THE MANAGEMENT AND FINANCING OF DRINKING WATER SYSTEMS: SUSTAINABLE ASSET MANAGEMENT

A Submission to the Walkerton Inquiry by

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Pollution Probe thanks the following:

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ABSTRACT

This paper constitutes a submission to the Walkerton Inquiry. It provides information on how various jurisdictions manage and finance their drinking water systems and proposes a new approach based on the concept of long-term sustainability and the principle of full cost accounting.

Based on our research and analysis, Pollution Probe wants to make the following main points to the Walkerton Inquiry:

- **We are not paying the full cost** of providing safe water and managing our water assets on a sustainable basis. Our water is cheap, compared to all other countries. It is becoming increasingly difficult for water system managers to provide safe drinking water to consumers in the face of pressures to maintain and operate a deteriorating infrastructure while responding to expansion demands for water, and being faced with unstable subsidy and funding programs.

- The provision of safe drinking water is an essential service that must be put on a steady, sustainable, long-term funding basis. A **Sustainable Asset Management** model is proposed for the financing of drinking water systems in Ontario. This conceptual model provides a more systematic, long-term, anticipative and transparent approach to planning and decision-making.

- There are a number of supportive **policy options** that we have identified based on our analysis of policies, practices and procedures in other jurisdictions. We would recommend a closer look at several that seem to be complementary to the Sustainable Asset Management model we propose.

The paper includes:

- An Overview section;
- Annex A — A report by R.V. Anderson Associates which focuses on the financing of drinking water systems, and describes the Sustainable Asset Management model; and,
- Annex B — A report by Stratos Inc. on how other jurisdictions manage and finance their drinking water systems.

1. INTRODUCTION

The reliance of a community on its water services is absolute. Adequate supplies of clean source water and an effective and efficient treatment system and distribution network are critical to the health, security and prosperity of a community, large or small.

In section 2 of this report, we briefly summarize the **challenges, emerging issues and trends** that we face in Ontario. Considerable political, public and institutional attention is now being focused on calls for a safer and more reliable drinking water system.

In section 3 we propose a new approach called **Sustainable Asset Management**; a model for the management and financing of drinking water systems that makes sense for the long haul. Water and the extensive infrastructure required for its collection, distribution and treatment are assets that need to be managed in a manner that protects their value to society. The concept of sustainability and the principle of full-cost accounting together with a long-term, life-cycle approach to protection of these assets (for example, over a 100 year time frame) will be needed in order to meet the needs of future generations. Source water itself is an asset that needs to be part of this long-term approach to asset management.

In section 4, we explore the ways that drinking water systems are being managed and financed outside of Canada. We set out additional **policy options** to consider based on our review of management practices and procedures in other jurisdictions, when determining how best to chart a path forward for Ontario.

2. CHALLENGES, EMERGING ISSUES AND TRENDS

2.1 We are not Paying the Full Cost of our Water

Current rates charged to consumers in Canada are relatively low when compared to other jurisdictions. While it is very difficult to come up with a standard accounting formula for estimating costs amongst and within various jurisdictions, including Ontario, broad conclusions such as are drawn by National Utility Service Inc. are indicative (*National Utility Service,* 1999). As is shown in Table 1, this study demonstrated that Canadians, on average, are charged significantly less for their municipal water supply and water services than other developed countries. Water prices in Germany and Denmark, for example, are about four times greater than Canada's prices — and this is after Canada posted a 100% increase from 1987 to 1999. The Netherlands, France and the United Kingdom have relatively similar water prices, and all are approximately three times higher than those in Canada. Australia and the United States have water prices that are more comparable to Canada's; however, they are still about 10% higher.

Table 1. Consumer Water Prices in Various Jurisdictions

	Country	Cost (US cents/m^3)	% Change from Last Year	12 Year Change
1	Germany	182	0.7	95%
2	Denmark	162	4.5	N/A
3	Belgium	122	0.1	54%
4	Netherlands	119	-0.2	75%
5	France	118	1.3	75%
6	United Kingdom	115	3.2	166%
7	Italy	73	2.1	119%
8	Finland	64	-2.3	N/A
9	Ireland	62	5.0	50%
10	Sweden	56	2.5	6%
11	Australia	55	3.1	-35%
12	Spain	54	1.3	N/A
13	United States	51	-0.5	39%
14	South Africa	50	9.8	N/A
15	Canada	41	3.9	100%

Information compiled from the National Utility Service World Water Cost Survey. Prices are based on prices as of July 1, 1999, for the use of 10, 000 cubic meters of water a year. All prices are in US cents per cubic meter.

A report on the performance and challenges facing water management systems in OECD countries (*OECD*, 1998) indicated that several jurisdictions have adopted a full-cost pricing scheme to recover costs associated with water and water services. The OECD divided water charges into two broad categories: (a) supply; and (b) sewerage and treatment. According to

the report, Australia, Germany, the Netherlands, the UK, France and the USA[1] all use full-cost pricing to determine the appropriate rates for water supply. Of those jurisdictions, all but France and the USA also use full-cost pricing to determine charges for sewerage and sewage treatment. Austria, in contrast, uses full-cost pricing for its sewerage and sewage treatment, but not for supply — most likely because over 80% of drinking water is supplied from private groundwater wells. Canada and New Zealand do not use full-cost pricing to determine rates for either water supply or sewerage and sewage treatment.

The principle of *full cost accounting* was one of six principles of sustainable development endorsed by the Ontario Round Table on Environment and Economy. Full cost accounting demands that "natural assets be fully valued to ensure proper use and allocation, and to make certain that the beneficiary of the activity pays the full price including the cost of any environmental damage and resource use" (O*RTEE,* 1990, p.6). Application of this principle should realize greater economic efficiencies and protection of the resource base (or system) for future generations. It should also lead to better use of existing water management infrastructure and provide a basis for rational assessment and informed decision-making about the need for new or expanded infrastructure.

2.2 Pressures on Infrastructure

Thirty years ago the investment costs per capita and per unit of capacity were understood to be rising rapidly due to higher per capita rates of water use, more frequent peaks in demand, the relationship between increasing demand and diminishing sources of clean water, and unchecked urban sprawl. Calls were made for a more rational approach to investment policy in water management (G*rima*, 1972 and 1973). Many of the same conditions apply today; population growth and its associated urban sprawl are hardly emerging issues, as they have been an influential factor in water services planning for many decades. Rapid population growth and urbanization continue to require large investments in water supply and treatment systems, and there is the additional serious problem of the need to repair and renew aging water systems. As a system ages, annual investments need to increase to deal with more frequent breakdown of services, and the cost of renewing and modernizing water and wastewater infrastructure is enormous. The National Round Table on the Environment and the Economy estimates that total capital requirements for maintaining, refurbishing and meeting the demands for new water and wastewater infrastructure will be in the order of $79–90 billion by the year 2015 (*NRTEE*, 1996).

The concept of sustainability suggests the consideration of the investment needs of water distribution and treatment facilities to the end of their useful life, which, as illustrated by historical records (*R.V. Anderson*, Annex A), can be in the order of 100 years for components of the system, such as piping.

In urban and suburban areas that are expected to experience intense population pressures and increased demand for water, delaying future capacity-building decisions could create significant problems for succeeding generations.

[1] Although this paper has referred only to the states of California, Wisconsin, and New York, looking at the USA as a whole remains valid for this comparison.

2.3 Funding Continuity

Especially in recent years, infrastructure funding has been constrained by the fiscal problems facing all levels of government. As the growth in suburban areas places pressure on municipalities to expand municipal infrastructure to serve these areas, the maintenance, repair and replacement of existing infrastructure increasingly has to compete for scarce resources (*CMHC*, 1997). In addition, the politically inspired up and down provision of infrastructure funding from both federal and provincial governments during the past two decades has added to the difficulties of long-term financial planning by municipalities and to the uncertainty of funding availability for all competing municipal service sectors, including water services.

With respect to water services, the challenge facing the deliverers of these services, principally municipal governments, is twofold: to provide the service and its associated infrastructure at the lowest cost possible and to secure the fiscal resources to pay for it. Municipalities use various revenue sources to finance services and infrastructure, including property taxes, provincial and federal grants, user fees (water rates), development charges and borrowing. However, in Ontario, cutbacks at all levels of government, redistribution of responsibilities among provincial and municipal governments, increased demand for water services, and need for expensive infrastructure improvements have forced municipalities to seek new and innovative means to obtain the necessary fiscal resources.

Within water management systems themselves there is competition for fiscal resources between the operations and maintenance responsibilities and the capital spending elements. Traditionally, municipal financial managers determine the budget allocations for operational and capital spending according to broad corporate policy objectives and the availability of funds. Water system managers are constrained to undertake only those capital works that the funding will allow in the budget period. Continuity of funding for multi-year capital programs or for projected needs in future years (if such projections have been encouraged) is not assured by this short-term approach. Application of long-term planning to ensure sufficient capacity in the system for future years requires the more innovative fiscal approach provided by a sustainable asset management strategy.

2.4 Quantity and Quality of Source Water

Managing water system assets for the long haul has requirements and implications that extend beyond the planning, inventory and analysis of the physical and financial capabilities of the facilities and institutions responsible for delivering water services. The source water itself is an asset that has value and needs to be included in the basic inventory of infrastructure assets. An assured supply of clean water is a fundamental prerequisite and, in the long-term planning of a system, consideration must be given to the conservation and protection of the water resource upon which the system is based.

There are increasing pressures on both the quantity and quality of Ontario's drinking water sources. Some of these are factors including demographic trends such as population growth and urban sprawl. Other factors include industrialization, agricultural intensification, local weather patterns and global climatic change, as well as other changes in land use patterns and practices. Because of this environment of constant change, assumptions regarding Ontario drinking water quality must be examined regularly for their current and future validity (*Pollution Probe*, 1999).

Ontario's municipal water systems have two sources of water supply — groundwater reached through wells and surface water drawn from lakes and rivers. The latter source provides more than two-thirds of water to Ontario water consumers. Most of these people have never faced the droughts and shortages experienced in many other parts of the developed and developing world and therefore tend to take a somewhat complacent attitude with respect to the cost and availability of water supply.

Groundwater is a precious resource that must be managed and protected using very long time-frame strategies and approaches. Groundwater has long been considered a safe, protected source of drinking water. However, overpumping of aquifers can eventually lead to serious depletion of such resources, or to the intrusion of poor quality groundwater from contaminated surface waters and from other connected aquifers. The quantity of groundwater has important implications for water quality because reduced flows can aggravate the effects of contamination. Land-use planning and transportation planning decisions also can have a major impact on the sustainability of groundwater resources. The Ontario government, together with other stakeholders, such as municipalities, industry, farmers and environmental groups, must ensure that these resources are protected and managed for the benefit of present and future generations. Source protection should become a priority. Watershed management and source protection programs are especially important in protecting groundwater as a future source of drinking water (*Pollution Probe*, 1999).

Surface water supplies in Ontario are also important to protect. Most of Ontario's major cities draw their water through deep intakes in one of the Great Lakes. Development in suburban areas and intensification of land use in rural southern Ontario are placing extraordinary demands on Ontario's water supplies. For example, the Greater Toronto Area is anticipating a population increase of two million over the next twenty years. Location of that new population will be important to the long range planning of water sources.

These lakes are subject to the influences of human activities (e.g., urban habitation, industry, transportation, agriculture and mining), but the volume and natural purification capacities of the lakes have, to date, minimized the impact of these activities on the suitability of the lakes as drinking water sources (*Pollution Probe*, 1999). Nevertheless, maintaining the generally high quality of the drinking water from the Great Lakes and other inland lakes and rivers, especially in near-shore areas close to major population influences, requires vigilance, and points to the importance to assuring long-term access to clean water of such activities as the Remedial Action Program (RAP) and Lakewide Management Program (LaMP) carried out under the auspices of the Canada-US Great Lakes Water Quality Agreement.

Although industrial water discharges are better controlled today, increased population, urbanization and industrialization continue to contribute, through water and air deposition, to contamination of Ontario's water supplies in the Great Lakes, inland lakes and rivers and groundwater. As monitoring and analytical techniques are becoming increasingly sophisticated, the detection and reporting of toxic pollutants in the province's water sources are becoming more frequent and alarming (e.g., "Hazardous solvents found in drinking water", *Globe and Mail*, March 21, 2001). Of particular concern are bio-accumulated and persistent toxic chemicals, such as PCBs, pesticides, dioxins and other industrial chemicals, as well as heavy metals such as lead, mercury and cadmium. Recent research has confirmed that some persistent organochlorines, such as PCBs, can pose a serious threat to human health by disrupting the human endocrine system, causing reproductive and immune system dysfunction and other developmental disorders. More than 35,000 commercial chemicals are reported to be in use in Canada today, but just how many of these are toxic is not clear. It must be anticipated that, as

further studies are conducted, additional chemicals (and microbiological contaminants) will emerge as substances for which safeguards must be established for both preventing their introduction to water sources and safely treating drinking water supplies

2.5 Climate Change

Climate change is an emerging, long-term issue that is expected to have a major impact on the quantity and quality of Ontario's water resources over the coming 100 years. Over the past century, climates of most regions around the world have been getting warmer. The increase in temperature in the last century is likely the largest of any century in the past 1000 years. The Intergovernmental Panel on Climate Change (*IPCC,* 2001) concludes that these trends reflect a growing influence of human activities, particularly increased emissions of greenhouse gases such as carbon dioxide and methane. Notwithstanding current national and international efforts to reduce greenhouse gas emissions, if the world continues on its present course, the globally averaged surface temperature is projected to increase by 1.4 to 5.8 degrees Celsius by the end of the 21st century. Temperatures are projected to increase even more in Canada over the same period. These changes are predicted to accompany increases and decreases in precipitation and changes in the frequency and intensity of extreme climate phenomena. Water quality and quantity are expected to be particularly vulnerable to climate change, with decreased water availability for populations in many water scarce regions due to changes in precipitation and evaporation.

Great Lakes levels may fall significantly and water flow between the lakes may decrease by as much as 20 percent. While supply is likely to drop under these conditions, the demand for water may increase, not only because of increased population and its associated needs in the warmer climate, but also due to the need for increased electricity generation and other competing municipal and agricultural uses. Clearly, climate change is a long-term issue that requires long-term planning and such consideration is consistent with a long-term sustainable asset management strategy. Ontarians will have to be prepared to learn how to conserve water and may have to pay increased prices to ensure both availability and quality. The move towards full cost pricing of water today could well be the most important decision taken to communicate to consumers the true value of our precious water resources as well as to raise the revenues needed to ensure the long-term integrity and sustainability of our water services.

3. SUSTAINABLE ASSET MANAGEMENT

3.1 A New Approach

The provision of safe drinking water is an essential service that must be put on a steady, sustainable, long-term funding basis. Based on the principle of full-cost accounting, a **Sustainable Asset Management** model is proposed for the financing of drinking water systems in Ontario. This conceptual model provides a more systematic, long-term, anticipative and transparent approach to planning and decision-making.

R.V. Anderson (see Annex A) describes the concept of Sustainable Asset Management and, more specifically, a sustainable infrastructure investment program that helps describe how to walk through the steps of doing it. Pollution Probe realizes that the Sustainable Asset Management concept we propose requires more development and detail to become an everyday operational tool, but we believe that both the concept and the term Sustainable Asset Management are timely and practical and represent a new approach to managing and financing drinking water systems. More development work on the Sustainable Asset Management model is recommended.

The *Sustainable Infrastructure Investment Program* walks through the evaluation of the full life-cycle of a water system by asking six basic questions:

- What do we have? — an inventory of infrastructure assets, including the water
- What is it worth? — total asset value (valuation and replacement value)
- What condition is it in? — relationship of asset condition to age
- What do we need to do to it? — maintenance/rehabilitation/replacement
- When do we have to do it? — life expectancies of system assets
- How much will it cost? — sustainable funding levels

With this approach the impact of annual or at least short-term budgetary decisions on sustainability of a municipal water service can be assessed. The corollary is that long-term financial planning is also undertaken to understand future funding needs and to propose ongoing revenue streams that will be necessary to satisfy these needs.

3.2 Case Study — Hamilton

The Sustainable Asset Management model was tested by R.V. Anderson Associates against actual conditions using the Hamilton Communal Water Systems as an example (see Annex A). The assessment was based on an estimated life expectancy of 100 years for the Hamilton system components, most of which were put in place between 1970 and 1990. As well as useful information on asset inventory, replacement value, system condition and life-cycle cost events, the assessment produced crucial results concerning sustainable funding levels for the system. For instance, the analysis gave an average annual sustainable funding level, for the assumed 100-year life span of the system of $750,000. This is the level of investment required each year for the 100-year life span to ensure that there is the capability to address all projected contingencies in the management of the system. Current water rates, based on average annual consumption, will generate only $175,000–200,000 per year, leaving an annual funding shortfall of $550,000–575,000. Clearly, policy, financial and administrative changes will be required to

address the fiscal imbalance and ensure the sustainability of this particular system. The difference between current revenues and those required to sustain the system over the long term is striking.

The sustainable asset management approach can also be applied to larger water systems, such as the central Hamilton water system, which is an order of magnitude larger than the communal systems, as well as provincial or national scale water management roles. The principal aim of such applications, regardless of the scale of the system, would be to enable authorities to make sound decisions on water systems, at regional, provincial or national levels.

The long-term approach advocated by a sustainable asset management strategy is consistent with other issues confronting Ontario's water supply and distribution systems. Population pressures, the effects of toxic contaminants and the impacts of climate change are all issues that will continue to exert an influence for many generations. Consequently, there is a strong need for a more disciplined and predictable approach to planning and decision-making. There is a need to de-link government funding programs based on short-term political decisions from drinking water management and financing. Safe and secure drinking water is a fundamental societal need and should not be subject to unstable and unpredictable funding.

3.3 The Consumer Has an Important Role

Water consumers include the public, as well as commercial, industrial and institutional users, and they all have a role in helping make wise decisions regarding the long-term sustainability of our water systems. Their involvement is necessary throughout the complete cycle of source protection, water supply access, water distribution and use, and, finally, the treatment of wastewater discharges.

Public and other consumer pressure is already being brought to bear on the political and administrative institutions that manage Ontario's drinking water systems. Such pressure is critical to the encouragement and development of new or improved policies, standards and procedures that will ensure an effective and efficient drinking water system. However, for the sort of long-range planning advocated by a sustainable asset management approach, reliance on crises to provoke public engagement may not contribute to sustainable solutions. A more orderly and predictable method of ensuring and obtaining public/consumer engagement needs to be an element of the sustainable asset management strategy.

Consumers have a right to know and should be informed regularly and periodically about their drinking water quality through consumer confidence reports. They should be provided with an opportunity to provide advice on the level of water quality or service that should be delivered, and of course the corresponding price one should therefore pay. (*Pollution Probe*, 1999)

The consumer is a user or client of the system, both as a generator of demand for water and as a subject of demand management and reduction schemes. The consumer is a financier of the system, through user fees, water rates, property taxes and other financial instruments. The consumer has an impact on the system as a producer of wastewater discharges, and needs to be aware of the impact of these discharges on water source areas.

Consumers should be aware of their role in the drinking water process and ideally should be involved in the planning, decision-making and implementation of the system. This is consistent with provisions in other jurisdictions. In the United States, the Safe Drinking Water Act

mandates public participation programs; similar requirements exist within the European Union and in Australia (*Stratos Inc*. Annex B)

A Sustainable Asset Management approach should be designed to reflect and include consumer participation. The planning and administration of the system should be transparent and allow convenient access to information. System planners and managers should be proactive in the distribution of information and advice to ensure that they build consumer awareness and confidence in the water system. This also ensures that the system operators are in a position to seek consumer support for proposed modifications or additions to the system that may require significant financial or political decisions. Consumer acceptance and support are especially critical with respect to financial decisions that involve local tax issues or increases in user fees or water rates in general.

The Sustainable Asset Management approach requires consideration of the full value of an asset and, as demonstrated in the modeling of the Hamilton Communal Water Systems, could result in increased investment in the system through higher consumer fees. Consumer awareness and acceptance of these implications are necessary for the success of a long-term fiscal approach to drinking water services.

3.4 Management and Governance Implications

Implementation of a sustainable asset management approach to the operation of municipal water systems in Ontario has several important management and governance implications.

While cost continues to be a controlling factor in the planning and operation of water systems, fragmentation of management of municipal water systems due to responsibilities of different levels of government reduces incentives to find and develop economic efficiencies. Today, as noted by Stratos Inc. (Annex B), a patchwork system of water management is still apparent in many jurisdictions. By taking a long-term approach and a full life-cycle view of water resource management and financing, a Sustainable Asset Management strategy has the capability of fostering the integration of the components of Ontario's water management systems.

Water system managers, while carrying out necessary day-to-day functions in running their systems to provide clean and safe water to satisfy demand, and to undertake the necessary care and upkeep of the system, must be cognizant of the longer term pressures on the system, and the need for adaptive planning. Similarly, authorities that influence the budget allocations and investment decisions impacting on the managers and the management of the systems must also introduce a long-term perspective into their analysis and deliberations. An important benefit of the Sustainable Asset Management approach advocated in this research paper would be the implementation of an integrated policy and fiscal framework, amongst all levels of government, to enable the long-term thinking that current and future circumstances demand.

4. POLICY OPTIONS

In Annex B of this report, we explore the ways in which drinking water supply is being managed in jurisdictions outside of Canada. We find that there is no single model that should be emulated. Rather, the patchwork system of management that is indicative of so many jurisdictions is a direct reflection of the jurisdictional, regulatory, and fiscal realities that have evolved in each. This review of management policies, practices and procedures suggests a number of policy options that Pollution Probe believes would be appropriate in an Ontario context, and would be consistent with the Sustainable Asset Management approach we present.

- Australia is the only other country we surveyed, in addition to Canada, where national drinking water standards are actually "guidelines" and are not directly enforceable by law. In the absence of such a system in Canada, it is interesting to look at the recent development of a European Directive on Water Policy, which creates **a regulatory framework** that will promote consistency in policies, practices and procedures across EU jurisdictions. Such an approach should be of interest to federal and provincial governments that share responsibilities for drinking water in Canada. Pollution Probe has called for a single, national and comprehensive health-based regulatory scheme for drinking water (*Pollution Probe*, 1999).

- The most advanced **regulatory and enforcement** systems are found in the United Kingdom and the Netherlands where watchdog inspectorates have been established.

- **Monitoring** drinking water quality is essential and **reporting** this information to consumers is a powerful performance incentive. New Zealand has consolidated its monitoring information in an online searchable database.

- Regular **consumer confidence reports** and State of the Environment reports are a trend among most jurisdictions, with U.S. and European examples showing the most comprehensive programs.

- The importance of **public involvement** in the decision-making process has been recognized by all jurisdictions, although Australia, the Netherlands and the United States are closer to requiring this participation, rather than encouraging it.

- With the exception of the United Kingdom and New Zealand, all jurisdictions analyzed in this report provided some sort of **subsidy** to facilities to assist with supplying essential water services. In the United States, the Drinking Water State Revolving Fund is a source that is available to all states once they have come into compliance with all regulations and standards. Several states have also established Capacity Development Programs to improve the financial, technical and managerial capacity of water facilities. California provides financial support through its California Water Bonds, allowing funds to be directed towards water-related projects.

- Several jurisdictions have specialized **capacity development programs** for small water systems.

- The most comprehensive **source water protection** program is in the United States. Each state is required to develop a Source Water Assessment and Protection Plan, to identify areas of public drinking water, assess water systems' susceptibility to

contamination, create a contaminant source inventory and inform the public of the results. There is a range of programs and legislation in place in other countries including France, The Netherlands, Sweden and Germany. Pollution Probe has called for source protection to become a priority, in Ontario (*Pollution Probe*, 1999).

5. CONCLUSION

In conclusion, this paper proposes a new approach to managing and financing our drinking water systems called Sustainable Asset Management. The concept of long-term sustainability and the principle of full-cost accounting provide a more systematic, long-term, anticipative and transparent basis for planning and decision-making for the benefit of the citizens of Ontario, now and in future generations.

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ANNEX A — SUSTAINABLE ASSET MANAGEMENT

Sustainable Asset Management: Financing Drinking Water Systems

Prepared for Pollution Probe by: R.V. Anderson Associates Limited; Reg Andres

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1. WATER — A VALUED ASSET

Canadians have often heard it stated that one of the most valuable resources or assets we own is a ‘plentiful’ supply of fresh water. One only needs to visit a country or area that does not have access to such an asset to realize what it means in the lives of individuals, in the life of a community and in the viability of a country. The important concept is the fact that fresh water is an asset. It has a value and it needs to be managed in such a way as to protect its value, as with any asset in a business, for the well being and future success of those who use this asset. The inference of protecting this asset leads one to the concept of sustainability — the protection of this asset for the needs of future generations, and the need to manage this asset in order to sustain its value.

One of the most important uses, if not the most important use of fresh water is its consumption by humans. The significance of this concept and of managing this asset to sustain a safe supply of potable water has been highlighted by the tragedy of Walkerton in the summer of 2000. Such an event causes one to take stock of what went wrong and to take measures to avoid a repeat of the same event. This is a multi-faceted problem that needs to address many aspects of water system management.

This paper focuses on one aspect of management as it relates to the financing associated with the upkeep, renewal and overall management of the facilities (i.e.; hard assets such as pipes, pumps and supply facilities) required to provide a municipal water service such as services a community like Walkerton. The focus of the sustainable asset management model presented in this paper is on water supply infrastructure. It is important to recognize, however, that these concepts and the model can be utilized to consider much broader management concepts, including those related to financial decisions associated with the protection of water supplies themselves.

2. WATER SUPPLY INFRASTRUCTURE — PHYSICAL ASSET DEVELOPMENT

The history of the municipal infrastructure that provides the water services to communities across Ontario began in the middle of the nineteenth century, more than 150 years ago. Two critical problems developed during this period as a result of the concentration of human activity in these growing urban centers related to public health (cholera epidemics) and safety (fire) that led to the creation of these systems. Formation of boards of health in Canada's two largest provinces in the 1880's coincided with the development of financial incentives from the fire insurance industry[2] for larger water systems. History also records catastrophic events that identified and confirmed the basic need for these systems and that were instrumental in securing the funding commitments required for their development.

An epidemic, which struck Hamilton, Ontario in the summer of 1854, prompted a competition for the best plan to supply the city with clean water. The historical documentation of many of the growing communities of this era includes horrific stories of cholera and typhoid epidemics resulting in numerous deaths. The reports of medical officials show the clear linkage to the overcrowding conditions of homes in these communities where the sanitation systems consisted of cesspools and outdoor privies. The congestion of homes serviced on this basis contributed to the pollution of their drinking water sources.

The proximity of more and more wooden framed buildings adjacent to each other was a recipe for disaster with fire from one building easily spread to the next. Major devastating and infamous fires are chronicled in the history of some of Canada's major cities during the 1800's and early 1900's (e.g.; the Great Fire of 1877 — Saint John; the fire of 1900 — Ottawa/Hull).

The importance and reliance on an adequate and clean water supply system in sustaining the social and economic fabric of a community is unquestionable. No community can exist without safe and adequate water services. It follows, therefore, that the infrastructure, the physical assets integral to the delivery of a municipal drinking water service, must be managed on the basis of, or applying the principles of, sustainability.

Political pressures associated with reducing public debt, holding the line on tax increases and fiscal responsibility are challenging water supply system managers today in sustaining a minimum level of service and securing the funds necessary to accomplish this goal. The need to identify the appropriate level of funding is of prime importance. Interestingly, there is recorded information about political battles to secure the amount of money required to build these systems at the time they were first being proposed in the 1800's and on into the 1900's. The system managers are still facing the challenge of financial commitments to sustain these systems. The question that needs to be answered is how much funding is required and what information is needed to convince the decision makers to commit to these investments? What is "sustainable funding" — the investment required to sustain a minimum standard of water service to a community — and how can it be determined?

[2] Canadian Public Works Association, Ball, Norman — Senior Editor. 1988. *Building Canada: A History of Public Works.* Toronto: University of Toronto Press.

3. SUSTAINABILITY — THE BASIS FOR AN ASSET MANAGEMENT STRATEGY

The concept of sustainability, as it relates to drinking water infrastructure, must be considered in developing a water system management strategy. An emerging 'business' perspective or approach that can identify the long-term investment required in a water system (i.e., sustainable funding) will incorporate the following concepts in a strategy for sustainable systems:

- **Infrastructure — Asset Value:** As one considers the physical evolution of the pipes, plants and related facilities associated with municipal water services the inherent value of these facilities must also be recognized and managed as any asset in a business. Normal concerns of any investors include the desire that their investments should be secure and managed in a way that ensures maximum return on their investments. Although the focal point of this paper is the physical infrastructure, in a broader context the source water itself should be viewed as an asset and managed with respect to sustainability. This leads to issues such as source water protection and water conservation programs.

- **Lifecycle Management:** The planning and management of a municipal facility has traditionally included the planning, construction, operation and maintenance of a particular asset to provide a basic service such as the supply and distribution of potable water. The concept of sustainability implies this must be taken a step further to include a consideration of these facilities to the end of their useful life. The concepts and principles of good management arising from life-cycle asset management need to be integrated into the overall process.

- **Integrate Financial and Technical Evaluations:** Sustainable or "life-cycle" management of a municipal asset requires the consideration of financial issues. Long-term investment protection, priorities, cost efficiency, asset depreciation, asset replacement and others issues must be evaluated in deciding on levels of investment in capital projects, maintenance, operations and replacement reserves. The municipal manager must fully integrate the technical and financial evaluations to ensure sound decisions in managing the asset through its full life cycle from inception to its ultimate replacement.

4. SUSTAINABLE FUNDING — LIFECYCLE ASSET MANAGEMENT FUNCTIONS

To understand future investment requirements of drinking water infrastructure, it is important to understand the various funding needs an asset will have on an ongoing basis and that may be required at specific stages of its life. Lifecycle asset management involves a series of activities, each of which offers an opportunity to assess appropriate and optimum investment needs. These functions include:

Asset Planning Strategies: Planning asset strategies involve the identification of needs that would warrant the acquisition or creation of new assets. This is a step currently undertaken by water system managers in the form of "master planning" studies and affords the opportunity to assess all costs associated with the lifecycle of the asset (i.e.; a new water treatment plant, new distribution piping, etc.). The costs to be considered include preliminary investigation and feasibility study costs, design and construction costs, operations and maintenance costs, rehabilitation and renewal costs, and replacement or depreciation costs. Planning strategies should identify all of these including cost drivers that could influence future costs and how these will be refunded. Strategic planning based on lifecycle principles offers the best opportunity to identify the most cost effective solutions through the recommendations to create new assets.

Asset Creation (design and construction): The main reasons for creating a new asset are to satisfy or improve a level of service, provide for a new demand from customers or to provide commercial return. An asset management approach will produce solutions creatively and economically by evaluating alternative designs, promoting innovation, simplifying methods and procedures, eliminating surplus items, updating standards, criteria and objectives, and so on. Asset creation affords the most significant opportunity to influence lifecycle costs.

Asset Accounting: This function requires the recognition of all costs associated with owning an asset including planning, design, construction, operations and maintenance, renewal and ultimate replacement. In dealing with the economics of asset ownership, lifecycle cost reduction opportunities must be understood and evaluated. Important issues to consider include:

- Life costs (determination of future costs including general timing for O&M, renewal and replacement costs);
- Risks (failure modes, probability of failures, asset condition);
- Funding (revenue streams, funding sources, financial planning); and,
- Valuations (method of valuation used, asset replacement costs).

In some jurisdictions, the concept of public registry of assets, including information on their value, has been adopted. This concept certainly reinforces the public accountability aspects of asset management.

Asset Operation and Maintenance: These functions relate to the day-to-day running and upkeep of the assets. These costs are generally programmed in a capital plan based on historical experience and general performance of a water supply system. As a system ages, the annual investment program will slowly increase to deal with more breaks, cathodic protection, pressure testing, etc. The annual O&M budget requires input from the system operators to ensure short-term needs are adequate to maintain the asset in good condition to provide water within a minimum standard or level of service.

Asset Condition and Performance Monitoring: Condition and performance monitoring is critical to future failure predictions, determining reasons for performance deficiencies, and determination of corrective actions. This includes estimating residual life relative to rehabilitation requirements and replacement timing.

Asset Rehabilitation/Renewal: Restoration of an asset is required to ensure an asset can deliver an adequate level of service. The key to this function is to understand the different failure modes, when they are likely to occur and the consequences of failure in terms of business risk.

Asset Management and Audit Review: Management and audit reviews establish a continuous asset management improvement program. They are aimed to target three key issues including corporate direction, asset management plan effectiveness and benchmarking against best practices.

Current practices associated with the management of water supply systems generally cover some aspect of the above functions. They are undertaken, however, within different corporate divisions and not necessarily in a comprehensive and integrated program that captures optimum economic returns and efficiencies. For this reason it has been difficult to determine the full cost of managing a water system (i.e., sustainable funding). Historical funding practice has been based on a financial determination of affordability. Public works managers present a long list of projects deemed important to expand, renew, rehabilitate, add functionality and similar rationale for inclusion in a capital plan. Based on a capital spending level determined by the financial managers on the basis of affordability for the community relative to a tax or utility rate deemed politically acceptable, the works department simply cut-off the prioritized project “wish-list” at the approved capital spending level. A new approach based on the principles of sustainability is required to determine sustainable funding for a water system infrastructure.

5. SUSTAINABLE FUNDING — STRATEGIC PLANNING METHODOLOGY/MODEL

5.1 General Outline

A lifecycle asset management approach would differ from the prioritized project method of determining a capital program. A lifecycle approach considers the long-term investment needs (sustainable funding) of the system infrastructure and then determines on a programmed basis, the annual spending that will sustain the level of service provided by the infrastructure assets. Based on the asset management functions described above, these costs include operations and maintenance, rehabilitation and ultimate replacement programs.

Knowledge of current asset inventories, condition, valuations and deterioration rates allows a determination of the long term investment needs at different times in the life of the assets and a subsequent financial plan to address or meet these needs. The determination of the long-term investment need is most appropriately carried out, initially, at a strategic level based on a limited information base. In many instances, this may be adequately determined using surrogate information when direct information is not available or too complex for this first level of estimation. An example of this strategic level of analysis would be the use of asset age as an indicator of asset condition with the assumption of a straight-line rate of deterioration Subsequent evaluations and investment needs can be progressively improved based on additional detailed information but using the same basic economic algorithms.

5.2 A Model — Sustainable Infrastructure Investment Program (SIIP)

A methodology for determining the long-term investment needs of a water supply system has been developed and tested at the municipal level based on the principles described above. This "sustainable infrastructure investment program" addresses the lifecycle aspects by answering six simple questions as follows:

- **What do we have?** This is a basic inventory of the infrastructure assets. Most municipal water system components are readily available. This would include such parameters as pipe lengths, sizes and material, number of service laterals, number and capacity of pumping stations and treatment plant capacities.

- **What is it worth?** (valuation – replacement value) Although not always done, the determination of a current replacement value for the inventoried components is not a difficult parameter to calculate. This would end with a total asset value, by component, for the entire system.

- **What condition is it in?** At a strategic level this question may seem difficult to answer. This is where it becomes useful to use a surrogate indicator for condition. Through a simple process of relating asset condition to its age, and an infrastructure age profile of the system based on population growth over the past 100 years, a general characterization of the overall system can be determined at a high level.

- **What do we need to do to it?** The investment activities for water system infrastructure can generally be identified to include minor maintenance, major maintenance, rehabilitation and replacement. These cost events can be annual programmed amounts, as is the case of the minor and major maintenance activities. They may also be one-time

events like rehabilitation or replacement activities that would occur at a specific time in the life of the asset.

- **When do we have to do it?** One of the more difficult aspects of an asset management program for water system infrastructure is to predict the future condition of a water pipe and the timing for renewal. Many external factors can affect the life expectancy of buried infrastructure. Multiple inspections over several years may be required to ultimately determine specific deterioration rates for these assets in their specific setting. For purposes of advancing the development of a business model, it is reasonable to make an informed estimate of when these events will occur. The sensitivity of these estimates is easily tested with the investment model to determine the impact of different life expectancies.

- **How much will it cost?** The use of the investment model will compute the lifecycle or sustainable funding levels based on the selected parameters. Different cost components can be identified to compare these with the current level of funding (i.e., annual budgets over the past several years) including O&M, rehabilitation and replacement.

Based on the life expectancies of buried water infrastructure reaching, in some instances, as much as 100 years, the financial model can be developed by answering these questions to present a 100-year operating and capital budget. This model could then be used to test the sensitivity of various parameters and variables that offer insights on issues such as the impacts of varying investment levels (i.e., annual budget commitments) or for developing a financial plan (i.e., utility water rate) to achieve a long-term, sustainable level of investment.

Lifecycle asset management is an ongoing process and not a one-time determination. The business model parameters, such as deterioration rates and replacement costs, can and should be constantly improved, thus effectively calibrating the model to the specific conditions associated with the infrastructure in question.

Average annual requirements for operations and maintenance, rehabilitation and renewal would be based on the condition and deterioration of system components as determined from the lifecycle needs of the water system infrastructure. With this approach the sensitivity or impacts of decisions to reduce investment expenditures in a particular year can be tested and long-term financing strategies can be developed to accommodate the financial capabilities of a community.

6. A MUNICIPAL EXAMPLE — HAMILTON COMMUNAL WATER SYSTEMS[3]

The communal water systems in Hamilton were assessed using this Sustainable Infrastructure Investment Program (SIIP) to determine the sustainable funding required and to compare this to the existing level of investment (i.e., annual budget) and revenue from rates. The following summarizes the information for each of the steps in the SIIP for this example.

Inventory: There are four (4) communal water systems in Hamilton servicing approximately 800 customers (service connections). Two of the systems have a fire fighting capability associated with the system, including additional fire storage and fire hydrant connections. Two of the systems do not have fire-fighting facilities as an integral part of the water supply infrastructure. There is approximately 28 km of water mains ranging in size from 50 mm to 400 mm in diameter with 80% of the systems 150 and 200 mm in diameter. The two communities with fire-fighting capabilities collectively include about 160 fire hydrants and 2 elevated storage tanks.

Replacement Value: A component-by-component cost estimate was prepared to determine its current replacement value. All four systems combined, the total asset value or current year replacement value has been estimated to be just over $18 million, split between the systems with fire protection at $15 million and those without fire protection at $3 million.

Condition: System age was used as an indicator of system condition assuming a straight-line deterioration of the infrastructure. All the systems were constructed between 1970 and 1990. Therefore, with an estimated life expectancy of 100 years for the buried pipes, they are only 30 years through their full life (30%) based on the oldest pipes installed. Other estimates for the service life of different components included 20 years for the mechanical and electrical components of pumping stations, 20 years for repainting of the water towers, 60 years for the structural components of the pumping stations and 100 years for the pipe systems.

Lifecycle Cost Events: Component cost profiles were developed based on the four cost events, including minor maintenance, major maintenance, rehabilitation and replacement. Sustainable levels of maintenance costs were estimated using the AWWA Research Foundation formula and determined to be $420,000 annually for all systems combined. This represents approximately 2.3% of the asset value (replacement cost). Rehabilitation costs were estimated conservatively low at 15% of the replacement cost to take place at around 67% of the total service life of the system.

Sustainable Funding: The analysis of these systems, based on the use of the readily available information, resulted in an average annual sustainable funding estimate of approximately $750,000, including operation and maintenance, rehabilitation and replacement requirements over the next 100 years. The current water rates, based on the average consumption in these systems, will collect an estimated $175,000–$200,000 per year. This represents a shortfall of some $550,000–$575,000 per year based on the sustainable funding or long-term investment needs to manage these communal systems. With this simple analysis, it is obvious that some changes are needed to address the imbalance between the revenues generated and the sustainable funding requirements of these communal water systems.

[3] R.V. Anderson Associates Limited, Andres, Reg — Project Manager. 2000. *Cost of Sustainable Service Report for Communal Water Systems.* Hamilton: Regional Municipality of Hamilton-Wentworth (now City of Hamilton).

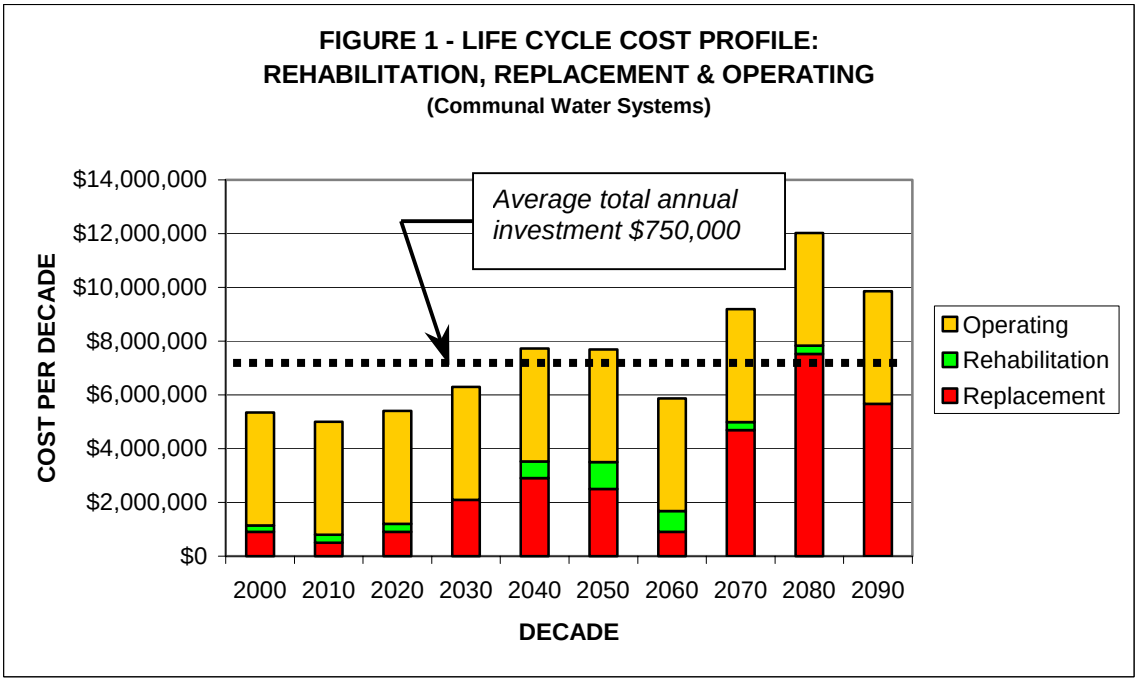

Figure 1 also shows a breakdown of sustainable funding needs for the individual O&M, rehabilitation and replacement programs. Considering the replacement program independently, the figure reflects the fact that the systems are relatively new and will not require major investments for some time. However, it also demonstrates that, under current year dollars, the replacement program needs to collect, on average, $300,000 per year over the full 100-year lifecycle analyzed as a sustainable level of investment for this water service. The current revenues are insufficient to fund even this component of the water system.

7. ASSET MANAGEMENT MODEL — APPLICATIONS

7.1 Assessing Municipal Management Issues

As demonstrated by the above municipal example for a number of small communal water systems, the lifecycle management process provides a capability to analyze any number of issues and their financial impacts with respect to sustainable funding levels.

Wellhead Protection vs. Regional Water Supply: As an example, one of the issues that may evolve from Walkerton is the question of wellhead protection. Once a model has been set up for a system, it would be reasonable to compare the financial impact of the costs associated with a wellhead protection program and build this cost into the model to determine any changes to the sustainable funding calculations. As a comparison, an alternative to hook up the same system(s) to a Regional water supply system could also be built into the model and the cost impact assessed on the sustainable funding calculations. The net comparison between these two options offers a valuable assessment of the financial viability and efficiency of these two approaches for improving the reliability of communal water supplies.

Communal Systems vs. Central Systems: A further application that demonstrates the value of the lifecycle management approach is a comparison that was completed for the Hamilton communal water systems with their larger central water supply system. The central water supply system was developed at a strategic level similar to the communal water systems. One key piece of information not readily available for the central water system was the date of construction. In this instance, the historical population growth data was used as a surrogate for the age distribution by assuming the water systems grew proportional to the population growth over each of the decades when the water system was developing. An age distribution was accordingly developed based on the distribution of population growth in each decade. This was assessed to be a reasonable assumption for the nature of the analysis to be carried out. In the future, the direct age information will be collected and will replace the population surrogate, thus improving the basis of the analysis. The important point to note is the fact that the analysis could be carried out in the absence of an apparent important piece of information, based on the 'top-down' concepts inherent in the asset management approach.

The results of the comparison between the communal water system and the central water system in Hamilton showed that the central water system, based on a lifecycle perspective, cost less on a per service or per person basis, to sustain. Some of the comparisons are noted in Table 1, below.

TABLE 1. COMMUNAL WATER vs. CENTRAL WATER SYSTEMS

Normalized Life Cycle Cost Factors		Communal Water System		Central Water System
		With Fire Protection	*Without Fire Protection*	
1	**Total cost over the next 100 years**	**$61,500,000**	**$12,900,000**	**$7,292,000,000**
2	**Average cost per year** (100 year average)	**$615,000 /yr**	**$129,000 /yr**	**$72,920,000 /yr**
3	**Average annual cost per service** (100 year average)	**$950/service**	**$827/ service**	**$587/ service**
4	**Average cost per ML of water produced**	**$2,230 / ML**	**$1,660 / ML**	**$668 / ML**
5	**Average annual cost per person**	**$317 / person**	**$276 / person**	**$159 / person**

The comparisons can also be made between communal systems with and without fire protection, which might further be assessed against fire insurance premium impacts. Other obvious considerations come into some of these assessments, but it does demonstrate the type of analysis that can be made using this simple financial presentation.

7.2 Assessing Provincial/National Water Policies and Funding Programs

Once an asset management model based on full lifecycle principles has been developed at a municipal level, it can be applied to analyze strategic programs or policies on a much broader base. By rolling up the asset information to a provincial or national level, the financial impacts of proposed policies for water management as well as proposed infrastructure funding programs could be better analyzed.

8. SUMMARY

A higher level of financial accountability is required in the management of the infrastructure that supports the delivery of municipal drinking water supplies. The concept of sustainable asset management is identified in this paper as an approach to meet this need. Sustainable asset management introduces lifecycle assessment techniques as part of the process in determining the long-term investment requirements to sustain this essential service to our communities. This process leads to the identification of sustainable funding levels over the full life of the infrastructure systems and a more complete picture that can be analyzed on a larger Provincial scale, but that is applied at the municipal level.

The most significant change that is needed in the overall management of our water resources and, in particular, the critical drinking water issues is to apply these principles of sustainability at all management levels. The direct responsibility for the development and delivery of a drinking water service rests at the municipal level — the front line when it comes to providing potable water to the residents across the country/province/regions. At the provincial and national levels, various water management policies and programs support the delivery of this municipal service through regulated programs designed to improve source water quality, subsidize certain capital works and so on. It is imperative that the application of the principles of sustainability be applied at all levels.

As a second significant principle, it is also imperative that an investment model used to assess the financial impact of various policies and programs on a sustainable basis is developed for application at the municipal level and subsequently rolled up for application to broader issues of a provincial or national scale. The Sustainable Infrastructure Investment Program presented in this paper is an example of such a model. This concept needs to be promoted throughout the municipal agencies managing water supply systems and it must receive the support of the senior governmental levels encouraging its application at the municipal levels, as well as at the senior government levels.

ANNEX B — MANAGING DRINKING WATER SUPPLY

Managing Drinking Water Supply: An Analysis of Policies, Practices and Procedures

Prepared for Pollution Probe by: Stratos Inc.; David Fairbairn and Mary Jane Middelkoop

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1. INTRODUCTION

Access to a safe and adequate supply of drinking water is something that many Canadians consider a fundamental right. It is often assumed that the water coming out of the tap is safe to drink, and that even in times of severe drought, there will be enough water to supply each and every citizen with as much water as necessary, or even desired. In many instances, these assumptions are correct: compared to other regions around the world, fresh water resources in Canada are indeed plentiful, and relatively clean. But the recent tragedy in Walkerton, Ontario, has changed Canada's outlook on drinking water. Serious doubts about the quality of our drinking water supply has prompted the public and the government alike to question the way Canada manages its fresh water resources, especially when that water is used to supply households with potable water.

Despite the fact that Canada is well endowed with fresh water, it is imperative that these resources be managed in a sensible and sustainable manner. Policies, plans and regulations should provide Canadians with a secure resource that will be able to meet the needs of both the present and future generations. Surface waters and groundwater alike are faced with increasing pressures that result from a rising population: greater demand for public and industrial use; loss of natural areas to urban, agricultural, and industrial development; and increasing threats of pollution from both point and non-point sources.

The situation in Walkerton suggests that Canada's fresh water resources are perhaps more vulnerable to anthropogenic forces than once thought. Drinking water supplies, whether acquired through a municipal system or a private well, are becoming increasingly more polluted – something that the public, as well as those responsible for its delivery, are often unaware of. What is known is that if this disturbing trend is to be halted, and even reversed, then corrective action will have to take place. What is yet to be determined, however, is exactly what form this corrective action should take.

1.1 Paper Objectives

This paper explores the ways in which drinking water supply is being managed in jurisdictions outside of Canada. Supplying a population with abundant and clean water is a challenge that every nation faces, but how this challenge is met varies greatly across jurisdictions depending, among other things, on systems of government, management philosophies, hydrological and geographical attributes, resource needs, and resource availability. By reviewing management policies, practices and procedures in other jurisdictions, we will have a better understanding of the options available to federal, provincial and municipal governments — as well as the public — in setting and achieving desired goals for Canadian drinking water.

1.2 Global Water Challenges

Fresh water resources around the globe are facing unprecedented pressures from a rising human population and increasing urbanization and industrialization. Meeting human, agricultural and industrial demands for water has never been so difficult, and highly stressed water resources in developed and developing countries alike are beginning to create constraints on development and progress. Although considerable progress has been made in policy development, the implementation and enforcement of these policies still lags.

An analysis of water management in OECD member countries (mostly highly developed countries) shows that vast improvements still need to be made in several areas, including:

improving the cost-effectiveness of water management and policies; reducing pollution discharges into water; integrating water management, sectoral, and land use policies; improving groundwater quality; and developing a renewed understanding of the health aspects associated with water management.[4] Furthermore, jurisdictions continue to battle with the challenge of providing their citizens with a safe, reliable supply of drinking water at a reasonable cost. Water supply facilities are under enormous pressure to keep the costs to consumers low, but at the same time they are faced with rising infrastructure, maintenance and improvement costs, increasing regulatory burdens, and a decrease in water quality and quantity. Conflicts over the use of the world's dwindling resources are becoming more frequent, and are also beginning to be waged at an international, rather than local level. Indeed, Canada is not alone in facing the formidable task of ensuring all of its citizens have access to a safe and adequate supply of drinking water.

1.3 Drinking Water Management Challenges in Canada

Canadians have the benefit of living in one of the most water-rich nations in the world. Approximately fifteen percent of the world's freshwater lies within Canada's boundaries, and nearly eight percent of its surface is covered by water. With freshwater appearing so abundant, it is perhaps understandable that Canadians are among the most wasteful users of water. After all, it is difficult to imagine that water needs to be conserved when lakes, rivers and streams seem to dot the landscape across the country. It is also difficult to imagine how water bodies that appear pristine are in danger of becoming contaminated. Nonetheless, the surface waters and groundwaters that provide Canadian citizens with a source of drinking water are not immune from threats of contamination. Over 260 communities across Canada, for example, face potential contamination from landfill leachate.[5]

In addition to concerns over source water contamination, municipal water supply and water treatment systems are simultaneously facing budget constraints and an aging infrastructure. It is becoming increasingly difficult for municipal water managers to operate and maintain their systems, and provincial bodies are finding it increasingly difficult to effectively monitor drinking water conditions across their jurisdictions. In retrospect, it was only a matter of time before a situation similar to that of Walkerton occurred, and it is perhaps fortunate that tragedies of equal or greater magnitude did not occur elsewhere.

The Walkerton tragedy has drawn attention to an area of public policy where Canada needs to make vast improvements. The fact that this nation is endowed with an incredible amount of freshwater resources is not enough: the focus must now turn to ensuring that these resources are used and managed in a sustainable manner. Access to a safe and reliable drinking water supply is indeed a right that all Canadians deserve to have. The challenge now is to develop a plan to ensure this becomes a reality.

1.4 Management System in Canada

With the exception of territorial and Aboriginal lands, which are federally managed, drinking water is a provincial responsibility. It is primarily the municipalities, however, that actually supply and distribute water to households, as well as provide sewerage and wastewater treatment services. At the federal level, there are several organizations involved in the management of drinking water, including Environment Canada, Natural Resources Canada,

[4] OECD 1998, p7.
[5] Pollution Probe 1998, p10.

Health Canada, Indian and Northern Affairs, the Department of Fisheries and Oceans, Industry Canada, Agriculture Canada, and several others. Provincially, the list of involved ministries and agencies is often equally as diverse and extensive — indicating that the management system is far from consolidated.

The primary tool for directing policy decisions is the Canadian Drinking Water Guidelines. The Guidelines contain over 100 drinking water objectives and are intended to offer guidance to provincial authorities in setting province-wide standards. The Guidelines, however, are not enforceable, and there is no legal means of ensuring that all provinces are in compliance with their targets and objectives. The degree to which drinking water is regulated varies greatly across provinces, and the standards themselves are not consistent. Testing and monitoring programs range from no requirements, to discretionary testing, to regular and consistent testing and monitoring programs at either the provincial/territorial or municipal level. In addition to this, many rural residents rely on private wells that are poorly regulated and rarely tested.

Source water protection is also without enforceable legislation. While some provinces have made efforts to introduce policies, most Canadian jurisdictions have yet to introduce strategies to protect drinking water sources from contamination. With increasing population pressures, urbanization, and industrial and agricultural activity, protecting drinking water at the source will become increasingly important and difficult. Rural residents — who largely rely on private wells – are especially vulnerable if groundwater becomes contaminated, as early detection of contamination is difficult in the absence of regular monitoring. Furthermore, it could take months, years or even decades for groundwater sources to recover from particularly severe cases of pollution, leaving residents to rely on bottled water supplies until their well water is again safe to drink. Canada has taken some steps to eliminate pollution at the source through various regulatory and voluntary programs, but there still remains room for significant improvement.

1.5 Selection of Jurisdictions for Analysis

To understand the options and approaches that can be taken towards the management of drinking water, the policies, practices and procedures in other jurisdictions were analyzed. The jurisdictions chosen for analysis were selected because they are widely recognized as being innovators in the field of environmental policy and resource management. Reviewing a dynamic range of management systems around the world will reveal the vast range of options available to assist jurisdictions in achieving the sustainable use of their fresh water resources. While no single, all encompassing model exists, valuable lessons can be learned by looking at what has and hasn't worked in other parts of the world where governments are faced with challenges similar to those in Canada. The jurisdictions included in the review are New York, California, Wisconsin, Sweden, the Netherlands, the UK, France, Germany, Australia and New Zealand.

2. GOVERNMENT ROLES AND RESPONSIBILITIES

Drinking water quality is largely determined by a jurisdiction's system of governance. The provision of safe, abundant drinking water requires careful planning and effective management by the responsible institutions, and their complementary institutional arrangements. The primary responsibility for water protection and water use management varies greatly across jurisdictions — often mirroring the overall political system and division of responsibilities. Like many environmental issues, however, there is rarely one single institution that manages everything related to a single media (e.g., water, air, or land). How the responsibilities are delegated, decentralized, or divided between institutions is important in determining the effectiveness of the overall system of governance. This section will analyze the roles and responsibilities of the government and related institutions as they apply to the management of drinking water supply, and will attempt to reveal the vast array of options available to those responsible for ensuring the public has access to a safe and adequate drinking water supply.

2.1 Lead Agencies

At the federal level, the primary responsibility for drinking water management is often split between two organizations: environmental protection and health. To generalize, environmental protection organizations are largely responsible for the maintenance of water quality, effective water use, and pollution prevention. Health organizations, on the other hand, are primarily responsible for setting health-based standards for drinking water consumption.

In the jurisdictions analyzed, the lead role in drinking water management was split in this manner in almost all instances. The exceptions to this were Wisconsin (the Department of Natural Resources has primary responsibility for all drinking water matters), the UK (Department of Environment, Transport and the Regions has the lead role), and California (where nearly all drinking water management responsibilities, including sourcewater protection, lie with the California Department of Health Services).

Many jurisdictions have given a substantial amount of responsibility to lower levels of government; however, it is still important to recognize the leadership roles taken by federal level organizations with regards to drinking water management. The approach used in Wisconsin and California, in which water responsibilities have been more or less consolidated into a single organization, has been proposed in other jurisdictions. The difficulty in effectively managing water is that it has a multitude of uses, including, inter alia, industrial processes, recreational purposes, drinking water, bathing water, irrigation, transport, hydroelectricity, and nuclear power. Rarely are all of these issues consolidated under one institution at the federal level, making intergovernmental coordination vital to successful management. Intergovernmental coordination is difficult, however, without effective leadership.

In the instance of Wisconsin and California, the federal Environmental Protection Agency provides overall leadership; however, at the subnational or state level, the Wisconsin Department of Natural Resources and the California Department of Health Services both stand out as providing significant leadership roles in the management of drinking water. Both departments are responsible for determining the health and/or environmentally based standards for their jurisdictions as well as establishing source water assessment/protection plans, certifying water supply operators, ensuring the public is aware of the state of their drinking water, and securing financial, technical, and managerial capacity for water supply facilities and their operators. The UK Department of Environment, Transport, and the Regions (DETR), along with its complementary Drinking Water Inspectorate is also distinctive for having a clear leading

role in the management of drinking water. Like the U.S. examples, the DETR has primary responsibility for ensuring its citizens are provided with a secure, viable source of water for consumption.

In the state of New York, the Department of Environmental Conservation and the Department of Health have formed a partnership for New York's latest Source Water Assessment Program. The Partnership encouraged collaboration between the two Departments in developing a Source Water Assessment and Source Water Protection Plan. With the responsibilities for drinking water quality shared between the two Departments, collaboration was clearly necessary, and it was determined that the best way to ensure intergovernmental coordination was to create an official partnership. The Partnership Agreement is in its beginning stages so it is difficult to assess its degree of effectiveness in managing drinking water; however, one indication of its potential is the successful completion of a Source Water Assessment Plan, outlining the specific responsibilities of each Department, that has received federal approval from the EPA.

In the remaining jurisdictions, identifying a single organization that has a lead role for water management is difficult. As described earlier, the responsibilities are often split along sectoral lines, with issues related to hydroelectricity, the nuclear industry, transportation, development and planning often falling under their respective organizations. The effect this has on drinking water management can be profound, often separating drinking water protection responsibilities from health-based considerations. The resulting patchwork could present insurmountable problems without the existence of an overarching policy framework or set of standards — something which nearly all jurisdictions have established.

2.2 Standards and Legislation

With many of the jurisdictions having responsibility for drinking water management spread among several federal, regional, and municipal organizations, the need for interdepartmental and intergovernmental coordination becomes clear. To provide a cohesive framework to direct the many organizations in their activities and efforts towards drinking water, all jurisdictions, except for Canada and Australia, have established enforceable drinking water standards at the federal level. Most notable for its comprehensive legislation is Sweden which has developed the Environmental Code — an all-encompassing piece of legislation that combines close to fifteen previous Acts related to the environment and natural resource management. Sweden's Environmental Quality Objectives are another set of national standards set by the federal government to guide environmental policy decisions, especially at the intergovernmental level. The Objectives encourage government departments and agencies to collaborate in achieving the specific goals, including those set out in the Environmental Code. Combined, the Code and the Quality Objectives provide Sweden with an effective and comprehensive set of federally enforceable standards that cover all aspects of drinking water supply management.

Similar federal legislation in other jurisdictions include The Federal Water Act (Germany), the Austrian Water Act, the Drinking Water Quality Decree (the Netherlands), the Drinking Water Standards for New Zealand, the Federal Water Law (France), and the Drinking Water Regulations (UK).

Beyond the national level, the European Union introduced the European Framework Directive on Water Policy in 1998, and finalized the directive in October 2000. The Framework Directive will set consistent drinking water standards across all jurisdictions within the European Union. To be in compliance with the Directive, jurisdictions will also have to establish consistent

monitoring and testing practices, implement source water protection policies, and adjust local planning policies in support of drinking water requirements. These initiatives, along with others, were to be incorporated into national legislation by the end of 2000, with close to full compliance by December 2003.

Australia and New Zealand have a similar overarching policy framework in the form of the National Water Quality Management Strategy. The Strategy was created by the Australian and New Zealand Environment and Conservation Council and the Agriculture and Resource Management Council of Australia and New Zealand. Additional information and input was provided by the National Health and Medical Research Council. The goal of the Strategy is to achieve sustainable use of water resources through protection and quality enhancement, while still maintaining economic and social development.[6] In New Zealand, the guidelines have been made enforceable with the development of the Drinking Water Standards for New Zealand (developed by the New Zealand Ministry of Health in collaboration with the Ministry for the Environment). Inconsistent monitoring and reporting as well as the discovery of trace microbiological contamination in drinking water prompted the federal government to develop the Standards along with accompanying implementation guidelines and action strategies.

Australia, however, has yet to develop enforceable standards at the federal level. The Water Quality Management Strategy along with the Australian Drinking Water Guidelines provide targets for state and territorial governments when setting standards, yet the Guidelines themselves are not codified into federal legislation. Since Australia emphasizes the need to establish regulations that relate to local water conditions and requirements, it has not fully embraced the concept of establishing standardized regulations at the national level.

In the United States, federal drinking water standards have been clearly outlined in the Safe Drinking Water Act (SDWA), with additional water quality standards being described in the Clean Water Act (CWA). Both federal level Acts are enforceable, with the Environmental Protection Agency (EPA) taking the lead role in ensuring the regulations are met at the subnational (state) level. Each state is required to meet or exceed the standards laid out in the SDWA or CWA, with federal funding for state programs being contingent on the development of appropriate legislation and action strategies.

2.3 Regulatory Supervision

Regardless of how well water policies have been developed, their ability to affect change within a jurisdiction depends on the regulatory supervision provided by government institutions and/or arms length organizations. The most specialized organization developed to assess compliance with drinking water regulations is the Drinking Water Inspectorate in the UK. The Drinking Water Inspectorate is a team of professionals that conduct audits of drinking water quality supplied by private companies and inspections of the individual companies.[7] The Inspectorate responds to customer complaints, reports on non-compliance, and issues annual reports which give the results of monitoring by water companies and a statement of general drinking water quality in England and Wales. The Inspectorate also authorizes supply companies to withdraw water from specified regions, and provides guidance to assist companies in meeting the requirements of the UK Drinking Water Regulations.

[6] ANZECC. 1994, p3.
[7] Department of the Environment, Transport and the Regions. 2000. www.dwi.detr.gov.uk.

In the Netherlands, the Inspectorate for the Environment ensures that water supply companies are meeting the regulations set out in the Federal Drinking Water Quality Decree. Although the Inspectorate deals with more issues than water, its centralized nature allows it to have extensive oversight abilities when it comes to assessing compliance with drinking water regulations. Water samples are submitted by supply companies for analysis at labs certified by the Ministry of Housing, Spatial Planning and the Environment (VROM).

The only other jurisdiction that has an institution comparable to the UK or Dutch Inspectorates is Sweden with its Environmental Protection Agency. The Swedish EPA monitors, assesses, enforces and follows-up on environmental efforts related to both Swedish and EU regulations. It is also responsible for proposing targets, standards and control instruments as well as evaluating and assessing progress towards Environmental Quality Objectives. The EPA's monitoring efforts are assisted by its Environmental Monitoring Program which regularly samples water quality of both groundwater and surface water across Sweden. It also provides basic training at the River Basin, County and Municipal levels, which will be a requirement for all water suppliers and managers by 2004 (in response to the EU Framework Directive). Furthermore, the EPA oversees the permitting process, where all water operators are required to possess an operating permit under Sweden's Environment Code.

Austria also has a comprehensive monitoring network, supervised by the Federal Environment Agency. In addition, the Agency investigates environmental conditions and anthropogenic contamination at over 2250 sites. With such a substantial monitoring network and abundance of sampling sites, it will frequently subcontract this work by issuing tenders for sampling and analysis on an EU-wide, public basis, awarding the contract to the best bidder. New Zealand has similarly consolidated its monitoring information in an online, searchable database called Water Information New Zealand (WINZ), a project of the Institute for Environmental Science and Research Ltd, an organization which is also responsible for monitoring the management activities of water suppliers. WINZ contains information on over 1760[8] water suppliers and registers the information by source, treatment plant, and distribution zone.

In Australia, state and territorial governments are largely responsible for regulatory supervision. Water supply and wastewater treatment facilities must obtain discharge consents, comply with codes of practice, and undergo "System Performance Monitoring" and "Operational Monitoring." State Health Authorities oversee most health related regulations, however catchment/region strategies are also forming partnerships with state/territories to develop action strategies towards clean water. The catchments/regions will develop targets and strategies that will be accredited by state and territorial governments. This Action Strategy was only recently introduced and is expected to take up to ten years to implement. It includes the suggested creation of a single Natural Resource Management Council to oversee the development of targets and standards, as well as monitor and measure progress. Tracking Australia's progress towards this community-based integrated management scheme will be of interest to many policy makers in other jurisdictions.

Germany's Health Authorities monitor water facility operators, and assess compliance with regulations through discharge and water data gathered by municipal water supply and wastewater treatment facilities. Discharge data is closely monitored because of Germany's extensive ecotax system, where all wastewater being discharged into a body of water is subject to a pollution charge.

[8] WINZ reports on all registered water suppliers.

The US EPA regulates drinking water in the USA through the Safe Drinking Water Act. Drinking water is routinely monitored both before and after treatment, and samples are analyzed at EPA certified laboratories. In addition, all operators at water facilities must undergo certified training sessions, although at facilities that serve less than 3,300 people, the EPA must provide reimbursement for the costs associated with these training programs.[9] At the subnational level, California's regulatory supervision is provided by the California Drinking Water Program's Monitoring and Evaluation Unit (a component of the California Department of Health Services), which ensures that all water supply and wastewater treatment plants meet the regulations described in the California Safe Drinking Water Act.

2.4 Enforcement

One of the most important components of a freshwater management system is the ability of organizations to enforce the regulations set out in government legislation. Regulations are only effective if there is some way of enforcing them, and they are even more effective if there is a deterrent to prevent non-compliance.

In the United States, failure to comply with the federal Safe Drinking Water Act on behalf of the States can lead to a decrease in funding towards drinking water programs. At the State level, operating permits held by public or private water supply and/or wastewater treatment facilities can be revoked if they are found to be out of compliance with State or federal regulations — often at a great cost to the owners and/or operators.

In jurisdictions such as Germany and the Netherlands where taxes and charges are associated with excessive withdrawals or pollutant releases, enforcement takes the form of a threat of increased costs. Economic instruments such as these encourage water supply companies to comply with regulations often through implementation of best management practices, which may consequently offer one of the most cost-effective means of achieving pollution reduction objectives. In addition to economic incentives, Germany also requires official authorization (from local water boards) for any activities related to discharges of substances or abstractions, whether from groundwater or surface water. The Netherlands similarly requires authorization for abstractions and discharges. France is contemplating the introduction of pollution charges, and the UK, which currently issues consents and authorizations for certain discharges, has proposed the introduction of economic instruments to achieve pollution reduction targets as prescribed in the EU Framework Directive.

The Drinking Water Inspectorate in the UK has the legal authority to enforce drinking water regulations on behalf of the Secretary of State. If a company fails to carry out new programmes of work, or to meet new standards or procedures for monitoring, the Inspectorate can take enforcement action in the form of prosecution in the courts if it is determined that a supply company is providing water that is unfit for human consumption. This represents an important element of the UK system: water companies are responsible for providing safe drinking water, and can be held liable in the event that the water supplied does not meet health standards. This appears to be the strongest enforcement action facing water supply companies in the jurisdictions analyzed. Germany has a similar provision which stipulates that individuals found to pollute a body of water without authority are liable to punishment under the German Criminal Code, or subject to compensatory charges under the Federal Water Act.[10]

[9] US EPA Office of Water, 1996 SDWA Amendments website. http://www.epa.gov/safewater/sdwa/theme.html.
[10] United Nations. 1998. www.un.org/esa/agenda21natlinfo/countr/germany/.

3. INFORMATION PROVIDED TO THE CONSUMER

An important aspect of supplying drinking water to customers is instilling a high level of consumer confidence in the products and services being provided. This confidence is gained not only through high quality performance, but also through transparent decision-making, public outreach programs, regular reports on the state the water resource, and encouraged involvement in the decision-making process by relevant stakeholders. A single negative incidence can quickly erode consumer confidence, but the effects can perhaps be minimized if stakeholders feel they have had adequate information and input into the drinking water supply management process.

3.1 Required Information

When it comes to drinking water, there are several parameters that can be considered when determining the overall quality. In general, these can be categorized into health-based, and/or environmentally-based parameters, as well as measures of relative abundance. Health-based parameters usually relate to the range of concentrations within which the consumer is not exposed to any significant health risk. Maximum contaminant levels, whether they be microbiological (e.g., coliform bacteria), chemical, or otherwise, are often modeled after the World Health Organization's Guidelines for Drinking Water Quality. Environmental standards, on the other hand, relate to the impact of contaminants and/or naturally occurring organisms and elements on an ecosystem. Drinking water standards consistently relate to health-based parameters; however, water quality reports frequently contain additional information about the ambient conditions of sourcewaters in terms of environmental quality.

Health organizations are usually given primary responsibility for developing health-based water quality standards, even if they are not directly involved with water management issues. Each jurisdiction analyzed in this report at the very least consulted with health organizations and institutes when determining these standards. It is these health-based parameters that are most often contained in consumer confidence reports to inform customers of the quality of their water. All jurisdictions required water supply companies to report on these parameters, with the American program exhibiting one of the most comprehensive reporting programs. Under the Safe Drinking Water Act, U.S. water supply companies, whether they be private or public, must produce water quality reports containing an extensive list of health-based parameters that are available for public review. The reports must be submitted at least annually, and contain information on detected contaminants, possible health effects, and the source of drinking water. States are then required to submit a summary report to the USEPA which will compile a National Compliance Report.

Reporting requirements are a component of all jurisdictions. For EU countries, the new Framework Directive requires annual reporting on behalf of all member jurisdictions, and it will also introduce extensive monitoring requirements that will contribute to the development of reports. All EU jurisdictions must also submit national reports on water quality to the EU on an annual basis. In Austria, information on both environmental and anthropogenic contaminants are posted on the Water Management Register and are also available from the Federal Environment Agency. The information, which includes both environmental and health parameters, is made possible through municipal testing programs and the water quality monitoring network. Water information is also contained in Austria's annual State of the Environment Report.

Required Information for Reports Issued by Water Suppliers in the USA[a]

- the lake, river, aquifer, or other source of the drinking water;
- a brief summary of the susceptibility to contamination of the local drinking water source, based on the source water assessments that states are completing over the next five years;
- how to get a copy of the water system's complete source water assessment;
- the level (or range of levels) of any contaminant found in local drinking water, as well as EPA's health-based standard (maximum contaminant level) for comparison;
- the likely source of that contaminant in the local drinking water supply;
- the potential health effects of any contaminant detected in violation of an EPA health standard, and an accounting of the system's actions to restore safe drinking water;
- the water system's compliance with other drinking water-related rules;
- an educational statement for vulnerable populations about avoiding *Cryptosporidium*;
- educational information on nitrate, arsenic, or lead in areas where these contaminants are detected above 50% of EPA's standard; and
- phone numbers of additional sources of information, including the water system and EPA's Safe Drinking Water Hotline.

[a] EPA Office of Water, www.epa.gov/safewater/ccr/ccrfact.html.

In the UK, reporting as well as supporting monitoring activities, data collection, and testing activities, are largely the responsibility of the private water companies, with additional reports contributed by the Drinking Water Inspectorate. The water companies are required to report on their performance to customers and stakeholders to demonstrate that they are an efficient and environmentally responsible business. Reports must include information about their operational costs in order to account for the prices charged to consumers, and they must also provide information on health-based standards and environmental quality standards of source waters (including the location of the source). The Drinking Water Inspectorate also provides information on general UK water quality, as well as the performance of individual water supply companies. Again, this information is available to the public.

The Netherlands has a similar reporting system to the UK in that water supply companies must publicly report water quality parameters, including health-based and environmentally-based standards and submit results to a central agency — in this case the Inspectorate for the Environment. National results are compiled annually by the Ministry of Housing, Spatial Planning and the Environment and provided for public viewing and comment. New Zealand's water suppliers report on microbiological parameters and submit the information to regional Health Service centers. The information from each supplier is collected by the Institute for

Environmental Science and Research Ltd which organizes the information into the Water Information New Zealand (WINZ) database. The database contains information on microbiological parameters from each water supplier, water source, and distribution area, and allows the public to view the state of their drinking water online at no cost. In Australia, annual reports provide information on the current state of water quality, but also compare performance levels (including health-based standards) to previous years. This information is provided to both State Health Authorities and the public.

3.2 Non-Compliance Reports

An element of consumer and state of the environment reports present in several jurisdictions was non-compliance reporting. The intent of non-compliance reports is essentially to encourage regulatory compliance on the part of water facilities and to inform the public of any infractions that might affect public health or quality of living. In the UK, for instance, infractions detected by the Drinking Water Inspectorate or self-reported by the water company itself had to be immediately reported to the public. The report would have to state what infraction occurred, how excessive the infraction was, and what remedial action was being taken to correct the situation. The Drinking Water Inspectorate also distributes an annual list of infractions by each individual company and makes the information available for public viewing. The Netherlands similarly requires its water companies to submit non-compliance reports and remedial action plans to their customers. In the USA, water systems must notify consumers immediately when there is a serious problem detected with water quality.

3.3 Public Participation in the Decision-Making Process

The European Union has identified public participation as a fundamental component of drinking water policies. With the public being one of the largest groups of stakeholders that are affected by water management decisions, public acceptance and confidence in policies can only be improved when all stakeholders are provided with the option of commenting and participating in decisions affecting drinking water. The EU Framework Directive requires all member states to incorporate local and regional commentary into the development and assessment of river basin management plans, policies, and strategies. In particular, EU members must publish and make available to the public (a) a timetable and work programme for the production of river basin management plans; (b) an interim overview of the significant water management issues identified in the river basin; and (c) draft copies of the river basin management plan at least at least one year prior to scheduled implementations.[11] Recognizing that solutions need to be bottom-up as well as top-down,[12] most jurisdictions (including the UK, Germany, The Netherlands, and Sweden) have developed programs to come into compliance with the Directive.

In the United States, the Safe Drinking Water Act has also developed comprehensive public participation programs. To encourage public involvement, the USEPA holds public meetings involving states, tribes, water systems and environmental and civic groups. Watershed councils also hold regular meetings open for public comment, to discuss planning issues associated with source water assessment and source water protection plans. The public is also allowed to comment on state operator certification programs, state revolving loan funds, and state capacity development plans.[13]

[11] Official Journal of the European Communities 2000, p16.
[12] World Wildlife Federation 2000. www.wwffreshwater.org.
[13] EPA 1999, p3.

Australia exhibits a similarly open system by encouraging the public to comment on local water quality management strategies, as set out in their National Water Quality Management Strategy. Australia's objective is to tailor water management strategies to the unique local conditions found in its various regions with the help of stakeholder input. Forms of stakeholder involvement vary according to state, territorial, and municipal governments, but the most common avenues for stakeholder input in Australia include community forums and discussions, stakeholder advisory committees, focus groups, invited written submissions, and extensive commentary periods.[14] The Environment Protection Authority in New South Wales, for example, administers a community consultation program that gathers information regarding the public's perspectives on the health of their river systems, the values they place on their waterways, and the environmental issues they identify as priority concerns. Participants are also given the opportunity to comment on the consultation program itself, as well as their opinion of the water quality objectives presented to them by the EPA.[15] The Environmental Protection Authority meets quarterly with industry, environmental groups, and local governments to discuss policies, programs, and challenges, and to maintain strong links between relevant government organizations and stakeholders.

3.4 Public Outreach Programs

The SDWA in the USA requires its states to implement comprehensive public outreach programs. In the instance of Wisconsin, New York and California, these programs have been well developed and well implemented. In Wisconsin, for example, where approximately two-thirds of the population drinks water drawn from over 750,000 private wells,[16] the Department of Natural Resources has an information clearinghouse where information is distributed through the mail and is also displayed on a website. The website includes a list of certified laboratories where private well water can be tested, a particular well's susceptibility to contaminants based on location and source, as well as advice regarding drilling, maintenance and installation of drinking wells. The DNR also administers the National Groundwater Week and the state Drinking Water Week, which are both intended to raise awareness of water issues in the USA, and in Wisconsin in particular.

The New York Department of Environmental Conservation's primary outreach activities are its Drought Awareness Program (which informs residents about activities they can undertake to conserve water before, after, and during drought periods), and the Watershed Stewardship Program. The Stewardship Program creates volunteer opportunities for New York residents to participate in activities directed towards the protection and enhancement of community watersheds. Activities include water quality monitoring programs, beach clean-ups, stormwater stenciling, fisheries habitat restoration and protection activities, and educational seminars.[17] Individuals or groups that participate in volunteer activities will receive credit in the form of certificates, posters, and mailings about upcoming events and opportunities. Furthermore, the Department of Environmental Conservation administers the Water Week awareness program that is targeted towards school-aged children and the general public alike.

[14] ANZECC and ARMCANZ 1999, p9.
[15] New South Wales Environment Protection Authority. http://www.epa.nsw.gov.au/ieo/Review/review.htm.
[16] Wisconsin Department of Natural Resources. 2000. www.dnr.state.wi.us/org/water/dwg/prih2o.htm.
[17] New York Department of Environmental Conservation, Division of Water. 2000. http://www.dec.state.ny.us/website/dow/stewop1.pdf.

The EU Framework Directive also encourages its member states to implement public outreach programs. In Sweden, environmental education is worked into the public school curriculum and includes programs on sustainable water use. Institutions that do an exemplary job are awarded Sweden's Green School Award. The Federal Environment Agency in Germany runs the ECOBASE[18] program which provides the general public with information regarding drinking water contaminants, who is responsible for maintaining drinking water quality, and city-specific water management information. All of this information is available electronically on the Environment Agency's website.

In Australia, outreach programs are conducted at many different levels of government. The American GLOBE program provides general environmental education to Australian elementary and high school students. Watercare III, a water-only education program administered by the South Australian Department for Environment, Heritage, and Aboriginal Affairs,[19] promotes investigation of sustainable water resource management practices, with the target audience being secondary school students. The goal of the program is to raise awareness and appreciation of the human dimension in water resources management, the importance of healthy water resources, and the relationships and interactions between built and natural environments. The public is also encouraged to assist in monitoring activities through the community-based Waterwatch Australia water quality monitoring program. Waterwatch programs have been established in five Australian jurisdictions, and include Waterwatch South Australia, Streamwatch (NSW), Waterwatch Victoria, ACT Waterwatch, and Ribbons of Blue WA.

[18] Information about the ECOBASE program can be found at http://www.umweltbundesamt.de/index-e.htm.
[19] Information about the Watercare III program can be found at http://www.watercare.sa.gov.au/sitemap.htm.

4. FINANCING

Supplying drinking water to a population does not come without a cost. The means of supplying a viable supply of water varies greatly across jurisdictions; however, what is consistent is that there are substantial costs associated with the treatment, production, extraction and delivery of safe drinking water. One of the greatest determinants of the funding available to water supply facilities relates to the ownership: namely whether they are private or publicly owned and/or operated. The ability of governments, municipalities, and corporations to provide water services in the most cost effective and comprehensive manner must be examined, and it must also be determined if any delegation of responsibilities is accompanied by the appropriate financial, managerial, and technical resources.

4.1 Ownership of Water Supply and Wastewater Treatment Systems

The jurisdictions studied in this report illustrate varying degrees of privatization, from a fully privatized sector to a fully public water supply system. The only jurisdiction where both water supply and wastewater treatment companies are fully privatized is the United Kingdom, where private companies operate under the regulations set out in the UK's Drinking Water Regulations and the EU Framework Directive. The water companies recover their costs with charges to the consumer, with the goal being full cost recovery in the most cost-effective manner.

Several other jurisdictions exhibit a mixed system of ownership and operation. The French system, for example, is publicly owned — however, municipalities or a group municipalities can contract private enterprises to supply and/or treat their water. Approximately 85% of the water supplied to communities is through private water suppliers. All companies remain subject to the same regulations and operating standards described in the Federal Water Law and the European Framework Directive, regardless of their ownership. New Zealand's water is supplied through approximately 400 publicly owned systems that are operated by local authorities. In some instances, private companies, whether they are operated under franchise or by contract, will operate under the direction of local authorities, who still retain ownership. The remaining 2000 community water systems are private. They are typically small water systems, and are required to operate in compliance with the Ministry of Health's Drinking Water Standards for New Zealand.

The system in the Netherlands is similar. The water companies are not necessarily associated with a particular municipality; however, they are fully owned by public shareholders. The companies operate under Dutch law (e.g., the Water Decree and the EU Framework Directive) and are obligated to provide safe, clean water to households, institutions, and industry in the most cost-efficient manner. The water companies ensure they are in compliance with regulations and standards by testing water during all phases of purification on a daily basis, and by further allowing certified labs to continuously monitor quality. With the water companies operating with relative independence from the Dutch government, several enterprises have expressed their desire to become corporately owned and operated. Legislation was passed in September 2000, however, to prevent the water companies from becoming private, largely due to concerns that financial goals would replace water quality goals. With a new government administration arriving in two years, it is uncertain if this legislation will remain upheld.

The U.S. system has examples of public water suppliers; private suppliers on contract from municipalities; and fully private water supply/treatment companies. Regardless of ownership, however, all supply companies are subject to the regulations laid out in the Safe Drinking Water Act and the Clean Water Act. Each municipality can decide whether or not it wants to supply,

distribute and treat water itself, or if it wants to contract or defer these services to a private company. Private companies are not granted permission to provide services until they have met the operational and performance standards required by state and federal laws. In states such as Wisconsin, they must also provide evidence that they are capable of operating and financing the entire water supply and/or wastewater treatment system, and that these services can be supplied to customers at a reasonable cost.

Germany has allowed private companies to supply water to municipalities on a trial basis. There are still only a few private companies that operate in this jurisdiction despite the fact that there is no regulation to prevent private enterprises from entering the market. It remains to be seen which direction Germany will move towards in the coming years. Similarly, Australia has allowed some of its public systems to become corporately owned and operated. In this instance, however, there are only federal Guidelines to direct owner/operator behaviour, rather than federal regulations. The ability of state/territorial governments to develop regulations and codes of conduct for corporations will greatly influence the quality of service provided by these enterprises.

Restructuring of the water sector in some regions of Australia has allowed approved water companies to become competitive enterprises. The Yarra Valley water company, for example, is a retail water company that supplies water and provides sewage treatment services to the greater Melbourne area. The company is owned by the State Government of Victoria; however, it operates commercially under the direction of a shareholder appointed Board of Directors. Corporately operated companies must obtain an operating license and abide by the regulations set out in the Water Industry Act, as would publicly owned facilities, and they must also submit sales tax and income tax payments equal to the amount that would be due if they were not State-owned enterprises.

4.2 Financing Methods

Regardless of the state of freshwater resources within a jurisdiction, the costs of supplying, treating, and delivering water and wastewater can be great. The amount of funding available to water companies largely depends on who actually owns the facility: publicly owned companies are often granted government funds to subsidize costs; private or corporately owned companies, on the other hand, produce many of their funds independently. How these facilities finance their services can greatly affect both the quality of water provided, and the price costs faced by consumers through water pricing. As with most components of drinking water supply management, the way in which water supply and treatment is financed across jurisdictions varies considerably.

4.2.1 Subsidies

Water subsidies can take many forms, including low interest loans, direct payments, or debt reductions. Subsidies, however, have the effect of disguising the real costs of supplying water and water services,[20] often providing consumers with lower consumption costs than would otherwise be encountered. The concern with subsidies is that the ability of market forces to affect consumer behaviour will not be realized unless consumers are forced to pay the full cost of a particular good and/or service. On the other hand, public systems that are unable to supply water and water services can benefit from subsidies available from governments.

[20] OECD 1997, p8.

With the exception of the UK and New Zealand, all jurisdictions analyzed in this report provided some sort of subsidy to facilities to assist with supplying essential water and water services. New Zealand had provided subsidies in the past, but at present there are none. In terms of government funding, France's public *and* private systems receive subsidies from several levels of government. To encourage effective management practices in the absence of market forces, the government regulates water extraction and wastewater discharges through withdrawal and pollution fees. Water-related subsidies in the United States come from many sources, but one of the most significant sources is the Drinking Water State Revolving Fund — a source that is available to all states once they have come into compliance with the regulations and standards laid out in the Safe Drinking Water Act. Several states have also established Capacity Development Programs in an attempt to improve the financial, technical, and managerial capacity of water facilities. Financial support for these programs comes from the federal government's State Revolving Funds, and support is contingent upon the states' ability to develop authorized programs. California has devised additional means of providing financial support to water facilities through its California Water Bonds, allowing funds to be directed towards water-related projects, particularly infrastructure improvements, from General Obligation Bonds.

In Austria where water facilities are publicly owned, the Ministry of Agriculture, Forestry, Environment and Water Management has created an environmental funding programme which provides financial assistance to water supply facilities, especially for compliance costs associated with the Austrian Water Act. Water companies in the Netherlands are eligible for subsidies from the federal Ministry of Housing, Spatial Planning and the Environment. At the provincial level, the Dutch taxes charged on groundwater extraction are specially earmarked for provincial water management programs and water companies.

4.2.2 Special Assistance for Small Water Systems

Specialized funding for small water supply systems, including rural, municipal systems was evident in several jurisdictions. Wisconsin, New York, and California had each developed a federally supported Capacity Development Program, which focused on improving the performance of small water systems. Guidance for these programs is provided by the USEPA and is outlined in the Safe Drinking Water Act. France has also developed a National Fund for Rural Water Supply to assist small community systems in achieving compliance with drinking water regulations, recognizing that smaller municipalities do not always have the same access to resources as other, larger municipalities.

In New Zealand, where special funding for small water systems has not yet been established, microbiological compliance with the Drinking Water Standards for New Zealand were found to lag considerably in small communities. A strategy to improve compliance in less populated areas has been proposed; however, as yet an official action plan has not been developed. It is problems such as this, which is reminiscent of the conditions that led to the Walkerton tragedy, that the funding programs in the USA and France are attempting to address.

4.2.3 Taxes

Of the jurisdictions analyzed, Germany and The Netherlands had the only examples of taxes being applied to water-related activities or services. Germany's ecotaxes, which are applied to a vast range of activities and products that impact the environment, are applied to all wastewater being discharged directly into the water. In addition, some Länders (Federal States) have instituted water abstraction charges — costs borne by supply companies that are

ultimately passed on to the consumer. The Netherlands also has an extensive taxing system, which includes Groundwater Taxes (applied to extraction and delivery activities), the Federal Tax on Water Supply (for delivery activities), and sewerage taxes (by-household charges). All of these taxes are factored into the equation that determines consumer water prices.

4.2.4 Water Pricing

Customers in all jurisdictions paid for the water and water services they received; what differed was the formula that was used to arrive at a price. In general, water is provided to its customers at an extremely low rate, which is often made possible through government subsidies. Low water prices make it easier for all members of a population, regardless of income, to fulfill what is perceived as a fundamental right: access to safe, abundant water. What low water prices fail to do, however, is provide an incentive to conserve water through cost-per-use charges. Jurisdictions are thus left with the challenge of supplying water at a reasonable cost, while still providing incentives for sustainable water use.

Austria's public water companies determine their charges to consumers based on a set price per cubic metre, which ranges from 3 to 25 Austrian schillings/m^3. This system of establishing a set price per unit of water is common, but it depends heavily on the use of individual water meters that can track the amount of water used per household or facility. Not all jurisdictions have water meters for each consumer, making it difficult to charge on a by-use basis, especially if the goal is to assess charges on a graduated scale. In these instances, households and facilities are usually charged a flat rate based on consumer attributes (e.g., number of household occupants, square footage of home, designated water use).

To keep prices low, water charges are usually based on a cost-recovery price system, implying that the prices charged to consumers will allow facilities to recover the costs associated with supplying potable water. Sweden's public facilities, for example, set water prices based on the cost of production, delivery, and treatment. Of note, however, is that there is still no water pricing policy for abstraction or agricultural use. In the instance of Germany and the Netherlands, these costs will include taxes that apply to the facility and its operations.

Prices in Germany vary, with each Länder (Federal State) establishing its own pricing system based on the goal of achieving full cost recovery. The water and drainage boards in Australia perform similar functions to the German Länder, determining water prices based on local needs and requirements. In the UK, the private water companies are responsible for setting their own water prices, based on the long run marginal cost of supplying water. The data used to determine this price must be reported to the Office of Water Services,[21] an independent economic regulator that places limits on how much water supply companies can charge their customers. The Office of Water Services encourages companies to improve their services through improved efficiency, rather than increased prices.

Additionally, as of April 1, 2000, customers in the UK can choose how they want to be billed. Individual households can have their fees determined by (a) a metered charge based on a water meter reading; or (b) an unmetered charge based on the property and its rateable value. For those who choose the first option, water meters will be installed without any cost to the consumer, and charges will be determined according to the amount of water used. There will

[21] The Office of Water Services (OfWat) is a government department led by the Director General of Water Services, and is responsible for making sure that the water and sewerage companies in England and Wales provide good quality, efficient service at a fair price.

also be some latitude given to customers who are considered vulnerable, i.e. subject to considerable charges for essential uses.[22]

"Full-cost pricing"

To recover the costs associated with providing an adequate and reliable amount of safe drinking water, many jurisdictions have adopted a "full-cost pricing" system. Full-cost pricing, which refers to the "total revenues required to cover operating expenditure, plus depreciation, plus a return on capital employed,"[23] is by no means a new concept, but the merits of such a system become more clear with the growing pressure to comply with increasingly stringent regulations.

A report on the performance and challenges facing water management systems in OECD countries indicated that several jurisdictions have adopted a full-cost pricing scheme to recover costs associated with water and water services. The OECD divided water charges into two broad categories: (a) supply; and (b) sewerage and treatment. According to the report, Australia, Germany, the Netherlands, the UK, France and the USA[24] all use full-cost pricing to determine the appropriate rates for water supply. Of those jurisdictions, all but France and the USA also use full-cost pricing to determine charges for sewerage and sewage treatment. Austria, in contrast, uses full-cost pricing for its sewerage and sewage treatment, but not for supply — most likely because over 80% of drinking water is supplied from private groundwater wells. Canada and New Zealand do not use full-cost pricing to determine rates for either water supply or sewerage and sewage treatment.

The differences in water rates and charges across jurisdictions can be attributed to many factors, but this is perhaps best summed up by an excerpt from the OECD report, which states that:

> "The cost of delivering clean water to urban areas greatly depends on the proximity of raw water sources, the degree of purification needed and the settlement density of the area being served. The cost of providing sewerage and treating waste water also depends on settlement density, as well as on the characteristics of the influent and the required quality of the effluent. It is therefore only to be expected that water prices, sewerage and waste water treatment charges vary widely among and within countries."[25]

Some of the greatest differences are due to variations in abstraction charges (which exist in 14 OECD member countries), service fees, and pollution charges (introduced in over 12 OECD countries). Any "full-cost" price calculation would then have to consider these factors. Furthermore, the full economic and environmental costs of providing water supply, sewerage and treatment services are often hidden from industrial and domestic consumers. Sources of variation are largely because (a) the environment is not, or is only partially, valued; (b) the central or local governments make large contributions to the required capital investment; and, (c) there is implicit cross-subsidization among user groups.

[22] The Government states that "No person should have to face the prospect of cutting down on essential water use — for washing, cooking and cleaning — because they cannot afford their bill." (DETR 2000, p5).
[23] OECD 1998, p23.
[24] Although this paper has referred only to the states of California, Wisconsin, and New York, looking at the USA as a whole remains valid for this comparison.
[25] OECD 1998, p20.

One of the most important conclusions to draw out of the discussion of full-cost pricing is that as expenditures associated with the tightening of drinking water standards continue to rise, water systems are faced with the challenge of financing any necessary technological, structural, and/or operational changes. There are several ways to acquire the necessary funds, but the emerging trend appears to be applying pollution charges for effluent discharge, abstraction charges for ground and/or surface waters, and service fees that cover the full operational and maintenance cost of running water facilities. This includes consideration of the natural resource, the physical infrastructure, and the required managerial capacity to deliver water and water treatment services. The greatest challenge then becomes determining which approach might best suit Canada's needs, taking into consideration the current rates charged to consumers, and the level of funding to be provided to water systems by both private and public sources.

Current rates charged to consumers in Canada are relatively low when compared to other jurisdictions. A study completed by the National Utility Service, Inc., demonstrated that Canadians, on average, are charged significantly less for their municipal water supply and water services than other developed countries. Water prices in Germany and Denmark, for example, are about four times greater than Canada's prices — and this is after Canada posted a 100% increase from 1987 to 1999. The Netherlands, France and the United Kingdom have relatively similar water prices, and all are approximately three times higher than those in Canada. Australia and the United States have water prices that are more comparable to Canada's; however, they are still about 10% higher (Australia has also experienced a 35% *decrease* in water prices from 1987 to 1999). From looking at these findings it appears that an increase in Canadian water rates to recover the costs associated with supplying water and water services would not be inconsistent with the global norm. Encouraging a move towards a full-cost pricing scheme to account for the full economic and environmental costs of providing water to consumers would undeniably cause a rate increase; however, when looking at the prices faced by consumers in other jurisdictions, this increase might be justified. At minimum, Canada should review its current financing practices to ensure that water supply and water treatment systems are receiving the necessary funds to guarantee the provision of a safe and adequate water supply.

Table 1. Consumer Water Prices in Various Jurisdictions

	Country	Cost (US cents/m^3)	% Change from Last Year	12 Year Change
1	Germany	182	0.7	95%
2	Denmark	162	4.5	N/A
3	Belgium	122	0.1	54%
4	Netherlands	119	-0.2	75%
5	France	118	1.3	75%
6	United Kingdom	115	3.2	166%
7	Italy	73	2.1	119%
8	Finland	64	-2.3	N/A
9	Ireland	62	5.0	50%
10	Sweden	56	2.5	6%
11	Australia	55	3.1	-35%
12	Spain	54	1.3	N/A
13	United States	51	-0.5	39%
14	South Africa	50	9.8	N/A
15	Canada	41	3.9	100%

Information compiled from the National Utility Service World Water Cost Survey. Prices are based on prices as of July 1, 1999, for the use of 10, 000 cubic meters of water a year. All prices are in US cents per cubic meter.

5. EMERGING TREND: SOURCE WATER PROTECTION

There are several trends occurring in drinking water supply management, including the development of coordinating mechanisms amongst responsible organizations, consolidating water related activities within a single organization, developing a strong legislative mechanism, and managing at the watershed or river basin level. Emerging as one of the most significant trends, however, is the development of source water assessment and protection plans. With the cost of water treatment increasing with the level of contamination in both surface water and groundwater sources, the focus of management is now turning towards protection.

In addition to economic savings, protecting water at the source provides the added benefits of improving overall ecosystem integrity, providing incentives for land preservation, and providing a framework for intergovernmental cooperation and partnerships with community organizations and private businesses. Financial savings alone have the potential to be quite significant: source water protection activities in New York State, for example, are estimated to have saved the state over four billion dollars in construction costs for filtration facilities, and also included the purchase of over 80,000 acres within important watersheds.

The most comprehensive source water protection program of the jurisdictions analyzed is in the United States. Under the guidance of the US EPA, and the federal Clean Water Act (CWA) and Safe Drinking Water Act (SDWA), each state in the U.S. is required to develop a Source Water Assessment and Protection Plan (SWAPP). The 1996 Amendments to the SDWA require states to identify areas of public drinking water, assess water systems' susceptibility to contamination, create a contaminant source inventory, and inform the public of the results. To assist with these activities, the EPA created the Drinking Water State Revolving Fund, which can be granted to any state that has successfully developed a strategic plan to fulfill the requirements under the SDWA.

The SWAPP programs in the U.S. rely heavily on stakeholder involvement and the development of partnerships between business, industry, and environmental interest groups. After identifying all sources of actual and potential drinking water sources through extensive data collection, remote sensing and GIS activities, watershed councils begin the process of developing both protection and remediation strategies. The focus of protection programs is largely on land acquisition, wherein watershed management councils along with their partner organizations purchase land surrounding or including valuable surface and groundwaters. Land that is not available for purchase is subject to conservation easements, impervious surface limits, and riparian buffers. Land use decisions will also require limited or no development in wellhead areas, recharge zones, artesian zones, and drainage areas.

One of the greatest challenges facing watershed management councils is being able to coordinate activities throughout the entire watershed, especially when it is recognized that each watershed may contain several municipal, county, state, or even national borders. In addition to this, land use patterns as well as cultural diversity and income disparity, can make a unified approach to source water protection an extremely difficult proposition. Point and non-point sources of pollution are often in conflict with drinking water intake zones that service downstream municipalities that can be in another political district. Encouraging action in the headwaters of a watershed where land use activities differ greatly from the downstream uses can be a monumental task; however, some of this disparity is eased through extensive stakeholder consultation and public participation. Including agricultural, municipal, recreational, residential, industrial, environmental, and government representatives on a single council (namely watershed management councils developed through the US Clean Water Action Plan)

opens the door for effective communication and fosters a greater understanding of the varied needs within the watershed.

The SWAPP initiative is a relatively new development in the U.S., making an assessment of its success rather difficult. Despite the actual results, however, what this program has been able to do at the very least is increase awareness of drinking water management issues amongst the various federal, state, and municipal governments, as well as all relevant stakeholders. The extensive outreach and public participation components of the SWAPP programs have encouraged the general public to become involved in source water protection activities, and have also increased public expectations for clean, safe drinking water. It can be speculated that this increased awareness, along with additional reporting requirements, will encourage public water suppliers to improve their operations as well as their product.

The United States is not alone in developing programs and legislation to protect drinking water sources. In France, for instance, municipal zoning decisions are linked to environmental protection responsibilities through Master Water Development Plans. This coordination of municipal planning and source water protection is mandated through both the EU Framework Directive and the French Federal Water Law. Water Control Boards in the Netherlands perform a similar function, with the Groundwater Act ensuring that development will not negatively impact groundwater resources used for drinking water. Although only 60% of Sweden's groundwater is currently protected, the National Objective for High Quality Groundwater will provide a legal means of protecting supplies through strategic municipal zoning by 2010. Water Protection Areas in Germany protect surface and groundwater supplies as specified in the Federal Water Act and Wastewater Charges Act.

6. DISCUSSION

Reviewing the policies, practices and procedures related to drinking water supply management in international jurisdictions has revealed that the amount of information regarding this topic is extensive. Despite the relative availability of information, however, it is still difficult to come to any single conclusion about how drinking water should be managed. There is no single model that can be emulated to develop a comprehensive system of management: instead, policymakers must recognize the existing political, cultural, social, environmental and economic conditions and limitations within their jurisdictions and adapt policies, procedures and practices that will best complement the existing conditions. The patchwork system of management that is indicative of so many jurisdictions is a direct reflection of the diversity of these various factors, as well as the uses for fresh water resources. The most fundamental elements of water are what in essence make it so difficult to manage.

Although there is no clear indication of exactly what an effective management system should look like, it is important to mention several trends that did appear in this study. Perhaps the most prevalent and obvious trend in drinking water supply management is the development of enforceable national standards at the federal level. Of all the jurisdictions studied, Australia was the only country where, like Canada, drinking water standards are not actually standards, but rather "guidelines" that are not enforceable by law. Of note in this area is the recent development of the European Framework Directive on Water Policy, which creates a regulatory framework that will promote consistency in policies, practices and procedures across EU jurisdictions.

Most jurisdictions also seemed to struggle with assigning one lead agency for all water related activities. With the exception of Wisconsin (Department of Natural Resources), California (Department of Health Services), and the UK (Department of the Environment, Transport and the Regions), the management of drinking water is often shared amongst several federal, regional and/or municipal organizations. The most common arrangement is to assign responsibilities to an environmental protection/conservation department and a health department, a relationship that appeared most effective in New York's Performance Partnership Agreement between the New York State Department of Environmental Conservation, the State Department of Health, and the federal US Environmental Protection Agency. Similar, less binding arrangements than New York's Partnership Agreement were demonstrated in other jurisdictions through the creation of interdepartmental commissions and catchment basin management boards, with the most prolific example being the Netherlands where it has been proposed to assign all water-related responsibilities to the "Water Boards".

With the creation of federally enforceable drinking water standards comes the need for regulatory supervision and enforcement. Again, the greatest difficulty with supervision and enforcement is that it is often coming from more than one organization, and often more than one level of government. The most advanced system of regulatory supervision *and* enforcement is the UK which has created the Drinking Water Inspectorate — a team of professionals that monitors water quality conditions, reports on infractions, and has the legal ability to bring charges against companies where infractions have occurred. This level of control is not exhibited in any of the other jurisdictions analyzed in this report. The Netherlands has a similar watchdog organization with the Inspectorate for the Environment; however, it is responsible for regulating and overseeing all environmental regulations, not just those related to drinking water.

Another trend among jurisdictions is the development of regular consumer confidence and State of the Environment reports. With effective monitoring, regulatory supervision and enforcement,

compiling information regarding the quality of source waters and the subsequent quality of drinking water becomes routine. Most commonly, consumers are made aware of what contaminants are harmful to human health, the extent to which these contaminants are found in their drinking water supply, the overall state of water quality in their area, where their water comes from, and any infractions that have occurred to date. All jurisdictions studied in this report had at least some reporting requirements, with the U.S. and European examples showing the most comprehensive programs.

The importance of public involvement in the decision-making process has been recognized by all jurisdictions, although in many instances this participation is only encouraged, rather than required. U.S. programs related to source water assessment in particular have an extensive public consultation component. Australian and Dutch programs are attempting to involve the same level of public consultation and input with their proposed integrated resource management plans. The European Framework Directive on Water Policy makes specific reference to the need to improve transparency in the decision-making process, and has mandated its member states to develop programs to ensure the public has access to this process. An important aspect of this process, as is illustrated in several jurisdictions (e.g., USA and Australia) will be to develop public outreach materials to notify and inform the public of relevant water management issues.

Finally, the ability to carry out water management decisions depends heavily on the amount of resources available to water supply and wastewater treatment facilities. This can be most problematic for small water supply systems where the financial, managerial and technical resources are not always available for complying with strict regulations. In France and the USA, this has been addressed through special rural development and capacity development programs. To overcome financial and technical difficulties in other systems, several governments (UK, France, USA and Australia) have allowed privatization within the water sector. Privatization remains a contentious issue, however, as demonstrated by the Netherlands' recent legislation that places a moratorium on the privatization of water companies after concerns over its implications. The Netherlands continues to finance its water through charges to its consumers that are equivalent to the costs of production, extraction, treatment and delivery. This system of full cost recovery is mirrored in most other jurisdictions, regardless of the facilities' ownership.

What can be learned from this report is that there are many options available for developing an effective management system for drinking water. The greatest challenge is in finding the combination of policies, practices and procedures that best suit the social, political, economic and environmental realities within a jurisdiction. In a country like Canada where our freshwater resources appear to be both plentiful and of high quality, water must still be managed in a sustainable manner if both present and future generations are to have access to a safe and reliable drinking water supply. With such a wealth of freshwater resources, Canada is well positioned to lead the way in establishing an effective and sustainable system of management. With further consideration of the options revealed in this paper, and through consultation with all relevant stakeholders, the opportunity exists to establish a secure resource for the future. Having access to a clean and abundant water supply is more than a wish, it is a fundamental right — and it is up to all Canadians to ensure that this right is fulfilled.

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