Water Conservation in the Regional Municipality of Waterloo, Ontario, and the Proposed Pipeline

by

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I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

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ABSTRACT

The Region of Waterloo relies on groundwater for 80% of the water supplied to its growing population. Ontario's Places to Grow Act (2005) designates the Region as a growth corridor, and over the next 20 years, significant development is expected. A water pipeline from Lake Erie to the Region of Waterloo is being considered as part of the Region's strategy to ensure sufficient amounts of water for the population.

The purpose of this research is to examine whether this pipeline would undermine current conservation efforts by the Region. Using a combination of questionnaires, expert interviews, and newspaper analysis, the following research questions are investigated: (1) How do Waterloo residents perceive the region's current water supply? (2) How do their actions related to water use reflect these perceptions about water supply arrangements? (3) How might perceptions change when a pipeline is constructed to Lake Erie? (4) To what extent might this pipeline encourage consumptive rather than conservation behaviour? These questions are connected with the social demographics of age, gender, income and education, to determine which, if any, plays the largest role in determining conservation behaviour.

Ten significant relationships are found regarding water supply issues, with the majority relating to age. Older respondents are more likely to believe there is an inadequate water supply in the region, and that money should be spent to increase the available supply. Older respondents are more likely to state they conserve water year

round. Older respondents and male respondents are more likely to have heard about a proposed pipeline. Younger respondents are more likely to prefer reducing the demand for water, while older respondents are more likely to prefer a combination of increasing the supply and decreasing the demand. Higher educated and higher income respondents are more likely to believe access to water should be limited. Higher educated respondents are more likely to prefer decreasing the demand instead of increasing the supply.

For the most part, Waterloo residents perceive the current water supply as inadequate. Some residents conserve water as a response to this, but others do not limit their use in order to compel the Region to increase supply. It is unclear how perceptions might change if a pipeline were constructed. However, it is probable that consumption would be influenced by the persistence of the Region in continuing conservation programs.

It is recommended that the Region consider limiting future growth, increase the cost of water to users, and deliver variable qualities of water to residents for different functions. It is important that the Region continue implementing water conservation measures at least at the current level. It would be valuable to study other communities which have built a water pipeline to determine effects that might not be anticipated. Finally, it is important that other municipalities affected by this pipeline be consulted before its construction.

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CHAPTER ONE: INTRODUCTION

1.1 CONTEXT

The Region of Waterloo has long been an advocate of water conservation. For over 30 years, the Region has implemented water efficiency measures, and various utility operations across North America have emulated its example (Region of Waterloo, 2006). Traditionally, the Region has relied on groundwater to serve its population. In 1992, the Region began to withdraw water from the Grand River to offer a larger supply as population had increased (Region of Waterloo, 2007). In 2007, the Grand River provided approximately 20% of the Region's water, while the remaining 80% came from groundwater (Region of Waterloo, 2007). With large population growth and economic growth anticipated over the next 20 years, partly as a result of the Places to Grow Act (2005), the Region has begun to rethink its water strategy. Although in the past demand management initiatives were significant and worked well, the Region has concluded that a new supply source may be necessary to accommodate future growth.

The most noteworthy option to increase water capacity would be the construction of a pipeline, intended to begin during 2035. This pipeline would extend from Lake Erie to the Region of Waterloo, with the possibility of serving other municipalities. This pipeline would alleviate the water shortages that the area anticipates and would provide about three times the amount of water currently available. There has been much controversy surrounding this water pipeline and

residents' reactions to it, including whether Lake Erie would be the most appropriate source. Some residents feel that this pipeline is long overdue, while others believe it is unnecessary, and the Region must learn to live within its means.

Once a pipeline is constructed, conservation efforts may be undermined, as there may be a perception that there is abundant water and hence less need to conserve water. Consequently, the pipeline may actually contribute to increased per capita daily water use. Against such a context, the purpose of this research is to examine whether a proposed water pipeline, were it to be constructed, might undermine current conservation efforts by the Region of Waterloo. In other words, could this initiative be detrimental to sustainability efforts?

The following four research questions will be investigated:

1. How do Waterloo residents perceive the region's current water supply?

2. How do their actions related to water use reflect these perceptions about water supply arrangements?

3. How might perceptions change when a pipeline is constructed to Lake Erie?

4. To what extent might this pipeline encourage consumptive rather than conservation behaviour?

These research questions are important to understand residents' responses to the pipeline, specifically, the willingness of residents to work with the Region on initiatives that may postpone the need for such a pipeline. In this thesis, I try to determine

whether it is probable that knowledge of an increased water supply will encourage consumptive behaviour. It may be difficult, however, to separate the anticipated reactions of residents and actual behaviour if the pipeline were to be implemented. It is often suggested that individuals tend to overstate their good intentions (e.g. De Oliver, 1999; Hamilton, 1985). Furthermore, professional opinions will be considered, and compared against those of residents. Finally, attention will be given to the long-term implications for the Region of Waterloo once a pipeline is constructed.

Supply management has been the dominant technique in Canada's past, and avenues such as demand management and soft path were not always explored. This thesis will help to determine whether the proposed pipeline is necessary, or whether it is the less complicated option relative to more intensive initiatives. It is possible that constructing a pipeline might be an easier alternative than gaining the support of all residents in the region to actively conserve water resources.

1.2 STRUCTURE

The first chapter of this thesis has introduced the issues to be explored. The second chapter contains the literature review, and addresses the conceptual and theoretical foundation on which the thesis is based. This includes a discussion of how demand management and soft path methodologies should be a preferred response relative to current supply management techniques. A discussion of pricing will be integrated into this chapter as part of the demand management review. The third

chapter explains the methodology and design, which include both quantitative and qualitative methods. Qualitative methods include interviews with Region of Waterloo officials and an analysis of local newspaper articles printed within the past five years. Quantitative methods are applied to the responses to mail-in surveys. The fourth chapter discusses the case study of the Region of Waterloo in the context of the Grand River watershed and the proposed pipeline to Lake Erie; it is explored whether this pipeline could undermine current conservation efforts from the Region of Waterloo. The fifth chapter provides the findings and analysis, and the sixth chapter presents conclusions and recommendations.

CHAPTER TWO: LITERATURE REVIEW

2.1 CONTEXT

Water is a resource vital to life, and as such, it is essential that its value be recognized. However, the importance of conservation can be challenging to convey since, in Canada, there is a misconception that water resources are extensive and renewable, and therefore indestructible (Foster and Sewell, 1981; Overgaard, 1960). The literature indicates that, because Canadians enjoy one of the most water rich landscapes in the world, they tend to believe the capacity of the resource is limitless (Bartoszczuk and Nakamori, 2002; Overgaard, 1960). However, that view is not realistic, and in many regions and local communities availability of potable water is limited. Compared to a modest population, Canada's water supplies may seem abundant, but much of this water is not located near cities, and many rivers flow northward (Environment Canada, 2004). Given the above, it is difficult to change the way Canadians use water because there is a false belief that water will never run out (Brandes et al., 2005; Gallaugher and Wood, 2006).

Water scarcity is a real threat to the Canadian economy, particularly in densely populated and arid areas (Brandes et al., 2005). Shrubsole and Tate (1994) note that, in some areas in Canada, natural supplies will soon not be adequate to accommodate the demand. "About 26% of municipalities with water supply systems reported water shortages during the 1994 to 1999 period, for such reasons as seasonal shortages due to

droughts, infrastructure problems, and increased consumption" (Environment Canada, 2004, 36). A limited supply, overuse, degradation, and climate change are only a few of many factors that place stress on water systems and water supply systems (Brandes et al., 2005; Environment Canada, 2004). It is possible that, through degradation and overuse, water systems can be rendered unusable (Bartoszczuk and Nakamori, 2002).

2.2 SUPPLY MANAGEMENT

Formal resource management was introduced during a scientifically dominated era; traditional paradigms supported the notion that resources were destined for human consumption. The primary goal of managers was to guarantee a constant stream of resources and to ensure sustained economic development (Cortner and Moote, 1994). The common attitude has been that water is a limitless resource that should be provided free of cost and for unrestricted use (Overgaard, 1960).

In the past, engineers were usually employed to solve water problems, and they provided Canadians with a high level of access. There was a focus on meeting demand by supplying sufficient quantities of water. Heath (2001) observes that building new structures was the old way to resolve water supply concerns. The focus was to alter the natural environment to provide for human needs (Shrubsole and Tate, 1994).

Supply management techniques treat water as a commodity, locating additional sources if necessary, and focusing on delivery. These attempt to increase the available supply of water to consumers, without questioning the factors behind consumption.

While some supply projects are indeed necessary to provide residents with suitable access to water, there is a fine line between providing an appropriate amount and promoting wasteful use. Supply management is at the far end of a continuum, encouraging the use of water as desired, and aiming to augment capacity through the withdrawal of large amounts of water (Brandes et al., 2005). Typically, the challenge for those working within this framework is to overcome the limited availability of water (Brandes et al., 2005).

In Canada, supply management is the most commonly used framework for water management. Canadians generally look for new water sources or ways to satisfy existing or predicted demand. Used on its own, this is an inadequate strategy for multiple reasons. Supply management techniques encourage unlimited consumption, which is arguably unsustainable. Supply management is increasingly "spawning ecologically damaging, socially intrusive and capital-intensive projects that fail to deliver their promised benefits" (Gleick, 2002, 373). Supply management has been criticized for ignoring negative economic and environmental impacts. It is costly, for example, for governments to subsidize large projects. Additionally, the infrastructure in many communities is outdated and cannot withstand the pressures of excessive water use combined with rising populations (Brandes et al., 2005). Furthermore, there is a lack of accessible freshwater sources within Canada (Brandes et al., 2005).

It is unfortunate that, with respect to resource management, unsustainable activities are allowed to thrive even where evidence suggests they have significant negative consequences (Ludwig, Hilborn and Walters, 1993). Scholars suggest that while current outlooks are changing, Canadians still operate within a highly supply-based model (Brandes et al., 2005).

Excessive water use in Canada can be partly attributed to a supply management model; Canadians may use unnecessary amounts because water is perceived as readily available. Many factors reinforce supply management approaches, including a lack of consumer awareness, policies, and incentives (Brandes et al., 2005). Also, under-pricing contributes to exaggerated demand and unnecessary extension of infrastructure (Shrubsole and Tate, 1994).

Water pipelines, intended to increase the supply of water in order to meet demand, are an example of a supply management technique. By providing ways to access additional resources, an inappropriate message may be sent to consumers. In contrast, policy makers should be able to begin making small changes that will dramatically affect the future of water resources by combining appropriate fees for water and limiting its availability.

Gleick (1998) warns that finding new sources of water should be done only when necessary. The value of that water must outweigh the negative consequences that may

result. Supply management is not usually concerned with ecological well being, nor with preserving resources for the future (Gleick, 1998).

2.3 DEMAND MANAGEMENT

Demand management closely aligns with an ideology that resources manage humans, as opposed to the contrary (Ludwig, Hilborn, and Walters, 1993). This interpretation means that people must live within their means. Demand management looks for ways to lower the demand and extend existing supplies. Many tools can be used within this demand management framework. Environment Canada (2004) insists that the country has demonstrated its ability to abandon exclusive supply management efforts by increasingly using demand management methods, including cost-recovery programs, metered water use, and usage restrictions.

The cost per capita of water for Canadians is the lowest among industrialized countries (Brandes et al., 2005). Residential users consume as much as twice the amount per day compared to those in many of these countries (Burke, Leigh, and Sexton, 2001). Only residents in the United States are higher per capita users of water. The low cost for water has been a direct result of governments' aims to ensure high quality water in sufficient quantity to all of its citizens. Federal subsidies contribute to the perception of abundant water (Bartoszczuk and Nakamori, 2002), and, in fact, prices in Canada have never been high enough to cover the actual cost of providing the service (Burke, Leigh, and Sexton, 2001; Rogers, de Silva and Bhatia, 2002). This is a main reason for high

consumption rates (Brandes et al., 2005; Burke, Leigh, and Sexton, 2002; Dinar and Subramanian, 1997).

Policy makers are able to assist in changing current values and behavior by using pricing as a tool to curb consumption (Tsur et al., 2004). Pricing is a valuable demand management tool as it can contribute to "demand reduction, efficient reallocation of the resource, and increasing the supply … improved equity, improved managerial efficiency, and improved sustainability of the resource" (Rogers, de Silva and Bhatia, 2002, 2).

In Canada, flat and volume-based rates are most commonly employed. When a flat rate is charged, the consumer pays a fixed amount and receives unlimited access to water; this rate is most often calculated based on predicted usage (Burke, Leigh and Sexton, 2001). Bartoszczuk and Nakamori (2002) state that flat fees do not encourage conservation behavior. Volume-based rates charge the user per unit of water consumed, rather than only access to water. Brandes (2003) found that volume-based rates are typically related to lower water use. Pricing arguably has the largest impact on citizens' reactions and their behaviours, and is thus an effective tool that can be used to reduce water use. However, there must always be consideration that aggressive pricing may make it difficult for the poorest members of society to be able to access a resource essential for life.

Block rates are an alternate way to charge for water. A declining block rate does not encourage conservation because the price of water per unit decreases as the amount of water used increases; in contrast, an increasing block rate encourages conservation. In Canada, pricing structures are normally designed to decline when more water is used; high water users therefore pay a lower price per unit than low water users.

Extensive government involvement is essential to ensure that equity is established when the price of any essential service is increased (Rogers, de Silva and Bhatia, 2002). The intent of water pricing policies is to ensure all citizens do their part to conserve. Ideally, consumption should decrease proportionately to an increase in awareness and efficiency. Therefore, while residents may pay a higher charge per unit of water, the total amount paid will remain relatively stable. Pricing water at a higher cost can lead to efficiency, lower consumption, and appropriate distribution (Dewees, 2002). A goal of the Canada Water Act is to ensure the "optimum use [of resources] for the benefit of all Canadians" (Environment Canada, 2006). It is important to note, however, that it is not the federal government that is in charge of water pricing; provincial governments establish prices, and municipal governments handle execution (Horbulyk, 1997).

Some evidence contradicts the assumption that pricing is the most successful way to curb excessive water use. Savenije and van der Zaag (2002) illustrate that in Europe, for example, quotas have proved far more useful than pricing for encouraging

conservation. A negative consequence of raised prices is that poor people can be burdened with the costs for basic necessities. To avoid this, in Europe, economic users such as industry pay a higher price to subsidize the poorer people who may not be able to afford higher costs (Savenije and van der Zaag, 2002). Accordingly, graduated pricing ensures that low-volume water users do not pay a high price for water. As a result, the cost normally rises with increasing water use, encouraging lower usage. Additionally, Molle and Turral (2004) argue that increasing the cost for water does not actually save water; instead, it merely reallocates water to users who are able to pay a higher price.

Pricing may not be an effective strategy because the demand for water can be viewed as inelastic, or, resistant to change. Savenije and van der Zaag (2002) explain that the poor use only basic amounts of water, and the rich will continue to pay for the same amount of water regardless of price.

A demand management approach can reduce costs by eliminating or postponing the need for new water supply infrastructure (Water and Megacities, 2001) and allowing residents to make better use of systems already in place. Education is a focal point and the public must be actively involved for the success of this approach (Niemcyznowicz, 1999). Demand management programs might "mitigate the pressures of excessive urban water use on municipal finances, infrastructure and the aquatic ecosystems that they rely on" and include "measures that reduce water use, or

improves the efficiency and timing of water use" (Brandes et al., 2005, 5). In general, demand management has a strong voluntary foundation; incentives are used to entice the population to embrace initiatives (Savenije and van der Zaag, 2002).

Integrated water resources management (IWRM), which aims to combine economic development with social welfare, may help shift current ways of thinking from supply management to demand management (Jonch-Clausen and Fugl, 2001). With IWRM, growth is seen as beneficial, provided that it is sustainable and remains balanced alongside environmental needs. Environment Canada (2004) states that IWRM is one way to alleviate pressures through meeting urban demands while attending to environmental consequences. IWRM blends both supply and demand management approaches; a combination of an adequate amount of water and a push towards conservation may prove fairly sustainable over time.

IWRM is a multi-disciplinary approach that attempts to bring together various sectors of an economy to collectively solve water issues. While IWRM represents favourable ideas, it has been criticized for its unfeasible nature. Biswas (2004) believes IWRM is a concept too vague to provide practical direction for resource managers. Braga (2001) states that IWRM is difficult to implement because it requires the coordination of various professionals.

Sustainability is considered a key concept in the management of resources, and demand management employs its principles as an integral part of the approach.

Although sustainability has been criticized for its ambiguity, others believe that its significance lies in its flexibility (Mitchell, 2002).

Carrying capacity is another important concept related to sustainability and water management. This refers to the natural limit that the ecosystem can handle before collapse or significant change. There is a delicate balance between the amount of water extracted and the force of the impact on nature. On a similar note, it is often the case that more waste is released into the environment than an ecosystem can absorb (Biswas, 1976). It is for this reason that managing an ecosystem may be necessary. Humans must re-examine the ways their interactions occur, and to ensure the future vitality of an ecosystem, interactions with the environment may need to be limited.

Demand management practices can potentially increase the carrying capacity of an ecosystem. Humans cannot always increase the amount of the resource, but they can increase its productivity. By using water more efficiently, for example, more people can be serviced and less water is wasted. There are two important distinctions to consider when defining carrying capacity. Biophysical carrying capacity refers to the maximum population that can be sustained based on current technology, and social carrying capacity deals with the maximum population that can be sustained based on the current consumption patterns of a community (Daily and Ehrlich, 1996). It is important to identify these differences so that a community can address the most appropriate way to solve concerns of over consumption.

MacIver (1970) discusses four options for any community when it has maximized the capabilities of the current water supply system: (1) collect additional water from the same source, (2) collect additional water from an alternate source, (3) use the existing water to a higher degree of efficiency, or, (4) discontinue the growth of the community. For the future health of an environment and community, it is most beneficial to practice the third option: not to look immediately for more sources of water, but rather to look for ways to better use current supplies. This is consistent with the notion that equity and environmental integrity are fundamental to a demand management approach (Savenije and van der Zang, 2002).

Serageldin (1995) notes that with continued consumption at current levels, the demand for water worldwide is anticipated to rise by approximately 650% by 2025. Postel (1994) explains that natural resources are finite, while population and economic growth can be unlimited. Furthermore, when human populations expand, competition for natural resources increases (Laurance, 2004). It is for these reasons that demand management will prove valuable in the future. In the United States, for example, increased expansion of water systems has not only led to unwarranted consumption, but it has also aided in the deterioration of various ecosystems (Postel, 1994). It is precarious to create an illusion of unlimited resources.

Demand management is critical to ensure the sustainability of such things as agriculture and the economy (Postel, 2000). All sectors in Canada must become

involved with finding ways to conserve water in order to reduce water scarcity and ecological impacts (Brandes, 2003). Education should lead to greater awareness and accountability of actions, and success can only be achieved when all stakeholders actively support conservation efforts.

Embracing demand management techniques is the first step toward the goal of long-term sustainability. Although it can be argued in Canada that water is not scarce, per se, it must be recognized that the degradation or overuse of freshwater sources will limit the ability of future generations to meet their needs for water.

2.4 SOFT PATH

Soft path is an intensified form of water demand management. A soft path approach is proactive and attempts to change fundamental values underlying water use. It aims to reduce consumption and to eliminate water from non-essential uses, using many of the same tools as demand management and "with the goal of encouraging efficient use, equitable distribution of the resource, and sustainable system operation over time" (Gleick, 2003, 1526). The main objective is to provide efficient services rather than unlimited amounts of water (Brandes et al., 2005). Human needs can be met by exploring alternatives to water, and using tools such as education, technology, pricing, regulation, and recycling (Brandes et al., 2003).

Soft path is considered a more holistic approach than supply management, taking into account not only the needs of the economy, but also the needs for societal

and environmental well being. It involves implementing changes to increase conservation through more efficient practices and technologies (Brandes et al., 2005). Soft path can work within the existing water supply system to reduce the amount of water used and prevent the need for further infrastructure development (Brandes et al., 2005). Soft path is a great contrast to the former belief that creating additional infrastructure is the sole way to meet demand for water (Gleick, 2002).

Soft path explores how to save energy by delivering differing qualities of water, since drinking quality water is not required for all daily activities. Many uses can be satisfied through recycled or gray water, which saves energy in the sanitation process. It has been suggested that people desire access to convenient and reasonably priced services, whether or not water is involved (Gleick, 2003). For instance, waste disposal does not require any water to be effective. However, minimal amounts may be appropriate because of cultural expectations (Gleick, 2003). Similarly, farmers are arguably concerned with producing high-quality crops, rather than with the amount of water they use. If technology can provide farmers with crops that need less water to grow, or improved irrigation systems, this would be an ideal form of soft path (Gleick, 2003). Soft path searches for techniques to reduce the quantity of water consumed and increase its productivity (Gleick, 2002).

A soft path approach is concerned with backcasting instead of traditional forecasting (Brandes et al., 2005). This means that instead of planning for the projected

need, resource managers establish their ideal future need by confirming what is available, and then working to try and meet that predetermined goal (Brandes et al., 2005).

Local communities and multiple stakeholders are encouraged to provide input for decision making. The first step in the soft path decision making process is to assess the current water usage. This provides a benchmark for measuring success. Then, water use is evaluated, to determine what changes could be made, and what areas could have improved efficiency. Backcasting is often used as a technique. Change is implemented; this includes conservation in the forms of water reuse, varying qualities, improved technology, education, and government policies. Effectiveness is then monitored, and the cycle repeats.

Soft path can be used to reduce water consumption. Any management plan should consider the future implications of current practices, and intend to remedy foreseeable problems. Successful water management should be aimed at reducing overconsumption, eliminating possible conflicts between shared resources, and improving the overall quality of water (Gleick, 2003).

Table 2.4.1 outlines the main differences between supply management, demand management, and soft path tools and principles.

Characteristic	Supply-Side Approach	Demand management (DSM)	'Soft path' for water
Philosophy	Water resources are viewed as virtually limitless. The primary constraint is our capacity to access new sources or store larger volumes of water.	Water resources are viewed as finite and to be used efficiently. Conservation is key and economic cost-benefit analysis guides development strategies.	Water resources are viewed as finite and driven by ecological processes. The focus is on a fundamental re-evaluation of the way we develop, manage and use water.
Basic Approach	Reactive Currently, the status quo approach—developing resources according to human needs and wants.	Short-term and temporary Generally used as a secondary approach, complementing and deferring supply-side options or until future supplies are secured. However, when used in a comprehensive, integrated and long-term fashion, represents an incremental step towards a broader "soft-path" approach.	Proactive Long-term with potential for fundamental change in societal attitudes and resource use.
Fundamental Question	How can we meet the future projected needs for water given current trends in water use and population growth?	How can we reduce current and future needs for water to conserve the resource, save money and reduce environmental impacts?	How can we deliver the services currently provided by water in the most sustainable way?
Primary Tools and Examples	Large-scale, centralized, expensive engineering solutions. Examples include dams, reservoirs, treatment plants, pumping stations and distribution systems.	Innovative engineering and economically-based solutions focused on any measure that increases the efficiency and/or timing of water use. Examples include low-flow technologies, drip irrigation, conservation-based pricing, education, and policies and incentives to reduce use.	Encompasses the full suite of social sciences and generally relies on decentralized distribution coupled with management strategies aimed at ultra-efficient ways of meeting end-use demand. The focus is on any measure that can deliver the services provided by the resource taking full costs (including environmental and social) into account and identifying new options to provide services associated with water use. Examples include drought resistant native landscaping, grey water reuse, ultra-low-flow technologies, and dry sanitation.
Planning Process	Planners model future growth, extrapolate from current consumption, plan for an increase in capacity to meet anticipated future needs then locate and develop a new source of supply to meet that need.	Planners model growth and account for a comprehensive water efficiency and conservation program to maximize use of existing infrastructure. Increasing capacity would be a final option as part of a least-cost approach.	Planners model future growth, describe a desired sustainable water future state (or scenario) and then "backcast" to find a feasible and desirable path between the future and the present using tools such as DSM and ecosystem restoration to address degraded aquatic systems.

Table 2.4.1: Supply management, demand management, and soft path techniques compared (Source: Brandes and Kriwoken, 2005)

2.5 SOCIAL DEMOGRAPHICS

Social demographics have been found to play a role in the conservation attitudes and behaviours of individuals. Social demographics can include age, gender, race, religion, education, income, and socio-economic status. Some studies have been able to link specific demographics with consumption. Hamilton (1985) finds that knowledge and socio-economic status are inversely correlated with consumption of water. Chermak and Krause (2001) discover that price is significant, and its elasticity varies depending on the age of the consumer. The most sensitive group to price changes is students. Lower income households are also more affected by rate increases than higher income households (Trumbo and O'Keefe, 2001). Several studies support the finding that price consciousness is significant to conservation (Heslop, Moran and Cousineau, 1981; Renwick and Archibald, 1998; Trumbo and O'Keefe, 2001).

Some studies, however, rule out demographic links with conservation. For example, De Oliver (1999) does not find that income, education, or home ownership are significantly associated with behaviour. Similarly, Chermak and Krause (2001) do not find that gender has any impact on consumption. Studies ruling out demographic links are the minority, as it is generally agreed in the literature that social demographics do play a role in conservation attitudes and behaviours. It is important to note that the aforementioned studies focus on North American data, and that demographic links might be different depending on the area in the world being researched.

There are many possible explanations as to why only some researchers find socio-demographic status linked with water conservation. For example, the study area could play a role in behaviours. A water scarce community might be more aware of water concerns as a whole, and therefore little discrepancy between the different demographic groups would exist.

It is important to recognize that attitudes and behaviours do not always align. Hamilton (1985) concludes that self-reported and actual behaviors are not strongly linked. The study by De Oliver (1999) shows that although a survey indicates high intent to comply with a new water management plan, no decrease in consumption occurs, and the plan is terminated due to lack of support. Furthermore, Nieswiadomy (1992) notes that if consumers feel they are saving water in one section of their household, they are more likely to use additional water in other areas, counteracting potential savings.

Nieswiadomy (1992) finds differences in behaviour depending on the region of study. In the United States, public education programs have significant impacts only in areas known for having severe water shortages. Also, demand in these areas tends to be far more elastic (Nieswiadomy, 1992). A study by Hamilton (1985) supports the notion that education and behaviour may be linked.

Corral-Verdugo et al. (2002) suggest that individuals respond to the perception of externalities when determining their environmental behaviour; individuals practice

behaviours they see being exhibited by others. Corral-Verdugo et al. (2002) therefore suggest that it is best to impose obligatory conservation demands upon residents, eliminating the voluntary basis that can contribute to low participation. De Oliver (1999) finds that when implementing voluntary measures, people with higher incomes and higher education respond less to conservation incentives; however, when mandatory measures are implemented, all income and education groups respond similarly. In order to persuade citizens to save water, governments must impose restrictions, and education must be a main component (Corral-Verdugo et al., 2002).

Demographics are important to consider in order to properly estimate consumer response to various strategies (Chermak and Krause, 2001). Heslop, Moran and Cousineau (1981) suggest that only two strategies will reduce consumption: an increase in price, or an increase in sensitivity to price. Trumbo and O'Keefe (2001) note that individuals respond best to conservation measures not when they are only provided with information, but rather when they also have an interest and are particularly engaged with the subject. The purpose of determining whether certain demographics are associated with behaviour is to be able to anticipate the response.

2.6 SUMMARY

This chapter has discussed the value of conserving water. Canada, a country generally envied for having an abundant amount of water, does not have unlimited quantities. The widespread perception that water is so plentiful is partly due to its low

cost. There are threats to the water supply including overuse, outdated infrastructure, climate change, and pollution. Furthermore, many metropolitan areas are not located in close proximity to a suitable water supply.

The traditional approach to solving concerns of scarcity is to find and tap new sources of water. Supply management treats water as a commodity and attempts to offer increased quantities to consumers. This approach is not cost efficient nor environmentally friendly.

Demand management is viewed as a viable alternative. This method decreases demand instead of increasing supply. It is more sustainable and better for the environment than supply management. Integrated water resources management can help bridge the gap between these two approaches. Demand management can increase the carrying capacity of both ecosystems and infrastructure. Pricing, quotas, and education have proved to be valuable tools.

Soft path is an extension of demand management, highlighting ways that water can be eliminated from daily activities and energy can be saved. Using gray water is encouraged, backcasting is a valuable tool, and community involvement is key.

It is important to understand that social demographics may play a role in the conservation attitudes of individuals. An individual's income, education, gender, age, race, religion, or socio-economic status may influence the way they view and conserve

water resources. Researching social demographics may help to determine the most appropriate way to change behaviours related to high water consumption.

It is my intention to research water use and conservation within the Region of Waterloo. I will attempt to determine whether a proposed pipeline will undermine current conservation efforts put forth by the Region of Waterloo. Furthermore, I will try to link demographic variables to the conservation of water in the City of Waterloo. A variety of methods will be employed. The next chapter discusses the methodology and design of the research.

CHAPTER THREE: METHODOLOGY

3.1 INTRODUCTION

The purpose of this research is to study water conservation in regard to the proposed pipeline from the Region of Waterloo to Lake Erie. An extensive literature review, focusing on water management techniques, was conducted before field research began. Three methods of data collection were combined to ensure validity and reliability: (1) questionnaires distributed to 750 households within the City of Waterloo boundaries; (2) an analysis of newspaper articles, covering five years prior to the date of research commencement; and (3) 7 expert interviews with officials and academics who were closely connected with the subject.

3.2 QUESTIONNAIRES

The purpose of the questionnaires was to determine how residents of the City of Waterloo: (1) perceive the region's current water supply; (2) feel about water conservation; (3) use water within their homes; (4) perceive the proposed water pipeline; and (5) might change their water use habits if a pipeline were constructed in the future. The questionnaire used a combination of closed- and open-ended questions. The closed-ended questions were intended to make the data straightforward to code, analyze, and compare, while the open-ended questions left room for ideas and opinions that might not have been anticipated.

A pilot study was conducted prior to the distribution of the questionnaire. Five homeowners who the researcher knew personally were asked to participate in a focus group. They completed the questionnaire and commented on any aspect they felt needed modification, with special attention given to the clarity of questions. Only minor revisions were required.

The study area was restricted to the City of Waterloo and did not include the broader Region of Waterloo. There may be distinct differences between each of the three cities that make up the tri-city area: Kitchener, Waterloo, and Cambridge. Trumbo and O'Keefe (2001) note that communities within a watershed may have distinctive characteristics that distinguish them from one another, despite their sharing an underlying resource.

Homeowners were targeted because it is believed that they are more sensitive to conservation issues than renters. Nieswiadomy (1992), for example, finds that homeowners are more aware of their water use since renters might not pay for their consumption.

Three demographically distinct areas, based on income, were targeted for the distribution of the questionnaire. Census maps illustrating the average income per census tract were used to identify areas with the desired attributes: one higher-income area, one middle-income area, and one lower-income area. These tiers were relative to the City of Waterloo and not determined by national averages.

A total of 150 respondents was desired; it was believed that this number would be sufficient to conduct chi-square analyses. In order to attain 150 respondents, 750 questionnaires were distributed. The literature suggests that the average response rate for mail-in questionnaires is 20% (Bernard, 2000; Neuman, 2003). However, there are methods that can assist in increasing the response rate. The questionnaire was limited to three double-sided pages, and non-intrusive questions were asked first (Bernard, 2000). Personal questions referring to income, education, age, and gender, were presented at the end of the questionnaire. Respondents feel less threatened and are more likely to answer these questions once the questionnaire has been completed (Bernard, 2000).

Two hundred fifty questionnaires were distributed in each of the three areas, with the intent that at least 50 would be returned, for a total of 150. It was not important which census tract each response came from, only that there was an appropriate range of responses from the social demographic categories of income, education, age, and gender.

At least three streets within each area were selected at random, depending on the number of houses per street. An envelope was left in the mailbox of each house, except in the event that the homeowner was outside. In this case, the researcher verbally provided a brief overview of the research and handed the envelope to the homeowner. Each envelope contained an information letter introducing the researcher and her

research, a questionnaire, and a preaddressed stamped envelope (Appendix A). The researcher's contact information was provided should any concerns arise, and it was indicated that the research was reviewed and received clearance from the Office of Research Ethics.

The questionnaires were distributed within a one-week time frame, on the days of May 24, 25, and 29, 2007, ensuring that all respondents had access to the same information, and no significant event occurred that would largely alter responses.

A deadline of three weeks was set to deposit the completed questionnaire into the mail, and a total of 135 questionnaires were returned by this date of June 15, 2007. To accommodate those who may have been on vacation or late for other reasons, a three-week grace period was used. One hundred fifty-one were returned by this new date of July 6, 2007. Four were returned after this date and were not used in the analysis. Based on the questionnaires included, a response rate of 20.13 percent was achieved.

3.3 NEWSPAPER ANALYSIS

The purpose of the newspaper analysis was to monitor the community conversation about water conservation in the media and determine the level of response and initiative from residents. Furthermore, newspaper articles were able to provide insight about the questions asked on the questionnaire. The study area was not restricted to the City of Waterloo, but included the broader Region of Waterloo; this was

intended to result in a more extensive range of information. *The Record*, a daily newspaper, was searched for relevant articles between January 2003 and November 2007.

3.4 INTERVIEWS

The purpose of these interviews was to acquire the perspectives of "experts" in water conservation. These experts might be able to offer valuable information and insight pertaining to water conservation and the possible effects of the proposed water pipeline. Seven interviews were conducted. Experts were initially contacted by email (see Appendix B). Six interviews took place in person, and one was conducted by telephone. Interviews were approximately 30 minutes in length; the shortest interview was 10 minutes long, and the longest was one hour. All experts were asked the same 7 questions:

1. In your opinion, what is the main purpose of the pipeline?
2. Why do you feel the pipeline was chosen as the means to solve water scarcity concerns?
3. What do you feel would be the potential advantages of constructing this pipeline?
4. What do you feel would be the potential disadvantages of constructing this pipeline?
5. How do you feel the pipeline would impact the Region of Waterloo?

6. How do you feel the pipeline would impact conservation?
7. Do you have any additional comments about this pipeline?

Four experts chose to remain partially anonymous. Those interviewed included: two Region of Waterloo staff, a professor from a southwestern Ontario university, Rob de Loë from the Department of Geography at the University of Guelph, James Etienne from the Grand River Conservation Authority, an anonymous staff member from the Grand River Conservation Authority, and Tony Maas from the World Wildlife Foundation.

3.5 DATA ANALYSIS

The data analysis for the questionnaire results was completed using Microsoft EXCEL and SPSS. Results for each question were recorded and tabulated using EXCEL. Histograms were created where appropriate. Chi-square was conducted using SPSS for each multiple-choice question, based on the variables of income, education, age, and gender. A significance level of 0.05 was used to identify statistically significant differences. Findings are presented in Chapter Five, with remaining figures and tables included in Appendix C.

A drawback of chi-square is the minimum numerical requirement. When this requirement is not met, chi-square cannot be applied. Kolmogorov-Smirnov was also considered, but not used because this test requires ordinal data, and many of the questions did not satisfy this requirement.

3.6 LIMITATIONS

It is difficult to find a method that will accurately enable a researcher to predict the future, and it is arguable that no such method exists. Chermak and Krause (2001) explain that a limitation with surveys is their hypothetical nature, not actually requiring the respondent to make changes in their behaviour. Unfortunately, this limitation could not be avoided since the research is based on how respondents' behaviours might change with the *possible* construction of a pipeline in the future. It is arguable that residents would not be able to accurately predict this because circumstances surrounding the pipeline are not yet known; for example, it is unknown whether the price for water would rise or whether conservation programs would be continued. Furthermore, De Oliver (1999) suggests that surveys typically attain socially desirable responses, rather than truths. This limitation could not be avoided because of the desire to survey the public.

Another limitation is the relatively small size of the sample. A larger sample would have provided results more representative of the population. The researcher attempted to offset this negative effect by using a smaller sample area: the City of Waterloo as opposed to the Region of Waterloo. Additionally, a larger sample size would have enhanced the chi-square application, as some categories did not meet the minimum numerical requirements for the test.

3.7 SUMMARY

Triangulation of data was important to the research. Questionnaires were distributed to 750 households in three demographically distinct areas based on income; one hundred fifty-one were returned in time to use for analysis. Chi-square was performed to discover statistically significant relationships. Newspaper articles and letters to the editor were collected and analyzed to provide additional viewpoints. Seven experts were interviewed to obtain their perspective on the situation. Limitations of the research include the hypothetical nature of questionnaires and the small sample size.

CHAPTER FOUR: CASE STUDY

4.1 THE GRAND RIVER WATERSHED

The Grand River watershed is the largest by area in southern Ontario. It is approximately 6800 square kilometers, and has 11 subwatersheds (Waterloo Hydrogeologic, n.d.). Figure 4.1.1 illustrates the boundaries of the watershed and the location of cities within it. The Grand River, the main river within the watershed, flows through the major urban centers of Kitchener, Waterloo, Cambridge, and Brantford; however, only five percent of the watershed is urban (Bellamy and Boyd, 2005). Traditionally, agriculture has been the main economic activity in the watershed and it continues to thrive today.

The 2005 population within the watershed was over 800,000 people (Bellamy and Boyd, 2005), and this is anticipated to increase by 250,000 people by 2030 (Grand River Conservation Authority, 2007), partly because of the Places to Grow Act. This act designates certain corridors in Ontario for economic development, and many urban areas within the Grand River watershed have been so targeted (Figure 4.1.2).

Humans have had a large impact on the natural landscape in the Grand River watershed because of their need to bring freshwater into homes and industries, and their propensity to locate far from the source. Large quantities of water are withdrawn from the ecosystem continually, and pressures will continue to rise, as future growth will undoubtedly strain existing water resources. Figure 4.1.3 illustrates municipal

water supply sources and the amount of water drawn per day in 2002. Management is important to regulate the amount of water used.

4.2 REGION OF WATERLOO

The Regional Municipality of Waterloo lies within the Grand River watershed. It was created in 1973, and includes the cities of Kitchener, Cambridge and Waterloo, and the townships of Woolwich, Wilmot, Wellesley, and North Dumfries. Figure 4.2.1 outlines the boundaries of these cities and townships. The Region of Waterloo has a land area of 1382 square kilometers (Region of Waterloo, 2007), and occupies approximately 20% of the watershed. In 2006, the population was about 507,000 with an average growth rate of 1.6 percent per year (Region of Waterloo, 2007). Between 2001 and 2006 the population increased 9%, compared with 6.6% for the rest of Ontario (Statistics Canada, 2007). By 2031, the population is expected to increase to 729,000 (Region of Waterloo, 2007).

In response to rapid population growth, the Region in 2003 created the Regional Growth Management Strategy. Six goals are outlined in this strategy: (1) "Enhancing our Natural Environment", (2) "Building Vibrant Urban Places", (3) "Providing Greater Transportation Choice", (4) "Protecting our Countryside", (5) "Fostering a Strong Economy", and (6) "Ensuring Overall Coordination and Communication" (Region of Waterloo, 2003a). Furthermore, a key element is the "protection and preservation of

our environmentally sensitive landscapes, including our moraine areas, which are vital to the integrity of our water resources" (Region of Waterloo, 2003a).

This strategy shows a concern for the natural environment. The Region is committed to protecting the environment and water supplies, reducing waste, and enhancing woodlands (Region of Waterloo, 2007). Water efficiency is also important to the Region and will be discussed later in this chapter.

4.3 CITY OF WATERLOO

The City of Waterloo makes up about 20% of households in the Region of Waterloo (Region of Waterloo, 2007) and has a land area of 64.1 square kilometers (Statistics Canada, 2007). In 2006, the population was 97,475, an increase of 12.6% over the past five years (Statistics Canada, 2007). This population growth is almost double the rate of the rest of Ontario. Since 1981, Waterloo has consistently had the highest growth rate of any city or township within the Region, as illustrated in Figure 4.3.1 (Region of Waterloo, 2003b).

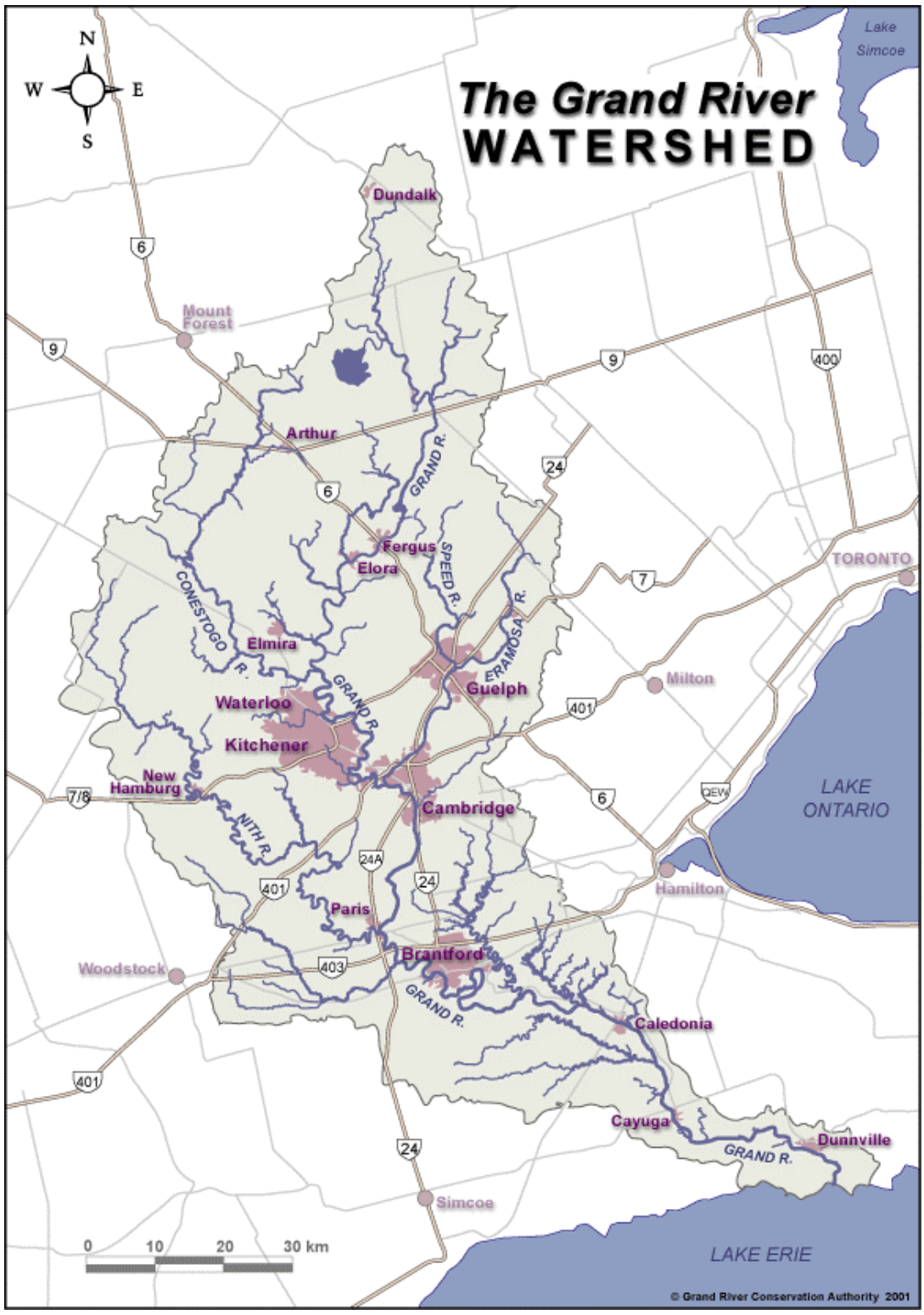


Figure 4.1.1: The boundaries of the Grand River watershed, and the locations of municipalities within (Source: Grand River Conservation Authority, 2001)

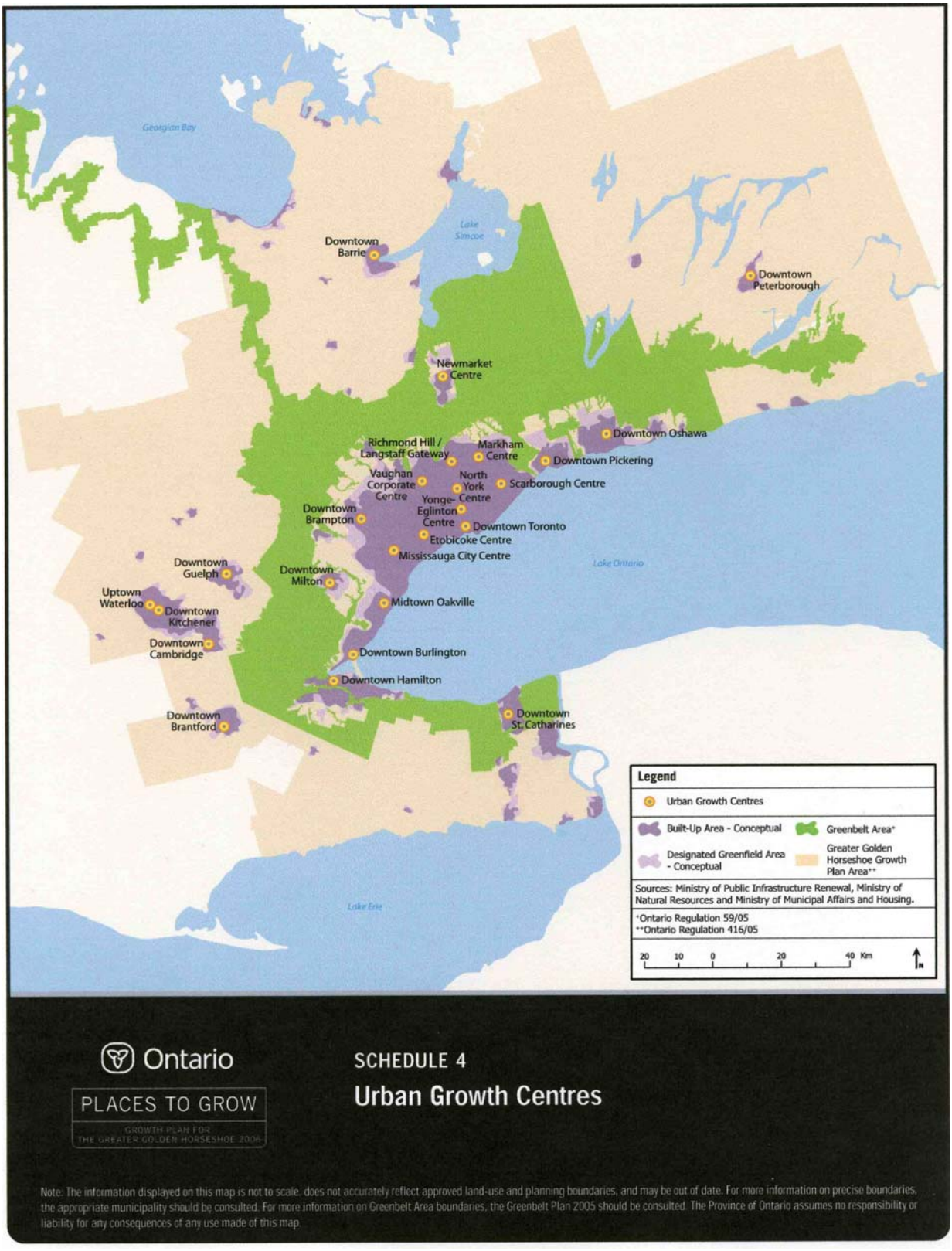


Figure 4.1.2: Urban growth centers of the Place to Grow Act (Source: Ontario Ministry of Public Infrastructure Renewal, 2005)

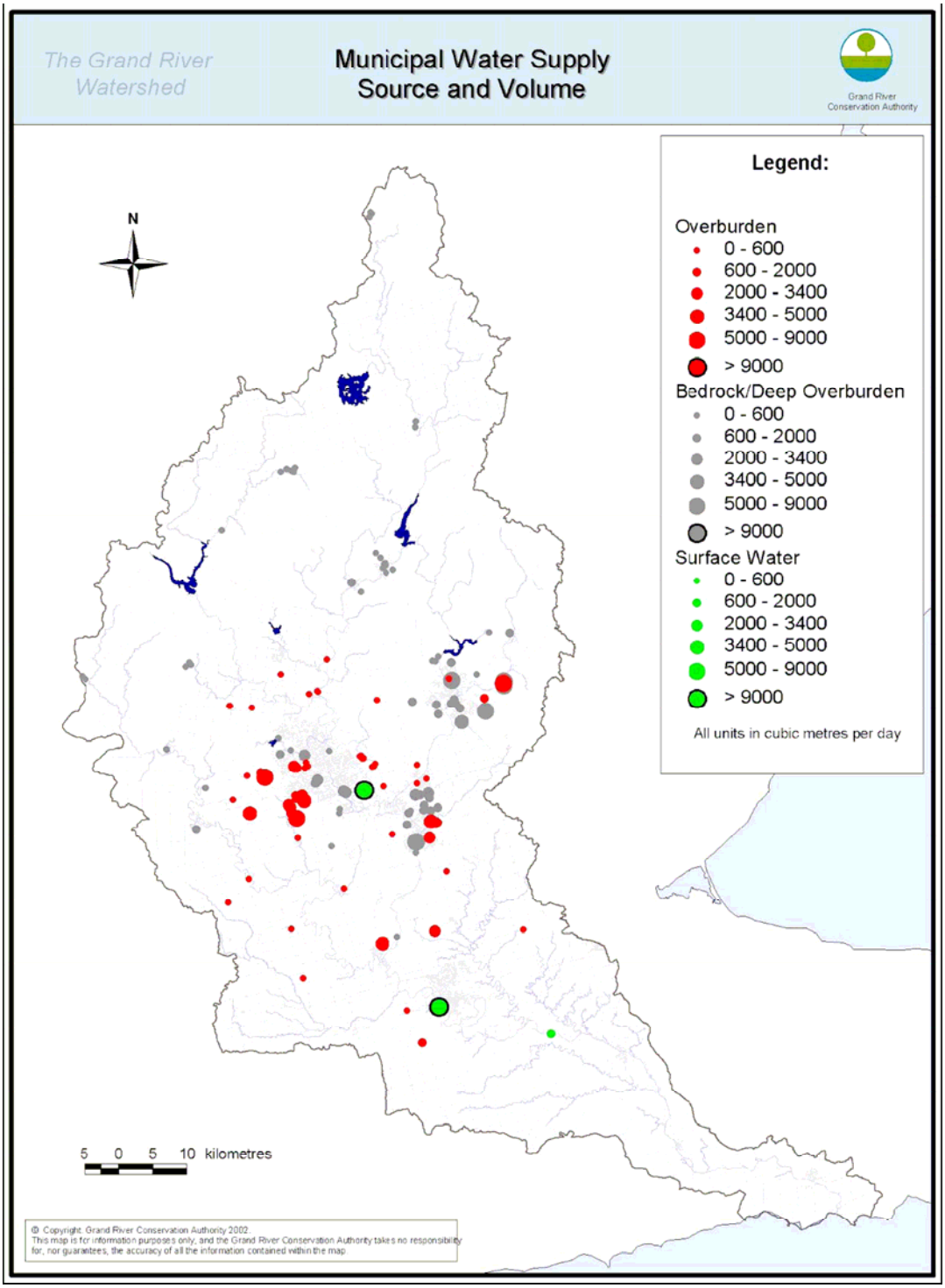


Figure 4.1.3: Municipal water supply sources, showing the amount of water drawn per day in 2002 (Source: Bellamy and Boyd, 2005)

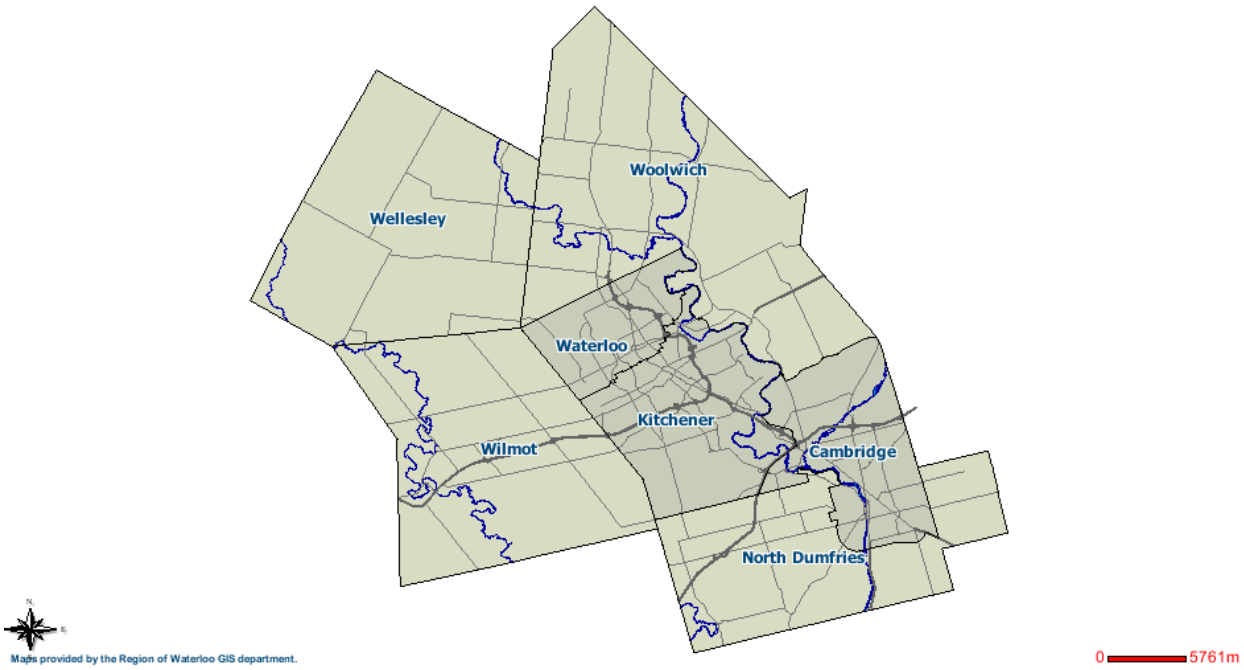


Figure 4.2.1: Location of municipalities within the Region of Waterloo (Source: Region of Waterloo, GIS department, 2007)

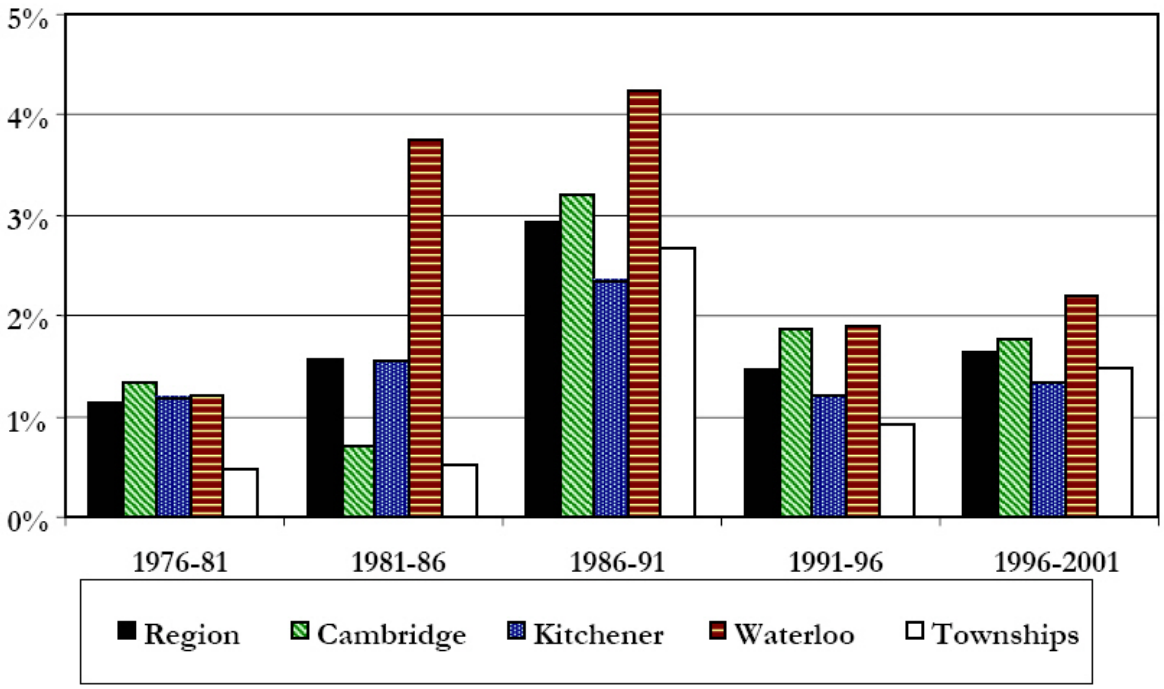


Figure 4.3.1: Average annual growth rates (Source: Region of Waterloo, 2003b)

In 2001, 55.7% of the population lived in 1-2 person households, with 16.4% in 3 person households (City of Waterloo, 2005). The average number of residents in private households was 2.6 people (City of Waterloo, 2005). A large majority (79.4%) of families were headed by married couples, and 65% of families had at least one child, with an average of 1.2 children per family (City of Waterloo, 2005). Over two thirds (69.5%) of dwellings were owned, and in 2000 the average household income was $76,978 (City of Waterloo, 2005). In 2006, the median age was 35.4 compared to 36.4 in the Region of Waterloo, and 39 for rest of Ontario (Statistics Canada, 2007). The top three areas of employment were manufacturing, educational services, and retail trade with 19.1%, 12.6%, and 10.5% of the population employed, respectively (City of Waterloo, 2005).

Consistently since 2001, Waterloo has had the highest enrolment in post-secondary institutions, compared with other cities and townships in the Region. In 2001, there were 18,409 students enrolled in Waterloo, and Kitchener had the next highest enrolment with 4,757 (Region of Waterloo, 2003b). This difference is likely due to the fact that two universities, the University of Waterloo and Wilfrid Laurier University, are located within the City of Waterloo boundaries, and students tend to live near the school that they attend.

In 2007, the City of Waterloo was named the top intelligent community in the world (No Author, 2006). This award recognizes "the community that best exemplifies

the development of a prosperous economy based on broadband and information technology" (Intelligent Waterloo, 2006). In 2006-2007, only one other Canadian community made the list. It is important to note that over time the economic structure has shifted from primarily manufacturing to more knowledge based. This change has resulted in reduced levels of water use because industry tends to consume more water than residential uses.

The City of Waterloo created a Strategic Plan for 2007-2010. Five imperatives for the living environment are: (1) "Protect our Natural Resources", (2) "Build a Sustainable City", (3) "Promote, Enhance and Demonstrate Environmental Stewardship", (4) "Focus on Transportation of all Forms", and (5) "Ensure the Integrity of our Core Infrastructure" (City of Waterloo, 2007). It is important to note that reducing resource consumption is listed as one way to protect natural resources. Table 4.3.1 shows that Waterloo has one of the lowest daily residential water consumption rates in the watershed (197 litres per day per capita), second only to Guelph (188 litres per day per capita). These values are lower than the values for both Canada and Ontario; in 2000, Canadians had an average consumption rate of 326 litres, and Ontarians had an average of 271 litres (City of Ottawa, 2001).

It is possible that there are distinct differences between the consumption rates of different cities because of their management strategies. Waterloo and Guelph likely

have the most aggressive water conservation campaigns, translating into lower consumption rates. Furthermore, these differences could be a result of differing demographic composition of the cities, and their varying consumption attitudes and behaviours.

Community	Residential Per Capita Demand (Litres/day/capita)	Unaccounted Water (% of Total)
Brantford	298	13.6
Cambridge	303	15.5
Guelph	188	17.3
Kitchener	235	14.9
Waterloo	197	8.0

Table 4.3.1: Residential per capita water use rates (Source: Grand River Conservation Authority, 2005)

In 1989, the City of Waterloo created the 'Environment First' Policy with the intent of considering environmental impacts before making business decisions (City of Waterloo, 2007b). In 2002, a 75-page Environmental Strategic Plan was created and will be implemented in three phases (Environmental Strategic Plan, 2002). Water quality is a focus and there are four main objectives: (1) "Improve Degraded Aquatic Ecosystems", (2) "Stakeholder Involvement", (3) "Water Resources Monitoring", and (4) "Water Conservation" (City of Waterloo, 2002). Figure 4.3.2 shows the location of all of the water sources within the City's boundaries.

The plan indicates that efficient water use is critical to groundwater protection (Environmental Strategic Plan, 2002), but conservation will not be implemented until

phase three, between 2009 and 2012. The strategy provides a brief summary of the Region's Water Efficiency Master Plan, but no indication that the City will implement additional initiatives.

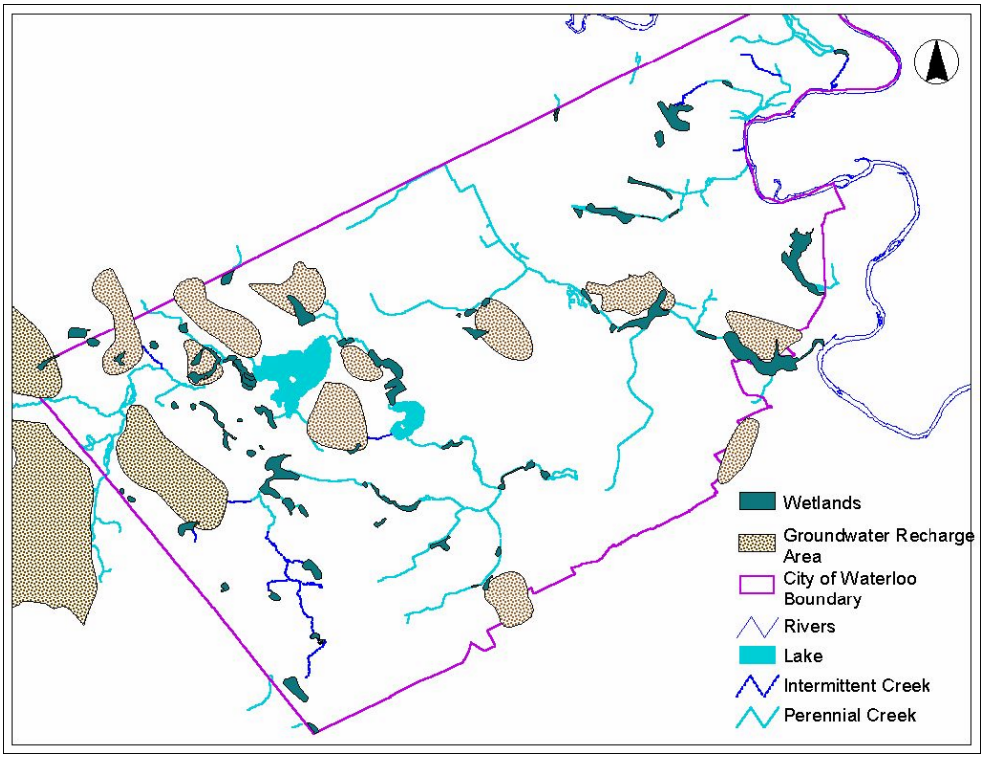


Figure 4.3.2: Water resources within the City of Waterloo (Source: City of Waterloo, 2002)

4.4 LEVELS OF GOVERNANCE

It is important to note the roles and relationships among managers of the watershed. Local managers include the Regional Municipality of Waterloo, its cities and townships (of which only the City of Waterloo will be highlighted in this research), and the Grand River Conservation Authority. Provincial level management includes the Ministry of the Environment, the Ministry of Natural Resources, and the Ministry of

Agriculture, Food and Rural Affairs. Lastly, the federal agency, Environment Canada, will be discussed.

The Region of Waterloo is unique in Ontario because both the Municipality, and the cities and townships, work together to control the water supply and its distribution (*The Record*, 2005g). The Regional Municipality of Waterloo is responsible for the collection and treatment of water from wells and the Grand River (Prender, 2005; *The Record*, 2005g). The Municipality treats sewage, which is pumped to its treatment facilities from individual cities and townships (Outhit, 2006). The Municipality also promotes water conservation and implements initiatives that the City must comply with, which will be explored later in this chapter.

Cities and townships are in charge of distributing water and controlling storm water runoff (Outhit, 2006; Prender, 2005; *The Record*, 2005g). In addition, they own and repair water supply and sewage pipes, as well as collect sewage for treatment by the Municipality (Outhit, 2006; Prender, 2005).

The Grand River Conservation Authority (GRCA) is responsible for ensuring the general well being of the watershed, and therefore the health of its people, animals, and natural resources as those are affected by the river system. It contributes to conservation and is " a corporate body established to enable municipalities to jointly undertake water and natural resource management on a watershed basis for the benefit

of all" (Grand River Conservation Authority, 2007). Conservation authorities were established by legislation starting in 1946 in Ontario because it was appreciated that watersheds do not normally conform to political boundaries. Key roles of conservation authorities include flood control, low-water response, and drinking water source protection.

The Ontario Ministry of the Environment (MOE) protects drinking water and encourages sustainable development. It creates and enforces environmental regulations and laws, and is responsible for ensuring water quality and healthy communities (Ontario Ministry of the Environment, 2007). There is a strong focus on preventing pollution in lakes and groundwater. The MOE has three branches responsible for protecting and providing clean drinking water. First, the Drinking Water Program Management Branch is in charge of policy development, program design and management (Ontario Ministry of the Environment, 2007). Second, the Education and Outreach Branch works with multiple stakeholders to coordinate outreach activities (Ontario Ministry of the Environment, 2007). Third, the Safe Drinking Water Branch is responsible for water quality compliance and investigating incidents (Ontario Ministry of the Environment, 2007).

The Ontario Ministry of Natural Resources (MNR) collaborates with environmental organizations and researchers to develop sustainable policies for the province (Ontario Ministry of Natural Resources, 2007a). Objectives include:

(1) Overseeing the safety of water control structures

(2) Supporting the development of healthy local, regional and provincial economies, and human communities through sustainable use of the Province's water resources

(3) Ensuring integrated management of Ontario's water resources through water budgets, river management and watershed planning

(4) Safeguarding Ontario's interest on shared boundary waters, including the Great Lakes. (Ontario Ministry of Natural Resources, 2007a)

One such example is the Safeguarding and Sustaining Ontario's Water Act, which is a provincial law mandating that water stay within the confines of its own watershed. In 2005, Ontario, Quebec, and 8 American States signed an agreement to ban new inter-basin water transfers (Ontario Ministry of Natural Resources, 2007b). In 2007, The Safeguarding and Sustaining Ontario's Water Act was implemented (Ontario Ministry of Natural Resources, 2007b). Furthermore, the province now has the ability to "require water users to prepare and implement water conservation plans" (Ontario Ministry of Natural Resources, 2007b). This act affected the Region of Waterloo because

it meant a water pipeline could not be linked to Lake Huron, the preferred and 'cleaner' source, because that would involve an inter-basin transfer; rather, it would be linked to Lake Erie, the lake into which the watershed drains.

The Ontario Ministry of Agriculture, Food, and Rural Affairs (OMAFRA) provides information and educational opportunities to farmers and rural residents. OMAFRA provides over 60 on-line fact sheets discussing water-related topics, so that best practices might be used on land affecting the quality of water resources. Some of these fact sheets include water quality, irrigation during drought, pesticide use, and impacts of nitrogen use (Ontario Ministry of Agriculture, Food, and Rural Affairs, 2007).

Environment Canada (EC) is responsible for setting national water quality standards that provinces must meet, and negotiating international agreements (Environment Canada, 2007). It aims to:

> "preserve and enhance the quality of the natural environment; conserve Canada's renewable resources; conserve and protect Canada's water resources; forecast weather and environmental change; enforce rules relating to boundary waters; and coordinate environmental policies and programs for the federal government" (Environment Canada, 2007).

Environment Canada's research facility, the National Water Research Institute in Burlington, leads research on multiple freshwater issues; the Water Survey of Canada collects and analyses water resource data (Environment Canada, 2007).

Multiple stakeholders at various levels of government create both opportunities and challenges for the Grand River watershed. Various agencies offer opportunities to collaborate and crosscheck methods, providing the watershed with thorough management, and a holistic representation. It may, however, be difficult to coordinate stakeholders, and it is imperative that there is communication about roles and responsibilities. Each stakeholder has unique objectives, and for this reason, vertical and horizontal coordination is necessary to ensure their cooperation.

4.5 MANAGEMENT APPROACHES

The Region of Waterloo has combined various management methods and initiatives to ensure the population has access to a sufficient supply, and a high quality, of water. The Region has been trying to live within its ecological means, and in 1998, projected the 2009 water demand. The Region is committed to lowering this projected demand by four per cent by 2009 (Region of Waterloo, 2006). However, officials have acknowledged that additional major sources of supply might be necessary for the future. In the meantime, using less water and finding new minor sources have been relied upon to enhance the capacity of the supply system.

Approaches include demand management, soft path, and supply management. It can be difficult to differentiate between demand management and soft path, as many strategies overlap. Consequently, there is no intent to draw a firm line between the two. Initiatives are included in the category believed to be the closest fit.

4.6 DEMAND MANAGEMENT

The Region of Waterloo has been proactive in promoting demand management for over 30 years. In 2006, the Region approved the Water Efficiency Master Plan (WEMP) for 2007 to 2015. This WEMP focuses on water efficiency in the following 6 areas: (1) "General Public Education", (2) "Outdoor Water Use Reduction", (3) "Efficient Toilet Replacements", (4) "Industrial, Commercial, and Institutional Efficiencies", (5) "Municipal Leak Reduction", and (6) "Research and Development" (Region of Waterloo, 2006).

The WEMP recommended that conservation initiatives remain steady, and not be reduced nor enhanced; current projects are already considered aggressive compared to other regions in Canada (Region of Waterloo, 2006). In 2002, the Region received an award from the Ontario Waterworks Association for its comprehensive list of water-saving initiatives (Region of Waterloo, 2006). The Region's demand management initiatives include price increases, toilet replacement rebates, xeriscaping, and a lawn-watering by-law.

Pricing

As illustrated in Chapter Two, pricing is arguably the most influential tool to lower water consumption. The City of Waterloo currently uses a constant rate to charge for water. In addition to a monthly service charge ranging from $2.42 to $4.89 for residential accounts, the consumption water rate in 2007 was $1.02 per cubic meter, and the sewer rate was $1.01 per cubic meter (City of Waterloo, 2007b). Since 2004, residential water rates have increased almost 49% (Prender, 2007), and by 2016, water rates could increase by as much as 145% more (Outhit, 2007a).

The City's water rate of $1.02 per cubic meter is relatively high compared to other Ontario cities. Waterloo is one of four cities in Ontario that has a rate consistently higher than one dollar; the other cities are Toronto, Kawartha Lakes, and London. Toronto has the highest rate in Ontario; a block rate is used and begins at $1.57 per cubic meter, rises to $1.64, and falls again to $1.53 (City of Toronto, 2007). Rates in Barrie reach as much as $2.05 per cubic meter, but this is the last tier of an increasing block rate, where the first block is set at a much lower $0.50 per cubic meter (City of Barrie, 2007). Sault Ste. Marie has the lowest rate of any Ontario city, with a block rate increasing from $0.30 to $0.65 per cubic meter (City of Sault Ste. Marie, 2007).

Toilet Replacement

The Region of Waterloo uses toilet replacement rebates to reimburse residents with 40 to 60 dollars when replacing a 13 litre or more flush toilet with a 6 litre or less version (Region of Waterloo, 2007). The rebates began in 1994 because approximately 40% of toilets in residents' homes were considered high-volume, and although lower-flush toilets became mandatory in new homes as of 1996 by the Ontario Building Code, many still needed to be replaced (Region of Waterloo, 2006). By 2005, the Region had distributed over 40,000 rebates (Region of Waterloo, 2006). These rebates will be offered until at least 2015, but the quantity available will gradually decline from 4000 in 2007 to 2400 by 2015 (Region of Waterloo, 2007). A family of three might save about $92 per year on water charges by using lower-flush toilets, and up to 52,000 litres of water (Region of Waterloo, 2007). By 2015, the Region estimates it will be saving 4,261,000 litres per day as a result of these rebates (Region of Waterloo, 2006).

Xeriscaping

Xeriscaping, sometimes referred to as naturescaping, is a drought-friendly form of landscaping that requires little water to maintain, and can be used in addition to, or as a replacement for, grass. Two demonstration sites in the Region of Waterloo provide examples of how this can be done. Both sites are located in Kitchener: one at the Greenbrook Pumping Station, and the other at the Regional Headquarters (Region of

Waterloo, 2007). The objective is to show homeowners that xeriscaping can be suited to individual needs, and various options are available, including plants, flowers, shrubs, and rocks. Additionally, annual xeriscaping seminars and landscaping contests are held, and an educational DVD helps the promotion of xeriscaping (Region of Waterloo, 2006).

The Greenbrook Demonstration Gardens were planted in 1996 with four zones: Woodland Garden, Mixed Woodland Garden, Prairie Garden, and Rock Garden. The two woodland gardens exhibit plants that are ideal for local rainfall patterns and soil types, and can be used on sloping land or underneath trees (Region of Waterloo, 2005). The prairie garden contains grasses and plants native to the Region (Region of Waterloo, 2005). The rock garden contains rocks and plants found near Ontario shorelines and can be sustained on rainfall alone (Region of Waterloo, 2005). In addition to these four themed gardens, 8 demonstration plots further illustrate the various options naturescaping provides, including: Aromatic Garden, Butterfly Garden, Sun Garden, Ornamental Grass Garden, Daylily Garden, and three kinds of Groundcover Gardens (Region of Waterloo, 2005).

The Regional Headquarters xeriscaping plots were created in 2004 with three zones: Conservative Zone, Transition Zone, and Meadow Zone (Region of Waterloo, 2005). The conservative zone is made of non-native plants and is ideal for residents

who are not avid gardeners (Region of Waterloo, 2005). The transition zone contains both native and non-native plants and is meant to appeal to residents with some knowledge of gardening, and who would like a more 'wild' appearance to their garden (Region of Waterloo, 2005). Lastly, the meadow zone is made of native plants and is aimed at more experienced gardeners who may wish to incorporate local ecology into their garden (Region of Waterloo, 2005).

Water Use Restrictions

There are three stages of watering restrictions in the Region of Waterloo. At stage one, residents must water according to odd-even rules; odd numbered houses watering on odd numbered days, and even numbered houses watering on even numbered days (Region of Waterloo, 2007). Watering with a hose or sprinkler is only allowed between the hours of 7 a.m. and 10 a.m. in the morning, and 7 p.m. and 11 p.m. in the evening. In May 1990, a by-law in the City of Waterloo made these restrictions permanent (City of Waterloo, 2007).

At stage two, residents are restricted to watering once per week, on a day assigned by the last digit in the address (Region of Waterloo, 2007). Regulations for washing cars and filling swimming pools are also present. In August 2004, five wells were closed due to high levels of the chemical dioxane (Burtt, 2005c). As a result, in the summer of 2005, stage two restrictions were temporarily implemented from May 31 –

September 30, 2005. In March 2007, regional councilors voted to make these restrictions permanent, even after the wells were up and running (Outhit, 2007c). This new by-law applies to all those in the Region serviced by a municipal or rural supply system. Officials estimate that summer water use has decreased 8.5% or 20 million litres as a result of watering restrictions introduced in 2005 (*The Record*, 2007c).

At stage three, all outdoor water use activities are restricted, with the exception of watering gardens with a watering can (Region of Waterloo, 2007).

Municipalities enforce these rules, issuing tickets during stage two and three offences (Region of Waterloo, 2007). While most people do comply with the laws, 504 residents and businesses were given warnings in the two summers of 2005 and 2006 for watering too frequently; three residents and two businesses received fines ranging from $150 to $250 (Outhit, 2007b).

4.7 SOFT PATH

Education

Public education is used to show residents the benefits of conserving water. For example, public information sessions held at local shopping malls illustrate current and future initiatives, and encourage the public to provide feedback to the Region. When the Water Efficiency Master Plan was in its research stage, resident surveys were conducted, focus groups were organized, and three open houses were held. Residents

were asked for their input on possible conservation measures, and to rate their level of preferred aggressiveness (Region of Waterloo, 2006).

Publications are another way to inform residents about important issues in the Region of Waterloo. Environews, published by the Region, is delivered to residents in the mail at least twice per year, in the fall and spring. Its goal is to help increase awareness about key issues concerning the environment, with water often as a focus. For instance, when the WEMP was developed, Environews noted its goal of conserving 1.8 million litres of water per day through conservation (Environews, 2006). Environews has been used in the past to notify residents of the summer watering schedule, discuss the benefits of naturescaping, and promote both subsidized rain barrels and low-flush toilets (Environews, 2006).

The Record is also used to convey important and current information, keeping residents up-to-date with water concerns. Furthermore, the Region of Waterloo website presents an extensive section on water conservation, highlighting how to save water in one's home, and the importance of doing so. It is estimated that general education programs contribute to a three percent reduction per capita in water use in the Region (Region of Waterloo, 2006).

For children, water education has been added to grades two and eight curricula in both the public and separate school boards. Although the program does align with

provincial requirements, it is unique to the Region of Waterloo and local school boards. Students learn "what water is, how water cycles through the environment, how to save water, its many uses and how to preserve it for future generations" (Region of Waterloo, 2007). Teachers can request that a representative visit their classroom to discuss water efficiency (Region of Waterloo, 2007). Seven presentations are available for schools or community groups: General Water Efficiency, Toilet Replacement Program, General Water Services, Water Protection, Water Efficiency for the Industrial, Commercial and Institutional (ICI) Sector, and Naturescaping (Region of Waterloo, 2007). Presentations range in length from 10-45 minutes.

Rain Barrels

Rain barrels collect rainwater flowing through eaves troughs for use at a later time, reducing the amount of drinking quality water that is used on lawns and gardens. Less water is wasted because the use of a sprinkler can be eliminated. It is estimated that 1200 litres of water are saved each year per barrel (Region of Waterloo, 2006).

In 2001, the Region of Waterloo began subsidizing the cost of rain barrels in an effort to distribute them widely across the Region. Residents were limited to one rain barrel per household, and by 2007, 28 000 rain barrels had been sold at the subsidized price of $30 each (Region of Waterloo, 2007). A limited number of barrels are available each year at the subsidized rate, and the number of barrels available in 2007 was sold

out (Region of Waterloo, 2007). In 2007, 3000 rain barrels were distributed on one day in the spring from local malls. In addition, 35 rain barrels were given away free of charge, as part of a draw published in Environews.

4.8 SUPPLY MANAGEMENT

The Region of Waterloo has had a municipal supply system since 1899 (Region of Waterloo 2007). In 2007, the Region supplied water to five areas: Kitchener, Waterloo, Cambridge, Elmira, St. Jacobs; Baden, New Hamburg; Ayr; Wellesley; and St. Clements (Region of Waterloo, 2007). In 2007, 80% of the Region's water was groundwater extracted from over 100 local wells, and 20% was surface water taken from the Grand River (Region of Waterloo, 2007).

The water supply system in the Region of Waterloo is under stress and it is questionable whether current supplies will be able to support the increase in demand that might accompany population growth. In the summer of 2005, peak water demand was nearly equal to the system's supply capacity (Swayze, 2005). In 2005, the Region had peak capacity to supply 227 million litres of water per day; three summers between 1998 and 2004 saw demand exceed this, forcing the Region to draw on limited water reserves (Outhit, 2005a). Councillor Geoff Lorentz is doubtful that there is enough resilience built into the current system (Outhit, 2005a).

In 1991, the Region began research for a Long Term Water Strategy (LTWS), and this was adopted in 2000 (Region of Waterloo, 2007). Its purpose was to ensure satisfactory water supplies until at least 2041. By increasing the capacity of the system, the Region is attempting to increase the buffer between available water supply and peak demand (Swayze, 2005).

Many variables were considered when creating the LTWS, including, "population projections, water demands, and water efficiency initiatives... water quality, quantity, reliability, environmental impacts and costs for a number of water supply options" (Region of Waterloo, 2000). There were 33 options that the strategy considered; these were narrowed down to 16 and then further evaluated (Region of Waterloo, 2000). From this, a Strategic Plan was created that attempts to increase supply by planning a new aquifer storage and recovery (ASR) facility, seeking new groundwater sources, and constructing a water pipeline (Region of Waterloo, 2007).

The ASR facility would supplement the supply by about 19 million litres per day, and new groundwater sources would add between 11 million and 19 million litres per day (Region of Waterloo, 2000). The noted advantages of the ASR and groundwater options are the low cost of $26 million for both, the reliable and secure supply, and its sustainability over time (Region of Waterloo, 2000).

The pipeline option would transfer water from Lake Erie to the Region of Waterloo starting in 2035, or sooner if necessary, and provide a significantly increased supply. Estimates are that this pipeline would be able to offer an extra 105 million litres of water per day to the Region (Region of Waterloo, 2007). To put this in perspective, water demand in 2007 was about 197 million litres per day, and the capacity of the water supply system was about 235 million litres per day (Region of Waterloo, 2000). In 2041, the projected demand is 250 million litres per day (Region of Waterloo, 2000).

Advantages of the pipeline option also include its reliable and secure supply, in addition to softer water and a low environmental impact (Region of Waterloo, 2000). The cost of constructing a pipeline to Lake Erie in 1999 was calculated to be $467 million (Region of Waterloo, 2000). Perceived advantages will be discussed in detail in Chapter Five.

4.9 SUMMARY

The Region of Waterloo expects substantial population and economic growth within the next 20 years, which will undoubtedly strain existing water resources. Multiple levels of governance are involved in the protection and management of water resources. These include the Region of Waterloo, the City of Waterloo, the Grand River Conservation Authority, the Ontario Ministry of the Environment, the Ontario Ministry of Natural Resources, the Ontario Ministry of Agriculture, Food and Rural Affairs, and

Environment Canada. Multiple stakeholders provide both opportunities and challenges to the management of water resources.

The Region of Waterloo has combined three management approaches to ensure residents have reliable access to safe water. Demand management and soft path approaches attempt to reduce the amount of water consumed through efficient appliances, xeriscaping, rain barrels, and education. A by-law and price increases influence the amount of water used. Supply management, on the other hand, attempts to ensure an adequate quantity of water is available to the public through using new sources, and therefore a pipeline may be constructed to address anticipated demand growth and associated shortages of water. Table 4.9.1 illustrates components of supply management, demand management, and soft path, and indicates which ones the Region of Waterloo currently uses, or plans to use, in the future.

Management Component	Currently used by the Region of Waterloo	Planned to be added in the future
Ground Water	Yes	
Surface water	Yes	
Aquifer Storage and Recovery	Yes	
Pipeline	No	Yes
Increased Pricing	Yes	
Tiered Pricing	No	No
Quotas	No	No
Toilet Replacement	Yes	
Xeriscaping	Yes	
Outdoor Water Use Restrictions	Yes	
Leak Reduction	Yes	
Gray Water	No	No
Rain Barrels	Yes	
Education	Yes	
Backcasting	No	No
Community Involvement	Yes	

Table 4.9.1: Supply management, demand management, and soft path components, and their usage in the Region of Waterloo

CHAPTER FIVE: FINDINGS AND ANALYSIS

5.1 OVERVIEW

The research questions being investigated, as indicated in Chapter One, are as follows: (1) How do Waterloo residents perceive the region's current water supply? (2) How do their actions related to water use reflect these perceptions about water supply arrangements? (3) How might perceptions change when a pipeline is constructed to Lake Erie? (4) To what extent might this pipeline encourage consumptive rather than conservation behaviour?

A questionnaire was developed to address these questions. The questionnaire contained four sections: Water Supply, Water Habits, Pipeline, and Demographic Information. The Water Supply section aimed to understand how residents perceived the Region of Waterloo's current water supply. This section is directly related to the first research objective, and questioned respondents about the region's current water supply.

The Water Habits section obtained information about personal habits and attitudes towards water conservation within the Region of Waterloo. This section aligns with the second research objective.

The Pipeline section questioned residents' knowledge about the proposed pipeline and asked how they felt it might affect them personally, as well as the Region

of Waterloo. This section correlates with the third and fourth research objectives, and although speculative, offers valuable insight to the changes that might occur in the future.

The Demographic Information section recorded personal information to facilitate connections between demographic variables and attitudes towards conservation. Respondents who did not complete this latter section were not included in the chi-square analysis. Demographic information will be presented here first, followed by discussions of the water supply in the Region of Waterloo, water conservation attitudes and habits, and the Lake Erie proposed pipeline. Information obtained through in-depth expert interviews and newspaper analysis is included in these sections as they complement the questionnaire findings.

Chi-square was applied to all multiple-choice questions, excluding the demographic information section, to determine significant relationships between the demographic variables and the questions asked. In the sections that follow, only significant relationships, based on a significance level of 0.05, will be discussed. Significance levels for each question will not be identified, and as a result should not be viewed as more or less significant than another. Each significant finding, then, has at least a 95% likelihood of being true, based on the chosen significance level. Possible relationships will also be identified when chi-square requirements were not met.

5.2 CHARACTERISTICS OF RESPONDENTS

This segment of the questionnaire was crucial to completing the chi-square analysis in order to determine whether gender, age, income, and education contribute to various perceptions or behaviours regarding water conservation. One hundred fifty-one questionnaires were used in the analysis. However, some respondents opted not to complete this section, resulting in chi-square totals of less than 151, depending on the variable.

Figure 5.2.1 shows that 142 respondents indicated gender. Sixty-five respondents were female, 69 were male, and in 8 cases both a male and female completed the questionnaire together. Questionnaires completed by both a male and female were not included in the chi-square analysis.

One hundred forty-eight respondents reported their age category (Figure 5.2.2). There was not an even balance among each of the four age categories: 18 to 24, 25 to 44, 45-64, and 65 plus. Over half (51%) of the respondents were between the ages of 45 and 64. For chi-square analysis, age categories were combined to create two new categories: 18 to 44, and 45 plus. The older age group had larger representation than the younger age group: 104 and 44 respondents, respectively. Although not evenly balanced, groups were large enough to complete the chi-square analysis.

One hundred thirty-five respondents indicated income (Figure 5.2.3). Nine initial income categories were combined into three new categories to meet chi-square requirements. Categories relate to this study only, and were not based on national or provincial categories. The lower-income category includes up to $59,999, the middle-income category ranges from $60,000 to $119,999, and the higher-income category is $120,000 and above. There were 38, 63, and 34 respondents in the respective categories.

Figure 5.2.4 depicts highest level of education, as indicated by 147 respondents: 11 did not complete high school, 27 completed high school only, 66 completed post-secondary college or university, and 43 completed post-graduate college or university. These four categories were combined into two for chi-square analysis: completed no more than high school, and completed at least post-secondary college or university. Minimum requirements for chi-square were not always met because of the large difference in numbers in the two groups: the less educated group had 38 respondents, while the more educated group had 109. Additional relationships may have been apparent if the categories had been more evenly balanced.

Figure 5.2.5 illustrates environmental education, both formal and non-formal. The term was used to include any way a respondent might obtain information about the environment. Respondents could choose from 11 options and answer as many as applicable; responses totaled 466. Options included: none, high school courses only,

college or university electives, college or university major, post-graduate college or university electives, post-graduate college or university major, work-related experience, volunteer experience, television, books, newspaper, and other. The most cited sources were television, newspaper, and books (269 responses). The least chosen sources were post-graduate college or university electives or majors (9 responses). Twenty-four respondents claimed to have no environmental education of any kind.

As depicted in Figure 5.2.6, 133 of 146 homes (91%) were built between 1960 and 1989. Seven homes were built before 1960, and 6 were built in 1990 or later. Sixty-five of 147 respondents lived in a two-person household, 22 in a three-person household, 26 in a four-person household, 16 in a more than four person household, and 18 lived alone.

Since homeowners were targeted, and there was no adequate way to determine ownership before distribution of the questionnaire, respondents were asked to indicate whether they owned or rented their home, and if they rented, whether or not they paid their own utility bills. The disadvantage to surveying renters is that they often do not pay their own utility bills and therefore are likely to have different attitudes towards conservation compared to owners. An overwhelming majority of respondents (95%) owned their home, and of the 7 renters only two did not pay their own utility bills. All were included in the analysis.

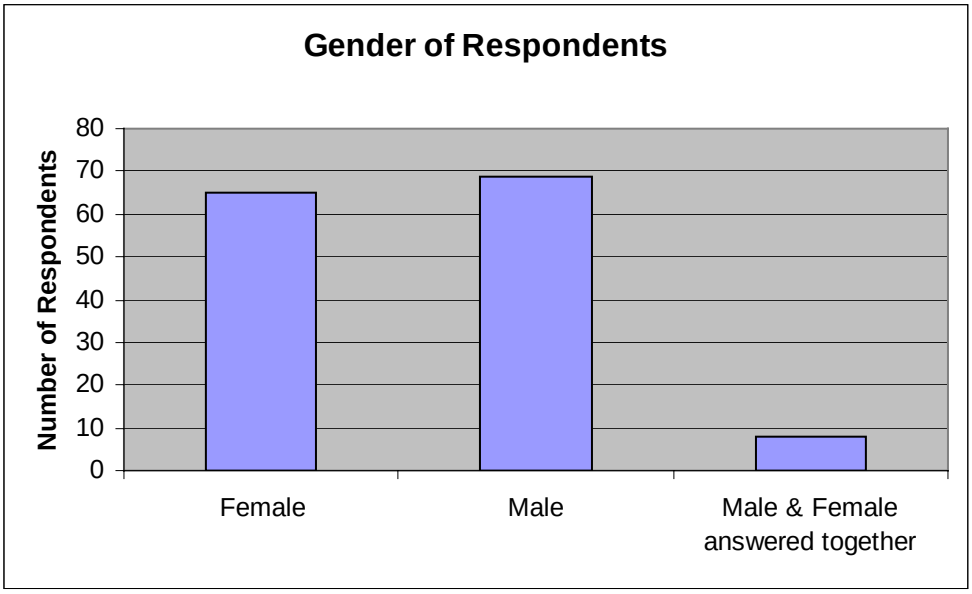


Figure 5.2.1: Respondents' gender

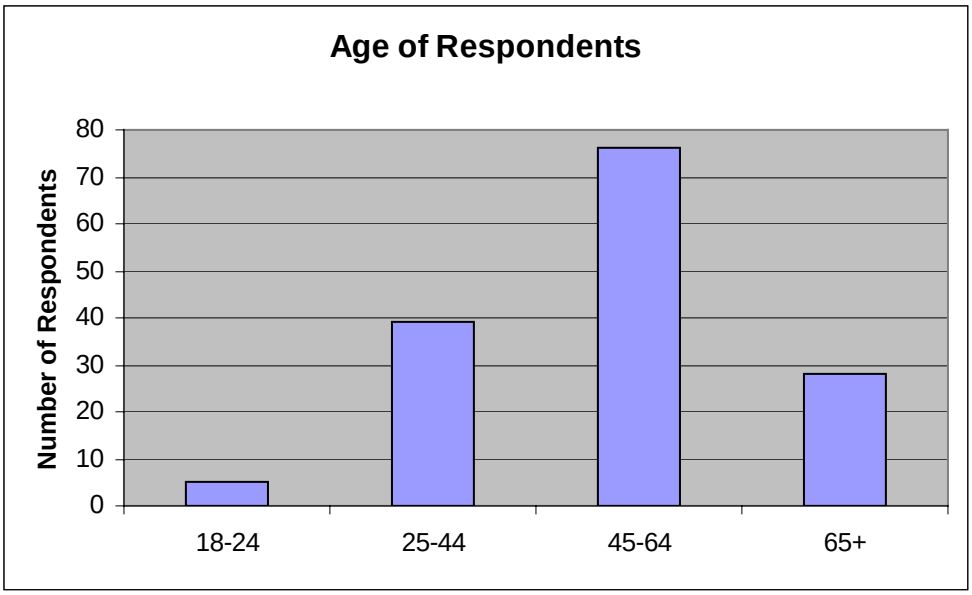


Figure 5.2.2: Respondents' age

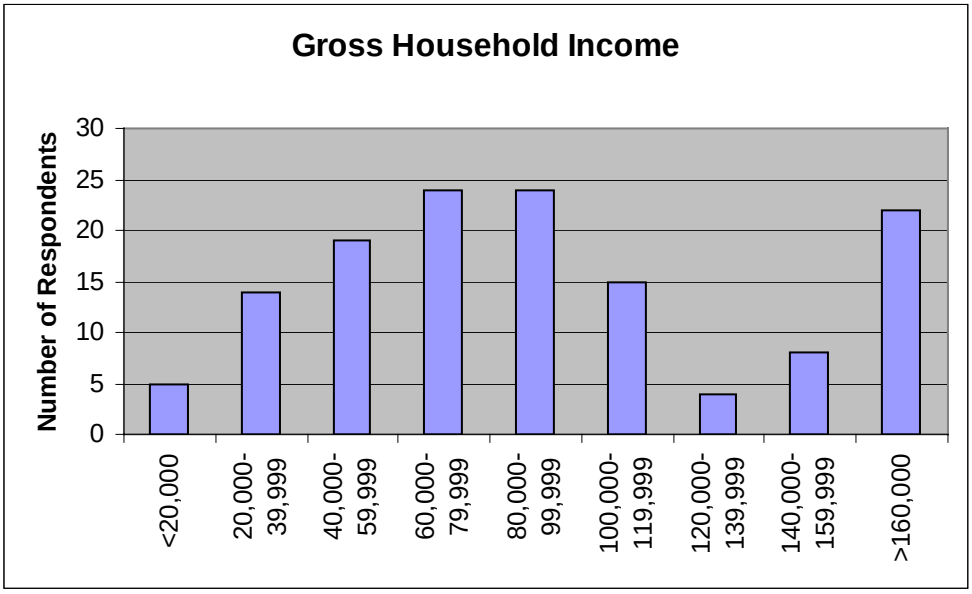


Figure 5.2.3: Respondents' gross household income

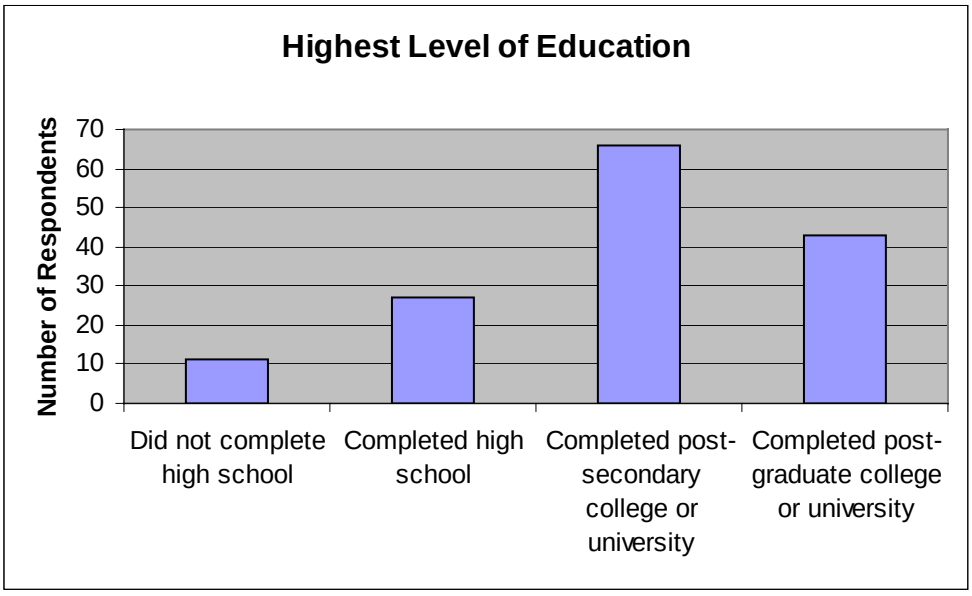


Figure 5.2.4: Respondent's highest level of education

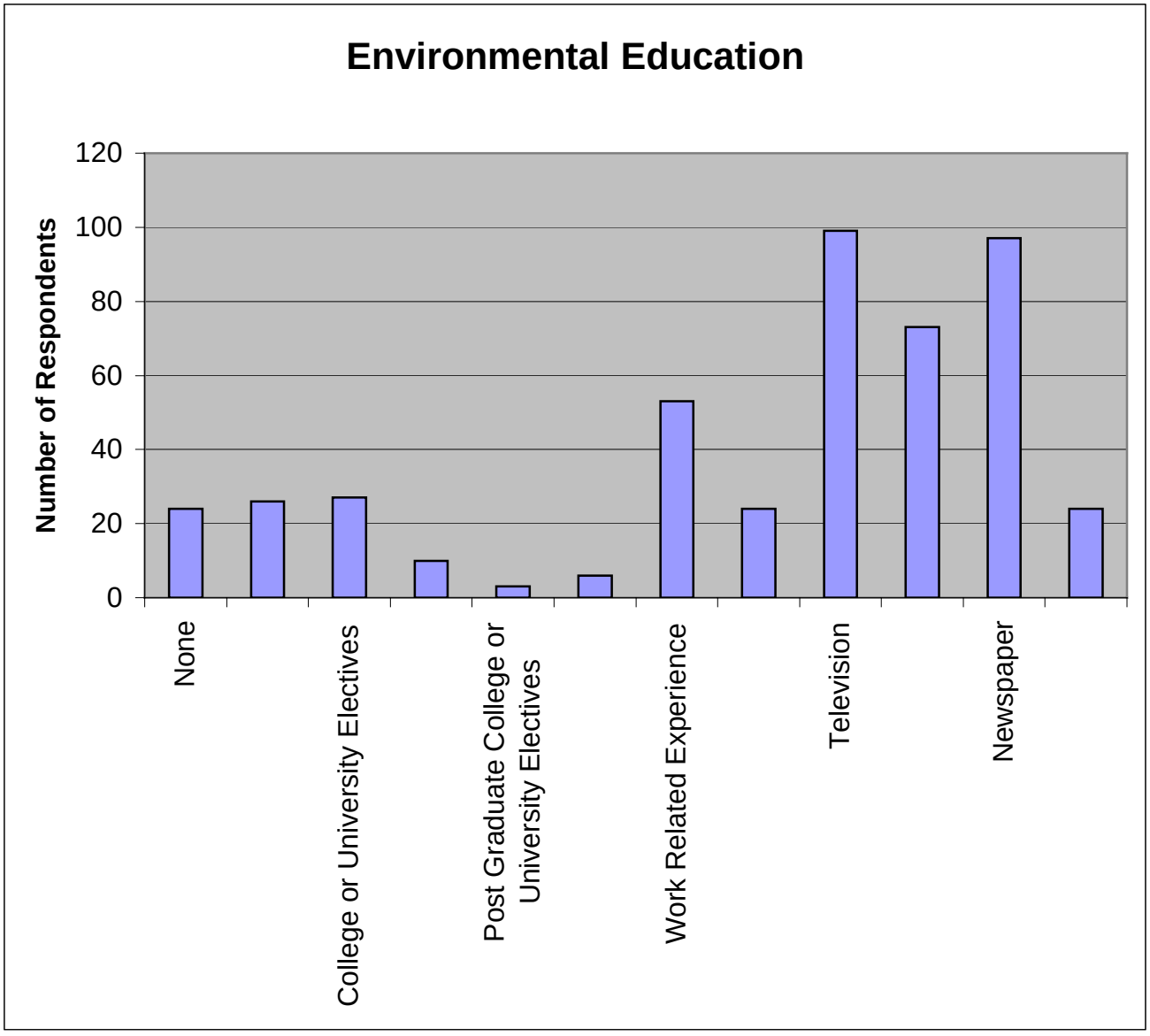


Figure 5.2.5: Respondents' environmental education

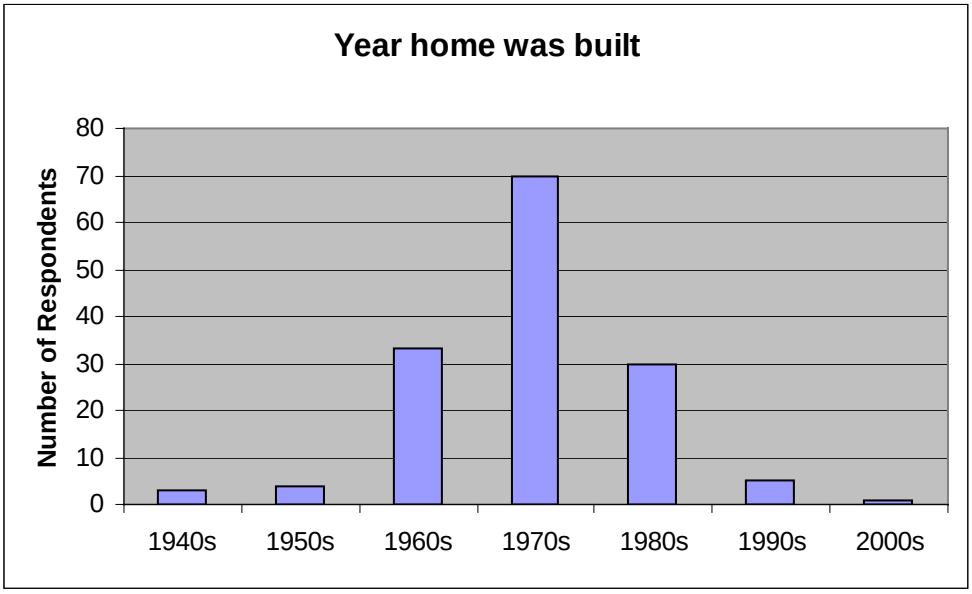


Figure 5.2.6: Year home was built

5.3 WATER SUPPLY IN THE REGION OF WATERLOO

Respondents were asked about the current water supply situation in the Region of Waterloo, as well as their preference for future initiatives.

Adequacy of Supply

Figure 5.3.1 shows that 45% of respondents believe there is an inadequate water supply in the Region of Waterloo, while 33% think the supply is adequate. Chi-square analysis confirms that this belief is related to age; respondents in the older age category were more likely to answer that there is not an adequate water supply (Table 5.3.1). Chi-square is significant, indicating an association between age and belief about adequacy or inadequacy of the water supply. This result may be explained by older respondents being more familiar with water issues concerning the Region, possibly

because they have lived longer in the area and have therefore been more exposed to these types of discussions. Unfortunately, no question about length of residence was included on the questionnaire.

Figure 5.3.2 illustrates that 73% of respondents believe that the Region could someday run out of water. Although minimum requirements for chi-square were not met for this question, Table 5.3.1 indicates a possible relationship with income; respondents in the lowest income bracket were more likely to answer that the Region will never run out of water.

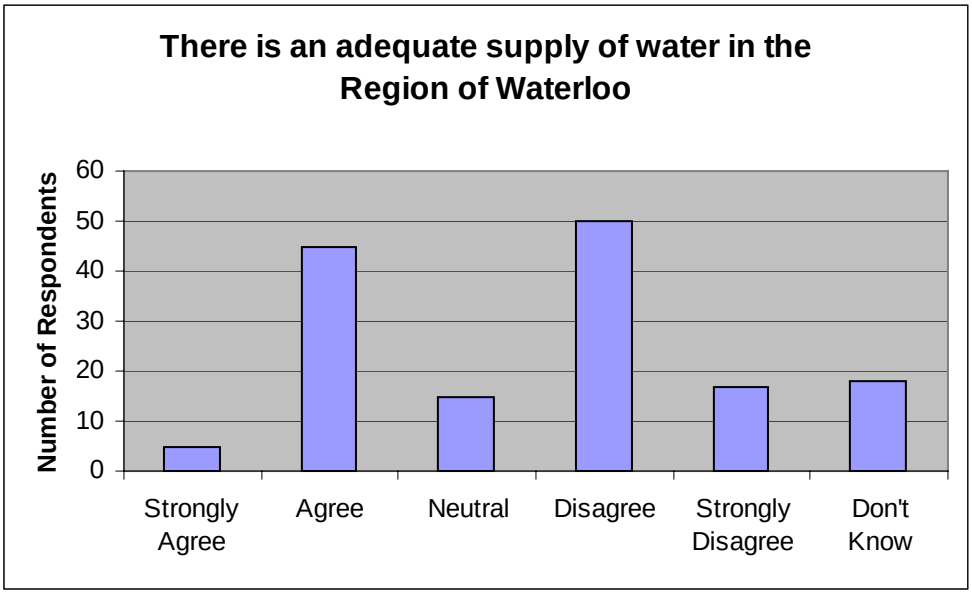


Figure 5.3.1: Adequacy of water supply

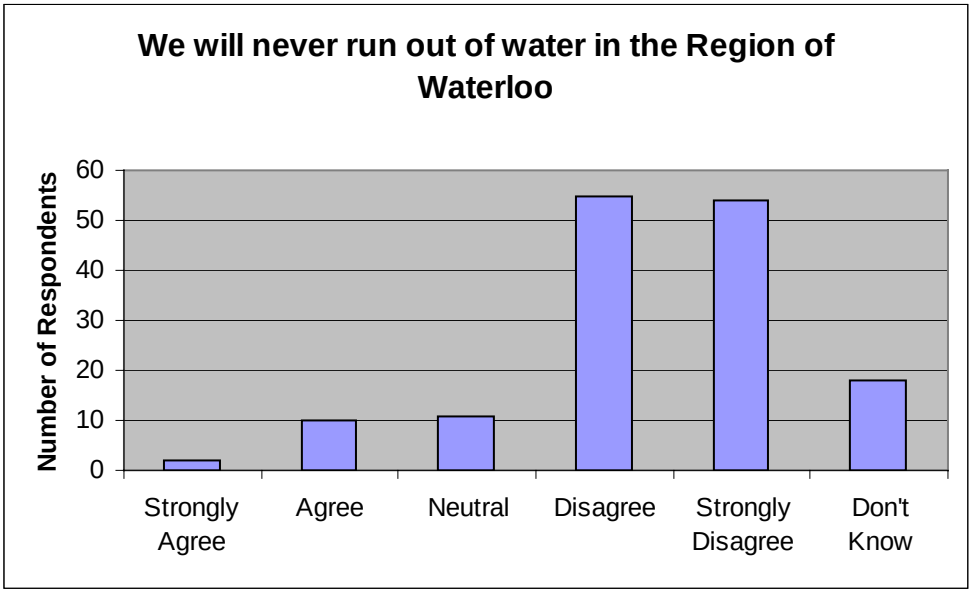


Figure 5.3.2: We will never run out of water

	Agree	Neutral	Disagree	Total
<$20,000-$59,999	7	2	23	32
$60,000-$119,999	3	3	51	57
$120,000+	0	3	27	30
Total	10	8	101	119

Table 5.3.1: We will never run out of water in the Region of Waterloo
Chi-square not valid

The Record has contained much discussion regarding the adequacy of the Region's water supply. According to Dwight Boyd, an engineer at the GRCA, aquifer levels in 2003 were suffering from several years of below average rainfall (Burtt, 2003b), and the fall of 2004 was one of the driest since 1915 (Burtt, 2004b). Philip Weiss, a resident of Kitchener, was concerned about the rapid rate at which the water supply

was diminishing (Weiss, 2004). Levels in streams and rivers in the Region were reported as worrisome in 2005 when levels were "far below normal" because of dry weather (Burtt, 2005a). Elizabeth Crocker, a resident of Kitchener, expressed alarm about the shortage of water (Crocker, 2005). Figures 5.3.3 and 5.3.4 are examples of editorial cartoons that have appeared in the newspaper, making light of the serious water concerns (*The Record*, 2002; 2005f). Despite the attention that water concerns received, some residents were reported to not believe there was, or is, a shortage (Barrick, 2007).

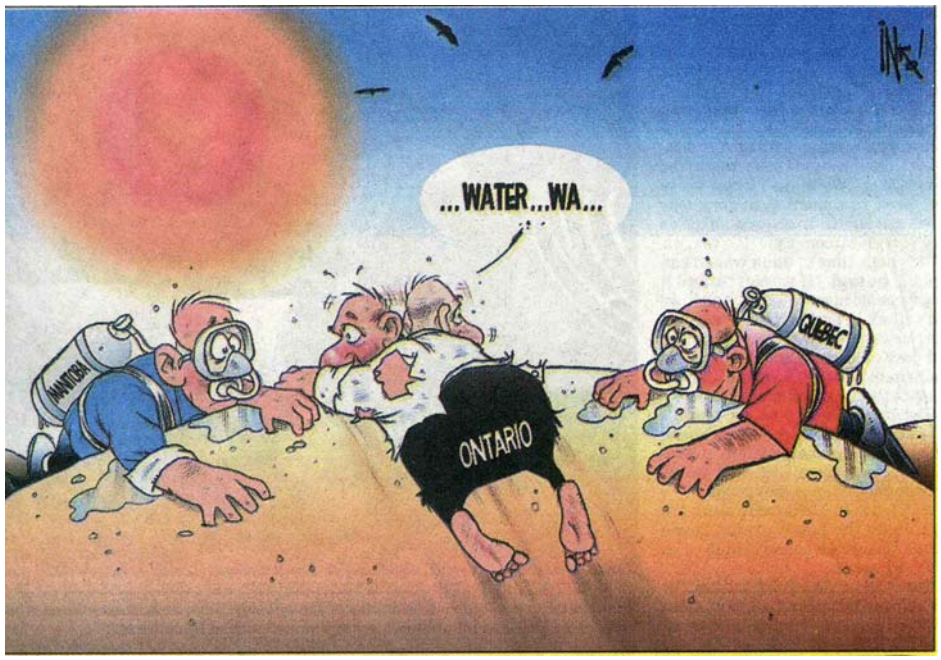


Figure 5.3.3: Editorial cartoon 1

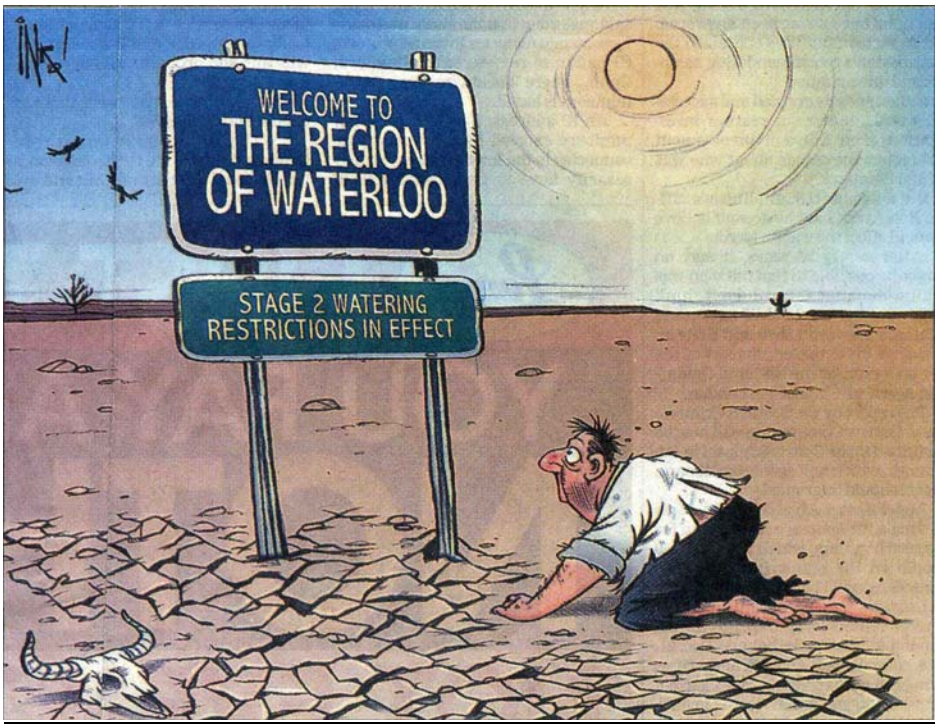


Figure 5.3.4: Editorial cartoon 2

Water Conservation

Figure 5.3.5 shows that 95% of respondents believe water conservation is an important issue in the Region of Waterloo. Because of the high response in only one category, however, chi-square requirements were not met. Most respondents (91%) also believe that their own water use habits have an impact on the Region's water supply (Figure 5.3.6). Again, because of the high response in one category, chi-square could not be applied.

Water conservation is important to the Region of Waterloo for many reasons, according to the media. First, the Region will grow substantially in terms of population over the next 30 years, meaning that water supplies will need to be carefully managed

to ensure enough for the future (Burtt, 2004a). Second, water conservation will help to defer expensive expansions to the water system (Outhit, 2007b). And third, the lack of rainfall in the last decade has lowered water levels in the watershed (Outhit, 2007f).

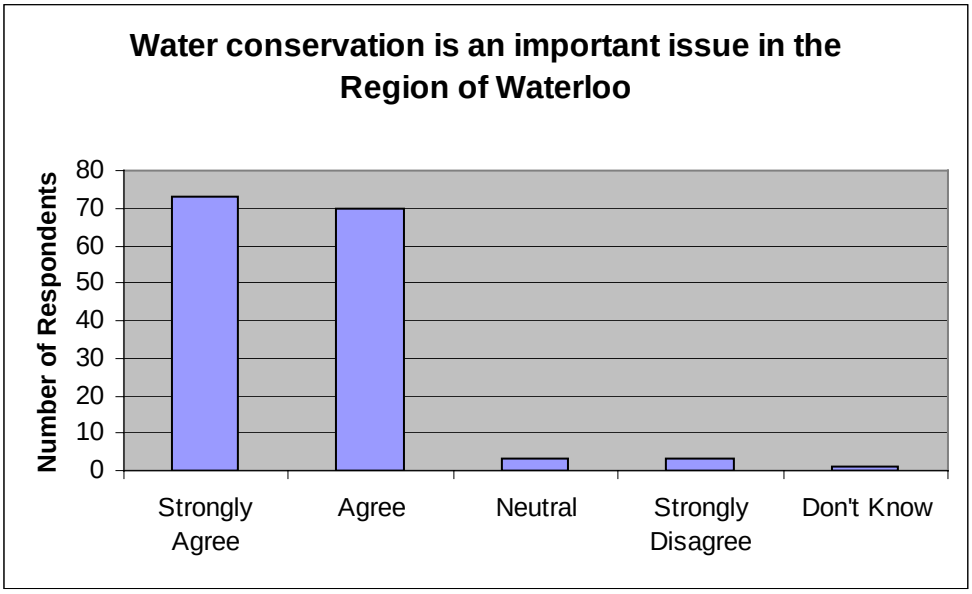


Figure 5.3.5: Importance of water conservation

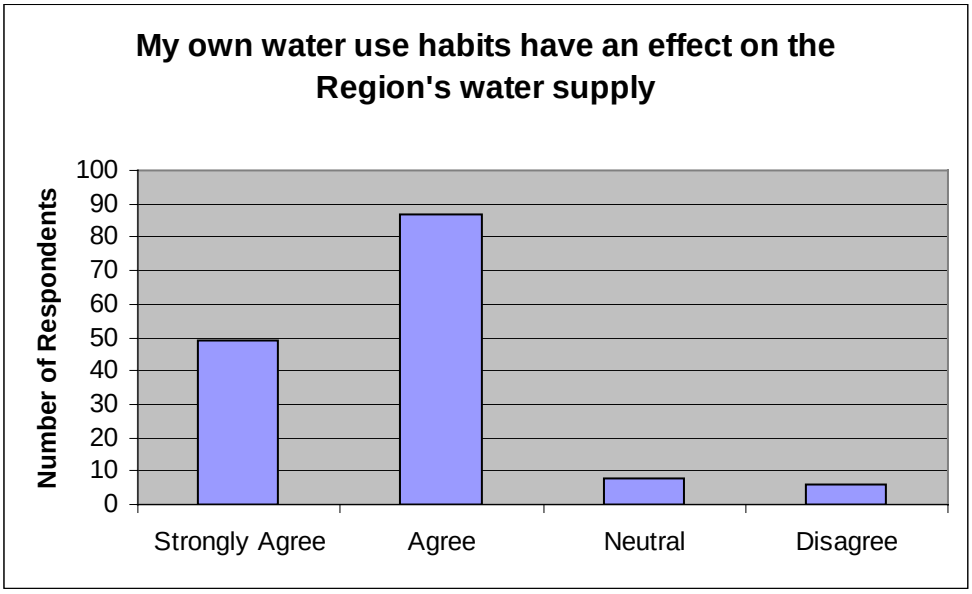


Figure 5.3.6: Effects of own habits

All three cities in the Region have collaborated to save water, especially during times of dry weather. For example, during a shortage in 2003 due to lack of rain, street cleaning and city flower watering was discontinued in Kitchener and Cambridge, and all but three sports fields were not watered (*The Record*, 2003). Not all residents, however, believe that the Region is doing its part to ensure conservation. Krista Stevenson, a resident of Kitchener, complained that the Region wasted water, using the example of a fire truck spraying a high arch of water into the air to salute an airplane (Stevenson, 2007).

Eighty-five percent of respondents believe that water conservation is necessary whether or not there is a limited supply of water (Figure 5.3.7). Requirements for chi-square were, again, not met. However, Table 5.3.2 indicates that a relationship may be present related to income. The lowest income group is more likely than higher income groups to answer that conservation is only necessary in cases of limited water.

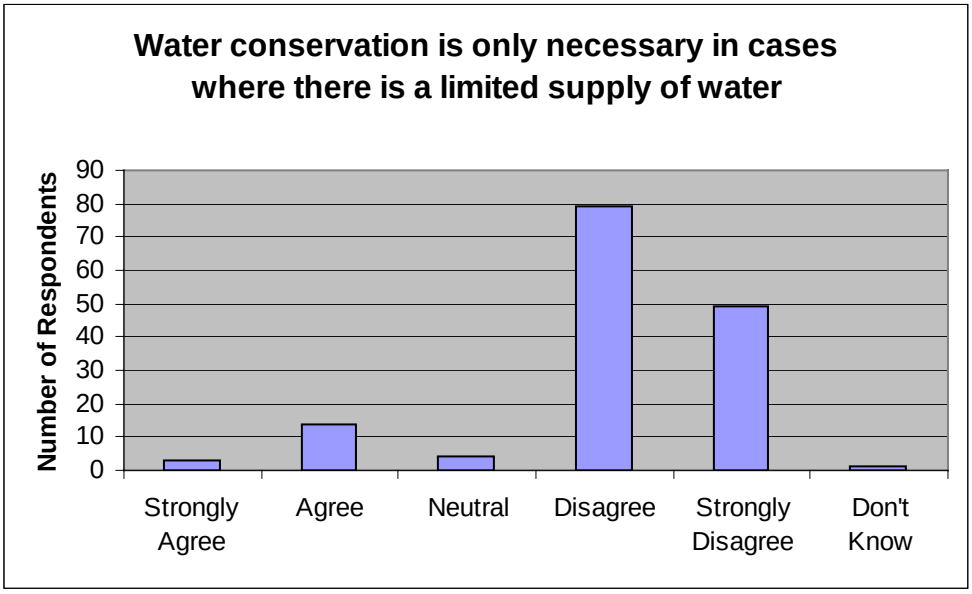


Figure 5.3.7: Conservation only if limited supply

	Agree	Neutral	Disagree	Total
<$20,000-$59,999	9	1	28	38
$60,000-$119,999	4	2	57	63
$120,000+	2	1	31	34
Total	15	4	116	135

Table 5.3.2: Conservation only if limited supply
Chi-square not valid

Access to Water

Sixty-one percent of respondents believe that access to water within the Region should be limited, while 22% believe access should be unlimited (Figure 5.3.8). Chi-square shows that income and education are significant with these beliefs. As income rises over the three levels, so does the belief that access to water should be limited; the

lowest income category had the most support for unlimited access, while the highest income category showed the least support for unlimited access. The same is true for education; the more educated group was more likely to answer that access to water should be limited.

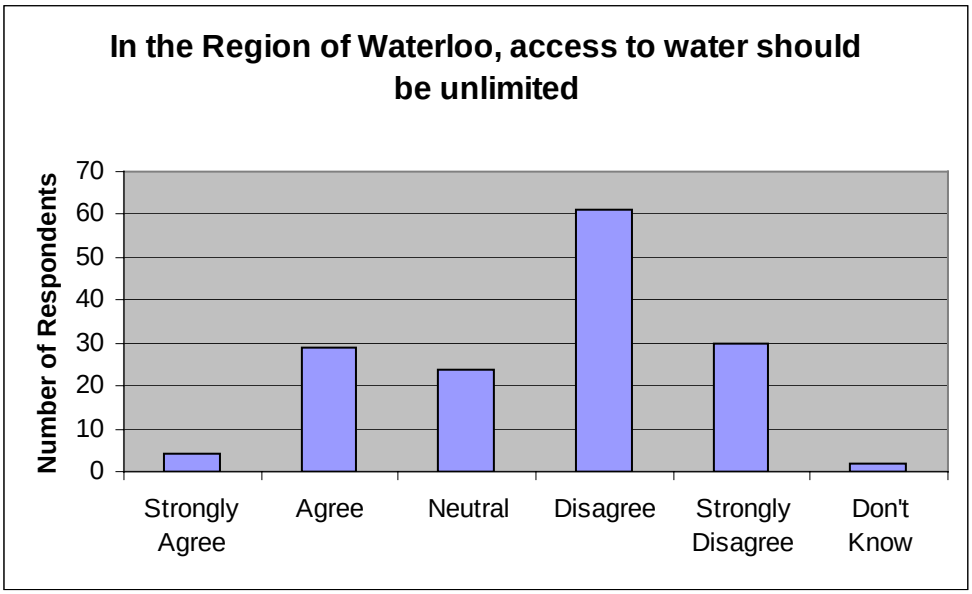


Figure 5.3.8: Access to water

The finding that income is significantly related to conservation is supported by Gilg, Barr and Ford (2005), who found that environmentalists were more likely to have higher incomes than non-environmentalists. Similarly, Gelissen (2007) found that personal income was positively related to environmental support. Jain and Kaur (2006), however, found that while income was positively related to environmental knowledge, it was a poor predictor of environmentally friendly behaviour. On a global scale, there

is a general agreement that water consumption is positively correlated with income. As income rises, so does the ability to consume larger amounts of water.

Carlsson and Johansson-Stenman (2000), and Torgler and Garcia-Valinas (2007), found that higher income individuals were keener to contribute financially to environmental protection. Corresponding with this finding, Sutherland (1994) found that higher income households more frequently participated in energy conservation programs than lower income households, and Lam (2006) found that higher income residents were more likely than lower income residents to retrofit their homes to save water. In contrast, Miller and Buys (2008) found that lower income individuals were more likely to plant drought-resistant plants than those with higher incomes.

Many studies support the finding that more highly educated individuals are more supportive of environmental initiatives (Casey and Scott, 2006; Gelissen, 2007; Raudsepp, 2001). Raudsepp (2001) believes this association may be attributed to the fact that more educated individuals might believe their personal actions could make an impact. Carlsson and Johansson-Stenman (2000) observed that more highly educated individuals were more willing than lower educated individuals to pay for improved air quality programs. Kollmuss and Agyemen (2002) noted that education is positively linked with environmental knowledge; however, education is not always related to behaviour.

In the Region of Waterloo, there has long been a debate about whether access to water should be limited or unlimited. It is clear that the Municipality has determined it should be limited, through its implementation of water restrictions. John Jackson, a resident of Kitchener, faults the Region for not being able to live within nature's ecological limits (Burtt, 2003a). For example, there are residents who did not abide by lawn watering rules in the summer of 2003 (Halma, 2003), and others who complained about not being able to wash their cars as often as they would like in the spring of 2005 (*The Record*, 2005e). Richard Tisdale, a resident of Waterloo, expected high levels of services for the amount of tax dollars he contributed (Tisdale, 2005). Bob Koligiannis, a resident of Kitchener, "shrugs off concerns about groundwater, saying he pays his taxes and utility bills" (Outhit, 2005b).

An anonymous resident of the region praised local government for not wasting tax dollars on unnecessary infrastructure updates (*The Record*, 2005c). Tom Oliverio, a resident of Kitchener, believed that sensible people would realize they have a responsibility to conserve resources (Oliverio, 2005), and Dave Pearson, a resident of Waterloo, stated that there were more important uses for water than keeping lawns green (Pearson, 2007).

Investing for Water Supply

Sixty-three percent of respondents think it is important for the Region of Waterloo to spend money to increase the supply of water (Figure 5.3.9). Chi-square shows that support for spending money to increase the supply is significantly related to age; respondents in the older age category were more likely to support this than those in the younger category. The response for this question is comparable to the response about the inadequate supply of water in the Region, and again, may be related to the length of residence in the area.

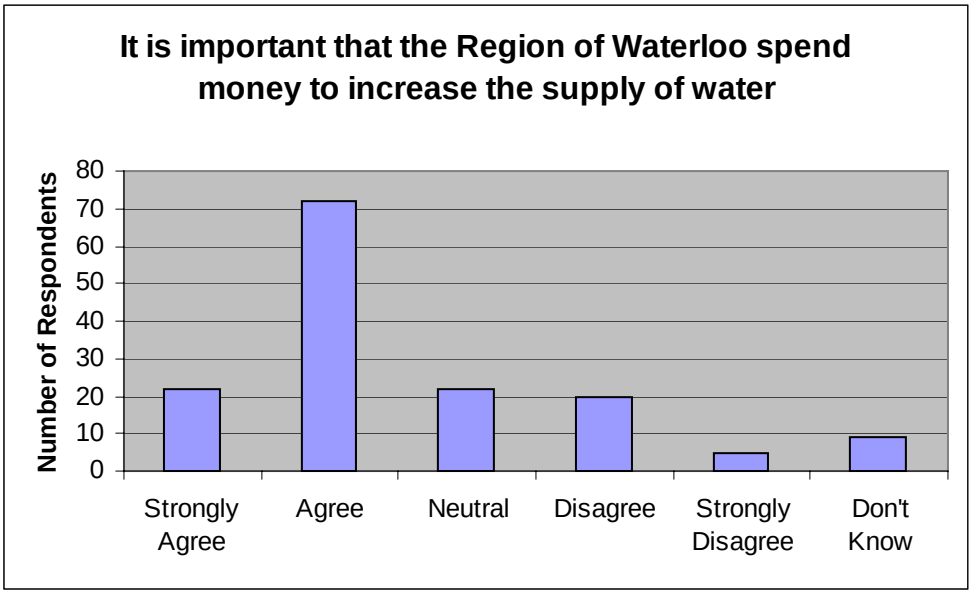


Figure 5.3.9: Increase supply of water

Some studies have found similar results with regard to residents' spending money on initiatives that help the environment. These differ from the present study, however, because they measure the willingness of residents to spend their personal

income rather than already collected tax money. For example, Jain and Kaur (2006) found that younger people were the most enthusiastic group with regard to environmentally friendly products, but were least likely to purchase these. This behaviour may be a result of their inability to spend higher amounts of money on more eco-friendly products (Jain and Kaur, 2006).

Gelissen (2007) found that older age groups were less keen to pay for environmental initiatives than younger age groups. This finding is supported by Carlsson and Johansson-Stenman (2000), who found that retired people were less willing to pay for improved air quality. It is possible that retired people are less willing to pay because they have a lower income than working age groups.

In 1980, Howell and Laska (1992) found that younger people were more likely to spend money for the benefit of the environment. In a subsequent study (1984), however, they found that age was not significant in predicting the amount of money one might spend on the environment.

Seventy-one percent of questionnaire respondents answered the Region should spend money to decrease the demand for water (Figure 5.3.10). Although chi-square requirements were not met, Table 5.3.3 illustrates that a relationship may exist related to income. The higher one's income, the more likely one is to answer that the Region should spend money to decrease the demand for water.

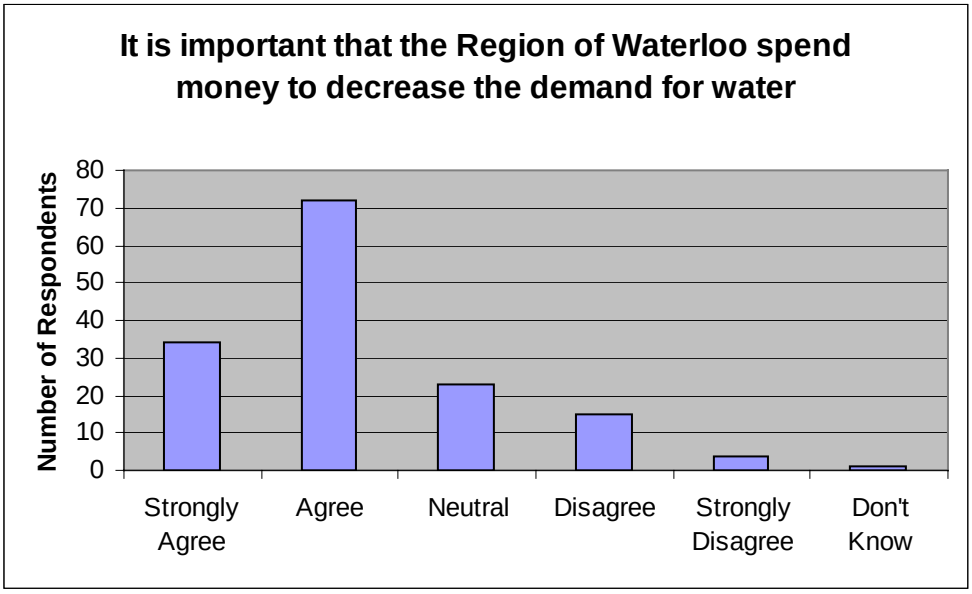


Figure 5.3.10: Decrease demand for water

	Agree	Neutral	Disagree	Total
<$20,000-$59,999	20	7	11	38
$60,000-$119,999	44	11	6	61
$120,000+	31	2	1	34
Total	95	20	18	133

Table 5.3.3: It is important that the Region of Waterloo spend money to decrease the demand for water
Chi-square not valid

Augment Supply or Conservation

Figure 5.3.11 illustrates whether respondents prefer an increase in supply or a decrease in demand. Half (50%) indicate that a combination of both is best, while 34% indicate that decreasing demand is more important, and 13% favour increasing supply. Chi-square is significant with age; younger respondents tend to prefer decreasing

demand, while older respondents prefer a combination of both increasing supply and decreasing demand. Furthermore, chi-square is significant for education. While both groups favour a combination, the less educated group prefers increasing the supply to decreasing the demand, and the more educated group favours the opposite.

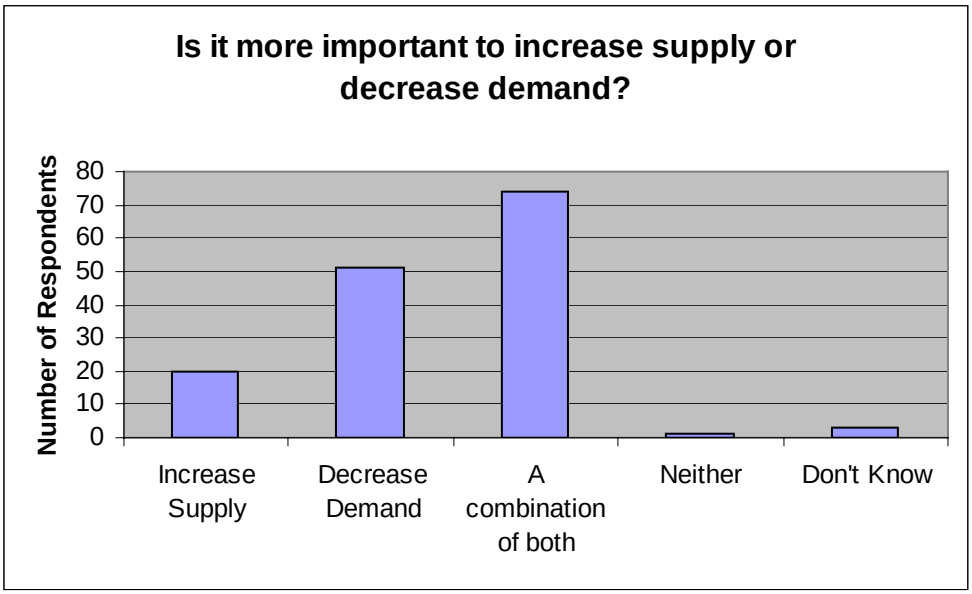


Figure 5.3.11: Increase supply or decrease demand

Several studies find that education is positively linked with pro-environmental behaviour (Gilg, Barr and Ford, 2005; Jain and Kaur, 2006; Tilikidou, 2007; Weigel, 1977). For example, Lam (2006) found that more highly educated individuals were more likely to retrofit their homes to save water than less educated individuals. Some studies also find that education is positively linked with energy conservation (Poortinga, Steg and Vlek, 2004; Stutzman and Green, 1982).

Howell and Laska (1992) found that, over time, education had become the most important indicator of environmental behaviour; in 1980 education was not significant, but by 1988 it was the most significant demographic variable of those tested. In contrast, De Oliver (1999) found that education was only significantly correlated to mandatory conservation measures; voluntary measures produced little change in behaviour.

An anonymous resident of the region was concerned about the flexibility of the water system, since "a five per cent loss of supply is sufficient to merit a consumption crackdown" (*The Record*, 2005b). Also, Councillor Geoff Lorentz expressed worry that there was not enough security built into the water supply system as of 2005 (*Outhit,* 2005a). An anonymous resident of the region noted that people who paid taxes for a water system wanted the luxury of being able to use it at his or her convenience (Outhit, 2005a). These concerns all point towards a need for an increased supply.

Many examples show the need to decrease demand. John Jackson, a resident of the region, believed the water supply to be adequate, but that the Region needed to conserve more aggressively (Burtt, 2003a). Lorrie Minshall, Source Protection Program Director of the GRCA, claimed the region had plenty of water, even for future growth, and the only challenge was its allocation (Burtt, 2004a). Thomas Schmidt, an

environmental commissioner for the Region, commented on the excessive cost of building a larger supply system (Outhit, 2005a).

Information Regarding Water

Question 7 asked respondents to indicate all the ways in which they obtained information about water initiatives, and indicate the most important. Figures 5.3.12, 5.3.13, and 5.3.14 show a breakdown of the responses. Newspapers are the most important, followed by inserts with utility bills, television, other, and lastly, people.

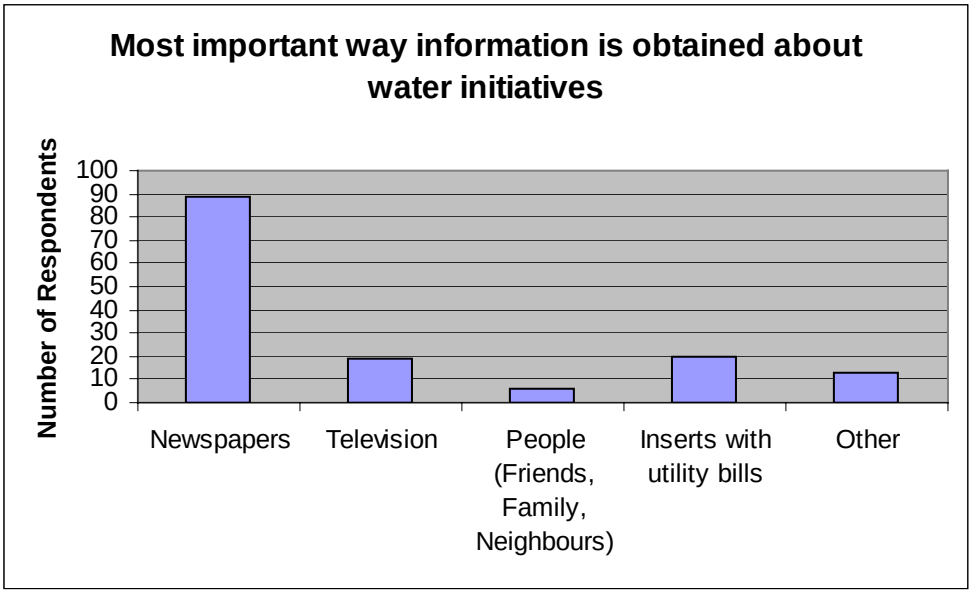


Figure 5.3.12: Most important way to obtain information

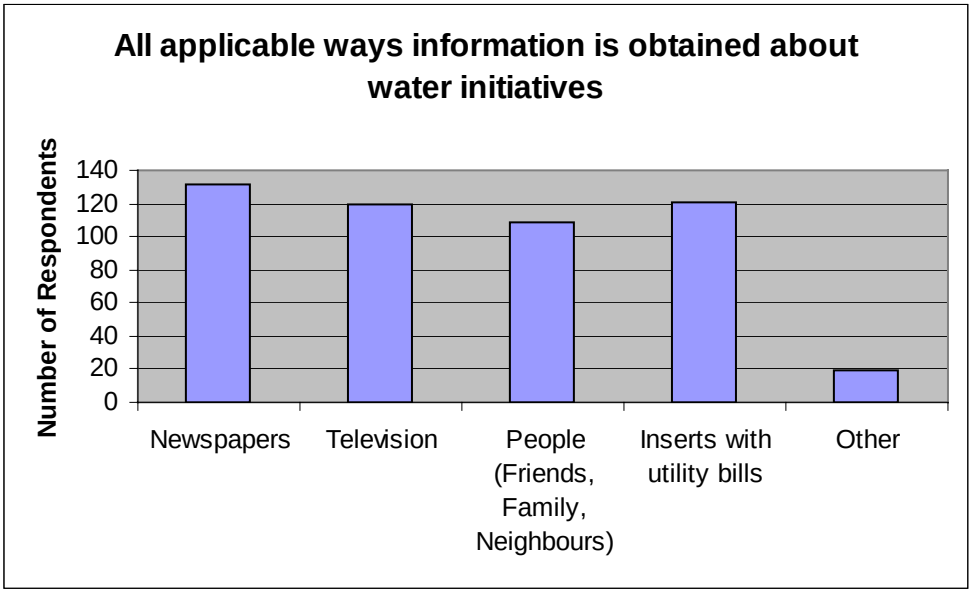


Figure 5.3.13: All applicable ways information is obtained

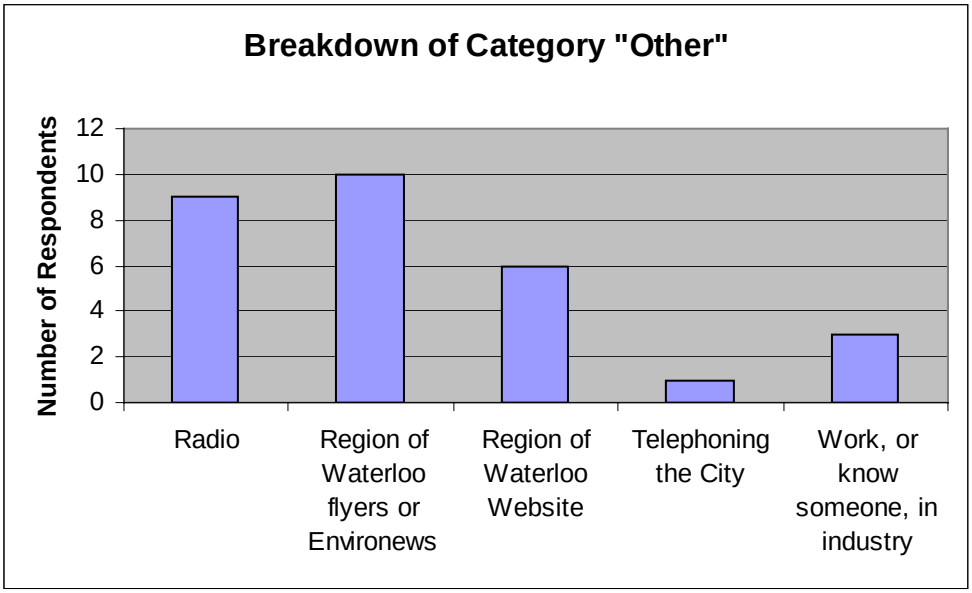


Figure 5.3.14: Breakdown of "other"

Role of Taxes and Water Rates

Figure 5.3.15 shows the amount of a tax increase respondents would support if necessary to increase the water supply in the Region of Waterloo. Thirty-one percent would not support an increase, 29% would support an increase of 0.1-0.3%, and 21% would support 0.4% or more. Chi-square did not show any significant relationships.

As illustrated in Chapter Four, water rates in the Region of Waterloo have risen greatly since 2004. Charlene Hodgson, a resident of the region, was worried about rising water rates, and noted that she already conserved as much water as possible by reusing water from her kitchen on house plants (Hodgson, 2006). Alternately, Clarence Beintema, a resident of Kitchener, was concerned that monthly water bills did not reflect the value of the resource, and compared paying for a bottle of water at Tim Horton's against paying 0.00111 cents per litre of tap water (Beintema, 2006). An anonymous resident of the region pointed out that when considering the vast importance of water, 'high' water charges were still a bargain (*The Record*, 2007a). Another anonymous resident of the region was concerned that without an increase in either supply or cost, there would not be enough water to meet needs in the future (*The Record*, 2006a). One respondent of the questionnaire believed it would be best to "make it clear that the price will keep going up until consumption drops." Another

respondent of the questionnaire noted, "People who have pools, hot tubs, or ponds, should be taxed higher for water usage."

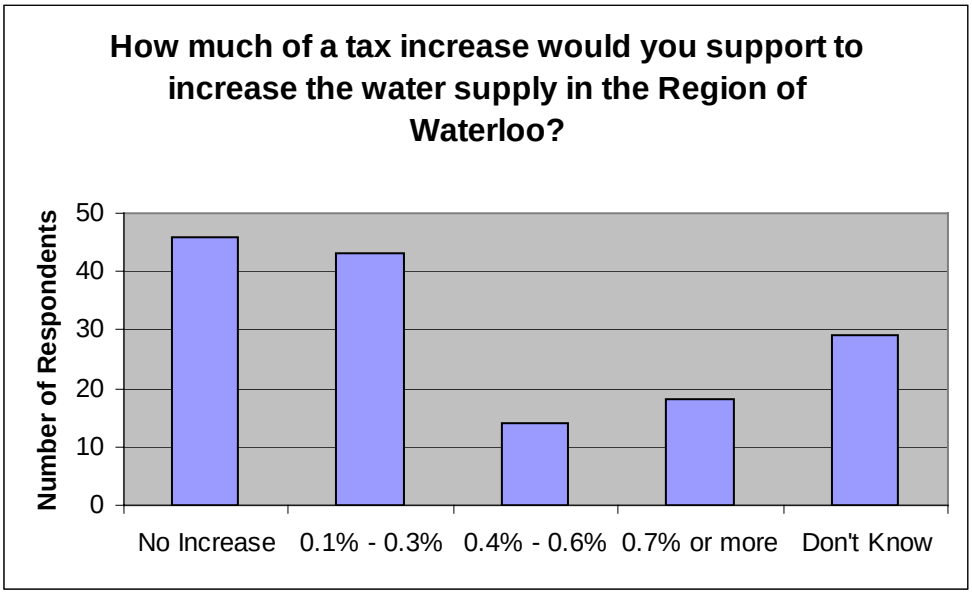


Figure 5.3.15: Supported tax increase

5.4 WATER CONSERVATION ATTITUDES AND HABITS

Respondents were asked about their water conservation attitudes and water use habits; some questions were hypothetical. Most were multiple-choice. However, two required written answers, two had respondents select from a list of options, and two required respondents to look up their last month's water bill.

Conservation Behaviour by Homeowners

Figure 5.4.1 shows that 75% of respondents agree that they actively conserve water year round, while 8% answer that they do not. Chi-square is significant and relates to age. The older age group is more likely than the younger age group to agree

that they do conserve year round. As previously highlighted, conservation behaviour may be explained by length of residence in the region. Or, perhaps the younger population is actively involved with activities that consume more water.

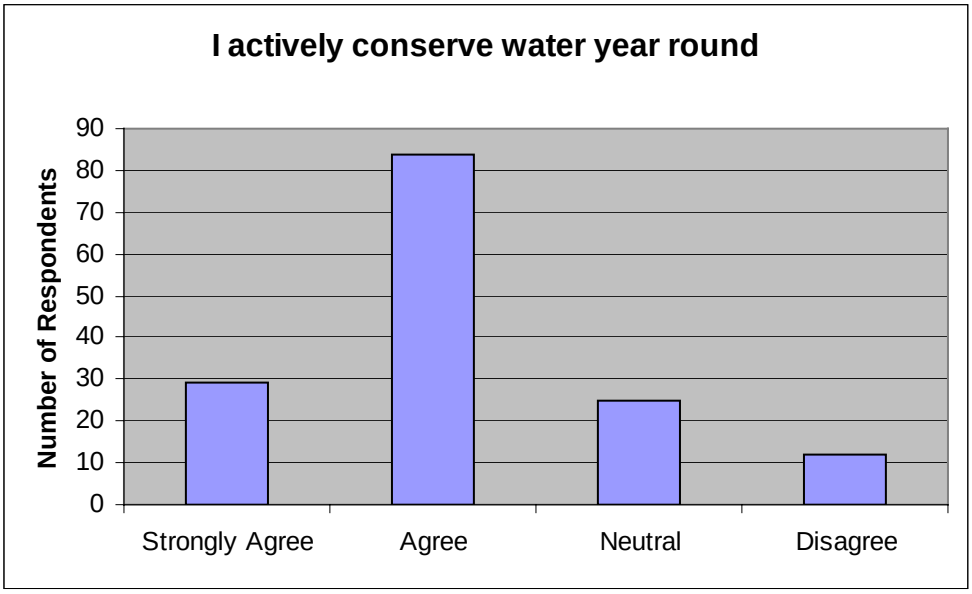


Figure 5.4.1: Conservation of water year round

A study by Casey and Scott (2006) found that older people had a higher frequency of environmentally friendly behaviour; they suggest that this behaviour might be the case because older people tend to be less materialistic. This result supports the finding that the older age group is more likely to conserve water year round.

Willingness to Decrease Water Use

Figure 5.4.2 shows a breakdown of how much respondents claim to be willing to decrease current water use if necessary. More than half (52%) answer that they would

decrease water use by up to 10%. Chi-square is not valid for any tests of relationship because numbers are too low in the upper category of 31% or more. However, all variables indicate a possible relationship.

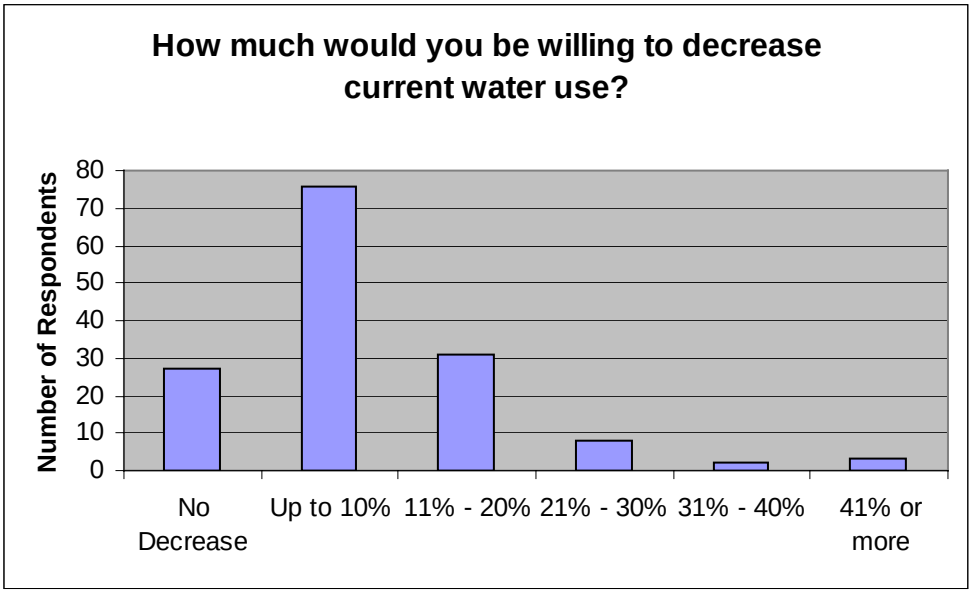


Figure 5.4.2: Willingness to decrease water use

Table 5.4.1 indicates that females may be more willing to conserve larger amounts of water than males. This finding is supported by a large literature. Raudsepp (2001) found that females were more likely than males to be concerned about environmental issues, and Casey and Scott (2006) found that females had a higher frequency of pro-environmental behaviours. Gilg, Barr and Ford (2005) found that females tended to be more environmentally active than males, and suggested that this female behaviour might be due to gender role expectations. Similarly, Barr (2003) found that females were more likely to reduce their waste than males, and suggested

that this behaviour might be due to the fact that females may have more opportunity to do so through household activities such as shopping. Likewise, Jain and Kaur (2006) found that females were more apt to search for environmentally friendly products than males, and they were also more frequently involved in environmentally friendly behaviours. Hunter, Hatch and Johnson (2004) found that women participate more frequently than men in environmentally friendly practices in the private sphere, including recyling and driving less.

	Up to 10%	11% - 30%	31% or more	Total
Female	39	22	3	64
Male	51	16	1	68
Total	90	38	4	132

Table 5.4.1: Willingness to conserve by gender
Chi-square not valid

Some literature, however, does not find that women engage more in environmentally friendly behaviour than men. For example, Carlsson and Johansson-Stenman (2000) found that men were more willing to pay for environmental initiatives than were women. Also, Domene and Sauri (2006) found that females used more water in the home for personal hygiene, hand washing, and toilet flushing.

Table 5.4.2 illustrates that younger respondents may be more willing to conserve compared to older respondents. This finding is supported by Lilienfeld and Asmild (2007), who found that younger farmers used less water on their farms than older farmers. Similarly, York (2007) found that communities with larger proportions of people over 65 years of age tended to have higher energy consumption than areas with lower proportions of this age group.

	Up to 10%	11% - 30%	31% or more	Total
18-44	23	18	3	44
45+	78	21	2	101
Total	101	39	5	145

Table 5.4.2: Willingness to conserve by age
Chi-square not valid

Some studies have found the opposite effect: older people tend to be more likely to engage in environmentally friendly behaviours than younger people. For example, Domene and Sauri (2006) found that older people tended to conserve more water than younger people. Chermak and Krause (2001) found that, among retired people, water consumption decreased with age. Similarly, Barr (2003) found that older people were more likely than younger people to reduce their waste, indicating that older people might be more environmentally conscious. It may be the case the older people consume less than younger people for any number of reasons. Also, Gilg, Barr and Ford (2005)

found that older residents were more devoted to sustainable consumption than younger residents. Raudsepp (2001) found that older people were more likely to engage in environmentally friendly behaviours in the home, and suggested that older people may be more locally invested. Last, Miller and Buys (2008) found that older residents were more likely to wash their car on a lawn, a more environmentally friendly practice than washing it on a driveway. This behaviour might indicate that older residents are more environmentally aware than younger residents.

As seen in Table 5.4.3, respondents in the highest income category are willing to decrease their water use more than respondents in the middle and lowest income categories; respondents in the lowest income category are willing to decrease water use the least. This response may be explained by the fact that higher income respondents may be able to afford to use more water, and therefore would be able to cut back by a greater amount. Lastly, Table 5.4.4 shows that respondents from the more highly educated group are more likely to answer that they would decrease water use by a greater amount than the less educated group.

	Up to 10%	11% - 30%	31% or more	Total
<$20,000-$59,999	29	7	1	37
$60,000-$119,999	43	16	2	61
$120,000+	18	14	2	34
Total	90	37	5	132

Table 5.4.3: Willingness to conserve by income
Chi-square not valid

	Up to 10%	11% - 30%	31% or more	Total
No post-secondary education	34	3	0	37
Post-secondary education	66	36	5	107
Total	100	39	5	144

Table 5.4.4: Willingness to conserve by education
Chi-square not valid

A few studies provide similar results. For example, Kessler (2006) found that water conservation was more prevalent in agricultural farms with higher incomes than with lower incomes. Also, Heslop, Moran and Cousineau (1981) found that higher income households were more responsive to energy conservation programs than lower income households, but they suggested that this result was due to the fact that higher income households' initial consumption is often higher. De Oliver (1999) found that

higher income households were less likely to respond to voluntary water conservation initiatives, but more likely to respond to mandatory measures.

In contrast, several studies do not support the finding that higher income residents are more willing to decrease their water use compared to lower income residents. In fact, many studies find that residential water consumption increases with income (Domene and Sauri, 2006; Malla and Gopalakrishnan, 1997; Zhang and Brown, 2005). Trumbo and O'Keefe (2001) found that lower income households had the greatest tendency for water conservation, and suggested that this tendency might be because they would be most affected by cost. Similarly, some studies find that higher income households have higher energy consumption than lower income households (Parker, Rowlands and Scott, 2005; Poortinga, Steg and Vlek, 2004).

Similarly, Figure 5.4.3 illustrates how much respondents would be willing to change their water use habits: drastically, considerably, somewhat, slightly, or not at all. Drastically refers to the greatest willingness to change, while slightly refers to the least amount of change, aside from not at all. The most cited response was 'somewhat' at 41%. Chi-square was not significant for any demographic variable. Nevertheless, Figure 5.4.4 shows that 62% of respondents would be willing to change their water use habits, even if there were no shortage. Twenty-five percent would only change their

habits in the event of a shortage. No significant relationships were found through chi-square.

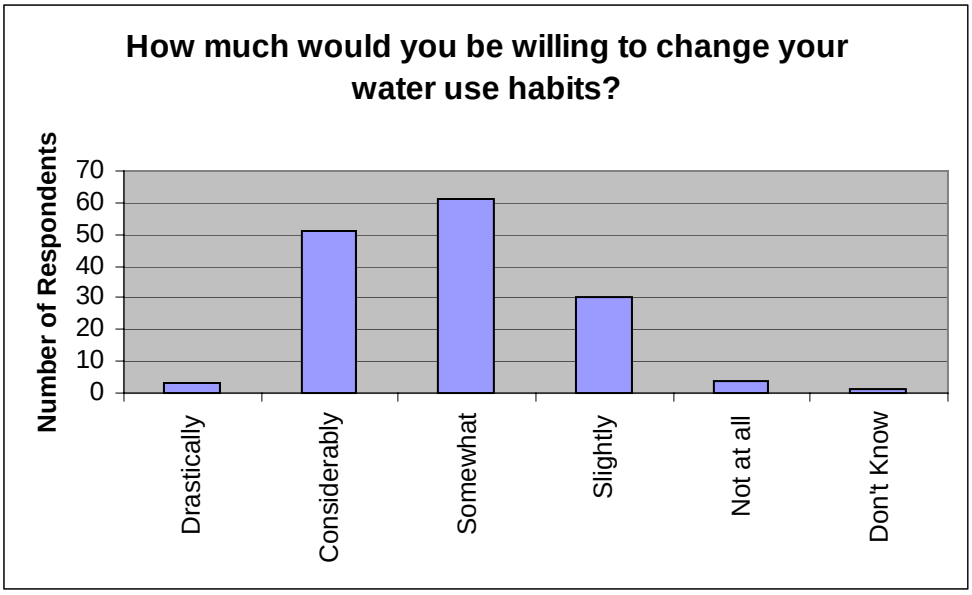


Figure 5.4.3: Willingness to change habits

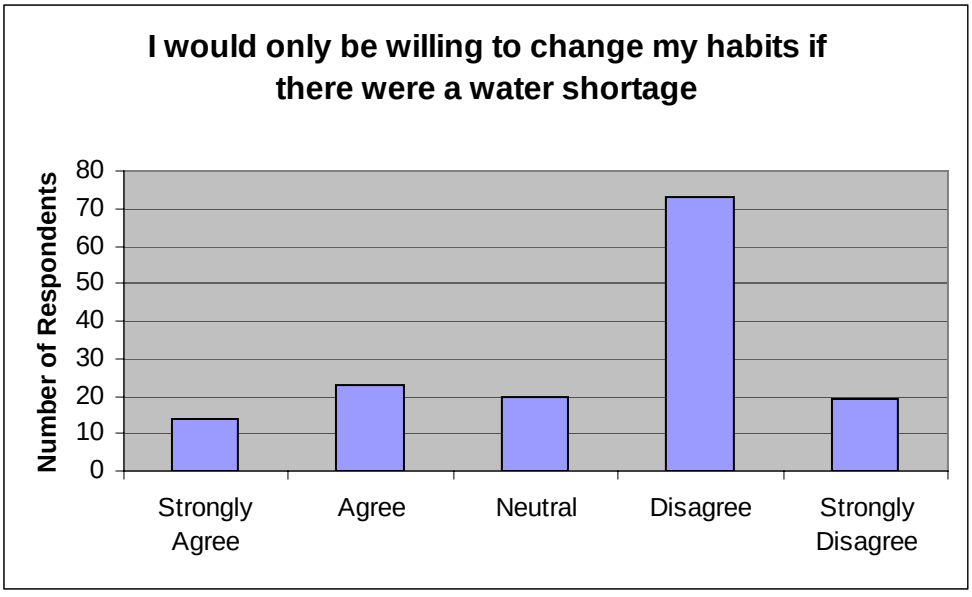


Figure 5.4.4: Willing to change habits only in event of shortage

A problem regarding this question is that respondents are not actually required to make changes. Because of its hypothetical nature, respondents can easily overstate their intentions. *The Record*, however, provides other insight as to how changes have occurred in the Region. For example, in 2005, peak water demand was about 15% lower than it had been in past years, indicating that residents did respond to conservation pleas by the Region (Burtt, 2005a); in 2007, water use was 21% lower than it had been in 2001 (Outhit, 2007g), even though the population had grown greatly in that 7 year period. Steve Gombos, manager of water efficiency at the Region of Waterloo, commented that residents were doing enough to conserve water, and pointed to the 1.21 million gallons saved in 2005 due to outdoor watering restrictions (Burtt, 2006c; Barrick, 2007).

Julius Greff, a resident of Waterloo, believed that restrictions would not be necessary if residents used common sense regarding water (Greff, 2005). Likewise, Wayne Schrader, a resident of Kitchener, was disappointed that his neighbours were not complying with bylaws, watering their lawns overnight and washing cars several times a week (Schrader, 2005).

Andy Halma, a resident of Kitchener, suggested tiered pricing as an effective way to target those who did not already conserve water (Halma, 2003). Anne Morgan, a resident of Waterloo, noted that she had 6 rain barrels for her gardens, and was an

advocate of drought-resistant plants (Morgan, 2003). Rob Holme, a resident of Kitchener, did not think residents needed to change their water use habits further because they were already conserving a sufficient amount (Holme, 2006).

Ninety-three percent of respondents claim they would be willing to incorporate additional water-saving devices in their home if there were no cost to them (Figure 5.4.5). Chi-square was invalid for all variables due to the high responses in only one category.

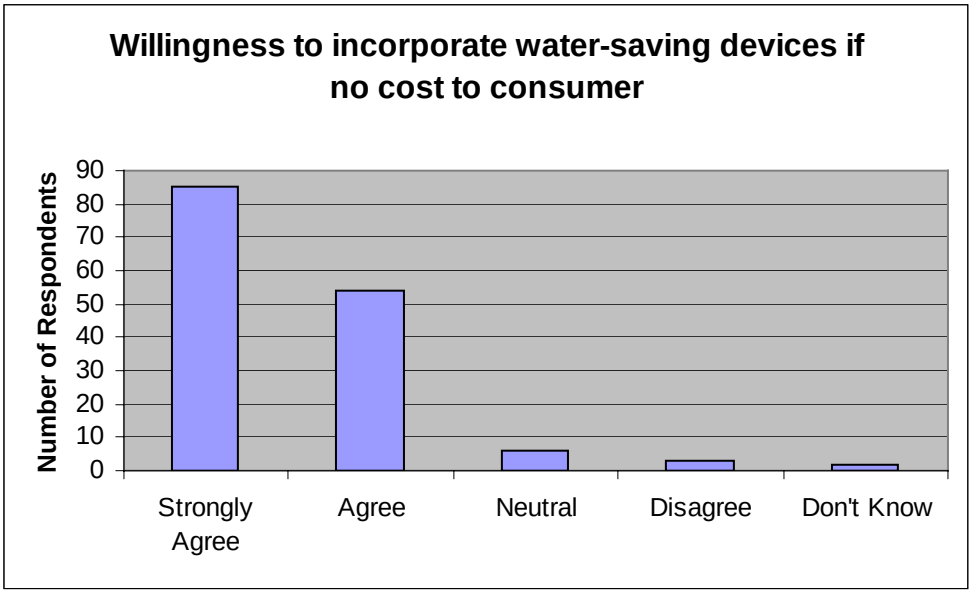


Figure 5.4.5: Willingness to incorporate devices if no cost to consumer

In Ayr, residents were offered low-flush toilets free of charge from the Region. However, many residents refused to install them (*The Record*, 2005d), possibly because of the popular belief that low-flush toilets do not work as well. Similarly, the Region offered rebates for water-saving dishwasher valves to restaurant owners, but many

chose to decline (*The Record*, 2005d); it is possible that many declined because it would still be costly to make the change.

Question 17 asked respondents to rate their personal water use in comparison to others around them (Figure 5.4.6). Options included: considerably less than average, slightly less than average, average, slightly more than average, and much more than average. Only 6% of respondents felt their water use was more than average, while 66% felt they used less than average. It is important to note that these findings do not show the extent to which respondents' actual water use behaviour is consistent with how they perceive their water use behaviour. Chi-square did not illustrate any significant relationships.

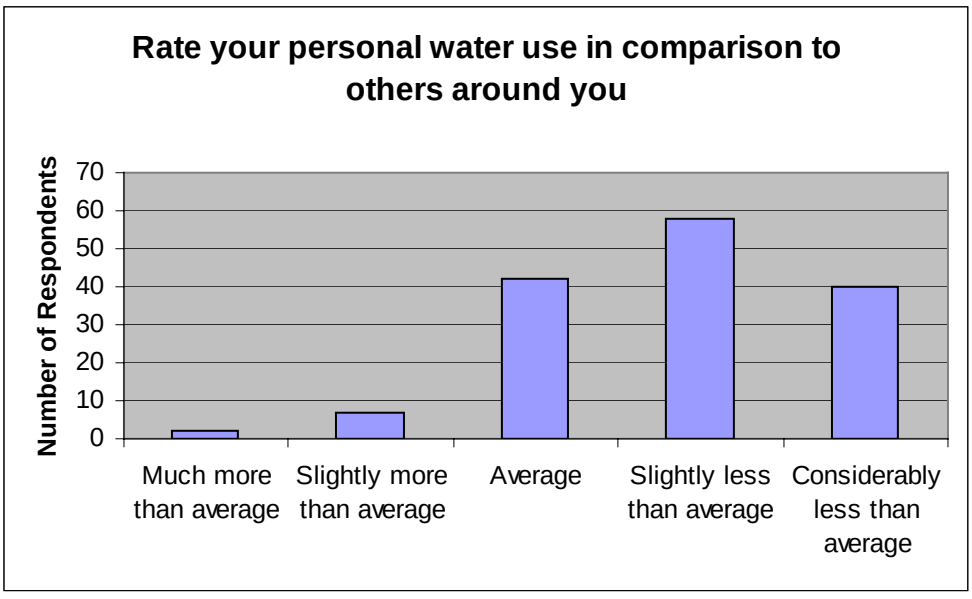


Figure 5.4.6: Water use compared to others

Water Charges

Figure 5.4.7 illustrates the amount of "total water charges" respondents paid on their last water bill, which in the City of Waterloo covers a period of two months. Since the questionnaires were distributed at the end of May, and the majority was received in June, it is expected that most respondents would have quoted a bill covering the period from March to April; however, this cannot be verified. The period that the bills likely cover is important to note because lawn-watering can increase the amount of water used greatly, and at the time the questionnaires were received, lawn-watering would most likely not have been prevalent.

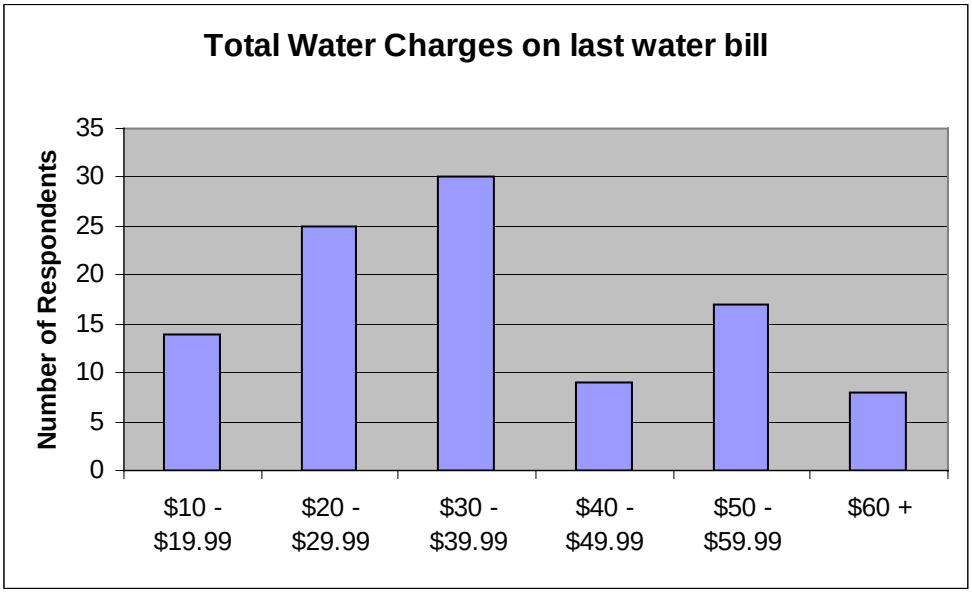


Figure 5.4.7: Total water charges on previous bill

The most commonly cited amount was between $30 and $39.99 (29%), and 8% of respondents paid $60 or more. Amounts in the highest category ranged up to $150, and

the two respondents who paid this amount also believed that their water use was slightly below average. A respondent with a water bill of $94 reported that his or her water use was considerably less than average. It is also noteworthy that one respondent reports slightly more than average water use, but water charges of only $16.72. Another respondent who reported water use was much more than average had water charges of only $22.66.

Daily and Weekly Water Conservation Behaviour

Question 18 asks respondents to specify actions on a daily or weekly basis to conserve water; 129 of 151 noted at least one activity. The more common responses included: not watering one's lawn, not washing one's car, turning off taps while brushing teeth, taking short showers, using a low-flush toilet or not flushing the toilet every time, using rain barrels, running the dishwasher or washing machine only when full, and using a watering can instead of a hose. Less common responses included recycling laundry or cooking water for use on a garden, keeping a pitcher of cold water in the fridge, using a suds saver washing machine, fixing leaky taps, planting drought-resistant plants, using peat moss to lock moisture in the garden, and keeping grass long.

Water-saving Devices

Figures 5.4.8 and 5.4.9 illustrate the water-saving devices that respondents have in their homes. Respondents could choose as many as applicable. Low-flush toilets

were the most common, reported to be in 92 homes, followed by high-efficiency clothes washers, both high-efficiency dishwashers and rain barrels, and then xeriscaping. The 'other' category was used to report low-flow showerheads, low-flow taps and sink valves, and water softeners. Only one respondent claimed to use a water softener, and this seems to be an anomaly since water softeners generally decrease the amount of detergent used in washing machines, rather than the total amount of water consumed. *The Record* reported that 52% of residents in the Region of Waterloo have a low-flush toilet, compared to 41% in all of Canada (McMahon, 2007).

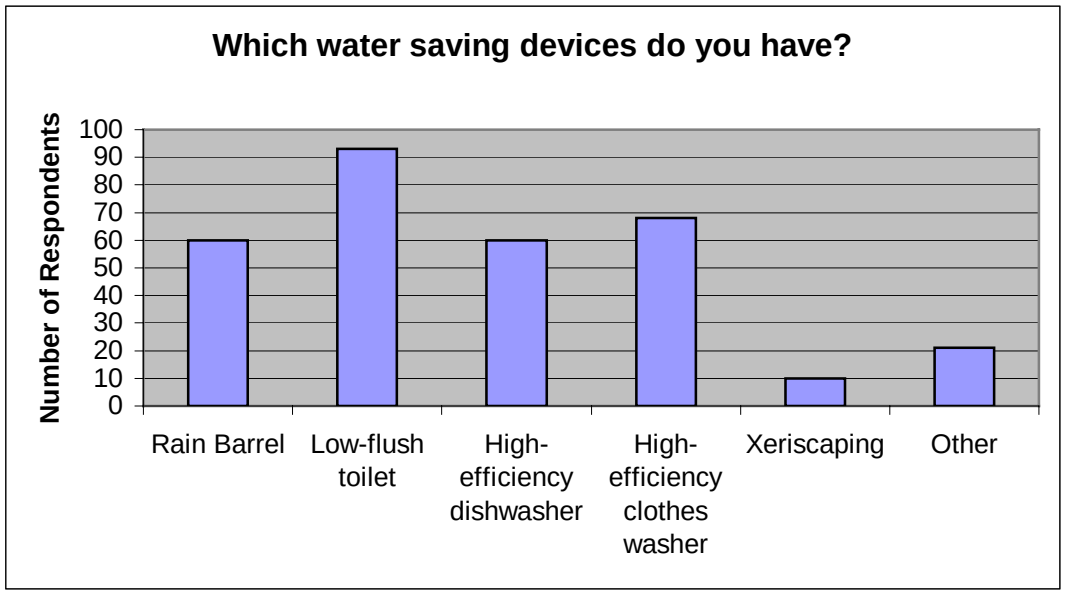


Figure 5.4.8: Water saving devices

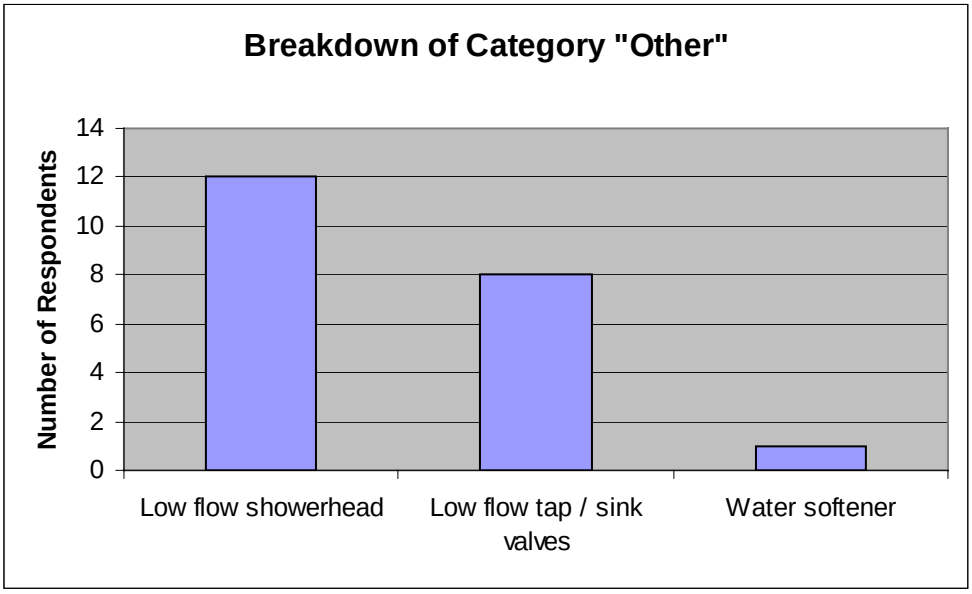


Figure 5.4.9: "Other" water saving devices

Determinants of Water Use

Respondents were asked to describe what determines how much water they use. The most common responses were need (based on activities and lifestyle) and time of year (including weather-dependent lawn watering). Many people noted that water use was related to the number of children and their ages, as this would affect laundry, showers, and dishes. Some respondents were very conscious of the amount of water they used, citing that concerns for the water supply, value of the environment, or conscience determine the amount of water used.

5.5 LAKE ERIE PROPOSED PIPELINE

Knowledge

Respondents were asked questions pertaining to the proposed pipeline that, if constructed, would extend from Lake Erie to the Region of Waterloo. Respondents who had not heard of this pipeline prior to the questionnaire were asked not to complete the section. Figure 5.5.1 illustrates that 40% of respondents had not heard of the pipeline prior to receiving the questionnaire.

Significant relationships were found with both gender and age. Chi-square is significant regarding gender; males are more likely than females to be informed about the pipeline. There is no obvious reason as to why males would be more informed than females. Chi-square is significant that the older age group is more likely than the younger age group to know about the pipeline. This significant relationship may be explained by older respondents having lived in the region longer, and therefore being more aware of initiatives. Income and education are not related to knowledge of the pipeline.

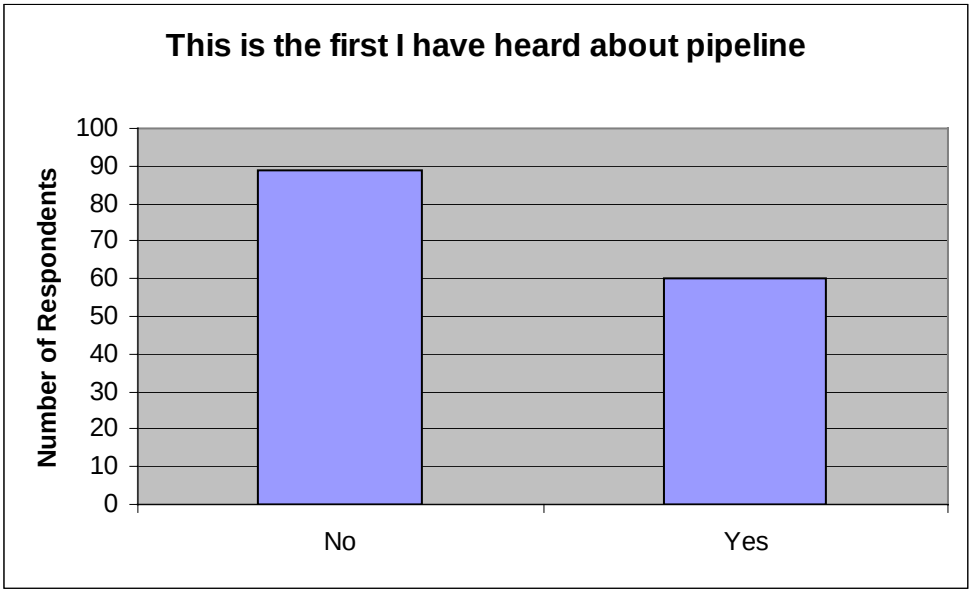


Figure 5.5.1: First time hearing about pipeline

A Region of Waterloo staff member noted that the pipeline would simply be a practical solution to supplying water (personal communication, November 13, 2007). James Etienne, of the Grand River Conservation Authority, stated that the pipeline would be a response to predicted population growth and the need to secure additional sources of water to provide certainty for the future (personal communication, January 17, 2008). Tony Maas, of the World Wildlife Fund Canada, believed the pipeline would be a response to the Places to Grow Act; the municipality may view a pipeline as an inevitable response to increased water demand in a water scarce area (personal communication, December 6, 2007).

Figure 5.5.2 shows that 36% of respondents agree that it is necessary to construct a pipeline to increase the water supply in the region, while 24% disagree. No socio-

demographic variables are significantly linked through chi-square. However, Table 5.5.1 shows that a relationship may exist with education. The more highly educated group may be more likely to believe that a pipeline is not needed. Chi-square was invalid for this calculation because of low totals.

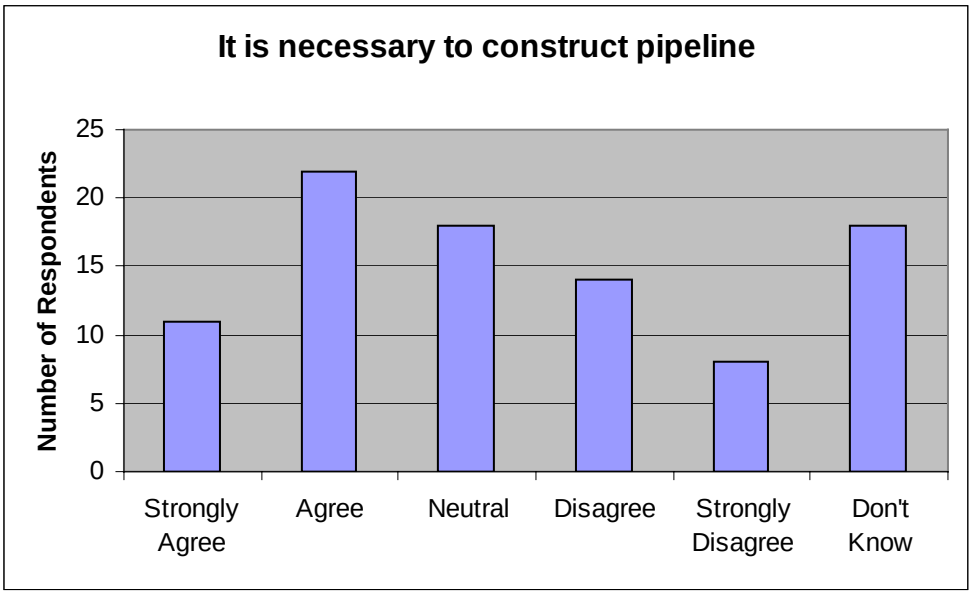


Figure 5.5.2: Necessary to construct pipeline

	Agree	Neutral	Disagree	Total
No post-secondary education	16	2	4	22
Post-secondary education	16	14	18	48
Total	32	16	22	70

Table 5.5.1: Necessary to construct pipeline by education
Chi-square not valid

Effects on Water Supply

Figure 5.5.3 illustrates that 71% of respondents believe a pipeline would increase the reliability of the water supply system in the region. Chi-square calculations were not valid because of the low number of respondents disagreeing with the statement. Although it is perceived that the pipeline would increase the reliability of the system, Figure 5.5.4 shows that 78% of respondents believe a pipeline would not provide the Region with an unlimited supply of water. Chi-square was not valid. However, Table 5.5.2 indicates that a relationship may exist with education. The less educated group may be more likely than the higher educated group to conclude that the pipeline would create an unlimited supply of water.

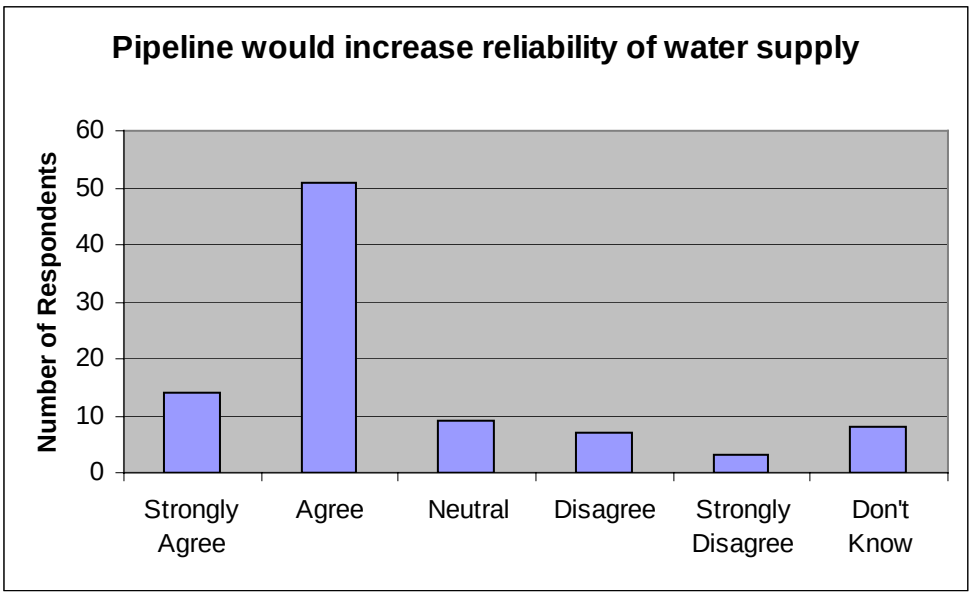


Figure 5.5.3: Pipeline increase reliability of supply

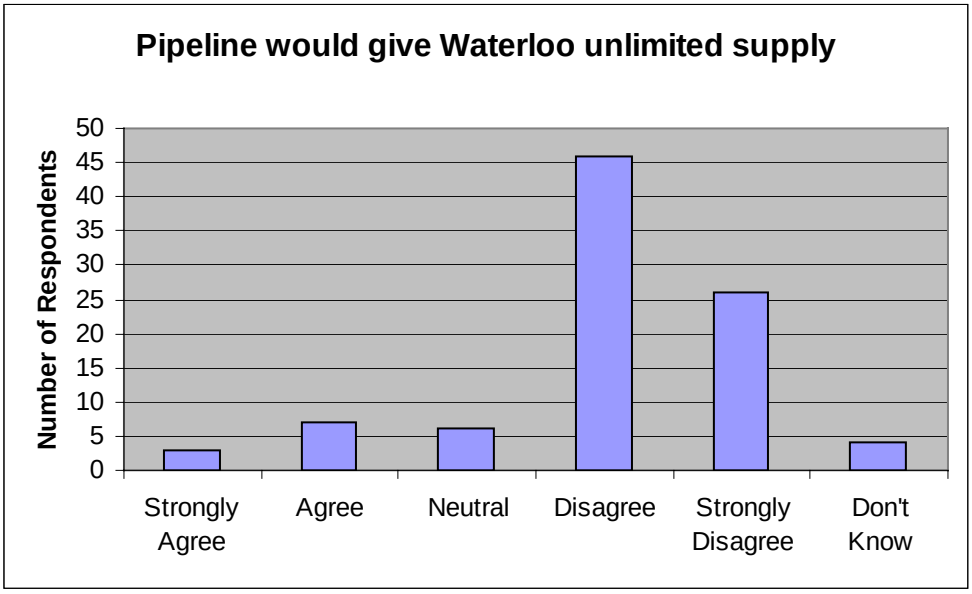


Figure 5.5.4: Pipeline would provide unlimited supply

	Agree	Neutral	Disagree	Total
No post-secondary education	5	3	14	22
Post-secondary education	5	3	53	61
Total	10	6	67	83

Table 5.5.2: Pipeline would provide unlimited supply by education
Chi-square not valid

Staff at the Region of Waterloo stated that the pipeline had not officially been chosen as the means to solve water scarcity concerns; it was one of many options being explored (personal communication, November 13, 2007). Etienne agreed that a pipeline was something the Region needed to investigate in order to determine if it was an appropriate solution (personal communication, January 17, 2008). Rob de Loë, of the

University of Guelph, believed that if a pipeline were to be constructed, it would be the easy way out for politicians; residents do not like to be inconvenienced, and it would be easier to secure a larger supply than try to change their behaviours (personal communication, November 27, 2007). Etienne stated:

> The approach of the Region is to put as many options on the table, to be upfront, and keep your options open. The Region wants to look at the security of supply. Currently it's a multi-well system, and certain sources are vulnerable, which creates concern. Maintaining and protecting existing sources is difficult, and it's costly to lose a source. (personal communication, January 17, 2008)

Etienne expanded by saying there was uncertainty on the conservation side; it may be safer to secure additional supplies, and later try to minimize water use (personal communication, January 17, 2008).

In 2003, Ken Seiling, Chairman of the Regional Municipality of Waterloo, acknowledged there was pressure on the Region to forego using groundwater as the main supply and build a pipeline. However, the Region opted to delay the building of this pipeline as long as possible (Burtt, 2003a). In 2005, the Region tried to create a larger buffer for peak demand, by making improvements to the water supply (Swayze, 2005). In 2007 regional staff noted that outdoor watering restrictions had reduced peak demand enough to delay a pipeline until 2034 (*The Record*, 2007b), and regional

councillors still planned to postpone a decision about the pipeline (Outhit, 2007d; 2007e).

Some residents in the region support the decision to delay a pipeline. Doris Moran Migus, a resident of Kitchener, believed that constructing a pipeline would be a waste of taxpayers' money (Moran Migus, 2004). It was estimated by the Region that if a pipeline were built, the cost for water in the city would rise from $2.16 in 2004 (per thousand gallons) to $2.80 in 2020, and $4.75 in 2040 (Prender, 2007).

An anonymous resident of the region argued that watering restrictions should not lead people to believe that the supply is unsatisfactory (Outhit, 2005a). John Jackson believed that building a pipeline would be irresponsible, and that communities should not be allowed to extract as much water as they want from the Great Lakes (Outhit, 2005a). Tony Maas stated, "The pipeline proposal seems the least effective way of ensuring water security for our communities" (Maas, 2007). One respondent of the questionnaire noted:

> "In a region with ample high quality water from both an aquifer and a river, we still find the need to engineer an aqueduct to a far-off lake so that we can carry on consuming more than our fair share of resources."

Although the Region plans to delay constructing a pipeline, not everyone agrees this delay is the best idea. Philip Weiss, a resident of Kitchener, was adamant that a pipeline is needed sooner rather than later:

> Action must be taken, immediately, to build a pipeline from the Great Lakes and also replace our deteriorating underground distribution systems. This project is constantly being pushed aside and has been ignored by regional governments for years. This is where our hard-earned dollars should be directed. (Weiss, 2004)

In 2005, Mayor Herb Epp and Councillor Geoff Lorentz of Waterloo both stated that they felt there was not enough security built into the current water system, and indicated that a pipeline would resolve this concern (Outhit, 2005a). Kurt Ditner, a resident of Kitchener, stated that a pipeline should be constructed by 2016 (*The Record*, 2006b). Robert Ross, a resident of Cambridge, thought the region's water supply was inadequate for the future (*The Record*, 2006c). Councillor Sean Strickland of Waterloo wanted a pipeline to be a top priority (Outhit, 2007e). One respondent to the questionnaire wrote, "Waterloo Region should have put in the pipeline to Georgian Bay years ago when the issue came up… now they are in a pickle."

Adam Harrison, a resident of Cambridge, was in favour of halting all housing construction and industrial growth until a pipeline was built (Harrison, 2004). Kevin Eby, the Region's director of community planning, stated that if growth projections for

the future were correct, a pipeline would be needed before 2035 (Burtt, 2006a). Hans Koster, a resident of Kitchener, concluded that growth could not be supported without a pipeline (Koster, 2006), and Vern Sherk, a resident of Kitchener, believed a pipeline would contribute to future growth by ensuring an adequate supply and quality of water (Sherk, 2006).

A pipeline would be directly related to growth opportunities. A professor from a southwestern Ontario university said a pipeline would allow the growth that the Region had seen over the past 10 years to continue (personal communication, November 22, 2007). A staff member from the Grand River Conservation Authority thought it might be best to redirect growth to areas with sufficient amounts of water (personal communication, November 29, 2007). De Loë from the University of Guelph mentions that water is not normally a consideration in urban planning processes, although it should be (personal communication, November 27, 2007). Tony Maas believed the Region should consider challenging the province on whether it should even be part of the Places to Grow Act because of the lack of water locally (personal communication, December 6, 2007). A staff member from the Grand River Conservation Authority noted that the Places to Grow Act did not take into account the types of infrastructures that were in place and would be need to be put in place (personal communication, November 29, 2007).

Effects on Conservation

Figure 5.5.5 illustrates that 62% of respondents think that if a pipeline were constructed, residents should still be concerned about the amount of water used. Chi-square was not significant for any demographic variable. Figure 5.5.6 shows that 91% of respondents do not believe that a pipeline would eliminate the need for conservation. Chi-square was not valid because of the high number of respondents who answered in only one category. Figure 5.5.7 illustrates that 73% of respondents believe their water use habits would not change if a pipeline were constructed, while 9% expect that their habits might change. Chi-square exhibited no significant relationships.

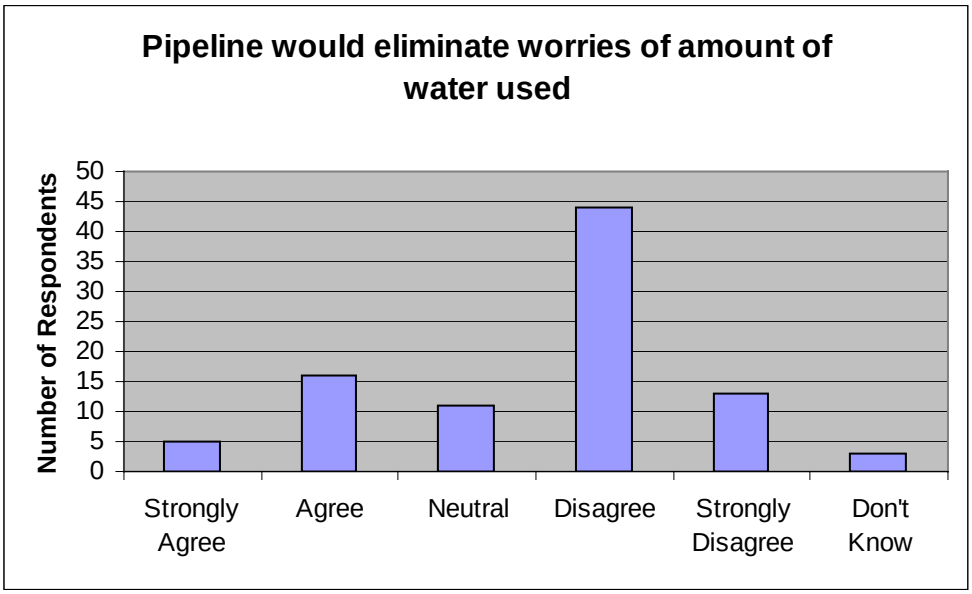


Figure 5.5.5: Pipeline eliminate worries of water use

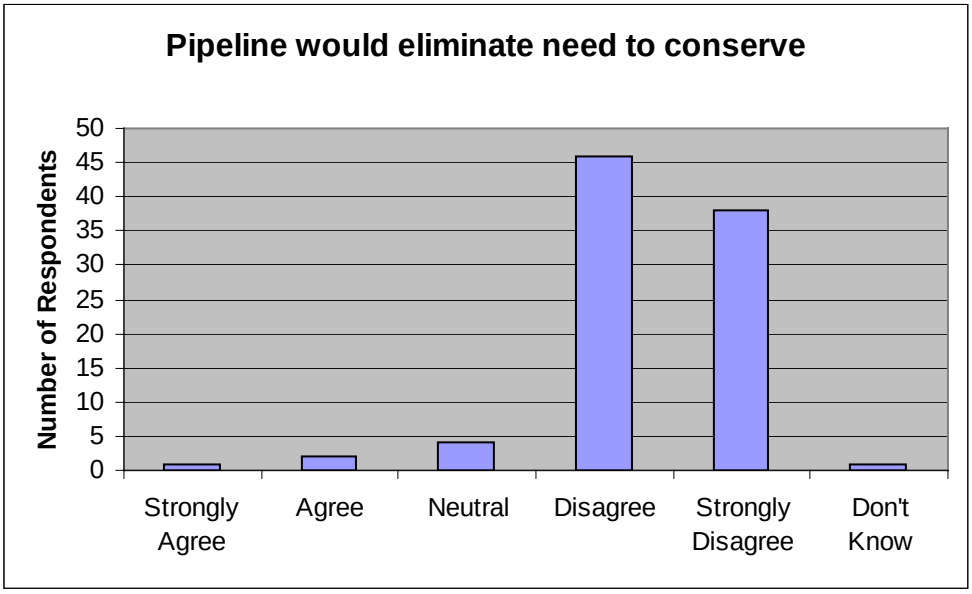


Figure 5.5.6: Pipeline eliminate need to conserve

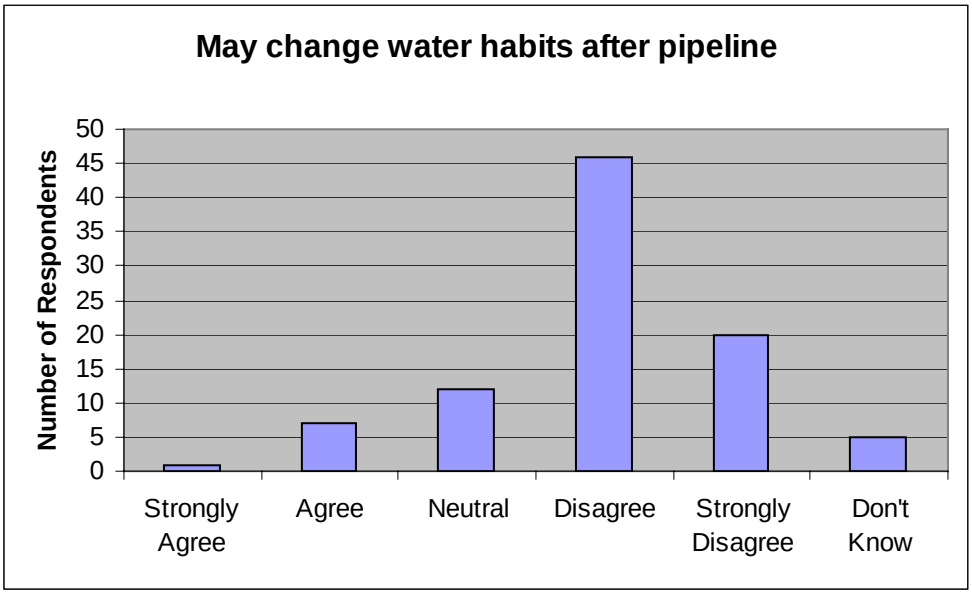


Figure 5.5.7: Habits may change after pipeline

The three findings presented in the previous paragraph are key because they indicate the potential response from residents to the construction of a pipeline. Even with a pipeline, many people believe conservation would be necessary. Based on the

responses, it is a reasonable conclusion that a pipeline would not contribute to non-conservation attitudes and behaviour. In the event that a pipeline were constructed, a majority (62%) believe that residents should still be mindful about the amount of water they use; an even larger majority (73%) state that their own habits would not change, and an astounding 91% do not believe a pipeline would warrant a reduction in conservation efforts. Although these findings are not conclusive as they are based on a hypothetical situation, they do suggest the behavioural response that residents in the area may show if a pipeline were constructed.

Habits

Question 31 asks respondents to explain how their water use habits might change if a pipeline were constructed. One hundred seventeen respondents did not answer this question. Of the responses, 22 indicate there would be no change in behaviour. One respondent stated, "Just because there is a water pipeline or unlimited water resources doesn't mean that you should not conserve water. Water, clean fresh water, is a limited resource wherever you are." Another respondent wrote, "I really like the 'one day per week lawn watering rule'. Flowers may need more frequent watering but not the lawns!" Two respondents claimed that they would use less water if a pipeline were constructed; one indicated that this response would be because the price of water would likely increase.

Seven respondents indicate that a pipeline would result in their using more water; five of these indicate that they would increase the amount of lawn watering and gardening they engage in. It was not indicated on the questionnaire whether outdoor water regulations would continue. However, it might be assumed that most respondents equate a larger water supply with relaxed rules. One wrote, "It would be nice not to have the stress of always being afraid of not having a good supply of water." Another indicated the hope that the price of water would decrease as a result, but did not say whether this decrease would lead to an increase in water use. Finally, one respondent noted he would add a water filtering system to his house.

Some residents believe that the construction of a pipeline would increase water consumption in the region. John Jackson stated that having a large supply would result in the careless use of water, and therefore affect the quality of water (Outhit, 2005a). Miles Schwindt, a resident of Waterloo, stated that a pipeline would lead to wasteful use and was confident that the conservation of water among residents was the best solution to solving shortages (Schwindt, 2008). Adam Morell, a resident of the region, agreed with Schwindt and suggested that every household should be made to collect and use rainwater (Morell, 2008). One respondent to the questionnaire noted:

> "A water pipeline will only address the short-term economic concerns of Waterloo Region. It will do nothing at all to raise awareness of, or respect for,

> the natural environment. Conservation efforts, on the other hand, will help to raise this awareness, and this is the direction 'the world's most intelligent community' must take."

M. Carl Kaufman, a resident of Waterloo, indicated that a pipeline would not lead to less emphasis on conservation, but that it would ensure an adequate supply and the protection of local wetlands (Kaufman, 2005). Thomas Schmidt, an engineer for the Region, stated that a pipeline would not solve water supply problems unless consumption was also addressed (Swayze, 2005).

Staff at the Region of Waterloo believed that a pipeline would not lead to increased consumption for two reasons: (1) the Region would maintain the water efficiency plan at current levels, and (2) some people are not even aware there is a shortage (personal communication, November 13, 2007). De Loë believed that if a conservation society were encouraged or created, and the pipeline was a last resort, people would continue to conserve; it is only the pipeline as a first choice that would ruin conservation efforts (personal communication, November 27, 2007).

A professor from a southwestern Ontario university speculated that the level of support for conservation might wane, unless full cost pricing was implemented (personal communication, November 22, 2007). A staff member at the Grand River Conservation Authority believed that any strides in conservation might be undermined

by a seemingly unlimited source of water (personal communication, November 29, 2007). Tony Maas said that a pipeline may encourage the belief that water is not as scarce as it once was; people may go back to washing their driveways and watering their lawns, thus negatively affecting progress made on water conservation and efficiency (personal communication, December 6, 2007).

Etienne believed that, because a pipeline would be such an expensive infrastructure, people may be encouraged by the city to use more water so that it could be paid off quickly; once this was accomplished there may be a push to reduce consumption (personal communication, January 17, 2008).

Advantages

Question 32 asks respondents to identify any positive effects they think would be attributed to the pipeline. Seventy-seven respondents answered this question; the most common response is a larger, more secure, and safer water supply. This response is mirrored in *The Record*, where it was reported there had been a concern about groundwater quality after the contamination of some wells in 2004; a pipeline, the article suggested, would eliminate these concerns (Burtt, 2006b). Other positive outcomes cited in the questionnaire responses include higher quality water, less concern over groundwater contamination, less strain on the local supply, availability of larger quantities in case of fires, fewer restrictions on water use, continued population

growth, more potential for industrial growth, and a continuing supply of water even in drought-like conditions.

Some respondents believe there would be no positive outcomes from constructing this pipeline, and they answered the question by indicating 'none', or 'nothing positive'. Others use sarcasm in their answer; for example, one respondent wrote, "We could help the other large cities dry up the Great Lakes", and another stated, "There are none, unless unlimited growth and consumption is considered positive". Others stated that more water would simply be wasted.

A staff member at the Region of Waterloo noted a pipeline would ensure an adequate supply of water, regardless of growth (personal communication, November 13, 2007). A professor at a southwestern Ontario university believed an advantage would be the possibility of expansion in the future, and the possibility to serve municipalities along the way if they ever experienced water shortages (personal communication, November 22, 2007). De Loë noted that advantages would differ depending on the group being examined; a pipeline would be advantageous to industries that needed water, to municipalities that wanted unlimited growth, and to consumers who did not want to change behaviours (personal communication, November 27, 2007).

Etienne believed there would be an advantage in the consolidation of sources; maintenance and operations would be cheaper, and the water quality would be consistent because the Region would be dealing with treating one source as opposed to more than 100 (personal communication, January 17, 2008). He also noted that a pipeline would not be as vulnerable to loss through pollution (personal communication, January 17, 2008).

Disadvantages

Question 33 asks respondents to identify potential negative consequences of the pipeline. Eighty-six respondents answered this question. The most common response is that people would no longer find a need to conserve and would become complacent with the amount of available water. Other consequences include an increased cost for water, environmental degradation, poorer water quality, increased population growth (and further development), and lower water levels in Lake Erie. One respondent noted, "We will keep adding people until there is some restriction. Water would be a good one." Another respondent supported this view by writing, "I believe in limits to growth and right now our supply of water is our limit to growth. Building a pipeline is a poor use of resources." Others are concerned that building a pipeline would be a waste of government money, or that "The earth does not have an unlimited supply of fresh water." On the same note, one respondent said, "Great Lakes cannot and should

not be used as a source to be diverted!!" One respondent did not believe there would be any negative consequences: "It is part of the same watershed so there isn't a negative, as I see it."

Doris Moran Migus wanted to see the Region set an example of water conservation for surrounding communities by saying 'no' to a pipeline (Moran Migus, 2004). Tim Morris, of the Sierra Club of Canada, and Tony Maas believed that building a pipeline would be "a 20th-century solution to a 21st-century problem... experts say the greatest 'new' source of water in the 21st century should come from greater efficiency and conservation" (Morris and Maas, 2007).

The Record documents concerns that a pipeline would negatively impact the environment. Levels in Lake Michigan and Lake Huron have dropped about 80 centimeters since the 1800s, as a result of both natural causes and human influence (*The Record*, 2005a). David De Launay of the Ministry of Natural Resources was worried about water levels in the Great Lakes depleting because of diversions from surrounding communities (Burtt, 2005b). One respondent to the questionnaire stated:

> We own a cottage on Georgian Bay where the water levels have declined significantly over the past 8-10 years. It is highly suspected that these levels have been affected by taking liberties with the Great Lakes in the forms of dredging (St. Clair River) and water diversion in the Chicago area among other things. To

> think that diverting water to this Region (Waterloo) would solve all our problems is incorrect thinking in my opinion.

De Loë commented on the pipeline being a very expensive proposition, and said that some taxpayers may be annoyed that they have to pay for their neighbour to water a lawn or wash a car (personal communication, November 27, 2007). Staff at the Region of Waterloo acknowledged that the initial cost of constructing a pipeline would be high, but noted that the cost would be balanced over 80 to 100 years so it would be manageable (personal communication, November 13, 2007). A staff member at the Grand River Conservation Authority said that the pipeline would be for the benefit of the urbanites, and wondered how the farmers would fare when there were lower water levels (personal communication, November 29, 2007). Tony Maas believed a disadvantage of the pipeline to be that the water would need to be pumped uphill, increasing the use of energy and potentially emissions of greenhouse gases (personal communication, December 6, 2007). Etienne stated that a disadvantage would be the length of a pipeline; approvals may be difficult to get because the Region would need to acquire a lot of land, and this is why the pipeline is being considered many years in advance (personal communication, January 17, 2008). A staff member at the Grand River Conservation Authority stated that social impacts of the pipeline may include

residents being displaced in order to physically put the pipeline into the ground (personal communication, November 29, 2007).

De Loë commented that Lake Erie was not a bottomless reserve; people may think that taking a little bit of water does not affect it, but if a lot of cities did the same thing the amount would add up quickly (personal communication, November 27, 2007). A staff member at the Grand River Conservation Authority stated that if the Region supports the concept of sustainability and living within its own means, it should critically assess the rationale for a pipeline (personal communication, November 29, 2007).

A staff member at the Grand River Conservation Authority questioned how a pipeline would affect water quality:

> Too much is put into the Great Lakes already. I question the security of Great Lakes water in terms of quality; surface water and groundwater is better. We can't control the quality of the Great Lakes, like we can control the quality of the water in our own area. (personal communication, November 29, 2007)

Etienne stated that no one would know in advance what the environmental impacts of changing this water system would be; for example there could be impacts of turning off groundwater pumps that have been on for years (personal communication, January 17, 2008). Tony Maas noted there might be ecological consequences due to a potentially

high level of effluent in the Grand River, which already contains a lot of effluent during low flow conditions (personal communication, December 6, 2007). A staff member at the Grand River Conservation Authority was also concerned about effluent creating more severe water quality issues in the Grand River and suggested that the Region might need an additional pipeline to transport effluent out of the area (personal communication, November 29, 2007).

5.6 SUMMARY

One hundred fifty-one respondents were separated into age, gender, income, and education categories. Answers were tested using chi-square, where appropriate, to identify significant relationships between demographic variables and conservation attitudes, habits, and knowledge about a possible future pipeline. Although some relationships were indicated without chi-square, only the statistically significant findings are highlighted below:

- Older respondents are more likely to believe there is not an adequate water supply in the Region of Waterloo
- Higher income respondents are more likely to believe access to water should be limited
- More highly educated respondents are more likely to believe access to water should be limited

- Older respondents are more likely to believe the Region should spend money to increase the supply of water
- Younger respondents are more likely to prefer decreasing the demand instead of increasing the supply
- Older respondents are more likely to prefer a combination of decreasing the demand and increasing the supply
- More highly educated respondents are more likely to prefer decreasing the demand instead of increasing the supply
- Older respondents are more likely to claim they conserve water year round
- Male respondents are more likely to have heard about a proposed pipeline
- Older respondents are more likely to have heard about a proposed pipeline

Six of the 10 significant associations are with the variable of age, two are related to education, one is related to income, and one is related to gender. These associations indicate that the most important variable to consider when implementing water conservation techniques is age. This finding could also be associated with time of residence in the area, an aspect not explicitly addressed in the survey. If so, it indicates that the Region is successfully creating a culture of conservation in the area.

Other studies have also found that age is the most important variable related to environmentally friendly practices (Miller and Buys, 2008; Raudsepp, 2001). However,

the majority of studies identify income as the most important predictor of environmentally friendly behaviour. It may be possible that there is a relationship between age and income, as in general, one's income typically increases during one's lifetime. Trumbo and O'Keefe (2001) found that income was the only variable related to water conservation, with lower income households conserving more than higher income households. Poortinga, Steg and Vlek (2004) found that income was the best determinant of energy use; higher income households used more energy than lower income households. Torgler and Garcia-Valinas (2007) found that income was the most significant predictor of willingness to financially contribute to environmental protection; higher income households contributed more than lower income households. Kessler (2006) found that income was the most important factor that determined whether agricultural farms engaged in water conservation; higher income farms conserved more water than lower income farms.

Education has also been found to be the most significant predictor of environmentally friendly activities. For example, Lam (2006) found that education was the only variable that could help determine a person's willingness to save water; more educated individuals conserved more water than lesser educated individuals. Also, Howell and Laska (1992) found that education was the best predictor of

environmentally friendly attitudes; this finding was different from a study they conducted 8 years previous, which found that age was the best predictor.

The finding that age is the most significant variable is inconsistent with some studies (e.g Howell and Laska, 1992; Kessler, 2006; Lam, 2006; Poortinga, Steg and Vlek, 2004; Torgler and Garcia-Valinas, 2007; Trumbo and O'Keefe, 2001). This finding is likely a result of the study area. While income and education may be highly important in many circumstances, the Region has long had concerns regarding the water supply. For example, it has been shown that over the past five years there has been much debate about the adequacy of the water supply in *The Record*. As a result of the Region's history of water concerns, age plays the largest role, as older residents are more aware of these specific issues.

The Record documents resident concerns that the Region's current water supplies are inadequate. It reports on the limits the Region has put on water use, and indicates the level of support from residents toward these programs. It is clear that water conservation is important to the Region, and that future growth is controversial because of limited water supplies. It can be seen in *The Record* that the majority of residents support plans to increase the supply, while an even larger majority would prefer to see a decrease in demand. It is clear that residents prefer a combination of approaches. Likewise, the majority of residents support raising water rates because they show the

value of water, while a minority think rates are already too high. *The Record* also demonstrates that the Region has been able to greatly reduce water consumption through summer outdoor water use restrictions. Decisions the Region has made regarding the proposed pipeline are illustrated, as well as discussions of whether this pipeline would lead to increased consumption and solve water concerns.

Seven experts provide valuable input to the questions asked on the questionnaire. In their view, the pipeline would be a practical solution to the expected population growth determined by the Places to Grow Act. Experts commented on the ways that increased consumption could be prevented if a pipeline were built. Advantages and disadvantages are discussed. A pipeline would eliminate worries about the security of the water supply, but it may come with a large financial expenditure, and environmental consequences such as lower water levels and increased effluent.

CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS

6.1 OVERVIEW

Canadian residents use more water per capita than residents in any other country, with the exception of the United States. This high use is largely the result of supply-oriented policies and the traditional low cost for water. Wasteful usage has been entrenched because of a false idea that water resources are infinite (Bartoszczuk and Nakamori, 2002; Overgaard, 1960). Supply management has generally been the dominant paradigm in the Canadian economy, but with rising concern and recognition of water issues, demand management and soft path are increasingly being brought to the forefront.

The conservation of water is vital to the future of Canadian municipalities, by helping to preserve resources for future generations and promoting sustainability. It may be difficult to persuade residents to change their behaviour, but with new regulations everyone should be encouraged to do their part.

The Region of Waterloo has been proactive in promoting water conservation; however, with high rates of expected growth, it is questionable whether demand management techniques will be able to offset the need for a larger supply.

6.2 RESEARCH OBJECTIVE

For over 30 years, the Region of Waterloo has focused much energy encouraging the conservation of water resources. The Region has long relied primarily on groundwater to serve its population. However, with expected urban growth, many residents and officials have begun to question the security of the supply. Various options to enhance the water supply system have been considered, and among these is a pipeline that would extend from Lake Erie to the Region of Waterloo.

The purpose of this research is to examine whether a proposed water pipeline, were it to be constructed, might undermine current conservation efforts by the Region of Waterloo. Four main research questions were investigated: (1) How do Waterloo residents perceive the region's current water supply? (2) How do their actions related to water use reflect these perceptions about water supply arrangements? (3) How might perceptions change when a pipeline is constructed to Lake Erie? (4) To what extent might this pipeline encourage consumptive rather than conservation behaviour?

6.3 MAIN FINDINGS

A questionnaire was used to elicit information from residents in the City of Waterloo, and to gain insight into the research questions. One hundred fifty-one residents responded. Chi-square was used to identify significant relationships between

water use behaviour and the demographic variables of age, gender, income, and education. Ten significant relationships were found.

Six significant relationships relate to age. Older respondents are more likely to believe there is not an adequate water supply in the Region of Waterloo; they are also more likely to believe the Region should spend money to increase the supply of water. Older respondents are more likely to claim they conserve water year round, and they are also more likely to have heard about a proposed pipeline. Younger respondents are more likely to prefer decreasing the demand instead of increasing the supply; and older respondents are more likely to prefer a combination of decreasing the demand and increasing the supply.

Two significant relationships relate to education. More highly educated respondents are more likely to believe access to water should be limited. They are also more likely to prefer decreasing the demand instead of increasing the supply.

One significant relationship relates to income. Higher income respondents are more likely to believe access to water should be limited.

One significant relationship relates to gender. Male respondents are more likely to have heard about a proposed pipeline.

Based on the statistically significant findings, the present study indicates that age is the best predictor of water conservation behaviour. This finding is supported by

previous studies; however there has been much debate over which demographic variable plays the largest role in predicting environmentally friendly behaviour. Some studies support the finding that age is the most important variable related to environmentally friendly practices (e. g. Barr, 2003; Miller and Buys, 2008; Raudsepp, 2001). Many more studies, however, find that income is much more connected with environmentally friendly behaviour, whereas a higher income is positively related to this (e. g. Kessler, 2006; Poortinga, Steg and Vlek, 2004; Torgler and Garcia-Valinas, 2007; Trumbo and O'Keefe, 2001). Education has also been noted the best predictor, as more educated individuals tend to be more environmentally friendly (e. g. Howell and Laska, 1992; Lam, 2006).

The present study finds that while older residents do claim to have more conservation behaviours than younger residents, they are also more in favour of increasing the water supply. This tendency to favour increasing supply might be explained by the Region's reliance on groundwater and the perception of scarce local resources. Residents who might have lived in the area for a longer period of time might be more aware of these issues, and therefore respond by supporting an increased supply.

In addition to using a questionnaire, newspaper articles from *The Record* were consulted, and show both support and concern for increasing the water supply. Seven

experts were interviewed and provide insight to the advantages and disadvantages that might accompany the construction of a pipeline. The most noted advantage was the security a pipeline would provide; the Region would be able to reconcile concerns about inadequate water supplies. The most noted disadvantages were the financial cost of constructing a pipeline and the environmental consequences that would ensue. An increased supply might increase the amount of effluent created and released into the Grand River, and it might impact the success rates of conservation programs.

In response to the first and second research questions, it is clear that many residents perceive the current water supply as limited. This has been illustrated through the questionnaire results and the newspaper analysis. Actions reflect this perception in many ways. For example, some residents conserve water as much as possible, and abide by rules by the Region in an attempt to minimize the amount of water they use. Others, who believe the Region should have already increased supply, do not change their habits and refuse to abide by regulations; this refusal to change behaviours may be an attempt to send a message of the necessity to increase supply.

In response to the third and fourth research questions, perceptions might change if a pipeline were to be constructed. Residents would likely begin to use more water, as indicated in the current study, assuming that conservation measures become less stringent. The Region, however, could influence this outcome; if conservation were still

encouraged and current outdoor watering restrictions kept in place, water use would likely not increase. If a pipeline were constructed, the extent to which it would encourage consumption could be strongly influenced by the actions of the Region.

6.4 MAIN CONCLUSIONS

The Region of Waterloo has been and is creating a culture of water conservation; residents are generally aware of water- related issues, and a dialogue is continually present in *The Record*. If length of residence in the area is an indicator of good conservation habits, the Region has been successful in conveying its message. On the same note, policy makers should adapt their policies to reflect this possibility, aiming new initiatives more at first-time homeowners in the area.

Many residents perceive the current water supply to be inadequate, or believe it will become inadequate with future growth. If the Region continues on its current path, securing additional supply sources seems inevitable. Delaying these additional sources would depend on the rate of growth, and the success of additional conservation programs. Some residents choose to support the Region by engaging in behaviour that limits water consumption. Others, however, feel that a pipeline is long overdue, and resist minimizing personal water use. Based on this, constructing a pipeline does seem to be the less complicated approach to solving concerns about water scarcity. In order to delay a pipeline, support from residents would need to be undivided.

It is unclear how perceptions might change if a pipeline were to be built in the future. Consumption, however, could likely be influenced by the persistence of the Region in continuing conservation programs.

6.5 RECOMMENDATIONS

It might be worthwhile for the Region to consider limiting anticipated growth, because growth could create a tremendous strain on water resources. It might also be reasonable to deliver varying qualities of water to consumers, so that energy can be saved and drinking-quality water distributed only where necessary. Furthermore, it is important that the Region identify other municipalities that the pipeline would affect, and consult them before constructing this infrastructure. Areas downstream of the region would be particularly affected by additional effluent discharged into the Grand River.

Education should be used as the primary tool to promote the value of water to future generations. This research has suggested that exposure to water conservation programs can greatly affect residents' attitudes and habits.

A change in pricing might encourage those not inclined to conserve to change their behaviours. An increasing block rate would be the most appropriate way to increase conservation. The first tier (approximately 100 litres per person) should be set fairly low to ensure that price increases do not negatively affect those on lower incomes.

The second tier (101-300 litres) should be at least double the first tier to deter residents from over consumption. The third tier should drastically increase to penalize those using more water than the Region deems necessary.

In order to ensure that a pipeline does not undermine conservation efforts, it is important that the Region at least continue water efficiency programs at the current level, and, ideally expand them. Outdoor water use restrictions should remain in place, and education still be pursued. Ultimately, it would be the example the Region sets that should determine the way water is used after the construction of a pipeline. The Region of Waterloo has the capacity to drive either conservation or consumption.

6.6 OVERALL STRENGTHS AND LIMITATIONS

The major strength of this research was its methodology, which included an extensive literature review and the incorporation of three types of data. The questionnaires were effective in uncovering attitudes and behaviours of residents in the region, as well as attaining demographic data so that significant relationships could be discovered. The newspaper review and expert interviews were essential to cross check the findings from the questionnaire, and to provide a context for answers.

A major limitation was that much of the research was based on a possible scenario, the construction of a pipeline; residents were questioned on how they believed they *might* respond. It is uncertain whether residents can accurately predict their

behaviour based on possible circumstances. Furthermore, research has found that questionnaire respondents often tend to overstate their good intentions (e.g. De Oliver, 1999). Another limitation was that the questionnaire did not ask about length of residence, which would have been useful in determining: (1) Whether age was the most important factor towards attitudes and behaviours, or (2) If age was inextricably linked with length of residence in the region.

6.7 OPPORTUNITIES FOR FURTHER RESEARCH

Two major suggestions exist for further research. First, it would be useful to explore the experiences of other municipalities already using a Great Lakes pipeline. The situations of these municipalities before and after a pipeline was built could be compared and contrasted to the Region's current experience. This analysis could be useful in determining whether the Region should continue moving forward with this initiative, and whether a pipeline is indeed the appropriate solution to existing issues. This analysis might also provide insight as to whether a pipeline would contribute to increased water consumption, as some expect that it might. Two communities that could be investigated in Ontario are London and Haldimand.

Many questions could be investigated, such as: (1) Why did these municipalities choose a pipeline as the means to solve water scarcity concerns? (2) How did their residents' water use change after a pipeline was constructed? (3) Was the outcome

similar to what the municipality had anticipated? (4) Were there any unexpected consequences? (5) What lessons could the Region of Waterloo learn from these municipalities?

Second, it would be useful to explore, in more depth, the effect of age on conservation attitudes and habits. As age was found to be the variable most linked with conservation in this research, as well as in other studies (e.g. Miller and Buys, 2008; Raudsepp, 2001), future research could explore how and why age affects a person's willingness to conserve. It would be important to consider examining multiple age groups to pinpoint more specifically the age at which a change in behaviours might occur. For example, a researcher could study ages by cohorts of five years to establish the changes in attitudes and behaviours over time.

It would also be beneficial to study other communities to establish if age is a significant variable elsewhere, or if this trend is unique to the Region of Waterloo. It would be important to determine, too, the interrelations among age, education, and income, as they are not independent variables. Length of residence would also be important to consider, and it would be valuable to separate the relationship between length of residence and age, determining which of these two variables plays the largest role in shaping behaviours.

REFERENCES

Barr, S. (2003). Strategies for sustainability: citizens and responsible environmental behaviour. *Area, 35*(3), 227-240.

Barrick, F. (2007). Meet the weed and water cop. *The Record*, August 11, A1, A14.

Bartoszczuk, P. and Nakamori, Y. (2002). Modeling Sustainable Water Prices. In Quaddus, M. and Siddique, A., editors, *Handbook of Sustainable Development Planning: Studies in Modelling and Decision Support*, Cheltenham, UK: Edward Elgar Publishers, 1-26.

Beintema, C. (2006). The math's all wet. *The Record*, July 13, A8.

Bellamy, S., and Boyd, D. (2005). *Water Use in the Grand River Watershed*. Cambridge, ON: Grand River Conservation Authority.

Bernard, H. Russell. (2000). *Social Research Methods: Qualitative and Quantitative Approaches.* Thousand Oaks, CA: Sage Publications, Inc.

Biswas, A. K. (2004). Integrated Water Resources Management: A Reassessment. *Water International, 29*(2), 248-256.

Biswas, A. K. (1976). *Systems Approach to Water Management.* New York, NY: McGraw-Hill, Inc.

Braga, B. P. F. (2001). Integrated Urban Water Resources Management: A Challenge into the 21st Century. *Water Resources Development, 17*(4), 581-599.

Brandes, O. M. (2003). *Flushing the Future? Examining Urban Water Use in Canada.* Victoria, B.C.: POLIS Project on Ecological Governance.

Brandes, O. M., Ferguson, K., M'Gonigle, M., and Sandborn, C. (2005). *At a Watershed: Ecological Governance and Sustainable Water Management in Canada.* Victoria, B.C.: POLIS Project on Ecological Governance.

Brandes, O. M. and Kriwoken, L. (2005). *Changing Perspectives – Changing Paradigms: Demand management strategies and innovative solutions for a sustainable Okanagan water future.* Kelowna, B. C.: CWRA Annual Conference.

Burke, D., Leigh, L., and Sexton, V. (2001). *Municipal Water Pricing, 1991-1999.* Ottawa, ON: Environment Canada.

Burtt, B. (2006a). Puzzling out region's future; swelling forecasts for its population force planners to reassess growth strategy. *The Record*, January 30, B2.

Burtt, B. (2006b). Well-aimed worries; Chlorinated solvents have contaminated an estimated 39 sites in Waterloo Region. *The Record*, March 25, P1.

Burtt, B. (2006c). Water limits 'here to stay'. *The Record*, July 4, A1.

Burtt, B. (2005a). Conserving water still vital to region. *The Record*, June 21, B3.

Burtt, B. (2005b). Pipeline for Lake Huron pipeline in jeopardy; Canada, U.S. negotiating deal that would force region to use Lake Erie. *The Record*, July 8, A1.

Burtt, B. (2005c). Water woes on tap until 2007; Conservation measure won't end with five wells out of commission. *The Record,* July 9, B1.

Burtt, B. (2004a). Municipalities, mining are top water users. *The Record*, March 10, B4.

Burtt, B. (2004b). Dry spell about to end. *The Record*, October 14, A1.

Burtt, B. (2003a). Grand, but not so clean; Environmentalists fear region's growth will be too much for the Grand River to handle. *The Record*, July 26, J1.

Burtt, B. (2003b). Rain has failed to replenish aquifers. *The Record*, July 31, B5.

Carlsson, F. and Johansson-Stenman, O. (2000). Willingness to pay for improved air quality in Sweden. *Applied Economics, 32*, 661-669.

Casey, P. J. and Scott, K. (2006). Environmental concern and behaviour in an Australian sample within an ecocentric-anthropocentric framework. *Australian Journal of Psychology, 58*(2), 57-67.

Chermak, J. M., and Krause, K. (2001). The Impact of Heterogeneous Consumer Response on Water Conservation Goals. *Technical Completion Report.* New Mexico: New Mexico Water Resources Research Institute.

City of Barrie. (2007). 2007 Residential Water and Sewer Rates. Retrieved December 11, 2007, from http://www.city.barrie.on.ca.

City of Ottawa. (2001). Water Consumption. Retrieved February 12, 2008, from http://www.ottawa.ca.

City of Sault Ste. Marie. (2007). Water Rates. Retrieved December 11, 2007, from http://www.ssmpuc.com.

City of Toronto. (2007). 2007 Water Rates. Retrieved December 11, 2007, from http://www.toronto.ca/water_bill/water_rates.htm.

City of Waterloo. (2007a). 2006 Ward and Polling Areas. Retrieved November 5, 2007, from http://wms.waterloo.ca/wards/GISAddress.asp.

City of Waterloo. (2007b). Strategic Plan. Retrieved November 28, 2007, from http://www.city.waterloo.on.ca.

City of Waterloo. (2005). Planning District Statistics. Retrieved November 19, 2007 from http://www.city.waterloo.on.ca.

City of Waterloo (2002). Environmental Strategic Plan. Retrieved November 26, 2007, from http://www.city.waterloo.on.ca/

Corral-Verdugo, V., Frias-Armenta, M., Perez-Urias, F., Orduna-Cabrera, V., and Espinoza-Gallego, N. (2002). Residential Water Consumption, Motivation for Conserving Water and the Continuing Tragedy of the Commons. *Environmental Management*, *30*(4), 527-535.

Cortner, H. J., and Moote, M. A. (1994). Trends and Issues in Land and Water Resources Management: Setting the Agenda for Change. *Environmental Management, 18*(2), 167-173.

Crocker, E. (2005). Stop wasting water. *The Record*, June 22, A14.

Daily, G. C., and Ehrlich P. R. (1996). Socioeconomic Equity, Sustainability, and Earth's Carrying Capacity. *Ecological Applications, 6*(4), 991-1001.

De Loë, R., personal communication, November 27, 2007.

De Oliver, M. (1999). Attitudes and Inaction: A Case Study of the Manifest Demographics of Urban Water Conservation. *Environment and Behavior, 31*(3), 372-394.

Dewees, D. N. (2002). Pricing Municipal Services: The Economics of User Fees. *Canadian Tax Journal, 50*(2), 586-599.

Dinar, A. and Subramanian, A. (1997). Water Pricing Experiences: An International Perspective. In A. Dinar and A. Subramanian, editors, *Water Pricing Experiences: An International Perspective* (1-12). Washington, D.C.: The World Bank.

Domene, E. and Sauri, D. (2006). Urbanisation and Water Consumption: Influencing Factors in the Metropolitan Region of Barcelona. *Urban Studies, 43*(9), 1605-1623.

Environews. (2006). *Water Conservation Target of 1.8 Million Gallons Per Day Set*. Region of Waterloo, ON: Transportation and Environmental Services.

Environment Canada. (2007). *Water*. Retrieved November 14, 2007, from http://www.ec.gc.ca/.

Environment Canada. (2006, September 15). *Canada Water Act.* Retrieved November 3, 2006, from http://laws.justice.gc.ca/en/C-11/225339.html.

Environment Canada. (2004). *Threats to Water Availability in Canada*. National Water Research Institute, Burlington, Ontario. NWRI Scientific Assessment Report Series No. 3 and ACSD Science Assessment Series No 1. 128 p.

Etienne, J., personal communication, January 17, 2008.

Gallaugher, P. and Wood, L. (2006). Conference Proceedings: *Water and Cities: Acting on the Vision.* Simon Fraser University.

Gelissen, J. (2007). Explaining Popular Support for Environmental Protection. *Environment and Behaviour, 39*(3), 392-415.

Gilg, A., Barr, S. and Ford, N. (2005). Green consumption or sustainable lifestyles? Identifying the sustainable consumer. *Futures, 37,* 481-504.

Gleick, P. H. (2003). Global Freshwater Resources: Soft-Path Solutions for the 21st Century. *Science, 302,* 1524-1528.

Gleick, P. H. (2002). Water management: Soft water paths. *Nature, 418,* 373.

Gleick, P. H. (1998). Water in Crisis: Paths to Sustainable Water Use. *Ecological Applications, 8*(3), 571-579.

Grand River Conservation Authority. (1995-2007). *Water.* Retrieved March 16, 2007, from http://www.grandriver.ca.

Grand River Conservation Authority staff, personal communication, November 29, 2007.

Greff, J. (2005). Water restrictions are severe but necessary. *The Record*, June 3, A12.

Foster, H. D. and Sewell, W. R. D. (1981). *Water: The Emerging Crisis in Canada.* Toronto, ON: James Lorimer & Co.

Halma, A. (2003). Make water-guzzlers pay. *The Record*, July 15, A8.

Hamilton, L. C. (1985). Self-Reported and Actual Savings in a Water Conservation Campaign. *Environment and Behavior, 17*(3), 315-326.

Harrison, A. (2004). Region needs a pipeline. *The Record*, April 14, A10.

Heath, L. K. (2001). *Education for Water Efficiency Initiatives in the Regional Municipality of Waterloo: Measuring Current Effectiveness to Improve Future Success.* Unpublished M.E.S. thesis, University of Waterloo, Waterloo, Ontario, Canada.

Heslop, L. A., Moran, L., and Cousineau, A. (1981). "Consciousness" in Energy Conservation Behavior: An Exploratory Study. *The Journal of Consumer Research, 8*(3), 299-305.

Hodgson, C. (2006). The region already uses its water wisely. *The Record*, June 30, A16.

Holme, R. (2006). We're doing our best. *The Record*, June 30, A16.

Horbulyk, T. M. (1997). Canada. In A. Dinar and A. Subramanian, editors, *Water Pricing Experiences: An International Perspective* (pp. 37-45). Washington, D.C.: The World Bank.

Howell, S. E. and Laska, S. B. (1992). The Changing Face of the Environmental Coalition. *Environment and Behaviour, 24*(1), 134-144.

Hunter, L. M., Hatch, A. and Johnson, A. (2004). Cross-National Gender Variation in Environmental Behaviors. *Social Science Quarterly, 85*(3), 677-694.

Intelligent Waterloo. (2006). *Intellect.* Retrieved November 19, 2007, from http://www.intelligentwaterloo.com/en/.

Jain, S. K. and Kaur, G. (2006). Role of Socio-Demographics in Segmenting and Profiling Green Consumers: An Exploratory Study of Consumers in India. *Journal of International Consumer Marketing, 18*(3), 107-146.

Jonch-Clausen, T., and Fugl, J. (2001). Firming up the Conceptual Basis of Integrated Water Resources Management. *Water Resources Development, 17*(4), 501-510.

Kaufman, M. C. (2005). Region needs a pipeline. *The Record*, June 4, A12.

Kessler, C. A. (2006). Decisive key-factors influencing farm households' soil and water conservation investments. *Applied Geography, 26*, 40-60.

Kollmuss, A. and Agyemen, J. (2002). Mind the Gap: why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research, 8*(3), 239-260.

Koster, H. (2006). This region needs better government; Keep pace with growth. *The Record*, May 13, A19.

Lam, S. (2006). Predicting Intention to Save Water: Theory of Planned Behavior, Response Efficacy, Vulnerability, and Perceived Efficiency of Alternative Solutions. *Journal of Applied Social Psychology, 36*(11), 2803-2824.

Laurance, W. F. (2004). The perils of payoff: corruption as a threat to global biodiversity. *TRENDS in Ecology and Evolution, 19*(8), 399-401.

Lilienfeld, A., and Asmild, M. (2007). Estimation of excess water use in irrigated agriculture: A Data Envelopment Analysis Approach. *Agricultural Water Management, 94,* 73-82.

Ludwig, D., Hilborn, R. and Walters, C. (1993). Uncertainty, Resource Exploitation, and Conservation: Lessons from History. *Science, 260*(2), 17, 36.

Maas, T. (2007). Opposed to pipeline. *The Record*, January 24, A10.

Maas, T., personal communication, December 6, 2007.

MacIver, I. (1970). *Urban Water Supply Alternatives: Perception and Choice in the Grand Basin, Ontario.* Department of Geography Research Paper No. 126. Chicago, IL: University of Chicago.

Malla, P. B. and Gopalakrishnan, C. (1997). Residential Water Demand in a Fast-growing Metropolis: The Case of Honolulu, Hawaii. *Water Resources Development, 13*(1), 35-51.

McMahon, T. (2007). Bottle Culture. *The Record*, July 13, A1.

Miller, E. and Buys, L. (2008). The Impact of Social Capital on Residential Water-Affecting Behaviors in a Drought-Prone Australian Community. *Society and Natural Resources*, *21*, 244-257.

Mitchell, B. (2002). *Resource and Environmental Management.* Harlow, U.K.: Longman.

Molle, F., and Turral, H. (2004). Demand management in a basin perspective: is the potential for water saving overestimated? *International Water Demand Management Conference.*

Moran Migus, D. (2004). Don't build Erie pipeline. *The Record*, July 28, A12.

Morell, A. (2008). Collect rain water before it enters sewers. *The Record*, January 12, A16.

Morgan, A. (2003). Garden expert's success comes from using what nature provides. *The Record*, August 19, A6.

Morris, T. and Maas, T. (2007). Your tap, your toilet and the Great Lakes. *Globe and Mail*, October 4.

Niemczynowicz, J. (1999). Urban Hydrology and Water Management - Present and Future Challenges. *Urban Water 1,* 1-14.

Nieswiadomy, M. L. (1992). Estimating Urban Residential Water Demand: Effects of Price Structure, Conservation, and Education. *Water Resources Research, 28*(3), 609-615.

Neuman, W.L. (2003). *Social Research Methods: Qualitative and Quantitative Approaches (5th ed.).* Boston, MA: Allyn and Bacon.

[No Author]. "Waterloo honoured as one of the top 7 intelligent communities." (2006, June 9). Retrieved November 19, 2007, from http://www.city.waterloo.on.ca.

Oliverio, T. (2005). We must limit water use. *The Record*, June 9, A8.

Ontario Ministry of Agriculture, Food, and Rural Affairs. (2007). *Water.* Retrieved November 28, 2007, from http://www.omafra.gov.on.ca/.

Ontario Ministry of Natural Resources. (2007a). *Water Resources.* Retrieved November 14, 2007, from http://www.mnr.gov.on.ca/.

Ontario Ministry of Natural Resources. (2007b). "New legislation provides stronger protection for Great Lakes and Ontario's Water Resources Backgrounder", June 1, Retrieved November 28, 2007, from http://www.mnr.gov.on.ca/Mnr/csb/news/2007/jun01bg_07.html.

Ontario Ministry of Public Infrastructure Renewal. (2005). *Places to Grow Act.* Retrieved November 5, 2007, from http://www.pir.gov.on.ca/English/growth/ggh_plan.htm.

Ontario Ministry of the Environment. (2007). *Water.* Retrieved November 14, 2007, from http://www.ene.gov.on.ca/.

Outhit, J. (2007a). Can't slash expensive projects, region says. *The Record*, February 8, B1.

Outhit, J. (2007b). Once-a-week watering could be 'new normal'. *The Record*, March 6, A1.

Outhit, J. (2007c). Tough water rules here to stay. *The Record*, March 7, B1.

Outhit, J. (2007d). The challenges of Earth Day. *The Record*, April 21, A3.

Outhit, J. (2007e). No rush for Lake Erie pipeline; Councillors decide to abide by plan of delaying construction until at least 2035. *The Record*, June 13, B6.

Outhit, J. (2007f). Rain, rain don't go away! *The Record*, June 28, A1.

Outhit, J. (2007g). Water limits save region 1.5B litres. *The Record*, December 5, B1.

Outhit, J. (2006). Cities resist pooling water works. *The Record*, June 24, A1, A12-A13.

Outhit, J. (2005a). Water gets political. *The Record*, June 4, P1.

Outhit, J. (2005b). Fine irks homeowner. *The Record*, October 7, B1.

Overgaard, H. O. F. (1960). *Water Problems in Southwestern Ontario.* Unpublished Ph.D. dissertation, Columbia University, New York.

Parker, P., Rowlands, I. H. and Scott, D. (2005). Who Changes Consumption Following Residential Energy Evaluations? Local Programs Need All Income Groups to Achieve Kyoto Targets. *Local Environment*, *10*(2), 173-187.

Pearson, D. (2007). Water ban supported. *The Record*, March 12, A8.

Poortinga, W., Steg, L. and Vlek, C. (2004). Values, Environmental Concern, and Environmental Behavior: A Study into Household Energy Use. *Environment and Behavior*, *36*, 70-93.

Postel, S. L. (2000). Entering an Era of Water Scarcity: The Challenges Ahead. *Ecological Applications 10*(4), 941-948.

Postel, S. L. (1994). Carrying Capacity: Earth's Bottom Line. *Challenge, 37*(2), 4-12.

Prender, T. (2007). Water, sewer rates jump another 8%. *The Record,* March 22, B2.

Prender, T. (2005). Merger votes 'outrageous'. *The Record*, October 8, B1-B2.

Professor from a southwestern Ontario university, personal communication, November 22, 2007.

Raudsepp, M. (2001). Some socio-demographic and socio-psychological predictors of environmentalism. *Trames, 5*(3), 355-367.

Region of Waterloo. (2007). *Water Services.* Retrieved March 19, 2007, from http://www.region.waterloo.on.ca.

Region of Waterloo. (2006). *Water Efficiency Master Plan.* Retrieved November 27, 2007, from http://www.region.waterloo.on.ca.

Region of Waterloo. (2005). *Naturescaping.* Retrieved December 4, 2007, from http://www.region.waterloo.on.ca.

Region of Waterloo. (2003a). *Regional Growth Management Strategy.* Retrieved November 28, 2007, from http://www.region.waterloo.on.ca.

Region of Waterloo. (2003b). *Statistical Profile.* Retrieved November 27, 2007, from http://www.region.waterloo.on.ca.

Region of Waterloo. (2000). *Long Term Water Strategy.* Retrieved December 17, 2007, from http://www.region.waterloo.on.ca.

Region of Waterloo GIS Department. (2007). *GIS Locator.* Retrieved November 5, 2007, from http://www.region.waterloo.on.ca/locator.htm

Region of Waterloo staff(a), personal communication, November 13, 2007.

Region of Waterloo staff(b), personal communication, November 13, 2007.

Renwick, M. E., and Archibald, S. O. (1998). Demand Side Management Policies for Residential Water Use: Who Bears the Conservation Burden? *Land Economics, 74*(3), 343-359.

Rogers, P., de Silva, R., and Bhatia, R. (2002). Water is an economic good: How to use prices to promote equity, efficiency, and sustainability. *Water Policy, 4*, 1-17.

Savenije, H. and van der Zaag, P. (2002). Water as an Economic Good and Demand Management: Paradigms with Pitfalls. *Water International, 27*(1), 98-101.

Schrader, W. (2005). Turn the hoses off. *The Record*, June 6, A8.

Schwindt, M. (2008). Piped-in water worries. *The Record*, January 5, A14.

Serageldin, I. (1995). Water Resources Management: A New Policy for a Sustainable Future. *Water Resources Development, 11*(3), 221-232.

Sherk, V. (2006). This region needs better government; Essential for growth. *The Record*, May 13, A19.

Shrubsole, D., and Tate, D., editors. (1994). *Every Drop Counts.* Cambridge, U.K.: Cambridge Water Resources Association.

Statistics Canada. (2007). *City of Waterloo.* Retrieved Oct 10, 2007, from http://www.statcan.ca.

Stevenson, K. (2007). Water salute a waste. *The Record*, July 14, A16.

Stutzman, T. M. and Green, S. B. (1982). Factors affecting energy consumption: Two field tests of the Fishbein-Ajzen model. *The Journal of Social Psychology, 117,* 183-201.

Sutherland, R. J. (1994). Income distribution effects of electric utility DSM programs. *Energy Journal, 15*(4), 103-118.

Swayze, K. (2005). Region to focus on local upgrades to meet Cambridge's water needs. *The Record,* June 29, D13.

The Record. (2007a). Higher water bills remain a bargain. February 17, A16.

The Record. (2007b). Water ban is necessary. March 9, A12.

The Record. (2007c). Abide by watering rules. June 16, A16.

The Record. (2006a). Water becomes as valuable as oil. July 5, A12.

The Record. (2006b). Great Lakes pipeline on Ditner's agenda. October 3, B7.

The Record. (2006c). Candidate looks ahead 25 years. October 24, A4.

The Record. (2005a). Huron's depth affects the region. January 26, A12.

The Record. (2005b). Is water system safe and secure? March 12, A16.

The Record. (2005c). Water cutbacks a necessary evil. May 21, A12.

The Record. (2005d). Don't supersize our waterworks. June 4, A12.

The Record. (2005e). A balanced water ban. June 10, A14.

The Record. (2005f). [Water… Wa…]. July 7, A6.

The Record. (2005g). Region should control water. October 14, A12.

The Record. (2003). Work delayed to save water. August 21, B1.

The Record. (2002). [Welcome to the Region of Waterloo]. June 29, A10.

Tilikidou, I. (2007). The Effects of Knowledge and Attitudes upon Greeks' Pro-Environmental Purchasing Behaviour. *Corporate Social Responsibility and Environmental Management, 14*, 121-134.

Tisdale, R. (2005). Region's water restrictions are unacceptable. *The Record*, May 30, A8.

Torgler, B. and Garcia-Valinas, M. A. (2007). The determinants of individuals' attitudes towards preventing environmental damage. *Ecological Economics, 63*, 536-552.

Trumbo, C. W., and O'Keefe, G. J. (2001). Intention to Conserve Water: Environmental Values, Planned Behavior, and Information Effects. A Comparison of Three Communities Sharing a Watershed. *Society and Natural Resources, 14*, 889-899.

Tsur, Y., Dinar, A., Doukkali, R. M., and Roe, T. (2004). Irrigation water pricing: Policy implications based on international comparison. *Environment and Development Economics, 9*(6), 735.

Water and Megacities. (2001). Conference Report: *Water Policy, 3*, S193-S194.

Waterloo Hydrogeologic. [n. d.]. *Grand River Watershed Groundwater Flow Model.* Retrieved March 21, 2007, from http://www.waterloohydrogeologic.com.

Weigel, R. H. (1977). Ideological and demographic correlates of proecology behavior. *The Journal of Social Psychology, 103,* 39-47.

Weiss, P. (2004). Make water a priority. *The Record*, May 21, A12.

York, R. (2007). Demographic trends and energy consumption in European Union Nations, 1960-2025. *Social Science Research, 36,* 855-872.

Zhang, H. H. and Brown, D. F. (2005). Understanding urban residential water use in Beijing and Tianjin, China. *Habitat International, 29,* 469-491.

Appendix A: Information Letter and Questionnaire

University of Waterloo

May 2007

Dear Resident,

This letter is an invitation to consider participating in a study I am conducting in partial fulfillment of my Masters of Environmental Studies degree in the Department of Geography at the University of Waterloo under the supervision of Dr. Bruce Mitchell.

This research project is designed to explore attitudes of residents living in the City of Waterloo with reference to the Region's water supply system, conservation initiatives, and the possible influence of a water pipeline.

Participation in this study is voluntary and anonymous. If you choose to participate, your involvement will include filling out one questionnaire, which is comprised of both closed-ended and open-ended questions (for example, Do you do anything, on a daily or weekly basis, to conserve water?). The questionnaire is expected to take approximately 15-20 minutes to complete. Your data will be combined with the data of approximately 150 residents in the City of Waterloo. You may decline to answer any questions if you so wish. Further, you may decide to withdraw from this study at any time without any negative consequences by advising the researcher. All information you provide is considered completely confidential. Your name will not appear in any thesis or report resulting from this study, however, with your permission anonymous quotations may be used. Data collected during this study will be retained for one year in a secure location and then confidentially destroyed. Only researchers associated with this project will have access. There are no known or anticipated risks to you as a participant in this study.

It would be appreciated if you would deposit the completed questionnaire, in the self-addressed stamped envelope and mail, by June 15, 2007. If you have any questions regarding this study, or would like additional information to assist you in reaching a decision about participation, please contact me by email at kmgold@fes.uwaterloo.ca. You can also contact my supervisor, Dr. Bruce Mitchell at (519) 888-4567 ext. 37502 or by email at mitchell@uwaterloo.ca.

If you do not wish to participate in this study, simply do not fill out the questionnaire.

The study results will be published as part of a thesis, tentatively scheduled for completion in April 2008. The results may be published in an academic journal and be presented at one or more conferences. If you are interested in receiving more information regarding the results of this study, please contact me by email. When the study is completed, I will send you a summary of the results.

I would like to assure you that this study has been reviewed and received ethics clearance through the Office of Research Ethics at the University of Waterloo. However, the final decision about participation is yours. If you have any comments or concerns resulting from your participation in this study, please contact Dr. Susan Sykes of this office at (519) 888-4567 Ext. 36005.

This research is intended to benefit the Region of Waterloo by investigating attitudes towards water conservation and the expected outcomes of implementing a water pipeline in the future.

Thank you again for your involvement in this study. Your participation is greatly appreciated.

Sincerely,

Kathryn Gold (Primary Investigator)
M. E. S. Candidate
University of Waterloo
Department of Geography
Faculty of Environmental Studies

Water Conservation in the Region of Waterloo and the Great Lakes Pipeline Option

If you have any questions or concerns, please contact Kathryn Gold by email at kmgold@fes.uwaterloo.ca, or Dr. Bruce Mitchell at (519) 888-4567 ext. 37502 or by email at mitchell@uwaterloo.ca.

For the resident to complete.

WATER SUPPLY (The following questions discuss water supply and conservation within the Region of Waterloo. Please circle, unless otherwise indicated.)

1. There is an adequate supply of water in the Region of Waterloo.

a) Strongly Agree b) Agree c) Neutral d) Disagree e) Strongly Disagree f) Don't Know

2. We will never run out of water in the Region of Waterloo.

a) Strongly Agree b) Agree c) Neutral d) Disagree e) Strongly Disagree f) Don't Know

3. Water conservation is an important issue in the Region of Waterloo.

a) Strongly Agree b) Agree c) Neutral d) Disagree e) Strongly Disagree f) Don't Know

4. My own water use habits have an effect on the Region's water supply.

a) Strongly Agree b) Agree c) Neutral d) Disagree e) Strongly Disagree f) Don't Know

5. It is important that the Region of Waterloo spend money to increase the supply of water.

a) Strongly Agree b) Agree c) Neutral d) Disagree e) Strongly Disagree f) Don't Know

6. It is important that the Region of Waterloo spend money to decrease the demand for water.

a) Strongly Agree b) Agree c) Neutral d) Disagree e) Strongly Disagree f) Don't Know

7. How do you obtain most of your information about the city's water initiatives? (rank all those that apply in order of importance: 1 = most important; 7 = least important)

_____ Newspapers
_____ Television
_____ People (Friends, Family, Neighbours)
_____ Inserts with utility bills
_____ Other (specify):_____

WATER HABITS (The following questions discuss personal habits and attitudes towards water conservation within the Region of Waterloo. Please circle where appropriate, and fill in the blank where necessary.)

8. I actively conserve water year round.

a) Strongly Agree b) Agree c) Neutral d) Disagree e) Strongly Disagree f) Don't Know

9. Water conservation is only necessary in cases where there is a limited supply of water.

a) Strongly Agree b) Agree c) Neutral d) Disagree e) Strongly Disagree f) Don't Know

10. In the Region of Waterloo, access to water should be unlimited.

a) Strongly Agree b) Agree c) Neutral d) Disagree e) Strongly Disagree f) Don't Know

11. Do you feel it is more important to spend money to increase the supply, or to decrease the demand?

a) Increase Supply b) Decrease Demand c) A combination of both d) Don't Know

12. If an increase in taxes were necessary to increase the water supply in the Region of Waterloo, how much would you support?

a) No increase b) 0.1% - 0.3% c) 0.4% - 0.6% d) 0.7% or more e) Don't Know

13. If necessary, I would be willing to decrease my current water use by:

a) No decrease b) Up to 10% c) 11-20% d) 21-30% e) 31-40% f) 41% Or more

14. I would be willing to incorporate additional water-saving devices in my home if there was no cost to me.

a) Strongly Agree b) Agree c) Neutral d) Disagree e) Strongly Disagree f) Don't Know

15. I would be willing to change my water use habits:

a) Drastically b) Considerably c) Somewhat d) Slightly e) Not at all f) Don't Know

16. I would only be willing to change my habits if there were a water shortage.

a) Strongly Agree b) Agree c) Neutral d) Disagree e) Strongly Disagree f) Don't Know

17. How would you rate your personal water use in comparison to others around you?

a) considerably less than average
b) slightly less than average
c) average
d) slightly more than average
e) much more than average

18. Do you do anything, on a daily or weekly basis, to conserve water? If yes, please list.

1. _____ 3. _____
2. _____ 4. _____

19. What determines how much water you use?

_____
_____
_____
_____

20. What activity consumes the greatest amount of water in your household on an average day?

_____ Toilet Flushing
_____ Showering and Bathing
_____ Laundry
_____ Cooking and Washing Dishes
_____ Outdoor Uses (i.e. lawn watering and car washing)
_____ Other (specify): _____

21. How much did you pay for your "Total Water Charges" on your last water bill? _____

22. How many cubic meters (m3) of water did you use on your last water bill? _____

23. Do you have any of the following water-saving devices? (check all that apply)

_____ Rain barrel
_____ Low-flush toilet
_____ High-efficiency dishwasher
_____ High-efficiency clothes washer
_____ Xeriscaping
_____ Other (specify)_____

PIPELINE (Please circle where appropriate, and fill in the blank where necessary.)

As part of the Region of Waterloo's Water Supply Strategy, a water pipeline may be constructed from the Region of Waterloo to Lake Erie as of 2035, with the intention of significantly increasing the water supply to meet the growing demand for the rising population.

24. This is the first time I have heard about the water pipeline.

a) Yes b) No

**** If yes, please skip this section and proceed to Demographic Information ****

25. It is necessary that the Region of Waterloo construct a pipeline to Lake Erie to increase the water supply.

a) Strongly Agree b) Agree c) Neutral d) Disagree e) Strongly Disagree f) Don't Know

26. A pipeline would increase the reliability of the water supply in the Region of Waterloo.

a) Strongly Agree b) Agree c) Neutral d) Disagree e) Strongly Disagree f) Don't Know

27. A water pipeline would ensure that residents would not have to worry about the amount of water used.

a) Strongly Agree b) Agree c) Neutral d) Disagree e) Strongly Disagree f) Don't Know

28. A water pipeline would mean that the supply of water in Waterloo would be unlimited.

a) Strongly Agree b) Agree c) Neutral d) Disagree e) Strongly Disagree f) Don't Know

29. A water pipeline would mean there is no longer a need to conserve water.

a) Strongly Agree b) Agree c) Neutral d) Disagree e) Strongly Disagree f) Don't Know

30. I may change my water use habits if a pipeline were constructed.

a) Strongly Agree b) Agree c) Neutral d) Disagree e) Strongly Disagree f) Don't Know

31. If your habits may change if a water pipeline were constructed, please explain how you would expect that they would change.

_____
_____
_____

32. What, if any, do you feel the positive outcomes of a water pipeline would be?

_____
_____
_____

33. What, if any, do you feel the negative outcomes of a water pipeline would be?

_____
_____
_____

DEMOGRAPHIC INFORMATION (These questions are included to establish which of these, if any, determine how residents conserve water in the Region of Waterloo. Please circle.)

34. Gender: Male Female

35. Age: 18-24 25-44 45-64 65+

36. Gross Household Income:

<$20,000	$20,000-$39,999	$40,000-$59,999
$60,000-$79,000	$80,000-$99,999	$100,000-$119,999
$120,000-$139,999	$140,000-$159,999	>$160,000

37. Including yourself, how many people currently reside in your household? 1 2 3 4 >4

38. In what year was your home built? _____

39. Do you own or rent your home? Own Rent

40. If you rent, do you pay your own utility bills? Yes No

41. What is your highest level of education?

Did not complete high school
Completed high school
Completed post-secondary college or university
Completed post-graduate college or university

42. What type of *environmental* education or experience do you have? (check all that apply)

_____ None

_____ High school courses only
_____ College or university electives
_____ College or university major (specify diploma/degree received)_____
_____ Post graduate college or university electives
_____ Post graduate college or university major (specify diploma/degree received) _____

_____ Work related experience
_____ Volunteer experience

_____ Television
_____ Books
_____ Newspaper

_____ Other (specify):_____

43. I agree to the use of anonymous quotations in the thesis or any resulting publications.

Yes No

44. Please use the remaining space to provide any comments you may have about the survey, or to expand on any answers to questions from this survey.

_____
_____
_____
_____
_____
_____
_____
_____
_____

Appendix B: Email Request for Expert Interview

Subject: “Water pipeline interview”

Dear (insert name),

My name is Kathryn Gold, and I am a 2nd year Masters of Environmental Studies student at the University of Waterloo. I am conducting research under the supervision of Dr. Bruce Mitchell (mitchell@uwaterloo.ca). My area of interest is water conservation, with specific reference to the proposed water pipeline that, if constructed, would run from Lake Erie to the Region of Waterloo.

Thus far, I have conducted a survey of residents within the City of Waterloo, and collected newspaper articles on the subject. I would now like to enhance these methods with personal interviews.

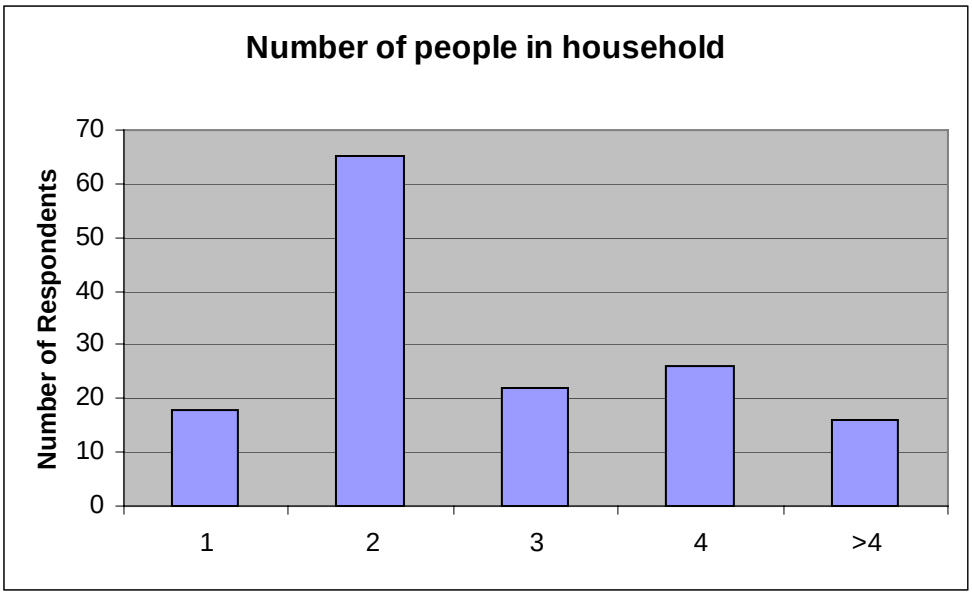
If possible, I would like to meet with you to discuss some of the possible implications of this pipeline. The interview would take approximately 30 minutes, and you may choose not to answer any question for any reason. The answers you provide may be cited in my thesis or any other publication that may result. You would, of course, be able to identify any answer that you would not want connected with your name. I would appreciate your participation in my research.

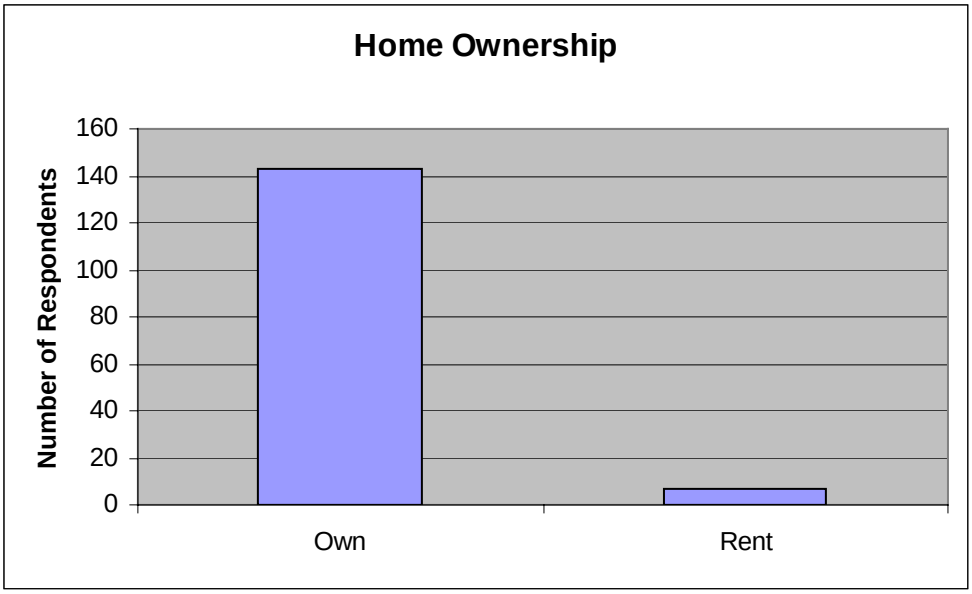
If you would like to participate, I can be reached through email at kmgold@fes.uwaterloo.ca. I look forward to hearing from you.

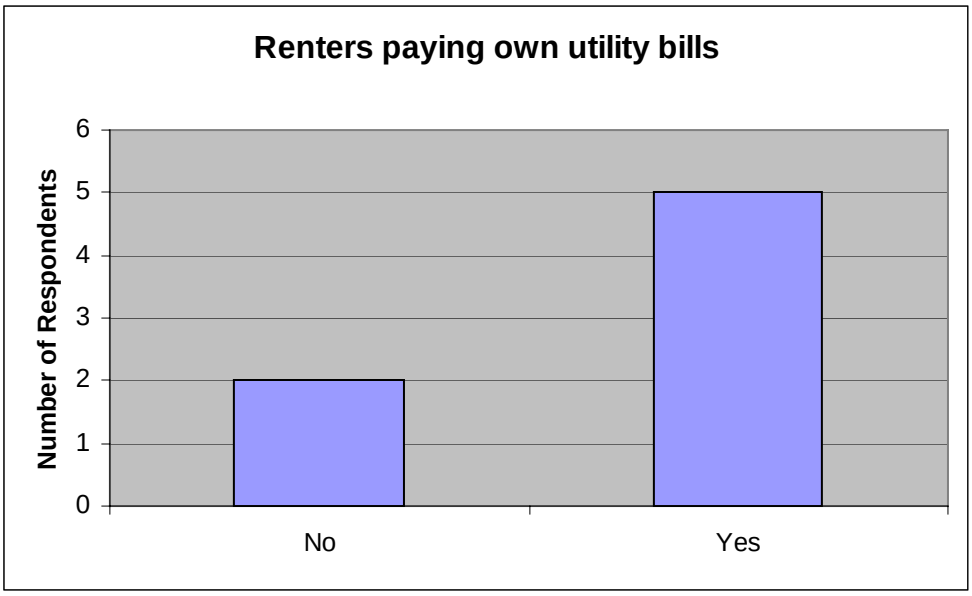
Sincerely,

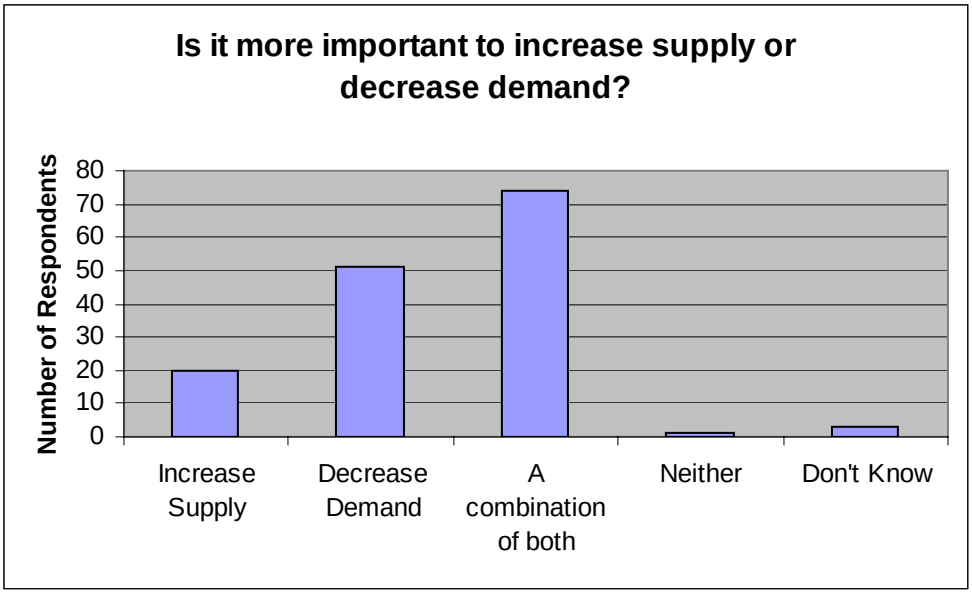
Kathryn Gold
M.E.S. Candidate
University of Waterloo

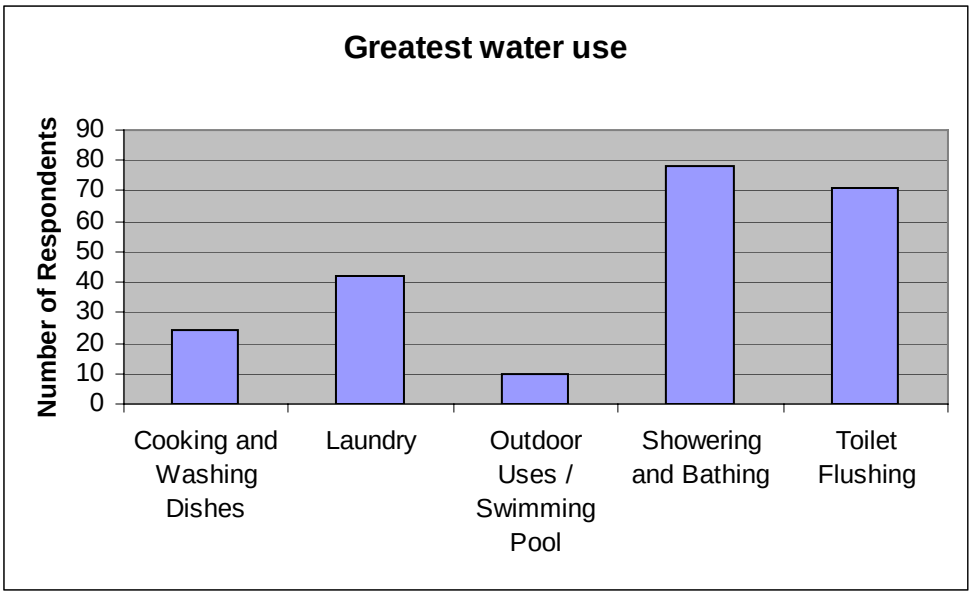
Appendix C: Figures and Tables not included in Chapter Five

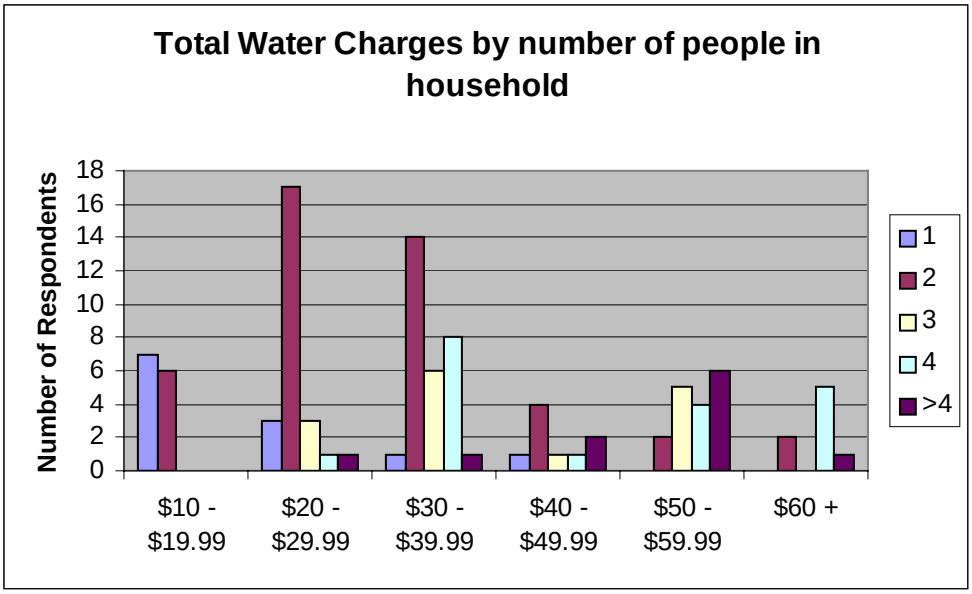

Number of people in household
Number of Respondents
70
60
50
40
30
20
10
0
1
2
3
4
>4

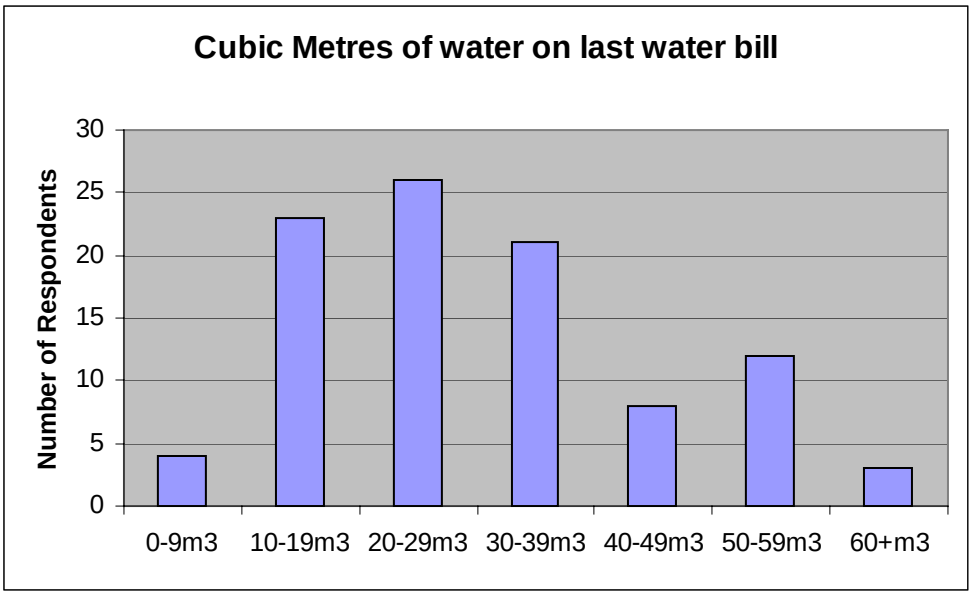

Home Ownership
Number of Respondents
160
140
120
100
80
60
40
20
0
Own
Rent

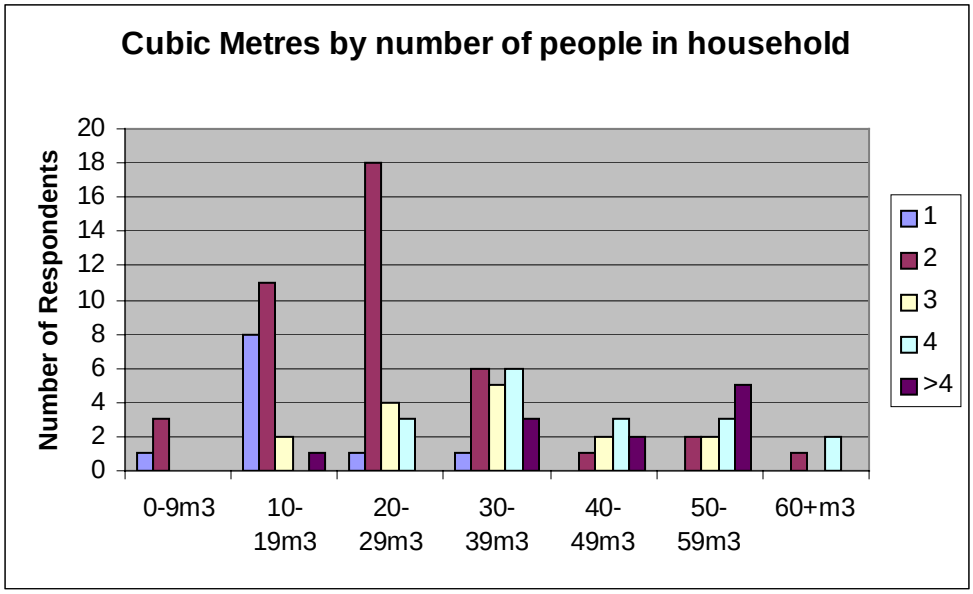

Renters paying own utility bills
Number of Respondents
6
5
4
3
2
1
0
No
Yes


Is it more important to increase supply or decrease demand?
Number of Respondents
80
70
60
50
40
30
20
10
0
Increase Supply
Decrease Demand
A combination of both
Neither
Don't Know


Greatest water use
Number of Respondents
90
80
70
60
50
40
30
20
10
0
Cooking and Washing Dishes
Laundry
Outdoor Uses / Swimming Pool
Showering and Bathing
Toilet Flushing


Total Water Charges by number of people in household
Number of Respondents
18
16
14
12
10
8
6
4
2
0
$10 - $19.99
$20 - $29.99
$30 - $39.99
$40 - $49.99
$50 - $59.99
$60 +
1
2
3
4
>4


Cubic Metres of water on last water bill
Number of Respondents
30
25
20
15
10
5
0
0-9m3
10-19m3
20-29m3
30-39m3
40-49m3
50-59m3
60+m3


Cubic Metres by number of people in household
Number of Respondents
20
18
16
14
12
10
8
6
4
2
0
0-9m3
10-19m3
20-29m3
30-39m3
40-49m3
50-59m3
60+m3
1
2
3
4
>4

1. There is an adequate supply of water in the Region of Waterloo.

	Agree	Neutral	Disagree	Total
Female	21	5	30	56
Male	24	9	30	63
Total	45	14	60	119

Significance Level = 0.627
Not significant

	Agree	Neutral	Disagree	Total
18-44	24	4	14	42
45+	25	11	52	88
Total	49	15	66	130

Significance Level = 0.006
Significant

	Agree	Neutral	Disagree	Total
<$20,000-$59,999	12	2	17	31
$60,000-$119,999	17	9	29	55
$120,000+	15	3	14	32
Total	44	14	60	118

Significance Level = 0.444
Not significant

	Agree	Neutral	Disagree	Total
No post-secondary education	12	3	19	34
Post-secondary education	37	12	47	96
Total	49	15	66	130

Significance Level = 0.74
Not significant

2. We will never run out of water in the Region of Waterloo.

	Agree	Neutral	Disagree	Total
Female	4	8	43	55
Male	4	1	57	62
Total	8	9	100	117

Chi Square not valid

	Agree	Neutral	Disagree	Total
18-44	4	4	31	39
45+	8	6	77	91
Total	12	10	108	130

Chi Square not valid

	Agree	Neutral	Disagree	Total
No post-secondary education	4	5	25	34
Post-secondary education	7	6	83	96
Total	11	11	108	130

Significance Level = 0.2
Not significant

3. Water Conservation is an important issue in the Region of Waterloo.

	Agree	Neutral	Disagree	Total
Female	60	2	2	64
Male	68	1	0	69
Total	128	3	2	133

Chi Square not valid

	Agree	Neutral	Disagree	Total
18-44	41	2	0	43
45+	100	1	3	104
Total	141	3	3	147

Chi Square not valid

	Agree	Neutral	Disagree	Total
<$20,000-$59,999	36	0	2	38
$60,000-$119,999	59	2	1	62
$120,000+	33	1	0	34
Total	128	3	3	134

Chi Square not valid

	Agree	Neutral	Disagree	Total
No post-secondary education	37	0	1	38
Post-secondary education	103	3	2	108
Total	140	3	3	146

Chi Square not valid

4. My own water use habits have an effect on the Region's water supply.

	Agree	Neutral	Disagree	Total
Female	57	6	2	65
Male	66	1	2	69
Total	123	7	4	134

Chi Square not valid

	Agree	Neutral	Disagree	Total
18-44	40	2	2	44
45+	94	6	4	104
Total	134	8	6	148

Chi Square not valid

	Agree	Neutral	Disagree	Total
<$20,000-$59,999	34	2	2	38
$60,000-$119,999	59	1	3	63
$120,000+	29	4	1	34
Total	122	7	6	135

Chi Square not valid

	Agree	Neutral	Disagree	Total
No post-secondary education	34	1	3	38
Post-secondary education	99	7	3	109
Total	133	8	6	147

Chi Square not valid

5. It is important that the Region of Waterloo spend money to increase the supply of water.

	Agree	Neutral	Disagree	Total
Female	39	10	13	62
Male	43	11	10	64
Total	82	21	23	126

Significance Level = 0.740
Not significant

	Agree	Neutral	Disagree	Total
18-44	22	10	10	42
45+	71	11	15	97
Total	93	21	25	139

Significance Level = 0.049
Significant

	Agree	Neutral	Disagree	Total
<$20,000-$59,999	25	3	8	36
$60,000-$119,999	41	10	7	58
$120,000+	17	8	7	32
Total	83	21	22	126

Significance Level = 0.223
Not significant

	Agree	Neutral	Disagree	Total
No post-secondary education	32	4	1	37
Post-secondary education	59	18	24	101
Total	91	22	25	138

Chi Square not valid

6. It is important that the Region of Waterloo spend money to decrease the demand for water.

	Agree	Neutral	Disagree	Total
Female	49	7	7	63
Male	47	13	9	69
Total	96	20	16	132

Significance Level = 0.402
Not significant

	Agree	Neutral	Disagree	Total
18-44	32	4	8	44
45+	74	18	10	102
Total	106	22	18	146

Significance Level = 0.198
Not significant

	Agree	Neutral	Disagree	Total
No post-secondary education	24	7	6	37
Post-secondary education	82	14	12	108
Total	106	21	18	145

Significance Level = 0.424
Not significant

8. I actively conserve water year round.

	Agree	Neutral	Disagree	Total
Female	50	9	6	65
Male	51	12	6	69
Total	101	21	12	134

Significance Level = 0.852
Not significant

	Agree	Neutral	Disagree	Total
18-44	28	7	9	44
45+	83	18	3	104
Total	111	25	12	148

Significance Level = 0.002
Significant

	Agree	Neutral	Disagree	Total
<$20,000-$59,999	29	8	1	38
$60,000-$119,999	49	9	5	63
$120,000+	23	5	6	34
Total	101	22	12	135

Significance Level = 0.220
Not significant

	Agree	Neutral	Disagree	Total
No post-secondary education	31	7	0	38
Post-secondary education	80	17	12	109
Total	111	24	12	147

Significance Level = 0.102
Not significant

9. Water conservation is only necessary in cases where there is a limited supply of water.

	Agree	Neutral	Disagree	Total
Female	5	1	59	65
Male	9	3	56	68
Total	14	4	115	133

Chi Square not valid

	Agree	Neutral	Disagree	Total
18-44	4	1	39	44
45+	13	3	87	103
Total	17	4	126	147

Chi Square not valid

	Agree	Neutral	Disagree	Total
No post-secondary education	6	0	32	38
Post-secondary education	8	4	96	108
Total	14	4	128	146

Chi Square not valid

10. In the Region of Waterloo, access to water should be unlimited.

	Agree	Neutral	Disagree	Total
Female	10	12	43	65
Male	17	10	41	68
Total	27	22	84	133

Significance Level = 0.372
Not significant

	Agree	Neutral	Disagree	Total
18-44	6	8	30	44
45+	26	16	60	102
Total	32	24	90	146

Significance Level = 0.283
Not significant

	Agree	Neutral	Disagree	Total
<$20,000-$59,999	17	8	12	37
$60,000-$119,999	12	8	42	62
$120,000+	2	5	27	34
Total	31	21	81	133

Significance Level = 0.001
Significant

	Agree	Neutral	Disagree	Total
No post-secondary education	15	9	13	37
Post-secondary education	17	14	78	109
Total	32	23	91	146

Significance Level = 0.001
Significant

11. Do you feel it is more important to spend money to increase the supply, or to decrease the demand?

	Increase Supply	A combination of both	Decrease Demand	Total
Female	9	31	23	63
Male	10	32	25	67
Total	19	63	48	130

Significance Level = 0.986
Not significant

	Increase Supply	A combination of both	Decrease Demand	Total
18-44	5	16	21	42
45+	15	57	29	101
Total	20	73	50	143

Significance Level = 0.050
Significant

	Increase Supply	A combination of both	Decrease Demand	Total
<$20,000-$59,999	8	19	9	36
$60,000-$119,999	8	35	20	63
$120,000+	2	15	15	32
Total	18	69	44	131

Significance Level = 0.193
Not significant

	Increase Supply	A combination of both	Decrease Demand	Total
No post-secondary education	9	22	6	37
Post-secondary education	10	51	45	106
Total	19	73	51	143

Significance Level = 0.005
Significant

12. If an increase in taxes were necessary to increase the water supply in the Region of Waterloo, how much would you support?

	None - 0.3%	0.4% or more	Total
Female	37	12	49
Male	40	20	60
Total	77	32	109

Significance Level = 0.313
Not significant

	None - 0.3%	0.4% or more	Total
18-44	27	10	37
45+	60	22	82
Total	87	32	119

Significance Level = 0.982
Not significant

	None - 0.3%	0.4% or more	Total
<$20,000-$59,999	26	8	34
$60,000-$119,999	37	14	51
$120,000+	17	10	27
Total	80	32	112

Significance Level = 0.496
Not significant

	Up to 0.3%	0.4% or more	Total
No post-secondary education	23	7	30
Post-secondary education	65	25	90
Total	88	32	120

Significance Level = 0.634
Not significant

14. I would be willing to incorporate additional water-saving devices in my home if there was no cost to me.

	Agree	Neutral	Disagree	Total
Female	62	1	2	65
Male	65	2	0	67
Total	127	3	2	132

Chi Square not valid

	Agree	Neutral	Disagree	Total
18-44	42	1	1	44
45+	96	5	1	102
Total	138	6	2	146

Chi Square not valid

	Agree	Neutral	Disagree	Total
<$20,000-$59,999	31	2	3	36
$60,000-$119,999	63	0	0	63
$120,000+	33	1	0	34
Total	127	3	3	133

Chi Square not valid

	Agree	Neutral	Disagree	Total
No post-secondary education	35	2	0	37
Post-secondary education	103	3	3	109
Total	138	5	3	146

Chi Square not valid

15. I would be willing to change my water use habits:

	Drastically / Considerably	Somewhat	Slightly / Not at all	Total
Female	26	27	11	64
Male	22	32	15	69
Total	48	59	26	133

Significance Level = 0.553
Not significant

	Drastically / Considerably	Somewhat	Slightly / Not at all	Total
18-44	16	18	9	43
45+	38	43	23	104
Total	54	61	32	147

Significance Level = 0.987
Not significant

	Drastically / Considerably	Somewhat	Slightly / Not at all	Total
<$20,000-$59,999	11	14	13	38
$60,000-$119,999	26	22	14	62
$120,000+	14	16	4	34
Total	51	52	31	134

Significance Level = 0.207
Not significant

	Drastically / Considerably	Somewhat	Slightly / Not at all	Total
No post-secondary education	10	16	12	38
Post-secondary education	44	44	20	108
Total	54	60	32	146

Significance Level = 0.151
Not significant

16. I would only be willing to change my habits if there were a water shortage.

	Agree	Neutral	Disagree	Total
Female	15	7	43	65
Male	18	9	41	68
Total	33	16	84	133

Significance Level = 0.778
Not significant

	Agree	Neutral	Disagree	Total
18-44	7	5	32	44
45+	30	14	59	103
Total	37	19	91	147

Significance Level = 0.178
Not significant

	Agree	Neutral	Disagree	Total
<$20,000-$59,999	14	3	20	37
$60,000-$119,999	18	6	39	63
$120,000+	3	4	27	34
Total	35	13	86	134

Significance Level = 0.088
Not significant

	Agree	Neutral	Disagree	Total
No post-secondary education	10	5	22	37
Post-secondary education	27	13	69	109
Total	37	18	91	146

Significance Level = 0.915
Not significant

17. How would you rate your personal water use in comparison to others around you?

	Less than average	Average	More than average	Total
Female	38	22	5	65
Male	53	12	3	68
Total	91	34	8	133

Significance Level = 0.054
Not significant

	Less than average	Average	More than average	Total
18-44	29	11	4	44
45+	69	30	4	103
Total	98	41	8	147

Significance Level = 0.421
Not significant

	Less than average	Average	More than average	Total
<$20,000-$59,999	23	12	3	38
$60,000-$119,999	45	15	3	63
$120,000+	21	12	1	34
Total	89	39	7	135

Significance Level = 0.631
Not significant

	Less than average	Average	More than average	Total
No post-secondary education	24	11	3	38
Post-secondary education	71	31	6	108
Total	95	42	9	146

Significance Level = 0.870
Not significant

24. This is the first time I have heard about the water pipeline.

	Yes	No	Total
Female	33	32	65
Male	22	47	69
Total	55	79	134

Significance Level = 0.026
Significant

	Yes	No	Total
18-44	28	16	44
45+	32	72	104
Total	60	88	148

Significance Level = 0.001
Significant

	Yes	No	Total
<$20,000-$59,999	18	20	38
$60,000-$119,999	23	40	63
$120,000+	16	18	34
Total	57	78	135

Significance Level = 0.453
Not significant

	Yes	No	Total
No post-secondary education	13	24	37
Post-secondary education	45	64	109
Total	58	88	146

Significance Level = 0.509
Not significant

25. It is necessary that the Region of Waterloo construct a pipeline to Lake Erie to increase the water supply.

	Agree	Neutral	Disagree	Total
Female	11	3	8	22
Male	19	10	13	42
Total	30	13	21	64

Significance Level = 0.627
Not significant

	Agree	Neutral	Disagree	Total
18-44	4	5	4	13
45+	28	11	18	57
Total	32	16	22	70

Chi Square not valid

	Agree	Neutral	Disagree	Total
<$20,000-$59,999	11	5	2	18
$60,000-$119,999	16	6	13	35
$120,000+	2	4	4	10
Total	29	15	19	63

Chi Square not valid

	Agree	Neutral	Disagree	Total
No post-secondary education	16	2	4	22
Post-secondary education	16	14	18	48
Total	32	16	22	70

Chi Square not valid
Table indicates a relationship may exist

26. A pipeline would increase the reliability of the water supply in the Region of Waterloo.

	Agree	Neutral	Disagree	Total
Female	18	4	5	27
Male	36	4	5	45
Total	54	8	10	72

Chi Square not valid

	Agree	Neutral	Disagree	Total
18-44	7	3	2	12
45+	53	6	8	67
Total	60	9	10	79

Chi Square not valid

	Agree	Neutral	Disagree	Total
<$20,000-$59,999	17	2	1	20
$60,000-$119,999	27	6	5	38
$120,000+	11	1	1	13
Total	55	9	7	71

Chi Square not valid

	Agree	Neutral	Disagree	Total
No post-secondary education	20	1	1	22
Post-secondary education	40	8	9	57
Total	60	9	10	79

Chi Square not valid

27. A water pipeline would ensure that residents would not have to worry about the amount of water used.

	Agree	Neutral	Disagree	Total
Female	7	4	18	29
Male	11	5	31	47
Total	18	9	49	76

Significance Level = 0.906
Not significant

	Agree	Neutral	Disagree	Total
18-44	4	1	10	15
45+	16	9	44	69
Total	20	10	54	84

Chi Square not valid

	Agree	Neutral	Disagree	Total
<$20,000-$59,999	8	3	9	20
$60,000-$119,999	6	5	27	38
$120,000+	5	0	12	17
Total	19	8	48	75

Chi Square not valid

	Agree	Neutral	Disagree	Total
No post-secondary education	8	1	14	23
Post-secondary education	13	9	39	61
Total	21	10	53	84

Significance Level = 0.252
Not significant

28. A water pipeline would mean that the supply of water in Waterloo would be unlimited.

	Agree	Neutral	Disagree	Total
Female	3	4	22	29
Male	6	2	39	47
Total	9	6	61	76

Chi Square not valid

	Agree	Neutral	Disagree	Total
18-44	2	0	13	15
45+	8	6	54	68
Total	10	6	67	83

Chi Square not valid

	Agree	Neutral	Disagree	Total
<$20,000-$59,999	4	3	13	20
$60,000-$119,999	4	0	33	37
$120,000+	2	1	14	17
Total	10	4	60	74

Chi Square not valid

29. A water pipeline would mean there is no longer a need to conserve water.

	Agree	Neutral	Disagree	Total
Female	1	2	28	31
Male	2	2	43	47
Total	3	4	71	78

Chi Square not valid

	Agree	Neutral	Disagree	Total
18-44	1	0	15	16
45+	2	4	64	70
Total	3	4	79	86

Chi Square not valid

	Agree	Neutral	Disagree	Total
<$20,000-$59,999	1	3	16	20
$60,000-$119,999	1	0	38	39
$120,000+	1	0	16	17
Total	3	3	70	76

Chi Square not valid

	Agree	Neutral	Disagree	Total
No post-secondary education	2	1	20	23
Post-secondary education	1	2	60	63
Total	3	3	80	86

Chi Square not valid

30. I may change my water use habits if a pipeline were constructed.

	Agree	Neutral	Disagree	Total
Female	3	1	25	29
Male	5	9	33	47
Total	8	10	58	76

Chi Square not valid

	Agree	Neutral	Disagree	Total
18-44	2	2	11	15
45+	6	9	52	67
Total	8	11	63	82

Chi Square not valid

	Agree	Neutral	Disagree	Total
<$20,000-$59,999	3	4	13	20
$60,000-$119,999	4	7	26	37
$120,000+	0	0	17	17
Total	7	11	56	74

Chi Square not valid

	Agree	Neutral	Disagree	Total
No post-secondary education	3	5	14	22
Post-secondary education	5	6	49	60
Total	8	11	63	82

Significance Level = 0.213
Not significant