2011

Recreational Value of Irrigation Infrastructure

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Keywords: Environmental Services, Irrigation Infrastructure, Water Management, Recreation Value

Abstract:

Increasingly irrigation infrastructure is serving multiuse demands such as urban (domestic), industrial, agricultural (irrigation), and Ecosystem Services (ES) provision such as recreation opportunities. Economic growth and forecasted decreases in water supplies are challenging water managers to balance ecosystem protection with economic goals. The Alberta government looks to revamp water allocation and management from the previous century old system toward a more market based allocation system. There is limited understanding of the values of the ES from irrigation reservoirs that provide recreational opportunities which would form the Willingness to Pay (WTP) by government in a market system. This paper overviews a current research project which is underway seeking to address the information gap on the value of ES for recreation, using the Chestermere Lake Reservoir near Calgary as a case study. Many ES have no established markets to set prices due to their public goods nature. Rigorous analytical methods have developed within the economic literature over the last 50 years to infer the value of non-market goods. Two main categories have emerged: i) Revealed Preference (RP) methods which assess real expenditure data to determine WTP; and ii) Stated Preference (SP) methods which utilize hypothetical survey data to determine WTP. Additionally there is an increase in the use of Geographic Information Systems (GIS) with the RP and SP methods to better capture spatial aspects of ES. The analysis of recreational use value currently underway at Chestermere Lake is going to combine the use of GIS with Travel Cost Method (TCM). The TCM is an established RP method that has numerous applications to recreational ES valuation in literature. The background, current problem, theoretical context, study site, and expected results and implications of current work are overviewed. Preliminary results from data collected to date are reported showing initial characteristics of participants including origin, travel distance, income, and education level.

1. Introduction:

Recreational opportunities provided by irrigation infrastructure are an important contributor to human quality of life and culture, as well as an economic benefit to the surrounding area from recreational based spending (Kulshreshtha et al., 2006; AARD; 2000; McNaughton, 1993; ARPA, n.d.b). However, water scarcity combined with increasing demand from population and economic growth potentially threatens the aquatic systems that provide Ecosystem Services (ES), one of which is recreational opportunities (Byrne et al., 2010; Grinder, 2010, AENV, 2007b). Southern Alberta's water reservoirs serve multipurpose demands with many reservoirs providing recreational based ES alongside traditional economic interests (IWMSC, 2002; AARD, 2000; McNaughton, 1993).

Over time economists and policy makers have recognized the need to incorporate non-market ES into economic accounting giving rise to methods of establishing the value of non-market ES (Tietenberg, 2006). These methods establish values for non-market ES by using the neoclassical economic theories of marginal decision-making and consumer choice to establish Willingness to Pay (WTP) (O'Sullivan, 2003). Alongside the economic principles there are geographic principles such as central place theory to show the spatial extent and patterns of non-market ES value (O'Sullivan, 2003, Pacione, 2001). Both the economic and geographic nature of non-market ES is needed to estimate sound values (Kozak et al., 2011; Bateman et al., 2002).

The Alberta government recognizes the need for change as the current water management system was designed more than a century ago during a time when no water shortages loomed (Kerr and Bjornlund, 2010; AENV, 2003). Among the management options is the use of markets to reallocate water to higher value uses that shows promise to achieve the goal of ES protection while ensuring economic growth (Brooks and Harris, 2008; Horbulyk and Lo, 1998). The use of market is the favoured management strategy for the Alberta Government (AENV, 2009; AENV, 2003). Information on the non-market value of water for ES such as recreation is needed for water managers to justify management decisions (Kerr and Bjornlund, 2010; AENV, 2003). The government can also use the information to establish WTP when entering water markets to acquire allocations to meet *Water Conservation Objectives* (WCOs), which include recreation (AENV, 2010).

The results of our current work are expected to show a strong positive relationship between distance and non-resident recreation value for Chestermere Lake within a defined geographic area. It is also expected to establish links between socioeconomic characteristics and type of recreational activity as well as the WTP. The proposed work compliments other work being done in Chestermere that is looking into local value of the reservoir for town residents by examining differences in real estate prices depending on distance and direct access to the water. Early results of the local study show a strong positive relationship between real estate prices and being near or on the water (Kim, 2011). The combination of the resident and non-resident studies is expected to show a large value for recreation at Chestermere Lake.

This paper is organized as follows. Section 2 provides the problem description in further detail with respect to Alberta's water management issues. Section 3 overviews the background of the proposed work with reviews of the historical development of the water infrastructure, water regulation, and growing conflicts in Alberta. Section 4 provides the conceptual framework that reviews the economic and geographic theories and methods of valuing non-market ES used for the proposed work. Section 5 describes the study site including its history and suitability for the proposed work. Section 6 details the methods used for data collection and analysis. Section 7 describes the expected results, benefits, and early findings of the work. Section 8 has concluding remarks.

2. Problem Description:

There are double threats to Alberta's water and non-market ES. The first is from climate change reducing amounts of water from the mountains that feed Alberta's rivers along with greater variability in water volumes (Grinder, 2010; Byrne et al., 2006). The second is increasing demands for water from both traditional economic sectors and non-market sectors as the economy and population grow (Grinder, 2010; AENV, 2007a,b). Studies using forecast models show decreasing trends in water supplies (Byrne et al., 2006), increases in demand (Grinder, 2010), and decline in health of aquatic ecosystems (AENV, 2007a,b). Reductions in the quantity and quality of water place the supply of ES at risk, and are predicted to negatively impact recreational opportunities in the future (AENV, 2007b). The policy response to the water management problem in Alberta is found in the *Water for Life (WFL) Strategy: Alberta's Strategy for Sustainability* (2003) and *WFL Action Plan* (2009) from Alberta Environment (AENV). Acquiring the information needed to make scientifically based decisions about water allocation and management is a key component of the *WFL Strategy* and *WFL Action Plan* (AENV, 2009; AENV, 2003).

The closure of the South Saskatchewan River Basin (SSRB) to new allocations, and establishment of WCOs for each sub-basin are among the actions taken in response to the issue of decreasing water availability (AENV, 2010; AENV, 2006). The WCOs were created to secure ecosystem health and thereby protect tourism, recreation, transportation, and assimilative ES (AENV, 2010; AENV, 2006). Market based allocation transfer is an allocation mechanism that is available to water managers to achieve WCOs that shows potential to increase benefits of water use over command-and-control management (Brooks and Harris, 2008; Horbulyk and Lo, 1998). The closure of the SSRB to new licenses provides the catalyst for the use of water markets and is the favoured management option of the Alberta government (Bjornlund, 2010; AENV, 2003). However there is little understanding of the value of non-market ES from irrigation reservoirs to compare with traditional water use sectors when determining the WTP for allocations to meet WCOs. The participants in transfers to date report lack of information on prices of water as one of the barriers to participation in market transfers (Nicol et al, 2008; Nicol, 2005). As such, information is needed to establish the WTP by the government to achieve WCOs when competing against bids from other use sectors. The continued presence of the information gap will pose a barrier to water management changes and reversing the projected negative trends in recreational benefits.

3. Background:

Southern Alberta's irrigation infrastructure first developed in the late 19th and early 20th centuries to encourage settlement and economic development (IWMSC, 2002; AARD, 2000). Over time irrigation infrastructure is increasingly being used to supply water for multiple uses including hydropower, municipal (domestic), recreation, and ecosystem health (AENV, 2004; IWMSC, 2002; AARD, 2000). Ownership of most irrigation headworks went to the province of Alberta in 1975 remaining so today, with the province operating the headworks for 11 of the 13 irrigation districts (AMEC, 2009; IWMSC, 2002). Alberta environment owns and operates 11 storage reservoirs in addition to the head works that supplies water to district works (AIPA, n.d.a). The storage reservoirs provide recreational opportunities throughout southern Alberta where such opportunities would be scarce otherwise (Figure 1; McNaughton, 1993).

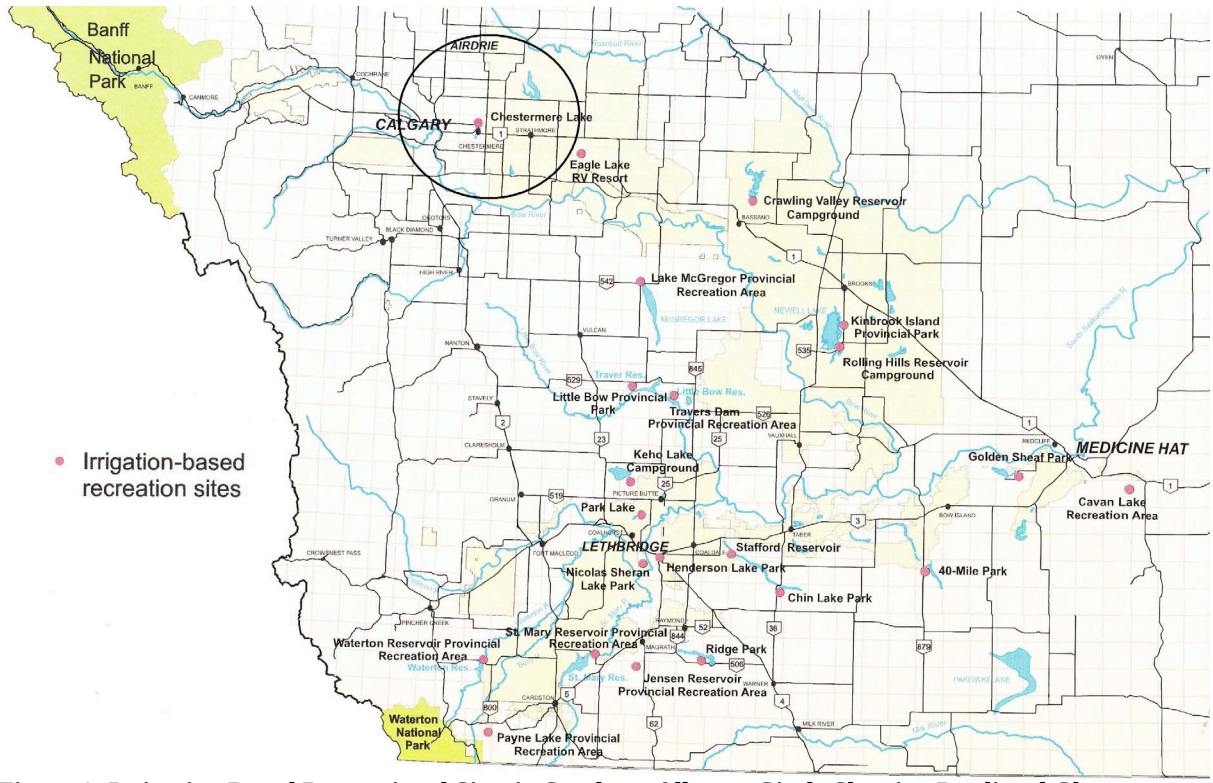

Figure 1: Irrigation Based Recreational Sites in Southern Alberta. Circle Showing Predicted Chestermere Service Area. Adapted from AIPA (2011).

Alberta's water regulation currently falls under the *Water Act* (2000) (the Act). The Act maintains aspects of its predecessors including the crown ownership of all water in Alberta, and the requirement of a license for withdrawing water (Water Act, 2000). Historically, the *Northwest Irrigation Act* of 1894 changed how water is managed by i) suppressing the doctrine of riparian rights in declaring all water as owned by the crown; ii) requiring a license to have the right to withdraw water, and iii) introduced the First in-Time-First-in-Right (FITFIR) principle (Block and Forrest, 2005). In 1930 the Government of Alberta took over management of water resources in the province from the federal government with the passing of the *Water Resources Act* (1931). The *Water Resources Act* carried over and consolidated the FITFIR principle (Block and Forrest, 2005). The current Act replaced the *Water Resources Act* in 1999 and was revised in 2000 (Block and Forrest, 2005, Water Act (2000)). Part of the driving force behind the above legal changes is the potential for an increase in the number of conflicts over access and use of water (Block and Forrest, 2005).

The double threat to water supplies described above combined with ambiguity in laws and regulations are expected to generate conflicts as scarcity intensifies (Block and Forrest, 2005). Examples of the conflict over water include court cases over access rights to water in Chestermere Lake (WID vs. Craddock et al., 1999; WID vs. Trobst et al, 1990), the Balzac development just north of Calgary that includes the new Cross Iron Mills Mall (Beveridge, 2008; FFWD, 2007), the amendment of irrigation district licenses to provide more flexibility to supply water to non-agricultural users, and the use of freshwater by the oil and gas industry for petroleum production (Block and Forrest, 2005).

The main problem is the incorporation of most ES values in markets, which has traditionally been difficult to evaluate due to the public good nature of water and most ES (King, 2007). The benefits provided by ES are typically not included in management plans due to poor understanding of the social benefits that has lead to changes or losses in ES supplies yielding substantial costs to society in some cases (King, 2007; MA, 2005a). Non-Market ES is defined as the benefits to human quality of life and well being from ecosystem processes that do not have established markets that capture their value (Tietenberg, 2006). Non-market ES fall into the categories of provisioning, regulating, and cultural services (MA, 2005a). Recreation falls into the category of cultural services

(MA, 2005a), and is one of the non-market ES provided by irrigation reservoirs (IWMSC, 2002; AENV, 2000). Recreation participation is expected to continue to increase into the future (ARPA, n.d.b; MA, 2005a).

4. Theoretical Framework:

Including nature in economic theory has evolved over the last 350 or so years (Gomez-Baggethun et al., 2010). However, only since the 1960s has the incorporation of ES into economic theory really expanded as a consideration in decision making (Gomez-Baggethun et al., 2010; Hein et al., 2006). Classical economists of the 17th to 18th centuries separated ES from the market system based on the notion of value being from labour-based production (Gomez-Baggethun et al., 2010). Here the extraction of raw inputs from the environment (ie: mining, harvest, etc.) and their transformation into goods by labour is the valued portion of the economic system, not the ES that produced the raw materials (Gomez-Baggethun et al., 2010). Aspects of what is now known as ES appear in classical work recognizing that there are aspects of nature that cannot be reproduced and that using land should be given a rent value (Mill, 1899; Smith, 1776)

Neoclassical economics laid the foundations for the "Equimarginal Principle" that holds that the level of an activity will be chosen such that the benefits and costs are equal at the margin (Tietenberg, 2006; O'Sullivan, 2003). Should benefits be greater than costs of a good or service then one chooses more, and if benefits are less than costs one chooses less of a good or service (O'Sullivan, 2003). Consumer Choice Theory holds that rational individuals with limited time and income purchase goods and services to maximize their utility (Young, 2005; Ward and Beal, 2000). However, most ES are public goods that are non-rival and non-excludible with no markets to reveal prices (Tietenberg, 2006). The above concepts of the equimarginal principle and consumer choice theory can be applied to estimate the WTP in the absence of a market (Tietenberg, 2006). In the case of recreation, one equates the marginal benefit (utility) of recreation (MU_R) and the Marginal Costs (MC_R) of participating in recreation subject to budget (Y_r) and Time (T_r) constraints as in eq. (1).

$$MU_R = MC_R \Big|_{Tr,\, Yr} \qquad (1)$$

The measures of utility levels like equation (1) are based on Marshallian assessments that evaluate utility changes that are easier to estimate (Young, 2005). Hicksian measures of benefit using dollar amounts are more applicable to market transactions, and the two need to be reconciled to allow for dollar figures to be attached to utility levels (Young, 2005). Young (2005, p. 33) argue that for goods and services that make up smaller portions of a household's budget, such as recreation, the Hicksian and Marshallian values are acceptably close. This comparable equality allows for the estimation of values for non-market ES based on equation (1) to be expressed in dollars. The challenge is to establish scientifically defendable methods of obtaining cost data for the right hand side of equation (1) that can reveal the utility (benefit) gained by users of non-market ES for recreation. The Revealed Preference (RP) and Stated Preference (SP) methods are two families of non-market valuation methods that meet this challenge by using differing scientifically defensible techniques to obtain the cost data needed to arrive at a benefit estimate for the right hand side of equation (1) (Tietenberg, 2006). The RP methods use actual expenditure information to estimate the value of the non-market ES (Young, 2005; Ward and Beal, 2000). The Travel Cost Method (TCM) is a well established RP method that utilizes the property that participation in recreation at sites like national parks incurs costs that are necessary and unavoidable (Hanink, 1995). The equimarginal principle and consumer choice theory above hold that the rational recreationalist would incur costs up to the benefit derived from the activity at the margin. As such, the total costs (TC) incurred by participating in recreation are equal to the total benefits of the trip (U_R) as in equation (2) after summing marginal benefits (Tietenberg, 2006; Young, 2005; Ward and Beal, 2000).

$$U_R = TC\,(p_t, p_{os}, p_v) \Big|_{TR,\, YR} \qquad (2)$$

Here TC is a function of p_t (opportunity cost of leisure time), p_{os} (on site expenses), and p_v (round trip vehicle operation costs), Y_R is the budget constraint for recreation, and T_R is the time constraint for leisure. Equipment costs are typically taken as the rental costs if equipment is obtained on-site for a given trip included in (p_{os}) variable (Parsons, 2003). The equipment costs are generally taken to be negligible for those who own their own equipment and use it at multiple sites over many years (Parsons, 2003).

The SP methods rely on presenting survey participants with hypothetical market scenarios involving changes in ES, recreation site characteristics, and other characteristics that reveal the WTP to achieve a higher benefit or avoid a cost/loss (Whitehead et al., 2008; Adamowicz et al., 1994; Cameron, 1992). The equimarginal principle then allows for the WTP to be equated to the utility (benefit). The Contingent Valuation Method (CVM) is an established SP method that elicits preference information about changes in ES (or other study aspect) and the WTP to achieve the

changes, or avoid changes if effects are negative (Whitehead et al., 2008; Young, 2005; Adamowicz et al., 1994). There are three requirements for CVM including a description of the ES to be valued, choice questions about ES changes and their anticipated benefits (or costs) if chosen, and questions about the respondents themselves such as age, income, etc. (Young, 2005). Regression estimates are then used to obtain the estimated value (Young, 2005). The methods of measuring non-market ES all have strengths and weaknesses depending on the scope and context of measurement (Abaza and Rietbergen-McCracken, 1998).

Over time there has been increasing recognition of the spatial aspects of ES (Kozak et al., 2011; Hein et al., 2006; Bateman et al., 2002). All ES are spatial in their benefits to human quality of life with some ES providing benefits to a larger area than others (Kozak et al., 2011; Bateman et al., 2002; Pacione, 2001). This spatial aspect of ES allows for geographical analysis to play a role in the overall economic analysis. The Central Place Theory (CPT) describes the spatial patterning of locations providing the same goods and services such that costs are minimised in travelling to obtain those goods and services (O'Sullivan, 2003; Pacione, 2001). The CPT holds that a location providing goods and services will have a limited range (Market Areas) due to costs associated with travel, opportunity cost of time, and physical effort (O'Sullivan, 2003; Pacione, 2001). Reservoirs provide a bundle of ES that fits the CPT description of a location that will have a limited "market area" where the benefit of accessing the site cannot compensate for the costs of travel and associated expenses (O'Sullivan, 2003; Pacione, 2001). As such, recreational sites are functionally "central places" to the population's WTP to obtain the recreational benefits from the site.

The dual geographic and economic properties of ES at recreational sites allows for the value of recreation to be shown spatially in maps as well as the numerical dollar value (Baerenklau et al., 2010; Hein et al., 2006). Studies using the RP methods of non-market value estimation have begun using Geographic Information System (GIS) to incorporate spatial aspects more accurately (Baerenklau et al., 2010; Bateman et al., 2002). The use of a GIS with the TCM has increased due to the combination being able to provide greater accuracy in value estimates (Baerenklau et al., 2010; Bateman et al, 2002;). The evaluation of non-market ES benefits requires both the estimation of the dollar figure, and examination of the spatial properties of ES value to obtain a better understanding of the implications of policy change (Bateman et al, 2002; Hanink, 1995).

5. Study Site:

The study site is the Chestermere Lake Reservoir (the Reservoir) near Calgary. This site is an optimal choice due to the close proximity to Calgary with a population of around 1,071,515 (City of Calgary, 2010), a history of multiuse demands, and past conflicts over access to the water (Owel, 1994; WID vs. Trobst, 1990). Sites with comparable amenities are an hour or more drive from Chestermere leaving Chestermere as the nearest day use water body near Calgary, Strathmore, and Airdrie (Little, Frank. 2011. Interview by Author, Chestermere AB. 08-Apr-2011). The lack of other sites isolates Chestermere Lake as a recreational hot spot for the Calgary region shown by the circled region in relation to other recreation sites in Figure 1. Surrounding the Reservoir is the Town of Chestermere with a population of 14,285, and over 300 lots with direct access to the reservoir as lakefront property (Town of Chestermere, 2011a). Along with resident and non-resident day users, there are three major organizations that use the lake directly for their programs and activities. These organizations are Camp Chestermere, the Calgary Yacht Club, and the Town of Chestermere (Little, Frank. 2011. Interview by Author, Chestermere AB. 01-Dec-2010). The author has visited the site and observed preliminary characteristics of the recreation users, and visited with two of the three major organizations.

The Reservoir serves demand sectors outside irrigation including four communities, and non-market ES provision including recreation (WID, 2010). This has at times let to conflict over access to water (WID vs. Craddock et al., 1999; WID vs. Trobst et al., 1990), water levels in the Reservoir (Town of Chestermere, 2010c), and water quality (White, 2001). The Town of Chestermere and the WID entered into a water level maintenance agreement to address conflicts over water levels in the Reservoir (Town of Chestermere, 2010b; White, 2001). The basis for determining the WTP by the Town is unclear given the information gap on ES value. This mixture of irrigation and non-irrigation uses and potential for conflicts provides a unique opportunity to study the WTP for recreational use at the Reservoir.

6. Methods*:*

The value of recreation at Chestermere will be examined using two approaches. The first is a GIS-TCM of non-resident recreational day users. The second will be case studies of the clients/membership of the three major user organizations that rely on the Reservoir for their operations. The GIS-TCM estimation will involve an on-site survey of day users. The case studies of the user organizations (Camp, Yacht Club, and Town Events) will involve an

examination of the costs of participating in activities that the organization provides to determine the WTP using distance and cost information. Data on the distance travelled and other expenses will be collected and analysed in a similar fashion to the GIS-TCM used for the non-resident day users. Additionally, the case studies will use interviews of personnel and collection of attendance and revenue data from the organization along with on site surveying of organization membership/clients to determine cost of participation. Interviews with major reservoir user groups have been conducted to provide background on the recreation activities at the reservoir over the course of the year to compliment the on-site surveys. The TCM estimation equation used for this work will be of the form (Liston-Heyes and Heyes, 1999)

$$TC_{Ch} = VC + t*\theta + OS \quad (3)$$

Where TC_{Ch} = Travel Costs for Chestermere recreation, VC = Vehicle Costs in $/Km travelled including fuel and operation costs, S = number of people in household, θ = Opportunity cost of travel and leisure time expressed as 1/3 the wage rate (Liston-Heyes and Heyes, 1999), and OS = Onsite costs including meals, incidentals, and other costs while at Chestermere. The evaluation of vehicle costs will be aided by the use of a GIS application to obtain a more accurate measure of travel distances using postal codes (Boxall et al., 1996). The data is being collected over a 12-month period to obtain a sample that captures activities across all seasons. One random weekend each month is selected for one-on-one surveying on-site. The questionnaire is self-administered and the researcher retrieves the questionnaire once filled in. Vehicle counters will be used at parking locations near recreation areas close to the water. The counter data will be portioned by the number of observed vehicle arrivals in parking areas that participate in recreation based on observations. The TCM surveys will then be placed into eq. (3) aggregated with the counter numbers to obtain a representative dollar estimate for recreation value over a 12-month period (eq. 2). The TCM survey contains an introduction letter and questionnaire. The questionnaire collects information on the origin city/town and postal code to establish travel distances, a question about distance travelled to compare with the GIS distances, if the trip is a day trip, where staying in Chestermere if not a day trip, number of trips each month over a year, activities participated in at the Reservoir, on-site expenses, loss of wages (if any), and demographic questions about age, education, and income levels. The case study results can provide information on the characteristics of members/clients, and be combined with the GIS-TCM to arrive at a total estimate of the value of recreation at the Reservoir.

The analysis of the distance data collected for the GIS-TCM estimate and the case studies will involve the use of GIS software such as ArcGIS 10 (ESRI, 2011) to estimate travel distances for the vehicle cost variable in eq. (3). Vehicle operation costs will come from the Canadian Automobile Association (CAA) and use an operation cost of $0.64/Km (CAA, 2010). Larger vehicles (full size cars, minivans, and trucks) are typically driven by recreational users needing larger vehicles to tow trailers and carry supplementary equipment (Author's own observations). The selection of the $0.64/Km value represents the vehicle class that best captures the majority of vehicles used by visitors to Chestermere. Road maps based on GIS data will be used to calculate the distances between the centre of the postal code region, or city/town (whichever is smaller) and Chestermere. The use of SPSS statistical software (IBM, 2010) will be used to assess the statistical relevance of the travel cost and demographic variables.

7. Expected Results, Benefit of Work, and Early Findings:

The completion of the first research objective is expected to show a variety of recreational attributes of the Reservoir for the non-resident public day users. The completion of the second objective is expected to show a large and significant value of the Reservoir for recreation on or near the water. The completion of the second objective is expected to show the service area of the Reservoir. The results of this work are expected be in line with other studies of reservoir recreation providing a scientifically based estimate for the value of Chestermere Lake recreation. This information can then inform water managers of the WTP for allocations, and inform private users when negotiating water agreements or transfers. The methods used in this study can provide insight for future studies of similar reservoirs with similar issues. This way values can be estimated consistently as the body of information for ES from Alberta reservoirs continues to grow.

The social benefit of this work is the protection of the aquatic environment that provides non-market ES including recreational opportunities. This will prevent increased cost to society (both direct and indirect) from loss of recreational opportunities seen elsewhere (MA, 2005a). The town of Chestermere, WID, and other stakeholders will greatly benefit from the results of this study by having current information on the recreational value and use characteristics of non-resident participants to use for future planning and management of the Reservoir. Early results indicate that those with higher income, work full time, have non-university post secondary education (trades), and

originate from the city of Calgary are the main users of the reservoir. The distance travelled ranges from under 10 Km to over 100 Km with the majority travelling 25-40 Km one-way to reach Chestermere. These findings are consistent with other studies on the value of recreational day users (McNaughton, 1993).

8. Conclusion:

Recreation is of high importance to the well-being and quality of life in Alberta and other regions (Kulshreshtha et al., 2006; McNaughton, 1993). The multiuse demand on reservoirs is expected to grow over time as the population and economic activities grow (IWMSC, 2002). At the same time changes in the timing of flows and reductions in the supply of water in natural and artificial waterways are expected in the future (Byrne et al., 2006; Grinder, 2010). Water managers need information about the value of water for different uses to examine policy options to allocate the available water resources among the competing users in the most beneficial manner. Water managers are increasingly turning to markets as an option for reallocating water (Kerr and Bjornlund, 2010; MA, 2005a). The government likely will be a participant in future markets by purchasing allocations to meet WCOs to ensure sustainable ES supplies and recreational opportunities. The WTP by government to acquire allocations for WCOs requires an understanding of water value for recreation and other ES benefits that is presently lacking for individual reservoirs that have multiuse demands. The market transactions that have taken place in Alberta to date are few and local in nature, and have not included transfers for ES or recreation provision (Nicol et al., 2008; Nicol, 2005). Studies of the barriers to trade showed a lack of price/value information identified as a barrier to transactions (Nicol et al., 2008; Nicol, 2005).

Non-market ES typically have not been included in economic measurements of well-being due to the difficulties in measurement of benefits (King, 2007). This has led to changes and losses of non-markets ES supplies that can be costly to society (MA, 2005a,b). ES changes in Alberta are predicted to greatly negatively affect recreational opportunities when modelled into the future (AENV, 2007b). The incorporation of non-market ES values involves the use of RP and SP methods that use the economic theories of the equimarginal principle and consumer choice theory to estimate the monetary value (Tietenberg, 2006; Young, 2005). Of these methods, the TCM has the longest history in the literature of valuing recreation (Ward and Beal, 2000). The geographic principle of central place theory applies to ES valuation by describing the spatial attributes of ES and recreation (Baerenklau et al., 2010; Bateman et al., 2002). The TCM is increasingly combined with a GIS that incorporates spatial aspects of ES, and improves value estimates (Baerenklau et al., 2010; Bateman et al., 2002).

The work will contribute information about the value of water for recreation at the Chestermere Lake reservoir. This site offers an excellent opportunity for the proposed study due to a history of increasing multiuse demands, high recreation demand, and potential for conflict (McNaughton, 1993; WID vs. Trobst, 1990). The current work will use a combined GIS-TCM method to estimate the value of recreation at Chestermere Lake via an on-site survey to collect distance, cost, and demographic information.

The long term benefits of this work will be scientifically sound information and practical methods that can be used for studying similar reservoirs where local data is needed. The results of this work will assist in determining the WTP by government participating in markets for allocations to meet WCOs, maintain ES supplies and health, and recreation opportunities. The WID and Town of Chestermere will benefit from this work by having current information for planning and management of the Reservoir.

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