RECREATIONAL VALUE OF IRRIGATION INFRASTRUCTURE: A CASE STUDY OF CHESTERMERE LAKE ALBERTA

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This Thesis is dedicated to

My Wife Melissa,

My Children Nathan and Jenaya,

My Parents Leo and Elaine

And

My Parents in Law Benedict and Theresa

ABSTRACT

Irrigation infrastructure provides many ecosystem service (ES) benefits that enhance the well-being of Albertans and is central to economic activity in southern Alberta. Management of irrigation infrastructure and water resources is becoming increasingly challenging as Alberta's population and economy grows. Past water allocation decisions have not generally considered the need of ecosystems leading to declining ecosystem health, and changes to provision of ES benefits in Alberta. The goals of current Alberta government policy include changing how water and land is managed to ensure that ecosystem health and ES provision is maintained.

The research in this thesis concentrates on establishing the value of recreational ES benefits provided by the Chestermere Lake Reservoir, and obtaining information on the spatial aspects and visitor characteristics. A mixed method approach is used combining a qualitative discussion with a quantitative analysis using a geographic information system (GIS) and the travel cost method (TCM). The selection of the mixed method and combined GIS-TCM approach was based on past success in previous studies. The findings reveal a substantial value for recreational ES benefits provided by the Chestermere Lake Reservoir occurring within a limited area similar to other studies of recreational benefits from reservoirs. The findings of this research provide information for decisions makers, water infrastructure managers, and water transfer participants when assessing the impact of planned actions. Further research is recommended to build upon the findings of this study and further expand the available information on ES benefits to include all ES provided by southern Alberta.

ACKNOWLEDGEMENTS

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To my wife Melissa, there are not enough or appropriate words that can adequately express my thanks for all the love and support you have given. This thesis is as much yours as mine as you have put in as much effort as I have to ensure its completion. Holding down the house in Saskatchewan while I was initially in Lethbridge studying, moving and keeping our family financially stable in Alberta, enduring me putting in long hours preparing this thesis, and your encouragement along the way can never be thanked enough. If I could put both our names on the thesis and degree I would.

To my children Nathan and Jenaya, I thank you for your assistance with the hands on aspect of the work, such as lugging equipment around, and hope that my journey will inspire you to follow your interests and embrace lifelong learning.

To my parents, Leo and Elaine, I thank you for your support and understanding through the challenges faced during my Master's journey.

This work is a family effort and I understand and am grateful for this. I couldn't have done it without all of you.

TABLE OF CONTENTS:

LIST OF TABLES

List of Figures

Chapter 1
Introduction

1.1. Background

Historically southern Alberta's irrigation infrastructure was constructed to promote settlement in the late 19th and early 20th centuries through storing and conveying water to agricultural land during periods of low precipitation common to the region (AARD, 2000; IWMSC, 2002; Owel & Freeman, 1994; Russell & Craig, 1993). Over time the same infrastructure began to provide water for non-agricultural use sectors including industry (manufacturing), domestic (municipal), hydropower, and environmental (AIPA, n.d.; AECOM, 2009). The environmental use sector includes the water needed to ensure aquatic ecosystem health and maintenance of ecosystem functions termed instream flow needs (IFNs) (AENV, 2009, 2005; Wenig et al., 2006). The creation of water conservation objectives (WCOs) as part of water management plans was done to meet IFNs (AENV, 2006, 2005; AMEC, 2009). However, doubt exists whether Alberta's water allocation and management system can achieve WCOs (Wenig et al., 2006). Climate change combined with population and economic growth in southern Alberta is expected to place increased pressure on Alberta's water resources, water allocation system, and irrigation infrastructure to meet demand while simultaneously ensuring IFNs are met (AENV, 2007b; AMEC, 2009; Wenig et al., 2006).

Benefits of ecosystem functions and processes that contribute to human well-being are generally termed "ecosystem services" (ES) (Costanza et al., 1997; Daily, 1997; MA, 2003; Westman, 1977).). Humans are dependent on the ES provided by ecosystem functions as inputs for economic activities that in turn bring improved quality of life (Costanza et al., 1997; Liu et al., 2010; Turner et al., 2008; Westman, 1977). The Millennium Ecosystem Assessment (MA) classified ES benefits into categories of provisioning, regulating, supporting, and cultural services (MA, 2005, 2003). Conversely, human activity impacts the health and function of ecosystems, which in turn effects the provision of ES (MA, 2005, 2003). The MA reported on changes to ES provision and ecosystem health worldwide that have negatively impacted human well-being (MA, 2005). One example is the loss of fish stocks (a provisioning service) from overfishing negatively impacting economic opportunities in Newfoundland (MA, 2005). A second example is the outbreak of algal blooms in the oceans having toxic effects on marine species and human health (MA, 2005). Decline in the health of ecosystems, and change to ecosystem functions and ES provision, are occurring all over the world with efforts underway in many jurisdictions to halt the decline (MA, 2005). Alberta Environment (AENV) studied the health of ecosystems and trends in the provision of ES in Alberta and found that some river ecosystems are moderately to severely degraded, declining overall ecosystem health across the province, and the potential for changes to ES provision to have a negative impact on the well-being of Albertans (AENV, 2007b, 2005). The decline of ecosystem health in Alberta and elsewhere stems from past management decisions failing to recognize the connection between IFNs, ecosystem health, and provision of ES benefits (AENV, 2007b; MA, 2005; Wenig et al., 2006).

1.2. Problem description

Water supplies in Alberta face a double threat. The first is from climate change that is expected to reduce runoff from alpine glaciers, shift the timing of seasons, and alter precipitation patterns resulting in greater variability in river flow patterns (AMEC, 2009; Byrne et al., 2006; Nemeth, 2010; Sauchyn & Kulshreshtha, 2008). The second is the increasing demand for water from population growth and economic activities potentially leaving less water for meeting IFNs (AENV, 2007a,b; BRBC, 2005; Grinder, 2010). The looming problem of safeguarding water supplies and ensuring sustainable ES provision has prompted the Alberta government to change legislation and policy regarding natural resource management (AENV, 2010, 2009, 2008a, 2003). The core approaches of current Alberta legislation and policy is applying a Cumulative Effects Management (CEM) and an Ecosystem Services Approach (ESApp) when developing legislation and policy (AENV, 2012; Kerr & Bjornlund, 2010). The CEM approach considers the combined environmental impact of projects in decision making (AENV, 2012; Kerr & Bjornlund, 2010). The ESApp commits government to ensure economic development falls within the ability of ecosystem functions to produce ES (AENV, 2012; Kerr & Bjornlund, 2010). Current Alberta government policy to address the water supply and ES provision challenges is found within the *Water for Life* (WFL) Strategy and the *Alberta Land Use Framework* (LUF). Alberta legislation regulating water and land resources includes the *Water Act* (2000), and the *Alberta Land Stewardship Act* (ALSA) (2009). The *Water Act* (2000) contains provisions for water transfers via markets, and the requirement of considering environmental effects in approvals absent in previous legislation (Block and Forrest, 2005; Percy, 2005). The ALSA (2009) was created to ensure CEM is considered in project and water transfer approvals, amendments to current legislation, and when drafting new legislation.

A key policy direction within both the WFL Strategy and LUF is using market style mechanisms to reallocate water to higher value uses while IFNs are maintained (Alberta, 2008; AENV, 2008a, 2003; Kerr & Bjornlund, 2010). Experience in other jurisdictions has shown that using market style transfers has the potential to increase economic benefits, move water to higher value uses, ensure water is available for meeting IFNs, and maintain ES provision (Brooks and Harris, 2008; Colby, 1990; Nicol et al., 2008; Nicol & Klein, 2006). The Water Act (2000) does not permit private or non-government organizations (NGOs) to buy and own water licenses for meeting IFNs (Water Act (2000), s. 51(2)), although commentators have supported its introduction (Bjornlund, 2010; Kwasniak, 2006). Market style transfers have been sparse in Alberta to date and not for ES provision (Nicol et al., 2008). Lack of information was identified as a barrier to the willingness of potential buyers and sellers in Alberta to use market transfers (Nicol et al., 2008). Information on the value of ES benefits to Albertans is scant to date posing a potential barrier to achieving policy goals (AENV, 2007b). The acquisition of information to develop scientifically based policy on water management to ensure IFNs are met is another key goal of the WFL Strategy and LUF (Alberta, 2008; AENV, 2008a, 2003).

1.3. Objectives and scope

The research goal of this study is to increase the available information on the value of recreational ES benefits provided by the Chestermere Lake reservoir (the Reservoir) for day use recreation visitors originating outside the Town of Chestermere (the Town). Specific objectives of this study are:

i) Identify the types of recreational activities, service area, and user characteristics of non-resident visitors to the Reservoir

ii) Estimate the annual value of the recreational ES provided by the Reservoir to non-resident day use visitors

In this study, both direct and indirect recreational activities are included. Direct recreational use includes activities such as boating, fishing, swimming, Nordic skiing, skating, and snowmobiling. Indirect recreational use includes walking, hiking, picnicking and biking for the purpose of scenic viewing near the Reservoir. Recreational benefits from activities taking place away from the Reservoir, such as indoor recreation, are outside the scope of this study. The focus of this study is recreational ES benefits alone. Valuing other ES (waste assimilation, habitat provision, etc.) provided by the Reservoir is outside the scope of this study. This study doe not include the value of recreational ES benefits provided by the Reservoir to residents of the Town.

1.4. Thesis organization

The thesis is organized into six chapters. Chapter two discusses the broad contextual background on Alberta's water resources, ecosystem health, irrigation development, water conflict, water legislation, and current Alberta government policy with respect to water management and ES provision. Chapter three provides the conceptual economic and geographic background and literature review. Chapter four discusses the methods used to achieve the research objectives. Chapter five details the study findings. Chapter six provides a summary, discussion, and conclusion.

CHAPTER 2

STUDY CONTEXT

2.1. Introduction

This chapter provides the broad contextual background on water management, irrigation, and ecosystem services (ES) in Alberta. The chapter consists of seven parts with the second part overviewing the distribution of water resources, water use sectors, and the state of ES provision in Alberta and the South Saskatchewan River Basin (SSRB). The third part reviews the development of irrigation in southern Alberta. The fourth part discusses past conflicts over water and the potential for future conflict. The fifth part reviews past and present water legislation in Alberta. The sixth part discusses the current policy of the Alberta government regarding water allocation, land use management, and provision of ES. The final part offers a summary and conclusion.

2.2. Water resources and ecosystem services in Alberta

Alberta's water resources are not uniformly distributed throughout the province. The majority of Alberta's water resources are located in the northern half of the province while the majority of the demand is in the southern half of the province (AENV, 2010, 2002). The bulk of Alberta's surface water originates from snowmelt, glacier melt, and precipitation (AENV, 2010; AMEC, 2009). The timing of water flows in rivers is not uniform throughout the year. The peak annual river flow occurs in the spring, primarily from snowmelt, with glacier melt and precipitation contributing to flow in the summer and autumn (AENV, 2010; AMEC, 2009). The southern half of Alberta normally receives lower amounts of precipitation than the northern half (Figure 2.1) resulting in low river flows staring around the mid-summer through to autumn (AENV, 2010; AMEC, 2009). About 97% of all water use in Alberta is drawn from surface water source (rivers, lakes, creeks, streams) (AENV, 2010).

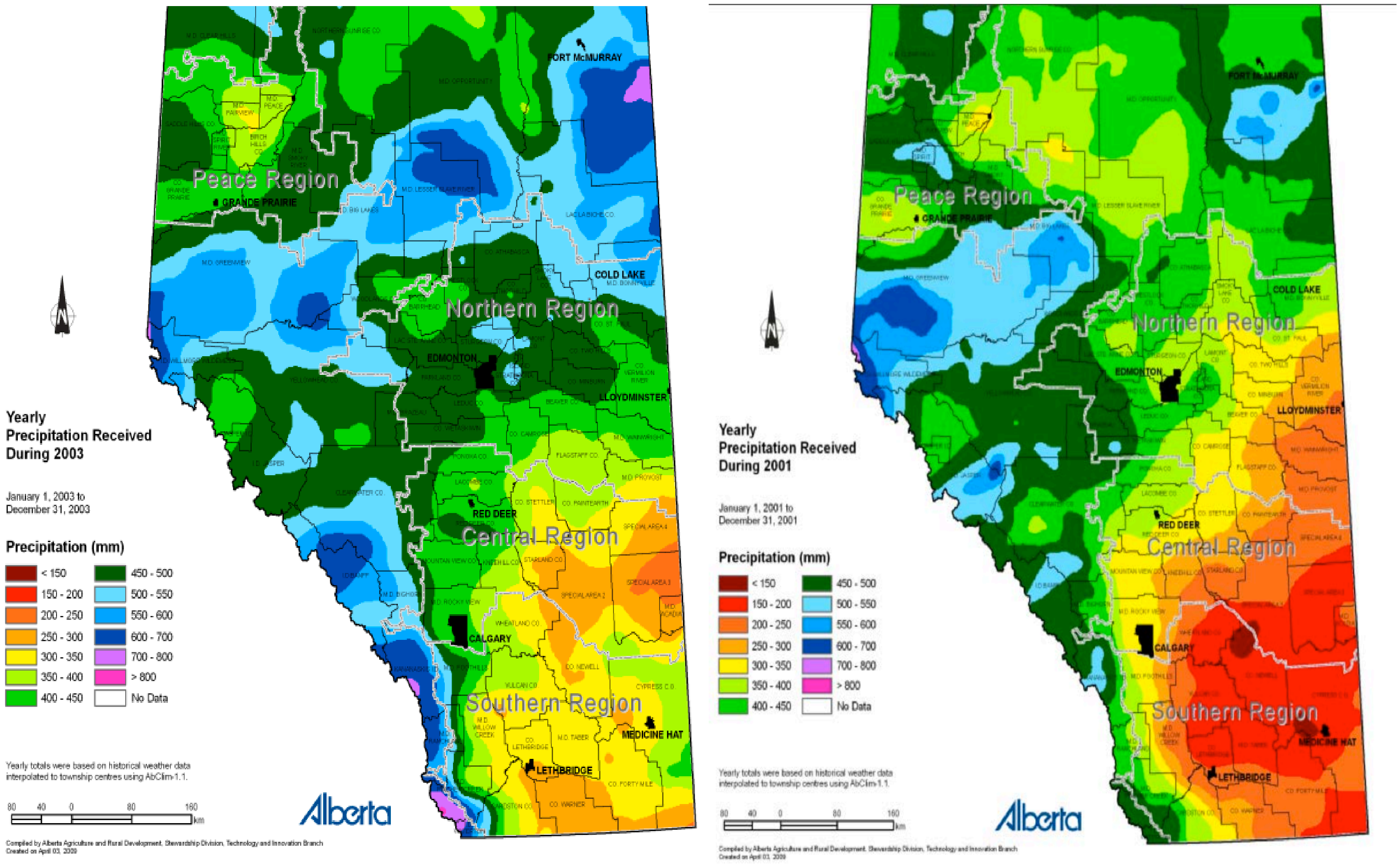

Figure 2.1: Precipitation maps for Alberta for a year with normal precipitation amounts (2003) (left), and for a dry year (2001) (right). Source: AARD (2009).

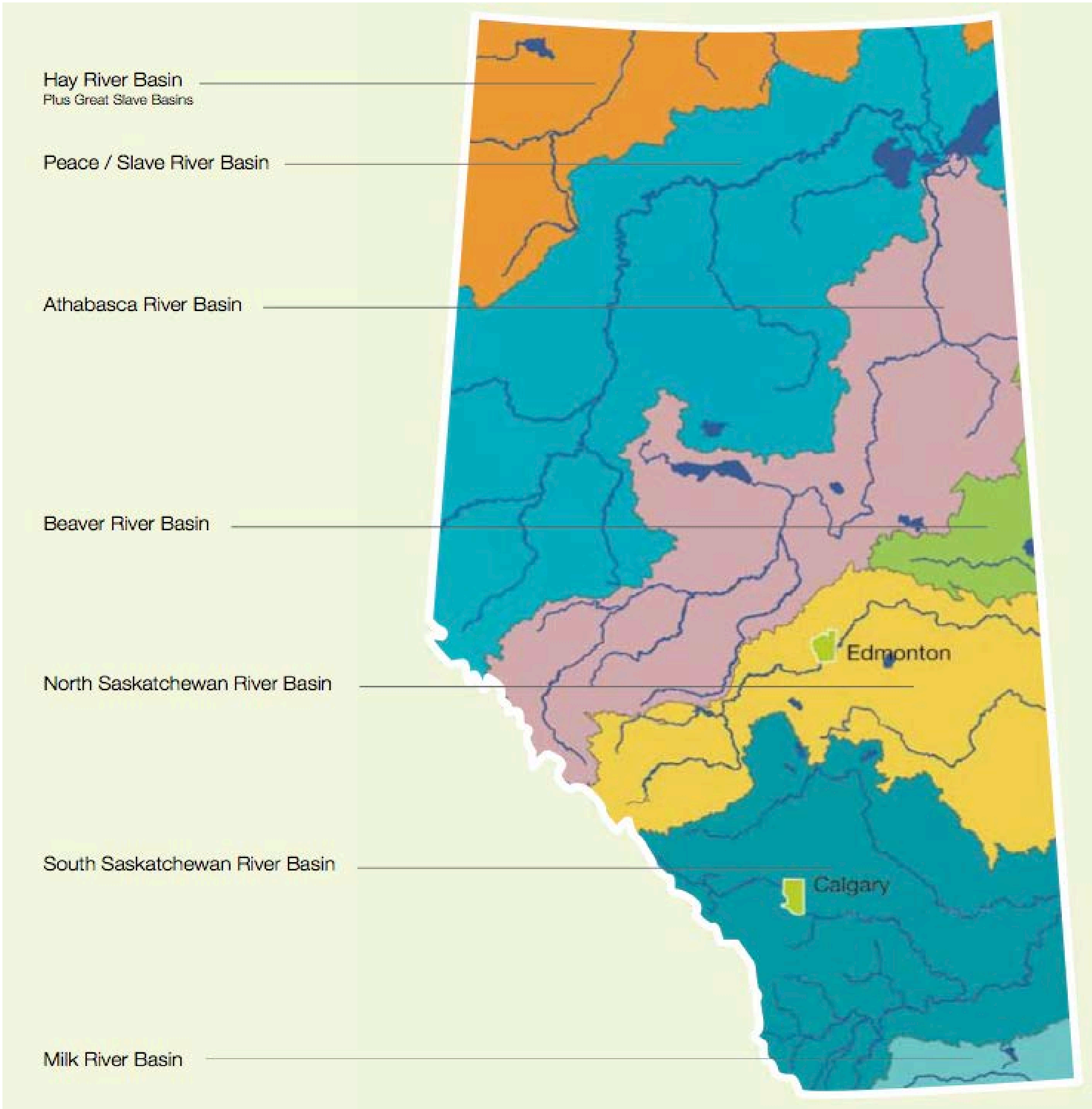

Figure 2.2: Major river basins in Alberta. Source AENV (2010).

There are seven major river basins located wholly or partially within Alberta's borders (Figure 2.2). This study focuses on the Chestermere Lake Reservoir located in the South Saskatchewan River Basin (SSRB). As such only the SSRB will be discussed in further detail. The SSRB has four sub-basins; the Red Deer, Bow, Oldman, and South Saskatchewan (Figure 2.3). The largest water use sector in the SSRB is irrigation (Figure 2.4).

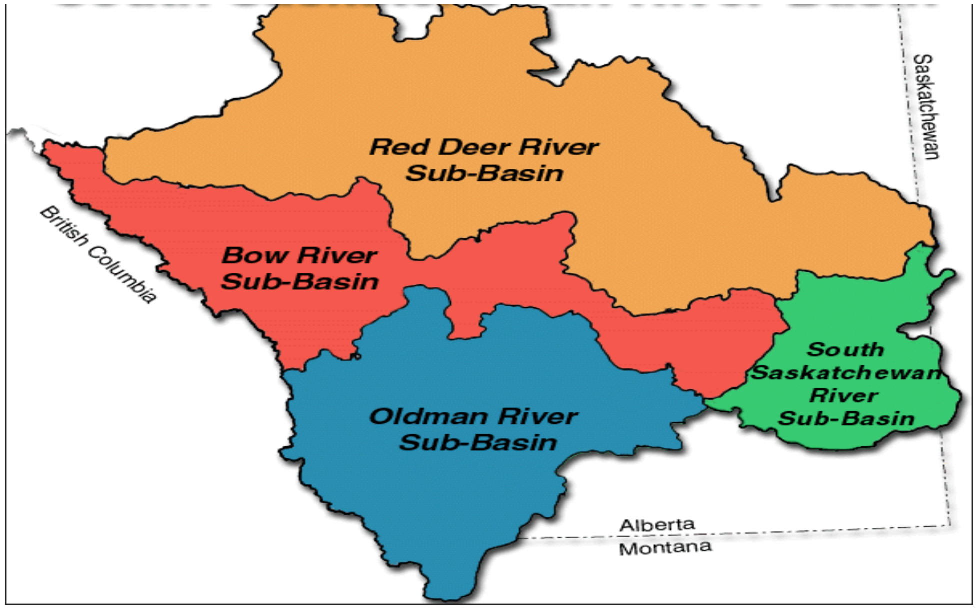

Figure 2.3: Sub-basins of the South Saskatchewan River Basin in Alberta.
Source AENV (2008b).

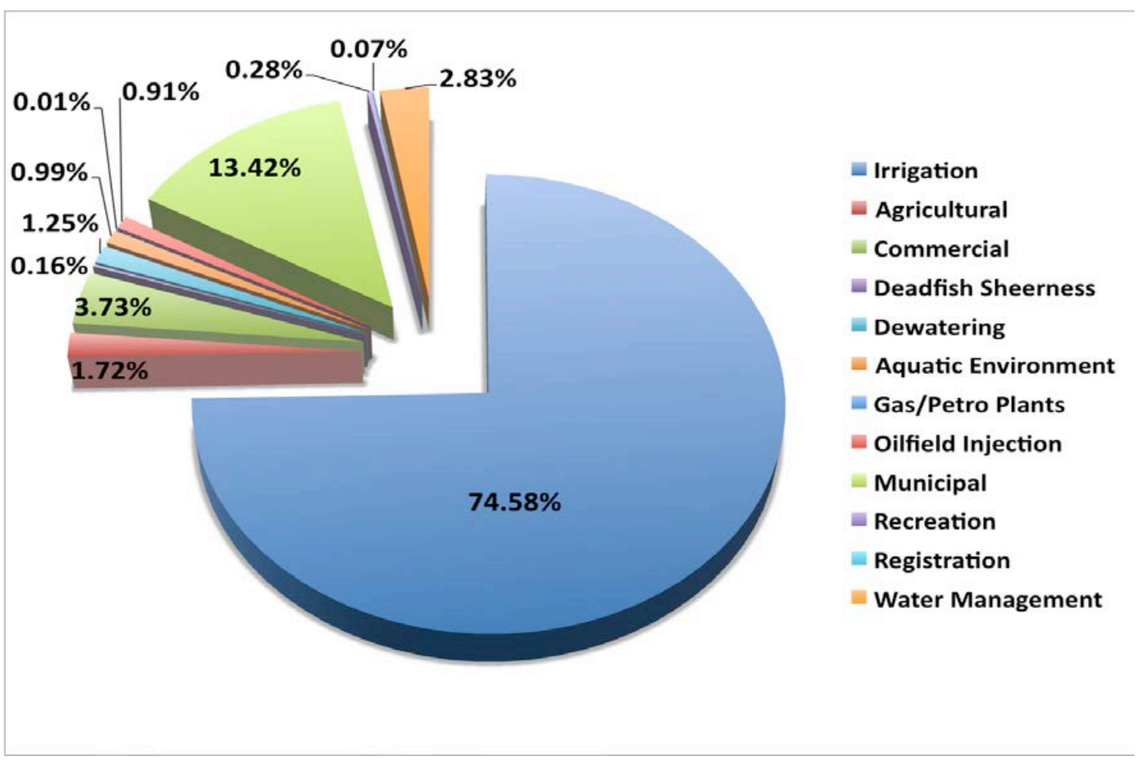

Figure 2.4: Water use by sector in the South Saskatchewan River Basin.
Adapted from AENV (2005b, p. 4).

Water for meeting in-stream flow needs (IFNs) is a small portion of the total water allocation in the SSRB falling under “aquatic environment” and “water management” categories in Figure 2.4. As noted in Chapter 1, the IFNs represent the amount of natural water flow required to maintain ecosystem health in a given watercourse (Bjornlund, 2010; AMEC, 2009; AENV, 2005a; 2003b). The current system of allocating water has the potential to consume the vast majority or all of the available natural flow in the sub-basins of southern Alberta, with river basins in southern Alberta particularly at risk (Figure 2.5). Currently the IFNs are generally being met by the unused allocations from other sectors, particularly unused irrigation sector allocations (Bjornlund, 2010).

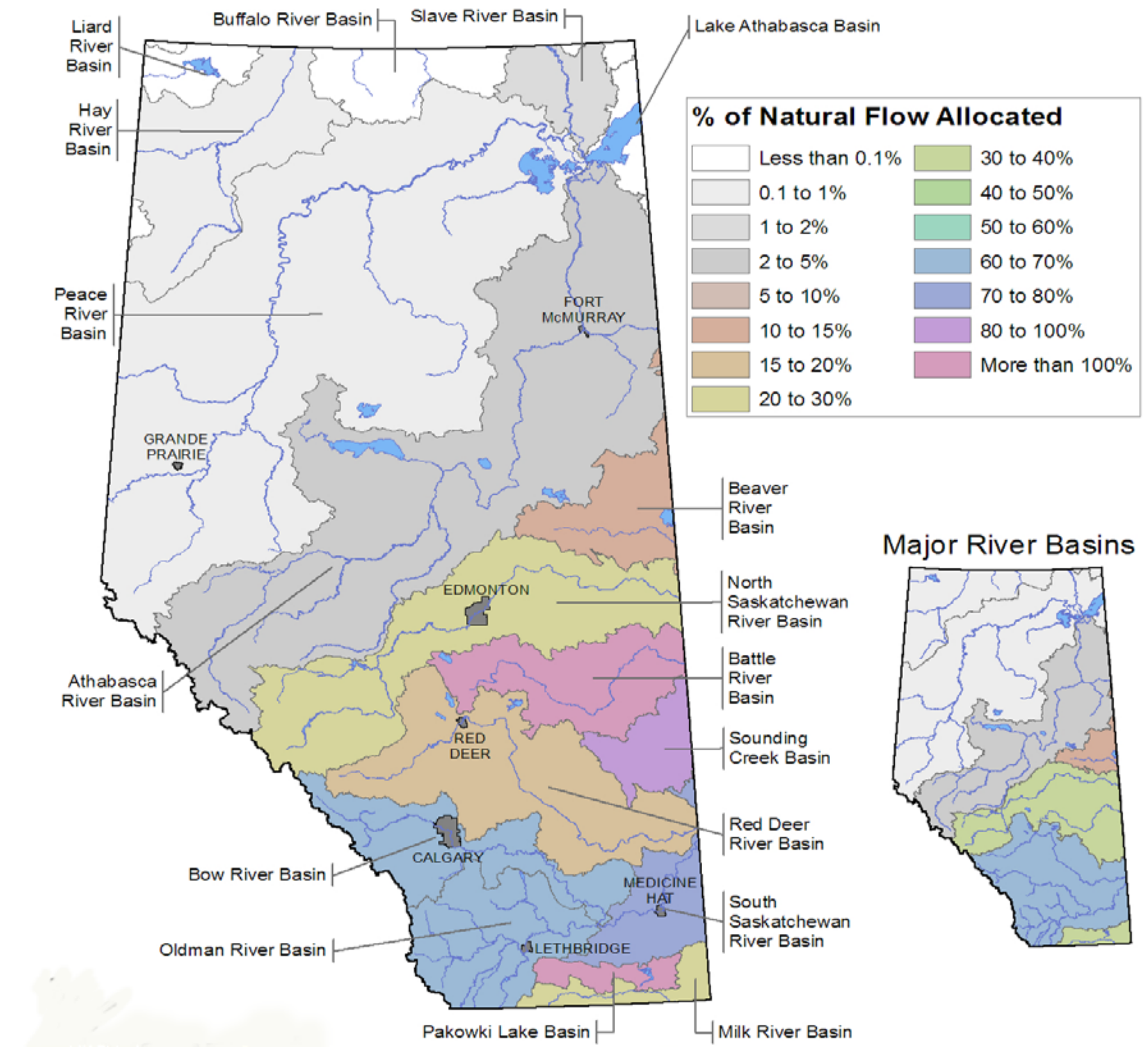

Figure 2.5: Licensed allocation compared to natural flows for Alberta sub-basins in 2010. Source: AENV (2011b).

Study of the current and potential changes to ecosystem health and ES provision has produced numerous reports including the *South Saskatchewan River Basin Water Management Plan – Phase 2 Background Studies* (the SSRB Plan Study) (AENV, 2003b) and the *Ecosystem Goods and Services Assessment-Southern Alberta Phase 2 Report – Conceptual linkages and Initial Assessment* (the ES Assessment) (AENV, 2007b). The SSRB Plan Study reported on the condition of the aquatic ecosystems in rivers using the categories of unchanged/recovered, moderately impacted, heavily impacted, and degraded. Findings for the 33 river reaches assessed in the SSRB Plan Study included that 22 rivers were determined to be moderately impacted, 5 heavily impacted, and 3 degraded (AENV, 2005a, 2003b) and that the current allocations cannot maintain IFNs for the Oldman and Bow sub-basins (AENV, 2005a).

The ES Assessment reported on ecosystem health, the connection between ecosystem health and ES provision, and a description of potential impacts to the well-being of Albertans (AENV, 2007b). The ES Assessment found that most ES are showing a downward (declining) trend (AENV, 2007b). This downward trend is in turn expected to have a high impact on the well-being of Albertans (Table 2.1). The ES Assessment also reported on information gaps that pose a barrier to achieving policy goals (AENV, 2007b). The information gaps are rated from low to high priority based on the level of urgency to resolve the gap (Table 2.2).High priority gaps should be addressed within six months, moderate priority gaps are less urgent and should be addressed in the next year, and low priority gaps still require attention but can wait a few years until the other gaps are addressed (AENV, 2007b).

Table 2.1: Trends in changes to ecosystem service provision and potential magnitude of impact to well-being in Alberta.

Ecosystem Service	Trend	Magnitude of Impact
Regulating Services		
Gas Regulation	Unknown	Low
Climate Regulation	Unknown	Moderate
Disturbance Regulation	Down	High
Water Regulation	Down	High
Erosion Control & Sediment Retention	Down	Moderate
Waste Treatment	Down	High
Biological Control	Down	High
Supporting Services		
Soil Formation	Down	Moderate
Primary Production	Down	Moderate
Nutrient Cycling	Down	Moderate
Pollination	Down	High
Habitat/Refugia	Down	High
Provisioning Services		
Water Supply	Down	High
Food Production	Up (Short Term)	High
	Down (Long Term)	Moderate
Raw Materials	Up (Short Term)	High
	Down (Long Term)	High
Genetic Resources	Down	High
Cultural and Aesthetic Services		
Aesthetic	Down	High
Spiritual & Traditional Use	Down	High
Science and Education	Down	Moderate
Recreation	Down	High

Adapted from AENV (2007b).

Table 2.2: Priority of addressing information gaps to maintain ecosystem services in Alberta.

High Priority	
Gap 1	More detailed understanding of the value of goods produced in Southern Alberta
Gap 2	Equal evaluation criteria for all ES needed for future ES Assessments
Gap 3	More in depth research of interrelationships between ES and natural assets
Gap 4	Greater in-depth research on the spatial analysis of asset and ES condition
Medium Priority	
Gap 5	Greater public review and feedback on the importance of ES to southern Alberta
Gap 6	Develop standard methods for assessing ES and the individual goods and services produced
Low Priority	
Gap 7	Coordinate valuation of ES with standardized methods and instruments to guide policy development

Adapted from AENV (2007b).

2.3. Irrigation in Alberta

Irrigated agriculture in southern Alberta originated with Mormon settlers arriving from Utah bringing knowledge of irrigation with them (Percy, 1996, 1977). The early irrigation works consisted of gravity flows using canals etched into the soil like that of ancient Egypt (IWMSC, 2002; Owel and Freeman; Bjornlund & Bjornlund, 2010). The first recorded use of irrigation in Alberta was on the Fish Creek area near Calgary in 1879 (Percy, 1996, 1977).

The completion of the Trans Canada railway in 1885 by the Canadian Pacific Railway Company (CPR) started the drive towards large scale irrigation development in southern Alberta (Owel & Freeman, 1994). The CPR sought to settle the large tracks of land in southern Alberta received from the dominion government as payment for building the Trans Canada railway by constructing irrigation works (Owel & Freeman, 1994) Captain John Palliser began an expedition in 1857 to ascertain the feasibility of agricultural development, find railway paths through the rocky mountains, and examine canoe settlement in the southern prairies, it lasted until 1859 (Owel & Freeman, 1994; Russell & Craig, 1993; Spry, 1959). Palliser's final report concluded that a large portion of the Canadian prairies was unsuitable for agriculture due to moisture shortages and poor soil conditions away from watercourses (Spry, 1959). He therefore advised against widespread agricultural settlement in the region known today as "Palliser Triangle" (Figure 2.6) (Spry, 1959). The CPR had recognized that some of the land granted by the federal government was located in the Palliser Triangle, however the economic and political interests in settling the region were strong and irrigation was therefore proposed to overcome the issue of moisture shortage and ensure that settlement would succeed (Owel & Freeman, 1994; Russell & Craig, 1993). The CPR felt gravity irrigation could be suitable for addressing the moisture shortage in the Palliser Triangle due to the slope of the land through the region permitting the free flow of water from west to east (Owel & Freeman, 1994). The CPR negotiated with the federal government to obtain three million acres of land in Palliser Triangle as part of the payment for building the Trans Canada railway, which was granted in 1903 (Owel & Freeman, 1994).

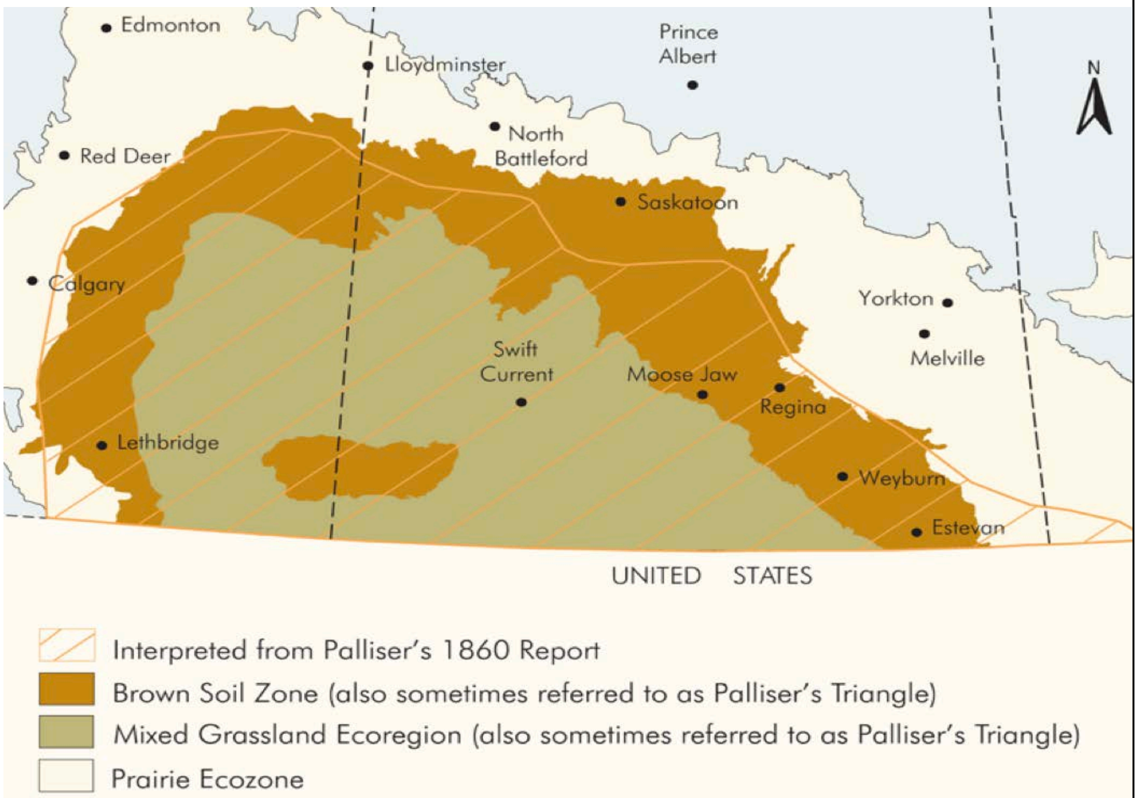

Figure 2.6: Palliser triangle in southern Alberta and Saskatchewan.
Source: Encyclopedia of Saskatchewan. 2006.

A second obstacle to the CPR settlement plans was the large scale irrigation would require the diversion of large amounts of water from watercourses and distribution it throughout large areas away from the rivers. This was however not permitted under the riparian doctrine governing water access and rights prior to 1894 (IWMSC, 2002; Percy, 2005, 1996). The passing of the federal *Northwest Irrigation Act* in 1894 changed water allocation and management such that large scale irrigation development in the Palliser Triangle could proceed (IWMSC, 2002; Percy, 2005, 1996, 1977). The CPR obtained a water license under the *Northwest Irrigation Act* to divert the volume of water needed for large scale irrigation, and commenced construction of irrigation infrastructure to supply water to land away from watercourses (IWMSC, 2002; Owel & Freeman, 1994). The CPR now felt it was in position to achieve a return on investment through expected increases in the productive value of the irrigated land and increased amount of rail traffic moving goods in and out of the region (IWMSC, 2002; Owel & Freeman, 1994). As time passed management inexperience, war, and drought between 1910 and 1940 resulted in poor returns (IWMSC, 2002; Owel &

Freeman, 1994). This prompted the CPR and other private companies to divest their stake in irrigation infrastructure and private ownership of major irrigation infrastructure was gone by 1950 (IWMSC, 2002).

The creation of the first irrigation districts (the districts) followed the passing of Alberta's *Irrigation Districts Act* in 1914 (IWMSC, (2002). The districts are farmer run member based cooperatives that took over administration and maintenance of irrigation infrastructure from the private corporations with the help of the federal and provincial governments (IWMSC, 2002). Between 1920 and 1950, the early districts had funding and operational problems requiring intervention from both federal and provincial governments to keep them from failing (IWMSC, 2002). The federal government set up commissions to oversee the process of solving the startup problems experienced by the districts, and invested public money in the construction and maintenance of irrigation infrastructure between 1920 and 1950 (IWMSC, 2002). Government investment and support served to stabilize water supplies for irrigated agriculture, and over time the farmer run districts proved to be the best management model for the operation of irrigation works (IWMSC, 2002).

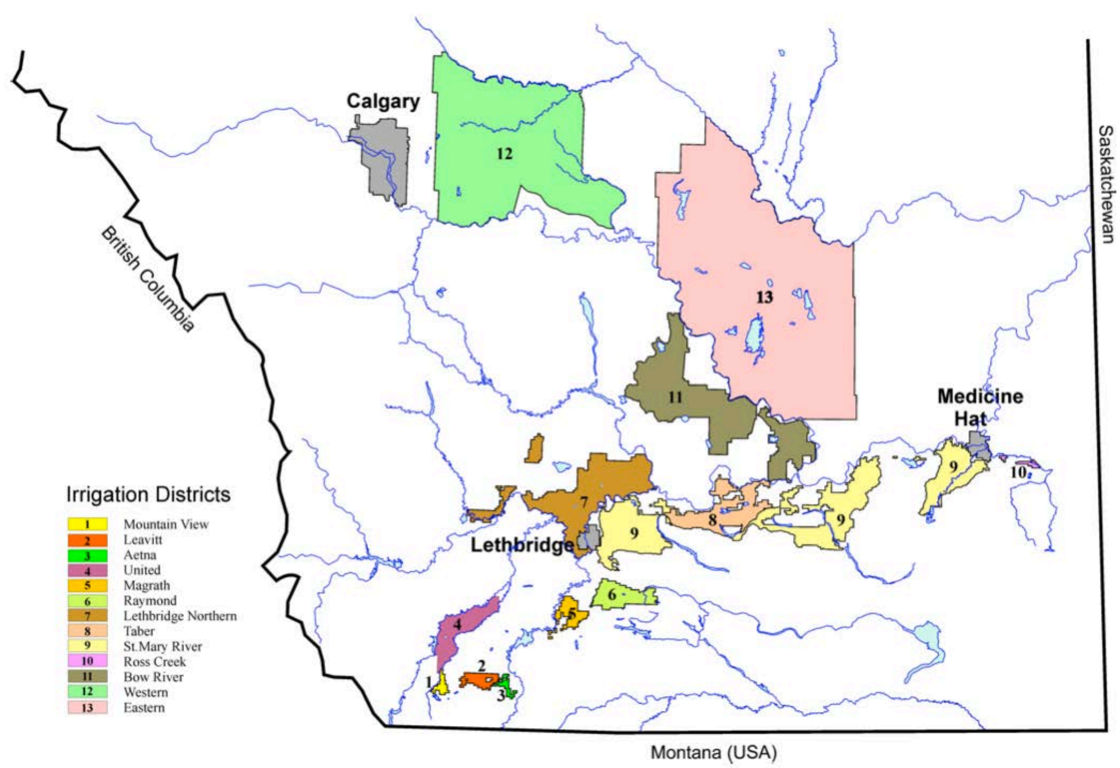

Figure 2.7: Irrigation districts of southern Alberta. Source AARD (2011).

The period between 1950 and 1970 saw the provincial and federal government taking a direct role in ownership, funding, and operation of most headworks and some reservoirs (IWMSC, 2002). By the 1970s the 13 irrigation districts in southern Alberta were established (Figure 2.7), and the federal government's objective of establishing irrigation in southern Alberta was achieved (IWMSC, 2002). The federal government entered into an agreement with the government of Alberta in 1973 to transfer ownership and management of publically owned headworks and reservoirs to the province (IWMSC, 2002). The government of Alberta continued working with the irrigation districts in maintaining and expanding irrigation infrastructure. A cost sharing program for the repair and expansion of irrigation infrastructure was created in 1969 based on the level of benefit that irrigation infrastructure provided to the producer (district), region, province, and country (Rogers et al., 1966 cited in IWMSC, 2002). The original cost sharing portion was 86% paid by the province and 14% by the district (IWMSC, 2002). The cost sharing formula has been revised over time and presently stands at 75% paid by the province and 25% by the districts (IWMSC, 2002). Another policy of the Alberta government is the requirement of all publically owned headworks and reservoirs to be managed for multiple uses (Multiuse Policy) introduced in 1975 after recognition of the importance of ensuring a stable water supply for all use sectors (AMEC, 2009; IWMSC, 2002; AARD, 2000).

Hydropower infrastructure was developed in the SSRB in the early 20th century to provide a continuous power supply and provide extra generating capacity for peak demand periods beginning with the Horseshoe Falls plant in 1911 (BRBC, 2005). The Bow sub-basin has six hydropower plants that are fed by reservoirs with a combined storage capacity of around 700 Million m^3 (BRBC, 2005). The hydropower plants are privately owned and are not governed by the Multiuse Policy. However the hydropower plants must still meet applicable environmental legislation, and the hydropower plants on the Bow river have environmental management systems (EMS) in place to continually reduce impacts to the environment and downstream users (BRBC, 2005, TransAlta, 2009).

2.4. Conflict over water in southern Alberta

Reservoirs are important for the provision of ES benefits including recreation, waste assimilation, and habitat provision (AARD, 2000; AEW, 2012; AIPA, n.d; McNaughton, 1994, 1993). However, irrigation reservoirs have traditionally been managed to meet the needs of irrigators at times leading to conflict over access to water for other demand sectors. Access to water from the Chestermere Lake reservoir (the Reservoir) is one example of past conflict. Property owners with land abutting the Reservoir started a legal challenge over access to water for domestic use (WID vs. Trobst et al., 1990). The basis of the conflict was that the property owners believed that they were riparian users and had a right to access water without having to pay a fee to the Western Irrigation District (WID) (WID vs. Trobst et al., 1990). The landowners argued that current legislation still allows for free water access for riparian landowners from natural surface water sources for domestic use (Water Act, 2000, s. 21-22; WID vs. Trobst et al., 1990). The challenge was defeated due to the Reservoir not being considered a natural watercourse under the Act (Water Act, 2000, s. 21; WID vs. Trobst et al., 1990). Nine years later a similar challenge was brought before the courts by other property owners with land abutting the Reservoir regarding accessing water for domestic use without having to pay water fees to the WID (WID vs. Craddock et al., 1999). These property owners also lost their case on the grounds that the Reservoir was not a natural watercourse (WID vs. Craddock et al., 1999).

A second example of water conflict surrounded the development of a the CrossIron Mills mall, a casino, and horse racetrack in the hamlet of Balzac just north of Calgary (Beveridge, 2008; D'Aliesio, 2007a,b; Christensen & Droitsch, 2008; FFWD, 2007; Pernitsky and Guy, 2010). The city of Calgary refused to supply the water for the development due to a policy issue forcing the developers to look elsewhere (D'Aliesio, 2007a). Next, the Municipal District (MD) of Rocky View applied for a license amendment to increase its diversion limit in order to supply the development with water (Beveridge, 2008; Pernitsky and Guy, 2010) This failed as the Alberta government has ceased issuing or increasing water licenses within the SSRB (Beveridge, 2008; D'Aliesio, 2007a,b; FFWD, 2007; Pernitsky and Guy, 2010). Another option considered was a sub-basin to sub-basin transfer from the Red Deer River through the construction of a pipeline where new licenses could still be issued (Beveridge, 2008; D'Aliesio, 2007a,b). However inter-basin transfers need the approval by the provincial environment ministry (Water Act, 2000, s. 81), which was not forthcoming due to considerable resistance from the residents of the Red Deer sub-basin (Beveridge, 2008; Christensen & Droitsch, 2008). This led the MD of Rocky View to approach the WID for a permanent transfer of around 2.2 million cubic meters of the WID's allocation for roughly $15 Million (Beveridge, 2008; D'Aliesio, 2007a,b; Christensen & Droitsch, 2008; FFWD, 2007). The WID membership held a plebiscite as required by the *Irrigation Districts Act* (2000, s. 11), which narrowly passed despite the financial benefits to the WID and its members (FFWD, 2007; D'Aliesio, 2007b). The WID made the water for the Balzac development available by spending the proceeds from the sale on infrastructural improvements (D'Aliesio, 2007b). A canal supplying water to WID members was converted to a pipeline that included a pipeline to the development (FFWD, 2007; D'Aliesio, 2007b). The upgrade reduced the amount of water lost through seepage from the conveyance system enough to compensate for the water that the Balzac development would use resulting in a water efficiency gain for the WID (D'Aliesio, 2007b).

The potential for conflict is expected to increase over time, as human based demand increases and supplies become less predictable (AMEC, 2009; Bjornlund, 2010; Block & Forrest, 2005; Byrne et al., 2006; Nemeth, 2010; Sauchyn & Kulshreshtha, 2008). Several communities in the Calgary region are projected to have their water demand meet or exceed their allocation limit by 2076 (Pernitsky & Guy, 2010). These communities will need to obtain additional allocations from another license holder in order to continue development into the next century (Pernitsky & Guy, 2010).

2.5. Water legislation in Alberta:

Water legislation in Alberta and Canada has historical ties to the common law of England, (Getzler, 2004; Percy, 1996, 1977). The common law in England regarding matters of water access and right of use evolved from the increased use of waterpower (mills) that impacted downstream water users causing conflict (Getzler, 2004). Over time the common law courts handed down numerous decisions to settle water access and use disputes leading to the establishment of the *Doctrine of Riparian Rights* (the Doctrine) (Gezler, 2004). The Doctrine upheld the right of all landowners with water running adjacent to or through their land (riparians) to access water as long as the volume and quality of water is not changed for other riparians echoing the Roman tradition (Gezler, 2004; Goodman, 2005; Percy, 2005, 1977).

Settlement of the Canadian prairies generally began in the late 17th century under the rule of England (Harris, 2008; Knafla, 2005). Alberta, Saskatchewan, Manitoba, portions of the Northwest Territories, Ontario, Quebec, and Nunavut was once governed by the Hudson Bay Company (HBC) under the name "Rupert's Land" (Harris, 2008; Knafla, 2005). The HBC was granted legal and administrative rights to Rupert's Land in 1670 by Charles II of England (Foster, 2005; Harris, 2008; Knafla, 2005). The HBC was able to create and administer laws in Rupert's Land so long as none of the established laws of England were contradicted (Foster, 2005; Knafla, 2005). The application of English common law and the Doctrine in Rupert's Land was mixed with aboriginal laws and HBC directives (Knafla, 2005). Rupert's Land was administered on a discretionary basis as company officials lacked knowledge and experience in legal procedure (Knafla, 2005). The HBC gave up control of Rupert's land in 1870 when the region was turned over to the new Canadian dominion government (Harris, 2008; Foster, 2005). Organized application of English common law and the Doctrine followed acquisition of Rupert's Land by the dominion government, and the common law and Doctrine prevailed as the means for determining water access and right of use until 1894 (Foster, 2005; Knafla, 2005; Percy, 1977).

During the 1880s it was becoming clear that the Doctrine was not capable of addressing water allocation issues as settlement of the prairies progressed (Goodman, 2005, Percy, 1977). Large-scale irrigation projects sought to divert large volumes of water to irrigate land located away from watercourses, which is not permitted under the Doctrine (Block and Forrest, 2005; Goodman, 2005; IWMSC, 2002; Percy, 2005, 1977). The Doctrine also lacked procedures to determine priorities when water was in short supply, as the condition of having enough water in the watercourse to meet all riparian needs was not always possible (Block and Forrest, 2005; Getzler, 2004; Percy, 2005, 1977). William Pearce and J.S. Dennis spearheaded change to the regulation of water in the prairies by reviewing legislative options drawing upon water legislation experience from the US and Australia (Goodman, 2005; IWMSC, 2002; Percy, 2005, 1996). Their work led to the passing of the *Northwest Irrigation Act* (NWIA) of 1894 that fundamentally changed how water is managed in Canada (Percy, 1996, 1977). The changes ushered in by the NWIA included; i) largely abandoning the Doctrine and placing ownership of all water in the crown (government); ii) requiring all water users to have a government issued license for the right to divert water for any use, iii) introducing the prior allocation system which applies a First-in-Time-First-in-Right (FITFIR) principle to determine access priorities during water shortages, and iv) establishing non-transferability of allocations (Block and Forrest, 2005; Percy, 2005, 1977). Use of the Doctrine remained to determine water access and use rights in eastern Canada where water supplies were abundant even though the NWIA was in force. Under FITFIR those with older (senior) licenses are permitted to divert the entire amount of water that their license allows before newer (junior) licenses could do the same (Hurlbert, 2006; Block and Forrest, 2005; Percy, 2005). The NWIA gave those with no water flowing through or adjacent to their land the ability to divert water out of a watercourse (IWMSC, 2002; Percy, 2005, 1977). This provided the foundation for irrigation, industrial, and municipal development in the southern prairies (IWMSC, 2002; Percy, 2005, 1977). The federal NWIA in turn provided the foundation for provincial water law in Alberta, Saskatchewan, and Manitoba (de Loë et al., 2009; Getzler, 2004; Percy, 2005, 1977).

The creation of the province of Alberta and Saskatchewan, plus the expansion of Manitoba's territory to present day boundaries occurred in 1905 (Historical Atlas of Canada, 2012; Percy, 2005). Control over public land and regulation of natural resources remained with the federal government under the NWIA after the provinces were formed (Percy, 2005). As the provinces matured, conflict between the provinces and the federal government developed over control of public land and natural resources (Percy, 2005). The conflicts were based on the provinces seeking to use their autonomy over resources in their borders granted by the Canadian constitution (Percy, 2005). The federal government resolved the conflict by having the British parliament amend the Canadian constitution to include the *Natural Resources Transfer Agreements* (transfer agreements) with Alberta, Saskatchewan, Manitoba, British Columbia, and Ontario in the summer of 1930 (Constitution Act, 1930; Percy, 2005). For Alberta, this transfer took place with the federal *Alberta Natural Resources Act* in December of 1930 (Alberta Natural Resources Act, 1930, s. 8; Constitution Act, 1930; Percy, 2005, 1977) which enshrined the terms of the transfer in Canadian law. The Alberta government passed the provincial *Water Resources Act* in 1931 carrying over many aspects of the previous federal law (Block and Forrest, 2005; Percy, 2005).

The *Water Resources Act* (1931) like its federal predecessors provided little incentive for water conservation, as the water itself was considered 'free' (Percy, 1996). The *Water Resources Act* (1931) was not equipped to adequately handle water reallocation when environmental and supply issues emerged stemming from Alberta's population and economic growth (AENV, 2011; Block and Forrest, 2005). Prior to the *Water Resources Act* in the 1920s, it was foreseen that the FITFIR system would use up all possible allocations and lead to future issues with water supplies, particularly for environmental purposes (Percy, 2005, 1977). Users requested more water than needed at the time of applying for the license to gain seniority under FITFIR and secure water for future expansion that rapidly consumed the available allocations (Percy, 1996, 1977). Increasing demand for water was met through efforts to increase supplies via construction of storage facilities during the 1960s – 1980s (IWMSC, 2002; Percy, 1996, 1986). The construction of dams and reservoirs expanded water storage and increased the area under irrigation greatly (IWMSC, 2002). However, securing water supplies via storage and conveyance expansion was increasingly costly and impractical (IWMSC, 2002; Percy, 1996, 1986). Several amendments to the *Water Resources Act* (1931) were made over time in response to emerging water supply and environmental issues (Percy, 1996). Amendments were generally reactionary and did not adequately address environmental issues, and in some instances conflicted with other legislation over management of environmental impacts (Percy, 1996). Efforts to replace the *Water Resources Act* began in 1989 and continued through the early 1990s (de Loë et al., 2009; Block and Forrest, 2005; Percy, 1996). Public meetings, consultations, and other activities to gather information about the needs of stakeholders were completed to ensure that the new law would protect the environment while ensuring economic stability and growth (de Loë et al., 2009; Block and Forrest, 2005; Percy, 1996).

The first *Water Act* (the Act) passed the Alberta legislature in 1996, was proclaimed in 1999, and revised in 2000 (Adamowicz, 2010; Block and Forrest, 2005; de Loë et al., 2009; Percy, 1996). The Act carried over aspects of its predecessors including the crown ownership of all water (Water Act, 2000, s. 3), requirement of a license for withdrawing water (Water Act, 2000, s. 49), general inseparability of licenses from the land (Water Act, 2000, s. 58), and maintains the FITFIR principle (Adamowicz et al., 2010; Block and Forrest, 2005, Water Act, 2000, s. 30). The greatest change from previous legislation is the ability to transfer all or part of a license to another parcel of land via market style transactions modeled after American and Australian experience (Block and Forrest, 2005; Percy, 2005, Water Act, 2000, s. 81). The allocation remains tied to the land specified in the license and must be tied to the land belonging to the new ownership once the transfer is complete (Water Act, 2000, s. 45). The ability to transfer all or part of a licensed allocation provides a way to move allocations between use sectors in times of shortage, or allow new users a way of securing water when river basins are closed to new licenses

(Adamowicz et al., 2010; Percy, 2005, 1996). Transfers are subject to administrative scrutiny to ensure that the transfer does not adversely affect other users and the aquatic environment (Adamowicz et al., 2010; Percy, 2005; Water Act, 2000. s. 53). Older licenses issued under previous legislation are "grandfathered" under the Act maintaining their original terms even if they did not meet the requirements for aquatic ecosystem protection (Block and Forrest, 2005; Percy, 1996; Water Act, 2000, s. 18). New licenses issued under the Act must include an end date and a list of terms to manage environmental effects (Water Act, 2000, s. 51(5), 55). The Act still recognizes the use of common law and the Doctrine for water access in limited contexts (de Loë et al., 2009; Percy, 2005; *Water Act*, 2000, s. 19, 21 – 22).

2.6. Water and land policy in Alberta

The Alberta government's policy response to the issues of water management, ecosystem health decline, and changes to ES provision is found in the *Water for Life (WFL) Strategy: Alberta's Strategy for Sustainability* (2003a) (the WFL Strategy), *Water For Life: A Renewal* (2008a) (WFL Renewal), *Water For Life: Action Plan* (2009) (WFL Action Plan), and the *Land Use Framework* (2008) (LUF). The WFL Strategy was created by the Alberta government in response to the need to change water management in the province (AENV, 2003a). The WFL Strategy was a product of extensive review of water management issues and options for changing the allocation system. The review took place from 2001 to 2003 involving many experts, stakeholders, and residents whom provided input to the strategy's development (AENV, 2003a). The three main goals of the WFL Strategy are: 1) A safe, secure drinking water supply, 2) healthy aquatic ecosystems, and 3) reliable, quality water supplies for a sustainable economy (AENV, 2003a, p. 7). The WFL Strategy included creating water management plans and water conservation objectives (WCOs) for each river basin to guide decision makers (AENV, 2003a). A WCO is defined as (AENV, 2010, p. 58)

> "The quality and quantity of water to remain in a river or other body of water for the
> - protection of a natural water body or its aquatic environment, or any part of them;
> - protection of tourism, recreation, transportation, and waste assimilation uses of water, and;
> - management of fish and wildlife"

The *Approved Water Management Plan for the SSRB* (the SSRB Plan) was the first, and to date only, water management plan created and implemented as part of the WFL Strategy (AENV, 2006). The SSRB Plan recommended the closure of the SSRB to the application for new licenses due to reduced ecosystem health found during the review period (AENV, 2006, 2005a). The closure of the SSRB to new licenses was implemented in 2006 (AENV, 2010, 2006). The WFL Strategy was reviewed to "take stock" of progress and re-tune objectives based on experience gained in the first five years leading to the release of the WFL Renewal document in 2008 (AENV, 2008a). The WFL Action Plan (2009) compliments the WFL Renewal in providing a timeline for achieving the actions required to meet each of the WFL goals. The WFL Renewal and WFL Action Plan contain new management goals (Table 2.3), and list the acquisition of information for decision making as a key goal (AENV, 2009, 2008a).

Table 2.3: Summary of management goals under Water for Life: A Renewal and Water for Life: Action Plan

• Recognition of limits to water supplies	• Knowledge is the key to effective decision making
• Management must consider the capacity of watersheds	• Preservation of healthy aquatic ecosystems is vital to quality of life
• Responsibility for water management is shared between all sectors of society and cooperative work is needed to improve local watershed conditions	• Ground and surface water must be preserved as economic growth and community development move forward
• Albertans must use water more effectively, efficiently, and responsibly	• Provide safe, secure, drinking water via leading water quality standards
• Best practices and market based tools are used for flexible adaptive management	• Manage water to ensure agreements with other jurisdictions are met
• Continue applying the FITFIR system while using transfers to meet social and environmental needs	• Managing publically and district owned water infrastructure for sustainability
• Ensure resource management policy integration via including Water for Life in other policies and plans	

Source: AENV (2008)

The *Land Use Framework* (LUF) was created in recognition of the fact that land resources face similar multiuse challenges as water resources (Alberta, 2008). The guiding principles of the LUF connect actions with goals including sustainability, accountability, ethical stewardship, collaboration, transparency, integration, knowledge centered, responsive, equitable and fair, timely, respect for private rights, and respect for aboriginal communities (Alberta, 2008). The LUF utilizes the Plan – Do – Check – Act approach at the core of management decisions similar to an environmental management system (EMS) (Alberta, 2008; Kirkland and Thompson, 2002). The Plan – Do – Check – Act approach ensures continual improvement and adaptability over time as new information becomes available (Alberta, 2008; Kirkland and Thompson, 2002). Priority actions were to ensure the success of the LUF including legislation to support the strategies, developing metropolitan plans for Edmonton and Calgary, create a regional plan for the Lower Athabasca, and create the plan for the South Saskatchewan Region (Alberta, 2008). The passing of the *Alberta Land Stewardship Act* (ALSA) in 2009 achieved the legislative priority action of the LUF providing a connection between aquatic ecosystems, land use, and decision making (Kerr & Bjornlund, 2010). The ALSA was given power over other resource management legislation, such as the *Water Act* (2000, s. 4.1), to ensure that regional plans carry the legislative weight needed to protect ecosystems (Alberta Land Stewardship Act, 2009, s. 17; Kerr & Bjornlund, 2010).

The *WFL Strategy*, *WFL Renewal*, *WFL Action Plan*, and *LUF* include the policy direction of incorporating market style mechanisms as key components of regulation and management reform (AENV, 2009, 2008a,b, 2003a). The ALSA and the LUF specify types of market based instruments (MBIs) that can be deployed to meet policy objectives (Kerr & Bjornlund, 2010). However, inconsistency over the definition of MBIs exists between these documents (Kerr & Bjornlund, 2010). The drive to use market style mechanisms versus command-and-control management stem from the potential economic gains and ability to secure ES provision experienced in other jurisdictions (Adamowicz et al., 2010; AENV, 2009, 2003a; Garrick et al., 2009; Horbulyk and Lo, 1998; Kerr & Bjornlund, 2010). As noted in chapter 1, market style transfers have shown the ability to increase the efficiency of water use through providing a disincentive to over consume water (Brooks and Harris, 2008; Horbulyk and Lo, 1998; Nicol et al., 2008; Percy, 2005) and to secure water for the environment (Wheeler et al., 2013). The closure of the SSRB to the application for new licenses noted above provides the catalyst for the use of market style management by creating scarcity of allocations (Bjornlund, 2010; AENV, 2003). To date, there have been limited trades in southern Alberta (Nicol et al., 2008; Nicol, 2005). These trades were in the same region or irrigation district and none involved transfers for ES maintenance (Nicol et al., 2008; Nicol, 2005). The participants in transfers reported lack of information on prices of water for different uses as one of the barriers to participation (Nicol et al., 2008; Nicol, 2005). Other barriers included the length of time and cost associated with the transfer approval process, and the prospect of the government holding back 10% of the allocation (Nicol et al., 2008). Research indicates limited support for the use of water trading and market based instruments in the irrigation sector (Bjornlund et al., 2007). Opposition to the use of market mechanisms has emerged stemming from the concern that market mechanisms will lead to greater water use exacerbating issues with water supplies and ecosystem health decline (Christensen & Droitsch, 2008).

A second key component of the *WFL Strategy*, *WFL Renewal*, *WFL Action Plan*, and *LUF* is acquisition of information for decision-making (AENV, 2009, 2008a,b, 2007c, 2003a). The Alberta government is addressing the need for information by conducting research. Research completed to date includes *Water for Life. Reliable, Quality Water Supplies for a Sustainable Economy: Current and Future Water Use in Alberta* (AENV, 2007a); *South Saskatchewan River Basin in Alberta: Water Supply Study* (AMEC, 2009); the *Approved Water Management Plan for the SSRB* (AENV, 2006); *Ecosystem Goods and Services Assessment-Southern Alberta (Phase 1 Report - Key Actors and Initiatives, Phase 2 Report – Conceptual linkages and Initial Assessment)* (AENV, 2007b); *Facts about Water in Alberta* (AENV, 2010); and *Recommendations for Improving Alberta's Water Management and Allocation* (Minister's Advisory Group, 2009).

2.7. Summary and Conclusion

This chapter reviewed the broad context of water resources, irrigation, water law, and land and water policy in Alberta. The demand from continued population growth alongside growing economic activity is expected to place increasing pressure on irrigation infrastructure and water resources in general. Climate change is altering, or expected to alter, the timing and availability of water resources compounding the challenge (Nemeth, 2010; AMEC, 2009; Sauchyn & Kulshreshtha, 2008; Byrne et al., 2006). Ecosystem health has been affected in some watercourses, with further decline anticipated if water and land management practice continues unchanged (AENV, 2007b, 2005a).

Small scale irrigation in Alberta began with Mormon settlement in the late 19th century. Large scale irrigation developed in the early 20th century following legislative changes permitting large volumes of water to be diverted (IWMSC, 2002; Percy, 1996). Corporate ownership of irrigation infrastructure gradually transferred to irrigation districts with federal and provincial government help (IWMSC, 2002). A mixture of government and irrigation district ownership of irrigation infrastructure currently influence the management of water in Alberta today (IWMSC, 2002).

Water legislation in Alberta has historical ties the common law of England. The doctrine of riparian rights was brought from England during early settlement of Canada, and prevailed as the means by which water access and use rights were established in the years following confederation (Foster, 2005; Knafla, 2005; Percy, 1977). Change came in 1984 with the first federal law governing water allocation that was a departure from the common law and riparian doctrine tradition (Percy, 1996). Aspects of the first federal law such as crown ownership of all water resources, licensing requirements, and the FITFIR principle were carried through to provincial legislation (Percy, 2005, 1996). Current water legislation facilitates the use of market style mechanisms to move water between demand sectors enabling water to be moved to higher value uses, and enable allocations to be obtained for maintaining ecosystem health (Percy, 2005, 1996; Wheeler et al., 2013).

The government of Alberta is meeting natural resource management challenges by enacting new laws and policies focused on protecting ecosystem health and securing ES provision (Alberta, 2008; Alberta Land Stewardship Act, 2009; AENV, 2009, 2008a,b, 2007c, 2003a; Water Act, 2000). The use of market based instruments (MBIs) is promoted in provincial policy to reallocate water and ensure adequate supplies are available for meeting WCOs (Alberta, 2008; AENV, 2009, 2008a,b, 2007b, 2003a; Bjornlund, 2010; Kerr & Bjornlund, 2010). The need for science-based information to guide decision making has been identified as key to achieving policy goals (Alberta, 2008; AENV, 2009, 2008a,b, 2007b, 2003a). The findings of this study contribute to current policy goals through expanding the available information about the value of recreational ES benefits provided by the Chestermere Reservoir.

CHAPTER 3:

GEOGRAPHY AND ECONOMICS OF ECOSYSTEM SERVICE VALUE

3.1. Introduction

There has been a large increase in the literature pertaining to the economic valuation of ecosystem service (ES) benefits in the last two decades (Adamowicz, 2004; Fisher et al., 2008; Gomez-Baggethun et al., 2010; Vihervaara et al., 2010). This increase is in response to efforts to include ES benefits in the economic analyses and better understand the consequences of past and future natural resource management decisions (Birol et al., 2006; Boyd and Banzhaf, 2007; Costanza et al., 1997; Liu et al., 2010; Turner et al., 2008; Wallace, 2007). The literature review in this chapter brings together the economic and geographic theories, concepts, and methods used in valuing recreational ES benefits. The review begins in second part with the evolution of the ES concept in the second part. The third and fourth parts review the economic and geographic theories, concepts, and the methods developed over time to value recreational ES benefits. The fifth part reviews and compares previous studies that estimate the value of recreational ES benefits. The sixth part provides a summary and conclusion.

3.2. Conceptualization of ecosystem services

The organized conceptualization of ES began to emerge in the 1970s and 1980s with early work limited to generalized descriptions of the benefits humankind receives from ecosystems (De Groot, 1987; Gomez-Baggethun et al., 2010; Vihervaara et al., 2010; Westman, 1977). The goal of developing the ES concept was to bridge emerging ecological literature on the negative impact of human activities on the environment and the economic literature commonly used in decision making (De Groot, 1987; Westman, 1977). Literature on the definition, classification, and valuation of ES grew and gained footing through the 1990s and 2000s (Gomez-Baggethun et al., 2010; Vihervaara et al., 2010). Notable examples include Daily's (1997) "*What Are Ecosystem Services*", Costanza et al.'s (1997) "*The Value of the World's Ecosystem Services and Natural Capital*", and the findings of the MA (2005).

Table 3.1: Classification of ecosystem services in the Millennium Ecosystem Assessment

Service Category	*Ecosystem Services Within the Service Category*	
Provisioning: → Goods produced by Ecosystems	→ Food, → Fresh water	→ Fuel wood, fiber (ie: clothing), biochemicals, genetic resources
Regulating: → Aspects regulated by ecosystem processes that benefit society	→ Climate control → Disease control	→ Water regulation → Water purification → Pollination
Cultural: → Benefits to society that do not consume materials directly	→ Recreation → Cultural Heritage → Educational	→ Inspirational → Spiritual/Religious → Sense of Place
Supporting: → Intermediate services needed to produce the other ecosystem services	→ Soil formation → Nutrient cycling	→ Primary production (Photosynthesis)

Source: MA (2003, p. 57)

As noted in chapter 1, the MA classification places ES into categories of provisioning, regulating, cultural, and supporting services (Table 3.1). The provisioning classification is the group of ES that provide goods directly used by humankind to meet basic needs such as food and fresh water (MA, 2003). The regulating classification consists of the ES that stabilize the provisioning ES and the general environment, such as climate control (MA, 2003). The cultural classification consists of non-material ES that contribute to human well being like recreation (MA, 2003). The supporting services are the ES required as inputs for producing the ES in the other classifications (MA, 2003). The definition and classification of ES is not without debate (Boyd & Banzhaf, 2007; Fisher et al., 2009; Wallace, 2007). The classifications by the MA have shown limitations when applied to problems with a more economic context leaving calls for improvements to ES definitions and classifications (Boyd & Banzhaf, 2007; Fisher et al., 2009; Wallace, 2007). Some argue that the classification of ES requires greater focus on the separation of environmental processes that produce ES from the ES classifications that are considered final goods (environmental assets or stocks) to improve economic analyses (Boyd & Banzhaf, 2007; Wallace, 2007). Even with the debate over classification, the MA is noted by some as a key contribution to ES definition and classification and has gained wide acceptance in literature (Fisher et al., 2009; Vihervaara et al., 2010). The MA classification and definition is used in this study due to its widespread acceptance.

3.3. Economics of recreational ecosystem service benefits

Most ES benefits, other than the provisioning services, are public goods that are non-rival and non-excludible with no markets to reveal prices (Birol et al., 2006; De Groot et al., 2009; Hanemann, 2006; King, 2007; Mäler, 1974; Samuelson, 1954; Tietenberg, 2006). The Equimarginal Principle and Consumer Choice Theory can be used to estimate the shadow value of ES benefits in the absence of a market (Tietenberg, 2006; Varian, 1992). The Equimarginal Principle holds that the benefit (utility) of consumption/participation will be equal to the cost of obtaining a given bundle of goods, services, or activities (Tietenberg, 2006; O'Sullivan, 2003; Van Kooten & Bulte, 2000; Varian, 1992). Should benefits be greater than costs of the next "unit" of a good or service then one chooses more (O'Sullivan, 2003). Conversely if costs are more than benefits one chooses less of the good, service, or activity (O'Sullivan, 2003). Consumer choice theory builds on the equimarginal principle in that a rational individual will need to make choices as to the combination of goods, services, and activities they can obtain within their budget and time constraints that gives the greatest benefit (Van Kooten & Bulte, 2000; Varian, 1992; Ward & Beal, 2000; Young, 2005). Application of the equimarginal principle and consumer choice theory to valuing recreational ES benefits is done by equating the costs (travel, onsite costs, time) of recreation (C_r) with benefits (U_r) of recreation participation (enjoyment, health, happiness, etc.) subject to monetary (Y_r) and time (T_r) constraints described by equation 3.1 (Gomez-Baggethun et al., 2010; Hanemann, 2006; Tietenberg, 2006; Ward & Beal, 2000).

$$U_r = C_r \big|_{Tr,\, Yr} \qquad (3.1)$$

The base assumptions of eq. (3.1) are (Ward & Beal, 2000; Varian, 1992):

i. A given person has a fixed set of preferences driving consumer choice,

ii. A person will always prefer more of a good to less subject to diminishing marginal utility, and

iii. Preferences are logically sequenced such that if a person prefers A to B, and prefers B to C, then they will prefer A to C as well

Various non-market valuation methods have been developed to estimate the value of non-market ES benefits including the *travel cost method* (TCM) by Harold Hotelling in 1947, the *contingent valuation method* (CVM) by S.V. Ciriacy-Wantrup in that same year (Ward & Beal, 2000; Young, 2005), and the *hedonic price method* (HPM) by Sherwin Rosen in 1974 (Green, 2003; Young, 2005). Table 3.2 summarizes the common non-market valuation methods developed to date. The revealed preference (RP) methods use historical expenditure (cost) data to "reveal" the individual's utility in dollar values by applying eq. (3.1). The stated preference (SP) methods use survey questions of hypothetical scenarios involving positive or negative changes to ES provision and benefits with an associated cost for each scenario (Turner et al., 2008; Young, 2005). A survey participant selects (states) the scenario that maximizes their utility and the associated cost of that scenario becomes the shadow value of the ES benefits examined (Turner et al., 2008; Young, 2005). The development of different valuation methods was done in response to the limitations in the applicability of individual methods across different situations. Additionally, the context, data availability, time, and financial resources available to a researcher influences the choice of method selected for a given study (CCME, 2010; Young, 2005). Table 3.3 summarizes the strengths and weaknesses of the ES valuation methods and Table 3.4 provides a summary of the estimation methods used in varying resource management contexts. The methods commonly used for valuing recreational ES benefits are the, TCM, CVM, and HPM (Turner et al., 2008; Young, 2005).

Table 3.2: Revealed and stated preference non-market ES valuation methods and descriptions

Revealed Preference:

- Market method: Valuations are directly obtained from what people must be willing to pay (WTP) for the service or good
- Travel cost method: Valuations of site-based amenities are implied by the costs people incur to enjoy them (e.g., surveys of costs to travel and use recreational lakes)
- Hedonic models: The value of a service is implied by what people will be WTP for the service through purchases in related markets, such as housing markets (e.g., open- space amenities)
- Production approach: Service values are assigned from the impacts of those services on economic outputs (e.g., increased shrimp yields from an increased area of wetlands)
- Random Utility Model: Individuals make tradeoffs among trip costs and site characteristics such as, natural scenery, congestion, and others are compared. The costs associated with visiting the site with the highest utility then serves as a proxy for the value.

Stated Preference:

- Contingent valuation: People are directly asked their WTP or Willing to Accept (WTA) compensation for some change in ecological service (e.g., surveys of willingness to pay for ES)
- Conjoint analysis/Choice Modelling: People are asked to choose or rank different service scenarios or ecological conditions that differ in potential utility for the respondent (e.g., surveys choosing between wetlands scenarios with differing levels of flood protection and fishery yields)

Sources: Liu et al. (2010), Whitehead et al. (2008), and Young (2005).

Table 3.3: Non-market ES valuation methods strengths and weaknesses

Valuation Method / Approach	*Strengths*	*Weaknesses / Limitations*
Market Prices	Best Estimate of WTP/WTA as these are the prices faced by economic agents in real life decision-making.	Potential market and policy failure can result in true WTP not being expressed (consumer surplus not included)
Replacement Cost/ Preventative Expense	Easy to calculate. Second best estimate.	Potential inaccuracy from unknown costs of project, benefits, and knowledge of risk
Proxy/Substitute Products	Easy data collection	Typically proxies are not perfect substitutes with same limits as market prices (above)
ES Productivity Change	Easily understood by policymakers (if it exists)	Input-output data needed on ES in question to be accurate. Hard to isolate cause & effect due to complex interrelationships
Opportunity Costs	Good for land based production with higher labour inputs.	Can be difficult and costly to assess labour opportunity cost. Only Gross value can be found
Travel Cost	Good for recreational based ES/Eco-tourism. Accuracy increases with shorter distances	Single or multi-purpose trip assumptions needed to develop demand. Sensitive to opportunity cost of time estimates, and travel cost estimates (ie: fuel). Data intensive/costly
Contingent Valuation	Good if rigid procedures are done to prevent error. Good for non-use value. Gives net-value	Knowledge and understanding of participants potentially creates erroneous estimates. Bias answers and credibility of respondents may pose issues. Income barrier issues.
Hedonic Pricing	Good for urban to semi-urban areas.	Needs highly developed real-estate markets. Multi-variable nature of purchases creates difficulty in examining one variable

Source: Adapted from Rietbergen-McCracken (1998)

Table 3.4: Non-market valuation methods in different resource management and policy contexts

Management Context	Conservation Action	Infrastructure Management	Water Quality Standards Development	Water Allocation	Water Pricing	Compensation for Damages or Use
Role of Water Valuation	Estimating the monetary value of benefits/costs associated with conservation/degradation of (environmental) resources	Est. Monetary value of project outcomes (e.g. costs and benefits)	Estimating monetary value of changes in water quality (e.g. benefits of reduction in health risk from an improvement in quality)	Estimating monetary value of marginal changes in the provision of water	Estimating monetary value of marginal changes in the provision of water due to pricing policy (charge, fee, etc.)	Estimating monetary value of impacts from abstraction, use, consumption or pollution of water resources
Market Price Approaches	Proxy for use value as far as actions influence availability of water as a commodity	Proxy for use value but only likely to be suitable for relatively small provision changes	Proxy for use value but only likely to be suitable for small changes in water quality & providing min. estimate of benefits	Proxy for use value but only likely to be suitable in cases of relatively small changes	Unlikely to provide suitable evidence for establishing level of price	Minimum estimate of use value for compensating the loss of water as a commodity
Production Input Approach	Use value where water is an input to production which benefits from actions	Use value where the project affects water as an input to production processes	Use value where the change in water quality affects water as an input to production processes	Change in use value where allocation affects water as an input to production processes	Cannot provide evidence for establishing price level but can analyze impact on use value of change in price	Use value associated with damages due to water not being available as an input to production
Revealed Preference Methods	Use value if actions affect (perceivable) amenity values and/or recreation activities	Use value if the project affects (perceivable) amenity values and/or recreation activities	Use value if the change in water quality affects (perceivable) amenity values and/or recreation	Use value in location-specific cases where allocation affects water supply to recreation	Use value evidence for establishing the price to account for (perceivable) impacts on recreation	Use value in location-specific cases where damages are perceived as an element of recreation
Stated Preference Methods	Use and non-use value associated with actions	Use and non-use value associated with project outcomes	Use and non-use value associated with changes in water quality	Use and non-use value associated with change in allocation between uses	Use & non-use value evidence for establishing the price for impacts on ES	Use and non-use value associated with damages
Benefit Transfer	Likely to be suitable for actions affecting small provision changes and/or impacts where a greater degree of uncertainty in evidence can be accommodated	Likely to be suitable for projects affecting small provision changes and/or impacts where a greater degree of uncertainty in evidence can be accommodated	Likely to be suitable for relatively small changes in water quality where a greater degree of uncertainty in evidence can be accommodated	Unlikely to be suitable where requirement for accuracy in evidence is high	Unlikely to be suitable where requirement for accuracy in evidence is high	Unlikely to be suitable where requirement for accuracy in evidence is high

Source: CCME (2010)

The literature review below is organized by first summarizing a non-market valuation method followed by a review of an article (or articles) applying the method to value recreational ES benefits. The monetary findings of the studies reviewed are reported in Canadian dollars (CAD) and adjusted to reflect the current (2012) price levels. This is done for consistency when comparing recreational ES value estimates from different years and locations (Chizinski et al., 2005). At the time of this thesis the Canadian dollar was approximately at parody with the US dollar (Bank of Canada, 2012a). As such, no currency conversion is done for studies from the US.

The TCM is a RP method that equates costs of participating in recreation activities (TC_R) with the utility from the recreation experience (U_R) using the basic functional form shown in eq. 3.2 (Hanink, 1995; Tietenberg, 2006; Ward & Beal, 2000; Young, 2005).

$$U_R = TC_R = (p_t + p_{os} + p_v) \Big|_{TR,\ YR} \tag{3.2}$$

Where p_t = round trip time cost travelling to the recreation site, p_{os} = on site expenses for the trip, and p_v = the round trip vehicle operation costs for the trip, Y_R is the budget constraint for recreation, and T_R is the time constraint for recreation. Equipment cost is typically represented by the rental costs for a given trip and included in the (p_{os}) variable (Parsons, 2003). The equipment costs are negligible for those who own their own equipment and use it at multiple sites over many years (Parsons, 2003). The cost of owned equipment is generally omitted from TCM analyses (Parsons, 2003). There are two general forms of the TCM, the Zonal TCM (ZTCM) and the Individual TCM (ITCM) (Turner et al., 2008; Ward & Beal, 2000; Young, 2005). The ZTCM uses the expense information on costs of recreation participation within a defined zone (ie: census enumeration areas) and assumes that all visitors originating from within this zone incur the same cost of accessing a recreation site and all have the same demographic characteristics (income, education, employment, etc.) (Turner et al., 2008; Young, 2005).

McFarlane & Boxall, (1998) used the ZTCM to estimate the value of camping at the Foothills Model forest in Western Alberta. Data from self-registration permits collected at provincially managed campgrounds and the William A Switzer Provincial Park was combined with census data to estimate the value of camping recreation (McFarlane & Boxall, 1998). The permits provided information on the origin postal code, number of people in the travelling party, number of previous visits to the site, number of days they stayed, license plate number, last name, origin province/state, and campsite number (McFarlane & Boxall, 1998). The zones were created by linking the postal code from the permit with the census enumeration area where the postal code is located using a Geographic Information System (GIS) (McFarlane & Boxall, 1998). The census data (income, age, etc.) from each census enumeration area was used for statistical analysis, and the estimation of travel distance was processed using the GIS (McFarlane & Boxall, 1998). Calculations of total cost for each of the 7510 camping trips made by Albertans was completed finding an estimated value of camping at the Foothills Model Forest to be around $583,000 annually (McFarlane & Boxall, 1998). Boxall et al. (1996) used the ZTCM with similar data collection and analysis methods as McFarlane & Boxall (1998) to value camping at managed sites in the Rocky-Clearwater Forest. Data from permits (postal codes, number of people in the vehicle, etc.) was combined with census data to measure travel distances and prepare the demographic data (income, education, etc.) for statistical analysis (Boxall et al., 1996). The findings revealed an estimated annual value of $750,000 for camping in the Rocky-Clearwater forest managed sites (Boxall et al., 1996).

The ITCM uses similar analysis methods to the ZTCM but uses data from individual respondents vs. aggregate data (Turner et al., 2008; Young, 2005). Surveys are deployed to collect travel, expense, origin, and demographic data from each respondent at the study site (Turner et al., 2008; Young, 2005). The data is then inputted into travel cost calculation equations to arrive at the cost of each trip (Turner et al., 2008; Young, 2005). The individual costs are then summed to obtain the total estimated value of recreational ES from the study site, or total is divided by the number of respondents to get the average per trip value of the study site (Turner et al., 2008; Young, 2005).

Chizinski et al. (2005) use the ITCM to estimate the value of fishing at the Lake Kemp Reservoir in Texas. A one-to-one survey was used to collected data from individuals recreating at the reservoir (Chizinski et al., 2005). Information was collected on the date and time, group size, recreation activities, expense information (lodging, transportation, and activity related costs), number of visits in a 12 month period, and demographic characteristics (age, income, and educational attainment) (Chizinski et al., 2005). The data from each survey respondent (117 in total) was inputted into their TCM model to arrive at a value estimate ranging from $114 - $230 per trip.

There are pros and cons of using the ZTCM or ITCM. The ZTCM benefits from lower data requirements and easier analysis (Turner et al., 2008; Ward & Beal, 2000). The drawbacks of the ZTCM include lost variability and specific information when using aggregated information and how to define zones (Turner et al., 2008; Ward & Beal, 2000). The benefit of using the ITCM is having individual data to capture individual characteristics that affect the number of trips and improved results from statistical analyses versus aggregate data (Turner et al., 2008; Ward & Beal, 2000; Young, 2005). Disadvantages of the ITCM include the high amount of data needed for analysis, high cost of obtaining data, and potential issues with how to handle non-use values (Turner et al., 2008; Ward & Beal, 2000; Young, 2005). General advantages of the TCM as a whole are the use of actual expenditure data revealing value estimates. Disadvantages of the TCM include the cost of collecting the data, limited data availability, how to formulate the estimation model, and handling of time values (Turner et al., 2008; Ward & Beal, 2000; Young, 2005).

The Hedonic Price Method (HPM) is a RP method that estimates the utility of a location (place) by the WTP for access to the location (Turner et al., 2008; Young, 2005). The HPM presumes that a given site possesses a bundle of valued characteristics such as reduced travel distance, onsite facilities, and so forth (Turner et al., 2008; Young, 2005). The price difference between sites reveals the shadow value of the environmental amenities when keeping all non-environmental value characteristics homogeneous (Turner et al., 2008; Young, 2005). An example would be real-estate prices where houses with identical characteristics will tend to have higher prices if closer to positively valued environmental amenities, and lower prices if closer to negatively valued environmental amenities (Turner et al.., 2008; Young, 2005). The general estimation equation for the HPM in the house-pricing example is (Young, 2005):

$$P_i = g(\mathbf{S}_i, \mathbf{N}_i, Q_i) + \varepsilon \qquad (3.3)$$

Where (P_i) is the price paid for the property, ($\mathbf{S}_i$) is the valued non-environmental amenities of the property such as room size, square footage, and so forth, ($\mathbf{N}_i$) is the neighbourhood characteristics (proximity to work, shopping, parks, etc.), (Q_i) are the positive (parks, rivers, wetlands, etc.) or negative (industrial plant, highway, etc.) environmental amenities at the location, and (ε) is a random error term.

Bastian et al., (2002) value environmental amenities expressed via differences in agricultural land values using a HPM with a GIS in Wyoming. The data analysis consisted of 1200 data sheets from land transactions with test variables of pasture/sub-irrigated meadowlands, irrigated cropland, operation size, on-parcel improvements, distance to then nearest town (remoteness), if the land was leased, and the distance to recreational ES amenities (wildlife viewing, water based recreation, water quality, and scenic views) (Bastian et al., 2002). Findings revealed that all things being equal land parcels with diversity of scenic views, access to water based recreation, and remoteness yielded higher prices (Bastian et al., 2002). Advantages of this method are the general availability of market data and the solid foundation in theory (Turner et al., 2008). Disadvantages include the large amount of data needed along with the requirement of high level of researcher experience to apply the HPM (Turner et al., 2008).

The CVM is an established SP method used in recreation studies that elicits preference information about changes in ES (or other study topic) and the WTP to attain the changes, or avoid changes if proposed changes yield negative utility (Whitehead et al., 2008; Young, 2005). There are three requirements for applying a CVM. These are i) a description of the ES to be valued, ii) choice questions about ES changes and their anticipated benefits (or costs), and iii) questions about the respondents themselves such as age, income, etc. (Young, 2005). Regression equations are then generated using the survey data to obtain the estimated value of the ES benefit studied (Young, 2005).

Loomis (1996) used the CVM in a study to value proposed removal of two dams to restore fish migration routes and stocks in the Elwha River in Washington. A CVM survey was sent to two groups; one to residents of Washington State, the second to households in the rest of the US. The survey asked if the respondent was WTP increased taxes to remove the dams and restore the river and fish populations along with other spatial details (Loomis, 1996). Specifics of the spatial details are not provided. A total of 523 surveys were collected from Washington based respondents, and 482 from the rest of the US. Findings revealed a WTP of $100/household in Washington and $93/household for the rest of the US to proceed with the project (Loomis, 1996). Multiplying the household WTP with the number of households in Washington and the US yields total benefits of proceeding with the project of $203 Million and $8.4 Billion respectively (Loomis, 1996).

The advantages of the CVM method include the ability to estimate the impact of proposed changes in management where information is not yet available, flexibility in questions, and estimating non-use values of ES benefits such as aesthetic values and existence values (Turner et al. 2008; Young, 2005). Disadvantages of this method centre on the hypothetical nature of the questions, potential for participants to be untruthful about their WTP, and the possibility of subjectivity when developing the survey questions (Turner et al., 2008; Young, 2005).

Literature has emerged that promotes combining a RP method with a SP method when using the benefits of one method to compensate for the weakness of the other (Adamowicz et al., 1994; Cameron, 1992; Whitehead et al., 2008). This approach is argued to be able to provide improved quality of information over using the RP or SP method alone (Adamowicz et al., 1994; Cameron, 1992; Whitehead et al., 2008). Adamowicz et al. (1994) develop a set of RP, SP, and a combined RP and SP multinomial logit models to test if a combined approach improves recreational value estimates. A phone survey collected data for the RP model, and a mail in survey collected data for the SP model. The survey asked about choices between combinations of site attributes for water based recreation. The results revealed that the combined model was able to reduce the level of colinearity, a noted weakness of a standalone RP model.

3.4. Geography of ecosystem service benefits

Over time there has been increasing literature on the spatial aspects, scales, and limits of ES benefits (Kozak et al., 2011; Boyd, 2008; Hein et al., 2006; Bateman et al., 2002). The spatial limits of ES benefits vary depending on the source. For example, a lake or reservoir might provide recreational ES benefits to a smaller region, where the oceans provide ES benefits globally (Bateman et al., 2002; Hanink & White, 1999; Hein et al., 2006). The spatial limit is determined by the ability of the ES to move from the point where it is produced to the location where the benefit is received (Hein et al., 2006). The ES benefits are no longer attainable in a location under two possible conditions (Hein et al., 2006). The first is that the cost of transportation to access the source of the ES benefits becomes prohibitive, such as a distant recreation site (Hein et al., 2006). The second is when natural forces (wind, water) are not able to transport ES to those who would benefit (Hein et al., 2006). The boundary beyond which the ES benefits are not attainable is given different terms in literature such as "economic jurisdiction" or "service area" (Kozak et al., 2011; Brouwer and

Georgiou, 2007; Loomis, 2000). In the case of recreational ES, the service area boundary is determined by eq. 3.1 where the utility and cost of travelling to access recreational ES are equal.

The distance decay principle (DDP) can be used to describe the rate of decline in the number of visits to a recreation site as the distance between a given recreation site and origin community increases (O'Sullivan, 2003; Pacione, 2001). Spatial vale decay (SVD) can be used to describe the rate of decrease in a given site's recreation value as distance increases, such that those living closer to the site will visit more often and place greater value on the site versus those living further away (Ando and Shah, 2011; Hannon, 1994; He at al., 2011; Heidkamp, 2008; Loomis, 2000,1996). For both the DDP and SVD, a point is eventually reached where the number of visits and value reaches zero (Ando and Shah, 2011; Hannon, 1994; He at al., 2011; O'Sullivan, 2003; Pacione, 2001). The gravity model employs the DDP to predict the likelihood of those living in a given community visiting another location at a certain distance away (Taaffe and Gauthier, 1973). The interaction coefficient (IC) represents the strength of the "pull" of a location as a place to visit for residents of another community with the functional form (Taaffe and Gauthier, 1973):

$$IC_{ij} = \frac{P_i \bullet P_j}{d_{ij}} \tag{3.4}$$

Where IC_{ij} = IC between two communities, P_i = Population of city i, P_j = Population of city j, d_{ij} = distance between two cities. The gravity model borrows from Newton's law of gravitation and is primarily used in transportation and travel studies with readily available travel data (Anderson, 2010; Sutherland, 1983; Freund and Wilson, 1974). The gravity model has been applied to a limit number of recreation studies to predict the number of visits to a recreation site from nearby communities (Bewer, 2011; McAllister & Klett, 1976), or estimating the amount of recreation travel between different sites in a region (Freund & Wilson, 1974).

Studies combining the use of GIS with the TCM (GIS-TCM) and the HPM (GIS-HPM) have become more common (Baerenklau et al., 2010; Bastian et al., 2002; Bateman et al., 2002). The GIS can process distance measurements in a few seconds to minutes, whereas measuring distances on maps by hand can take hours (Boxall et al., 1996). The use of a GIS also permits the inclusion of other environmental data and spatial characteristics in the analysis to produce integrated information on ES values (Bateman et al., 2002). This makes GIS a valuable tool in current and future research on the value of ES benefits (Baerenklau et al., 2010; Bastian et al., 2002; Bateman et al., 2002). The potential drawback of using GIS is that it can be the difficulty or it can be associated with high cost of attain the data needed for the analysis (Bateman et al., 2002).

Baerenklau et al. (2010) apply the combined GIS-TCM approach to estimate the value of backcountry recreation at the San Bernardino National Forest in California. They used data by the Forest Service in the form of State Park permits that backcountry users are required to fill out when beginning a trip (Baerenklau et al., 2010). The card asks for the date, number of people in the hiking group, start and end point of the hike, and home address including ZIP code (Baerenklau et al., 2010). The ZIP codes were linked with census information in a GIS, Google Maps® (a publically available GIS) was used for the distance measurements, and a semi-log Poisson negative binomial model was used to estimate the recreation value of backcountry recreation (Baerenklau et al., 2010). Results revealed an aggregate total value of back country recreation of around $5.2 Million. ArcGIS 9™ was then used to develop a Digital Elevation Model (DEM) with a value weighting attached to each cell of selected land parcels where trails were present (Baerenklau et al., 2010). A DEM map of values was created showing that land parcels with higher elevation points had a greater recreation value (Baerenklau et al., 2010). This approach permitted the value of ES benefits to be visible instead of just a number (Baerenklau et al., 2010). Other applications of the combined GIS-TCM include Boxall et al. (1996) and McFarlane & Boxall (1998) discussed above.

3.5. Recreational ecosystem services benefits from reservoirs

The studies reviewed below value recreational ES benefits provided by reservoirs. These studies are used as a basis of comparison for the findings of this study. Cutlac & Horbulyk (2011) use the Aquarius Software package to estimate the value of sub-basin level recreation in the SSRB under six different allocation scenarios. Forty water demand and supply nodes (municipal, agricultural, recreational, etc.) along with assigned values for competing water uses are entered into Aquarius. Four virtual lakes/reservoirs were created to represent all the reservoirs and lakes in each SSRB sub-basin to simplify calculations (Cutlac & Horbulyk, 2011). Findings for the recreational value for water in the SSRB ranged from $6.2-$6.5 Million depending on the scenario (Cutlac & Horbulyk, 2011).

Taylor et al. (2010) use a TCM to value recreational sport fishing locations on the Snake River Reservoirs in Idaho. Data was collected via a mail in survey inquiring about driving costs, time costs, distance travelled, angling and non-angling activities while onsite, and demographic information (Taylor et al, 2010). The survey was supplemented by counts of anglers taken from the air (Taylor et al, 2010). The authors developed multiple TCM models to account for multisite visits, as there were other location options nearby if a given location does not yield any fish. Findings for the value of recreational sport fishing ranged from $19.51 - $45.80 per trip depending on the number of sites visited and the TCM model used.

Literature on the combination of qualitative and quantitative methods has increased in recent years, particularly in the behavioural sciences (Johnson & Christensen, 2012; Neuman & Robson, 2012; Onwuegbuzie & Leech, 2005; Johnson & Onwuegbuzie, 2004). The benefits of a combined qualitative and quantitative approach include the ability to gain greater context and perspective (Johnson & Christensen, 2012; Johnson & Onwuegbuzie, 2004; McNaughton, 1993; Moeller et al., 1980; Neuman & Robson, 2012; Onwuegbuzie & Leech, 2005).

McNaughton (1993) used a combination of formal (CVM) surveys and informal interviews and observations to value recreation provided by irrigation reservoirs with developed recreation facilities in southern Alberta. The surveys were administered one-to-one onsite with the majority of interactions resulting in an informal discussion (McNaughton, 1993). The quantitative formal survey revealed that day use recreationalists travel an average of around 56 Km, spend an average of about $33 per trip, and the majority take two trips or less per month (McNaughton, 1993). The annual estimated value of recreational ES benefits ranged from roughly $19,000 - $1.1 Million depending on the location (McNaughton, 1993). The author concedes that the estimates are crude with large margins of error stemming from data availability issues. The informal interview portion of McNaughton’s (1993) study revealed contextual information and the driving forces behind the recreational ES value. Conversation with recreationalists reveled that the WTP for recreation reported was less than the true value due to resentment over fees (McNaughton, 1993). Other insights on influences on recreation value gained during informal interviews and observation included knowledge of alternate sites, sense of ownership, available facilities, and lack of low cost alternatives (McNaughton, 1993).

Moeller et al. (1980) used both formal and informal interviews to test peoples' willingness to pay (WTP) more for public camping in New York State (NY State). The formal interviews (surveys) collected information on age, gender, group size, origin, distance travelled, stay length, level of camping experience, reason for camping, equipment used, and the if they expressed a WTP more for camping (Moeller et al., 1980). For the formal interview, the researchers identified themselves as researchers (graduate students) and conducted the survey with the respondent aware they were being interviewed for an academic study (Moeller et al., 1980). For the informal interviews, the researchers identified themselves as novice campers seeking information about equipment and camping techniques with the respondent unaware they were being interviewed for an academic study (Moeller et al., 1980). The informal interview relied on general conversation to lead into the question of a respondent's WTP more for camping with observed details of respondents (children with them, equipment used, etc.) recorded secretly to compare with the formal survey (Moeller et al., 1980). Findings from the formal interviews revealed that a low number of people expressed a WTP more for camping (Moeller et al., 1980). The informal interviews reveled that about half expressed a WTP more for camping (Moeller et al., 1980). The authors conclude that using formal and informal interviews (surveys) together shows potential to improve the quality and accuracy of data (Moeller et al., 1980). Debate over the methods of Moeller et al.'s (1980) study appeared with varying opinions about the collection of information without informed consent (Christensen, 1980; LePage, 1981).

3.6. Summary and Conclusion

This chapter reviewed the evolution of the ES concept, the economic and geographic theories, concepts, and methods that have been used to value recreational ES, and reviewed studies valuing recreational ES benefits using established methods. The ES concept gained footing beginning in the 1970s – 1980s, as increased information became available on the impacts human economic activities have on the environment (Gomez-Baggethun et al., 2010; Hubacek, & van den Bergh, 2006). The ES concept sought to bridge ecology and economics so that ES benefits can be included in decision making (Gomez-Baggethun et al., 2010; Hubacek, & van den Bergh, 2006). The methods developed over time for estimating the value of non-market recreational ES use a revealed preference or stated preference approach grounded in the equimarginal principle and consumer choice theory from economics (Green, 2003; Young, 2005). The revealed and stated preference methods used alone have limitations to applicability and accuracy that can be reduced when used in combination (Adamowicz et al., 1994; Cameron, 1992; Whitehead et al, 2008). The TCM has the longest history of valuing recreational ES benefits (Ward & Beal, 2000)

The inclusion of the spatial aspects of recreational ES provision is newer to literature (Baerenklau et al., 2010; Bastian et al., 2002; Bateman et al., 2002). The use of geographic models (gravity model) and tools (GIS) has been shown to provide greater flexibility, accuracy, and faster processing time than previous manual measurements (Baerenklau et al., 2010; Bastian et al., 2002; Bateman et al., 2002; Boxall et al., 1996).

The use of a qualitative and quantitative mixed method approach has increased in the social and behavioural sciences literature (Johnson & Christensen, 2012; Neuman & Robson, 2012; Onwuegbuzie & Leech, 2005; Johnson & Onwuegbuzie, 2004). Application of the mixed method approach valuing recreational ES benefits is scant in literature to date. The few recreation value studies applying the mixed method approach have found improved results over stand alone approaches (McNaughton, 1993; Moeller et al., 1980).

CHAPTER 4:

METHODS

4.1. Introduction

This chapter details the methods used to achieve the research objectives. The methods used in this study consist of a mixed method approach that combines a qualitative framework of informal interviews and observations with a quantitative framework of established economic and geographic methods. The remainder of this chapter is organized as follows. The second part provides a description of the study site and case study organizations. The third part outlines the qualitative framework. The fourth part outlines the quantitative framework. The final part provides a summary and conclusion.

4.2. Study site and case study organizations

The Chestermere Lake Reservoir (the Reservoir) is located in the Town of Chestermere (the Town) near Calgary Alberta (Figure 4.1). The Reservoir is the northernmost of 22 reservoirs with formal recreation facilities in southern Alberta (AIPA, 2011). The Reservoir is 5.12 Km long, 0.77 Km wide, covers 750-acres (White, 2001), and has a capacity of 4,075 acre-feet (about 5 million m^3) (Owel & Freeman, 1994). The Canadian Pacific Railway (CPR) constructed the Reservoir during 1903-04 and it was filled with water for the first time in 1905 (WID, 2011a; IWMSC, 2002; Owel & Freedman, 1994). The canals were completed by 1910 delivering water to new settlers in the area (WID, 2011a). The Reservoir is owned and managed by the Western Irrigation District (WID) (BRBC, 2005; WID, 2011a). The WID was formed in 1944 and took over management and ownership of the Reservoir and canals from the CPR that same year (BRBC, 2005; WID, 2011a). The current WID water distribution system consists of the headworks bringing water from the Bow River to the Reservoir, three main canals, and other reservoirs that store water (Owel & Freeman, 1994).

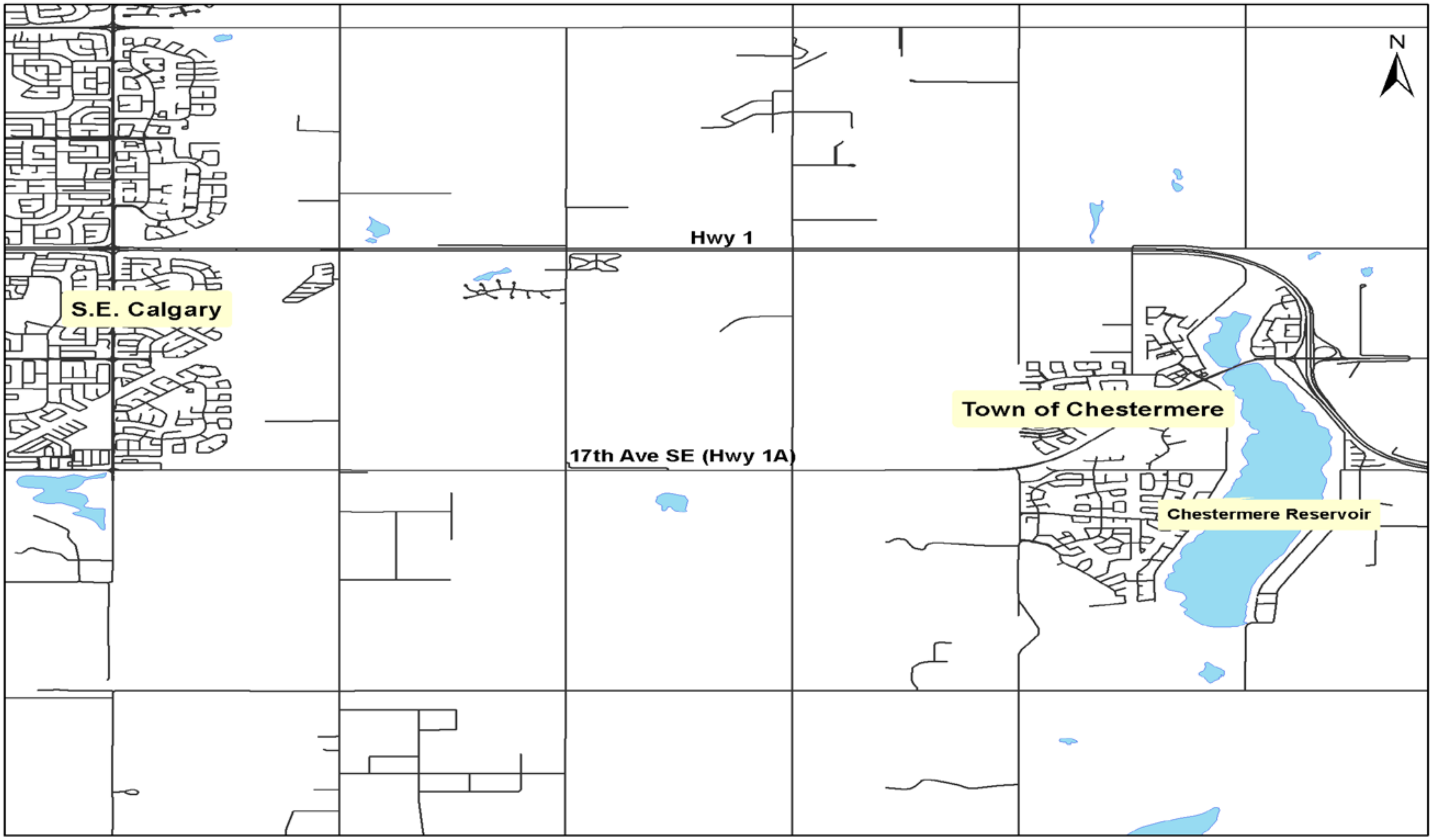

Figure 4.1: Town of Chestermere and the Chestermere Lake Reservoir. Created using ArcMap 10 (ESRI, 2010a).

The headworks from the Bow River is owned and operated by the Province of Alberta, and the reservoirs and other canals are owned by the WID (IWMSC, 2002; WID Staff, email correspondence to author, April 13, 2011). Despite this being a privately owned and operated reservoir the WID manages the Reservoir to meet multiuse demands including municipal, commercial, ES provision (including recreation), legal agreements regarding water levels, and commitments to WID members (AIPA, n.d; BRBC, 2005; WID, 2011a, 2011c).

As discussed in chapter 2, multiuse demand for the water in the Reservoir has let to past conflicts over water quality, water level regulation, and right of access (WID vs. Calgary, 2001; WID vs. Craddock et al., 1999; WID vs. Trobst et al., 1990). Some conflicts were resolved through the courts, or settled out of court with the parties agreeing to management plans (AECOM, 2011; WID vs. Trobst et al., 1990). One such agreement exists between the Town and WID regarding water level maintenance for the Reservoir (Town of Chestermere, 2010b; BRBC, 2005; White, 2001). The agreement entails the WID maintaining constant water levels in the Reservoir during the summer season so recreation activities are not impacted by irrigation use, and lowering the water level during the winter to prevent ice movement from damaging private docks (BRBC, 2005; White, 2001). Another activity based on agreements to mitigate negative impacts to users of the Reservoir is the Shepard Storm Water Diversion Project (the Shepard Project) (AECOM, 2011). The Shepard Project restored lost wetlands and the ES benefits these wetlands once provided, particularly waste assimilation to improve water quality on the Reservoir (AENV, 2012a; AECOM, 2011).

The development of the Town began in the 1950s when the WID leased parcels of land for private cottages along the waterfront (Town of Chestermere, 2011c; Owel and Freedman, 1994; WID vs. Trobst, 1990). Over time, more people were drawn to the Reservoir for water based recreation resulting in more land sold/leased by the WID for cabins (Town of Chestermere, 2011c; Owel and Freedman, 1994). As the number of cabins along the Reservoir grew, the cabin owners sought to have greater capability to independently manage growth and development around the Reservoir. This was achieved in 1977 with the creation of the Summer Village of Chestermere (the Village) (Town of Chestermere, 2011c; Owel and Freedman, 1994). The Village had the authority to levy taxes and manage the land surrounding the Reservoir (Town of Chestermere, 2011c; Owel and Freedman, 1994). Growth of the Village continued eventually achieving Town status in 1993 (Town of Chestermere, 2011b,c; Owel and Freedman, 1994). As of 2011 the population of the Town was 14,682 (Town of Chestermere, 2011b), with 352 lake front lots (Town of Chestermere Staff. Email correspondence. 30-Sept-2011). Growth of the Town is expected to continue with road expansion plans in place to accommodate an expected population of 20,000 in 5 to 10 years (Town of Chestermere, 2010a). This growth potential is evident by new home, road, and business constructions observed onsite by the author during the preliminary survey development and data collection periods. Recreational benefits provided by the Reservoir are the underpinning behind the magnetism of the Town as a place to live (AIPA, n.d.; BRBC, 2005; Town of Chestermere, 2011e).

Two case studies are included as part of the estimation of the value of recreational ES benefits provided by the Reservoir. The organizations selected for the case studies are Camp Chestermere (the Camp) and the Calgary Yacht Club (CYC). The recreational benefits provided by the Reservoir to the Camp and CYC are expected to be substantial. Excluding the Camp and CYC from the analysis would result in artificially lower the value estimate of the recreational value of the reservoir for residents and be a missed opportunity to gain information. The Camp and CYC are located within the Town and have direct access to the Reservoir. The Camp and CYC were selected as case studies due to the programs, facilities, and services of these organizations directly or indirectly depending on access to the Reservoir.

The Camp was formed in 1953 after the Gospel Missionary Association purchased waterfront land from the Sea Cadets (Camp Chestermere, 2011a). This original purpose of the Camp was to teach Christianity while participating in recreation activities (Camp Chestermere, 2011a). Over time the Camp has been expanded to offer additional programs, services, and facilities (Camp Chestermere, 2011a). Participants in Camp programs come from within the Town and nearby communities including Calgary, Strathmore, Langdon, and Airdrie (Camp Chestermere, 2011b). There is a daytime summer camp and overnight summer camp option (Camp Chestermere, 2012a,b). The day camp is five days long (Monday to Friday) running during working hours and offered eight times during July and August (Camp Chestermere, 2012a). The overnight camp also has eight choices of camp weeks where participants remain at the Camp for the full five-day period sleeping in facilities onsite (Camp Chestermere, 2012b). The weeks offered for the overnight program alternate by age group (Camp Chestermere, 2012b). A multitude of recreation activities are provided to program participants in and around the Reservoir (Camp Chestermere, 2012c).

The CYC was founded in 1933 and is the oldest established group on the Reservoir (CYC, 2011a). The Reservoir is central to the existence of the CYC with facilities, training programs, social events, and races hosted by the CYC each year directly using the Reservoir (CYC, 2012b, 2011b). The CYC was created to meet demand for day trip boating/sailing recreation allowing sailing/boating enthusiasts from Calgary and the surrounding area to participate in their hobby. The Reservoir is a convenient location for CYC members, as other feasible water bodies are further away (CYC Staff. 2011. Personal Communication, August 12, 2011). The CYC offers learn-to-sail training programs open to members and non-members with the majority of the participants in the training programs subsequently becoming members (CYC, 2011b; CYC Staff. 2011. Personal Communication, August 12, 2011). The CYC completed a new clubhouse in 2011 to increase available space for social events as the CYC grows (CYC Staff. 2011. Personal Communication, August 12, 2011). The CYC also plans to rent the clubhouse to outside groups as a means of increasing revenue (CYC, 2012a; CYC Staff. 2011. Personal Communication, August 12, 2011).

4.3. Qualitative framework

The inclusion of a qualitative framework in this study was done to capture aspects, perspectives, and context of the recreational ES benefits provided by the Reservoir that may be missed using a quantitative approach alone (Johnson and Christensen, 2012; Johnson and Onwuegbuzie, 2004; McNaughton, 1993; Moeller et al., 1980; Neuman & Robson, 2012; Onwuegbuzie & Leech, 2005). The method of collecting qualitative information follows the method used by McNaughton (1993) consisting of observed activities while onsite surveying and attending events, information gained during informal conversation, and information revealed by formal interviews during the initial phase of the study. The use of a covering letter on the survey document describing the risk and purpose of the study is provided when the researcher approaches a potential participant (Appendix A). The participants are aware of the purpose of the research and who the researcher is while engaging in informal conversation avoiding ethical issues like that raised by Moeller, et al.’s (1980) study.

4.4. Quantitative framework

4.4.1. Assumptions

Limitations on time, resources, and equipment require the use of assumptions to provide the foundation for the value estimate. The assumptions used in this study are based on information from previous studies, meetings with stakeholders, and initial observations of recreation activities at the Reservoir.

1) The trip is to the Reservoir only (single site) and not a multi-destination trip

Day trip recreationalists face higher opportunity cost of time due to the shorter and fixed amount of time available for recreation (Palmquist et al., 2010; Smith & Kopp, 1980). As such, recreation at multiple sites is not preferred unless the alternate sites are close by (Palmquist et al., 2010; Smith & Kopp, 1980). McNaughton (1994) reported an average one way travel distance of around 56 Km for day use recreationalists travelling to southern Alberta reservoirs. The travel distance between the Reservoir and alternate day use sites will exceed 56 Km presenting a deterrent to multisite visits. Conversation with the public and stakeholders during the initial visits to the Reservoir confirmed that visiting multiple sites was not generally done due to the distance and the limited time available for recreation.

2) Travel to and from Chestermere is by the fastest and shortest possible route

Travelling between a day trip recreationalist's home and the destination is generally a cost of the recreation experience, particularly if visiting a site close to home (Bockstael et al., 1987; Cherlow, 1981; Larson & Lew, 2005; Ory & Mokhtarian, 2009). The disutility stems from higher vehicle and time costs while travelling together with reduced time for activities at the recreation site (Bockstael et al., 1987; Cherlow, 1981; DeSerpa, 1971; Palmquist et al., 2010; Susilo & Dijst, 2010;).

3) Travel to and from Chestermere is done using private vehicles

Previous recreation studies reveal that most people use private vehicles (cars, trucks, etc.) to travel to a recreation site (Nelson & Niles, 2000; Clawson & Knetsch, 1966). Initial observations of recreation on or near the Reservoir are consistent with the literature with recreationalists using their private vehicles. Onsite observation revealed that there is no bus service or other mass transit systems available to transport recreationalists and their equipment to the Reservoir.

4) People who use the Camp or CYC programs and services do not participate in recreation on the Reservoir as general public users

Information on whether Camp and CYC users also travel to the Reservoir as public non-resident recreation users was not available for this study. The assumption that the users of the Camp and CYC do not come as public users is made for ease of calculations. Due acknowledgement is given that users of the Camp and CYC may well also come to the Reservoir as public users.

5) Camp users located east of the camp only use the day program and users located west of the camp only use the overnight program

Information on the programs attended by each Camp participant was not available for this study. Interviews with Camp staff revealed that users of the day camp program generally reside east of the Camp, while users of the overnight program generally reside west of the Camp (Camp Chestermere Staff. 2010. Interview by Author, Chestermere AB. 01-Dec-2010). The eastern based users commonly use the day program as a child care option for children when parents work during the day. The day camp users would drop children off on their way to work (usually in Calgary) and pick them up after work before driving home (Camp Chestermere Staff. 2010. Interview by Author, Chestermere AB. 01-Dec-2010). This requires five round trips to the Camp while children are attending the day program. Camp program users from location west of the Camp avoid doing this due to the prohibitive time and cost of travelling to the Camp to drop off children and then back to work (Camp Chestermere Staff. 2011. Interview by Author, Chestermere AB. 01-Dec-2010). Only one round trip to the Camp is needed while children are attending the overnight program. It is further assumed that the trips to the camp and back are made from the participants' residence for all Camp program users, as no information on other stops made by Camp program users before dropping off or after picking up children was available.

6) All estimated CYC members originating from outside the Town of Chestermere are from Calgary

Specific information the origins and travel characteristics of non-resident CYC members was not available for this study. A meeting with CYC staff indicated that about half of the members originate from outside the Town (non-residents) and that non-resident members are mainly from Calgary (CYC Staff. 2011. Personal Communication, August 12, 2011). The availability of Calgary postal code data from the day use survey respondents (Appendix A) allows for driving cost estimates to be done if all non-resident CYC users are assumed to originate from Calgary.

7) Estimated non-resident CYC members take five trips during the period when the water level in the Chestermere Reservoir is raised

The estimated non-resident CYC members are assumed to make one trip per month to use the CYC facilities and Reservoir. The selection of this assumption was based on the findings of the survey with respondents making around 5 trips per year to the Reservoir (chapter 5).

8) The estimated non-resident members of the CYC purchased a individual membership and not a family membership

This assumption is based on researcher judgement for ease of calculations, as no information on which type of membership purchased by non-resident CYC members was available for this study.

4.4.2. Expected Outcomes

Previous studies reveal that the recreational ES benefits provided by a given location have a limited spatial area (Baerenklau et al., 2010; Brainard et al., 1999; Douglas & Taylor, 1999; Hanink & White, 1999; Smith & Kopp, 1980; Tietenberg, 2006). The extent of this spatial area is determined by the increasing vehicle operation and time costs (Baerenklau et al., 2010; Brainard et al., 1999; Douglas & Taylor, 1999; Hanink & White, 1999; Smith and Kopp, 1980; Tietenberg, 2006). Statistics Canada (2003) indicates the one way distance travelled for day trip sport and recreation ranges from 80 to 200 Km. Clawson and Knetsch (1966) report a day trip one way driving distances averaging 32-50 Km to reach a recreation site. McNaughton (1993) reports the average one way distance travelled by recreational day users to Alberta Reservoirs to be around 56 Km (chapter 3). Parsons & Hauber (1998) report a median one-way travel time for day trip recreation to be 20 minutes, with 85% of day trips having a travel time less than an hour in their study on recreational fishing in Maine. Interviews with stakeholders at the reservoir indicate the one way travel distance can be around 55-60 Km from the Reservoir (Camp Chestermere Staff, 2011. Interview by Author, Chestermere AB. 08-Apr-2011). Based on the above information, the expectation in this study is that the vast majority of recreationalists will travel a one way distance of 60 Km to reach the Reservoir.

The Alberta Irrigation Projects Association's (AIPA) recreation brochure lists the Reservoir as a day use site informing potential participants that there are no overnight accommodations or facilities in the Town (AIPA, 2011). Initial trips to the Reservoir confirmed that there are no hotels or campgrounds within or near the Town. As such, the expectation is that the majority of non-resident visitors are day trip travellers returning home after participating in recreation.

The close proximity and large population of the city of Calgary produces an expectation that the majority of non-resident recreational users originate from Calgary. As discussed in chapter 3, the gravity model uses the interaction coefficient (IC) to gauge the magnitude of how attractive a site is as a place to visit (Anderson, 2010; Freund and Wilson, 1974; Haggatt, 1966; Sutherland, 1983; Taaffe and Gauthier, 1973). The community that the majority of non-resident visitors are likely to originate from can be estimated by applying eq. (3.4) to cities within the expected driving distance of the Reservoir. The terms for this test are: P_i = the population of the Town, P_j = the population of Calgary, Airdrie, Okotoks, or Strathmore, and d_{ij} is the distance between the community administration offices of the two communities measured by ArcMap 10 (ESRI, 2010a). Table 4.1 shows the findings of applying the gravity model to estimate the likely origin of the majority of non-resident recreation visitors to the Reservoir. The IC for Calgary is around three orders of magnitude higher than the others. This result indicates that Calgary is the likely origin of the majority of non-resident visitors to the Reservoir.

Table 4.1: Interaction coefficients for communities within 50 Km of the Chestermere Reservoir.

City	Population in 2011	Distance (Km)	IC with Town of Chestermere (Population: 14,824)
Calgary	1,214,839	18	1.0×10^{9}
Strathmore	12, 305	20	9.1×10^{6}
Okotoks	24,511	54	6.7×10^{6}
Airdrie	42,564	45	1.4×10^{7}

Population data Source: Statistics Canada (2012). Distances measured using ArcMap 10 (ESRI, 2010).

Previous studies have found that demographic characteristics including annual income, education attainment (high school, university degree, etc.), and employment status (working full time, part time, etc.) influences participation in recreation (Boxall et al., 1996; Chizinski et al., 2005; Mallett & McGuckin, 2000; McFarlane & Boxall, 1998; McKean et al., 2010). Consensus is lacking as to whether the influence of income on recreation participation is positive or negative. Some studies concluded that income and recreation participation are positively related (Chizinski et al., 2005; Mallett & McGuckin, 2000; McNaughton 1993), and others conclude that income and recreation are negatively related (Boxall et al., 1996). For example, Boxall et al., (1996) reported a negative relationship between income and recreation participation for multiday camping trips where Chizinski et al., (2005) found a positive relationship for day use fishing. Other literature reports that TCM based studies cannot fully capture income effects resulting in income having no apparent effect on recreation participation (Phaneuf & Smith, 2005; McConnell, 1985). Recreation participation and trip frequency of non-resident recreation users of the Reservoir is expected to depend on income following Chizinski et al. (2005), as the Reservoir is a day use recreation site and offer a variety of recreational activities appealing to different income groups.

Previous studies indicate a significant positive or negative relationship between recreation participation and employment status (Boxall et al., 1996; Mallett & McGuckin, 2000; McFarlane & Boxall, 1998). Mallet & McGuckin (2000) analyzed data from the 1995 American Travel Survey (ATS) and 1995 Nation Wide Personal Transportation Survey (NPTS) for recreation travel characteristics. Their analysis concluded that higher employment status positively influences recreation travel frequency. McFarlane & Boxall

(1998) analyzed 6830 Alberta Provincial Park registration permits with census data and found that employment status positively influenced trip frequency for camping trips. Boxall et al. (1996) used 18,350 Forest Recreation Area (FRA) permits collected by the former Alberta Forest Service and PARADOX software to analyze the permit data and found that employment status negatively influenced trip frequency. The expectation in for non-resident Reservoir recreation users is that recreation participation in activities requiring costly equipment (boats, personal watercraft, and snowmobiles) and trip frequency will depend on the employment status following McFarlane & Boxall (1998) and Mallet & McGuckin (2000).

Previous studies lack consensus on the influence of educational attainment on recreation participation. Chizinski et al. (2005) found that education positively influenced angling trip frequency. McFarlane & Boxall (1998) found educational attainment to positively influence camping trip frequency. Boxall et al. (1996) found that educational attainment did not influence camping trip frequency in their study of the Rocky-Clearwater forest. The differing findings between Boxall et al. (1996) and McFarlane & Boxall (1998) shows the sensitivity of findings to the processing of data despite using nearly the same method of analysis and study area. The expectation for this study is that trip frequency is dependant on educational attainment following Chizinski et al. (2005), and that recreation activities requiring costly equipment (boating, personal watercraft, and snowmobiles) depend on educational attainment based on the generally accepted view that a higher level of educational achievement brings the greater income needed to purchase equipment.

Previous studies have shown that the value of recreational ES provided by irrigation reservoirs to be substantial and quantifiable using one of the methods detailed in chapter 3 (Daugherty et al., 2011; Huszar et al., 1999; McKean et al., 2005; McNaughton, 1994, 1993; Niemi & Raterman, 2008; Ward et al., 1996). As reviewed in chapter 3, McNaughton (1993) used individual information from surveys and found an annual value of recreation ranging from around $20,000 to $1.1 Million for southern Alberta reservoirs. Chizinski et al. (2005) collected individual information at day use site using surveys finding a per trip value of $115-$230 per trip. As such a substantial value for recreational ES benefits is expected in this study due to the Reservoir's long history of recreation activities, close proximity to Calgary, and the use of similar data collection methods to Chizinski et al. (2005) and McNaughton (1993).

4.4.3 Data Collection

Data collection consisted of a survey, vehicle counters, formal interviews, informal conversation, and observation. Meetings with stakeholders aided development of the survey, provided information about potential locations for deploying the survey, established the best locations to place the counting units, and provided information on some of the expected findings for this study discussed in the last section. The survey was used to collect information on the distance travelled, onsite cost, and socio-demographic information from public non-resident recreation participants that use the Reservoir. The survey was administered face to face with respondents. A covering letter, describing the purpose of the study, risk of participation (if any), and options for contacting researchers if issues or questions developed regarding participation, was handed to the responded prior to interviews or filling in the questionnaire (Appendix A). The questions included community of origin, postal code of origin, number of people in the vehicle, household numbers of adults and children, if the trip is a day trip (if not, length of stay and where staying), number of trips in each month over the year, recreation activities (boating, fishing, swimming, etc.), if the public boat launch facility in the Town was used, alternate recreation day trip destinations, onsite expenses (food, permits, etc.), lost wages for the trip (if any), and demographic information (income level, education attained, and employment status). The survey was short and could be completed in roughly three minutes with the majority of that time needed to read the covering letter. The age of the respondent was not included in the survey due to limited space on the survey document, and age having mixed results as an explanatory variable in the literature (Bell & Leeworthy, 1990; Boxall et al., 1996; Chizinski et al., 2005; McFarlane & Boxall, 1998) The choice of questions and the short survey length was made to encourage participation, as respondents are generally reluctant to spend much time completing a long survey (Nicol, 2005). The University of Lethbridge Human Subject Research Policy (2004) required approval of the survey instrument to ensure no undue harm is caused to participants. Approval for the survey used in this study was granted on November 15, 2010.

Deployment of the surveys was done over a 12-month period. One random weekend each month during the October 2010 to May 2011 period was selected for deploying surveys when the water level in the reservoir is lowered. More frequent trips were made during the June to October 2011 period while the water level in the Reservoir was raised. The distance between the Town and University of Lethbridge where the author is based resulted in a high cost of travel and accommodation reducing the number of site visits for survey deployment. An individual residing in the Town was hired to administer surveys to increase the number collected ensuring a suitable sample size for analysis. The individual was provided with instruction on the survey procedures as per the University of Lethbridge Human Research Subject Policy such that there were no differences in the deployment of the surveys if done by the author or the hired individual.

Surveys were collected in the Town at John Peake Memorial Park near the boat launch facility, Sunset Park on the east side of the Reservoir, Anniversary Park on the west shore of the Reservoir, and along the headwork canal. These were the primary locations for recreation activities on or near the Reservoir providing the best possibility for obtaining completed surveys. A rotational pattern was used according to which the interviewer conducted all possible surveys at a given location and then moved to the next location. Both the author and the hired individual used this pattern to ensure survey information collected is from a diverse cross section of recreation visitors.

Vehicle counting units (Figure 4.2) were used on roads near parking locations with access to recreation areas close to the water to measure the numbers of vehicles travelling to recreational areas in the Town (Figure 4.3). The rationale for using the counting units was to provide a consistent stream of information on the number of vehicles entering parking areas near recreation areas when the author was offsite. Information from the counters can then be combined with data collected from the surveys to estimate the total recreation visits to the Reservoir. The setup consisted of a counter unit (Figure 4.2) with an attached rubber tube placed across the road (Figure 4.3).

Figure 4.2: Exterior and interior views of vehicle counting units used for data collection. Photos taken by author

Figure 4.3: Vehicle counter placement near John Peake Park (right) and Sunset Park (left) in Chestermere. Photos taken by author.

The counting units register a "hit" when the tires of a car ran over the tube causing a pressure wave to travel along the tube that is sensed by the counting unit. The tubes were placed inside used fire hoses in locations where the road surface was gravel instead of pavement to prevent puncture of the tubes by sharp stones when run over (Figure 4.3, left). The counter units were manufactured by International Road Dynamics Inc® (IRD) and have the ability to work 24 hours a day for up to two years providing a continuous stream of data assuming no damage or malfunction comes to the units or tubes (IRD Staff. Telephone conversation January 17th, 2011). Collection of information recorded by the counter units is done using IRD's Road Reporter® software (IRD, 2012) and a serial connecting cable. After the data is "dumped" from the counting units the count data is exported to a spreadsheet format by the Road Reporter® software. Microsoft Excel® was then used to separate the count data into daily totals for each day of the week (Sundays, Mondays, etc.) and into two time periods. The two time periods considered in the analysis are when the water level in the Reservoir is lowered (down) or raised (up). The water level in the Reservoir is lowered in early October and raised in late April to be full by May 1st each year (Town of Chestermere, 2011e). As such, the water down period for the analysis is from October 1st to the end of April and the water up period is from May 1st to October 1st.

Damage to the road tubes, inadequate information on equipment operation, and the inability of the researcher to be onsite on a frequent basis to repair damage to the road tubes produced gaps in the counter unit data. Missing hit count data was estimated based on available data before and after missing data period using linear trend regression in SPSS 19 (2010). This method worked well for small periods of missing data. The Sunset Park lot was partially inaccessible after mid- May 2011 due to road construction. This prevented counters from working properly, as the tubes were damaged as work progressed. The road work also limiting access to the Sunset Park lot. For these reasons counter data is missing for the entire water up period at the Sunset Park location. The data gap is too great to use linear regression to estimate the missing data and the data points for any linear regression estimate from the water down period. Using the water down period data for estimating the water up period counts would bias the counts downward. Options considered on the treatment of the missing data included omitting the period from the analysis or estimating the missing data by other means. According to discussions with a local real estate agent, the use of Sunset Park for recreation activities by non-residents during the summer period is so high that many residents argue the park should be gated to exclude non-residents (REMAX Real-estate Agent, interview by author. May 10, 2010). It was therefore essential to include this activity in the recreational value estimate despite the disruption of vehicle counter data during the data collection period.

Estimating missing daily hit counts at Sunset Park for the water up period was done by using the ratio of counter hits recorded between the water up and down periods (hit ratio) from the John Peake Park counter. For each day of the week (ie: Sundays, Mondays, etc.), the hit count during the water up period is divided by the hit count recorded during the water down period to get the hit ratio. The hits recorded for Sunset park during the water down period are then multiplied by the hit ratio to estimate the number if hits during the water up period for each day of the week. An example is the estimation of the missing water hits for Sundays during the water up period. Suppose the water up period hit count for Sundays at John Peake Park totalled 5000 hits and the water down period totalled 2000 hits giving a hit ratio of 2.5. Suppose the average daily water down period hits recorded by the Sunset Park counters on Sundays is 50. The average (50) is multiplied by 2.5 to arrive at an estimated value of 125 daily hits for Sundays during the water up period. Onsite observation of the number of cars entering the Sunset Park lot carrying non-resident recreators during the water up period was up to twice that of when water levels were lowered. Similar observations were noted for the John Peake Park lot during the water up versus down period. Based on these observations the use of the above method is reasonable. The estimated number of counter hits during the water up period at Sunset Park is a conservative estimate based on the real estate agent's comments above.

The vehicle counters cannot differentiate the purpose of a visitor. The portion of counts representing recreation visits by non-residents of the Town needs to be separated from the total count data in order to be applied to eq. (4.3). Onsite observations at both the John Peake Park and Sunset Park recreation locations revealed that on weekdays around 10 – 25% of all people participating in recreational activities were non-residents. Observation of both locations during weekends revealed that around 30 – 50% of people participating in recreational activities were non-residents. The number of non-resident visitors on a given day was observed to be highly sensitive to weather conditions with no visitors during wet cool weather and many visitors during good weather. Scenarios representing the portion of non-resident recreational visits were developed to use in eq. (4.3). The scenarios are:

1) The weekday non-resident recreation portion is 15% of the daily counter unit hits, and the weekend non-resident portion is 30% for both the water up and down periods.

2) During the water up period the weekday non-resident recreation portion is 20% of the daily counter unit hits, and the weekend non-resident portion is 40%. During the water down period the weekday non-resident recreation portion is 15% of the daily counter hits, and the weekend non-resident portion is 30%.

3) The weekday non-resident portion is 20% of daily counter hits, and the weekend portion is 40% for both the water up and down periods

The portions selected represent a conservative estimate of the number of non-resident visitors that best incorporates the observed portions and the effect of weather.

4.4.4 Estimation models

The TCM has the longest history of use in estimating the value of recreational ES benefits (Turner et al., 2008; Ward & Beal, 2000; Young, 2005). As reviewed in chapter 3, the combination of the travel cost method (TCM) with a geographic information system (GIS) (GIS-TCM) has been shown to improve the accuracy of distance measurements and allows inclusion of other spatial characteristics (Baerenklau et al., 2010; Bateman, 2009: Bateman et al., 2002; Ward & Beal, 2000). Based on this success, the GIS-TCM approach was selected for estimating the monetary value and spatial range of recreational ES benefits provided by the Reservoir for the non-resident visitors. Two separate GIS-TCM models were developed: one for public visitors, and a second for the case studies.

The TCM model for the public visitors is (Boxall et al., 1996; Liston-Heyes & Heyes, 1999)

$$TC_i = VC \bullet D + OS + \mu \bullet t \tag{4.1}$$

Where TC_i = per trip travel costs for recreation for each survey respondent, VC = per Km variable vehicle operation costs, D = round trip (2-way) distance travelled to the Reservoir, OS = total onsite costs (food, fees, incidentals. etc.), μ = opportunity cost of time rate, and t = round trip travel time to the Reservoir. The average per trip cost of recreation (AVC_i) at the Reservoir is found via summing distance, time, and expense variables and then dividing by the number of survey responses (N):

$$AVC_i = \frac{\sum TC_i}{N} \tag{4.2}$$

The total value of recreation for public visitors for each day of the week (TV_{Day}) is found by multiplying the portion of vehicle counter hits representing non-resident recreation visits for each weekday (Mondays, Tuesdays, etc.) by the average trip cost (AVC_i):

$$TV_{Day} = (\text{Daily non-resident counter hit total}) \bullet AVC_i \tag{4.3}$$

The estimate of the value of recreational ES benefits for public non-residents (RV_{Public}) is found by summing the values for each day of the week.

$$RV_{Public} = \sum TV_{Day} \tag{4.4}$$

The vehicle operation cost (VC) selected for this study is $0.20/km (CAA, 2011). Initial observations of visitors to the Reservoir revealed the vast majority used minivans, SUVs, and trucks. The Canadian Automobile Association (CAA, 2011) large vehicle class best incorporates the observed vehicle size. The use of variable vehicle operation costs in this study follows the convention of many previous TCM studies (Boxall et al., 1996; Chizinski et al., 2005; McFarlane & Boxall, 1998; Ribaudo & Epp, 1984; Smith & Kopp, 1980). The variable operation cost consists of fuel, maintenance (wear and tear), and tire costs per Km (CAA, 2011). Fixed costs of vehicle operation include aspects like registration, insurance, finance costs (loan), and depreciation (CAA, 2011). The use of the full per Km cost of vehicle operation in travel cost calculations does rarely appear in the literature (Fleming & Cook, 2008). This study also uses the University of Lethbridge vehicle use mileage rate as part of the sensitivity analysis on the effect of the choice of driving cost on the finding for recreational ES value.

The round trip travel distance (D) for eq. (4.1) is calculated using ArcMap 10 (ESRI, 2010a) software with GIS based road network and postal code data (ESRI, 2010b). The postal code data contains point files for all the postal codes in Alberta and Saskatchewan. The network analyst extension in ArcMap 10 (ESRI, 2010a) is used to calculate the shortest route between the origin postal code and the Reservoir. The travel distance reported by the respondent is used for the travel distance calculations for cases where the postal code is not reported on the survey.

The total onsite costs (OS) for eq. (4.1) is the sum of onsite expenses (food, incidentals, etc.) and expenses associated with permits (fee for using the boat lunch facility, fishing license, etc.) specific to the trip to the Reservoir. Onsite costs of equipment and licenses that can be used at multiple sites over multiple years is not included in this study, as is convention in TCM studies (Parsons, 2003).

Many studies use a value of 1/3 the wage rate to represent the opportunity cost of time rate (μ) when travelling for recreation (Boxall et al., 1996; Cesario, 1976; Liston-Heyes & Heyes, 1999). There is some debate over what best represents the opportunity cost of time rate with values of zero, one third, the full wage rate, and derived formulas used in the literature (Bockstael et al., 1987; Palmquist et al., 2010; Phaneuf & Smith, 2005; Shaw & Feather, 1999). Palmquist et al. (2010) report there is little difference between opportunity cost of time rates derived from formulas and using portions of the wage rate (1/3, 1/2, etc.) when the travel time is two hours or less. The average expected travel time to reach reservoirs in southern Alberta (day use and multiday use) is about 56 Km (McNaughton, 1993.) The time needed to travel a one way distance of 56 Km and back is under two hours. As such, this study uses 1/3 the wage rate for the opportunity cost of time rate like of versus a derived formula. The opportunity cost of time rate is calculated by dividing the median of the reported income category from the survey by 52 to obtain the weekly income. Next the weekly income is divided by the average hours worked per week in Canada to get the hourly wage rate. Lastly, the hourly wage is divided by three to arrive at the opportunity cost of time rate. For example, suppose the income category was reported to be $50,000-60,000 per year. The median of this category is $55,000. The $55,000 is divided by 52 to get weekly income of $1,057.70. The weekly income is divided by Canadian average of 33 hours worked per week (StatsCan, 2012) resulting in a wage of $32.05/hr. Lastly, the hourly wage rate is divided by three arriving at an opportunity cost of time rate (μ) of $10.68/hr in this hypothetical example. This method of computing the opportunity cost of time rate is similar to previous studies (Boxall et al., 1996; Chizinski et al., 2005; McFarlane & Boxall, 1998).

Round trip travel time (t) is calculated using the GIS and postal code data like the distance calculations above. The network analyst extension in ArcMap 10 (ESRI, 2010a) uses the postal code and road network dataset (ESRI, 2010b) to calculate the travel time between two points. An approximation of the travel time calculated for cases reporting no postal code is done by dividing the reported distance from the survey by an average driving speed of 80 Km/hour. For example, suppose a survey respondent reported a round trip distance travelled of 100Km but did not report the postal code. The resulting round trip travel time (t) estimate would be 100Km ÷ 80Km/hr = 1.25hrs or 75 minutes. This method of imputing travel time is adopted from previous literature (Boxall et al., 1996; Martinez-Espineira & Amoako-Tuffour, 2008; McFarlane & Boxall, 1998).

4.4.5 Case studies.

The recreational value estimations for the Camp and CYC are calculated separately due to the utility of recreation coming from using programs and facilities offered by these organizations. There is no meaningful way to separate the Reservoir's recreation value from that of the other facilities and programs offered by the Camp and CYC (Peter Boxall, personal communication. February 4th, 2011). The estimation models and term definitions for the Camp and CYC are similar to the public model with the functional form:

$$TC_{Campi} = \sum\left(\frac{VC_{Camp} \bullet D_{Camp} + F_{Camp} + \mu_c \bullet t_{Camp} \bullet T_{Camp}}{P_{Camp/CYC}}\right) \quad (4.5)$$

and

$$TC_{CYCi} = \sum\left(\frac{VC_{CYC} \bullet D_{CYC} + F_{CYC} + \mu_c \bullet t_{CYC} \bullet T_{CYC}}{P_{CYC}}\right) \quad (4.6)$$

Where TC_{Campi} and TC_{CYCi} = per household round trip travel cost to the Camp or CYC, $VC_{Camp/CYC}$ = vehicle per Km variable operating cost of travelling to the Camp or CYC, $D_{Camp/CYC}$ = round trip distance travelled to reach the Camp or CYC, $F_{Camp/CYC}$ = fees paid to access Camp or CYC facilities and programs, μ_c = opportunity cost of time rate when travelling to the Camp or CYC, $t_{Camp/CYC}$ = round trip travel time to the Camp or CYC, $T_{Camp/CYC}$ = number of round trips to the Camp or CYC, and $P_{Camp/CYC}$ = number of households using the Camp or CYC.

The calculation of the round trip travel distance ($D_{Camp/CYC}$) and round trip travel time ($t_{Camp/CYC}$) for both the Camp and CYC is done using the same GIS based approach and road network data as the public non-resident visitor analysis. The vehicle costs for those travelling to the Camp or CYC ($VC_{Camp/CYC}$) uses the same vehicle variable operating cost of \$0.20/km as the public analysis (CAA, 2011). The opportunity cost of time rate (μ_c) for both the Camp and CYC is calculated using a similar approach to the public analysis. However information on the income of those using the Camp or CYC was not available for this study. The average annual income from the 2006 Census (StatsCan, 2010) is used in lieu of individual income information for calculating (μ_c) for users of the Camp and CYC. The 2006 Census average income for each enumeration/dissemination area data is matched with postal code point data using the join tool in ArcMap 10 (ESRI, 2010a). The average income from the 2006 Census for each postal code is then used in calculating (μ_c) using the same steps as the survey data described above.

The Camp provided postal codes of households that used the Camp's programs in 2010, from which 551 postal codes originate outside the Town (P_{Camp} = 551). Information on programs used by each household (day or overnight), fees paid by each household, and how often each household used a program was not available for this study. The number of round trips taken by eastern (day program) households is five (T_{Camp} = 5) and the number of trips by western (overnight) households is one (T_{Camp} = 1) by assumption 5. Some of the postal codes located west of the Camp are potentially close enough to use the day program. A 15-minute travel time is selected as the cut off between the day camp (east) and overnight (west) groups for the analysis. The choice of 15 minutes for the cut off draws on Statistics Canada (2005) information on the extra travel time needed to drop off children at childcare facilities before going to work. Identification of the postal codes located west of the Camp within a 15-minute or less travel time zone is done using the network analyst-service area tool in ArcMap 10 (ESRI, 2010a). All postal codes west of the Camp located within the 15-minute travel time zone are included in the day camp (east) group. Once the east or west groups are established, the fees paid for each program are F_{Camp} = \$345 for the overnight (west) program and F_{Camp} = \$215 for the day (east) program (Camp Chestermere, 2012a,b). The number of times a given household used the Camp's programs is inconsequential to the analysis, as the postal codes provided by the Camp captures repeat program users.

The CYC analysis required the use of estimated parameters for the number of members, fees paid for membership and services, origin postal codes of non-resident CYC members, and demographic characteristics, as this information was not available for this study. The club is reported to have 110 members in 2011 (Weismiller, 2011). As such, there are 55 non-resident CYC members all from the city of Calgary by assumption 6 (P_{CYC} = 55). The number of trips per year for the theoretical members totals five (T_{CYC} = 5) by assumption 7.

The random selection of 55 Calgary postal codes from the public survey data using the SPSS 19 (2010) simulates the origins of the theoretical non-resident CYC members The fee paid by the theoretical non-resident CYC members is \$428 annually (F_{CYC} = \$428) by assumption 8.

4.5. Summary and conclusion

This chapter reviewed the methods used to attain the estimated value of recreational ES benefits provided by the Reservoir. The choice of the Reservoir as a study site is based on the site having a long history of multiuse demands, close proximity to a large city, past conflict over water access, and the potential for increased conflict between demand sectors in the future. The qualitative and quantitative descriptive framework and methods for achieving the research objectives were discussed. The selection of a combined qualitative and quantitative (mixed method) approach is due its success in previous work (Johnson and Christensen, 2012; Johnson & Onwuegbuzie, 2004; McNaughton, 1993; Moeller et al., 1980; Neuman & Robson, 2012; Onwuegbuzie & Leech, 2005). The quantitative framework utilizes informal conversation and observations of activities to capture aspects not captured in the quantitative analysis. The quantitative framework utilizes the GIS-TCM approach based on the success of this approach in previous studies (Baerenklau et al., 2010; Bateman, 2009: Bateman et al., 2002).

The assumptions and expected outcomes of this study are based on previous studies, interviews/conversations with stakeholders and the public, and observed activities during preliminary visits to the Reservoir. Assumed parameters include single site only visits, shortest route is used by visitors when travelling to the Reservoir, only private vehicles are used, Camp and CYC members do not visit the Reservoir as public users, Camp users only use the day or week program depending on location, all non-resident CYC members are from Calgary, non-resident CYC members make five trips when water levels in the Reservoir are raised, and CYC members only by individual memberships. The expected outcomes include a limited service area of recreational ES benefits provided by the Reservoir exists, one way travel distances made by visitors of around 60 Km, visits are day trips, most of the non-resident visitors are from Calgary, a substantial value for recreation ES benefits provided by the Reservoir, and that demographic characteristics (income, education, and employment status) influence recreation participation on or near the Reservoir.

Data collection for the quantitative analysis consists of a survey and vehicle counting units. The survey asks for postal code, travel distance, expenses, and demographic information. The vehicle counting units recorded the number of vehicles passing over the tubes each day for 12 months near recreation areas in the Town. Gaps in the vehicle count data are resolved using linear trend regression or count ratios from other counters.

The GIS-TCM models developed for assessing the monetary value of recreational ES provided by the Reservoir to the public, Camp, and CYC utilized a similar functional form. The models used inputs of vehicle cost, distance travelled, onsite cost, travel time, and income data from the surveys and information provided by the case study organizations. The models for the Camp and CYC utilized census and survey data in the calculations due to information not being available.

CHAPTER 5

FINDINGS

5.1. Introduction

This chapter presents the findings from applying the qualitative and quantitative frameworks to achieve the research objectives. The second part presents the qualitative findings. The third part presents the quantitative findings. The last part presents a summary and conclusion.

5.2. Qualitative findings

The qualitative findings are presented in a discussion of the social and recreational events taking place in the Town of Chestermere (the Town), the Camp Chestermere (the Camp), and the Calgary Yacht Club (CYC) including how the social and recreational events are related to the value of recreational ES benefits provided by the Reservoir. The benefit of the events is not included in the quantitative findings due to a lack of information on origins, travel characteristics, and onsite expenses. However the findings from informal conversations with event attendees and organizers as well as observations contribute additional information about the recreational use and value of the reservoir that would be missed otherwise (Johnson and Onwuegbuzie, 2004; McNaughton, 1993; Moeller et al., 1980).

5.2.1. Events hosted by the Town of Chestermere

The Town holds three community-based festivals (events) annually intended to increase community spirit and enhance quality of life for residents of the Town and the surrounding area (Chestermere Festivals, 2011a). Informal conversation with event attendees confirmed that the events are highly valued with the Reservoir significantly contributing to the benefit of attending.

Winterfest typically occurs in mid-January and consists of a fishing derby, motorcycle races on the ice, polar bear swim, hockey games, and sleigh rides that directly use the Reservoir (Chestermere Festivals, 2011b). Winterfest 2011 took place on January 15th

and the temperature was quite cool staying around -20ºC all day (Environment Canada, 2012a). The cool temperature seemed to deter attendance as few people were outside (Authors' own observations). The Town spends approximately $19,000 to host the event and is attended primarily by local residents (Town of Chestermere Staff. Interview by the author, January 6, 2011). Estimates of attendance to Winterfest range from 500-800 (Town of Chestermere Staff. Interview by the author, January 6, 2011). However, this number is a rough estimate due to people having free access to event venues (Town of Chestermere Staff. Interview by the author, January 6, 2011). Entering the fishing derby cost $10 with a maximum of one line per competitor (Town of Chestermere Staff. Interview by author. January 6, 2011), and requires a current provincial fishing license that costs $25.66 annually (Alberta, 2011). The 2011 Winterfest fishing derby was small due to the cold weather with only 20 participants (Town of Chestermere Staff, email correspondence. February 24, 2012). The motorcycle ice race is organized by the Second Gear Club (SGC) based in Calgary and is a large draw for Winterfest (SGC, 2011). The cost of watching ice motorcycle races from the formal spectator area for non-resident spectators is $5/person or $10/carload (SGC, 2011) plus the cost of travel to the Reservoir. Attendance to the paid spectator area averages 300-600 people comprised of Town residents and non-residents with weather playing a large role in attendance (SGC Staff. Email correspondence. February 27, 2012). Onsite conversation with spectators of the ice racing revealed that most non-resident spectators originated from outside Alberta and do not use the Reservoir routinely for personal recreation activities.

The Canada Day event is small due to the short time span between Canada Day and Waterfest. Estimates of attendance for the Canada Day event is about 1000 people with a small portion coming from out of the Town (Town of Chestermere Staff. Interview by author. January 5, 2011). The estimate of Canada Day attendance is rough due to open access to the event (Town of Chestermere Staff. Interview by author. January 5, 2011). The Canada Day event consists of an outdoor movie in John Peake Park near the Reservoir and vendors in kiosks promoting their businesses or groups (Chestermere Festivals, 2011c). Informal conversation with vendors revealed the event is a valuable time for marketing motivating businesses from outside the Town to attend the event. There are no activities directly using the water like the other two festivals. Informal conversation with the public attending the event revealed that it is a valuable time to be with the family, enjoy the scenic view provided by the Reservoir, visit the kiosks, mingle with other attendees, and watching the movie. Non-resident public attendees revealed they primarily originate from locations east of the Town and travelled to the Town to attend Canada Day events for a combination of reasons. The first is the Town's event being a larger draw than the smaller events in their home community, or their home community not having an event. The second is the benefit of a shorter and less stressful commute and smaller crowds versus going to Calgary for Canada Day celebrations.

Waterfest takes place in July and is the largest event hosted by the Town. Activities at the Waterfest that directly use the Reservoir include a wakeboard competition, boat tours, duck race, fishing derby, boat parade, paddleboat race, and fireworks display launched from a barge (Chestermere Festivals, 2012a). Waterfest costs the Town approximately $25,000 to put on, and attendance estimates are approximately 3000 people with limitations on accuracy due to open access to the event (Town of Chestermere Staff. Interview by author. January 5, 2011). The fishing derby operates similar to Winterfest with a $20 per person entrance fee, only one line allowed per participant, and the requirement of a valid fishing license (Chestermere Festivals, 2012a). The wakeboard competition is organized by Hyperactive Watersports out of Calgary and is a large draw for Waterfest with spectators able to watch without cost (Chestermere Festivals, 2012b). Conversation with non-resident attendees revealed similar characteristics to the spectators attending the ice race during the Winterfest. They generally originated from outside Alberta and did not use the Reservoir for general recreation. The crowd attending the wakeboard event was generally younger (age 18-25) with the beer garden a large draw for this group. The number of families attending the event decreased during the wakeboard competition likely due to the incidents of unruly behavior by beer garden patrons (Author's own observations). Conversation with non-resident recreationalists visiting the Reservoir after Waterfest revealed the event is avoided due to crowding, behavior of people in the beer gardens, and the public boat launch being restricted to festival based activities only (Sea-Doo, Jet Ski, etc).

5.2.2. Camp Chestermere

As noted in the previous chapter, the Camp derives great value from its location with direct access to the Reservoir (Camp Chestermere Staff. Interview by Author. December 15, 2010). The lots where the camp sits are presently very valuable due to being located on the waterfront. The Camp's ownership have refused offers in the $7-8 Million range to buy the lots the camp occupies (Camp Chestermere Staff. Interview by Author, Chestermere AB. December 1, 2010). The ownership feels that the Camp programs and services will be adversely affected if the camp was relocated to a lake further away (Camp Chestermere Staff. Interview by Author, Chestermere AB. December 1, 2010).

The Camp routinely rents its facilities to outside groups wanting to benefit from the Camp's amenities and access to the Reservoir. Groups that rent the Camp's facilities include school bands, leadership retreats, choirs, and special interest groups (Camp Chestermere, 2011b). The Camp enjoys a healthy demand for its facilities demonstrating the value of the recreational ES benefits provided by the Reservoir to the Camp.

5.2.3. Calgary Yacht Club

As noted in the last chapter, the CYC's existence is based upon their location situated along the shoreline of the Reservoir. The CYC has its own boat launch used for training and by members. An agreement exists between the Town and the CYC to not allow the public to use the boat launch (CYC Staff. Personal communication. August 15, 2011). The CYC considers membership applications carefully to ensure that new members will be full participants in the club's social network, programs, and activities and not use the membership as a means to avoid the public launch fees. This scrutiny results in some membership applications being denied (CYC Staff. Personal communication. August 15, 2011). The CYC hosts eleven social events and five races throughout the year attended by members and guests from within and outside the Town (CYC, 2012b; CYC Staff. Personal communication. August 15, 2011).

The clubhouse facilities at the CYC were replaced in 2011 at a cost of $550,000 to expand the available space for club activities and increase revenue from rentals to outside groups (CYC Staff. Personal communication. August 15, 2011). Rentals are still few to date, and development of policies governing facility rental is ongoing (CYC, 2012a). Groups such as political parties, scout groups, navy cadets, and private weddings have expressed interest in renting the clubhouse (CYC Staff. Personal communication. August 15, 2011). The social events, races, instructional services, and interest in facility rentals allude to the value of recreational ES benefits provided by the Reservoir to the CYC.

5.3. Quantitative findings

A total of 308 surveys were collected over the 12 month data collection period (October 2010-October 2011). Some cases reported unreasonably high total onsite costs (up to $500) potentially inflating the average trip cost, and some cases were not day trip visitors. As such, non-day trip cases and cases reporting over $200 in total onsite costs were not used resulting in 285 surveys used in the analysis. The findings presented in this section are compared with the expected outcomes described in the last chapter. The comparison of findings with expected outcomes is limited to stating whether or not the expectation was in line with the findings. A detailed discussion comparing the findings and expected outcomes is provided in chapter 6.

The average annual income category was $60,000 - $70,000 per year with most respondents (65%) earning $50,000 or more annually. Over a quarter of respondents (26%) reported earning over $90,000 annually (Figure 5.1). By contrast, the average salary in Alberta is just under 28.84/hr (Alberta, 2012), or $42,625 per year. The figure for the average annual income in Alberta was calculated by multiplying the average hourly wage by the 2011 Canadian average of 33 hours worked per week (StatsCan, 2012). The weekly income is then multiplied by 52 to arrive at the average annual income. The majority of survey respondents acquired a post-secondary education (65%) with respondents attaining post-secondary diplomas or trades (journeyman) close in numbers to those with undergraduate university degrees (Figure 5.2). The majority of respondents work full time, followed by the self-employed and part time workers (Figure 5.3).

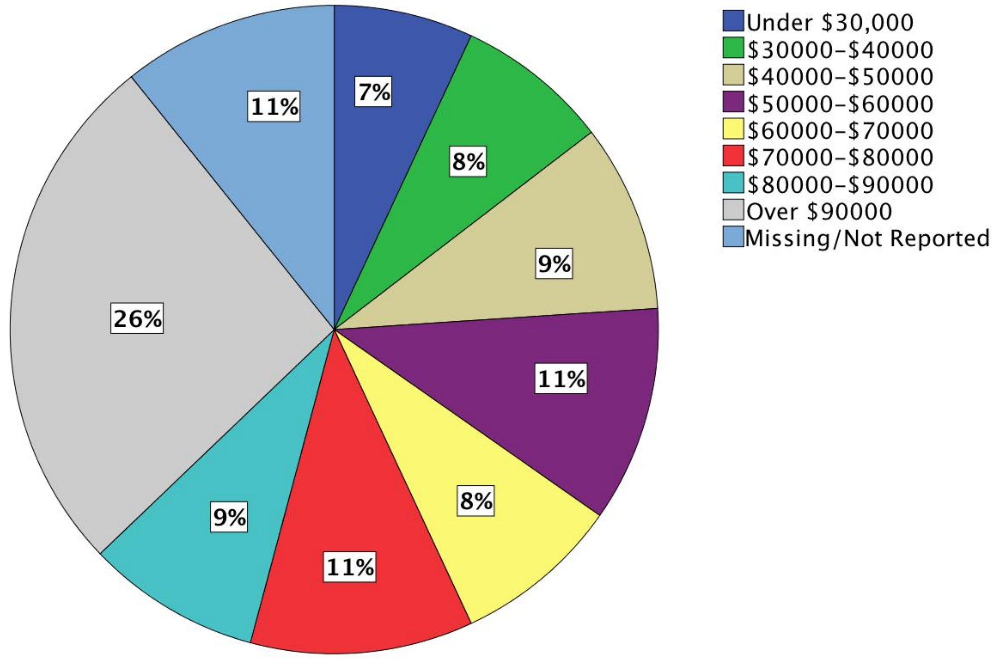

Figure 5.1: Household income of survey respondents. Created using SPSS 19 (2010)

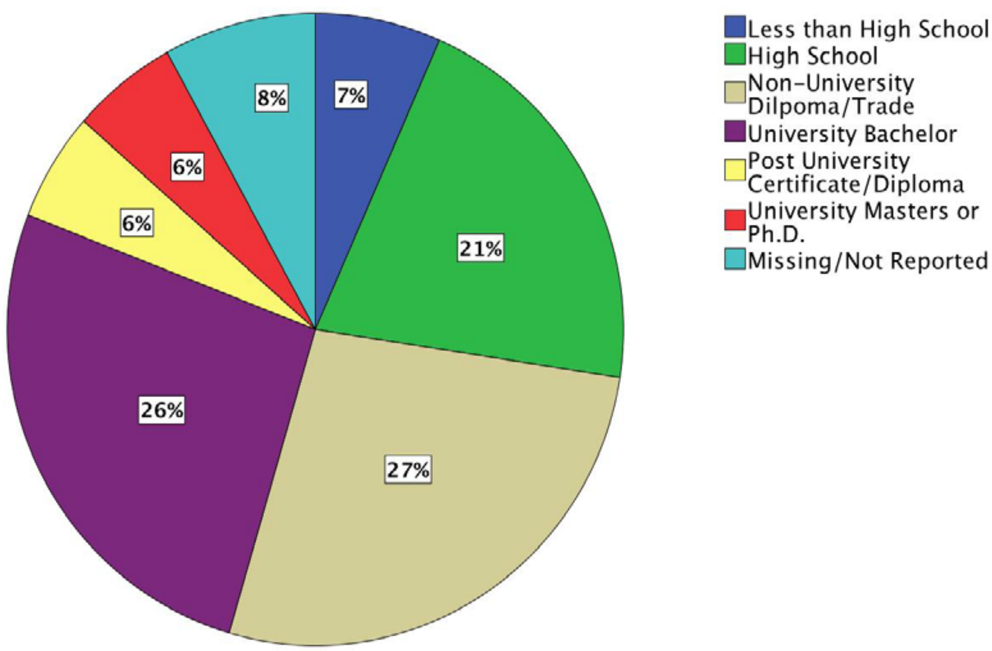

Figure 5.2: Educational attainment of survey respondents. Created by SPSS 19 (2010).

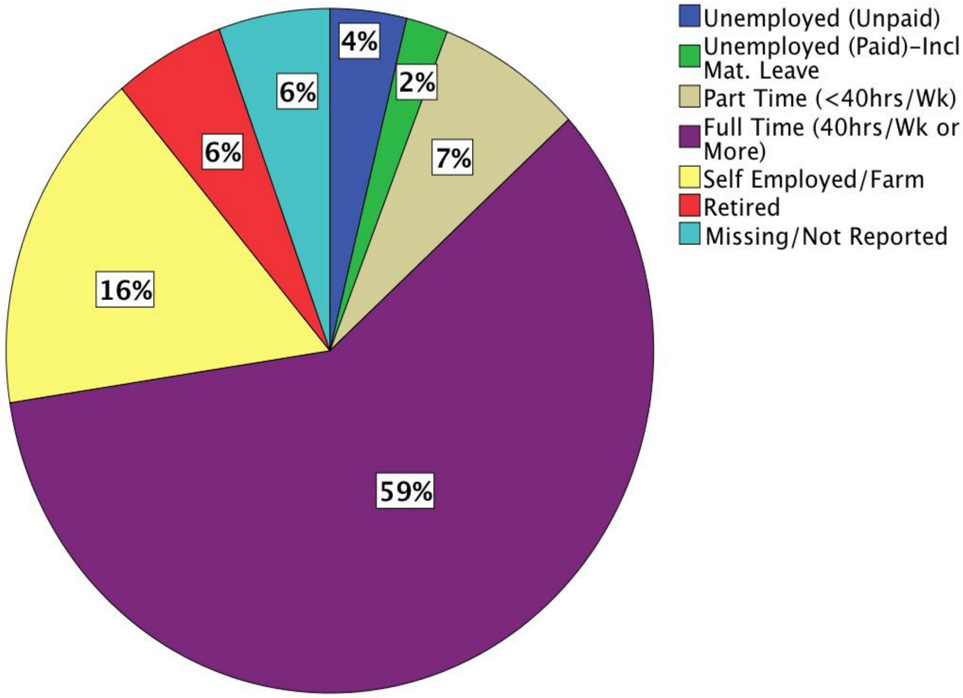

Figure 5.3: Employment status of survey respondents. Created by SPSS 19 (2010).

The average per trip cost was \$50 calculated using the CAA (2011) small vehicle variable operating cost, \$56 using the CAA (2011) large vehicle variable operating cost, and \$68 per using the University of Lethbridge (2007) mileage repayment rate. The calculation of average per trip cost is found using eq. (4.1) by summing the:

i. Average round trip travel driving costs calculated by multiplying the average round trip travel distance of 60 Km by the vehicle operation costs,

ii. Average total onsite expenses, and

iii. Average time cost for the trip calculated by multiplying the average opportunity cost of time rate of \$13/hr by the average round trip travel time of 46 minutes

The total onsite cost from the survey data varied from 0 to \$200 per trip. An explanation for the variation in per trip total onsite costs may rest in activity and food consumption choices while visiting the Reservoir. Total onsite costs are affected by choice of eating at restaurants in the Town or bringing food in coolers. A question about eating in restaurants was not part of the survey. Onsite observation revealed both extremes. Some visitors were observed to arrive with large boats and eating in restaurants at some point during their visits. Other visitors were observed to arrive by small car with a fishing rod, tackle box, and a cooler with sandwiches and a drink. The choice of restaurant also potentially increases onsite costs, as eating at Boston Pizza® is more costly than eating at Tim Horton's®.

The annual number of day trips per year to the reservoir is five or less for the majority of survey respondents (~57%) (Figure 5.4). A small percentage of respondents reported taking a large number of trips to the Reservoir (Figure 5.4). Onsite observation and informal conversation revealed that some non-resident visitors travel to the Reservoir from their place of employment during the lunch break (lunch visitors). The lunch visitors originated from businesses located in the southeast portion of Calgary and indicated they enjoy scenic viewing while eating lunch travelling to the Reservoir frequently (up to five times a week). This lunchtime visitation activity offers an explanation for the high number of trips reported by a small portion of survey respondents.

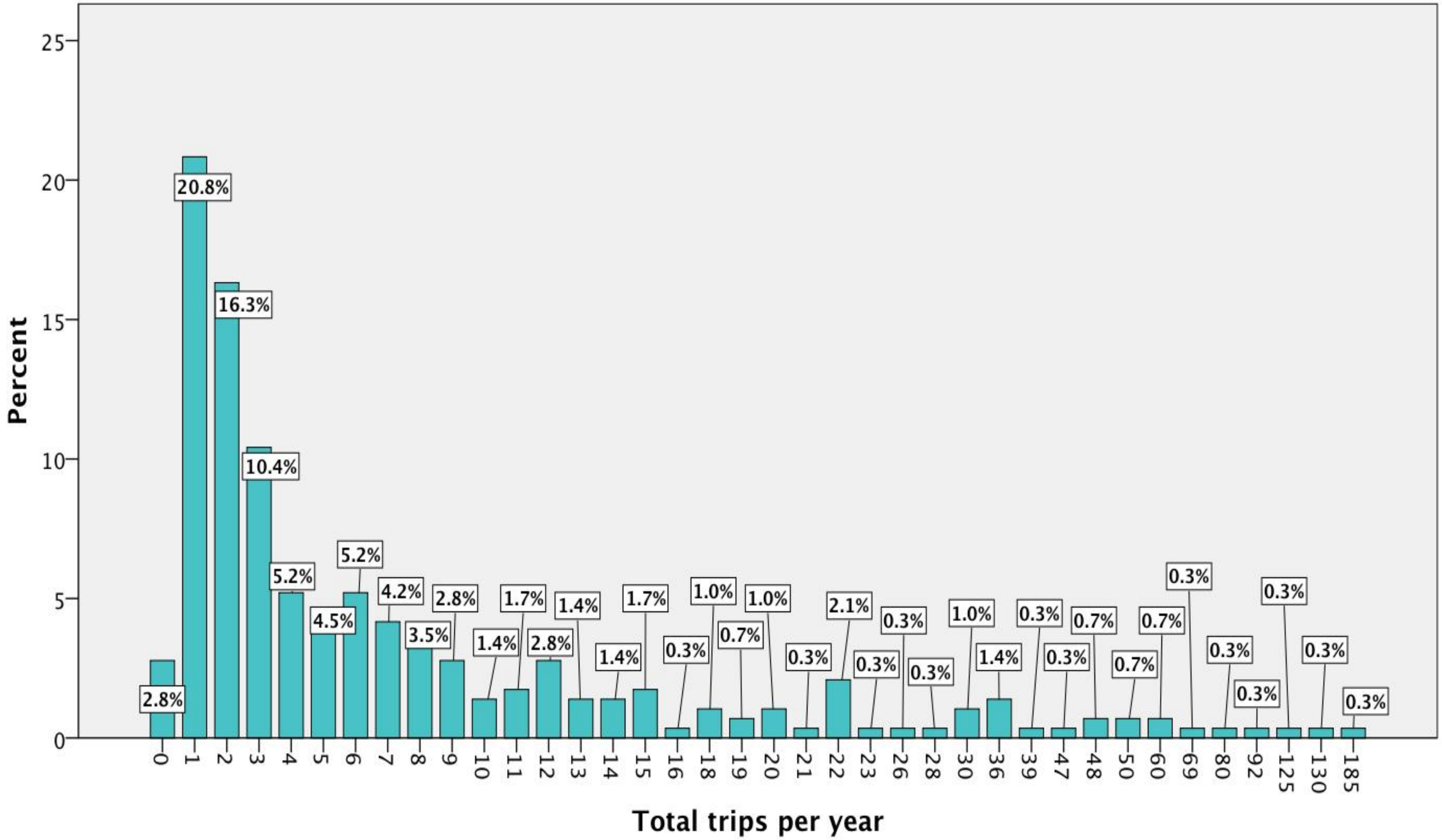

Figure 5.4: Percentage of survey respondents by number of trips per year to Chestermere Reservoir Created using SPSS 19 (2010).

The average round trip distance travelled to the Reservoir is 60 Km with an average round trip travel time of 46 minutes. The furthest one way distance travelled by a day use survey respondent was 309 Km and the shortest was 6 Km. Over 90% of survey respondents traveled a one way distance of 45 Km or less for a day trip to the Reservoir (Figure 5.5). This finding is not in line with expectations as the literature reviewed indicated that the travel distance would be longer (Chapter 3).

The service area map was generated by first joining postal code point data with survey responses using the join tool in ArcMap 10 (ERSI, 2010). Next the map of the service area was generated using the network analyst (service area) extension in ArcMap 10 (ESRI, 2010) and road network data (ESRI, 2010b) based on the one way distance travelled by the majority of survey responses (Figure 5.5). The service area map of the spatial extent of recreational ES benefits provided by the Reservoir is presented in Figure 5.6. The map is similar in appearance to previous studies that mapped the spatial range of recreational ES benefits (Baerenklau et al., 2010; Bateman, 2009: Bateman et al., 2002; Bateman et al., 1999). The cities of Airdrie, Calgary, Irricana, Okotoks, Langdon, and Strathmore are all within the recreational ES service area of the Reservoir (Figure 5.6). The majority of survey respondents originated from Calgary (85.4%), which is in line with expectations (Figure 5.7).

The vast majority (93%) of survey respondents reported that their trip to the Reservoir was for day use recreation (Figure 5.8). This finding is in line with expectations. There were 22 cases reporting multiday stays, of which the majority (64%) reported staying with family or friends in the Town. Conversation with some of the multiday users revealed they generally originate from locations outside Alberta including British Columbia, Saskatchewan, Manitoba, eastern Canada, and outside Canada (US, Netherlands).

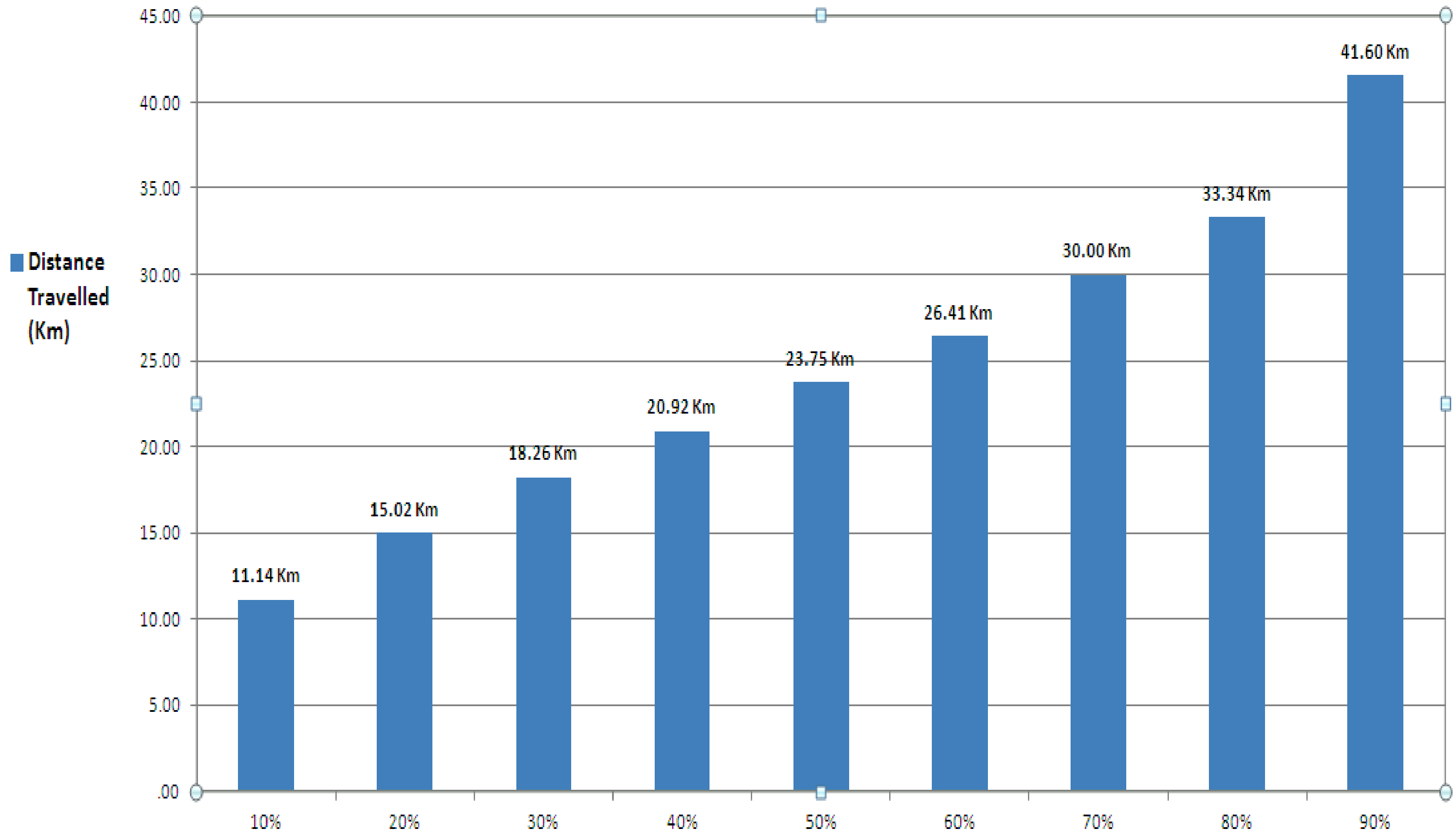

Figure 5.5: One-way distance travelled by percentile of survey respondents.
Created using SPSS 19 (2010).

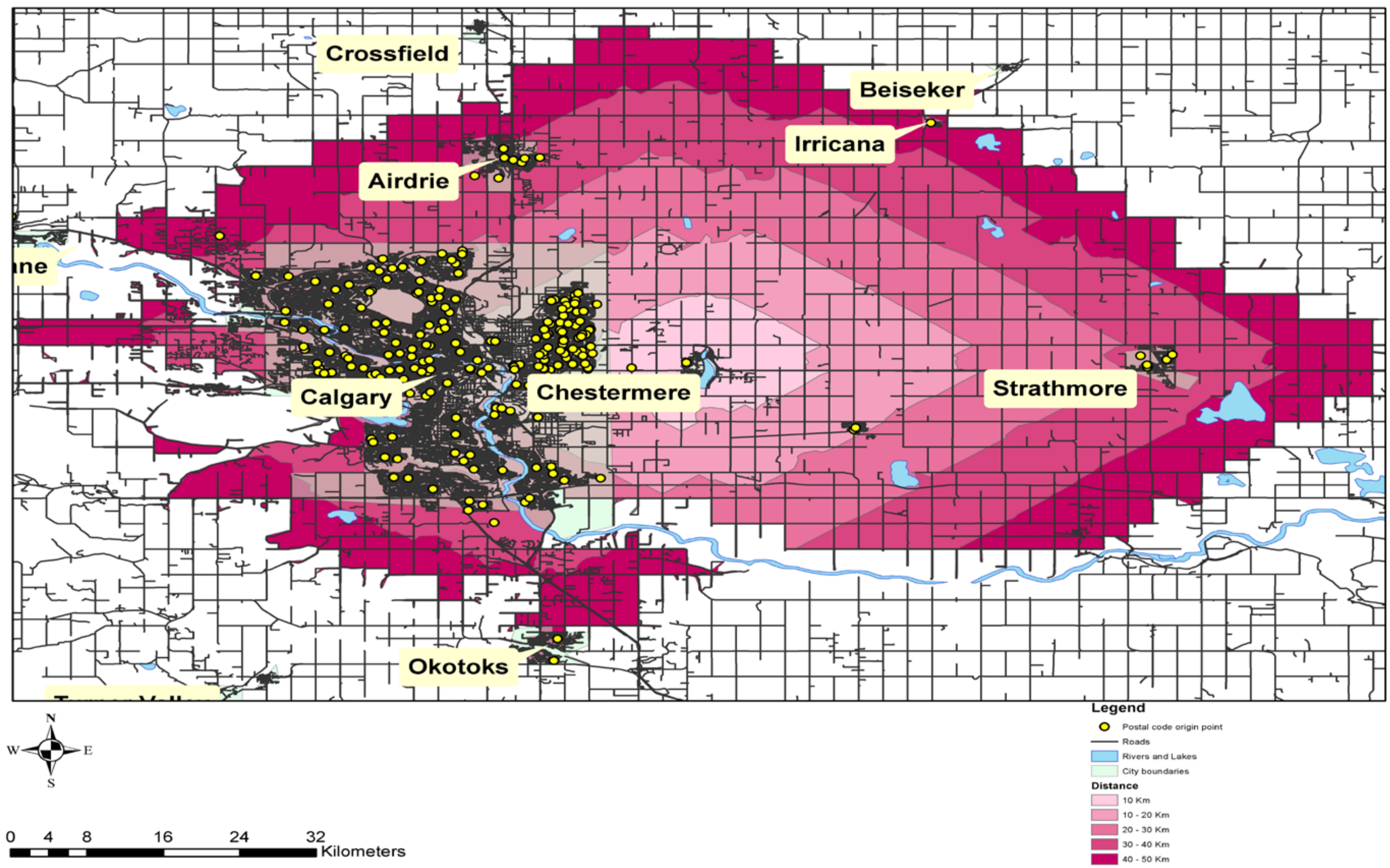

Figure 5.6: Service area for recreational ES benefits provided by the Chestermere Reservoir. Created using ArcMap 10 (ESRI, 2010).

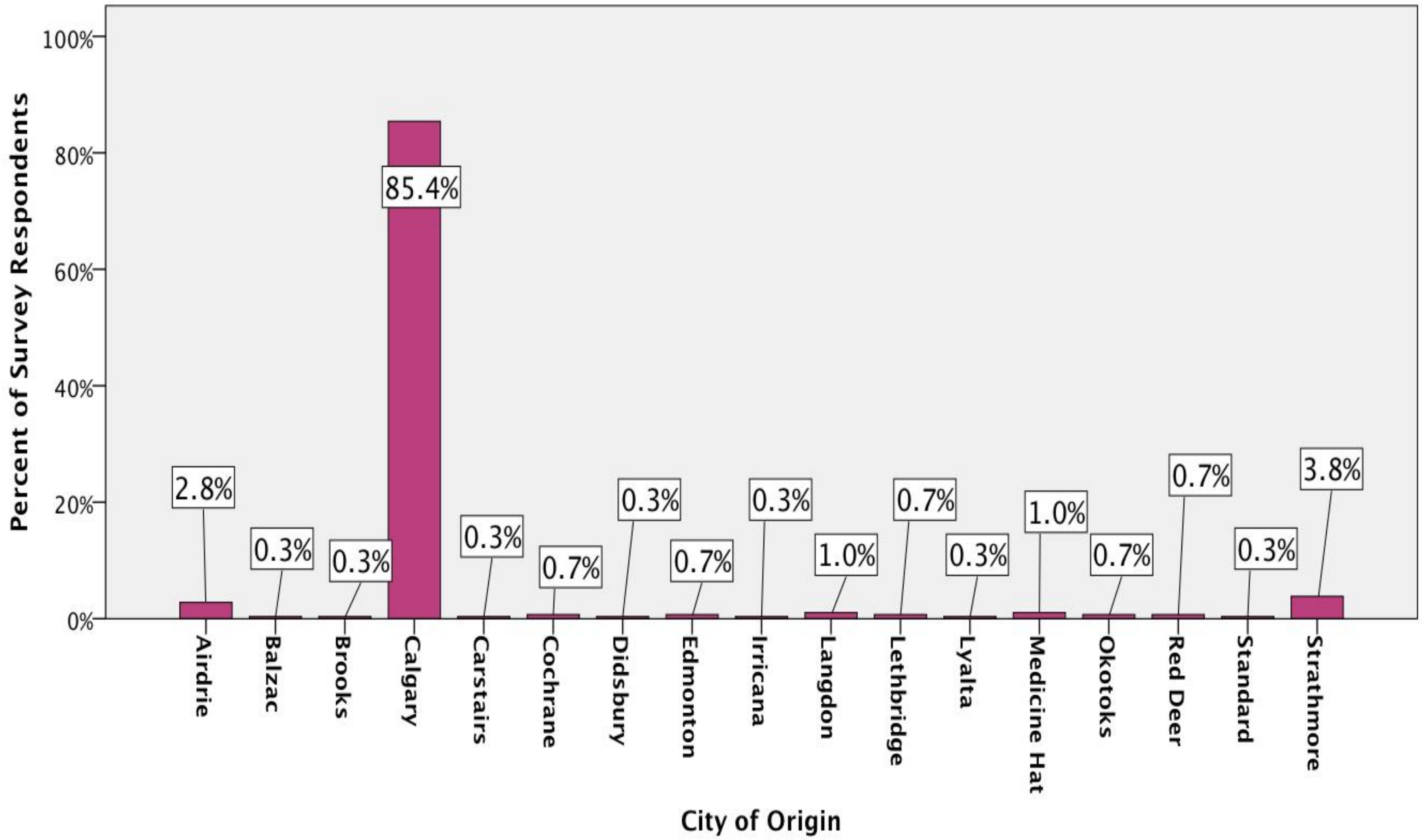

Figure 5.7: Origin of non-resident day trip recreational visitors to the Chestermere Reservoir as a percentage of the total number surveyed. Created using SPSS 19 (2010).

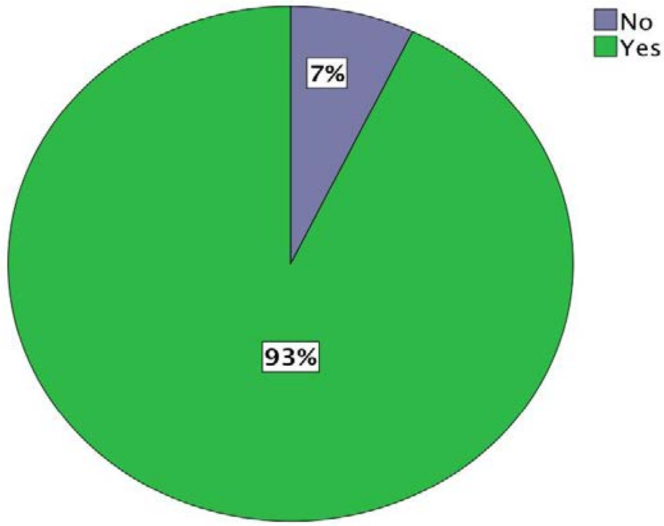

Figure 5.8: Response to survey question about visit being a day trip.
Created using SPSS 19 (2010).

Statistical testing was done to check if expectations about the dependency of the number of trips annually and participation in recreation activities[1] on annual income, educational attainment[2], and/or employment status[3] were met. Responses to the survey questions regarding income, educational attainment, and employment status, trip frequency, and recreation activities were inputted as variables into the Pearson Chi^2 (χ^2) crosstab test in IBM SPSS (2010). In this study, a p-value of 10% and under (≤ 0.10) indicates a high likelihood of a dependant relationship (Sarantakos, 2007). The majority of the survey data is not normally distributed or continuous, and is categorical (nominal). The Pearson Chi^2 (χ^2) crosstab test was selected due to the suitability of this test for nominal and non-normal data (Sarantakos, 2007). The findings of the Pearson Chi^2 (χ^2) testing are presented in Table 5.1. The findings of the Pearson Chi^2 (χ^2) crosstab test reported below describe if dependant relationships were found and if expectations were met. A more detailed discussion on possible reasons behind the discrepancy between expectations and findings is provided in the next chapter.

[1] Recreation activities include skating, Nordic skiing, snowmobiling, swimming, boating, fishing, personal watercraft use (JetSki/SeaDoo), walking, scenic viewing, and biking
[2] Educational attainment includes less than high school, high school, diploma or trade (journeyman), bachelor's degree, certificate or diploma above bachelor's degree, and a masters or Ph.D.
[3] Employment status includes unemployed (unpaid and paid (leave)), part time (under 40hrs/week), full time (40 or more hrs/week), self employed/farm, and retired

Table 5.1: Dependence of trip frequency and activities on income, education, and employment status for the Chestermere Reservoir.

	Household Income		Educational Attainment		Employment Status	
	Chi2 Result (P-Value)	Direction of dependence	Chi2 Result (P-Value)	Direction of dependence	Chi2 Result (P-Value)	Direction of dependence
Number of trips annually	8.795 (0.066)	More trips made by higher income households	7.982 (0.092)	More Trips made by those with post secondary education	4.554 (0.336)	Trip frequency independent of employment status
Skating	1.598 (0.450)	Skating independent of income	2.128 (0.345)	Skating independent of education	Participation rate too low results to draw any conclusions	
Nordic Skiing	Participation rate too low results to draw any conclusions					
Snow-mobiling	0.399 (0.819)	Snow-mobiling independent of income	4.939 (0.085)	More snow-mobiling done by those with below post secondary	Participation rate too low results to draw any conclusions	
Swim	1.612 (0.447)	Swimming independent of income	0.980 (0.613)	Swimming independent of education	0.363 (0.834)	Swimming independent of employment status
Boating	0.265 (0.876)	Boating independent of income	2.017 (0.365)	Boating independent of education	3.085 (0.214)	Boating independent of employment status
Fishing	0.186 (0.911)	Fishing independent of income	1.074 (0.585)	Fishing independent of education	0.259 (0.879)	Fishing independent of employment status
Personal Water-craft	0.959 (0.619)	Personal Watercraft use is of income	2.021 (0.364)	Personal Watercraft use is of education	Participation rate too low results to draw any conclusions	
Walking	0.306 (0.858)	Walking independent of income	11.723 (0.003)	More walking done by those with below post secondary	2.118 (0.347)	Walking independent of employment status
Scenic Viewing	1.645 (0.439)	Scenic viewing independent of income	3.440 (0.179)	Scenic viewing independent of education	2.948 (0.229)	Biking independent of employment status
Biking	2.160 (0.340)	Biking independent of income	0.231 (0.891)	Biking independent of education	Participation rate too low results to draw any conclusions	

Significant at the 10% level (p-value < 0.10), dependent relationship likely exists

Household income categories were; i) under $50,000 annually, ii) $50,000 - $75,000 annually, or iii) Over $75,000 annually

Educational attainment categories were; i) had less than post secondary education, ii) had post secondary education, or iii) had a university Masters or Ph.D.

Employment status categories were; i) not working or worked less than full time, ii) worked full time, or were self employed, or iii) were retired

Created using IBM SPSS 19 (2010).

The number of trips per year was found to be dependent on household income (p = 0.06) with those with a higher income generally traveling to the Reservoir more often than those with a lower income. Participation in recreation activities was found to be independent of household income for the Reservoir. The finding of a dependant relationship between trip frequency and income is consistent with expectations and previous literature (Chapter 4). However, the finding that participation in recreational activities is independent of income is inconsistent with expectations and previous literature, particularly activities requiring costly equipment (boats, personal watercraft, and snowmobiles). The number of trips per year and all recreational activities were found to be independent of employment status. This finding is inconsistent with expectations drawn from previous literature, as full time work is generally needed to afford activities requiring costly equipment. The number of trips per year (p = 0.092), snowmobiling (p = 0.085), and walking (p = 0.003) were found to be dependent on educational attainment. Respondents that obtained a post-secondary education (university degree, college based trade or diploma) generally traveled to the Reservoir more often. Respondents that obtained less than a post secondary education (high school or less) generally participated in snowmobiling and walking more often than those with a post secondary education. The other recreation activities were found to be independent of educational attainment. The findings for the dependence of trip frequency, snowmobiling, and walking are in line with expectations. However the finding that the other activities requiring costly equipment were independent of education does not meet expectations, as greater education is generally thought to bring the income needed to participate in recreational activities requiring costly equipment. The participation rate in Nordic skiing was too low to draw any meaningful conclusions regarding dependency with income, employment status, or educational attainment. The participation rates were too low for skating, snowmobiling, personal watercraft use, and biking to draw any meaningful conclusions with respect to dependency on employment status (Table 5.1).

The finding for the total value of recreational ES benefits provided by the Reservoir to non-resident users ranges from $794,000 to $980,000 annually.

Table 5.2: Value of recreational benefits provided by the Chestermere Reservoir for each vehicle counter unit portion scenario and driving cost

Assumed Vehicle Size and Per Km Cost		Recreation Scenarios Representing the Percentage of Non-Resident Recreation Visits out of Total Daily Vehicle Counter Hits on Weekdays and Weekends		
		Scenario 1 - 15% weekday, 30% Weekend	Scenario 2 - Water Down: 15% Weekday, 30 % Weekend. Water Up: 20% Weekday, 40% Weekend	Scenario 3 - 20% weekday, 40% Weekend
	Lg Vehicle (Var Cost Only- $0.20/Km)	$794,000	$917,000	$980,000
	Sm Vehicle (Var Cost Only- $0.09/Km)	$720,000	$817,000	$875,000
	All Vehicle Sizes (Uleth Milage Rate-$0.40/Km)	$966,000	$1,129,000	$1,213,000

Created using Microsoft Excel 2007

This range is based on the large vehicle class variable operation costs of $0.20/Km (CAA, 2011) applied to the three counter unit data portion scenarios representing non-resident recreation visits used in the calculations (Table 5.2). The finding for total value of recreational ES benefits provided by the Reservoir is sensitive to the choice of vehicle cost and scenario used in calculations (Table 5.2). The finding of a substantial annual value for recreational ES benefits provided by the Reservoir is in line with expectations.

The analysis considered two time periods depending on whether the water level is lowered (water down) or raised (water up), and three scenarios representing the portion of daily vehicle unit counts representing non-resident recreation visits (chapter 4). The period when the water is up had a greater recreation value than when the water is down for all days of the week, water levels, locations, and all three scenarios (Tables 5.3-5.5). This finding is reasonable as many of the recreational opportunities provided by the Reservoir depend on the water level in the Reservoir being raised, particularly summer activities requiring the boat launch. The John Peak Park location was found to have a higher recreation value versus the Sunset Park location for all days of the week, both the water level periods, and all three portion scenarios (Tables 5.3-5.5). The higher recreation value for the John Peake Park location is attributable to easier access from main roads leading into the Town, easy access to nearby restaurants and stores, and the presence of the public boat launch facility that are not available at the Sunset Park location (Author's own observations). The value of recreation on weekends (Saturday and Sunday) is greater than the other days of the week. This finding is reasonable as most people are working during the weekdays.

Table 5.3: Summary of the value of recreational ES benefits provided by the Chestermere Reservoir for scenario 1

John Peake Park Recreation Value Summary by Day: Water Level Down			Sunset Park Recreation Value Summary by Day: Water Level Down		
Day	Total Non-Resident visits	Value Estimate (Lg Vehicle, $0.20/Km)	Day	Total Non-Resident visits	Value Estimate (Lg Vehicle, $0.20/Km)
Sun	600	$ 28,000	Sun	239	$ 11,000
Mon	395	$ 18,000	Mon	32	$ 1,000
Tues	461	$ 21,000	Tues	36	$ 2,000
Wed	428	$ 20,000	Wed	36	$ 2,000
Thurs	375	$ 17,000	Thurs	32	$ 1,000
Fri	566	$ 26,000	Fri	35	$ 2,000
Sat	638	$ 29,000	Sat	272	$ 13,000
Totals	**3463**	**$ 159,000**	**Totals**	**682**	**$ 32,000**
John Peake Park Recreation Value Summary by Day: Water Level Up			**Sunset Park Recreation Value Summary by Day: Water Level Up**		
Day	Total Non-Resident visits	Value Estimate (Lg Vehicle, $0.20/Km)	Day	Total Non-Resident visits	Value Estimate (Lg Vehicle, $0.20/Km)
Sun	1531	$ 70,000	Sun	386	$ 18,000
Mon	753	$ 35,000	Mon	39	$ 2,000
Tues	663	$ 31,000	Tues	33	$ 2,000
Wed	562	$ 26,000	Wed	23	$ 1,000
Thurs	827	$ 38,000	Thurs	41	$ 2,000
Fri	1165	$ 54,000	Fri	46	$ 2,000
Sat	1700	$ 78,000	Sat	459	$ 21,000
Totals	**7200**	**$ 332,000**	**Totals**	**1026**	**$ 48,000**
Total Value of Camp		**$ 192,000**	**Total Vaue of Recreation for Scenario 1**		**$ 794,000**
Total Value of CYC		**$ 31,000**			
Note: Counter portion scenario 1: Non-resident recreation visits = 15% of daily counts for weekdays, 30% of daily counts for weekends for both water up & water down periods					

Created using Microsoft Excel 2007.

Table 5.4: Summary of the value of recreational ES benefits provided by the Chestermere Reservoir for scenario 2

John Peake Park Recreation Value Summary by Day: Water Level Down			Sunset Park Recreation Value Summary by Day: Water Level Down		
Day	Total Non-Resident visits	Value Estimate (Lg Vehicle, $0.20/Km)	Day	Total Non-Resident visits	Value Estimate (Lg Vehicle, $0.20/Km)
Sun	600	$ 27,600	Sun	239	$ 11,000
Mon	395	$ 18,000	Mon	32	$ 1,000
Tues	461	$ 21,000	Tues	36	$ 2,000
Wed	428	$ 20,000	Wed	36	$ 2,000
Thurs	375	$ 17,000	Thurs	32	$ 1,000
Fri	566	$ 26,000	Fri	35	$ 2,000
Sat	638	$ 29,000	Sat	272	$ 13,000
Totals	**3463**	**$ 158,600**	**Totals**	**682**	**$ 32,000**

John Peake Park Recreation Value Summary by Day: Water Level Up			Sunset Park Recreation Value Summary by Day: Water Level Up		
Day	Total Non-Resident visits	Value Estimate (Lg Vehicle, $0.20/Km)	Day	Total Non-Resident visits	Value Estimate (Lg Vehicle, $0.20/Km)
Sun	2041	$ 94,000	Sun	514	$ 24,000
Mon	1004	$ 46,000	Mon	51	$ 2,000
Tues	884	$ 41,000	Tues	44	$ 2,000
Wed	749	$ 34,000	Wed	31	$ 1,000
Thurs	1103	$ 51,000	Thurs	54	$ 2,000
Fri	1554	$ 71,000	Fri	61	$ 3,000
Sat	2266	$ 104,000	Sat	612	$ 28,000
Totals	**9601**	**$ 441,000**	**Totals**	**1368**	**$ 62,000**

Total Value of Camp	**$ 192,000**	**Total Vaue of Recreation for Scenario 2**	**$ 916,600**
Total Value of CYC	**$ 31,000**		

Counter portion scenario 2: a) Water down period: Non- resident recreation visits = 15% of daily counts for weekdays, 30% of daily counts for weeknds, b) Water up period: Non-Resident recreation visits = 20% of daily counts for weekdays, 40% of daily counts for weekends

Created using Microsoft Excel 2007.

Table 5.5: Summary of the value of recreational ES benefits provided by the Chestermere Reservoir for scenario 3

John Peake Park Recreation Value Summary by Day: Water Level Down			Sunset Park Recreation Value Summary by Day: Water Level Down		
Day	Total Non-Resident visits	Value Estimate (Lg Vehicle, $0.20/Km)	Day	Total Non-Resident visits	Value Estimate (Lg Vehicle, $0.20/Km)
Sun	800	$ 37,000	Sun	318	$ 15,000
Mon	527	$ 24,000	Mon	43	$ 2,000
Tues	615	$ 28,000	Tues	48	$ 2,000
Wed	571	$ 26,000	Wed	48	$ 2,000
Thurs	500	$ 23,000	Thurs	43	$ 2,000
Fri	755	$ 35,000	Fri	47	$ 2,000
Sat	850	$ 39,000	Sat	363	$ 17,000
Totals	**4617**	**$ 212,000**	**Totals**	**910**	**$ 42,000**

John Peake Park Recreation Value Summary by Day: Water Level Up			Sunset Park Recreation Value Summary by Day: Water Level Down		
Day	Total Non-Resident visits	Value Estimate (Lg Vehicle, $0.20/Km)	Day	Total Non-Resident visits	Value Estimate (Lg Vehicle, $0.20/Km)
Sun	2041	$ 94,000	Sun	514	$ 24,000
Mon	1004	$ 46,000	Mon	51	$ 2,000
Tues	884	$ 41,000	Tues	44	$ 2,000
Wed	749	$ 34,000	Wed	31	$ 1,000
Thurs	1103	$ 51,000	Thurs	54	$ 2,000
Fri	1554	$ 71,000	Fri	61	$ 3,000
Sat	2266	$ 104,000	Sat	612	$ 28,000
Totals	**9601**	**$ 441,000**	**Totals**	**1368**	**$ 62,000**

Total Value of Camp	**$ 192,000**	**Total Vaue of Recreation for Scenario 3**	**$ 980,000**
Total Value of CYC	**$ 31,000**		

Note: Counter portion scenario 3: Non-resident recreation visits = 20% of daily counts for weekdays, 40% of daily counts for weekends for both water up & water down periods

Created using Microsoft Excel 2007.

5.3.1. Use of the public boat launch facility in the Town of Chestermere

The boat launch facility located in the Town is an important part of recreation on the Reservoir as there are no other publicly available locations to launch boats, watercraft, and skidoos (Author's own observation; Town of Chestermere Staff. Interview by the author, January 6, 2011). As such, findings related to the boat launch facility use are included in this section. Approximately a third of survey respondents reported using the boat launch facilities (Figure 5.9).

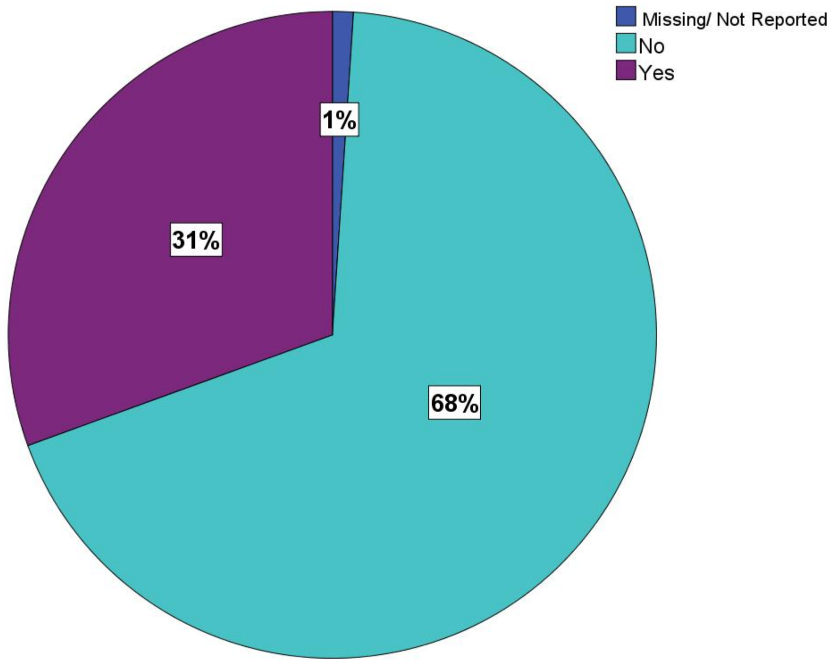

Figure 5.9: Percent of survey respondents using the boat launch as part of recreation activities on the Chestermere Reservoir
Created using IBM SPSS 19 (2010)

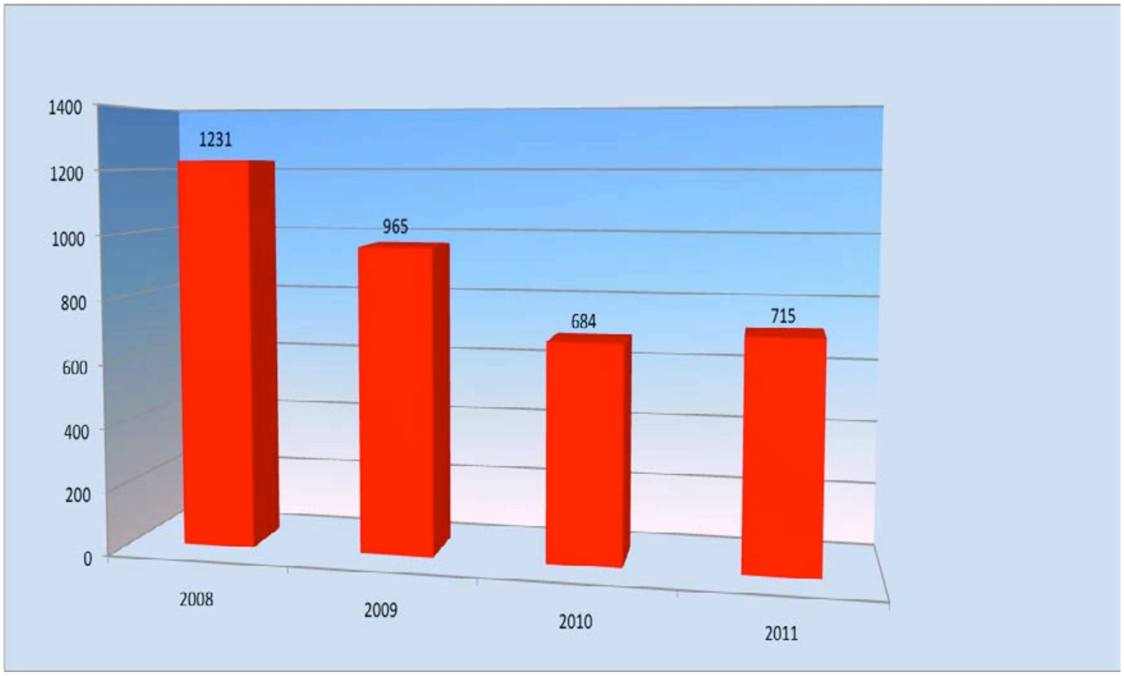

Figure 5.10: Number of non-resident boat launch users for the 2008-2011 seasons
Source: Town of Chestermere Staff, email correspondence, December 8, 2011

A total of 715 non-residents launched boats during the 2011 season using the boat launch facility (Figure 5.10). Repeat trips and type of craft launched are not separated from the total numbers. Non-residents of the Town pay a fee of $40 for large power boats, $30 for personal watercraft, and $10 for small (under 10 hp) and non-powered craft each time they use the boat launch (Town of Chestermere, 2011f). Residents of the Town are able to apply for a permit to bypass the fees when launching a boat, and must present the permit at the time of launch or the fees are applied (Town of Chestermere, 2011f).

The boat lunch facilities in the Town were upgraded in 2006 to better serve both residential and non-residential users (Town of Chestermere Staff, email correspondence, December 12, 2011). A large fee increase was put into place that same year (e.g. $12 to $40 for large craft) to help finance the construction costs and to address safety concerns on the Reservoir. Safety concerns arose due to congestion on the Reservoir producing a higher than acceptable risk of collisions during peak use days, such as weekends when the weather was warm (Town of Chestermere Staff, personal communication, August 8, 2010). The fee increase was intended to aid in reducing the number of crafts on the water at a time, specifically the number of non-resident launches (Town of Chestermere Staff, personal communication, August 8, 2010). The number of non-resident boats launched declined overall from 2008 to 2011 with a small increase in 2011 (Figure 5.10). It is unclear if the fee increase in 2006 caused the decline in non-resident launches after 2008. However, the fee increase was unpopular and remains so today based on informal conversation with non-resident boat launch users and Town Staff (Town of Chestermere Staff, email correspondence, December 12, 2011). Data on boat launches for the 2006 and 2007 seasons was available, however the totals for residents and non-residents was not separated. Of the non-resident visitors that used the boat lunch, the majority participated in boating (70.5%) followed by fishing (47.7%), use of personal watercraft (22.7%), and snowmobiling (14.8%).

Observations onsite revealed that the temperature on a given day and the day of the week appeared to have an effect on the number of non-resident boat launches. Correlation testing between the numbers of non-resident launches, daily maximum temperatures, and the day of the week was done to test if observations were true generally. Information on the number of non-resident users of the boat launch for each day for the 2011 season was drawn from the log book kept by Town staff in the shack where users must pass by to pay fees or show their pass (Town of Chestermere, 2012). Information on the maximum daily temperature was obtained from weather data recorded at the Calgary airport (Environment Canada, 2012b). Temperature data from the Calgary airport is used due to the lack of a weather monitoring station in the Town. The results revealed that the number of launches made by non-resident users is not dependant on temperature or the day of the week for all three tests. This finding indicates that other influences drive the number of non-resident launches that could not be captured by general observation onsite.

As shown in tables 5.6 and 5.7, the number of non-resident launches was found to have a positive and statistically significant relationship with weekends (p = 0.026) and daily maximum temperature (p = 0.015) indicating that there was a greater number of non-resident boat launches on weekends and warmer days. A negative and statistically significant relationship was found between the number of non-resident launches and weekdays (Monday to Friday) (p = 0.037) indicating that the number of non-resident launches decreased for the Monday to Friday portion of the week. The findings for the influence of the day of the week and daily temperature are consistent with onsite observations.

Table 5.6: Correlation between the number of daily non-resident boat launches with daily temperature and day of the week (weekdays only) for 2011

		Number of Non-Resident Launches	Max Temperature of the Day	Day of the Week (Weekdays Only)
Number of Non-Resident Launches	Pearson Correlation		.269*	-.232*
	Sig. (2-tailed)		.015	.037
Max Temperature of the Day	Pearson Correlation	.269*		-.121
	Sig. (2-tailed)	.015		.284
Day of the Week (Weekdays Only)	Pearson Correlation	-.232*	-.121	
	Sig. (2-tailed)	.037	.284	

*. Correlation is significant at the 0.05 level (2-tailed).

Created using SPSS 19 (2010)

Table 5.7: Correlation between the number of daily non-resident boat launches with daily temperature and day of the week (weekends only) for 2011

		Numebr of Non-Resident Launches	Max Temperaure of the Day	Day of the Week (Weekends Only)
Number of Non-Resident Launches	Pearson Correlation	[redacted]	.419*	.388*
	Sig. (2-tailed)		.015	.026
Max Temperature of the Day	Pearson Correlation	.419*	[redacted]	.186
	Sig. (2-tailed)	.015		.301
Day of the Week (Weekends Only)	Pearson Correlation	.388*	.186	[redacted]
	Sig. (2-tailed)	.026	.301	
*. Correlation is significant at the 0.05 level (2-tailed).				

Created using SPSS 19 (2010)

5.3.2. Camp Chestermere

The value of recreation provided by the Reservoir to the Camp ranged from $185,000 to $206,000 annually depending on the driving cost used in calculations. The service area of the Camp was determined by inputting postal code data provided by the Camp and the road network dataset (ESRI, 2010b) into the network analyst (service area) extension in ArcMap 10 (ESRI, 2010a) (chapter 4). The resulting service area map for the Camp is shown in Figure 5.11. The majority of Camp program users originated from Calgary (71.7%) followed by Strathmore (11.8%) and Langdon (6.7%), with smaller portions from numerous other communities (Figure 5.12). The average round trip travel distance to the Camp was 70 Km with an average round trip travel time of 58 minutes. The average income of Camp users was $45,766 based on 2006 Census data. The travel cost calculations of using the camp programs was divided into two groups based on the location of a given user's postal code (Chapter 4). The average cost of using Camp programs including fees, driving cost, and opportunity cost of time ranged from $261 - $336 for the day program, and $362 - $387 for the overnight program depending on the vehicle operating cost selected for analysis (Table 5.8).

Table 5.8: Average cost to use Camp Chestermere programs depending on driving cost used in calculations

	Driving Cost Assumtion		
	Lg Vehicle var costs ($0.20/Km)	Sm Vehicle var costs ($0.09/Km)	Uleth Per Km Rate ($0.40/km)
Average Cost for Day Camp Users	$ 287	$ 261	$ 336
Average Cost for Overnight Camp Users	$ 371	$ 362	$ 387

Created using Microsoft Excel 2007

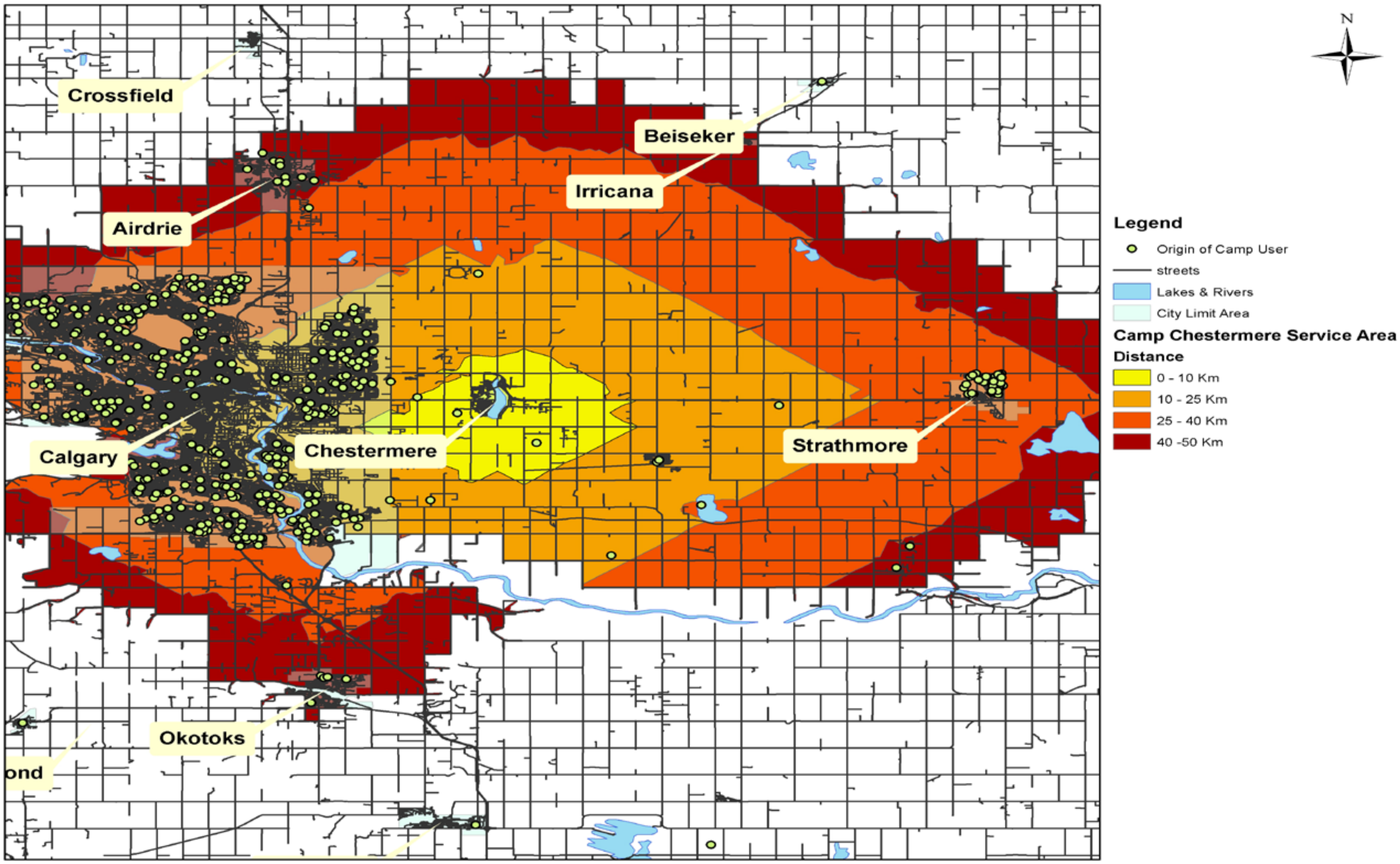

Figure 5.11: Service area of Camp Chestermere. Created using ArcMap 10 (ESRI, 2010)

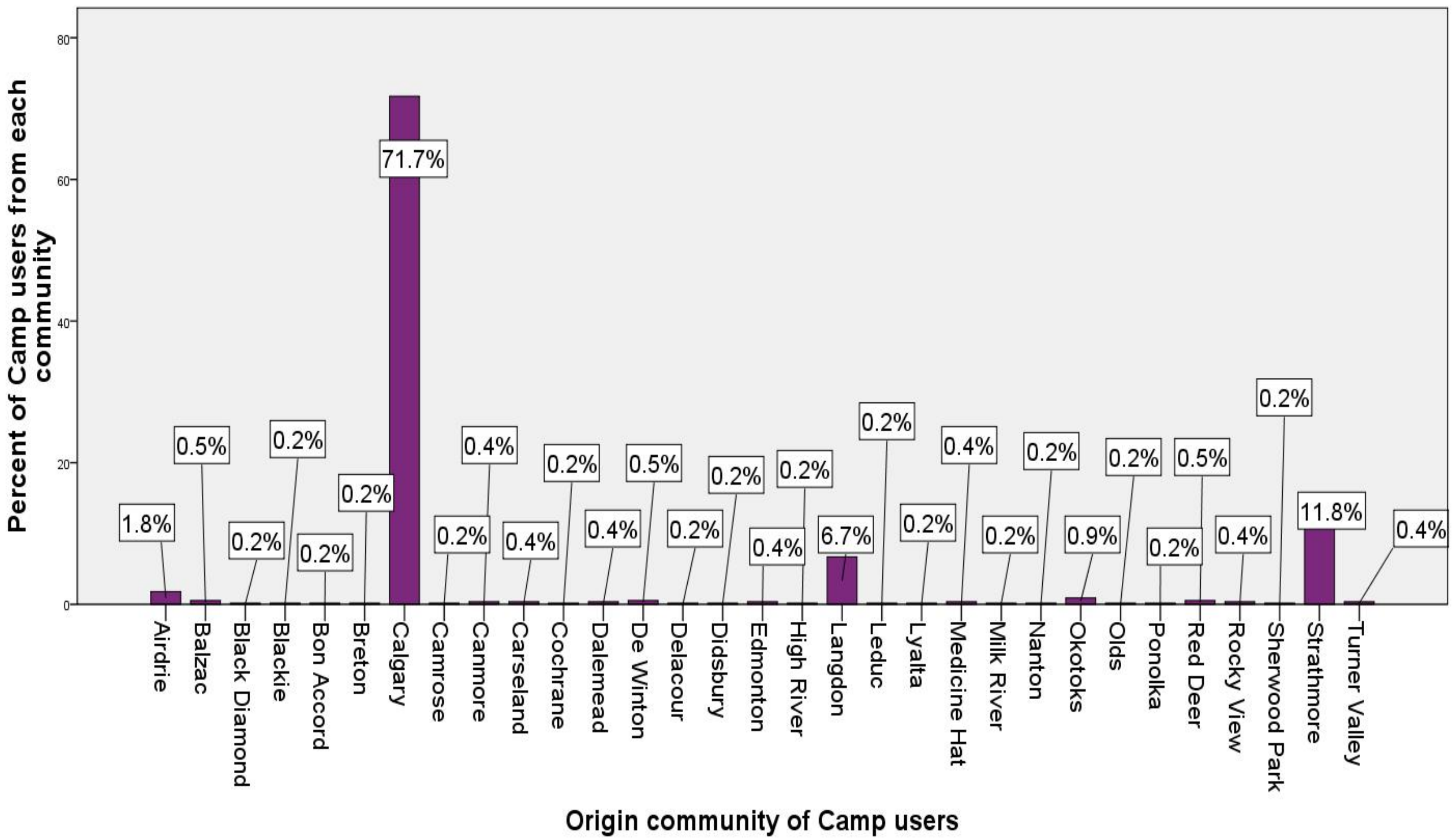

Figure 5.12: Origin communities for Camp Chestermere summer program users in 2010.
Source: Camp Chestermere Staff. Email Correspondence. December 15, 2010.

5.3.3. Calgary Yacht Club

The estimated value of recreational ES benefits provided by the Reservoir to the CYC ranges from $32,000 - $36,000 annually. As noted in the last chapter, information on the number of non-resident members, origins, and demographic characteristics was not available for this study. Instead assumptions, alternate publicly available information sources, and survey data are used as a substitute in calculations (Chapter 4). The Manta Media (2012b) small business index reported the CYC had total revenues of $48,560 for 2011. The revenue report is a single value with no separation of revenue sources. The Southern Alberta Navy Cadets rent the CYC facilities for $3000 annually to train cadets on boating for three weekends in May and three weekends in September (CYC Staff. Personal communication. August 15, 2011). The navy Cadets use the CYC due to the close proximity to Calgary reducing travel costs versus going to a lake/reservoir further away. The $3000 paid by the Navy Cadets is included in the value estimate of recreational ES benefits provide by the Reservoir to the CYC.

The estimation of the service area is not included for the CYC due to the use of assumed members and origins in calculations, as such any finding for the service area would be speculative. The estimated average seasonal cost of using the CYC ranges from $476 - $546 depending on the driving cost assumption used (Table 5.9). The estimated average round trip travel distance of the estimated CYC non-resident members was 46 Km with a round trip travel time of 38 minutes.

Table 5.9: Average annual cost of Calgary Yacht Club membership including travel for each driving cost used in calculations

	Driving Cost Assumption		
	Lg Vehicle variable per Km Cost ($0.20/Km)	Sm Vehicle variable per Km Cost ($0.09/Km)	Uleth per Km rate ($0.40/Km)
Average Annual Cost	$ 501	$ 476	$ 546

Created using Microsoft Excel 2007

The average annual income of the estimated non-resident CYC members was $41,303 based on 2006 Census income data. The finding for the average annual income for non-resident CYC members is likely an underestimation of the true average income. A more realistic average annual income for a non-resident CYC member is likely to be closer to that of the public survey in the $60,000 - $70,000 range. There is a high cost associated with membership in a boating club (Table 5.9) and boat ownership (trailer, insurance, gear, etc.). Those earning around $40,000 - $45,000 annually are not likely going to become CYC members due to the high cost.

5.4. Summary and conclusion

This chapter presented the findings from applying the qualitative and quantitative frameworks detailed in chapter 4. The qualitative findings revealed that the events hosted by the Town provide a high level of utility to non-resident visitors beyond what is captured in the quantitative analysis. Similarly non-residents renting the facilities, attending social events, and using the programs and services of the Camp and CYC derive similar benefits from recreation on or near the Reservoir not captured by the quantitative analysis. The additional insight gained through informal interviews/conversations and onsite observations show the finding for the value of recreational ES provided by the Reservoir to be a conservative estimate.

The quantitative findings revealed an estimated total value of recreational ES for day users provided by the Reservoir to range from around $794,000 to $980,000 annually depending on the portioning scenario used in the calculations. The estimated service area of recreation benefits provided by the Reservoir was around 50 Km. The average round trip travel distance and travel time for public non-resident recreationalists was 61 Km and 47 minutes respectively. The estimated value of recreation provided by the Reservoir to the Camp ranged from $185,000 – 206,000 annually depending on the vehicle operating cost used in calculations. The value of recreational ES benefits provided by the Reservoir to the Camp represents 17 – 26 % of the total recreational ES benefits provided by the Reservoir. The average round trip travel distance to the Camp was found to be 70 Km, and the average round trip travel time was 58 minutes. The estimated value of recreational ES benefits provided by the Reservoir to the CYC ranged from $32,000 - $36,000 annually depending on driving cost used in calculations. The value of the recreational ES benefits provided by the Reservoir to the CYC represents around 2 – 3 % of the total value of recreational ES benefits provided by the Reservoir. The average estimated round trip travel distance to the CYC was 46 Km, with round trip travel time of 38 minutes.

The boat launch located in the Town is a vital facility for resident and non-resident recreational users with boats, personal watercraft, and skidoos. The weather was shown to be an influencing factor in the number of boat launches, as was the temperature of the day. The number of launches has declined as of 2008. It is unclear if the decline is due to the fee increase in 2006, or some other external influence like slowdown in the economy occurring in the last few years.

The findings achieve the research objectives. A substantial value for recreational ES benefits provided by the Reservoir was found. Information on the recreational activities, service area, and characteristics of non-resident recreational visitors was also gained. The findings met some expectations but not others. A discussion of the differences between the expected outcomes and findings is presented in the next chapter.

CHAPTER 6

DISCUSSION AND CONCLUSION

6.1. Study summary

The purpose of this study was to gain information on the value of recreational ecosystem service (ES) benefits provided by a multiuse irrigation reservoir located near a large urban centre. The first objective was to estimate the annual value of recreational ES provided by the Chestermere Lake Reservoir (the Reservoir) to the non-resident public visitors to the Reservoir and case study organizations. The second objective was to identify and quantify the recreation activities, service area, and user characteristics of non-resident visitors to the Reservoir.

Water flow patterns in Alberta are changing due to climate change, and further changes expected in the future (AMEC, 2009; Byrne et al., 2006; Nemeth, 2010; Sauchyn & Kulshreshtha, 2008). Past water allocation and management decisions have not included the impact on ecosystem health and provision of ES benefits resulting in reduced amounts of water to meet instream flow needs (IFNs) (AENV, 2007a,b; MA, 2005). Alberta government has begun changing the water allocation system in response to changes in river flow patterns and increasing awareness of the value ES benefits provided by aquatic ecosystems to Albertans. A lack of information on the value of ES benefits has been identified as a barrier to water management change in Alberta and worldwide (AENV, 2007b, MA, 2005). Current Alberta government policy seeks to acquire information to inform decision makers. This study contributes to the available information on the value of recreational ES benefits provided by the Reservoir to aid decision making.

Economic and geographic theories, concepts, and models have developed over time to estimate the monetary value and spatial range of recreational ES benefits. The equimarginal principle and consumer choice theory have been used as a foundation in imputing the value of recreational ES benefits. The willingness to pay (WTP) of people to acquire goods and services that increase the individual’s utility (benefit) subject to time and budget allows the WTP to be a shadow of value (Gomez-Baggethun et al., 2010; Hanemann, 2006; Tietenberg, 2006; Ward & Beal, 2000). Different methods have been used to estimate the value of recreational ES benefits using revealed and stated preferences (Turner et al., 2008; Ward & Beal, 2000; Young, 2005). The reveled preference methods use actual expenditures as a proxy for value and the stated preferences methods use hypothetical questions to establish the WTP (Turner et al., 2008; Ward & Beal, 2000; Young, 2005). Geographic concepts of distance decay and the gravity model have been used to gain insight into spatial characteristics of recreation and other travel (O'Sullivan, 2003; Pacione, 2001; Taaffe & Gauthier, 1973). Distance decay precludes that the benefit of goods and services will be limited by the effort (cost) needed to acquire them (O'Sullivan, 2003; Pacione, 2001). Once the benefit and cost is equal no further travel is undertaken to the recreation site. As such, recreational ES benefits provided by a given location are limited to a finite region. The gravity model is used in anticipating the origin and number of visitors to recreation sites based on the populations and distance between the origin and recreation site (Taaffe & Gauthier, 1973). The combination of a geographic information system (GIS) with economic value methods has shown promise to improve the quality and efficiency of data processing, as well as mapping recreational ES values (Baerenklau et al., 2010; Bateman, 2009: Bateman et al., 2002; Bateman et al., 1999: Bateman et al., 1996; Lovett et al., 1997; Boxall et al., 1996). Maps allow for ES service areas and values to be visually shown instead of only a dollar value.

The methods selected to achieve the research objectives in this study adopts a combined qualitative and quantitative mixed method approach. A quantitative analysis is supplemented by a qualitative discussion to enable information to be collected that may be missed improving the findings of the study, as experienced with previous literature (McNaughton, 1993; Moeller et al., 1980). The qualitative method consists of collecting information from informal conversation and onsite observation of activities. The quantitative method consisted of value estimation models using a combination of a geographic information system (GIS) and the Travel Cost Method (TCM) (GIS-TCM). The GIS-TCM was selected based upon the success of previous studies using this approach (Baerenklau et al., 2010; Bateman, 2009: Bateman et al., 2002; Bateman et al., 1999: Bateman et al., 1996; Lovett et al., 1997). Data collection consisted of a survey and vehicle counting equipment. The survey was deployed face-to face by the researcher and/or a hired assistant onsite for a twelve-month period. The survey queried respondents about postal code, recreation activities, household numbers of adults and children, number of recreation trips to the Reservoir for each month of the year, expenses incurred while onsite, income category, education attainment (high school, trade/diploma, university bachelor, etc.), and employment status (work full time, part time, self employed, retired, etc.). The vehicle counter units collected daily vehicle count data over the same twelve-month period the surveys were deployed. The daily count data was portioned using three scenarios representing non-resident recreation visits. The portions were aggregated with average trip cost data from the survey to arrive at the estimated annual value of recreational ES benefits provided by the Reservoir to non-resident public visitors. Estimating the value of recreational ES benefits for the case studies of Camp Chestermere (the Camp) and the Calgary Yacht Club (CYC) utilized separate GIS-TCM models. Some information on the characteristics, origins, and spending of Camp and CYC users was not available for this study. Data from the survey and the 2006 Census were used in lieu of actual data for the Camp and CYC value estimates.

The findings of the qualitative discussion revealed that social events in the Town and two case study organizations greatly add to the value of the recreational ES provided by the Reservoir. Informal conversation with non-resident attendees to events hosted by the Town revealed that they were highly valued even drawing in people from outside Alberta that do not routinely use the Reservoir for recreation. The additional qualitative information shows that the quantitative finding for the value of recreational ES benefits provide by the Reservoir is a lower bound estimate.

The findings of the quantitative analysis for the public surveys revealed that on average respondents earned \$60,000 - \$70,000 annually, the majority had a post secondary education (73%), and the majority worked full time (59%). The majority of survey respondents made 1 – 5 trips each year to the Reservoir. The average round trip distance was found to be 60 Km with a round trip travel time of 46 minutes. The vast majority of non-resident recreationalists (~85%) were from Calgary. The finding for the estimated total value of recreational ES benefits provided to day users by the Reservoir was $794,000 - $980,000 annually.

The findings of the Camp analysis revealed an estimated average income of $45,766 annually for program users based on census data. The majority of Camp program users originated from Calgary (71.7%). The average round trip travel distance was found to be 70 Km taking an average of 58 minutes to complete. The average cost of using Camp programs was $261 - $336 for day program users, and $362 - $387 for overnight program users depending on the vehicle operating cost used in the calculations. The estimated value of recreational ES benefits provide by the Reservoir to the Camp was found to range from $185,000 - $206,000 annually depending on the vehicle operation cost used in calculations.

The findings for the CYC analysis revealed an estimated average annual income of $41,303 based on the census data and postal codes selected to represent the estimated non-resident CYC members. The average distance travelled by the estimated non-resident CYC members was found to be 46 Km taking an average of 38 minutes. The average cost of membership to the estimated non-resident CYC members ranges from $476-546 depending on the driving cost used in calculations.

6.2. Discussion of findings

The quantitative findings of this study were in line with some of the expected outcomes. The expectation that the recreational ES provided by the Reservoir has a finite service area was met in this study (Figure 5.8), and the expectation for the travel distance was not met. The travel distance for a round trip was expected to be 120 Km (60 Km one-way). The finding for travel distance was around half of the expectation at 60 Km for a round trip (30 Km one-way). Previous studies reviewed when formulating the expected outcomes included information from multiple recreation sites with different amenities or used aggregate data in calculations (Chapter 4). McNaughton’s (1993) study included day use recreation taking place at multiple reservoirs with multiday facilities (overnight camping), and further from locations with large populations. Statistics Canada (2003) and Clawson & Knetsch (1966) use aggregated recreation travel data that does not specify the recreation activities or sites visited. The differences in data and study sites in previous studies served to inflate the expected average travel distance. The expectation that the majority of non-resident recreation visitors would originate from Calgary was met with the application of the gravity model to communities within 50 Km of the Reservoir agreeing with findings. The expectation was that the majority of non-resident recreation visits would be day use was met with around 93% of survey respondents reporting the trip was day use.

Results were mixed when comparing findings and expected outcomes with respect to the dependence of the number of trips per year and participation in recreation activities[4] on income, educational attainment[5], and employment status[6] using the Crosstab Pearson Chi^2 (χ^2) in IBM SPSS 19 (2010) (Chapter 5). The finding for the dependence of the number of trips per year on income met expectations. The finding for the dependence of participation in recreational activities on income was not met. The finding for the dependence of the number of trips per year and participation in recreation activities on the employment status was not met. The finding for the dependence of the number of trips per year and educational attainment was met. The finding for the dependence of participation in recreation activities was not met with the exception of snowmobiling.

The discrepancy between the expected outcomes and findings for the demographic characteristics can be attributed to differences in the available amenities at recreation sites, number of nearby alternate recreation sites, type of data used, and analysis procedures used in the previous literature. The study sites in Boxall et al. (1996), McFarlane & Boxall (1998), and McNaughton (1993) offered multiple campsite options. The study site for Chizinski et al. (2005) offered multiple boat launch facilities at three different sites. When alternate site and amenity options are close those with a higher income, post-secondary education, and full time employment may have a preference for one location over other allowing patterns to be detected. The Reservoir has only one publicly available launch and no other alternate day use locations a short distance away.

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[4] Recreation activities include skating, Nordic skiing, snowmobiling, swimming, boating, fishing, personal watercraft use (JetSki/SeaDoo), walking, scenic viewing, and biking

[5] Educational attainment includes less than high school, high school, diploma or trade (journeyman), bachelor's degree, certificate or diploma above bachelor's degree, and a masters or Ph.D.

[6] Employment status includes unemployed (unpaid and paid (leave)), part time (under 40hrs/week), full time (40 or more hrs/week), self employed/farm, and retired

As such, recreational users of all income levels, educational backgrounds, and employment status are forced to use the same facilities preventing the influence of the demographic characteristics from being statistically significant. The location of the Reservoir as a recreation site offers another explanation. The closeness of the Reservoir to the city of Calgary where the majority of non-resident visitors originate likely provides a draw strong enough to mute any effects of income, employment status, and education.

Table 6.1: Comparison between findings of this study and previous studies valuing recreational ES from reservoirs

Author(s) (Year)	Location	Aspect Studied	*Value Estimates ($CAD)
Current Study	Chestermere Alberta	General recreation taking place on or near the Reservoir and at case study sites (Camp Chestermere, Calgary Yacht Club (CYC))	$0.794 - $0.98 Million annually [1]Avg. of $50 - $68 per trip (public) [1,2]Avg. of $261 - $336 (Camp day Program) [1,2]Avg. of $362 - $387 (Camp overnight Program) [1,2]Avg. of $476 - $546 per season for CYC
Taylor et al. (2010)	Washington, USA	Sport fishing on Snake River Reservoirs	~$21 - $47 per trip. ~$1.35 - $2.1 Million annually
Chizinski et al. (2005)	Texas, USA	Fishing at the Lake Kemp Reservoir	~$114 - $230 per trip
McKean et al. (2005)	Washington, USA	Picnicking, camping, boating, water skiing, and swimming at the Lower Snake River Reservoirs	~$5 - $12 per trip. ~$0.23 – $2.3 Million annually
Ward et al. (1996)	California, USA	Change in recreation value as water level rises/lowers	$8 - $825/ Acre-foot rise in level
McNaughton (1995)	Alberta, Canada	Fishing and hunting in or near reservoirs in southern Alberta	~$120 per person Annually (Fishing) ~$170 per person Annually (Hunting) ~$5.3 Million annually (Fishing) Annual hunting N/A
McNaughton (1994, 1993)	Alberta, Canada	General recreation at southern Alberta irrigation reservoirs with formal recreation facilities	~$26 - $97 spent per day trip. ~0.027 -$1.5 Million Spent annually

*Dollar values adjusted to 2012 values where needed using the Bank of Canada (2012b) inflation calculator. Exchange rate between the Canadian and US Dollar is approximately 1-to-1 at the time of this thesis (Bank of Canada, 2012a)

1. Dependant on vehicle cost used in calculations

2. Forms part of total recreation value calculations when avg. program (Camp) or seasonal cost (CYC) is combined with the number of non-resident users.

The finding for the total annual value of recreational ES benefits provided by the Reservoir is generally in line with previous studies (Table 6.1). The value estimates are sensitive to the choice of vehicle cost and vehicle count data portion scenarios used to representing non-resident recreation visits. The finding for total value of recreational ES provided by the Reservoir is based on the Canadian Automobile Association (CAA, 2011) large vehicle class variable operation cost. As noted in chapter 4, the selection of the CAA (2011) large vehicle variable operation costs was based on observations of the type of private vehicles used by the majority of recreationalists visiting the Reservoir.

6.3. Study implications

6.3.1. Methodological implications

The methodological contribution of this study is showing that a combined qualitative and quantitative (mixed method) approach, and the combination of a geographic information system (GIS) with the travel cost method (TCM), can be successfully applied to value recreational ES provided by water infrastructure in southern Alberta. As discussed in chapter 3, social and behavioral science literature increasingly uses the mixed method approach due to improved information and insight gained versus a quantitative or qualitative approach alone (Johnson & Christensen, 2012; Neuman & Robson, 2012; Lopez-Fernandez & Molina-Azorin, 2011; Onwuegbuzie & Leech, 2005; Johnson & Onwuegbuzie, 2004). The use of mixed method research in recreational ES valuation literature is scant to date with the vast majority of recreational ES valuation literature applying a quantitative approach to estimate values for ES benefits. A search of ISI Web of Science (2012) using the keywords “mixed method”, “qualitative”, and “quantitative” for the topic fields on May 3, 2012 returned 1777 studies. None of the Web of Science (2012) search results as a mixed method study were for valuing recreational ES benefits.

Table 6.2: Matrix of mixed method research approaches

		Time Order Choice and Order of Method Application	
		Concurrent	**Sequential**
Balance of Influence Between Methods	**Equal**	Qualitative & Quantitative	Qualitative ➔ Quantitative Quantitative ➔ Qualitative
	Dominant	**Qualitative** & Quantitative Qualitative & **Quantitative**	**Quantitative** ➔ Qualitative Quantitative ➔ **Qualitative** **Qualitative** ➔ Quantitative Qualitative ➔ Quantitative

Bold represents which of the methods contributes more to answering the research question in a given study (dominant), and the "**➔**" or "**&**" indicates time flow between application of methods.

Example 1: (**Quantitative** ➔ Qualitative) is a study where the qualitative portion is contributes more to answering the research question (is dominant) versus the qualitative component, and the data collection and analysis for the quantitative portion is completed before the qualitative portion.

Example 2: (Qualitative & Quantitative) is a study where the Qualitative & Quantitative portions equally contribute to answering the research question with data collection and analysis for both portions taking place at the same time.

Adapted from Johnson and Onwuegbuzie, 2004

The application of the mixed method approach has several possible directions that a researcher can choose from (Table 6.2). Choices by the researcher determine the balance and dominance of the quantitative and qualitative portions of the study to best answer the research topic (Johnson & Christensen, 2012; Neuman & Robson, 2012). This study utilized a dominant quantitative primary analysis supplemented by a qualitative discussion (chapter 4). Data collection for the quantitative and qualitative components of the analysis occurred at the same time and would fall under the "Qualitative & **Quantitative**" within Table 6.2.

As noted in chapter 3, methods that have been developed to estimate the value of recreational ES benefits including the Hedonic Price Method (HPM), Random Utility Model (RUM), and TCM. Previous studies valuing recreational ES benefits have also shown the benefit of combining a GIS with the TCM (GIS-TCM approach) or HPM (GIS-HPM approach) to improve the precision of measurements, and reduce processing time (chapter 3). The literature review for this study revealed that previous studies have not used the GIS-TCM approach to value recreational ES benefits from irrigation infrastructure in southern Alberta. Studies using the GIS-TCM approach are from other jurisdictions or do not study southern Alberta reservoirs (Baerenklau et al., 2010;

Bateman, 2009; Bateman et al., 2002; Bateman et al., 1999; Bateman et al., 1996; Boxall et al., 1996; Lovett et al., 1997; McFarlane & Boxall, 1998; McNaughton, 1994, 1993).

6.3.2 Practical and policy implications:

The practical and policy contribution of this study is providing new information to aid in achieving Alberta government policy goals and inform decision makers, water transfer participants, and water infrastructure managers on the recreational value of ES benefits provided by the Reservoir. As discussed in Chapter 2, Alberta uses cumulative effects management (CEM) and an ecosystem services approach (ESApp) at the heart of policy development (AENV, 2012a). The water for life (WFL) Strategy and the Land Use Framework (LUF) are two key policy directives of the Alberta government aimed at changing water allocation and land management to ensure ecosystem health is protected, thereby protecting the ES benefits they provide (AENV, 2008a, 2003; Alberta, 2008). Regulators require information to ensure the proposed transfers are legal and do not pose an unacceptable impact to ecosystem health and loss of ES benefits (Water Act, 2000, s. 82). Acquiring information on the value of ES benefits has been identified as a key policy action of the WFL Strategy and LUF (AENV, 2008a, 2003; Alberta, 2008). The findings of this study can be used in conjunction with other work to inform decision makers when approving transfers, developing management plans, or updating current policy.

Past research on market style water transfers in Alberta shows that information on the value of water for different uses is lacking creating a barrier to participation in transfers (Nicol et al., 2008; Nicol, 2005). Water allocation transfers to meet water conservation objectives (WCOs) and maintain ecosystem health have not occurred to date (Kerr & Bjornlund, 2010; Nicol, 2005). Future water market activities will likely include transfers for meeting WCOs. The findings of this study can inform water transfer participants of the potential value of recreational ES benefits provided by reservoirs, or guide development of their own studies to obtain information for negotiating prices.

Water infrastructure management in Alberta is an increasingly complex and challenging task. Water infrastructure provides water for hydropower, municipal (domestic), recreation, and ecosystem health uses. To manage this infrastructure and balance these three needs when allocating water managers need information about the value of water in the different uses (AENV, 2004; IWMSC, 2002; AARD, 2000). Water level drawn down during the peak recreational season has potentially devastating effects on recreational ES provided by the Reservoir. The findings of this study can assist water infrastructure operators in Alberta and other jurisdictions to understand the potential outcomes of operation plans and ensure that recreational ES benefits provided by reservoirs are given due consideration.

6.4 Limitations and recommended future research:

The findings of this study are substantial, however there are limitations. The transferability of the findings of this study to other reservoirs in southern Alberta must be done with caution for a few reasons. The first is the location of reservoirs relative to populations willing to pay (WTP) to access the recreational ES provided. As discussed in chapter 3, a key component driving the value of an ES is the WTP of people to obtain it (Hanemann, 2006; Tietenberg, 2006). The Reservoir is located close to Calgary and its large population. Other southern Alberta reservoirs are located near communities much smaller than Calgary. As such, the value of the recreational ES benefits will be lower than the findings of this study. Secondly, the service area and visitor characteristics of multiday recreation site differ from a day use site (McNaughton, 1993). Many of the reservoirs in southern Alberta have facilities for multiday stays, and are visited by both day users and multiday users (AIPA, 2011; McNaughton, 1994, 1993). McNaughton (1993) found the travel distance for day use recreationalists was around 56 Km one-way, whereas campers (multiday users) travelled an average of around 128 Km one-way The service area for a multiday recreation site is therefore greater than an equivalent day use only site. The third reason is that recreational ES value is dynamic and will change over time. For example, the value of the recreational ES benefits provided by the Reservoir was so low in McNaughton's (1993) study it was grouped together with other sites so that value findings could be reasonably compared with other reservoirs. However the value of recreational ES benefits provided by the Reservoir has increased substantially over time as found in this study (chapter 5). The value of recreational ES benefits provided by the Reservoir will continue to change over time due to expected changes to precipitation, water flow patterns, and population growth increasing water scarcity and competition between use sectors.

Future study of the value of all ES benefits provided by each southern Alberta reservoir is needed to best inform decision makers, water infrastructure managers, and water market participants. Additionally, research to update the value estimates for the recreational ES provided by the Reservoir is recommended in coming years to ensure available information is current.

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Appendix A: Intercept Survey

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Economic Valuation of Environmental Goods and Services: Chestermere Lake Recreation

You are invited to participate in a very brief survey about the value of recreational activities at Chestermere Lake. This project seeks to determine the value of Chestermere Lake for recreation as part of a larger study on the economic value of Environmental Goods and Services (ES). ES are the benefits the environment to humankind such as food, climate control, and recreational opportunities. Information and findings from the survey will be presented in an aggregate form in a Master's Thesis. Policy makers will use this information to develop policy to meet the goals of the Water for Life (WFL) Strategy. The Alberta Water Research Institute (AWRI) is funding this and other projects in the ES valuation study.

There is no risk to you in participating in this survey and no direct personal information is needed. The survey is very brief and will take 1-3 minutes to complete. The survey consists of questions about hometown and postal code, distances traveled to Chestermere, expenses of being at Chestermere, and general demographic information. Your name, phone number, email, home address, or other identifying information are ***not*** required as part of this survey. Participation in the survey is completely ***voluntary*** and you can withdraw at any time during the completion of the survey. Once completed and returned to the researcher, the information will be added to the study and cannot be retrieved later due to the lack of identifying information on surveys. Questions regarding your rights as a participant in this research may be addressed to the Office of Research Services, University of Lethbridge (Phone: 403-329-2747 or Email: *research.services@uleth.ca.* If you choose to withdraw from the survey, your survey will be excluded from the study and destroyed.

Further information about this project or other projects of the AWRI can be found at www.waterinstitute.ca, contacting the researcher at *r.bewer@uleth.ca*, or co-researcher at *Henning.Bjornlund@unisa.edu.au*. By completing this survey you agree that you have read and fully understand the above information, and provide consent to participate in the survey. Thank you for your participation in the survey. Your contribution is greatly appreciated.

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Hometown: ___________ Province: ___________ Postal Code: ______________
If not Canadian: Country: _______________________, State or City: _________________

1) What is the distance travelled to get to Chestermere Lake? __________(Km)

2) How many people are: in your vehicle ___________, adults in household ________, children < 5 _______, children 5-9 ________, children 10-14 _______, children 15-17 ________

3) Is your visit to Chestermere for one day only; that is, you return to your home tonight? If yes, proceed to question 6. ☐ Yes, ☐ No

4) Where do you stay while participating in recreational activities in Chestermere?
☐ Hotel in Calgary
☐ Other accommodation
☐ With family or friends in Chestermere
Distance between accommodation and Chestermere: _____

5) How many days will you stay in or near Chestermere to use the Lake? _________________________

6) Please indicate the number of trips to Chestermere during each of the last 12 months when the lake was used for recreation?

Jan. ___________	Apr. ___________	Jul. ____________	Oct. ___________
Feb. ___________	May. __________	Aug. ___________	Nov. ___________
Mar. ___________	Jun. ____________	Sept. __________	Dec. ___________

7) Please indicate the types of recreational activities that you participated in (Select all that apply).

kating	☐ Swimming (by boat and on shore)	☐ Walking/hiking
ross Country/Nordic Skiing	☐ Boating (including waterskiing)	☐ Scenic viewing
howmobiling	☐ Fishing (by boat and on shore)	☐ Biking
	☐ Jet Ski/Sea do	

8) Do you use the John Peake park boat launch for launching equipment (ie: Boat, Skidoo, Sea Doo, Quad)? ☐ Yes, ☐ No

9) Please list the top three destinations you may also use for similar recreational activities.
___________________________________ ________________________________
____

10) Total on-site expenses for food and lodging
(If applicable, day use would have no lodging costs)
$ __________________________

Total employment wages lost to participate in recreation at Chestermere.
$ ______________________________

Total expenses on souvenirs, permits, licenses to use Chestermere lake (ie: boating license)
$ __________________________

Annual Household Income[7]	Highest Education Level completed	Employment status:
☐ Under $30,000	☐ No certificate, diploma or degree	Unemployed (unpaid) _________
☐ $30,001 - $40,000	☐ Secondary (high school) diploma or equivalency certificate	(incl. Leave, maternity)
☐ $40,001-$50,000	☐ College or other non-university certificate or diploma (Incl. trade certificate)	Unemployed (paid) _________
☐ $50,001-$60,000	☐ University – Bachelor's Degree	(incl. leave, maternity)
☐ $60,001-$70,000	☐ University – Certificate or diploma above Bachelor level	Part time (<40 hrs/week) ________
☐ $70,001-$80,000	☐ University – Master's or PhD degree	Full Time (40 + hrs/week) _______
☐ $80,001-$90,000		Self-employed/Farm _________
☐ $70,001-$80,000		Retired _________
☐ $80,001-$90,000		
☐ Over $90,000		

[7] Income ranges based on Statistics Canada Economic Family Income Ranges, 2001 Census data from Ranges truncated to fit survey and income ranges based on median income level of $55, URL: http://www12.statcan.ca/english/census01/Products/Analytic/companion/inc/canada.cfm#6 .