CANADIAN HOUSEHOLD WATER USE AND THE ROLE OF ECONOMIC INCENTIVES IN WATER USE REDUCTION

by

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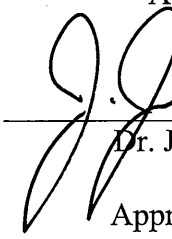

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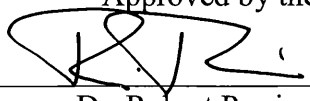

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Abstract

Canada is considered a water-rich nation; however, this both renewable and non-renewable natural resource is slowly decreasing in supply. As a water rich country, it is challenging to contest Canadians should monitor their water use, yet some regions are already facing water shortages. These variations in supply are caused by different climates and pricing structures across Canada.

Economic incentives can help to decrease water use, and promote conservation. Through the adoption of water meters and appropriate pricing structures, the use of demand-side management can decrease the rate of water use in Canada.

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Chapter One: Introduction

"Water is an essential natural resource. Without it, all life on earth would perish."[1] Water is considered to be both a finite and a renewable resource. This is because although water is "renewed" through the water cycle, the cycle produces only so much water per year. With a fixed production level supplying an increasing population, water scarcity is not just a growing concern but an imminent problem that must be acknowledged.[2] The issues of distribution, equity, and sustainability are predominant in the international political forum. Imbedded within these issues are even more problems for example, the question of water privatization, ownership, and trade.

1.0 Overview

The heightened awareness of water scarcity is evident in some of the research projects of the United Nations. "The United Nations General Assembly, in December 2003, proclaimed the years 2005 to 2015 as the International Decade for Action 'Water for Life.'"[3] This declaration serves as an umbrella to a group of water goals including the Millennium Development Goals. The Millennium Goals aim to "...reduce by half the proportion of people without access to safe drinking water by 2015 and to stop unsustainable exploitation of water resources."[4] The UN, by making this declaration, has created accountability for the objectives. Projects such as these give ways for Canada to help on the world stage. However, confronting this international problem may also be a question of looking within Canada's own borders.

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[1] John M. Hartwick and Nancy D. Olewiler, *The Economics of Natural Resource Use: Second Edition* (United States: Addison-Wesley Educational Publishers, 1998), 57.
[2] Sandra Postel. *Last Oasis: Facing Water Scarcity.*(United States: W.W. Norton & Company, 1997), 28.
[3]United Nations, International Decade: Water for Life 2005-2015. November 4, 2006 <www.un.org/waterforlifedecade/background.html>.
[4] United Nations, International Decade: Water for Life 2005-2015. November 4, 2006 <www.un.org/waterforlifedecade/background.html>.

1.1 Canada's Water Supply

Canada has one of the largest quantities of the world's freshwater. With these over-arching perceptions on water quantity, it is not surprising that Canadians are abusing this resource. However, in spite of Canada's abundance in the aggregate, the country does experience regional problems with water supply. These deficiencies have sparked the promotion of water conservation. Water conservation aims to, "...reduce the *absolute* amounts of water we use...and/or reduce the *rate* at which we use water in our daily lives."[5] On a national level, conservation addresses sustainability, and tackles current issues including water shortages, water tables falling due to excessive pumping, and municipal infrastructure problems.[6]

1.2 Water Challenges

Water usage is a macro problem that can be broken into many micro subsections the most evident being agriculture, energy, households, and industry. The aim of this thesis is to focus specifically on the household sector's water use as "...understanding how Canadian communities use water is a prerequisite to gauging Canada's progress toward the sustainable use of its water resources."[7]

The allocation of water is studied though water resource economics. In this field of study the "...overall aim...is to assure current and future water uses are met in the most economically efficient way."[8]

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[5]Environment Canada, November 2, 2006 < www.ec.gc.ca/water/en/info/pubs/primer/e_prim03.htm >.
[6]Environment Canada, November 2, 2006 < www.ec.gc.ca/water/en/info/pubs/primer/e_prim03.htm >.
[7]Environment Canada, Municipal Water Use Report, Accessed November 2006 <http://www.ec.gc.ca/water/en/info/pubs/sss/e_mun2001.pdf>.
[8] Environment Canada, Water Resource Economics November 4, 2006 <www.ec.gc.ca/water/en/manage/res/e_res.htm>.

1.3 Jurisdiction

Water in Canada is regulated at both the federal and provincial[9] level. Under federal jurisdiction are the "...fisheries, navigation, federal lands, and international relations...[The federal government] also has significant responsibilities for agriculture, health and the environment."[10] This thesis, as it addresses household use of water, is more concerned with the provincial responsibilities. Under provincial authority "...waters that lie solely within a province's boundaries fall within the constitutional authority of that province...[They] include, but are not restricted to, areas of flow regulation, authorization of water use development, water supply, pollution control, thermal and hydroelectric power development."[11] For territorial control the Indian and Northern Affairs Canada (INAC) control the Northwest Territories and Nunavut, while the Yukon governs its own water.[12]

1.4 Distribution

Canadian water distribution is interesting as it reflects the diverse climate and various degrees of development present within the country. This is apparent in the spectrum of methods for water supply. In Canada, city households rely on pipelines run by the municipalities; alternatively those is rural areas are usually supplied by wells. In some areas of the North where the ground is frozen and in the prairies where the wells may dry up, water has to be transported by trucks.[13]

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[9] For the purpose of this thesis, the word "provincial" is in reference to both the provinces and territories of Canada.
[10] Environment Canada, November 4, 2006 <www.ec.gc.ca/water/enpolicy/federal/e_intro.htm>.
[11] Environment Canada, November 4, 2006 <www.ec.gc.ca/water/en/policy/prov/e_prov.htm >.
[12] Environment Canada, November 4, 2006 < www.ec.gc.ca/water/en/policy/prov/e_prov.htm >.
[13] Environment Canada, November 2, 2006 < www.ec.gc.ca/water/en/info/pubs/primer/e_prim03.htm >.

1.5 Value

Currently, the majority of Canadians pay a fee for their water. This fee helps to cover the charge of administration, upgrades and technological changes. The fee also helps to cover the cost for water to be "...pumped, stored, moved, and treated to make water available and safe for use and then have it taken away after discharge."[14] The fee paid for water varies from province to province. This fee, and the provincial government's justification for it, will be examined in more detail throughout the thesis.

Just like all other resources, water faces the economic challenge of allocating of a limited resource to an unlimited demand. This situation, however, is especially complex because it is allocating a basic life need. Economic theory dictates that price can indicate scarcity; however, water is relatively abundant which keeps prices low. Furthermore, the majority of Canadians do not feel that they are at risk of dying of thirst.

Demand for water by households has been proven to be determined by a number of factors including "...price of domestic water, price of related goods, income of domestic water consumers, climate, and municipal water conservation policies."[15] It is used for "...indoor uses for sanitation, drinking, and cooking, and outdoor uses for lawns, gardens, and occasional washing of cars and driveways."[16] When pricing water, however, one must confront issues of scarcity and sustainability, while conversely ensuring it can be obtained by the entire population. Presently there are many different methods used to charge for water. The following section will discuss this concept further, and introduce different pricing schemes.

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[14]Environment Canada, November 2, 2006 < www.ec.gc.ca/water/en/info/pubs/primer/e_prim03.htm >.
[15] Robert A. Young, Determining the Economic Value of Water (United States: Resources for the Future, 2005), 246.
[16] Young, 246.

1.6 Pricing Schemes

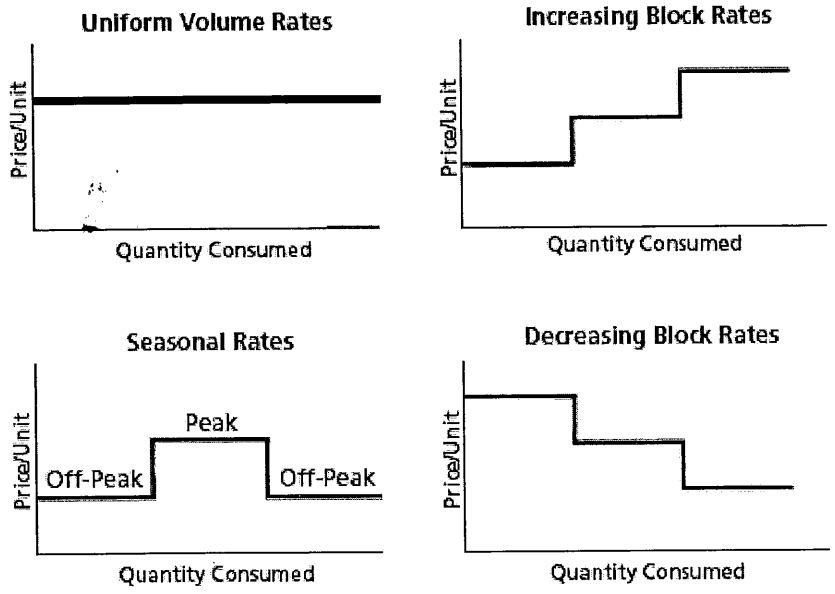
The first method of pricing would be uniform rates. With uniform rates, households pay a fee to have water delivered. However, that fee does not depend on the amount of water used. Under this method marginal cost equals zero, and waste is created. The benefits of this method, however, include easy administration and affordability that increases equality. The alternative is a form of volumetric pricing. One type of volumetric pricing is average cost pricing. However average cost may be less than marginal cost (almost certainly not equal); therefore average cost price is almost certain not to be efficient. This inefficiency occurs because to the household, marginal cost does not equal the marginal price. Again, however, there are advantages of easy administration and the ability to make this method equitable.

Another method for pricing would be to use decreasing block rates. Some references suggest that this method, although it encourages water use, was probably adopted as a way to encourage the development of water industries (for example, manufacturing). Decreasing block rates charges a lower price per unit the more one uses. This method encourages excess use. The high price of administration also promotes waste. Due to high costs, governments want to minimize the amount of management needed. Therefore there is a push for a few large accounts to supervise, instead of the micromanagement of water use. Conversely, there is increasing block rates. This method works similar to the last, except that the rates increase in units. This method allows for greater equity, by having a low rate for the first "block" of water use.

One method of marginal cost pricing, is arguably the most effective, but this is the most difficult to calculate. The seasonal or peak load pricing method, charges different

prices depending on time of day, or season; thus those with the greatest demand will pay the highest price. Additionally, one may view variation in marginal delivery cost as a method to determine price. The charge would be based on the cost to supply the water. Essentially those who live farther away from the source should pay a higher fee.[17]

The following table illustrates four of the discussed methods of water pricing:



[18]

Figure 1.6.1

Uniform Volume Rate:	Constant flat rate
Increasing Block Rate:	Rate increases once specific quantity is consumed
Seasonal Rate:	Higher prices during times of greater demand
Decreasing Block Rate:	Price decreases once specific quantity consumed

These rates all illustrate different ways to apply monetary value to water. By establishing a financial worth, economic theory can then be applied. In the following section the use of economic incentives, as a technique to reduce water consumption, are introduced.

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[17] Dr. John Janmaat. Acadia University Lecture. January 31, 2006.

[18] Government of Canada, Policy Research Initiative, Economic Instruments for Water Demand Management in an Integrated Water Resources Management Framework (Policy Research Initiative, 2005), 15.

1.7 Economic Incentives

Implementing some of these different pricing methods in Canada has shown positive results. Environment Canada has been conducting the Municipal Water Uses (MUD) survey every two to three years, since 1983. MUD research supplied the foundation for this thesis. Their surveys presented data that provided validity to the economic theory through empirical evidence. These studies show that in areas where Economic Incentives (EIs) have been used, lower consumption is observed. EIs are mechanism which try to, "...stimulate an economic actor to voluntarily adopt...certain behaviour. The underlying rational is that human beings react to price incentives, when prices are high less resources will be consumed."[19] These areas used volume based pricing and water metering. Metered homes use less water, as displayed in the table following. Additionally, "...both nationally and provincially, Canadians use more water when they are charged a flat rate...These findings suggest that metering and volume-based pricing can be valuable demand-management tools for promoting the responsible use of water resources."[20]

[19] David Sawyer& Genevieve Perron & Mary Trudeau. Analysis of Economic Instruments for Water Conservation. (Canadian Council of Ministers of the Environment, 2005), 3.
[20] Environment Canada, Municipal Water Use Report, Accessed November 2006 <http://www.ec.gc.ca/water/en/info/pubs/sss/e_mun2001.pdf>.

Table 1: Water Flows and Metering Rates, by Province/Territory and Municipal Population					
Province/ Territory	Percentage of flow from surface water	Total average daily flow (litres per capita)	Average daily residential flow (litres per capita)	Percentage of residential clients that are metered	Percentage of business clients that are metered
Newfoundland	95.1	971	664	0.0	47.4
P.E.I.	0.0	529	218	13.4	100.0
Nova Scotia	91.4	667	351	89.1	99.4
New Brunswick	79.7	1314	416	49.6	89.5
Quebec	93.4	777	395	16.2	32.8
Ontario	88.4	533	285	89.9	98.4
Manitoba	81.6	410	223	96.6	98.6
Saskatchewan	87.5	517	236	98.5	99.6
Alberta	93.9	519	282	82.3	98.9
British Columbia	84.6	651	425	26.5	93.9
Yukon	69.0	803	556	52.8	100.0
N.W.T.	100.0	424	204	97.3	n/a
Nunavut	100.0	105	88	76.7	20.0
Municipal Population					
Under 2000	61.2	715	446	42.4	53.2
2000 to 5000	57.3	732	466	35.4	55.5
5000 to 50 000	78.9	665	397	47.5	75.0
50 000 to 500 000	88.9	596	326	61.7	91.3
More than 500 000	99.6	614	300	69.0	81.8
Total	89.2	622	335	60.6	83.1
Responding Population	21 634 144	23 822 869	23 822 869	24 235 565	16 075 854

Source: Values derived from the 2001 Municipal Water Use Database, Sustainable Water Use Branch, Environment Canada.

[21]

Table 1.7.1

This table, complied by MUD, shows the decrease of water use, where homes are metered.

Across Canada, "...there has been growing interest in evaluating our ability to continue to meet our needs for water, while using less of it, by increasing efficiency of use."[22] Governments are working on

> [e]nsuring that the economic aspects of water are balanced with the social goods aspects. Water needs to be affordable for people while at the same time making certain that water agencies are financially healthy and able to expand service coverage and improve quality.[23]

[21] Environment Canada, Municipal Water Use Report, Accessed November 2006 <http://www.ec.gc.ca/water/en/info/pubs/sss/e_mun2001.pdf>.
[22] Peter H. Gleick. The World's Water. (United States: Island Press, 2004), 126.
[23] Gleick, 53.

1.8 Focus of Research

Water is a topic worthy of study for a great number of reasons. For the purpose of this thesis, the area of Canadian household water conservation use was chosen. The focus of water scarcity research has been predominantly in dry regions and developing nations. Canada is a water-rich, developed nation. As such, research into water scarcity is a younger, growing field. Through exploring water use, it is hoped that conservation will become a proactive action towards ensuring sustainability[24] in Canada.

Since water costs for households are allocated through the provincial governments, each province and territory will have to be individually assessed. Chapter two presents an outline of each province's current means of water pricing. Chapter three then presents the provincial water conservation policy.

Following the provincial assessments, methods for economically efficient and equitable means of distribution will be offered and conclusions presented. Ultimately, "...understanding how Canadian communities use water will help water managers balance the needs of the Canadian economy, Canadian society and the environment."[25]

[24] The word "sustainable" has multiple definitions. For the purpose of this thesis, it refers to the concept of intergenerational equity with respect to choosing the most efficient path of consumption for depletable and non-depletable resources.

[25] Environment Canada, Municipal Water Use Report, Accessed November 2006 <http://www.ec.gc.ca/water/en/info/pubs/sss/e_mun2001.pdf>.

Chapter Two: Provincial and Territorial Backgrounds

This chapter will first address the importance of water pricing in Canada. Next, the chapter evaluates each province and territory. Assessing each province individually is crucial to illustrating the immense variations in water policy across the nation. Additionally, changes in the environment that have affected water supply will be noted. Finally, the number of metered citizens will be addressed. Metering allows users to monitor their consumption rates. Through knowing exact levels of water use, decreased use and conservation can be observed.

2.0 Canadian Water Use

Canadians have significantly increased their level of water use over the past thirty years. From 1972 to 1996, water use rose by almost 90%; however, the population only grew by 30%.[26]

With, "...increasing demands for water use, increasing water consumption rates, and decreasing water availability,"[27] water policy is an area of pressing concern for Canada. Upon closer examination, it becomes apparent that current methods of supply-side management are not sustainable. Continuing to use supply-side management is irresponsible and unsustainable. It cannot be maintained economically or environmentally.[28]

> An international comparison shows Canada to be one of the highest users in the world. Potential consequences of such high and rising use are ecological stresses, quality concerns, and regional and seasonal shortages due to over-extended local water supplies and supporting infrastructure. Furthermore, the scale and scope of

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[26] Susan McFarlane & Erik Nilsen., On Tap: Urban Water Issues in Canada Discussion Paper (Canada West Foundation, August 2003), 1.
[27] McFarlane & Nilsen 2.
[28] J. Consulting Kinkead & A. Boardley & M. Kinkead An Analysis of Canadian and Other Water Conservation Practices and Initiatives: Issues, Opportunities and Future Directions (Canadian Council of Ministers of the Environment, 2006), 17.

> urban water use coupled with the existing state of wastage and inefficiency in the urban setting suggest opportunities to reduce water use patterns with little impact on lifestyles or quality standards for Canadians.[29]

Thus, governments are turning towards a demand-side approach. When faced with increased demand, "demand-side management" aims to change consumption patterns instead of trying to fins new ways to supply. Central to the success of this method is being able to measure how much water one uses; hence the importance of metering comes into effect. The specifics of demand-side management (DSM)[30] are presented in chapter four, yet it is necessary to stress the importance of metering now, as it is a main factor in assessing provincial water policy.

2.1 Economic Theory

In applying economic theory to water use, one would argue that an increase in price would decrease water demand, and conversely a decrease in price may increase water demand. Currently Canadians face a variety of pricing methods, depending on many factors such as their provincial government, municipality, and water delivery organization. The most efficient water pricing is arguably marginal cost pricing. When using this pricing method "...water users can do a cost-benefit analysis of increasing (or maintaining) their water use, and are able to make efficient decisions."[31]

2.2 Provincial Assessment

In order to fully appreciate the water situation in Canada, it is first necessary to asses each province in turn, before analyzing on a macro level. Through isolating provincial shortcomings it will help to highlight regional water problems. Reviewing

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[29] Oliver M Brandes. & Keith Ferguson Flushing the Future? Examining Urban Water Use in Canada (POLIS Project on Ecological Governance, 2003), 26

[30] Government of Canada, Policy Research Initiative, Economic Instruments for Water Demand, 15.

water allocation in the provinces is a natural division, as water is monitored under the provincial governments.

> The substantial variation in water use across Canadian cities is not easily explained. Many factors could influence water use, from physical environment and the nature of the city and its infrastructure, to local social attitudes, making it difficult to discern important common variables affecting use.[32]

There are three main areas where water strains are particularly apparent. Some areas of the country face "semi-arid" weather conditions, especially during the summer. Secondly, many Canadians rely on groundwater. When water is overdrawn, it can lower water tables. Reliance on groundwater for water supplies is particularly common in rural areas. Municipalities also face water challenges. Here, in more densely populated areas, older water and sewage systems can be wasteful and are also a risk to water quality. These areas also face varying demands, specifically in the summer season.[33]

In evaluating each province, the aim is to highlight both problems and solutions for water conservation in Canada. With each province and territory facing varying conditions, it is necessary to asses them individually. Every province is varied in terms of policy and development. This thesis aims to increase understanding of how DSM can help water conservation. However; the proposal is not that every province reaches the "same level" of water conservation by a specific period, as that is an unrealistic goal. Instead, it is hoped each province makes improvements to their current system.

Taking a step back, before persuading the governments to make changes, it must first be evident that there is a problem.

> The view of abundance masks other realities concerning the availability of these resources and discounts the significance for the mounting list of situations where sustainable-use concerns exist at the local and regional levels. It also ignores the

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[32] Brandes & Ferguson, 28.
[33] Environment Canada, February 6, 2006 < www.ec.gc.ca/water/en/info/pubs/primer/e_prim03.htm >.

> substantial economic costs and forgone opportunities associated with inefficient and less-productive uses of water.[34]

This is where advocating sustainability must be addressed.

As previously stated, water policy and allocation varies across Canada. Indeed, the population experiences somewhat different methods of water supply depending on their region. This thesis asserts that the foundation for a sustainable water allocation is household metering. Household metering is the first step towards acknowledging and monitoring water use. Once meters are in place then water supply ca be monitored. This, therefore, allows for volume rate pricing to be employed. "Residential water metering is prerequisite to any volume based pricing structure...The existence of meters generally corresponded to the use of volume-based pricing structures."[35] The following data presents the percentage of households metered in 2001. The number of households metered is roughly inversely related to household water use. This reinforces the argument for household metering.

[34] J. Kinkead & Boardley & M. Kinhead,17.
[35]Brandes & Ferguson, 32.

Province or Territory	Number of Metered Citizens	Pricing Method
New Brunswick	49.6%	Volumetric or Uniform Rate
Nova Scotia	89.1%	Volumetric
Prince Edward Island	13.4%	Uniform Rate
Newfoundland and Labrador	0%	Uniform Rate
Quebec	16.2%	Uniform Rate
Ontario	89.9%	Volumetric
Manitoba	96.6%	Volumetric
Saskatchewan	98.5%	Volumetric
Alberta	82.3%	Volumetric
British Columbia	26.5%	Uniform Rate, Mixed, and Volumetric
Nunavut	76.7%	Volumetric
Yukon	52.8%	Uniform Rate and Volumetric
Northwest Territories	97.3%	Volumetric

[36]

Table 2.2.1

2.3 Provincial Characteristics

This section presents water supply, demand and scarcity in each province. The provinces have been divided into four groupings: British Columbia and Central Canada, the Prairies, Atlantic Canada, and Northern Canada. These groupings are discussed briefly below, followed by a series of tables.

The first group includes British Columbia, Ontario and Quebec. The first two provinces have experienced water scarcity; however, Quebec's current water use rate suggests that water scarcity has not yet been a problem.

The second group, the Prairies, are a naturally dry area of Canada. The southern areas of Manitoba, Saskatchewan and Alberta are very important in the agriculture and

[36] Susan McFarlane & Erik Nilsen., On Tap: Urban Water Issues in Canada Discussion Paper (Canada West Foundation, August 2003), 1 & Environment Canada, Municipal Water Use Report, Accessed November 2006 <http://www.ec.gc.ca/water/en/info/pubs/sss/e_mun2001.pdf>.

farming sectors. These provinces are densest in the south regions. This area receives an average annual precipitation level of 400mm.[37]

The area of southern Alberta and Saskatchewan became known as the famous "Palliser Triangle." Here, the explorer John Palliser believed it was too dry to ever be productive for agriculture. Ironically, with irrigation, this area represents some of the most productive land on the prairies.

The third group, Atlantic Canada, includes Newfoundland and Labrador, Prince Edward Island, New Brunswick, and Nova Scotia.

> Canada's Atlantic-provinces have generally not experienced the levels of concern over water use sustainability felt in other parts of the country. This is a combined product of higher water-renewal rates in proportion to demand and slower rates of population and economic growth. Recent drought-like conditions approaching historic lows have, however, begun to raise concerns in parts of Nova Scotia, New Brunswick and Prince Edward Island.[38]

Lastly, Northern Canada includes Nunavut, the Yukon, and the Northwest Territories. These communities face water challenges unique to their regions. Due to the frozen ground and severely low temperatures, it is hard to use piping systems; therefore, many areas still have their water trucked in. Due to these transport costs, they encounter higher prices.[39]

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[37] J. Kinkead & Boardley & M. Kinhead, 21.
[38] J. Kinkead & Boardley & M. Kinhead, 26.
[39] J. Kinkead & Boardley & M. Kinhead, 42.

2.4 Western and Central Canada

Province	Characteristics		
	Water Supply	**Demand**	**Scarcity**
British Columbia	-Large supply of renewable freshwater, but much of this water is not easily accessible	-Province grants licences based on prior appropriation -Groundwater licences began in 2004, however surface water licensing has been in use for a long time -Those with licences pay administration costs and have their meters monitored occasionally, depending on the case	-2003 experienced a drought that lowered water tables to an historic low
Ontario	-Majority of water drawn from the Great Lakes -Water is also supplied by the northern lakes and rivers -Ontario receives an average of 600-1000mm of rain annually	-The Great Lakes has shaped the countries history and development, both socially and economically	-Ontario has faced regional water shortages, especially in the southern regions
Quebec	- Quebec contains the largest supply of freshwater in Canada -Draws from watersheds -Quebec receives 750mm of precipitation annually	-Quebec has the largest consumption per person, per day, of water in the world -The average Quebecer uses 400L/ day, compared to the Canadian average of 350 L/day, and United Kingdom's 200L/day	-Quebec's high rate of water use, suggests that they have not experienced shortages

[40]

Table 2.4.1

[40] J. Kinkead & Boardley & M. Kinhead, 31-32, 40, 44, 218.

2.5 Prairie Provinces

Province	Characteristics		
	Water Supply	Demand	Scarcity
Alberta	- 98% of water used is surface - Lakes: The Hay, Athabasca, and Peace/Slave empty into Arctic - Northern area contains 80% of renewable freshwater	-Water demand is primarily in the south (88%)	-Experienced water shortages (especially in the last six years) -The demand is in the south, and supply is primarily northern
Saskatchewan	-The weather fluctuates greatly	-Due to weather fluctuations, the public stores their water for household, commercial and industrial use	-The demand is primarily in the south, and the supply in the north
Manitoba	-13% of Canada's freshwater drains through Manitoba -Rainfall varies -Southwest receiving less than 400mm annually -Central and northern areas receive 600-900 mm	-The demand, as with the other prairie provinces, lies mainly in the south	-Rainfall amounts vary so greatly that there is drought some years and flooding others

[41]

Table 2.5.1

[41] J. Kinkead & Boardley & M. Kinhead, 33, 38, 181, 220.

2.6 Atlantic Canada

Province	Characteristics		
	Water Supply	**Water Demand**	**Water Scarcity**
New Brunswick	-The province receives and average 1100mm of rain per year -33% of this comes from snowfall	-Water demand varies across the province	-New Brunswick has not experienced any drought problems
Nova Scotia	-Municipal water systems serve 54% of the population -Mainly rural areas account for the other 46% and receive their water from private sources or ground water supplies -Precipitation varies between coastal, inland and highland regions, with averages ranging from 1000-1600mm annually	-Water demand varies across the province	-Nova Scotia seldom faces water shortages, and when it does, they do not last for an extended period of time
Prince Edward Island	-Only province that relies almost entirely on groundwater for drinking -Over half the population operates on private wells -Annual rainfall of 1000-1100mm	-Water demand in Prince Edward Island is largely agricultural	-Water scarcity in Prince Edward Island is hard to measure, as the majority of the population gets their water from private wells
Newfoundland and Labrador	-The mean precipitation is greater than 1000mm and 1650mm along the south coast	-Newfoundland uses among the highest amount of water in Canada	-Newfoundland's high rate of water use suggests that they have not experienced shortages

[42]

Table 2.6.1

[42] J. Kinkead & Boardley & M. Kinhead, 46-48, 196, 198.

2.7 Northern Canada

Province	Characteristics		
	Water Supply	**Water Demand**	**Water Scarcity**
Nunavut	-In larger towns and cities, some citizens have piped systems -Other areas still rely on trucking their water in	-The majority of the population still has their water trucked in. Because of this, an increase in demand can not easily being ful filled	- It is hard to access the groundwater because of the low temperatures -Water availability, therefore, is strongly seasonal dependant -Despite the high costs of transporting water via trucking systems, it is still a lower rate than for water to be piped directly to the home -Given the cold climate it would be very costly to install the infrastructure required at such low temperatures
Northwest Territories	-The mean precipitation rate is 250-350mm annually -There are many bodies of frozen water	-Due to the frozen ground, only eight of thirty-three communities have piped water systems -The rest of the population has their water piped in	-As in Nunavut, it is still more economical to have the water trucked in than to install a piped delivery system
Yukon	-Large supply of freshwater, from water bodies, snow, glaciers, and ground water	-Water demand is relatively constant, like the other Territories. This is due to the constrictions on water supply caused by the climate	-In the recent past, Whitehorse experienced drought for the first time, and had one of the driest years on record

[43]

Table 2.7.1

[43] J. Kinkead & Boardley & M. Kinhead, 42, 49, 52.

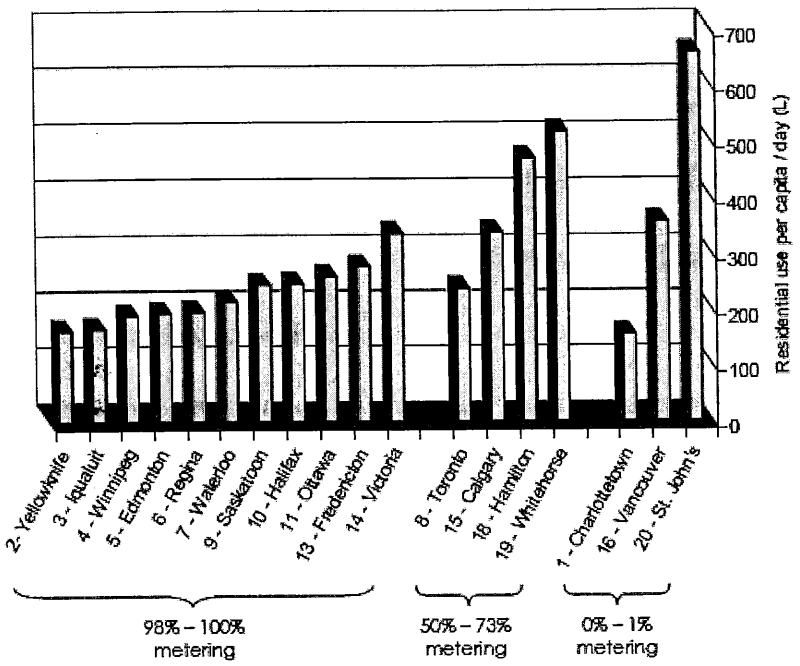
2.8 Conclusions

The key conclusion to draw from this provincial and territorial assessment is the huge variation across the nation. Water supply is sensitive to climate, demand and pricing – all of which are location dependant. Every area has different characteristics and challenges. It is this range that makes the study of water policy challenging.

Across Canada there is huge variation in water pricing. Every province and territory has many levels of government ranging from federal to regional, municipal, and local which have some role in water related policy. Additionally, the climate across Canada is vastly different. Some provinces, as seen in the following chapter, have been adopting and modifying water strategies for many years, while others are still trying to lay the foundations of basic water distribution. With this spectrum of development stages, the challenge and complexity of water policy are apparent.

The statistics presented in the following graph illustrate the direct relationship connecting metering, pricing methods, and household water use.

Figure 4.7: **Residential use grouped by percentage metered, 1999**



Source: Environment Canada MUD database [44]

Table 2.8.1

According to research on municipal water use

> [A]ll surveys since 1991 indicate that, both nationally and provincially, Canadians use more water when they are charged a flat rate…These findings suggest that metering and volume-based pricing can be valuable demand-management tools for promoting the responsible use of water resources.[45]

In the above graph Charlottetown and Toronto do not appear to follow the trend presented. Charlottetown's low water use, despite low metering, can be explained by their water source. Price Edward Island relies almost exclusively on groundwater. With

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[44] Environment Canada, Municipal Water Use Report, Accessed November 2006 <http://www.ec.gc.ca/water/en/info/pubs/sss/e_mun2001.pdf>.

[45] Environment Canada, Municipal Water Use Report, Accessed November 2006 <http://www.ec.gc.ca/water/en/info/pubs/sss/e_mun2001.pdf>.

over half the population using private wells, the accountability of water use is very low. Thus within Charlottetown the measured water deliveries from the municipal system only represent a fraction of total water consumed. Similarly, Toronto stands out with about half the population metered and yet falling about average with the other cities in consumption level. There are different theories presented as to why this is occurring. For example, it is possible that with the dense population lawn sizes may be small, or non-existent, thus reducing the aggregate level of water use. This variation occurring in Toronto has still yet to be explained.[46]

In the next chapter provincial water policy will be further examined. Specifically, provincial strategy for water conservation will be discussed. This information can be used to help understand current views on water conservation.

[46]Government of Canada, Policy Research Initiative, Economic Instruments for Water Demand Management in an Integrated Water Resources Management Framework (Policy Research Initiative, 2005), 15.

Chapter Three: Provincial and Territorial Water Conservation Initiatives

Current trends in Canada show a rise in the number of households metered. In "...2001, 61% of Canadian residents were metered, up from 56% in 1999..."[47] This chapter highlights provincial initiatives for water use reduction and sustainability.

The maintenance of clean water has always been important; however, there has been increased public awareness since the Walkerton and North Battleford events. In Walkerton, Ontario, during May of 2000 "...seven people died from drinking [E-coli] contaminated water. Hundreds suffered from the symptoms of the disease, not knowing if they too would die."[48] The following year in North Battleford, Saskatchewan, there was an "...outbreak of gastroenteritis between late March and early spring. An estimated 5,800 to 7,100 people from the Battlefords were affected [by]... *Cryptosporidium*...[contaminating] drinking water."[49] Since that time, provincial water incentives have taken a more proactive role in maintaining water quality. Additionally, provinces and territories are recognizing the importance of sustainability and conservation in maintaining water quality.

The previous chapter discussed water source, quantity, and pricing. This chapter looks further into water policy. Specifically, through assessing the provinces and territories water conservation strategies, perceptions towards water pricing are exposed. Essentially, if the province's and territory's governments have developed a water strategy or plan for conservation, it can be inferred that the importance of water conservation has

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[47] Environment Canada, Municipal Water Use Report, Accessed November 2006 <http://www.ec.gc.ca/water/en/info/pubs/sss/e_mun2001.pdf>.
[48] CBC, Canada's Worst-Ever E-coli contamination March 13, 2007 <http://www.cbc.ca/news/background/walkerton/>.
[49] Public Health Agency of Canada, March 12, 2007 Waterborne Cryptosporidiosis Outbreak, North Battleford, Saskatchewan, Spring 2001 <http://www.phac-aspc.gc.ca/publicat/ccdr-rmtc/01vol27/dr2722ea.html>.

been acknowledged. Just as climate and pricing vary across the nation, attitudes towards conservation also range. This chapter aims to highlight both provincial and federal incentives to maintain water quality. As this thesis is addressing household water use, only projects which directly affect residential use will be discussed.

3.0 British Columbia

In 2004, British Columbia released its *Water Sustainability Action Plan for British Columbia*. Under this umbrella, the province aims to create cohesion within all sectors of water use, including agriculture, fishing, and household use. This plan approaches water use on a macro level. Specifically the plan "...is to encourage province-wide implementation of fully integrated water sustainability policies, plans and programs."[50]

The Action Plan has six main components on which it is based:

- Water Sustainability Website Partnership – A multi-partner, centralized and comprehensive website for finding out what's going on in water management.
- Water Save Tool Kit – Everything individuals and communities need to know to achieve conservation and efficiency objectives.
- Water Sustainability Roundtable – Multi-stakeholder forum for dialogue on issues, directions and partnerships.
- Green Infrastructure Partnerships – Initial efforts focus on developing a best practice 'Model Subdivision Bylaw and Green Infrastructure Standards' for use in land development regulation.
- Water Balance Model – A web-based evaluation tool for enhanced land development decision-making with a focus on site-level storm water controls.
- Watershed/Landscape Based Approach to Community Planning – 10-step methodology stressing watershed features requiring consideration and protection.[51]

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[50]Water Sustainability Committee of the British Columbia Water & Waste Association, Water Sustainability Action Plan for British Columbia: Framework for building Partnerships. (February 2004), 3.
[51]J. Consulting Kinkead & A. Boardley & M. Kinkead. "An Analysis of Canadian and Other Water Conservation Practices and Initiatives: Issues, Opportunities and Future Directions." (Canadian Council of Ministers of the Environment, 2006), 3.

British Columbia has also introduced the *Drought Management Plan* in 2003 that "...coordinated measures to address immediate drought-related issues and...provide[d] direction for longer-term review of provincial water policy focusing on allocation, use and conservation."[52] This plan was implemented in reaction to drought that occurred in 2003. Having a reactive approach is unfortunately the norm in most environmental situations. Through education and increased awareness, it is hoped that more governments will be proactive. As this thesis argues, a demand-side approach is one way to create positive changes.

Thirdly, the governments *Action Plan for Safe Drinking Water* is an "...action plan [that] includes comprehensive legislation and measures to protect drinking water from source to tap by improving standards for monitoring, treatment, reporting and accountability to the public."[53]

All three of these projects are currently underway. To date, all have pursued educating citizens as the backbone of change. The drought management plan, in particular, has really pushed education as a means to promote demand-side management.[54] Economic theory, as discussed in chapter four, supports demand-side management. Under demand-side management ways to reduce water consumption, or alter consumption patterns are presented, instead of supply-side management which looks for new ways to supply more water to satisfy the demand.

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[52] Environment Canada, Water and Canada: Integrated Water Resources Management: An Overview of Perspectives, Progress, and Prospects for the Future at Home and Abroad (Canada: Environment Canada, 2005), 8.
[53] Environment Canada, Action Plan for Safe Drinking Water in British Columbia (British Columbia Ministry of Health Planning, 2002), 3.
[54] J. Kinkead & Boardley & M. Kinhead, 189.

Previous to these projects British Columbia developed a *Water Conservation Strategy for British Columbia,* in 1997. This plan promoted supply and demand side management. The main challenge that British Columbia found when implementing this, and subsequent changes, is that they all lacked a central regulatory authority. The provincial government argues that it is public perception on water and water supply which will ultimately determine if economic incentives (EIs) should be introduced.[55] British Columbia has also implemented a number of municipal case studies. One of these is highlighted as case studies in chapter five.

3.1 Prairies

Alberta

Alberta has acknowledged their water shortage issues, perhaps more than any other province. Unfortunately this was also a reactive approach, as much environmental policy is. The province developed the *Water for Life: Alberta's Strategy for Sustainability* in March 2003 in response to the

> Population growth, drought and agricultural and industrial development and increasing demand and pressure on the province's water supplies, and the risk to the health and well-being of Albertans, our economy and aquatic ecosystems.[56]

Through the *Water for Life* strategy, Alberta holds three main goals:

- Safe, secure drinking water supply
- Healthy aquatic ecosystems
- Reliable, quality water supplies for sustainable economy[57]

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[55]David Sawyer & Genevieve Perron & Mary Trudeau, Analysis of Economic Instruments for Water Conservation (Marbek Research Consultants for Canadian Council of Ministers of the Environment, 2005), A-1.
[56] Alberta Environment, Water for Life: Alberta's Strategy for Sustainability (Government of Alberta, 2003), 5.
[57]Kinkead & Boardley &Kinkead, 34.

Alberta's plan is unique in that each of their goals has a short, medium, and long term time frame established.

Safe Secure Drinking Water	
Short Term (2004/05- 2006/07)	-Develop a comprehensive strategy to protect Alberta's drinking water
Medium Term (2007/08 to 2009/10)	-Albertans have knowledge of the water situation -Albertans have time to acquire knowledge of water issues
Long Term (2010/22 to 2013/14)	-Drinking water standards are strong and sustainable -Albertans have the knowledge and tools to implement the changes
Healthy Local Eco-systems	
Short Term (2004/05- 2006/07)	-Protecting ecosystems has begun
Medium Term (2007/08 to 2009/10)	-Established objectives for managing watersheds and ecosystems
Long Term (2010/22 to 2013/14)	-Water managed and allocated in sustainable way -Albertans have the knowledge to implement actions in sustainability -Communities take leadership in watershed development
Reliable, Quality Water Supplies for a Sustainable Economy	
Short Term (2004/05- 2006/07)	-Broad range of management tools implemented -Albertans understand the value of their water to life, and the economy
Medium Term (2007/08 to 2009/10)	-Water objectives support sustainable economic development -All sectors are using the best, most efficient plans in relation to water use
Long Term (2010/22 to 2013/14)	-Sustainable, and allocated economically efficiently -Water use efficiency has improved 30% from 2000 to 2015 -Albertans have the knowledge to implement sustainability

[58]

Table 3.1.1

This detailed strategic plan that Alberta has presented demonstrates the importance of education when promoting sustainability and the use of EIs. Central to the third goal is the use of management tools. In 2005 there was a performance review of the plan. At

[58] Alberta Environment, Water for Life: Alberta's Strategy for Sustainability (Government of Alberta, 2003), 184.

that time the major issues were that they were behind schedule in implementing EIs. The problem they encountered was that they did not have enough funding from the government.[59]

Saskatchewan

Saskatchewan first released *Saskatchewan's Safe Drinking Water Strategy* in 2002, in response to North Battleford. Since its publication, the strategy has been amended several times. The most recent is the 2006-2007 edition. The current vision calls for "...a sustainable, reliable, safe and clean supply of drinking water that is valued by the citizens of Saskatchewan."[60] The plan operates under four main goals:

- Waterworks systems provide safe, clean and sustainable drinking water
- The drinking water regulatory system is clear and effective
- High quality source water are protected now and into the future
- Citizens trust and value their drinking water and the operations which produce it[61]

Using this *Safe Drinking Water Plan* as a stepping stone, the province decided to push further. They developed the *Water Conservation Plan*, which asserts that:

> Water conservation does not mean we have to go without. Water conservation means being aware of how much water we use and using it efficiently so that there will always be enough to support Saskatchewan's communities, industries and agricultural sectors.[62]

Central to this plan is the use of EIs. The province aims to partner with water users across all sectors, including promoting education for households. This province is a

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[59] Alberta Water Council, Review of Implementation Progress of Water for Life 2004-2005 (Alberta Water Council, October 2005), 9.
[60] Department of the Environment, 2006-2007 Saskatchewan Provincial Budget Performance Plan: Safe Drinking Water Strategy (Department of the Environment), 4.
[61] Department of the Environment, Saskatchewan: Safe Drinking Water, 4-5.
[62] Department of the Environment, Saskatchewan: Safe Drinking Water, 8.

leader in metering, and has acknowledged the validity of water pricing. The plan asserts that it will look at increasing water prices, while also trying to maintain social equity.[63]

> To ensure that pricing and incentives promote efficient water use Saskatchewan's Water Conservation Plan will:
> • respect the fact that water is essential for life by not charging municipal, domestic or irrigation users for water itself;
> • encourage a pricing structure that charges all water users the full cost of supplying water including treatment and infrastructure as well as maintenance and other improvements associated with those works;
> • encourage full cost pricing for recipients of provincial water infrastructure grants;
> • work with industry, environmental groups, municipalities and others to promote the use of water efficient fixtures and appliances; and
> • review the current fee structure related to issuing water rights.[64]

This plan, released in November of 2006, is an example of a provincial initiative directed towards sustainability. The challenges the province faces now are educating the public and obtaining funding to maintain goals. Unfortunately, the first statement in this plan does not reflect dynamic efficiency. Water has a "scarcity value," related to marginal user cost, which this statement ignores.

Furthermore, even if the water supply is not finite, expanding the infrastructure needed to treat and deliver is costly. Reducing consumption today can put off these costly expansions to a later date. Thanks to discounting, this implies a positive present value for saving water.

Manitoba

Manitoba's Water Strategy was published in 2003. The goal of the strategy is

> [T]o develop watershed-based planning across the entire province to ensure that future management of specific water issues is done carefully. A sustainable approach will ensure that all our needs are met, while maintaining ecosystem protection. Sustainability is the key to successful water management.[65]

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[63] Department of the Environment, Saskatchewan: Safe Drinking Water, 19.
[64] Department of the Environment, Saskatchewan: Safe Drinking Water, 4.-519.

This strategy aimed to use EIs "...demand side management, generating revenue, rewards efficient behavior (through incentives) and discouraging inefficient behavior (through disincentives)."[66]

The province has been working towards metering households, and has been successful in most municipalities. Their current challenges, and lessons learned thus far, are mainly surrounding public perception. Citizens argue that the government is just seeking out tax dollars. Conversely, however, the province has found that citizens respond well to environmental projects when, or if, money is generated, it is then put into a fund towards conservation. This proved effective for the government when they initiated levies on cartons and cans.[67]

3.2 Ontario

Ontario has implemented a variety of strategies for water sustainability and quality. The province's water awareness, although fueled strongly by Walkerton, was present previous to that time. In the post-Walkerton years, the Ontario government released a proposal for a *Watershed-based Source Protection* Plan. This plan includes, "...stakeholder involvement at the local level; proposed legislative framework for the development and approval of source water protection plans."[68] As seen with many of the

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[65] Manitoba Conservation, The Manitoba Water Strategy: Protecting and Managing our Future Water Branch (Manitoba Conservation, April 2003), 23.
[66] Sawyer & Perron & Trudeau, A-2.
[67] Sawyer & Perron & Trudeau, A-2..
[68] Environment Canada, Water and Canada: Integrated Water Resources Management: An Overview of Perspectives, Progress, and Prospects for the Future at Home and Abroad (Canada: Environment Canada, 2005), 8.

other provinces strategic plans this "...watershed-based source protection was a key recommendation of the Walkerton Inquiry. [69]

3.3 Quebec

In 2002 Quebec implemented the first water policy in their history.[70] This strategy was a culmination of five years of research, and presents the following five areas to be addressed:

- Water governance reform;
- Integrated management of the St. Lawrence River;
- Protection of water quality and aquatic ecosystems;
- Continued clean-up and improved management of water services;
- Promotion of water-related recreation tourism activities. [71]

Quebec is slowly introducing EIs into the province. They are considering "a water use charge or abstraction fee...The objective of economic instruments is to make water users accountable for the costs of protecting, restoring, and developing water and aware of the value of this resource."[72]

Currently Quebec is one of the highest water users, per person, in the world. Their water strategy has been in constant evolution. Principally because of changes in focus, plans have been slow to materialize. Originally EIs were going to target commercial sectors, specifically water bottling agencies, but the province changed their mind and decided to include all sectors in their water conservation plan.[73]

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[69] Ontario Ministry of the Environment, Water-Based Source Protection Planning February 21, 2007 <http://www.ene.gov.on.ca/envision/water/spp.htm>.
[70] Environment of Quebec, February 21, 2007 <http://www.mddep.gouv.qc.ca/eau/politique/index-en.htm>.
[71] Environment of Quebec, Water. Our Life. Our Future: Quebec Water Policy Highlights (Environment Quebec, 2002), 6.
[72] Sawyer & Perron & Trudeau, A-10.
[73] Sawyer & Perron & Trudeau, A-10.

3.4 Atlantic Canada

Atlantic Canada also has water conservation policy; however, overall the plans are less detailed. Perhaps this is because water shortages are so rare, that conservation has not been addressed in the past, or thought of as a pressing concern.

New Brunswick

New Brunswick has both a *Source Drinking Water Protection Program,* and a *Water Treatment and Distribution Program;* however, plans for implementing a *Water for Life* strategy, and the use of EIs has yet to materialize. There is a management board that is working towards creating goals for a sustainable environment in New Brunswick.

Nova Scotia

Nova Scotia Drinking Water Strategy is a

> Comprehensive management of drinking water based on the multi-barrier approach...[It] builds on current legislation and the philosophy of continuous improvement...[It represents a] first step of a comprehensive approach to effectively manage all water resources in Nova Scotia.[74]

The "multi-barrier approach" is one that uses a variety of techniques to minimize water use, and guide the consumption level in a specific direction.

Since 1919, Nova Scotia has necessitated that one has a license for water withdrawal. Since that time the province has tried other variations on water pricing, including increasing block rate pricing in 1991. Currently the main challenge faced is the lack of regulation on water use. Although users are supposed to report their water use, there is little monitoring of this.[75]

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[74] Environment Canada, Water and Canada: Integrated Water Resources Management: An Overview of Perspectives, Progress, and Prospects for the Future at Home and Abroad (Canada: Environment Canada, 2005), 9.
[75] Sawyer & Perron & Trudeau, A-6.

The challenge of accountability is an incentive for Nova Scotian's to use EIs in conjunction with metering.

Prince Edward Island

Prince Edward Island introduced a Drinking Water Strategy in 2004, entitled *Clear: from the ground to the glass.* "The strategy uses a multi-barrier approach to protecting drinking water, focusing on source protection, system design and operation, and monitoring and reporting."[76] Under this strategy there are "10 Points to Purity" which act as the framework for the model. The first five points are focused towards private supply users, and the latter five points towards municipalities.[77]

The following is the outline to the points:

- Invest in public information materials
- Expand current homeowners kit
- Invest in a field manual for technical staff
- Revise regulations governing water wells and sewage disposal systems
- Update "site assessment" handbook
- Develop water monitoring and public reporting regulations
- Develop standards and guidelines for supply storage distribution and maintenance of water systems
- Enforce mandatory certification for water supply and wastewater operators
- Achieve full accreditation
- Work with municipalities and land owners for development of a strategy for municipal welfare protection[78]

Currently, PEI does not intend to implement EIs in the foreseeable future.

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[76]Government of Prince Edward Island, InfoPEI February 21, 2007 <http://www.gov.pe.ca/infopei/index.php3?number=50234&lang=E&PHPSESSID=27b70dfe0cbafbbe12b2d70154d3aed8>.

[77] Government of Prince Edward Island, InfoPEI February 21, 2007.

[78] Environment Prince Edward Island, Clear from the Ground to the Glass: Ten Points to Purity, What we'll do, and When we'll do it (Department of Fisheries, Agriculture, and the Environment, 2001), 5-6.

The majority of drinking water in PEI is obtained through groundwater supplies. As shortages through this supply are not expected, the public does not feel that EIs are needed. Currently there are no EIs in relation to water, as the fees are paid municipally and are minimal. The province has promoted water sustainability through education. Additionally the government has acknowledged that implementing EIs would be helpful, especially to illustrate the value of the resource. Yet the public perception and experience of water abundance makes implementing metering seem unnecessary and is unwanted.[79]

Overall PEI has a low per-capita level of recorded water use. This is because a large percentage of the population operates on private wells with groundwater as their water source. As these users are on private wells, their water level use does not have to be recorded.

Newfoundland and Labrador

In 2002, Newfoundland released the *2002 Water Resources Act.* Under the terms of this act, all non-domestic water users must obtain a water license regardless of their size; this is unique to Newfoundland. Additionally, although these license holders are supposed to report their water use, there are no laws which enforce precise measurements.[80] The Act is supposed to be the first step towards creating sustainability through economic incentives; however, the province has acknowledged that their minimal use of metering "...can be an impediment in achieving full effectiveness from these initiatives."[81]

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[79]Sawyer & Perron & Trudeau, A-9.
[80] Kinkead &Boardley & Kinkead, 49.
[81] Kinkead &Boardley & Kinkead, 49.

3.5 Northern Canada faces challenges, mainly due to its cold climate.

Nunavut

Nunavut follows a *Northern Strategy*. This plan, which also spans over Northwest Territories and the Yukon is "...a comprehensive strategy for the North to strengthen governance, partnerships, and foundations of the economy, to protect the environment, to promote healthy communities, and to expand scientific knowledge."[82]

Northwest Territories

The current objective of the Northwest Territories is to lower costs. Such initiatives involve the "...conversion of free-flow frost protection bleeders thermostatically controlled devices, reclamation of grey water for non-potable use, and conversion outreach awareness campaigns."[83]

This territory published *Managing Drinking Water Quality in the Northwest Territories* in 2003. The foundations of the Northwest Territories goals are based on their 1997 Sustainable Development Policy. According to this document, "...natural resources should be managed so that opportunities for future resource uses are maximized and maintenance of ecosystems is ensured."[84]

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[82] Environment Canada, Water and Canada: Integrated Water Resources Management: An Overview of Perspectives, Progress, and Prospects for the Future at Home and Abroad (Canada: Environment Canada, 2005), 9.
[83] Kinkead &Boardley & Kinkead, 51.
[84]Kinkead &Boardley & Kinkead, 51.

Yukon

The Yukon implemented a *Rural Public Drinking Water Access Consultation* which is a "...drafting of guidelines for new regulations that reflect source-to-tap protection of public drinking water systems and bulk water delivery systems."[85]

3.6 Federal Involvement

Urban water use in Canada is monitored by the provincial governments; however, the federal government has implemented some policies that influence infrastructure, use, and sustainability. The federal government can help via fiscal policy, and increase grants towards conservation organizations, or those that promote demand-side management.[86] The government could also use its money as leverage or "tied aid." Essentially, it could allocate funds under the specific guidelines. For example, "...new infrastructure could be contingent on preparing an effective demand management plan that explores least-cost alternatives, and on implementing education, metering, pricing and regulations to promote conservation."[87]

The federal government established the *Federal Water Plan* in 1987. Under this plan there were two main objectives:

- To protect and enhance the quality of water
- To encourage the efficient and equitable use of fresh water in a way that can meet the social, economic, and environmental needs of present and future generations[88]

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[85] "Environment Canada, Water and Canada: Integrated Water Resources Management: An Overview of Perspectives, Progress, and Prospects for the Future at Home and Abroad (Canada: Environment Canada, 2005), 9.
[86] Brandes, 30.
[87] Brandes, 30.
[88] Brandes, 32.

Since this time, however, the policy has evolved in many ways. There has been a series of cutbacks; however, in the recent past the federal government established the *Integrated Water Resources Plan,* and created a *Sustainable Water Use Branch* under Environment Canada.[89]

The federal government needs to recognize the importance of variation across Canada. Without acknowledging this, they will continue to create "blanket" plans that are both ineffective and costly.

3.7 Non-Government Organizations

Non-government organizations (NGOs) play an important part in water conservation. The Canadian Water and Wastewater Association, and the Federation of Canadian Municipalities, for example, are two NGOs that work to promote water conservation nationally. These particular organizations are interesting, as they both promote metering systems as a means to reduce water consumption levels.[90]

3.8 Conclusion

Across Canada there is an obvious variation in approach to water sustainability. Provinces such as Saskatchewan and Alberta have grasped the issue and are moving forward to sustain their provinces. Others, such as PEI, have not really even addressed the situation. The Prairies conservation efforts, however, have been catalyzed by the challenges they have faced with water supply caused by both climate and population growth. Conversely, PEI has never faced water shortage problems, and rely almost exclusively on groundwater sources.

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[89] Brandes, 32.
[90] Kinkead &Boardley & Kinkead, 52-53.

Federally, the government has been slow in addressing water conservation. With such a great variation of water programs it is challenging for the federal government to provide a plan that can help everyone. Perhaps their current blanket approach needs to be revisited and one with greater flexibility generated.

Across the country the use of EIs does not appear strong, yet every province seems to have accepted their value and acknowledged that implementing them would be a positive step. Conversely the uniform challenge appears to be public perception. Without the desire among the populous to create change, it will not happen. Through continued education, the provinces hope that this desire will alter. For EIs to be effective, they need public acceptance. In order to foster the adoption of metering and water pricing systems, education can be useful to build this consensus.

> The need for consistent, province-wide approvals was a recommendation in both the Walkerton and North Battleford inquiries. All municipal utilities were issued consistent, province-wide approvals in the spring of 2003 that require them to meet provincial and industry standards for providing safe, clean drinking water. Municipalities have until 2008 to meet the standards contained in these approvals.[91]

These guidelines, however, do not affect wells, or private supply for residences. This is important to take into consideration, as this water use will still not be regulated.

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[91] Government of Nova Scotia, A Drinking Water Strategy For Nova Scotia: A Final Report (Government of Nova Scotia Department Environment and Labour, 2005), 2.

Chapter Four: Demand-Side Management and Economic Incentives

The previous chapters have outlined provincial and territorial water supply, pricing methods, and current conservation programs. Throughout the thesis, the argument has held that demand-side management (DSM) can help with water conservation challenges. This chapter presents an outline of the economic theory that justifies the use of DSM.

With the increased awareness of Canadian water sustainability, many questions have surfaced on the effectiveness of current water policy. As shocking statistics of excess water use are produced, Canada's minimal practice of demand-side management is evident. This chapter aims to frame the basic concepts of demand-side management (DSM), and the role that economic incentives (EIs), play in this method of policy. It is argued that though the use of EIs, water use in Canada may evolve from supply-side management to demand-side management and with these changes water use may be both efficient and sustainable.

4.0 Canada's Past Experiences with Economic Incentives

Canada's experience with EIs dates back to the early 1970s. Before this time Canada's water policy was dominated by a "command and control" system. Unfortunately this method of regulation left little room for changes or advancements. As EIs increased in popularity in other member countries of the Organization for Economic Co-operation and Development (OECD), Canada soon started to take notice as well. In 1987, the federal government released *Federal Water Policy* which supported the concept of EIs. Yet despite this apparent interest, EIs never became a front runner in federal policy, but were implemented only in some provinces and generally on the municipal

level. Again the desire to use EIs declined as other political issues dominated the government's attention. EIs remained in the background until the Walkerton and North Battleford tragedies, when water policy became a main government concern once more. In the post-Walkerton years, there has been a resurgence interest in EIs.[92]

4.1 Demand-Side and Supply-Side Management

When there is a demand for water, the supply-side approach looks for new ways to provide it (for example building new infrastructure). Under this system, water is perceived as an infinite resource, or at the very least supply can be increased at a lower cost than any alternative approach.[93] Supply-side management focuses on "...securing and treating sufficient quantities of water to meet forecast demand."[94] This form of management does not address economic or environmental impacts of its methods.[95]

Demand-side management provides an alternative form of regulating water use. DSM:

> Demand-side management uses less water to meet the same human benefits, though conservation and a dramatic increase in water use efficiency. Demand-side practices include conservation pricing, smart technologies, public education, and regulation that forces innovation by promoting efficiency, conservation and recycling.[96]

4.2 Economic Incentives under Demand-Side Management

> Economic incentives that stimulate water use efficiency are central to DSM. Establishing water prices that better reflect true costs of the resource and implementing rate structures that ensure both equitable access to potable water and conservation are policy priorities.[97]

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[92] Bernard Cantin & Dan Shrubsole & Meriem Aït-Ouyahia, Using Economic Instruments for Water Demand Management: Introduction (Canadian Water Resources Journal 30, no.1:(2005) 1-10), 3.
[93] Brandes & Ferguson 37.
[94] Tony Mass, What the Experts Think: Understanding Urban Water Demand Management in Canada (Canada: POLIS Project on Ecological Governance, 2003), 2.
[95] Brandes, 04.
[96] Brandes, ii.
[97] Mass, 29-30.

Economic incentives (EIs), can encourage conservation many different ways. This particular EI method makes it cheaper for households to adopt the water saving investment. Essentially, price and demand are inversely related. Although metering is the first step towards acknowledging water consumption, it is not a sufficient condition to reduce water use. Metering done makes the public aware of their water use. The initial "shock effect" of realizing one's consumption generally reduces use. However, once people get used to the information their water use level tends to rebound. Thus the challenge is not only to increase the use of meters but also to find an effective water price. Even in areas that are currently using meters, the water prices are so low that the price is not an effective deterrent against the more wasteful water uses.[98] This shortcoming must be addressed for EIs to operate effectively. Without the desire to reduce consumption, EIs as mechanisms to achieve DSM, does not work. The following sections illustrate how metering works, and also how to find the most economically efficient price.

4.3 Metering

The first step towards reducing water use is to implement household metering. It is necessary to know how much water is being used, in order to monitor changes. On a metering system, households will pay in proportion to the amount of water they are using. Water is a normal good, in that if its price increased the amount consumed falls. The direct relationship between water use and price will result in the downward sloping demand curve.

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[98] Mass, 18.

In the graph below, the downward sloping demand curve is illustrated.

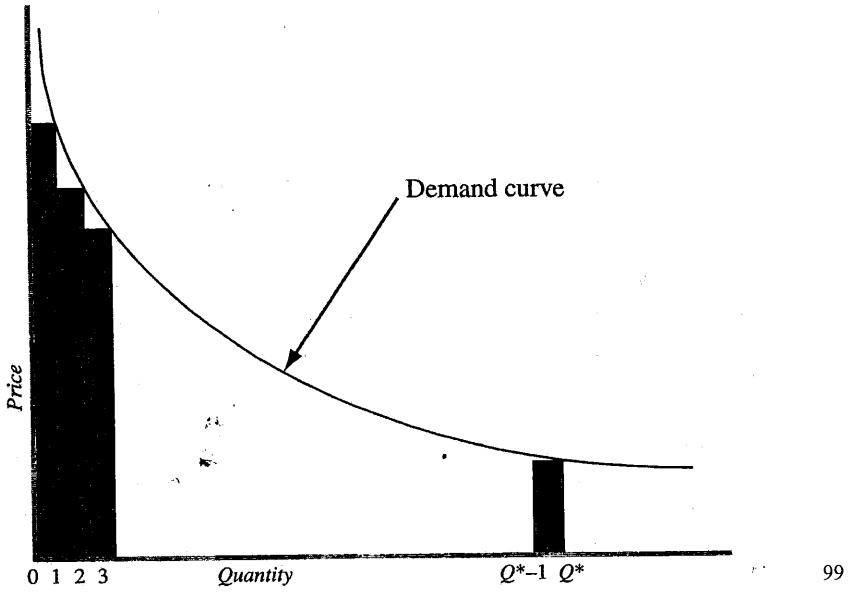
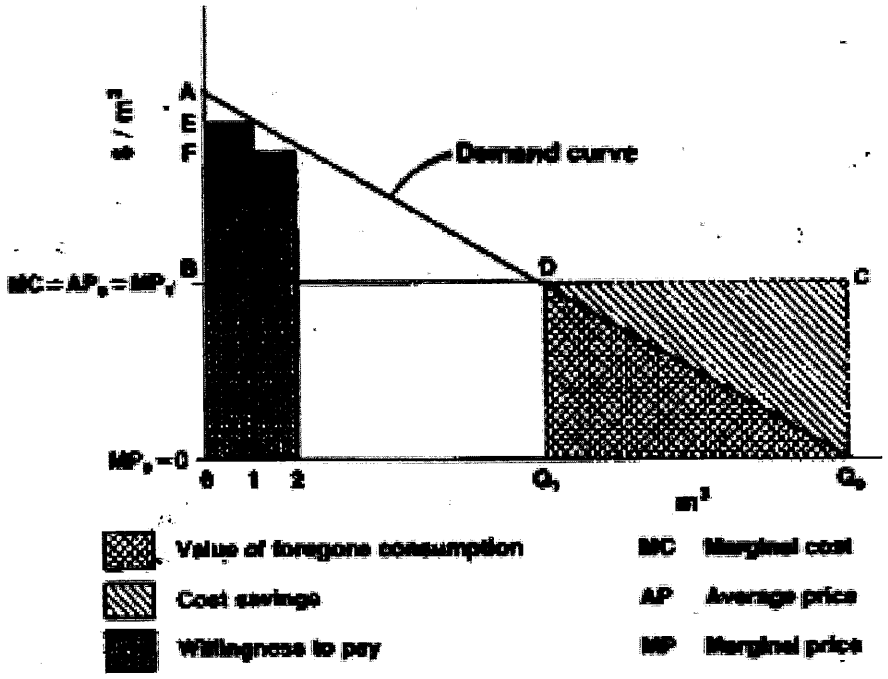


Figure 4.3.1

- This graph is illustrating a household's demand for water. The area under the demand curve illustrates the consumer **benefits** from consumption
- The downward sloping demand curve, resulting from a decrease in willingness to pay for each additional unit, is also apparent

[99] Franklin M. Fisher ed. & Annette Huber-Lee ed. Liquid Assets. (United States: Resources for the Future, 2005), 12.



[100]

Figure 4.3.2

This graph illustrates the relationship between a metered system, and flat-rate system.

Q_o	Chosen if MP = 0
Q_1	Chosen if MP = MC
$Q_o - Q_1$	Water Saved
$\square$ DCQ_o Q_1	Cost of Supplying $Q_o - Q_1$
$\triangle$ DCQ_o	Recovered Dead Weight Loss
$\triangle$ DQ_o Q_1	Consumer Surplus to Household $Q_o - Q_1$

Table 4.3.1

Basically, if the dead weight loss, triangle DCQ_o, in present value terms is less than the cost of installing meters and of the administration system needed to support volume based pricing, then it is not efficient to move to volume based pricing. Similarly if the present value of the savings does not exceed the resources required to bring about the

[100] Roger McNeil & Donald Tate Guidelines for Municipal Water Pricing (Social Science Series No, no. 25 1991), 4.

political change then metering is not worth it. Many policy reforms in Atlantic Canada may fit this model.

Unfortunately, the simplicity of this graph does not illustrate the costs of implementing metered systems. The initial installation and maintenance of the metering is a cost that must be confronted if the efficiency of a metered system is to be fully assessed. When reviewing water allocation systems, both the fixed and variable costs must be taken into consideration, so that establishing a rate that better reflects this resource, may be determined. Fixed costs include infrastructure, administration, and maintenance, versus the variable costs of water supplied, and wastewater.[101]

Marginal user cost arises when a non-renewable resource is consumed. Once it is gone the "...cost of future use forgone is known as the user cost, or depletion premium."[102] Marginal user costs should be apparent to water users as water is a "replenishable, but depletable resource."[103] Presently many pricing methods do not reflect these concepts. To confront water conservation prices should be raised. By maintaining low rates there is greater consumption in the current period then efficient or sustainable. If water prices are kept low then, "...the time of transition is earlier under price controls...and the transition is abrupt, with prices suddenly jumping to new higher levels."[104] A dynamically efficient price is higher than a static marginal cost. The marginal user cost is the present value of the avoided future costs. It is the present value

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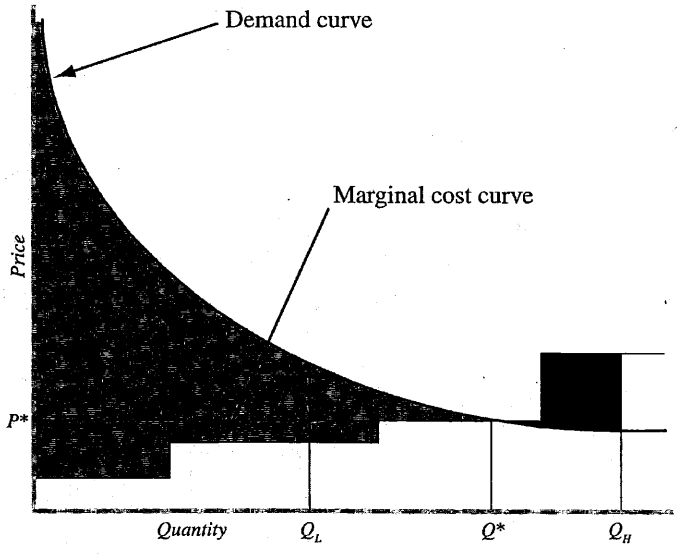
[101] McNeil & Tate, 16.
[102] Jeremy J. Warford Marginal Opportunity Cost Pricing for Municipal Water Supply (Ottawa: International Development Research Center, 1997), 4.
[103] Tom Titenberg, Environmental and Natural Resource Economics. 6th ed. (United States: Pearson Education, 2003), ix.
[104] Titenberg, 154.

of the saving. Consuming more today leads to an earlier need to build the extra infrastructure.

4.4 Pricing

Metering residents without changing water prices has been found to be unsuccessful. Through metering, citizens are aware of how much water they are consuming; however, this does not create an incentive to change habits, just increases awareness of how much water is used.

A pricing structure is deemed economically efficient if "...it results in maximum net value of water use to society."[105]



106

This graph illustrates the **costs** associated with water distribution. The marginal cost curve rises as it becomes more expensive to provide water.

- To provide at Q* the consumer benefit is the shaded area below the demand curve, and above the marginal cost curve

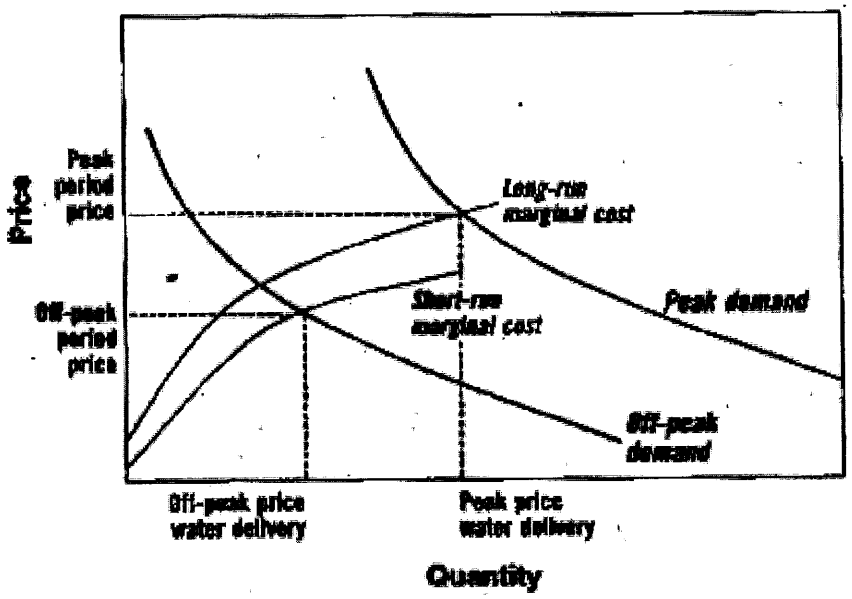
Figure 4.3.3

- The point to the **left** of Q* represents a consumer who is willing to pay for additional units of water. At this point: **Benefits > Costs**
- The point to the **right** of Q* represents a consumer who would not be willing to pay for additional units of water. Here the **Benefits < Costs**
- At **Q*** a **equilibrium** has been reached

[105] McNeil & Tate, 9.
[106] Fisher ed. & Huber-Lee ed, 13.

This graph illustrates that the efficient price occurs when the marginal cost curve intersects with the demand curve. As indicated by the name, "marginal cost pricing" sets the price equal to the marginal cost.

Marginal cost pricing varies from the short to long run. With prices in the short run, "...capital costs cannot be varied and marginal costs include only the variable costs of production or delivery." [107] Under this framework having MC=P will allow for profit maximization. Conversely, in the long run, the costs of expanding or reducing infrastructure must be accounted for.[108]



[109]

Figure 4.3.4

In the graph above, it is evident that there should be a different price for peak and non-peak seasons, depending on how it will affect the short and long run. For the off-peak situation, the prices should be set where the off-peak demand intersects short-run

[107] McNeil & Tate, 11.
[108] McNeil & Tate, 11.
[109] McNeil & Tate, 11.

marginal cost. This is because changes occurring in the off-peak season rarely affect long-term costs. Conversely, during the peak season, water must be charged at a higher price. This is due to shortages resulting in infrastructure changes, thus affecting long term costs.[110] The infrastructure is built to accommodate peak demand; therefore peak demand pricing should pay for the infrastructure.

Peak Period = marginal operating cost (volumetric) + marginal capacity cost (volumetric) + marginal waste treatment cost (volumetric) + connection charge (fixed)

Off- Peak Period = marginal operating cost (volumetric) marginal waste treatment cost (volumetric) + connection charge (fixed)

Note: "Peak" periods, occur daily, weekly, monthly, etc. however for the purpose of this pricing, seasonal peak-periods will be focused on.

[111]

Theoretically, distance from water supply should also be reflected in the price of water. But "...differences in marginal costs related to pumping may often be very small relative to capacity...[making it] more practical to ignore."112 Similar to the previous discussion, even though the price reflecting distance from source or pumping elevation would be more efficient, the cost of calculating this price for each user probably more than offsets any savings from using the efficiency price.

Pricing has also shown to facilitate change that education does not. In the sort-run, rapid fluctuations in price are usually, not greatly effective and breed resentment. Command and control type tools are probably more effective in these situations. However; pricing, does seem to influence the longer term and cause an overall change in consumption behaviour.

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[110] McNeil & Tate, 11.
[111] McNeil & Tate, 27-28.
[112] McNeil & Tate, 11.

4.5 Elasticity

Households face budget constraints. This is important to address, as households with different income levels have varying sensitivities to water prices. If one has a large income, a marginal increase in water price is not felt strongly relative to total expenditures. Conversely, those on a lower income are more sensitive to price changes. This sensitivity is important for determining an appropriate pricing structure, while maintaining social equity.

"Price elasticity of demand for water measures the willingness of consumers to give up water use in the face of rising prices, or conversely the tendency to use more as price falls."[113]

$$\eta = \frac{\Delta d}{\bar{d}} \div \frac{\Delta p}{\bar{p}}$$

η = price elasticity
$\bar{d}$ = average quantity of water demanded
Δd = change in demand
$\bar{p}$ = average price

The results of elasticity calculations illustrate sensitivity to price. Water elasticity is difficult to calculate, in that it is inelastic to a specific point, as it is necessary for life. However, there is also a point where water use becomes elastic. The shape of the demand curve is most likely very steep close to the vertical axis, and very flat near the horizontal axis. The steep part captures the fact that some minimum level of water is essential and the household will pay almost anything to secure it. The flat part reflects the demand for things like car washing and driveway washing that can be done away with in response to even a small price increase. For example, one may not water the lawn if

[113] Larry W. Mays Urban Water Supply Management Tools. (United States: McGraw Hill, 2004), 2. 4 – 2.5.

the price is too high. Here, the consumer has done a cost – benefit assessment, and has chosen the economically efficient course of action. Essentially, this is how EIs function. They are not designed to be socially unjust, but rather promote conservation and sustainability in areas that may be influenced as such.

Elasticity > 1	• The good is defined as "elastic" • An increase in price results in a decrease in demand
Elasticity = 1	• The good is defined as "unit elastic" • An increase/ decrease in price will result in the same change in demand
Elasticity < 1	• The good is defined as "inelastic" • An increase in price will not change demand

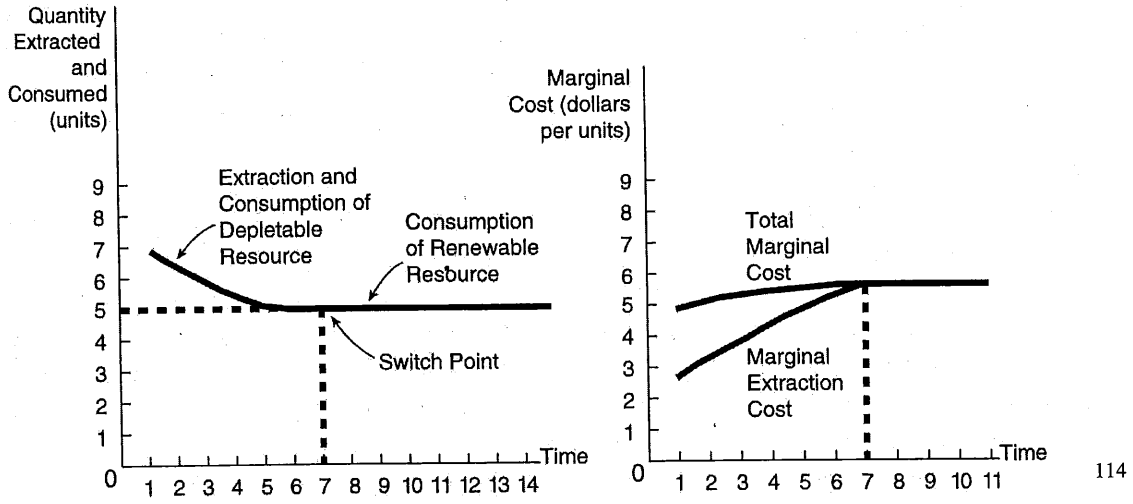
Table 4.5.1

Through calculating elasticity values across Canada, insight is provided into water use. This information can then be used towards establishing a pricing scheme that is both economically efficient and socially equitable. The information can also be used towards decreasing opposition to change. Specifically, if one area is found to be more sensitive than another, perhaps more time should be spent educating here, before implementing the new system, to decrease hostility.

Water supply may be broken into surface water and groundwater. Under this differentiation, surface water becomes the substitute renewable resource for groundwater. Following is an assessment of the costs associated when transferring from a current supply to an alternate. Specifically, one must acknowledge that although there is a replacement, it comes at a higher cost. Recognizing that water pricing will rise significantly when this transition occurs should be an argument in favor of slowing down consumption today. Through EIs reducing today's consumption, the number of time periods into the future before surface water will need to be used, increases. Thus

decreasing groundwater use now will create intergenerational equity. To decrease this groundwater use, pricing reforms and meters must be implemented. However, a dynamically efficient price is higher than a static marginal cost. Essentially, marginal user cost is the present value of the avoided future costs. It is the present value of the saving, while consuming more today leads to an earlier need to build the extra infrastructure.

The cost to provide homes with surface water is greater than with groundwater. Thus, when the transition is made, the marginal cost is going to increase.



[114]

Figure 4.5.1

The graph on the left hand side shows the extraction of groundwater and the "switch point," where the consumption of surface water as a substitute begins. In the graph on the right-hand side, the increasing marginal cost is illustrated. The cost increases, as previously stated, because of the higher cost to supply homes with surface water. It is also more costly, because surface is not a just a substitute, but is also a current supplier. Therefore it now has to be allocated over a greater number of consumers.

[114] Titenberg, 139.

4.6 The Goal of Economic Incentives

EIs can be used to promote water saving activity in three ways. From a financial standpoint they create the desire to increase efficiency. Secondly, EIs form a fiscal barrier. Lastly, as EIs reduce water use, they are environmental allies.[115]

EIs provide a financial incentive to produce at a lower-cost and increase efficiency.

> [F]lexibility and transferring decision-making to water users...enables cost-effective decisions to be made which, in theory, allow conservation costs to be achieved at lower overall costs relative to other management options.[116]

The use of EIs allow the governments to gain a better understanding of consumer responsiveness to water price, and water consumption levels. Furthermore, from the government viewpoint, tax shifting may occur. Tax shifting means that tax dollars will be paid by those who are receiving the benefit, as opposed to a blanket tax which everyone pays (such as income tax).[117]

4.7 Implementing

There are many challenges one must take into consideration when implementing EIs. Specifically, one must note whether it is a *transitional* or *transformational* EI being considered. The former is in reference to installing in an area that already has some foundation of water pricing (for example the use of volumetric pricing). The assumption of a transitioning EI, is that the area is looking for innovation and advancement. Under a transformational EI, there is little or no current system that reflects strong water pricing policy. There could possibly be the use of tradable water rights.[118]

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[115] Sawyer & Perron & Trudeau, 18.
[116] Sawyer & Perron & Trudeau, 29.
[117] Sawyer & Perron & Trudeau, 30.
[118] Sawyer & Perron & Trudeau, 31-32.

4.8 Social Equality

It is politically challenging to increase water pricing. This is a type of transactions cost. The transaction is the change of policy and the costs is the opportunity cost of the resources (time, money, etc.) needed to actually bring about the change. Institutional economics, a specific branch of economics, considers these changes. Politics often diminish or eliminate the potential positive outcomes that could be derived through EIs use. Due to controversy over water cost, governments keep water prices so low that despite metering, there is little incentive to reduce ones water use.

Historically Canada charges minimally for water systems. Water infrastructure and maintenance is largely covered through taxation and government spending. As this system ensures water supply at a low cost, many view it as socially progressive, unfortunately "...this social policy has overshadowed the need for efficient water management, as subsidized water prices do not signal to consumers the "true" cost of providing the service."[119] As the country moves towards different policy, citizens are concerned that the Canadian political ideologies of socialism will not be reflected in the new water strategy. The conflict between water sustainability and distribution under EIs is known as the "equity challenge."[120]

The ultimate challenge is to provide "...a pricing system that ensures social equity, cost recovery and conservation objectives are achieved."[121] Some have suggested that increasing block rate pricing may provide a solution for both low income homes, and

[119] Mass, 19.
[120] Mass, 19.
[121] Mass, 19.

environmental goals. The conflict arising here is that many low-income homes, have large occupancy, and cannot afford to move to a "higher block."[122]

Fundamentally, water pricing is

> ...about sustainable resource management and social equity, not about privatization...when [water] is processed and distributed, pricing must be considered b/c there are considerable costs associated with supplying treated water.[123]

4.9 Conclusions

Demand-side management uses economic incentives to direct water consumption patterns. Through the use of meters, the levels of water use can be monitored. Next, pricing schemes are applied. Essentially, through reducing one's consumption there is the incentive to save money. Without first implementing meters, changes in use patterns would be almost impossible to track.

Creating an incentive to reduce water use today may be functional for more than just increasing today's conservation efforts. As global warming progresses, the use of an established water infrastructure that is based on EIs, might be the most cost-effective way to confront new shortages.

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[122] Mass, 20.

Chapter Five: Case Study

This chapter presents a Case Study in Canada that has successfully implemented economic incentives, through metering and an effective pricing strategy. Case studies are important as they provide "...documentation of municipal water conservation program initiatives and accomplishments...[which can be used as]....benchmarks for what may be more broadly achievable."[124] On the municipal level, incentive programs generally have two focuses. The first is to decrease water waste from an infrastructure standpoint. The second aims to decrease consumer demands through conservation programs.[125]

5. 0 Kelowna, British Columbia

The Case Study assessed is from Kelowna, British Columbia and the findings highlighted are from the article, *Context Matters: What Shapes Adaptation To Water Stress In the Okanagan,* by Philppa Shepherd, James Tansey and Hadi Dowlatabadi.

This case study was done in the Okanagan region. Here metering was introduced into the residential sector. It is important to thoroughly asses specific cases where EIs have been introduced. By doing so, both the positive and negative aspects of EIs can be highlighted. The positive results should be promoted as support for the use of EIs. Conversely, shortcomings or unanticipated challenges that are confronted are useful learning mechanisms for other communities.

"The Okanagan Basin is located in the south central interior of British Columbia...[and has a] dry climate"[126] The Basin serves the area through agriculture, tourism, and forestry. In the recent past the area has been confronting great changes. As

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[124] J. Kinkead & Boardley & M. Kinhead, 80.
[125] J. Kinkead & Boardley & M. Kinhead, 82.
[126] Philippa Shepherd & James Shepherd & Haid Dowlatabadi. Context Matters: What Shapes Adaptation to Water Stress in Okanagan? (Climate Change 78: 31-62 Springer, 2006), 32.

population grows, there is an increase in demand for water from all sectors. Additionally, climate changes are hurting the already dry area. Together, the growth rate and climate changes have resulted in increased stress on water supply.[127]

"Authority to manage and regulate water supply, quality and consumption in the Okanagan Basin is divided between four levels of government: federal, provincial, regional and local."[128] The majority of decisions are made under the local government; however, in this area water has three regional districts and eleven municipalities. Additionally, British Columbia faces challenges in the equitable division of water, as historically the province practiced prior appropriation.[129]

The city of Kelowna is located in the Okanagan, with domestic use being the major source of consumption. Kelowna decided to push for EIs, with the goal of the project to have citizens on meters using a volumetric pricing system. Furthermore, the city wanted to increase public awareness through education.[130]

The following is an outline of the steps that occurred towards achieving the city's goals.

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[127] P. Shepherd & J. Shepherd & Dowlatabadi, 33.
[128] P. Shepherd & J. Shepherd & Dowlatabadi, 33.
[129] P. Shepherd & J. Shepherd & Dowlatabadi, 33.
[130] P. Shepherd & J. Shepherd & Dowlatabadi, 36.

5.1 Timeline of Events

- April 1992: Water Conservation Program adopted by Council
- End of 1994: 1994-2014 service plan complete
- January 1995: Metering proposal complete
- 1995-1998: During this time 102 volunteered residences had meters installed
    - After installation was complete in 1998, there was a period of transition. During this time, consumers were educated on ways to reduce water use. There was also a "mock" pricing system in effect, so that households were aware of the water cost
- November 1998: Metered Rate implemented: $8 base rate + unit charge of $\$0.2076/m^3$
    - Previous to this was flat rate of $15.50
- 2000: Rates were modified
    - The rates were set with the goals of
        - Reducing water use
        - Generate enough revenue for the city to recover costs
        - Socially equitable (the rates did not vary significantly from the previous water cost)

- Overall 11, 500 homes were metered
- Kelowna's **goal was to reduce residential consumption by 20%** through metering and educating concurrently
    - Kelowna also aimed for a 10% reduction in multifamily homes, and commercial areas
- 1998 – 2000 the city's **per-capita consumption dropped 24.29%**

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[131] P. Shepherd & J. Shepherd & Dowlatabadi, 40.

5. 2 Implementing Meters

Kelowna's implementing of meters was "...not a reaction to an event, but as a proactive move to defer and lighten an impeding pressure; it was made not because of dire need but because someone estimated that is would lessen the strain and cost of growth."[132] Once it was decided to go ahead with a metering plan, it was a seven year process to prepare for the metering. During this time there was a pilot project. By doing a pilot project test, Kelowna was aiming to reduce negativity from the public. Within this plan there were four main sections.[133]

1. Mock-billing:
    a. This was implemented for one year. Its purpose was to create awareness among consumers. Also, it provided insight into the affect of metering on water costs.
2. To confront high rates of water use
3. Public Education:
    a. Kelowna basically had an education blitz to help residents fully understand water use cost, benefits, and reduction techniques. Education came through posters, public meetings, and consultations.
4. Citizen Group to discuss the new rate:
    a. When the new rate of water was established, Kelowna wanted it to promote efficiency and sustainability, but also be politically desirable, and allow for social equity.[134]

By allowing for a grace period to educate the public before fully putting the metered system into affect, Kelowna minimized opposition from the community.[135]

Kelowna's success story can be attributed to many different factors. As previously discussed, the city was able to benefit from having a "practice period" that allowed citizens to adapt to the new plan. Secondly, the city was fully supported financially, and was able to acquire the $3.5 million needed for infrastructure. Lastly,

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[132] P. Shepherd & J. Shepherd & Dowlatabadi, 41.
[133] P. Shepherd & J. Shepherd & Dowlatabadi, 42.
[134] P. Shepherd & J. Shepherd & Dowlatabadi, 42.
[135] P. Shepherd & J. Shepherd & Dowlatabadi, 42.

and perhaps the most influencing, was that the majority did not feel a great impact on their income, due to an appropriate chosen price level.[136]

5.3 Role of Education

The example of Kelowna is promising in many ways, the most obvious being that the use of meters reduced water use. Perhaps more importantly, this case shows the effectiveness of proper education. Chapter three outlined provincial and federal initiatives for water conservation. The underlying commonality with every initiative was public opposition to metering due to the belief that it was not needed, and socially unfair towards the economically challenged. Kelowna however, has shown that education can be used effectively as a tool towards creating understanding and acceptance of metered water systems. Education here served the dual purpose of generating an awareness of the need for policy reform and making households aware of how the reform would affect them. Education and price reform here worked together. One of the members involved in the reform stated:

> Overall, reactions were ok, probably due to emphasis on education. You will always face some opposition to new programs, some people just won't like it. Some people didn't like it but understood it. This led to decreased backlash. We were able to show people that metering would not increase customer cost.[137]

5.4 Lessons Learned Through Case Study

Using Case Studies such as this one aids in drawing conclusions and focuses on ways to make improvements. In chapter three provincial water goals were presented. Through assessing these plans the following conclusions were drawn about EI use in Canada, and the "lessons learned" thus far:

- Time for public consultations is easily underestimated

[136] P. Shepherd & J. Shepherd & Dowlatabadi, 42- 43.
[137] P. Shepherd & J. Shepherd & Dowlatabadi, 43.

- Public perception of the value and abundance is a significant barrier
- A regulatory foundation is very important for the successful implementation of EIs
- Some provinces have fragmented regulatory systems, and may not be able to implement EIs directly but instead need to work through existing regulations or codes
- Fully metered systems provide good opportunities since users are accustomed to paying for water [138]

5.5 Success of Economic Incentives

Through provincial and territory assessments, provincial and territory initiatives, and the case study, two main reoccurring themes emerged that ensured the success of EIs: education and price level.

Education has appeared as the main underlying thread to the success of EIs. Education not only increases awareness of water sustainability, but also reduces opposition to demand-side management. Through understanding the transformations that are being made, and the new costs, consumers are more likely to be accepting of changes.

With water being managed through many levels of government, it is hard to gain consistent support from all divisions. As seen in Kelowna, effective planning takes many years and cooperation. Unfortunately, politicians are often not around long enough to follow through with plans. From a political perspective they may not want to initiate something which probably will not show its positive effects until after they have left office. Additionally, the funding needed is so large, it requires long term commitment.

Implementing an effective price level also relates to education. Through education consumers can learn how EIs work. As with the case in Kelowna, allowing for a "mock" trial period provided the adjustment time needed to ease into changes.

[138] Sawyer & Perron & Trudeau, 43.

Choosing an appropriate price level that allows for social equality and consumer adoption is not the only challenge. The price level must also be set high enough so that there is incentive to reduce water consumption.

5.6 Conclusions

This case study of Kelowna, BC demonstrates the ability for EIs to be successful. Additionally it shows the importance of education in reducing opposition. It must be noted, however, that the city had all the funding that it needed to execute such a large plan. This funding, and government support, solidified the success of the city.

Chapter Six: Conclusion

The overall intention of this thesis was to explore the management of water in Canadian households. The purpose of this work was to bridge the gap between current provincial and territorial water pricing techniques, and economic theory. This connection was drawn between assessing current water supply methods, and conservation strategies, with the theories of demand-side management. The overall effectiveness of this cohesion was illustrated in the case study on Kelowna, BC.

6. 0 Initial Stages

During the preliminary stages of research, it was intended that there be a baseline established, perhaps by the federal government that all provinces and territories adhere to. This framework would be enforced through law. By establishing over-arching guidelines, it would create accountability for all regions of the country.

After exploring and extrapolating the findings, however, it was found that variations are great, not only in pricing schemes, but also the challenges faced with water supply. Every province and territory has varying climates that affect not only supply, but the infrastructure as well. Additionally, creating cohesion among varying levels of government was another hurdle. Thus, the original plan for a nation-wide demand-side management model, no longer held.

6.1 Purpose of Provincial and Territorial Assessment

Through outlining provincial and territory goals, the current perceptions on water supply were hoped to be highlighted. Through this research it was found that conservation practices were very diverse. Furthermore, the most effective plans

implemented used education to decrease opposition, and increase awareness. Education also served to calm anxieties of social inequality.

6.2 Demand-Side Management

Next, the fourth chapter presented the technical components of demand-side management. This section of the thesis illustrated through graphs, the marginal benefits of installing meters and how equilibrium is derived. Moreover, this section discussed the sensitivity of consumers towards change in price, as calculated through elasticity.

6.3 Case Study Assessment

Lastly, case study served to demonstrate that economic theory can be applied successfully. In this study, a city adopted the demand-side management approach with great success. The case study also illustrated how to minimize opposition towards change. The case of Kelowna reinforced the importance, and effectiveness of education and adjustment time, when trying to implement new infrastructure.

6.4 Closing Remarks

Bringing the entire work together, it has become evident that demand-side management is an effective means towards increasing sustainable water use in Canada, by reducing current household consumption rates. Climate differences and water supply methods are also addressed.

It was found that the initial idea for a national benchmark was neither realistic nor efficient. Yet despite the national variation, it was established that through demand-side management and regional strategies, it is possible for water use in Canadian households to become sustainable.

Appendix 1

"There are two types of freshwater: surface freshwater and groundwater. Surface freshwater is found in lakes and rivers, and is unevenly distributed across the country. Groundwater is withdrawn from underground water sources called aquifers."[139] Surface water is a renewable resource, although climate changes are shifting supply patterns. On the other hand, some groundwater is a non-renewable resource. With a portion of groundwater being depletable, its ability for intergenerational equity is hindered by current consumption rates.

Within Canada there is information on surface water, but little is known on groundwater. Despite the lack of information, groundwater's importance is widely acknowledged. It is estimated that Canada's groundwater supply, may be larger than the surface water supply.[140] Additionally groundwater is "...less prone to contamination and more protected against climate changes..."[141] Furthermore, every province not only has different legislation for water use, but also a different definition of groundwater.[142]

To ensure groundwater use for future generations, the current consumption patterns must be altered. As the use of groundwater increases, the water tables fall. Eventually, the population will reach a point where either the water has run dry, or the marginal cost of extraction exceeds benefit. Under an economically efficient system, the price of water should rise over time, until it the cost of extraction is too high, and the switch point, or exhaustion point would prevail.[143]

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[139] Susan McFarlane & Erik Nilsen., On Tap: Urban Water Issues in Canada Discussion Paper (Canada West Foundation, August 2003), 1.
[140] Linda Nowlan. Buried Treasure: Groundwater Permitting and Pricing in Canada. (Walter and Duncan Gordon Foundation, March 2005), 5.
[141] Nowlan, 5.
[142] Nowlan., 42.
[143] Titenburg, 214-215.

Groundwater faces a challenge when many users are on the same aquifer. Under the system of open access, the incentive to withdraw at an efficient rate is lost. Instead, as water under this method is common property, there is a race to pump the water. To minimize the problem of open access, those involved in water sustainability are educating on the cost-effectiveness of reducing consumption patterns. By reducing consumption levels today, the future and usually higher costs associated with finding an alternative method may be prolonged.[144]

Groundwater can be renewed through natural forces, such as rain and snow. Unfortunately, this self – replenishing resource can also be exhausted if used too quickly. As stated, the greatest challenge facing groundwater is property rights. Without being able to establish proper rights and pricing schemes, those who are already on groundwater services do not have incentive to maximize the resource. Essentially, if this water is "first come, first serve," using as much water as possible while one can becomes the course of action. [145]

[144] Titenburg, 219.
[145] Hartwick, 76.

References

"2006-2007 Saskatchewan Provincial Budget Performance Plan: Safe Drinking Water Strategy." Department of the Environment.

"A Drinking Water Strategy For Nova Scotia: A Final Report." Government of Nova Scotia Department Environment and Labor, 2005.

"Action Plan for Safe Drinking Water in British Columbia." British Columbia Ministry of Health Planning, 2002.

Alberta Water Council "Review of Implementation Progress of Water for Life 2004-2005" Alberta Water Council, October 2005.

Brandes, Oliver M. *At a Watershed: Ecological Governance and Sustainable Water Management in Canada.* Canada: POLIS Project on Ecological Governance, May 2005.

Brandes, Oliver M. & Ferguson, Keith. "Flushing the Future? Examining Urban Water Use in Canada." POLIS Project on Ecological Governance, 2003.

Cantin,Bernard & Shrubsole, Dan & Aït-Ouyahia, Meriem. "Using Economic Instruments for Water Demand Management: Introduction." *Canadian Water Resources Journal* 30, no.1:(2005) 1-10.

"Clear from the Ground to the Glass: Ten Points to Purity, What we'll do, and when we'll do it." Department of Fisheries, Agriculture, and the Environment, 2001.

Consulting Kinkead, J & Boardley, A & Kinkead, M. "An Analysis of Canadian and Other Water Conservation Practices and Initiatives: Issues, Opportunities and Future Directions." Canadian Council of Ministers of the Environment, 2006.

"Economic Instruments for Water Demand Management in an Integrated Water Resources Management Framework." PRI Project for Sustainable Development, 2005.

Fisher, Franklin M. ed. & Huber-Lee, Annette ed. *Liquid Assets.* United States: Resources for the Future, 2005.

Gleick, Peter H. *The World's Water.* United States: Island Press, 2004.

Hartwick, John M. and Olewiler, Nancy D. *The Economics of Natural Resource Use.* United States: Addison Wesley Educational Publishers, 1998.

Improving Water Management: Recent OECD Experience. London, UK: IWA Publishing, 2003.

Mass, Tony. *What the Experts Think: Understanding Urban Water Demand Management in Canada.* Canada: POLIS Project on Ecological Governance, 2003.

Mays. Larry W. *Urban Water Supply Management Tools.* United States: McGraw-Hill, 2004.

McFarlane, Susan & Nilsen, Erik. "On Tap: Urban Water Issues in Canada Discussion Paper." Canada West Foundation, August 2003.

McNeil, Roger & Tate, Donald. "Guidelines for Municipal Water Pricing." *Social Science Series No*, no. 25 (1991).

Nowlan, Linda. "Buried Treasure: Groundwater Permitting and Pricing in Canada." Walter and Duncan Gordon Foundation, March 2005.

Postel, Sandra. *Last Oasis: Facing Water Scarcity.* United States: W.W. Norton & Company, 1997.

Postel, Sandra A. *Pillar of Sand.* W.W. Norton & Company, 1999.

Sawyer, David & Perron, Genevieve & Trudeau, Mary. "Analysis of Economic Instruments for Water Conservation." Canadian Council of Ministers of the Environment, 2005.

Shepherd, Philippa & Tansey, James & Dowlatabadi, Hadi. "Context Matters: What Shapes Adaptation to Water Stress in Okanagan?" *Climate Change* 78: 31-62 Springer, (2006).

Titenberg, Tom. *Environmental and Natural Resource Economics.* 6th ed. United States: Pearson Education, 2003.

"The Manitoba Water Strategy: Protecting and Managing our Future." Water Branch Manitoba Conservation, April 2003.

Water and Canada: Integrated Water Resources Management: An Overview of Perspectives, Progress, and Prospects for the Future at Home and Abroad. Canada: Environment Canada, 2005.

"Water for Life: Alberta's Strategy for Sustainability." Government of Alberta, 2003.

"Water Sustainability Action Plan for British Columbia: Framework for building Partnerships." Water Sustainability Committee of the British Columbia Water & Waste Association, February 2004.

"Water. Our Life. Our Future: Quebec Water Policy Highlights." Environment Quebec, 2002.

Young, Robert A. *Determining the Economic Value of Water.* United States: Resources for the Future, 2005.

On-Line Reference Sources:

Canadian Broadcasting Corporation , "Canada's Worst-Ever E-coli contamination" March 13, 2007 <http://www.cbc.ca/news/background/walkerton/>.

Environment Canada. November 4, 2006 <www.ec.gc.ca/water/enpolicy/federal/e_intro.htm>.

Environment Canada. November, 4 2006 <www.ec.gc.ca/water/en/policy/prov/e_prov.htm>.

Environment Canada November 4, 2006 <www.ec.gc.ca/water/en/info/pubs/primer/e_prim03.htm>.

Municipal Water Use Report. November 2006 <http://www.ec.gc.ca/water/en/info/pubs/sss/e_mun2001.pdf >.

Public Health Agency of Canada, March 12, 2007 "Waterborne Cryptosporidiosis Outbreak, North Battleford, Saskatchewan," Spring 2001 <http://www.phac-aspc.gc.ca/publicat/ccdr-rmtc/01vol27/dr2722ea.html>.

United Nations. November 4, 2006.< www.un.org/waterforlifedecade/background.html>.

Water Resource Economics. November, 4 2006 <www.ec.gc.ca/water/en/manage/res/e_res.htm>.