0.8% | 1.7% |
| York Region | 40 | 12% | 61% | 0.3% | 1.5% |

Note: Percentage per year = $(ADU_{proj} - ADU_{BAU}) \times 100/(ADU_{BAU} \times$ no. of years).
*This is an interim goal based on a 20-year time frame.

become more difficult, because the most cost-effective and the most politically acceptable measures are implemented first. On the other hand, as technology advances, the cost-effectiveness of efficiency and conservation measures will improve, and innovation will reveal new solutions. Throughout, active education and communications programmes will be needed to gain public support for implementation of many water soft path measures.

Supporting these indications from Canadian cities are data from the United States that show both total water use and per capita water use levelling off despite continuing increases of population and GNP (Gleick, 2003). Apart from growing lot sizes, there are few reasons for residential water use to increase with wealth (Cole, 2004). Canada is probably following a similar pattern. Water withdrawals did not increase during the first half of the 1990s, after which surveys of national water use were halted. In 2005, they were re-established, but with an improved survey methodology that does not permit easy comparison with past years. However, there are useful suggestions. For example, average daily water use in Canadian residences dropped by 27%, from 342 litres per person in 1991 to 251 litres per person in 2011 (See http://www.ec.gc.ca/indicateurs-indicators/default.asp?lang=en&n = 7E808512-1).



### *Moving from analysis to implementation in urban areas*

The analyses above indicate that water soft paths are technically feasible, but experience demonstrates that they are practically challenging. Water soft paths inevitably confront the current state of water pricing and social, political and bureaucratic acceptance of traditional means of delivering water to growing populations. Therefore, it is all the more surprising that some communities have embraced long-term water conservation planning and adopted significant targets for reducing water use. What characteristics allow these communities to make such visionary commitments to water conservation? The answer to this question is arguably a research study of its own, but we believe that an important element is the mindset of the people leading the planning process (Molle, Mollinga, & Wester, 2009; Mehan, 2010; Gilbride & Maas, 2012, see appendix).

More specifically, reflection on York Region's process, and our own experience, suggests that a successful soft path planning process requires a champion (or several champions) working in local governments or water agencies who:

- believes in the legitimacy of water conservation as a long-term, viable source of new water
- sees the planning process as adaptive and dynamic
- commits to a long-term goal while embracing the uncertainty of the future
- promotes an optimistic 'we can' attitude.

Even with such champions, soft path planners are apt to come into policy conflict with people in municipal government who are charged with trying to ensure that growing populations and new enterprises have as much water as they want whenever they want it. Though there is too little experience to be definitive, we propose that champions should explain their purposes and processes from the very beginning of the planning process. They must emphasize that soft path alternatives are appropriate for long-term, not short-term, planning, and that planning around scenarios is different from planning around projections. This sort of framing may assist champions in managing uncertainty in the minds of practitioners who are involved, perhaps for the first time, in a demand-focused rather than a supply-focused planning process.

## Conclusions

The four case studies indicate that we can live within our current water budget into the foreseeable future. 'No new water' will not bankrupt us, and we will maintain our current quality of life. Further, soft paths promise a sustainable water future for urban areas – something that no other management philosophy can do because none starts with sustainability as a guiding premise. Results from the three analytical case studies are similar despite their different locations – central Canada, prairie Canada, and western Canada. We are confident that the same would be true for WSP studies of large urban areas, but they would be more complex and more expensive.

In the same way, we are confident that similar results would be obtained from studies of urban areas outside Canada but within developed regions of the world. For example, European cities tend to be denser and, parks to one side, to have less greenery around buildings (Tsenkova, 2005). Such differences will alter specific results, but not the character of soft path analysis. However, in developing countries, with a large proportion of people living in dire poverty, badly leaking water infrastructure or none at all, and an a mixture of planned and unplanned sectors, we are not sure that soft path analysis can be applied without significant adaptation.

Of course, this study could not incorporate all aspects of urban water management. Notably, recent studies show that water is not just under-priced across Canada; price structures are poorly designed (Renzetti, 2009; Brandes, Renzetti, & Stinchcombe, 2010). In addition, as part of the institutional changes required for a soft path, water utilities must shift from earning revenue by selling water to selling water services, including conservation (Mehan, 2009; Totten, Killeen, & Farrell, 2010). Given the many services that water provides, such change is probably advisable in any case, but it becomes essential as successful WDM and WSP programmes cut into a utility's earnings and thereby endanger funding for renewal of existing infrastructure, as well as for new infrastructure in growing areas of the city.

From a longer-term perspective, we suspect that barriers to translation of water soft paths from concept to practice will stem less from lack of analytical support than from lack of active political leadership and imaginative public participation. To embrace the opportunity that water soft paths offer, communities must make a shift in mindset. The water soft path requires shaking off our blinders – sometimes we may not even know we wear them! – and embracing new, and often different, ways of seeing and using water. Then, and only then, will people dealing with water be able to recognize the economic, political and social institutions that impede the achievement of a full soft path for water governance in their community.



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## Note

1. We are aware that the common term in water engineering and planning literature is 'average daily demand' (ADD). However, in the economics literature, 'demand' is a function, generally

relating use to price, not a specific number. Therefore, we have opted to use the term 'average daily use' (ADU), where use is measured by the cubic metre at the first point of entry into the house, the institution, the factory, or the farm, irrespective of whether the use is consumptive or non-consumptive. Conservation or recycling of water will be indicated by lower rates of use and thus lower ADU.

## References

Alliance for Water Efficiency. (2010). *Water conservation tracking tool*. Chicago, IL: Author.

Brandes, O. M., & Ferguson, K. (2004). *The future in every drop: The benefits, barriers and practice of urban water demand management in Canada*. Victoria: University of Victoria, POLIS Project on Ecological Governance.

Brandes, O. M., & Maas, T. (2009). Thinking beyond pipes and pumps: Water soft paths at the urban scale. In D. B. Brooks, O. M. Brandes, & S. Gurman (Eds.), *Making the most of the water we have: The soft path approach to water management* (pp. 113–122). London: Earthscan.

Brandes, O. M., Maas, T., & Reynolds, E. (2006). *Thinking beyond pipes and pumps—Top 10 ways communities can save water and money*. Victoria: University of Victoria, POLIS Project on Ecological Governance.

Brandes, O. M., Renzetti, S., & Stinchcombe, K. (2010). *Worth every penny: A primer on conservation-oriented water pricing*. Victoria: University of Victoria, POLIS Project on Ecological Governance.

Brooks, D. B. (2005). Beyond greater efficiency: The concept of water soft paths. *Canadian Water Resources Journal*, *30*, 83–92. doi:10.4296/cwrj300183

Brooks, D. B. (2006). An operational definition of water demand management. *International Journal of Water Resources Development*, *22*, 521–528. doi:10.1080/07900620600779699

Brooks, D. B., & Brandes, O. M. (2011). Why a water soft path, why now and what then? *International Journal of Water Resources Development*, *27*, 315–344. doi:10.1080/07900627.2011.571235

Brooks, D. B., Brandes, O. M., & Gurman, S. (Eds.). (2009). *Making the most of the water we have: The soft path approach to water management*. London: Earthscan.

Brooks, D. B., & Holtz, S. (2009). Water soft path analysis: From principles to practice. *Water International*, *34*, 158–169. doi:10.1080/0250806090283994

City of Tucson. (2008). *City of Tucson code, Article viii: Rainwater collection and distribution requirements*. Retrieved from http://www.tucsonaz.gov/files/ocsd/CMS1035088.pdf

City of Vancouver. (2012). *Greenest city: 2020 action plan*. Retrieved from http://www.vancouver.ca/files/cov/GC2020-brochure.pdf

Cole, M. A. (2004). Economic growth and water use. *Applied Economics Letters*, *11*(1), 1–4. doi:10.1080/1350485042000187435

Daly, H. E. (1977). *Steady-state economics*. San Francisco, CA: Freeman and Company.

de Loë, R., Moraru, L., Kreutzwiser, R., Schaefer, K., & Mills, B. (2002). Demand side management of water in Ontario municipalities: Status, progress, and opportunities. *Journal of the American Water Resources Association*, *37*, 57–72. doi:10.1111/j.1752-1688.2001.tb05475.x

Furlong, K., & Bakker, K. (2007). *Water governance in transition: Utility restructuring and water efficiency in Ontario*. Vancouver: University of British Columbia, Program on Water Governance.

Gleick, P. H. (2000). A look at twenty-first century water resources development. *Water International*, *25*, 127–138. doi:10.1080/02508060008686804

Gleick, P. H. (2003). Global freshwater resources: Soft-path solutions for the 21st century. *Science*, *302*, 1524–1528. Retrieved from http://www.jstor.org/stable/3835774

Grand River Conservation Authority. 2000. *Wellington groundwater management study*. Ontario Ministry of the Environment.

Kerr Wood Leidl. (2006). *AMWSC drought management and water conservation study*. Burnaby: Author.

Kevinsen, J., Patrick, R. J., & Bharadwaj, L. A. (2014). A framework for assessing effective urban water management: Lessons from the Canadian Prairie. *Water International*, *39*, 113–127. doi:10.1080/02508060.2014.865300

Maas, C., & Maas, T. (2009). Turning principles into practice: The WSP scenario builder. In D. B. Brooks, O. M. Brandes, & S. Gurman (Eds.), *Making the most of the water we have: The soft path approach to water management* (pp. 104–113). London: Earthscan.

Mehan, III, G. T. (2009, March 31). EPA's role in promoting water use efficiency. Testimony before the Subcommittee on Water and Wildlife, Senate Committee on Environment and Public Works, Washington, DC. Retrieved from http://www.epw.senate.gov/public/index.cfm?FuseAction=Files.View&FileStore_id =94d659a0-fda0-4b9c-b132-21af3e482bd2

Mehan, III, G. T. (2010). A symphonic approach to water management: The quest for new models of watershed governance. *Journal of Land Use and Environmental Law*, *26*, 1–34. Retrieved from http://heinonline.org/HOL/Page?handle=hein.journals/jluenvl26&collection=journals&page=1#3

Molle, F., Mollinga, P. P., & Wester, P. (2009). Hydraulic bureaucracies and the hydraulic mission: Flows of water, flows of power. *Water Alternatives*, *2*, 328–349. Retrieved from http://www.water-alternatives.org/index.php/alldoc/articles/vol2/v2issue3/65-a2-3-3/file

Renzetti, S. (2009). *Wave of the future: The case for smarter water policy*. (Commentary No. 281). Toronto: C.D. Howe Institute.

Strathcona County Utilities. (n.d.). *Water conservation, efficiency and productivity plan*. Sherwood Park: Author.

Totten, M. P., Killeen, T. J., & Farrell, T. A. (2010). Non-dam alternatives for delivering water services at least cost and risk. *Water Alternatives*, *3*, 154–177. Retrieved from http://www.water-alternatives.org/index.php/volume3/v3issue2/90-a3-2-13/file

Tsenkova, S. (2005). *Urban sustainability in Europe and North America: Challenges and opportunities*. Calgary: Faculty of Environmental Design, Research Series. Retrieved from http://www.ucalgary.ca/cities/files/cities/UrbanSustainability-English.pdf

Vickers, A. (2001). *Handbook of water use and conservation*. Amherst, MA: Waterplow Press.

Victor, P. A. (2008). *Managing without growth: Slower by design, not disaster*. Cheltenham: Edward Elgar Publishing.

Wutich, A., White, A. C., Roberts, C. M., White, D. D., Larson, K. L., & Brewis, A. (2013). Hard paths, soft paths or no paths? Cross-cultural perceptions of water solutions. *Hydrology and Earth System Sciences Discussions*, *10*, 7809–7835. doi:10.5194/hessd-10-7809-2013

York Region. (2011). *Long term water conservation strategy*. Newmarket: The Regional Municipality of York.

## Appendix: Source materials for the four case studies reviewed in this article

Forsyth, S., & Brooks, D. B. (2011). Applying water soft path analysis in an agricultural region of Canada. *Water International*, *36*, 894–907. doi:10.1080/02508060.2011.628568

Gilbride, P., & Maas, C. (2012). *Walking the water soft path: York Region water strategy puts theory into practice*. Victoria: University of Victoria, POLIS Project on Ecological Governance.

Maas, C., & Porter-Bopp, S. (2009). *Soft path for water strategy for the Abbotsford/Mission water and sewer commission*. Victoria: University of Victoria, POLIS Project on Ecological Governance.

Maas, C., & Porter-Bopp, S. (2011). *A soft path strategy for Fergus-Elora, Ontario: A soft path for water case study*. Victoria: University of Victoria, POLIS Project on Ecological Governance.