Valuing Ecosystem Services in the Salmon River Watershed, British Columbia: A Choice Experiment Approach

by

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RESEARCH PROJECT SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF RESOURCE MANAGEMENT

REPORT NO: 541

in the
School of Resource and Environmental Management
Faculty of Environment

SIMON FRASER UNIVERSITY

Summer 2012

Approval

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Degree: **Master of Resource Management**

Title of Thesis: ***Valuing Ecosystem Services in the Salmon River Watershed, British Columbia: A Choice Experiment Approach***

Report No: **541**

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Abstract

Private land in the Salmon River watershed of British Columbia makes major contributions to the natural capital of the watershed. Ecosystem services (ES) produced by private holdings contribute to general environmental health and community well-being. This paper reports the results of a choice experiment (CE) to assess resident's preferences for future ES conditions in the watershed. The CE was part of a survey mailed to watershed residents and included attitudinal questions to be used as covariates in the CE. Respondent bias was treated using a novel segmentation procedure of known protesters. The results show that a majority of respondents are willing to pay in the form of increases to income tax for marginal improvements to ES provision from private land. Respondents exhibited heterogeneous preferences for ES, and were classified as Aquaphiles, Naturalists, and Conservatives, based on their preferences for water quality, wildlife habitat, and farmer income respectively. Watershed management implications are discussed.

Keywords: Choice experiment; environmental valuation; watershed management; ecosystem services; protest responses.

Acknowledgements

There are many people I am indebted to. First, I would like to thank Dr. Wolfgang Haider for accepting this salty sea-dog and giving me a chance for a new career as a social scientist. Your insights, advice, and humour were greatly appreciated. I am also thankful to Dr. Van Lantz who helped me see the world through the eyes of an economist. Your feedback and encouragement were invaluable.

I owe a huge thanks to Ryan Trenholm, whose loss of a supervisor became my gain as a colleague and friend. Your dry wit brightened my day and helped keep me focused on the light at the end of the tunnel. Sandra Warren and the rest of the tourism lab, you made my latest and last higher education experience a joy. I am a lucky man to have made so many great new friends.

To my Mum, until now I did not appreciate the sacrifices you made to achieve your masters and subsequent PhD while raising three children. You are a study in strength, character and perseverance; and forever will be an inspiration to me.

To my Dad, through your love and support you have given me the confidence to pursue my dreams. Thank you.

Finally, to my amazing partner Jennifer. Your love and encouragement was essential to my successful completion of this project and degree. I am blessed to be with you and I look forward to building our family together.

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1. Introduction

Watersheds provide humanity with essential ecosystem services (ES), such as water purification and wildlife habitat, yet are being degraded by agricultural, industrial, and real estate development (Farber, Costanza, and Wilson 2002a). ES lie outside the realm of typical commercial markets[1], and therefore they are often undervalued and over-exploited, suggesting that public policies to conserve and enhance ES provision are warranted (Banzhaf 2010). Historically, environmental regulations were the main tools governments used to protect Canada's natural heritage, and these tools solved many of Canada's most tractable environmental problems (NRTEE, 2011). However, as complex issues of sustainability become central policy goals for Canadians, alternative methods for environmental protection are needed (Kenny et al. 2011). With increasing frequency, economists, governments, and ENGOs have turned to environmental incentive programs to enhance the conservation of natural capital within watershed boundaries (Vercammen 2011).

Environmental incentive programs are well positioned to help address the complex problems of sustainable development (NRTEE, 2011). *Market based incentives*, such as payment of ecosystem services (PES), pay landowners to conserve portions of their land to increase conservation of important habitat (Engel, Pagiola, and Wunder 2008; Fisher et al. 2008). PES is increasingly used by domestic and international governments and environmental organizations to further their conservation and environmental protection goals as they are considered more flexible and compatible with stakeholder's varied goals (Vercammen 2011). However, market based incentives require detailed information on individual and, by extension, community values for the

[1] Benefits and costs which lie outside traditional market transactions are referred to be economists as 'externalities.'

environment in order to produce efficient and effective results (Sorice et al. 2011). Stated preference (SP) valuation methods are an effective method for determining socio-economic values of ES, yet Canada suffers from a dearth of these environmental valuation studies (Kenny et al. 2011).

The marketplace assigns value to commodities, products, and services based on an agreed price between buyer and seller. ES are not traded in traditional markets; therefore hypothetical marketplaces may be created to assign values to ES for use in resource management decisions. Assessing value requires the individual to make trade-offs between their preferences for the condition of the good or service under consideration (Zander, Garnett, and Straton 2010). Understanding the trade-offs that the general public is willing to make between future environmental, social, and economic conditions will facilitate more efficient allocation of resources and result in more equitable outcomes for all stakeholders (Millenium Ecosystem Assessment 2005). Choice experiments (CE) are a survey based method, originally developed as a market research tool for consumer products (Rolfe and Bennett 2006), and can be used to create hypothetical markets. Beginning with Adamowicz, Louviere, and William's (1994) study of recreation preferences, CE's are increasingly applied to the valuation of ES and, in turn, the calculation of willingness to pay (WTP) for these non-marketed goods and services.

The question then, is the general public willing to make trade-offs for improving ES provision from private land and they are willing to pay for those improvements? To answer this question and related queries, I undertook a mail based choice experiment survey of residents in the Salmon River watershed, located in the southern interior of British Columbia. The watershed provides its residents with a host of benefits from ES yet scant information exists on public preferences and the structure of those preferences for ES provision from private land. To address this gap, my research explores residents' preferences for ES in the Salmon River watershed for use in ES incentive policy discussions and future research into resource management and planning.

1.1. Study Area and Background

Our study focused on the Salmon River watershed, which drains 1,510 km^2 of British Columbia interior plateau into Shuswap Lake through the town of Salmon Arm. The population of Salmon Arm was 16,205 in 2006, with approximately 7,000 additional residents living within the geographic confines of the watershed (Statistics Canada 2011). Figure 1.1 shows the major cities, towns and villages of the watershed, as well as its biophysical boundaries.

The Salmon River watershed is comprised of mountains, forests, agricultural land waterways, wetlands, aquifers, riparian vegetation, with a variety of species some of which are endemic to the area and are considered rare, threatened, and endangered. The major economic activities in the region are farming, ranching, mining, light industry, tourism, and related services.

Figure 1.1. Map of the Salmon River watershed.

Source: Salmon River Watershed Roundtable website (www.srwr.ca).

Dating back to early European settlement of British Columbia, land-use practices have focused on human settlement, energy production, agriculture and industry needs

(Hodge 1986). These large scale land use changes through real estate development, agricultural expansion, and industrial uses, encouraged continuous growth resulting in the degradation of ecosystem services. For example, agricultural and forestry development in the valley focused on flood plains and valley bottoms, resulting in large swaths of the most biologically productive land such as, wetlands, estuaries, old-growth forests, and grasslands, being irreparably damaged (Markey et al. 2005). As a result the most critical areas from a biological, ecological, and in turn, socio-economic point of view are underrepresented in the portfolio of protected areas within the watershed (Dearden and Dempsey 2004). Paradoxically, areas which provide the greatest quantity of public goods and face the greatest threats from human activities receive the least protection under current provincial laws and policies (Boyd 2003).

Throughout much of the 20th century, water quality in the Salmon River was deemed 'poor' due to effluent run-off from farming operations, soil erosion from forestry, and toxic discharges from mining in the upper reaches of the watershed. Despite significant improvements in farming practices and a decrease in the level of timber harvesting in the watershed, the historical threats to water quality persist, posing threats to wildlife, fish, and recreational uses of the river. The main threats to aquatic life in the Salmon River are elevated turbidity from agriculture and forestry non-point sources, and low water flows combined with high water temperatures in summer as a result of irrigation and the effects of climate change respectively. The legal protection of the river's liquid assets at the provincial level is hamstrung by the ineffectual *Riparian Areas Regulation* and *the Water Regulation Act* which paradoxically do not apply directly to private land (Boyd 2003). At the federal level, the *Fisheries Act* has grandfathered previously cleared riparian areas which do not meet current legislated minimums, leaving the decision to improve these areas up to the individual landowner (Quigley and Harper 2006).

Today, high percentages of the Salmon River flood plain are owned privately and experience intensive agricultural use and cattle ranching. Residents continue to deal with real-estate development pressures of the land base, threats to their water quality from agricultural and forestry run-off, and negative impacts to their rural quality of life as a result of fluctuating commodity prices. The recent demise of the Salmon River Watershed Roundtable whose aim was to improve ES conditions in the watershed

through community engagement, shows that alternate approaches to watershed scale management are required.

1.2. Research Purpose

My research project is part of the larger Social Sciences and Humanities Research Council (SSHRC) funded, Canadian Watershed Project (CWP). The purpose of the CWP is to investigate community compatible incentive structures that will best facilitate ES improvements within four Canadian watersheds, including the Salmon River watershed in British Columbia, the Credit and Humber river watersheds in Ontario, and Little River watershed in New Brunswick. These were chosen as broadly representative of the rivers that predominate the southern reaches of Canada, encompassing rural (Salmon River and Little River) and urban qualities (Credit and the Humber River). In this paper I examine the Salmon River only. The results of my analysis on the Salmon River watershed will contribute to the comparative research and benefits transfer modelling to be undertaken at a later date on the aforementioned watersheds.

It is important to note that ecosystems are composed of complex, interrelated processes, products, and services, which frequently confound the best attempts at modelling them (Millennium Ecosystem Assessment 2005). Capturing all of the interactions and complexities of a watershed ecosystem in a survey instrument is theoretically possible but practically implausible. Therefore, our survey conveyed a generic depiction of the issues facing resource managers, municipal decision makers, and the resident stakeholders. The intention of this project is to establish a baseline of resident's preferences for ES provision from private land, to be used by the community for policy formation. It is not intended to be an exact measure of the ecological processes within the watershed.

Watersheds are considered a natural scale for ecosystem service management and planning (O'Neil 2005), however, the jurisdictional borders that comprise BC's management areas rarely conform to the ecosystem service areas that watersheds represent. The Salmon River watershed exhibits this incongruence between biophysical boundaries and jurisdictional boundaries, as it overlaps the Thompson-Nicola Regional District, the North Okanagan Regional District and Columbia-Shuswap Regional District.

As a result the limited information about development and environmental trade-offs that exist is often poorly disseminated and not analysed at a regional level. A goal of this study is to contribute to the growing base of watershed scale information being compiled and utilized by regional planners, local municipal governments, provincial ministries, the federal government, as well as citizen interest groups working throughout Canada.

To these ends, our project uses a stated preference approach called a choice experiment (CE) to assess residents' willingness to pay for non-market ecosystem services provided by private land in the Salmon River watershed. Our approach looks at two ecosystem services which were designed to capture the largest variety of services produced within the watershed boundaries. The first is the supporting services provided by increased conservation of wildlife habitat on private land, and the second captures provisioning services provided by increased protection of riparian areas resulting in improved water quality.[2] To realistically convey the trade-offs inherent in our hypothetical marketplace, a third attribute, "farmer income" is included to simulate the potential community impacts of conservation on private land (Vatn 2004). Choice experiments force respondents to make trade-offs between attributes (i.e. ES) and enable the calculation of separate welfare estimates for each of these environmental services. Through our parameter estimates the general public's willingness to pay for increases to the provision of water quality, wildlife habitat and the resultant changes in farm/woodlot income production is calculated. These calculations and information may inform policy decisions in its own right and they are essential for a complete cost/benefit analysis (CBA) of watershed planning and management decisions. In a broad sense, contributing to the growing body of literature on ecosystem service valuation is the ultimate goal of this project.

1.2.1. Research objectives and questions

The research questions posited below reflect the purpose and objectives of the project. This project set out to answer:

[2] Section 2.1 explains in more detail the specific services which comprise both supporting and provisioning types of ecosystem services.

1. From the perspective of the general public, what are the roles and responsibilities of private landowners as stewards of their land?
2. What value does the public ascribe to the increased provision of those services from private land?
3. Is the public uniform in their valuation, or do they exhibit preference heterogeneity?
4. From a methodological perspective, what effect does the inclusion of a priori segmentation of “protesters” and “serial non-participants” have on model results?

1.3. Report Organization

This report is organized in six separate chapters including this introductory chapter. Chapter two will review the pertinent academic literature related to ecological services (ES), defining and measuring value, approaches to economic valuation, and environmental valuation using discrete choice experiments. Chapter three describes the research methods used to gather, compile and analyze the data. The results will be presented in chapter four. Chapter five discusses the key findings of our survey analysis, and chapter six will conclude the paper.

2. Literature Review

This chapter reviews the relevant literature on ES terms and concepts, and ES valuation. It begins with a definition of the concept of "ecosystem services" that will be used in this paper followed by a discussion of how ecosystem values are classified. Then, a summary of the various analytical tools used in the literature to calculate values of non-marketed goods is presented, followed by a discussion of the strengths and weaknesses of two types of stated preference methods, contingent valuation (CV) and choice experiments (CE). Finally, the current state of the environmental valuation literature as it relates to this project is examined.

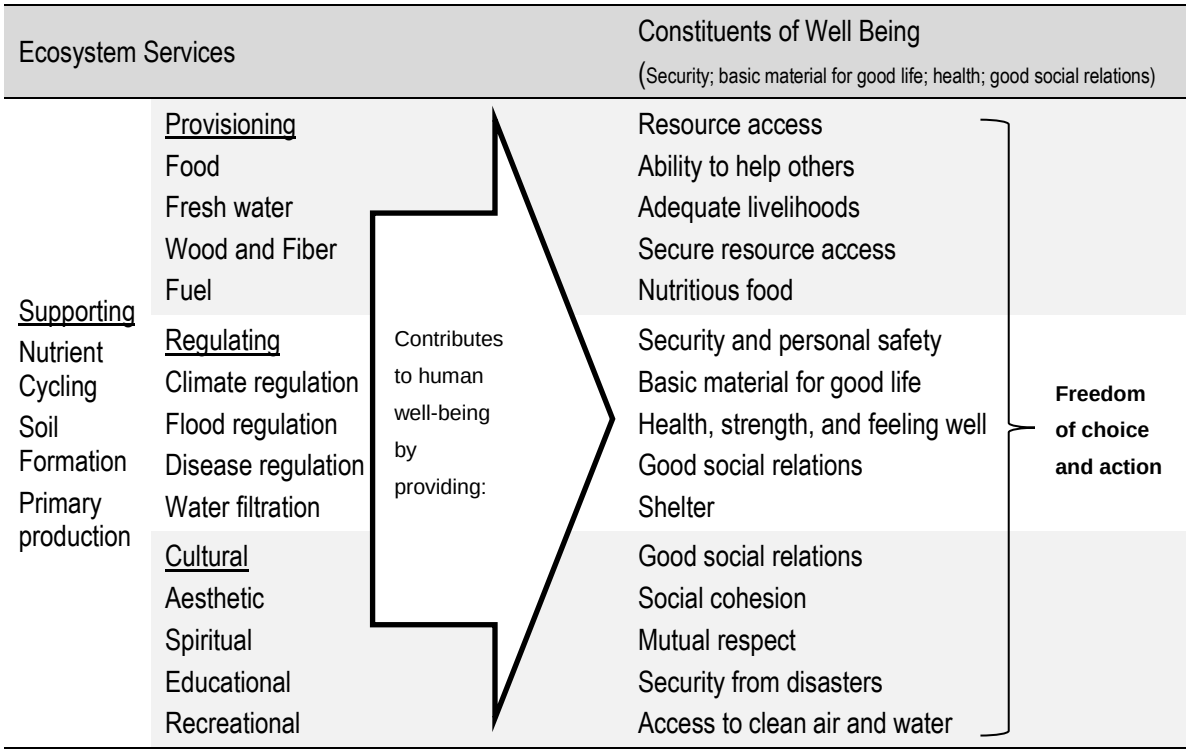
2.1. Ecosystem Services

In his seminal paper titled "Economics in a Full World" (2005) Herman E. Daly shows that the concept of "ecosystem service" can be a useful measure for evaluating the trade-offs between economic growth and nature when assessing the development of our public resources. Private markets are effective at allocating resources but they fail to account for the public goods that flow from nature i.e. ecological service benefits that flow outside market transactions. The Millennium Ecosystem Assessment (MEA) is an attempt by a group of ecologists and economists to create a framework for the inclusion of natural systems into our social and economic decision making processes. The vision is to create a world in which our natural assets, vital to all of our socio-economic activities, are recognized for the central role they play in human wellbeing, thereby affording them increased consideration for conservation (Daily et al. 2009).

Many definitions and classification schemes for ecosystem services exist (Norberg 1999; de Groot, Wilson, and Boumans 2002; Millenium Ecosystem Assessment 2005; Gómez-Baggethun et al. 2010). The definition used for my project, and the most widely cited, is from the MEA (2005), which defines ecosystem services as "the benefits that people obtain from ecosystems." The MEA identifies four functions of

ecosystem services which contribute to human wellbeing (Figure 2.1). Supporting, provisioning, regulating, and cultural services supply humanity with security, the basic material for good life, health, and good social relations.

Figure 2.1. Ecosystem Services



Adapted from Millennium Ecosystem Assessment, 2005.

Since the advent of the industrial revolution, humans have disrupted ecosystem functions more extensively and rapidly than in any other comparable period in human history, primarily to meet exploding world demand for food, fresh water, minerals, timber, fiber and fuel (MEA, 2005). This "*growth paradigm"* is fueling the rapid conversion of natural capital, causing negative environmental externalities which lead to the degradation of our ecosystems (Costanza and Daly 1987). Externalities occur when a market transaction between a buyer and a seller affects a third party and that party receives no compensation. Externalities can be negative and positive. An example of a negative externality occurs when effluent from a source degrades water quality for downstream users. A positive externality is created when a farmer remediates riparian buffers on his land resulting in improved fish habitat, increased water quality, and improved aesthetics for downstream users.

Conventional measures of economic growth largely ignore the importance of intact and functioning ecosystems in the production of our goods, effectively treating resources as inexhaustible and the environment as capable of absorbing all of our wastes (Ayres 1996). Costanza and Daly (1987) highlight problems of sustainability, distribution of wealth, discounting, existence values, and externalities. At its foundation the problem of the growth paradigm is one of socio-economic and inter-generational equity.

In order to reverse the institutionalized causes of environmental degradation, the true costs of our economic activities and the real benefits of nature's ecological services must be calculated (Liu et al. 2010a). Many of the ecological service benefits of private land, whether the land is located on the 'urban fringe' or in 'rural' locales, provide benefits that flow beyond property boundaries. ES from private land supply important habitat for native flora and fauna can purify source and groundwater, improve air quality, mitigate the impacts of flooding, and provide rich sources of soil. They can provide for recreation (given landowner permission), as well as provide an aesthetic appeal and sense of wellbeing humans have lost in our urban landscapes. In short, private land provides a wide range of ES.

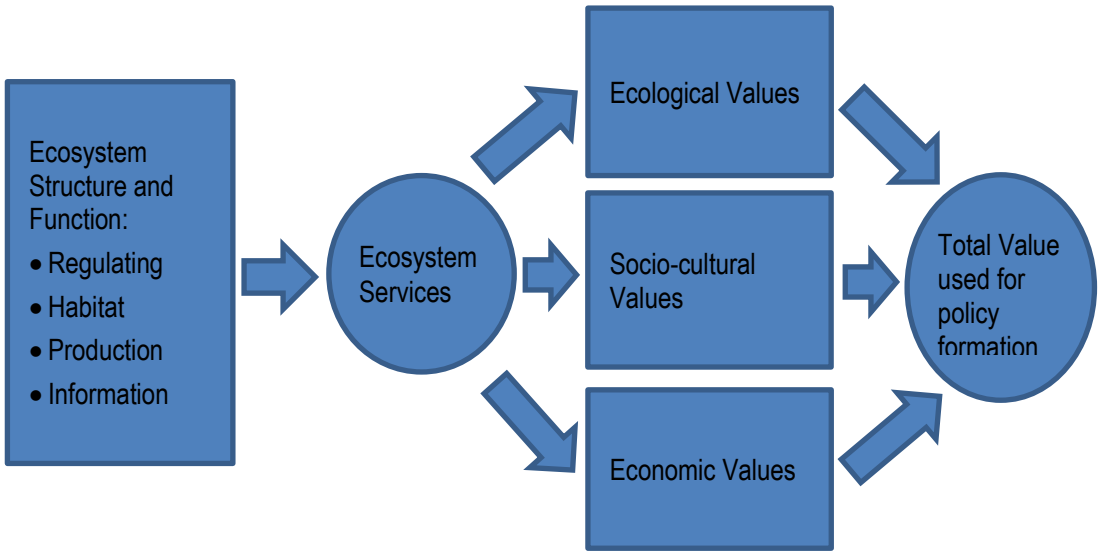
2.2. Defining and Measuring Ecosystem Value

In attempting to determine the monetary worth for non-marketed goods, one must first define the concept of value. To begin, it is important to make the distinction between intrinsic and instrumental value. On one side, one may view ecosystems and species as having an intrinsic right to exist free from human dominion over them. On the other, one may view ecosystems as having an instrumental value in satisfying human preferences. Intrinsic and instrumental values can be considered two sides of the same coin (Farber *et al.* 2002). Intrinsic values for nature, such as avoiding extinction or extirpation of species are considered decision boundaries, within which instrumental values will guide resource management goals and decisions.

The value of ecosystems, determined by the cultural norms and values of society, is separated into three value lenses: ecological, socio-cultural, and economic value, where the sum of all three values is considered to be the total value (TV) for the

ecosystem (de Groot, Wilson, and Boumans 2002). Figure 2.2, shows ecosystem services as a product of the ecosystem's structure and function. The hypothetical total value can be used to inform decision making, policy options, and management measures (de Groot, Wilson, and Boumans 2002).

Figure 2.2. Framework for valuation of ecosystem function, goods and services



Adapted from De Groot, Wilson, and Boumans 2002

'Ecological value' is a product of the regulation and habitat functions of a given system (de Groot, Wilson, and Boumans 2002). Since the products of the relationship between regulation and habitat are complex and mutually dependent, sustainable use levels should be determined very carefully. Ecological criteria such as resilience, resistance, and integrity are essential factors in determining the level of sustainable extraction of resources from a system, as well as the system's ability to provide the required good and services in perpetuity (Norberg 1999).

Natural systems are an important source of non-material socio-cultural wellbeing. Cultures depend on environmental functions for the provision of important goods and services which contribute to physical and mental health, education, heritage values, freedom and spiritual values (Salomon 2008). Socio-cultural values are related almost exclusively to information functions of ecosystems (Figure 2.1). Given the appropriate

research question, attributes, and experimental design, stated preference methods can inform decision makers on socio-cultural values for the environment.

Economic values are a product of the information functions, regulation functions, and production functions of an ecosystem (Jaeger 1995). In ecological valuation, it is common to distinguish between use and non-use values whose sum amount to the total economic value (TEV) of a resource. Stated preference methods are unique in their capacity to calculate TEV of non-marketed public goods and are discussed in detail in section 2.4

2.3. Economic Valuation methods

Since many Ecosystem services are not traded in the market, one needs to develop hypothetical markets as one means of assessing economic values for these 'public goods.' A variety of approaches have been developed which fall into one of four categories. Turner *et al*. (2010) summarize the variety of economic valuation techniques which exist to capture the value of ES when more traditional markets are unable to do so: *cost based* approaches (avoided cost, replacement cost, and production function); *revealed-preference* approaches (factor income, travel cost, and hedonic pricing, and market pricing); *stated preference* approaches (contingent valuation, and choice experiments); and *non-monetizing valuation* approaches (individual index based analysis, and group based methods).

Cost based and revealed preference valuation methods for ES are effective at valuing the whole of the environmental good and not the constituent parts or attributes of the good (Liu *et al*. 2010b). The attributes of these methods are often highly correlated making it difficult to isolate the effects of individual attributes on choice (Hanley, Wright, and Adamowicz 1998a). These methods also require large sample sizes, which are difficult to obtain in, for example, smaller watersheds such as the Salmon River or the Little River in New Brunswick. Thus, revealed preference and cost based non-market valuation techniques are ill-suited for calculating the value of improvements to ES in specific watersheds.

Stated preference (SP) methods use hypothetical changes to environmental attributes in order to calculate willingness to pay (WTP) for ES or willingness to accept compensation (WTA) for individual service loss (Farber, Costanza, and Wilson 2002). The coefficients produced by stated preference surveys can be used to calculate dollar values for non-marketed goods and services for use in resource allocation and economic development decision making.

2.4. Stated Preference Methods for Valuing Ecological Services

Stated preference methods use survey based instruments to create hypothetical markets that examine the trade-offs people are willing to make between different policies, programs, or goods. Contingent valuation (CVM) and choice experiments (CE) are the most popular stated preference methods as they enable the researcher to estimate WTP for the good or policy under investigation. CVM and CE use ratings, rankings and choice to arrive at welfare values for ES under consideration. Both approaches share the same random utility framework, therefore, the welfare estimates produced by each method may be compared (Adamowicz *et al*. 1998). While both methods have been criticized for the many assumptions required in making the models (Spangenberg and Settele 2010) work by Powe *et al*. (2005) shows that the public considers their responses to stated preference experiments sufficiently accurate to guide policy decisions for resource allocation.

2.4.1. Contingent Valuation

Contingent valuation is the older of the two methods and first gained prominence in resource management applications following the civil trial for the 1989 *Exxon Valdez* oil spill in Prince William Sound in Alaska. CVM requires the researcher to describe precise changes in environmental goods and/or services through information contained in the survey. Respondents are then asked to respond to a WTP or WTA question related to the loss or improvement of the environmental good in question. CVM is administered through one of four elicitation methods: open ended, payment card, bidding game, or dichotomous choice, the latter of which can be further divided into single-bounded or double-bounded formats.

Critics of the CVM approach point to issues of reliability and validity of CVM welfare estimates as a result of strategic bias, hypothetical bias, elicitation effects, information effects and sequencing (Venkatachalam, 2004). With adequate consideration of these experimental biases it is possible to obtain valid welfare estimates from CVM. However, the structure of the methodology does not allow for the calculation of welfare estimates for the individual attributes that comprise the environmental good and/or service under investigation. Values for ES, such as water quality and wildlife habitat, can easily be confounded with each other and with other environmental services.

2.4.2. Choice Experiments

According to Hoyos (2010), the theoretical foundations of choice experiments (CE) lie in psychology, economics, and statistics; and use Lancaster's (1966) consumer theory as the theoretical backbone of the approach. The first application of a CE in environmental resource management was conducted by Adamowicz et al. (1998), and since then, use of the CE method in ecosystem service valuation has become increasingly widespread (Hoyos 2010). In the CE methodology, the respondent is presented with a succession of choice scenario comprised of mutually exclusive hypothetical alternatives. Each alternative is defined by a set of attributes on a variety of levels. Individual's choices imply trade-offs between the levels of the attributes in the different programs presented to each respondent. If one of the attributes utilized is a cost or price of the program, then the model coefficients can be converted into WTP estimates for the ES being evaluated, in this case water quality and wildlife habitat (Kanninen 2007). Given that these estimates can be interpreted as a measure of compensation, the values can be used within a cost-benefit analysis framework for decision making (Hanley, Wright, and Adamowicz 1998b).

The statistical foundation of CE models is in random utility theory (RUT), logit models and welfare estimation (Louviere, 1988). RUT postulates that an individual's utility is a product of the linear component of utilities in a context where the choice is considered the observed quality of utility and the remainder the unobserved random component of utility (Kanninen 2007). The multinomial logit model (MNL) is the workhorse of CEs as it is simple to estimate through packaged estimation software, does not require re-estimation after adding or removing levels and attributes for testing

responses to changing market shares, and is computationally quick. However, the MNL assumes all preferences for the attributes to be equal, and therefore the researcher is unable to observe if respondents have differing preferences for the attributes under consideration.

To increase model realism by incorporating respondent preference heterogeneity, alternatives to the MNL have been developed and are being increasingly used by CE practitioners. Nested Logit (NL), Random Parameters Logit (RPL), and Latent Class Models (LCM) cluster respondents according to the similarity of their answers, enabling the researcher to determine preference heterogeneity for each attribute. Segmenting respondents in this manner enables a richer interpretation of the data than the MNL.

The Choice Experiment methodology shares some of the same respondent biases as Contingent Valuation; however, the CE methodology is considered more flexible while providing a greater amount of data to the researcher (Hanley, Mourato, and Wright 2001). In CVM respondents are questioned about a single event in detail, whereas in CE respondents are "…questioned about a sample of events drawn from a universe of possible events of that type," (Boxall *et al*. 1996, 244). That is, CE experiments can incorporate a multitude of changes within one survey enabling the respondent to express their preferences many times (Kanninen 2007). Recording the same amount of data with a CV instrument would require many separate surveys. As well, the separation of attributes in CE allows for the calculation of individual welfare estimates for each environmental attribute under consideration; a significant advantage over CV when one is attempting to inform public policy discussions for resource management decisions.

To address the continued criticism of the hypothetical nature of stated preference studies, concepts from social psychology such as the theory of planned behaviour (TPB) have been integrated into the model to improve reliability and validity (Meyerhoff 2006). According to the TPB, human action is influenced by three major factors: a favourable or unfavourable attitude towards the behaviour (personal preference), the subjective norm to perform the behaviour (peer-pressure) and self-efficacy in relation to the behaviour (personal control) (Ajzen and Fishbein, 2005). The combined effect of these behavioural intentions is postulated to be "the most immediate and important predictor of a person's

behaviour," (Meyerhoff 2006, 210). According to the theory, positive attitudes toward ES, perceived peer pressure to conserve our natural capital for future generations, and past behaviours (such as belonging to an environmental organization) are positively related to the respondent's WTP for ecological services (Zander, Garnett, and Straton 2010). By incorporating the TPB into choice experiments, researchers are able to gain insight into how and why respondents choose, thereby enabling them to justify response patterns and reduce biases in their data (Sorice et al. 2011).

The Salmon River watershed produces valuable ES, where management of these services requires knowledge about the trade-offs the general public is willing to make between the qualities of the goods. Although all environmental valuation methods have limitations and issues of reliability and validity (Chee 2004), for the purposes of this project a CE is the most adept method to answer the research questions.

2.5. Environmental Valuation with Choice Experiments

The preceding sections highlighted various stated preference techniques and fundamental concepts when embarking on valuation exercises. This section will present findings from other choice experiments that can provide insights into expected results for this study.

Using a random parameters logit, Zander, Garnett, and Straton (2010) showed that 90% of Australians were willing to pay for the improved management of tropical rivers in the country's north. Their sample population exhibited heterogeneous preferences identified a priori to the model estimation as 'environmentalists', 'developers', and 'neutral', urban Australians, with all three segments in their experiment preferring high farmer income to low (Zander, Garnett, and Straton 2010).

Exploring heterogeneity or preferences between stakeholder segments enables a greater understanding of the impacts of prospective policy changes. A search of the academic literature reveals the importance of understanding heterogeneity in the estimation of welfare estimates used in cost-benefit analysis and the impact those estimates may have in environmental planning policy (Vercammen 2011; Colombo, Hanley, and Louviere 2009; Travisi and Nijkamp 2008). Sorice *et al*. (2011) in a latent

class CE identified three latent classes of landowners whose choices of conservation programs varied on the basis of their attitudes and perceived social norms. The researchers concluded that given the heterogeneity in landowner preferences for conservation programs, integrating incentive compatible social recognition programs would increase conservation rates (Sorice *et al*. 2011). In another study, considerable preference heterogeneity for wetland management was shown for the sustainable management of the Cheimaditida wetland in Greece (Birol, Karousakis, and Koundouri 2006).

In general, LCM are more meaningful for resource allocation decisions if one is able to determine class membership characteristics (Boxall and Adamowicz 2002; Semeniuk et al. 2009; Zander, Garnett, and Straton 2010). In a LCM of a wetland ecosystem restoration, Milon and Scrogin (2006) showed that environmental attitudes about perceptions of water scarcity, and general "pro-environmental" attitudes were significant determinants of class membership, while demographic characteristics of age, gender and income also contributed to class composition. Using attitudinal measures of stewardship responsibilities along with demographic indicators, this paper seeks to explain differences in individual's preferences and values for increased provision of ES on private land.

Following the large payout by Exxon Mobil to the stakeholders in Alaska, contingent valuation welfare estimates were scrutinized and criticized for their structural and theoretical biases (Venkatachalam 2004). Of particular concern was the propensity of respondent 'protests' to bias model results and therefore WTP estimates. In response, CV studies attempted to weed out protesters through use of screening questions following the valuation exercise and through screening for strategic behaviour in scenario responses (Meyerhoff and Liebe 2007). The screening process begins with a definition of what constitutes a protest. In both CV and CE methodologies protesters are defined as "those respondents who do not state their true value for the good in question" (Meyerhoff and Liebe 2007, 433). An assumption implied in this definition and in the use of protester screening questions in general, is that researchers are able to reliably identify and remove respondents who are creating perceived anomalies in the data.

The accepted best practice in CE, as in CVM, considers the removal of protest bids as state-of-the-art and necessary for the calculation of realistic welfare estimates (Hoyos 2010). Yet, a meta-analysis of protest treatments in CE by Meyerhoff and Liebe (2010) shows that a majority of studies do not explicitly mention protesters or make only a fleeting description that they were "removed" in order to reduce "noise" in the data. The authors support the development of a more systematic approach to protest votes in order to improve welfare estimates and model reliability. Elsewhere, key arguments from deontological ethics suggest that people's preferences and beliefs are guided by rights and duties rather than the economic utilitarianism assumed in choice experiments (Chee 2004; Spash 2006). In other words, removing protesters may reduce so called noise and bias in the data but doing so may also remove legitimate 'rights' and 'duty' based responses from the analysis.

Additional debate circles around how to treat the repeated selection of the status quo or alternative specific constant (ASC) in CE, also referred to as "serial non-participants," (von Haefen, Massey, and Adamowicz 2005). These respondents repeatedly choose the same answer regardless of the levels within the choice scenario; behaviour which is deemed 'irrational' by a majority of studies found in the literature (Meyerhoff and Liebe 2010; Hoyos 2010). Typically in CEs these responses are eliminated from the data, however, removing all 'irrational responses' may induce sample selection bias and reduce the power of the estimated models (Hoyos 2010).

To date, no comprehensive cleaning procedure for the removal of protest bids exists. In the literature, there is much debate about how protest bids and serial non-participants should be treated as the removal of responses from the data has both positive and negative implications for model results (Turner, Morse-Jones, and Fisher 2010; von Haefen, Massey, and Adamowicz 2005; Meyerhoff and Liebe 2009; Meyerhoff and Liebe 2007). The debate revolves around the respondent's motivation for their choices, and whether those choices constitute a 'protest' of the valuation scenario or whether they represent a choice based on a perceived "right" or "duty" to the ES in question (Spash 2006). Deontological ethics, the *duty* to perform an action over the *utility* it provides the individual, provides a lens through which respondent 'protests' can be interpreted and included in the analysis (Chee 2004).

3. Methods

The layout for this chapter follows a modified framework for executing a discrete choice experiment adapted from Hensher, Rose, and Greene (2005); Louviere, Hensher, and Swait (2000); and Kanninen (Ed. 2005). Designing a CE is an iterative process and feedback from each step is incorporated into the final design of the CE.

3.1. Step 1: Characterization of the Decision Problem

Given that watersheds produce public goods which provide valuable benefits to residents, an efficient and effective management of watershed resources is required. O'Neil (2005) shows that the most effective management regimes are those that incorporate community preferences based on consensus agreements. Therefore to best represent a consensus based approach to resource management, community preferences should be assessed (O'Neil 2005). Inherent in a consensus approach are trade-offs between ES and other community goals, and if there are trade-offs then valuation occurs consciously or not. Economists measure value at the margin, where goods and services are continuously divisible, and gains or losses of the service result in a sliding scale of utility more commonly referred to as the law of diminishing marginal utility. This logic is rooted in the concepts of *utility* and *scarcity* and justifies the use of *money* as a standard unit of measure for value. Farber et al. (2002) explain, "… as value was assumed to be determined by utility on the margin, and consumers were assumed to allocate money optimally across uses, the marginal utility of money was the same for an individual in all its uses. *Money* thus becomes the standard unit of measure," (p.378). The significance of marginal utility is that it enables one to measure use and non-use values in monetary units. Our CE solicited the general public's willingness to pay for ecological services and was situated in the context of improvements through government programs, to the ecology of the Salmon River watershed in central British Columbia. The results of the CE present the marginal

welfare gains associated with the improvements to ES in the Salmon River watershed as a result of government programs.

3.2. Step 2: Attribute Selection and Market Creation

In CEs, attributes can be quantitative or qualitative within the same alternative. The levels of the attributes can be generic (number of levels are the same between attributes) or alternative specific (number of levels can vary within attributes and across alternatives) (Bennett and Blamey 2001). The attributes for this project were developed from a thorough review of the literature on environmental valuation and ecological services, attribute relevancy considerations as determined by the Canadian Watershed Project research team; and through an iterative attribute selection process during our focus group meetings (Hoyos, 2010). This section describes in detail how the attributes were defined and how the hypothetical market for ES provision improvements was developed.

3.2.1. Wildlife Habitat

Using CE to value wildlife and wildlife habitat is a large and growing field of environmental valuation (Pearce 2007). Research has focused on the role of habitat in wildlife management (Semeniuk et al. 2009), the importance of wildlife viewing for park visitors (Juutinen et al. 2011; Naidoo and Adamowicz 2005), public preferences for biodiversity (Christie et al. 2006), and estimating preferences for changes in forest biodiversity (Czajkowski, Buszko-Briggs, and Hanley 2009; Boxall and Macnab 2000) to name some recent examples. Initially, we considered using species endemic to the Salmon River watershed similar to Naidoo and Adamowicz (2005), however this would preclude comparison between watersheds for the benefits transfer model and was therefore abandoned for the more generic 'wildlife habitat'.

The levels for wildlife habitat were determined through discussions with experts on the Salmon River Watershed Roundtable prior to its demise, as well as by using GIS information. The status quo was developed by assessing the amount of protected area in the watershed. The second and third levels were developed by assessing the province's stated goals for conservation, recommendations from focus group members,

and through CWP group discussions. Wildlife habitat was identified by the Salmon River focus groups as a meaningful and coherent attribute for the choice model.

3.2.2. Water Quality

Water quality was identified as an important ecosystem service early on by our focus groups and through my literature review. Given the applied nature of this research it was decided that the levels should be based upon a policy relevant scale (Blamey et al. 2002). The water quality indicator endorsed by the Canadian Council of Ministers for the Environment (CCME), was best suited for adaptation to our survey instrument. The freshwater quality indicator provides an overall measure of the ability of water bodies to support aquatic life in Canada (Lumb, Halliwell, and Sharma 2006). Tests from individual water quality stations are compared to a national water quality guideline, and then assigned a score based on three factors: scope, frequency, and amplitude. The calculation yields a number between 0 and 100 with a higher score indicating higher water quality. Scores are then categorized into five groups according to the rating system in Table 3.1.

Initially we chose the labels ‘marginal’ to ‘good’ as the levels for our choice model. However, further research group discussion and feedback from our focus groups determined that the descriptions of the ratings (water quality is threatened: *often*, *sometimes* and *rarely*) were easier to interpret and carried more meaning to the respondent.

Table 3.1. Canadian Council of Ministers for the Environment – Water quality rating descriptions.

Rating		Interpretation
Excellent (95.0 to 100.0)	→	Water quality measurements **never or very rarely exceed** water quality guidelines.
Good (80.0 to 94.9)	→	Water quality measurements **rarely exceed** water quality guidelines and, usually, by a narrow margin.
Fair (65.0 to 79.9)	→	Water quality measurements **sometimes exceed** water quality guidelines and, possibly, by a wide margin.
Marginal (45.0 to 64.9)	→	Water quality measurements **often exceed** water quality guidelines and/or exceed the guidelines by a considerable margin.
Poor (0 to 44.9)	→	Water quality measurements **usually exceed** water quality guidelines and/or exceed the guidelines by a considerable margin.

As of November 2011 water quality in the Salmon River was given a rating of 'marginal' by Environment Canada (EC 2011). This level represented the status quo for the CE while the 'fair' and 'good' levels were selected as conceivable future conditions given the ongoing work by federal, provincial, and non-governmental organizations to improve water quality[3].

3.2.3. Farm/Woodlot Income

Farm/Woodlot income represents the decrease in the landowner's income as a result of remediating productive farmland to increase ES provision under government programs. The Farm/Woodlot Income attribute was developed through focus group feedback, and a review of the literature on ES valuation, in order to make the choice scenarios more realistic for the respondent (Powe, Garrod, and McMahon 2005). Based on a search of the choice modelling literature, attributes representing declines in stakeholder income is a new approach to increasing choice model realism. More typically attributes portray increased benefits as a result of changes to ES provision such as increases in employment (Birol, Koundouri, and Kountouris 2010), re-training of farm

[3] During our initial conceptualization phase for the survey design and structure in 2010, water quality in the Salmon River was rated as "poor" according to the CCME Water Quality ratings.

workers (Birol, Karousakis, and Koundouri 2006), increases in agricultural production (Colombo, Calatrava-Requena, and Hanley 2006), and the creation of long term employment (Bergmann, Hanley, and Wright 2006). However, given our focus groups vociferous and intense belief of their right to good water quality it was deemed unrealistic to portray further improvements to the ES attributes without some sort of decline in another important factor. The levels (0%, 10%, and 20%) were developed during the focus group discussion, and through calculations of the impact that the removal of land from production would realistically have on a farmer's income.

3.2.4. Increase in Annual Income Tax

For the calculation of WTP estimates a "payment vehicle" is required to allow welfare coefficients to be expressed as a dollar value that can then be used in decision support tools and CBA. Despite the general perception that income taxes are already high in Canada, valuation studies typically use "increases to household income tax" for the payment vehicle, although "voluntary donations", "payments to special funds", "entrance fees" or "annual increases to household utility bills" are also common (Meyerhoff and Liebe 2010). We chose "Additional Income Tax" as our payment vehicle since, historically, the government has funded the adoption of best management practices and payments for ecosystem services programs through public revenues. Therefore, it follows that an increase in government funded programs would require increases to income taxes. Since our choice scenario presented only improvements to the provision of ES from private land, WTP estimates were calculated, while WTA were considered inconsistent for this type of scenario.

3.2.5. Constructing the hypothetical marketplace

In order to arrive at implicit prices for the respective ES, CEs require the creation of a hypothetical market, and one option for doing so is with a choice environment. Within this hypothetical marketplace respondents are asked to make trade-offs amongst complex interactions of ecological and socio-economic processes. Respondents in our questionnaire were asked to select between environmental conditions improved by government programs in ten years or the status quo option of the future conditions being similar to today. Arriving at meaningful and interpretable results requires the researcher to consider a variety of design characteristics described below.

It is important to note that valuing ecosystem services with stated preference techniques is challenging due to the complex relationships between ecosystem attributes and the difficulty in conveying that information within a short CE survey (Czajkowski, Buszko-Briggs, and Hanley 2009). The wildlife habitat and water quality attributes selected are not wholly representative of the ES produced in the Salmon River watershed, as there are many additional services that could be selected. However, incorporating all of the environmental attributes would place an intolerable level of cognitive burden on the respondent and make the experimental design prohibitively large. Hanley, Mourato and Wright (2001) show that welfare estimates from CE are improved by experimental designs that reduce cognitive burden. Cognitive burden as a result of task complexity was reduced by presenting four attributes, three of which had generic levels of three differing values, while the cost attribute took on six levels enabling more accurate welfare measures (Louviere, Hensher, and Swait 2000). To summarize, Table 3.2 lists each attribute and the associated level.

Table 3.2. Final attributes and levels used within the choice experiments

Attribute	Attribute Levels**
Wildlife Habitat	10*, 20, 30 - % watershed protected
Water Quality	Often*, Sometimes, Rarely – is the water quality threatened
Farm/Woodlot Owner Income	0*, 10, 20 - % reduction in gross income
Increase in annual household income tax	0*, 25, 50, 75, 100, 150, 200 ($)

*Status quo
** All effects apply to the whole of the Salmon River Watershed

A CE must be designed with an eye towards task plausibility and realism from the respondent's perspective (Bennett and Blamey 2001). A random sample of a population will result in a large variation of education levels. To improve respondent comprehension of the ecological complexities within watersheds resulting in more meaningful welfare estimates, effective surveys need to strike a balance between comprehension and complexity (Christie et al. 2006; Hoyos 2010). The introduction to the CE was tested and reviewed extensively to ensure that sufficient information for rational and informed decisions was available for the greatest number of respondents.

Blamey et al. (2000) showed distinct advantages for choosing either generic descriptors or alternative specific descriptors to each alternative. Generic descriptors

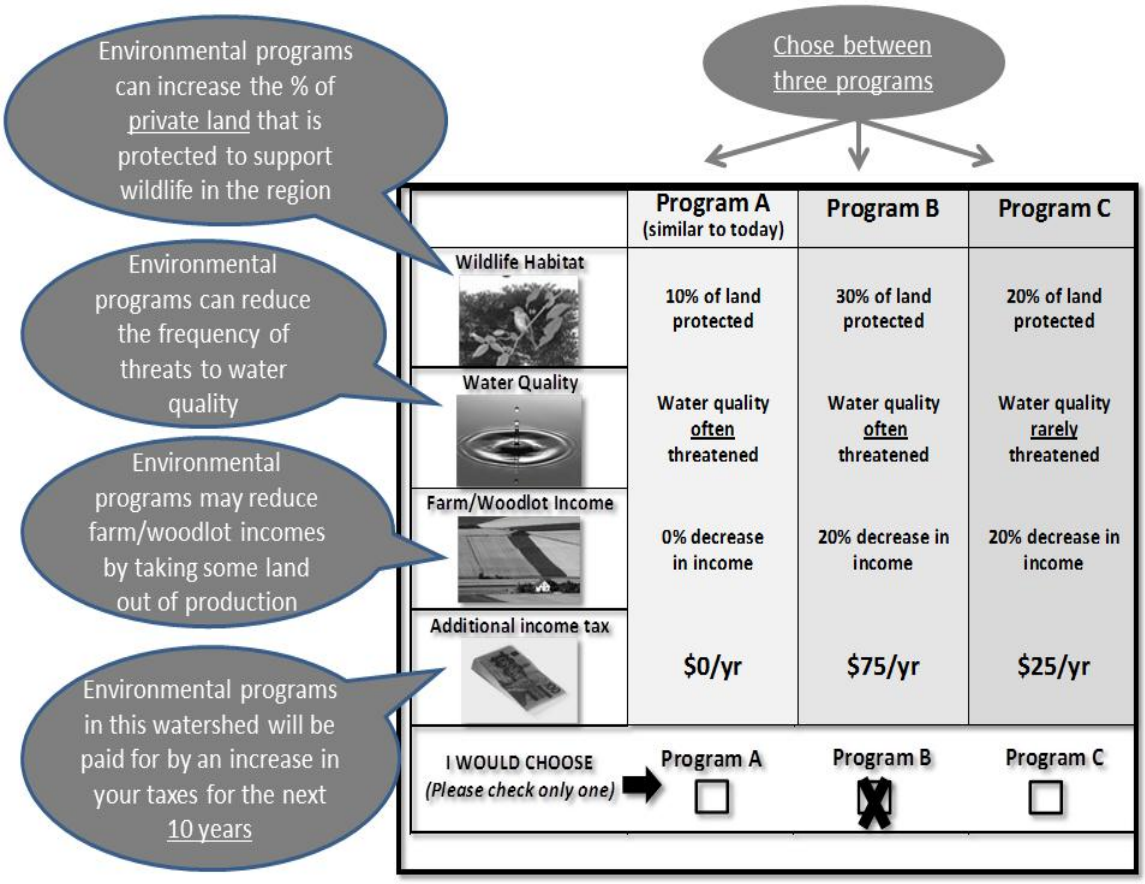
use letters or numbers as titles for each choice alternative. Alternative specific descriptors use words or phrases to describe each choice alternative. Since we were valuing the ecological goods produced in the Salmon River watershed, and not a specific governmental program, generic labels were chosen, which provided the additional benefit of improved information regarding trade-offs among attributes (Blamey et al. 2000).

Rolfe and Bennett (2009) show that welfare measures improve and serial non-participation is reduced by using three choice alternatives per choice set instead of a dichotomous choice between two; three choice alternatives were presented within each choice set for this project.

The design of a CE questionnaire requires careful deliberation. Special attention should be given to the conceptualization of the choice task and the attributes by which the alternatives are defined. During the focus group sessions, respondent understanding of the choice context and task, the adequacy and precision of the attributes and levels, and the length and timing of the survey were discussed. Figure 3.1 shows an example of a choice set.

The survey was organized into five sections. Section One contained questions about the respondents' geographic location with respect to the watershed boundaries, their activities within the watershed and the importance of ES in the watershed, section two solicited attitudinal responses about land management and land use in the watershed, section three asked the respondents to rate the current state of ES in the watershed and their levels of concern for these services in the future, section four contained the choice model and follow-up explanatory questions, and section five solicited demographic information for use in the analysis of the attitudinal statements and choice model (see Appendix A for full survey).

Figure 3.1. Choice set example with instructions, as used in the mail survey



3.3. Step 3: Choice of Experimental Design

Choice experiments are structured to test the effects of attribute levels on respondents' choices. In a perfect world the respondent would see all possible combinations of attributes in the experiment, in this case ($3^3 * 6^1 =$) 162 to determine the significance of all effects, an overly onerous request of respondents' time. In order to reduce task length yet maintain survey orthogonality, a fractional factorial, main effects design of 36 choice sets was reduced to six sets per survey using a blocking procedure (Louviere, Hensher, and Swait 2000). To minimize the number of dominant alternatives the initially efficient design was subject to a swapping procedure (Viscusi, Huber, and Bell 2008).

The fractional factorial main effects design is the most common experimental design in choice modelling as most full factorial designs are too unwieldy to be used (Louviere, Hensher, and Swait, 2000). However, with the reduced number of profiles comes a reduction in estimation power; main effects designs explain 70%-90% of the variance versus the theoretical 100% of full factorial design (Louviere, Hensher, and Swait 2000).

3.4. Step 4: Data Collection, Cleaning and Analysis

As part of the larger SSHRC funded Canadian Watershed Project, the Salmon River watershed survey was distributed to randomly selected households using an address list obtained from a market research company and followed a modified Dillman technique (Dillman 2007). During the recruitment call by the market research company, respondents were asked if they owned ten or more acres of land. Those who did were considered "landowners" and omitted from the sample population.

The project boundaries are the catchment basin of the Salmon River, including the immediate shores of Shuswap Lake in the town of Salmon Arm. The sample population was recruited from the communities of Salmon Arm, Yankee Flats, Armstrong, Vernon (located outside of the physical project boundaries), and other rural locations within the watershed.

Given our survey administration method and the effort it took to return the completed survey, it was assumed that the respondent opinions and preferences expressed in the survey could realistically be motivated by a perceived right or a duty in addition to the utility derived from their choices. Therefore, it would be draconian to remove protesters from the analysis. However, inclusion of "protesters" has been shown to inflate welfare estimates, especially when one is valuing controversial subjects such as the environment (Rolfe and Bennett 2009). To address these issues, I developed a novel comparison process by which protesters were identified a priori and separated as a known segment in the latent class analysis.

Protest responses for this study were identified as those answers which were strategic in nature and which disregard viable choice alternatives such as repeatedly

choosing the status quo option or one of the two hypothetical choice scenarios (Meyerhoff and Liebe 2009), or were responses identified by the selection of one of the two a priori defined protest responses in the follow up questions to the choice experiment[4] (Chang, Lantz, and MacLean 2011). Respondents identified through the above conditions are coded as protesters in order to compare data cleaning techniques in the choice model. Three specifications of the model are run to test the effects of data cleaning on model coefficients: "All-In" (AI) includes all respondents; "Protesters Removed" (PR) erases all protest responses from the data; and "Known Protesters" uses the known class segmentation described above (see Section 4.4.1 for the results).

Although combining latent class and a priori segmentation is routine practice in choice model analysis, treating protesters as a known class is an innovative method for incorporating interdisciplinary perspectives on the attitudes and motivations of stated preference respondents (Sorice et al. 2011). The "Known Protester" approach segments rather than eliminates identified protest responses, thereby enabling the inclusion of rights based responses previously removed in the majority of other choice experiments. This segmented treatment of protesters attempts to address the theoretical contradictions of the pragmatic removal method and the need to incorporate dissenting responses as viable choices identified by deontological ethics. By separating the protesters from 'less noisy' respondents and treating them as a separate segment in known class segmentation I can evaluate the effect of this approach on welfare estimates and the implications it may have for the future treatment of protesters in CE.

The returned survey responses were manually entered using Microsoft Access. IBM SPSS Statistics 19 was used to compile the results from Access and for general statistical analysis of the attitudinal responses, while Latent Gold 4.0 (Vermunt and Magidson 2005) was used for the estimation of the choice model.

[4] For a complete list of the follow-up questions see the survey example in the appendix.

3.5. Step 5: Estimation Procedure

After data collection, statistical models are used to see how attribute levels affect respondent's choices of the programs. A majority of CE studies utilize the MNL for the analysis of the choice data (Louviere, Hensher, and Swait 2000). However, the MNL requires assumptions which reduce model realism. Firstly, the independence of irrelevant alternatives (IIA) suggests that an introduction of option *X* must not affect the selection of option *A* from a previous choice between choice alternatives *A* or *B*. Secondly, the error terms are independently and identically distributed (IID); and lastly attribute preference is assumed to be homogeneous.

To increase model realism through exploration of heterogeneity, respondent preferences can be analyzed using the random parameters logit (RPL) or "mixed logit", the nested logit (NL), or the latent class model (LCM). These models vary the degree to which the IIA and IID assumptions are disentangled and/or relaxed which enables "behaviourally richer interpretations of the choice process," through the exploration of preference heterogeneity (Louviere, Hensher, and Swait 2000, 15). Probit models such as the multinomial probit model relax the IID assumption entirely, adding further behavioural realism but are computationally more complex. For a full description of the logit models used in CE see Louviere, Hensher, and Swait (2000).

CE are effective tools for assessing marginal values of non-marketed goods due to the differing levels for each attribute. For the calculation of WTP, CE analyze the part worth utilities of each attribute in the choice set and assign a value to them, typically in dollar figures. The remainder of this section provides an overview and justification of the latent class model used to analyze the trade-offs respondents made between the survey attributes, and describes the WTP estimates.

3.5.1. Random Utility, Multinomial, and Latent Class Model Estimation

Derived from RUT, the random utility model (RUM) is the foundation upon which stated preference analysis rests and assumes that respondents are rational agents who choose one good over another because the utility gained from that good is greatest

(Kanninen 2007). From the perspective of the researcher, there are observable and unobservable qualities of utility:

$$U_{ij} = V_{ij} + \varepsilon_{ij} \quad [1]$$

An individual *i* choosing an alternative *j* receives utility, U_{ij}, where V_{ij} is the observable (or deterministic) component of utility and ε_{ij} is the unobservable (stochastic) component of utility. In random utility theory, it is assumed an individual will choose alternative *j* if $U_i > U_q$ for all $j \neq q$ (Louviere, Hensher, and Swait 2000). Therefore, the probability of choosing alternative *j* is:

$$P_{ij} = Pr(U_{ij} > U_{iq}) \quad [2]$$

It is assumed the probability of an individual choosing an alternative out of a finite set of alternatives can be determined by the individual's socio-demographic characteristics, the attributes that comprise the good, and the unobserved function of utility (Hensher, Rose, and Greene 2005), since we are unable to account for all factors involved (stochastic component of utility). The multinomial logit model (MNL) describes these relationships by assuming that individuals preferences are identical; the model error terms are assumed to be independently distributed across those individuals; and follow a Type-I extreme value distribution (Louviere, Hensher, and Swait 2000). Given the above, probability distribution is expressed:

$$P_{ij} = \frac{expV_j}{\sum_q \exp V_q} \quad (\text{for all } q \text{ in choice set C where } j \neq q) \quad [3]$$

The probability that individual *i* will choose *j* is equal to the deterministic component of utility (V_j) raised to the exponent, divided by the sum of all other observable utilities (q) raised to the exponent. Although the MNL has been the dominant application for most stated preference valuation studies throughout the 1990s, the assumption of homogeneity in preferences across respondents creates limitations in the explanatory power of the model (Colombo, Hanley, and Louviere 2009).

Latent class models (LCM) have emerged in the literature partly as a response to the theoretical limitations of the conditional or multinomial logit. Rather than assume homogeneous preferences across all respondents as in the MNL, preference

heterogeneity in LCM is obtained by assigning respondents to latent classes based on their choices while simultaneously running a MNL choice model. This subtle shift in the application of the MNL allows one to explain preference differences across individuals conditional on the probability of belonging to one of the latent classes identified by the researcher. Understanding the factors that underlie latent consumer behaviour will improve WTP estimates and highlight how the costs and benefits of policy decisions are distributed amongst stakeholders (Colombo, Hanley, and Louviere 2009). The LCM uses the same random utility found in equation [1], by including the conditional latent class as follows:

$$U_{ij|y} = \beta_y(Z_{ij} + S_i) + \varepsilon_{ij|y} \quad [4]$$

Where the utility U received by individual i from the jth alternative conditional on the individual being in group y. The Z_{ij} is the characteristic of the good or service, in this case our survey attributes, and S_i are the socio-demographic, psychometric, and attitudinal variables associated with individual i. Equation [4] above can be expanded to include 1 through to n attributes as well as S_a through to S_x socio-demographic variables used in this analysis as covariates. Probability in the latent class follows equation [2] with class membership y affecting the probability distributions:

$$P_{ij} = (P_{iy}) * (P_{ij|y}). \quad [5]$$

Where P_{iy} is the probability that individual i will be part of class y and $P_{ij|y}$ is the probability that individual i will choose alternative j conditional on membership in class y. The probability distributions of equation [5] follow the same error term assumptions described in equation [3]. Therefore, in order to account for preference heterogeneity, the MNL model becomes:

$$P_{ij} = \sum_{y=1}^{y} \left[\frac{\exp(\alpha_y S_i)}{\sum_{y=1}^{Y} \exp(\alpha_y S_i)}\right] \left[\frac{\exp(\beta_y Z_j)}{\sum_{q \in C} \exp(\beta_y Z_q)}\right]. \quad [6]$$

The first term in brackets represents the probability of observing the individual in group y. The parameter α_y is associated with the socio-demographics, attitudinal or psychometric effects S specific to group y. The second term represents the probability of choosing j conditional on membership in y. The $\beta_y$vector represents the marginal

utilities of each attribute conditional on group membership, while Z is defined as above. It is important to note that the product of the two terms is estimated simultaneously (Milon and Scrogin 2006) and if α_y = 0, than equation [6] reduces to the MNL outlined in equation [3].

3.5.2. Model with Covariates and Known Classes

Studies show that the variance explained by CEs can be increased by the inclusion of respondent's attitudes and objective norms as covariates in the model (Meyerhoff 2006; Sorice et al. 2011). These explanatory variables are used to refine the prediction of class membership in the latent class. We assessed the general public's attitudes toward the provisioning qualities of the watershed for select ES, rights and responsibilities of the private landowners toward their land, and the current and future perceptions of ES quality as it pertained to the attributes. Following Magidson and Vermunt (2005) the inclusion of covariates modifies the probability structure in equation [6]:

$$P_{ij} = \sum_{y=1}^{y} P(iy|e_i^{cov}) \prod_{t=1}^{T_i} P(ij|y). \quad [7]$$

Class membership is now influenced by a set of covariates e_i^{cov}, for which a MNL is run on covariates:

$$P(iy|e_i^{cov}) = \frac{expV_j}{\sum q\, V_q}. \quad [8]$$

For the known protester model which contains the known protester segment, let τ_i be a vector for variables containing the "known class" information for case, where τ_{iy}=0 if it is known that case I does not belong to the class and $\tau_{iy} = 1$ otherwise:

$$P_{ij,\tau_i} = \sum_{y=1}^{y} \tau_{iy}\, P(iy|e_i^{cov}) \prod_{t=1}^{T_i} P(ij|y). \quad [9]$$

3.5.3. Measuring Compensating Variation

In choice experiments the marginal utility of income is represented by the coefficient of the payment vehicle attribute, in this case the increase in annual income tax. The ratio between the negative of the cost coefficient and the coefficients of the other attributes, provide the "implicit prices" that represent the WTP for a marginal increase of the attribute, in this case the qualitative attributes of wildlife habitat, water quality, and farmer income (S Colombo, Hanley, and Louviere 2009). In our survey, by proposing hypothetical improvements to ecological service provision from private land as a result of government programs, we can calculate compensating variation. Following Hanemann (1984) estimating compensating variation is accomplished by:

$$CV = -\frac{1}{\beta cost}\,(U^A - U^B). \qquad [10]$$

CV is the compensating variation, where $\beta cost$ is the coefficient of the income tax attribute variable, and $U^A - U^B$ represent the difference in utility after the change in ES provision. When calculating compensating variation for a multinomial logit model as above, the heterogeneity of the public's values for conservation on private land is obscured. Following Milon and Scrogin (2006), in order to incorporate latent class segmentation into the calculation of compensating variation, the welfare effects associated with policy changes for each respective class is required:

$$CV_{i|y} = -\frac{1}{\beta cost\ y}\left[\ln\left(\sum_{j\epsilon J} exp\ \left(\beta_y Z_j^o\right) - \ln\ \left(\sum_{j\epsilon J} exp\left(\beta_y Z_j^1\right)\right]\right]. \qquad [11]$$

Where $\beta cost\ y$ denotes the marginal utility of income for respondents in class y. Terms Z_j^o and Z_j^1 represent the initial and post program state of the ES under consideration, respectively.

Given the law of diminishing marginal utility, the marginal utility of income should incorporate a quadratic function to take into effect the varying levels of risk an individual will respond to. For example, a risk adverse individual will exhibit a diminishing marginal utility of income while a risk preferring individual will exhibit increasing marginal utility of income. The risk neutral individual has a linear marginal utility of income. This complicates the calculation of WTP significantly since the quadratic term will cause the WTP estimates to vary with the level of the cost attribute.

Further complications arise when the levels of the cost attribute are not equidistant (as with this study) necessitating the conversion of the levels of the cost attribute to a linear scale. To remedy this, the cost levels were centered around its mean and then divided by a common denominator which is the average of the intervals between the levels. In this case the attribute's mean was subtracted from the attribute level and then scaled by 35 which was the common denominator of our cost attribute levels. Therefore, Equation [11] becomes:

$$CV_{i|y} = 35 * \left[\frac{\partial i/\partial y}{-\partial i/\partial C}\right]. \qquad [12]$$

In this case compensating variation is calculated by dividing the partial derivative of V_{iy} in Equation [11] with respect to the ES attribute by the partial derivative of the cost attribute. In order to reduce the impact of outliers in our calculations and to provide one value for ES to policy makers, we chose to substitute the mean welfare estimates of the classes and the mean of the tax levels into equation [12]. The results of these WTP calculations are found in Section 4.5 of the results chapter.

3.5.4. Choosing the number of latent classes

Determining the appropriate number of classes in a LCM is an iterative process and considered more of an art than a science (Milon and Scrogin 2006). To reduce the arbitrary nature of model selection Nylund, Asparouhov, and Muthén (2007) show that the bootstrap likelihood ratio test (BLRT) outperforms other information criteria; however it is computationally demanding and outside the scope of this analysis. Yang (2006) argues that the BIC information criterion produces the most stable results given a consistent sample size and a limited number of latent classes. Nevertheless no rigorous method exists to select the number of latent classes for CE as the application of hard-and-fast rules in determining latent class segmentation are difficult to apply in practice (Swait 1994). Following what has become the accepted best practice, the number of latent classes was determined on the basis of Bayesian Information Criterion (BIC), Akaike Information criterion (AIC and AIC3) and through researcher judgement of model interpretability (Sorice et al. 2011). The test statistics for the All-In (AI), Protesters Removed (PR), and Known Protester (KP) specifications of the CE are presented in Section 4.4.1.

4. Results

This chapter presents the results of the survey data analysis and modelling. It begins with the survey response rates followed by a comparison of the sample population's socio-demographic characteristics to the latest census data. Next, the results from the attitudinal questions which were used in the interpretation of the CE are presented. The following section of the chapter contains the results of the three latent class models and explains why the Known Protester model was selected for the calculation of the willingness to pay estimates. The chapter concludes with an examination of the WTP estimates from the Known Protester model.

4.1. Survey Response Rates

Using the addresses of pre-screened respondents provided by the telemarketing firm, 800 questionnaires were mailed to respondents in the Salmon River watershed and surrounding areas. Despite mailing the surveys during the contentious HST referendum, the total response rate was considered excellent with 454 returned surveys. Of the 454 returned surveys, 64 choice surveys were either incomplete or contained missing responses and were omitted from the analysis. The remaining 390 surveys (49%) contained 2,340 valid choice observations for estimating the latent class models.

4.2. Socio-demographics

Our survey elicited socio-demographic information after the completion of the choice task. Questions included gender, birth year, highest level of education attained, place where you grew up, working status, and household income. Table 4.1 compares our sample population with the census data for the Salmon Arm census agglomeration for the year 2006.

Table 4.1. Comparison of socio-demographic information between sample and census.

Socio-Demographic Characteristics		Sample Population (%)	Census Population (%)
Age (n=438)	0-19	0	0
	20-34	3.9	16.6
	35-49	16.3	26.7
	50-64	39.2	27.4
	65-79	28.6	20.3
	80 and over	12.0	9.0
Gender (n=454)	Male	54	46
	Female	46	54
Income (n=410)	Average	$30-$49k	$30-$49k
	Median	$50-$74k	$50-$74k
Education (n=442)	Up to High School	46.4	50.8
	University or higher	53.6	49.2

Numbers in bold denote sample population is significantly different from census population at the 5% level.

Chi-square tests showed that the sample population differed significantly from the census data with regard to age, gender, and education, while the sample did not significantly differ on income. The differences in socio-demographic characteristics did not necessitate the weighting of CE model results, since household income was the only significant socio-demographic variable used as a covariate to define the latent classes.

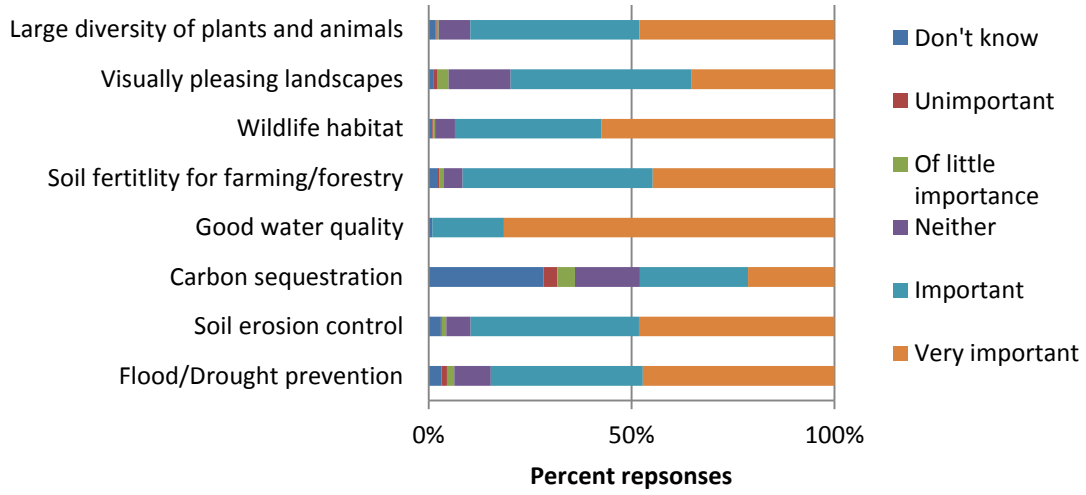
4.3. Attitudinal Responses to Land Owner Stewardship Questions

Sections one, two, and three of the survey asked respondents to rate their agreement with, or the importance of, general statements regarding ES in the watershed, land use in the watershed, and their perspectives on the state of ES in the watershed, using Likert scales. For all questions landowners were defined as people who own at least 10 acres of land and include farmers, woodlot owners, and people who own their land for other reasons. Analysis of the attitudinal results consisted of reporting the percent responses to survey questions and statements, principle component analysis of the responses and cluster analysis using the Ward Method.

4.3.1. Survey Section One: General Watershed Characteristics

Section one questioned respondents about their attitudes for ES provision (Figure 4.1). A majority of the ecosystem services were deemed important or very important with the exception of carbon sequestration which showed a polarization between ignorance (52% ranged from 'don't know' to 'neither') and importance (48% thought it 'important' or 'very important'). Water quality was overwhelmingly considered important (17%) or very important (80%), while a large diversity of plants and animals was considered important or very important by 41% and 48% of respondents respectively.

Figure 4.1. Importance of environmental services (Question 5)



A principle component analysis (PCA) revealed two components following the varimax rotation in SPSS (Table 4.2). The first component contained statements scoring a high importance for provisioning and cultural services (wildlife habitat, large diversity of plants, and animals, water quality, visually pleasing landscapes, and soil fertility for farming) while the second component captured statements related to regulating functions of ecosystems (flood control, soil erosion, and carbon sequestration). These factor scores were later used as covariates in the choice experiment. Next, using the factor scores from the PCA, Ward's cluster analysis suggested that the respondents could be grouped into two clusters. However, a graph of the results confirmed that respondents were generally homogeneous in their stated importance for the ES under

investigation, except for carbon sequestration. As a result, no cluster was attempted on question five.

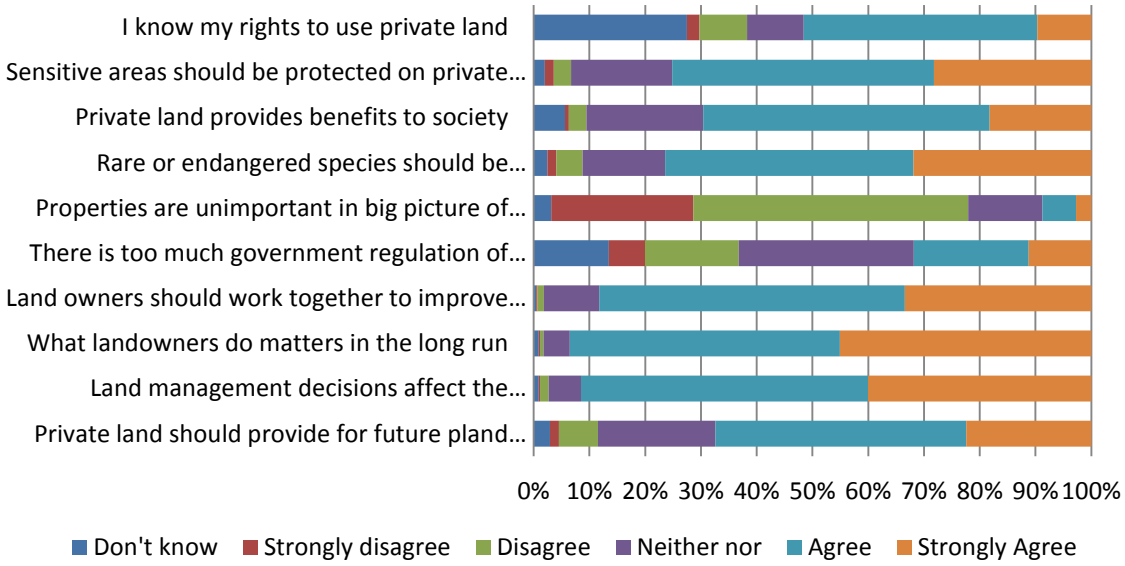
Table 4.2. PCA component loadings (Question 5)

Ecosystem Service	Component 1	Component 2
Flood/drought prevention		0.762
Soil erosion control		0.751
Carbon sequestration		0.7
Water quality	0.713	
Soil fertility for farming and forestry	0.558	
Wildlife habitat	0.831	
Visually pleasing landscapes	0.647	
Large diversity of plants and animals	0.804	

4.3.2. Survey Section Two: Land Management and Land Use

Section two of the survey solicited the general public's opinions on land management and land use within the Salmon River watershed. Question six of the survey asked respondents to rate their level of agreement about general land use and landowner stewardship responsibilities using a Likert scale (Figure 4.2). The respondents exhibit remarkable homogeneity of preferences for a majority of statements, with most respondents being in agreement either for or against the statement. An exception is the statement "there is too much government regulation of private land" where respondents appear evenly split between agreement (20%) and disagreement (17%). Consequently, this statement tested as a significant covariate in the choice model, the results of which are presented in Section 4.4.4.

Figure 4.2. Land owner's land management decisions (Question 6)

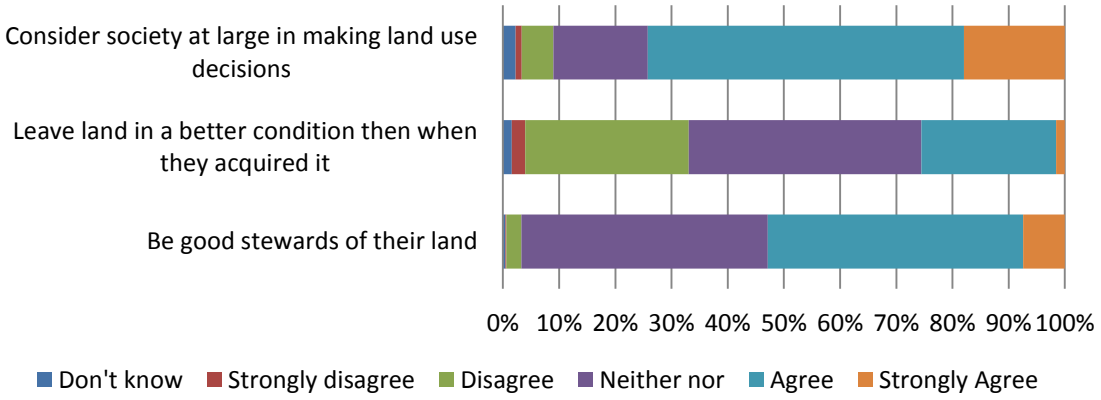


Principle component analysis identified three components (Table 4.3). Component one scored the highest importance for those statements related to conservation on private land (‘rare or endangered species should be protected on private land’, ‘sensitive areas should be protected from being altered or damaged’ and ‘private land should provide for the needs of future plant and animal populations.’) Component two contained the statement ‘Individual properties are unimportant in the big picture of all the land in the region’. While component three contained statements pertaining to landowner rights (‘I am aware of my rights with respect to my legal use of other people’s land’ and ‘There is too much government regulation of private land use’). Ward’s cluster analysis showed that the sample population could be separated into three clusters, although similar to question five, the clusters exhibited similar response patterns to the statements with only minor differences in the levels of agreement or disagreement.

Table 4.3. PCA component loading - Land owner's land management decisions (Question 6)

Land management issue:	Comp. 1	Comp. 2	Comp. 3
Private land should provide for the needs of future plant and animal populations	0.724		
Land management decisions affect the community	0.558		
What landowners do matters in the long run	0.647		
Land owners should work together to improve ES	0.63		
There is too much government regulation of private land			0.596
Properties are unimportant in big picture of the region		-0.827	
Rare or endangered species should be protected on private land	0.757		
Private land provides benefits to society			0.438
Sensitive areas should be protected on private land	0.731		
I know my rights to use private land			0.813

Figure 4.3. Landowner's stewardship responsibility (Question 7)

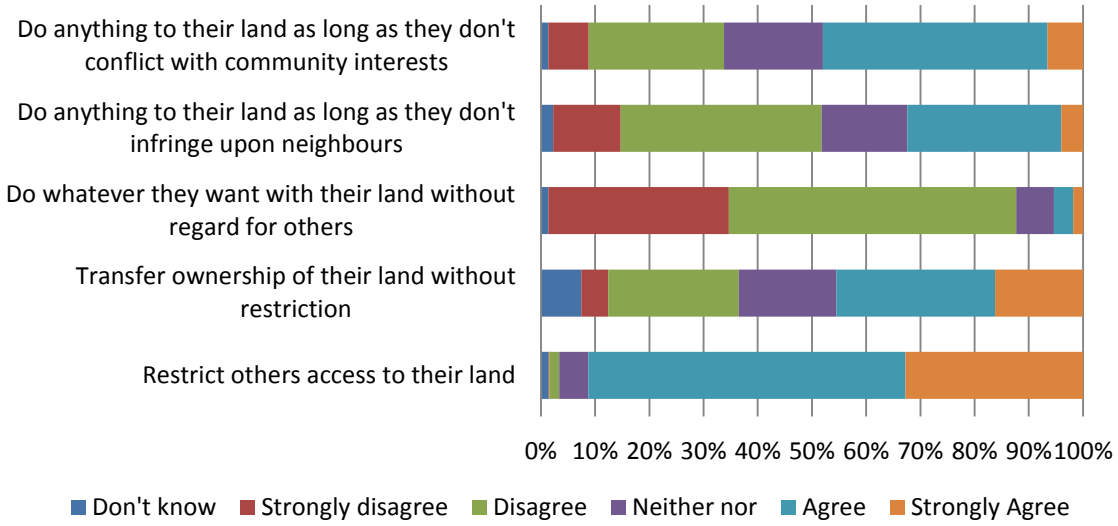


Next, respondents were asked to rate their agreement to general statements on land owner stewardship responsibilities to current and future generations. Figure 4.3 shows these results. The general public agrees that landowners should take into account the values and interests of society at large when making decisions about their land, yet they appear to be evenly split on whether or not landowners should leave the land in a better condition than when they acquired it. This split in perspectives suggests that although most residents feel landowners should consider the society at large in their

land-use decisions, a considerable portion of residents do not think it mandatory. In other words, unfettered property rights trump the rights of ES benefiters according to some of the residents of the Salmon River watershed. Meanwhile, a slight majority agreed that landowners have a responsibility to be good stewards of their land.

Statements in question eight of the survey pertain to landowner's rights to make decisions about their land. Responses exhibited a divergence from the general agreement pattern that had been seen in the questions above. Figure 4.4 shows the results of the Likert scale responses. The most contentious statements related to land use and ownership rights. The respondents were evenly split between the statements 'Do anything to their land as long as they don't conflict with community interests' (47% agreed or strongly agreed and 31% disagreed or strongly disagreed); and 'Do anything to their land as long as they don't infringe upon neighbours' (32% agreed or strongly agreed and 49% disagreed or strongly disagreed).

Figure 4.4. Landowners rights (Question 8)



Initial Eigenvalues of the PCA suggested only one component. However, an additional component was forced to make two components given that its Eigenvalue was 0.981 (Table 4.4). Component one contained statements obliging landowners to consider neighbours and community interests in their land management decisions, while component two contained statements which reinforced the rights of the landowner to make decisions without restrictions. Ward's cluster method identified 3 clusters with

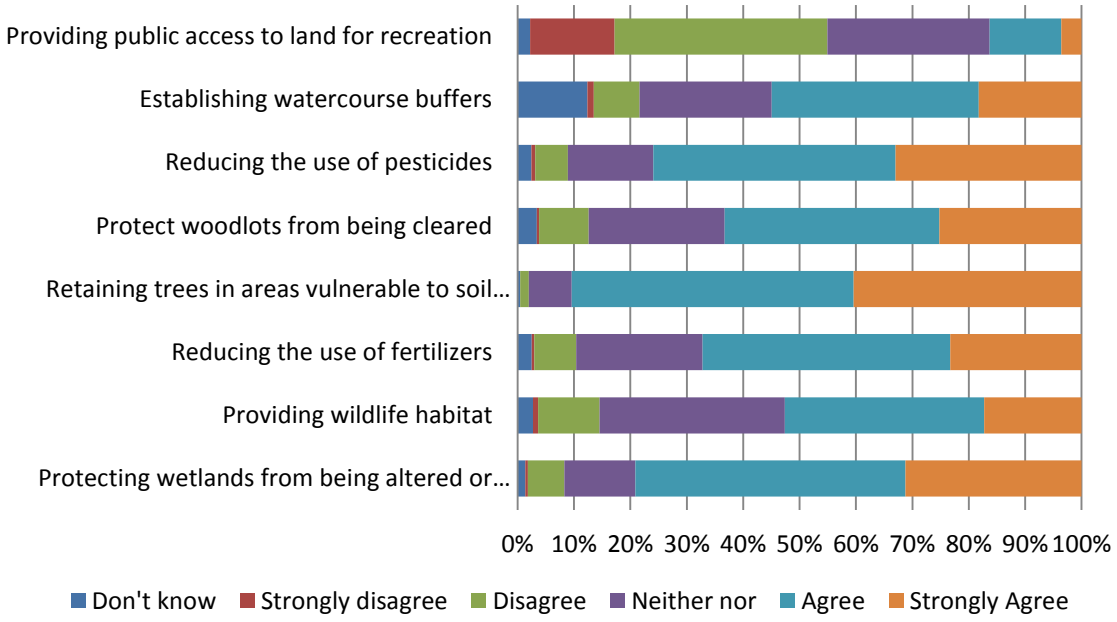
divergent attitudes to the statements '…transfer ownership of their land without restriction' and 'do anything with their land so long as their actions do not infringe upon neighbours rights'.

Table 4.4. PCA component loadings (Question 8)

Landowners have the right to…	1	2
…restrict others access to their land.		0.774
…transfer ownership of their land to others without restriction.		0.815
…do whatever they want with their land without regard for others.	0.525	
…do anything with their land so long as their actions do not infringe upon neighbours' rights.	0.789	
…do anything with their land so long as their actions do not conflict with the interests and values of the local community.	0.812	

Question 11 asked the respondent to rate their level of agreement to statements about specific land management actions that landowners have the power to make (Figure 4.5). From a review of the responses, residents feel that landowners are obliged to make changes in their land-use practices, such as reducing fertilizer use and reducing soil erosion, a part of responsible land stewardship practices.

Figure 4.5. Landowner responsibilities to public (Question 11)



Similar to the trends in questions 5, 6, 7 and 8, a majority of respondents reply in similar fashions to all of the statements. The PCA revealed two components with Eigen values greater than 1.0 (Table 4.5). Component one contained statements related to specific landowner actions which should be reduced or prohibited ('reducing the use of pesticides', 'reducing the use of fertilizers', 'protect woodlots from being cleared', and retaining trees in areas vulnerable to soil erosion'.) Component two contained statements about increasing provisioning and cultural services on private land ('Providing wildlife habitat', 'protecting wetlands from being damaged', 'establishing watercourse buffers', and 'providing public access to land for recreation).

Table 4.5. PCA component loadings (Question 11)

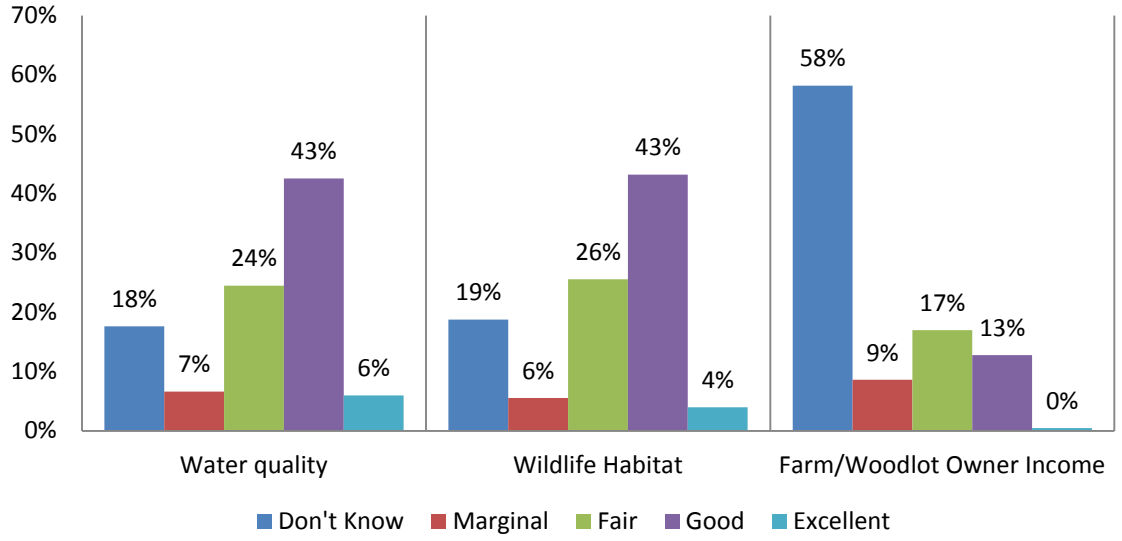
Landowners should be primarily responsible for…	1	2
…protecting wetlands from being altered or damaged	0.409	0.705
…providing wildlife habitat		0.781
…reducing the use of fertilizers	0.88	
…retaining trees in areas vulnerable to soil erosion	0.549	0.414
…protecting woodlots from being cleared	0.641	0.398
…reducing the use of pesticides	0.875	
…establishing watercourse buffers		0.659
…providing public access to land for recreation		0.598

4.3.3. Survey Section Three: State of the Salmon River

Section three of the survey solicited respondent perspectives on the current condition of the choice experiment ES attributes and their level of concern for the future condition of these services (Figure 4.6). They considered water quality in the river to be good or excellent, a quarter thought water quality to be fair; while only a small percentage judged the water quality to be 'marginal', the actual rating determined by the CCME guidelines (EC 2012). Responses to the Wildlife Habitat attribute closely followed the same pattern as water quality, however other than expert opinion no baseline measurement exists from which to compare the perceived wildlife habitat conditions to

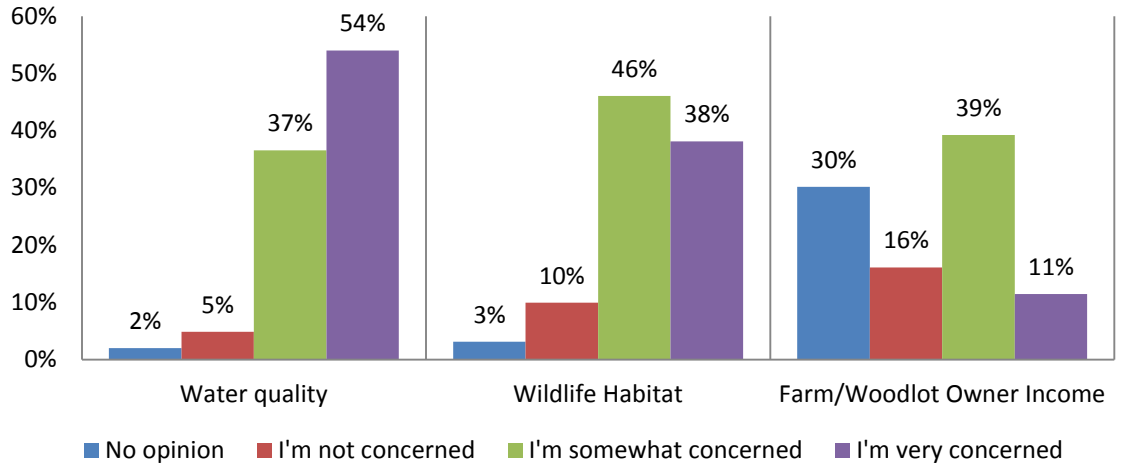
the actual one. (At the time of the writing no authoritative assessment of the wildlife habitat quality within the Salmon River was available.) Nevertheless residents appear to consider the current state of the wildlife habitat to be satisfactory. The current state of farm/woodlot owner incomes were deemed difficult to judge as over half the respondents selected 'don't know' as their response, while the remainder of respondents were distributed between good to marginal. Therefore, it can be inferred that a majority of respondents consider the current state of the ES in the watershed to be adequate. Nevertheless, the lack of knowledge regarding the current state of the ES in the watershed is not considered an impediment evaluating the value of the ES in the CE (Barkmann et al. 2008).

Figure 4.6. Perceptions of current ecosystem service quality (Question 12)



When asked about their concern for the future state of the selected ES attributes, 54% were very concerned for water quality in the valley while those who considered themselves very concerned for wildlife habitat and farmer income were 38% and 11% respectively (Figure 4.7). A large proportion of respondents (30%) had no opinion about their concern for the future income of farm and woodlot operators. Hence, the overall future condition of water quality and wildlife habitat in the watershed appears to be a serious concern for a majority of residents.

Figure 4.7. Level of concern for future condition of ecosystem services (Question 13)



The results of the current and future state questions are particularly interesting considering what residents think the water quality is and what their future concerns for the water are. Given that only 7% of respondents were aware of the current 'marginal' water quality rating, it stands to reason that if all residents were made aware of the actual rating many of the water related statements and choices in the survey would increase in importance.

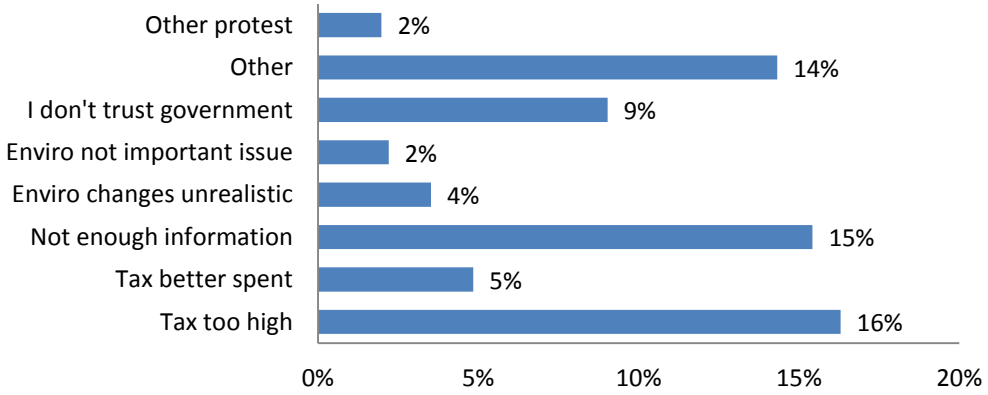
4.3.4. Evaluating respondent bias: follow-up questions

Follow-up questions are used by CE researchers to determine respondent motivations for their choices and to determine if those motivations constitute a protest response (Barrio and Loureiro 2010). Following completion of the choice tasks, respondents were asked to select a reason which best represented the motivation behind their choices from a list of statements or to write their own. Within each list of possible responses was one statement deemed to be a protest response by the research group. Selection of that response was considered a protest vote. Due to the limitations of the mail out format described earlier and concerns about respondent fatigue, the respondent was asked to answer these questions at the end of the choice model as opposed to after each choice set. Deviating from the order of the survey sections, the results of these questions are presented before the choice experiment

results in order to define the protester class which was used in the CE model estimations.

Question 26 sought explanations for any choice of the status quo (Figure 4.8). Of those respondents who chose the status quo for one or more of their choice set responses, 41 respondents (9%) chose the protest response 'I don't trust the government', suggesting that their responses were biased since the choice scenarios were contextualized as a choice between government programs to improve ES. In addition, another 9 respondent's written explanations under 'other' were deemed to be protests, for a total of 50 status quo protesters.

Figure 4.8. Explanation of status quo choices (Question 26)

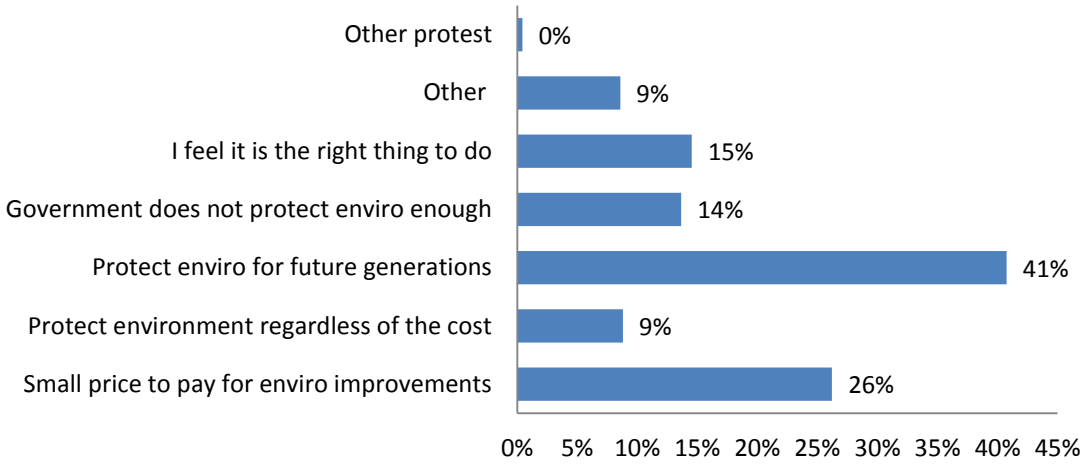


Question 27 sought explanations for any selection of the two choice alternatives, the results of which are presented in Figure 4.9. Of those respondents who chose either hypothetical choice alternatives (Program B or C), 40 respondents (9%) chose the a priori protest response 'I think we should protect the environment regardless of the cost'. Selection of this statement represented strategic behaviour on the part of the respondent. An additional two written responses were deemed to be protests for a total of 42 choice alternative protesters.

It is interesting to note that of all the respondents who selected at least one "government program" response in their choice experiment, 185 (47% of the CE respondents) selected "It is important to invest in protecting the environment for future generations," as an explanation for their choices. Although not initially intended as an

attitudinal screening question, the statement carries with it ethical connotations, suggesting that these respondents considered intergenerational equity and the right of future generations to a reasonable quality of life (Spash 2006); it also emerged as a significant covariate in the CE.

Figure 4.9. Explanation of choice alternative choices (Question 27)



In summary, protesters were identified in two ways. By their selection of one of the two post-choice experiment motivation statements or by repeatedly selecting the same answer for all six of the choice sets, be it the status quo or programs B or C. In all 24% (n=104) of the respondents were judged to exhibit potentially biased explanations of their choices, and therefore were deemed protesters.

4.4. Choice Experiment Results

This section presents the results of the choice models. Three specifications of the model were run using the definitions of protesters outlined above, in order to test for the effects of protester removal versus segmentation. The first specification contained all of the choice observations and is dubbed the “All-In” model (AI). The second model removed all of the identified protesters from the data set and was dubbed the “Protesters Removed” model (PR). In the third specification all identified protesters were assigned to the fourth class and labelled the “Known-Protester” Model (KP). The test statistics of the competing models are presented first, which were used to determine the optimal

number of classes for each model. Then the parameter estimates and the WTP calculations of the three model specifications are compared, to determine what effects the three treatment of protesters had on welfare estimates. Next, I report on why the KP model was selected as the final model. The chapter concludes with an analysis of the KP model reliability and validity tests.

In total 1, 2, 3, and 4 class models were assessed for the AI, PR and KP specifications of the choice model (Table 4-6). Each estimated latent class results in coefficient scores reflecting respondent preferences for the attributes with corresponding BIC and AIC values for the model. Wald statistics test in class significance of coefficient estimates, while the Wald(=) statistics test for significant differences between classes (Vermunt and Madgison 2005). When BIC, AIC, and AIC3 values were similar, models were selected based on model interpretability as judged by the consistency of the welfare estimates to general economic theory, distribution of respondents between classes, the significance of Wald and Wald (=) statistics, and where the quality and number of significant covariates are greatest.

Table 4.6. Test statistics for model fit of the CE

Model Type	Model #	LL	BIC(LL)	AIC(LL)	AIC3(LL)	$R^2(0)$	R^2
All-In	1-Class	-2268.694	4591.1294	4555.388	4564.388	0.1223	0.109
	2-Class	-1689.5032	3576.058	3445.0064	3478.0064	0.4238	0.4147
	3-Class	**-1572.8865**	**3486.1349**	**3259.7729**	**3316.7729**	**0.5318**	**0.5242**
	4-Class	-1499.9911	3483.6543	3161.9821	3242.9821	0.5702	0.5632
Protesters Removed	1-Class	-1572.5379	3196.4994	3163.0758	3172.0758	0.2359	0.1706
	2-Class	-1361.7737	2832.1083	2761.5474	2780.5474	0.4057	0.3546
	3-Class	**-1294.2562**	**2754.2106**	**2646.5124**	**2675.5124**	**0.5113**	**0.4689**
	4-Class	-1264.4384	2751.7124	2606.8768	2645.8768	0.5660	0.5282
Known Protesters	2-Class	-2578.3797	5272.3215	5194.7594	5213.7594	0.2024	0.1941
	3-Class	-2366.4465	4909.2773	4790.8929	4819.8929	0.3228	0.3157
	4-Class	**-2299.2886**	**4835.7838**	**4676.5773**	**4715.5773**	**0.3989**	**0.3924**
	5-Class	-2267.4161	4832.8609	4632.8322	4681.8322	0.4387	0.4325

For the AI model it appears that**,** the BIC, AIC and AIC3 suggest a 4-Class model. However, this model exhibited unstable results when run repeatedly, and had unusually high standard errors for the ASC terms of some of the classes. In Latent Gold model instability and high standard errors result from imposing too many exogenous

segments on the data (Vermunt and Magidson 2005). On the other hand, a three class model produced the most stable model with the lowest test statistics and the most interpretable results.

As with the AI model, the PR 4-class model had the best test statistics, however, the classes were less easily interpreted than the 3-class and the again proportion of respondents in the classes was less well distributed. Therefore, the 3-class PR model was retained for further analysis.

The KP model test statistics point toward a 5-class model (4 latent classes and 1 known class); however as with the AI and PR specifications, model interpretability and consistency of welfare estimates to economic theory indicated that the combination of 3 latent classes and 1 known class provided the most robust results. Therefore, the 4-Class KP model was used, which actually is most comparable to the 3-class PR model.

It is important to note that the PR model test statistics are more favourable compared to the AI and KP models. However, in determining which data treatment produces the best model outcome, erroneous conclusions could be made when consulting the model statistics only. It is essential that the researcher considers the interpretability of the model (Louviere, Hensher, and Swait 2002; Sorice et al. 2011), the consistency of welfare estimates to economic theory, model stability, and the size and proportion of individual classes when making decisions on how to treat protesters. Models which may seem loose in statistical efficiency can offer greater interpretability in return.

To summarize, the models which produced the best combination of low BIC, AIC, AIC3 values, and stable interpretable results were the AI 3-Class model, the PR 3-Class iteration, and the KP 4-class, all of which contain similar structures of the 3 latent classes, except the KP which differs only with the inclusion of the known class. Furthermore, test statistics for all models improved with the inclusion of active covariates which enhanced the definition of latent classes and improved the R^2 and $R^2(0)$ values for the model (Vermunt and Magidson, 2005).

4.4.1. Choice model results

For all three models specified above, the attributes were coded as nominal variables except for the “Additional Income Tax” attribute which was recoded in linear and quadratic terms allowing the specification of different functional forms.

As stated earlier, eliminating protest responses is intended to reduce response biases or “noise” in the data, which is purported to increase model realism by aligning observations with applied economic theory (Vatn 2004). In comparing attribute coefficients between models the effect of protester treatments is observable (Meyerhoff and Liebe 2010). My comparisons of the model parameters are approached from an exploratory position and are not formally tested through statistical analysis. Table 4.7 shows the parameter estimates of all three models, while Figure 4.10 shows the graphed welfare estimates for the model specifications and makes the exploratory comparison of model results easier.

The AI, PR and KP models share similar characteristics in that all three models contain three latent classes which can be characterized as “Aquaphiles” (Class-1),”Naturalists” (Class-2), and “Conservatives” (Class-3) respectively (Table 4.7). For all model specifications Class-1 (Aquaphiles) was drawn almost exclusively from those respondents who valued water quality highly. Class-2 (Naturalists) showed preferences for increases to wildlife habitat, water quality and farmer income, indicating they would prefer the general environmental and economic conditions in the watershed to improve. Class-3 (Conservatives) showed similar preferences to Class-2 however they exhibited a marked disutility for paying additional taxes and for declining farmer incomes. For all models, the Aquaphiles and Naturalists had positive ASC values indicating a preference for environmental improvements through government programs while the Conservatives through all three models had negative ASC terms, indicating they preferred the status quo condition for the watershed in 10 years.

Table 4.7. Results of the CE for the different protest treatments by latent classes

Attributes and Levels		All-In Model (n=390)			Protesters Removed Model† (n=281)			Known Protester Model (n=389)				Mean		
		Aqua. (n=216)	Natura. (n=95)	Conser. (n=78)	Aqua. (n=118)	Natura. (n=84)	Conser. (n=79)	Aqua. (n=120)	Natura. (n=87)	Conser. (n=78)	KP (n=104)	AI	PR†	KP
Wildlife habitat	10%	**-0.737****	**-0.485****	0.477	0.343	**-0.754****	-0.221	-0.339	**-0.724****	-0.139	**-0.207***	-0.453	-0.343	-0.367
	20%	**0.354****	**0.399****	0.402	**0.340**	**0.411****	**0.264****	**0.343****	**0.399****	**0.194****	**0.209****	0.364	0.303	0.295
	30%	**0.415****	0.086	-0553	-0.003	**0.343****	-0.043	-0.003	**0.325****	-0.054	-0.002	-0.089	0.039	0.072
Water quality	Often	**-2.269****	**-0.121****	**-0.733****	**-3.385****	**-0.589****	**-0.956****	**-3.372****	**-0.592****	**-0.874****	**-0.458****	-1.287	-1.977	-1.427
	Some.	**0.296****	**0.24****	-0.139	**0.647****	**0.297****	0.221	**0.621****	**0.315****	0.185	0.031	0.166	0.443	0.3038
	Rarely	**2.00****	-0.119	**0.872****	**2.739****	**0.292****	**0.735****	**2.751****	**0.277***	**0.689****	**0.427****	1.120	1.534	1.1229
Farm Woodlot Income	0%	0.161	**0.306****	**1.059****	0.222	**0.236****	**0.839****	0.224	**0.253****	**0.819****	-0.107	0.416	0.385	0.342
	10%	**0.290****	0.085	-0.192	**0.262***	**0.238****	0.016	**0.252***	**0.244****	-0.016	0.013	0.117	0.208	0.1379
	20%	**-0.451****	**-0.391****	**-0.867****	**-0.484****	**-0.474****	**-0.855****	**-0.475****	**-0.498****	**-0.804****	0.094	-0.532	-0.593	-0.372
Tax Linear		**-0.142****	**-0.408****	**-0.619****	**-0.393****	-0.102*	**-0.859****	**-0.387****	**-0.114****	**-0.849****	**-0.08***	-0.332	-0.372	-0.306
Tax Quadratic		**-0.138****	**-0.031****	**0.213****	**-0.107****	**-0.071****	**0.148****	**-0.11****	**-0.068****	**0.1621****	0.0116	-0.024	-0.058	-0.02
ASC		**2.876****	**0.971****	**-3.58****	**2.927****	**2.586****	**-1.279****	**2.889****	**2.499****	**-1.286****	**-1.047****	0.7944	1.955	0.9848

† The Protester Removed model wald (=) statistics for wildlife habitat and farmer income had a p-values > 0.05

**** Significant at 0.05**

*** Significant at 0.10**

The AI 3-Class model assigned 389 respondents to three latent classes as follows: 56% (n=216) belonged to Class-1, 24% (n=95) of the respondents belonged to Class-2 and 20% (n=78) belonged to Class-3. All parameters in the first class are significant at the 5% level except the status quo level for farmer income (10%). Most parameters in the second class are significant at the 5% level, while the third class has significant values for some levels of water quality and farm woodlot income only. Both the linear and quadratic tax levels and the ASC were significant at 5% confidence intervals.

The PR 3-Class model placed 42% (n=119) of the respondents into the first class., while the second class contained 30% (n=85) and the third class contained 28% (n=81) for a total of 285 choice profiles used in the PR model. Due to the smaller sample size of the PR model, both the Wildlife Habitat and the Farmer Income attributes have Wald (=) statistics above a 5% confidence interval, indicating that there are not significant differences for these attributes between classes. If the PR model was the only protester treatment being considered (as is currently the accepted best practice), I would assume preference homogeneity for these attributes and restrict the effect of Wildlife Habitat and Farmer Income to be equal across all three classes (Vermunt and Madgison, 2005). In other words the PR model suggests that residents have homogenous preferences for Wildlife Habitat and Farmer Income while the AI and the KP models maintain a richer explanation of respondent preferences.

The KP 4-Class model added all protesters as one known class while the remaining respondents were segmented according to their latent preferences (Vermunt and Magidson 2005). The first noticeable trend is the convergence of the data to the median attribute level. This is a result of the effects coding used in the Latent Gold Choice 4.0 MNL estimation procedure. A total of 389 choice profiles were separated into three latent classes and the Known Protester class. The Aquaphiles were 30% (n=120) of respondents; the Naturalists 23% (n=87) of respondents; the Conservatives 20% (n=78) of respondents; and the protesters were 27% (n=104) of the respondents. As expected the 4-Class KP iteration of the model had similar parameter estimates to the PR model since the latent classes run in the KP model were essentially the same respondents as those found in the PR model. However, the additional known class segment of protesters in the KP model increased the number of significant parameter

estimates compared to the PR model. More importantly, unlike the PR model the KP model has significant results for all of the class specific linear and quadratic tax coefficients. Finally, the parameter estimates for the KP model tend to be slightly lower than the PR models. The removal of protesters has implications for the interpretation of model results. Figure 4.10 presents the graphed coefficient results for wildlife habitat, water quality, farmer income and increases to household income tax.

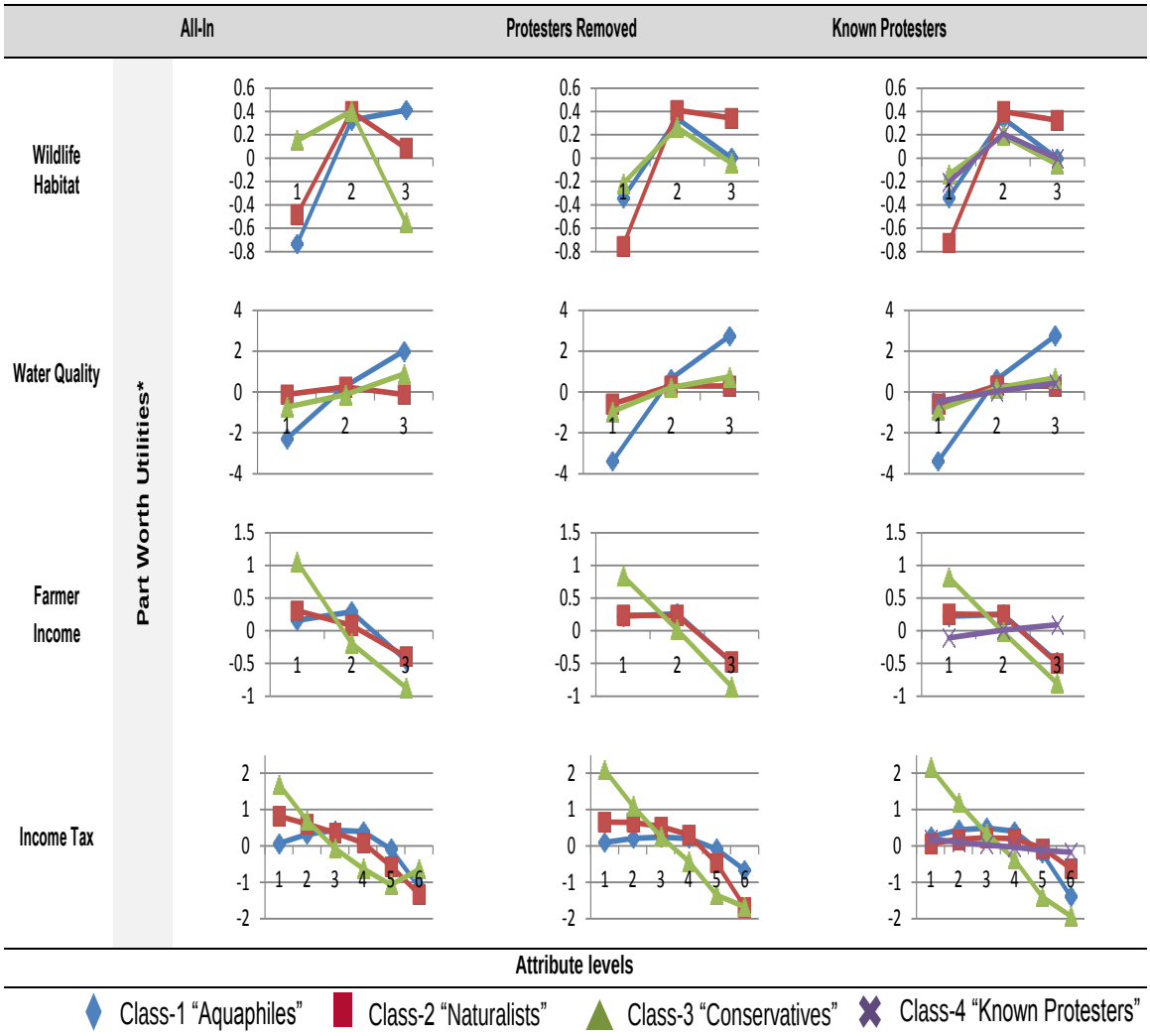
Prior to the removal of protesters, the AI-Aquaphiles had significant parameter estimates for the Wildlife Habitat attribute. Following the removal of protesters, the Wildlife Habitat attribute in both the PR and KP models became significant while the AI levels where no longer significant. The PR and the KP models showed the greatest change in parameter estimates, as both models now contained significant estimates for all levels for the Naturalists. A comparison of the PR and KP graphs in Figure 4-10 show that regardless of which protester treatment was performed, the preferences of the classes for the wildlife attribute are constant between treatments, and therefore consistent preferences may indeed be “uncovered”, as observed by Vatn 2004,1.

The removal of protesters causes the water parameters to increase substantially for Aquaphiles, while water estimates increase modestly for Naturalists and decline moderately for Conservatives in the PR and KP models, suggesting that protesters may have a declining marginal utility for water quality since by removing them the water parameters increase for all classes.

The welfare measures for farm income become more conservative in both the PR and the KP models following the removal of protesters. This could indicate a status quo bias on the part of the identified protesters and explains the changes in wildlife habitat estimates and water quality estimates between models (Meyerhoff and Liebe 2009).

The estimates for Household Income Tax decline, reflecting consistency with economic theory across all models.

Figure 4.10. Parameter estimates for CE models with different protest treatments and by latent classes.



*scale of y-axes varies for each attribute.

These varied impacts of protester trimming/segmenting are consistent with the general CE literature (Barrio and Loureiro 2010). In summary, all three model specifications exhibit similar preference heterogeneity between classes, slightly different proportions of respondents in each class (AI Class-1 being the exception at 55%), and slightly different parameter estimates for each attribute level between the treated and untreated models. These results suggest that protest responses had a negligible to modest effect on the welfare estimates (Meyerhoff and Liebe 2010). As anticipated, the KP segmentation produces similar latent class results to the PR model with the added

benefits of more comprehensive understanding of respondent preferences as a result of the additional segment. Next, I will compare the AI, PR, and KP WTP estimates to determine the effect, or lack thereof, of protester treatments on welfare estimates.

4.4.2. Willingness to Pay Results

Implicit prices from the welfare estimates in Table 4.7 were calculated using equation [12]. Allowing for the diminishing marginal utility of income the cost attribute was coded using the quadratic function. As a result, WTP varied with the level of the cost attribute. In order to compare WTP between models, the mean of the parameter for each attribute was divided by the mean of the tax attribute ($100) to calculate implicit prices (Table 4.8).

Table 4.8 Marginal Willingness to Pay for changes to ES provision by model specification

Attribute	Levels	AI Mean	PR Mean	KP Mean
Wildlife habitat	10% (SQ)	$ -	$ -	$ -
	20%	$86.17	$69.30	$75.69
	30%	$57.08	$48.56	$50.20
Water quality	Often (SQ)	$ -	$ -	$ -
	Sometimes	$153.24	$200.14	$198.14
	Rarely	$253.85	$288.54	$291.92
Farmer Income	0% (SQ)	$ -	$ -	$ -
	10%	- $31.55	- $15.05	- $11.03
	20%	- $99.98	- $ 81.31	- $69.42

The results between all three model specifications show similar trends. Respondents exhibit diminishing marginal utility for wildlife habitat, as their WTP to increase from 10% protection (Status quo) to 30% protection are lower than the estimates for 20%. Apparently the respondents are satisfied with 20% protected land in the watershed due to their heterogeneous preferences for the other attributes. It also suggests that the levels for the wildlife habitat attribute incorporated a realistic range of protection.

Given that our tax levels ranged from $25 to $200, the high implicit prices for water quality might raise some concern, as WTP values which are bounded by the tax attribute levels used are considered more reliable. However, very large WTP bids have been associated with public perceptions for a right to a clean and safe natural environment (Vadnjal and O'Connor 1994). Therefore, given the results of question five which show that 97% of respondents agreed that water quality was important or very important, and given the probabilities used in calculating implicit prices using the linear and quadratic functions, it is logical that the implicit price for water would be higher than the upper bounds of the tax levels used for the CE.

The farmer income results are deceptive, as by definition a negative implicit price value indicates the respondent is willing to accept compensation for a decline in farmer income (Equation 12). If used in compensating variation calculations for CBA, these negative values would have the perverse effect of lowering payouts to ES incentive program participants. Therefore, the farmer income WTP values are best interpreted as an expression of societal preferences to limit the impact that ES incentive programs have on farm and woodlot owners. Alternatively, the negative farmer income implicit prices could also be interpreted as the amount of compensation the public thinks landowners should receive for their loss of productive land as a result of program implementation.

4.5. The Known Protester model

So far, a comparison of the parameter estimates and of the WTP estimates between model specifications have not provided a definitive answer to which model provides the best and most justifiable results. All three specifications have conformed to the assumptions of random utility theory, have provided stable interpretable parameter estimates and reasonable implicit prices. Therefore, all parameters being equal, alternative justifications for keeping, removing, or segmenting data anomalies as a result of perceived respondent bias are required. The answer returns us to the debate between maintaining a strict utilitarian approach to modelling human choices or incorporating rights and duty based perspectives such as deontological ethics.

The purpose of CE is to provide a structured approach to analyzing human choices, enabling the modelling of preferences (Kanninen 2007). Utility theory provides the theoretical foundation for CE, yet recent progress in psychology and behavioural economics has cast doubt on utility as an all-encompassing theory through which human decisions can be evaluated (Spash 2006). Social, emotional and attitudinal dimensions of preferences have been shown to be important explanations of decision making (Lehrer 2009). Work by Vatn (2004) eloquently implores researchers to systematically incorporate the social dimensions of preference construction such as rights based ethics into their valuation models. The known protester segmentation method includes rights based ethics by considering all responses as valid ones worthy of inclusion in the model, while segmentation of the protesters enables the model to remain consistent with utility theory.

The treatment of protesters as a known segment in the LCM produces practical and theoretical benefits. Firstly, it maintains a larger sample size than eliminating protesters, which has benefits for model interpretability, model test statistics, parameter estimates, and increases the likelihood of having significant explanatory covariates.

Secondly, when one considers the expensive nature of survey work, trimming data is inefficient. For example, to recruit respondents and administer our survey cost approximately $20,000; or approximately $44 per survey before data cleaning. This figure jumps to $70 per returned survey when protesters are excluded.

Thirdly, and most importantly, it enables the inclusion of potential rights based perspectives into parameter estimates and WTP calculations. By incorporating the known protester segmentation into the CE results and WTP estimates, decision makers are given a larger breadth of information from which to form policy. From a theoretical perspective, known protester segmentation incorporates new insights from disciplines outside of economics, thereby expanding the confines of traditional choice theory.

Fourthly, protester segmentation reduces the impact of the arbitrary nature of protester identification on model estimates. Certain survey characteristics such as elicitation format, payment vehicle, and survey method are associated with increased levels of protest responses (Meyerhoff and Liebe 2010). Therefore, researchers rely on

protest screening questions to remove bias in the data. The assumption is that the protester screening procedures and questions are effective. Our questions were developed through a review of the literature and were deemed by the CWP team as effective methods for removing protesters. However, many of the statements can be interpreted in a variety of ways. For example “I would be willing to pay any cost to protect the environment” could be interpreted by the respondent as an opportunity cost to forgo development in order to protect the environment, not necessarily an out of pocket expenditure. Hypothetically this is a cost the respondent could afford and therefore the selection of this response should not constitute a protest. The statement “I do not think the environment is an important issue” was not selected as a protest response but could be interpreted to indicate that the respondent was not taking the valuation exercise seriously. For screening questions to be effective researchers must assume that their intended meaning behind the statement is shared by the respondent reading the statement. How can we be certain that this is the case? Therein lays the unobserved random component of protesting. Like the unobserved component of utility which contributes to respondent preferences, there is an unobservable component of motivation for selecting response explanations. Ultimately, we are not able to categorically determine what the respondent’s beliefs and attitudes are toward the valuation exercise. Therefore practitioners should air on the side of caution by segmenting protesters rather than removing them. By segmenting protesters into a known class we are retaining information which has positive implications for model parameters, providing additional information on community preferences.

Given the practical benefits to the sample population and model statistics listed previously, that segmenting protesters reduces the impact on model parameters of arbitrary protester screening questions, that the questions are subject to misinterpretation by the respondent and the researcher, and that respondents may be responding from a rights based perspective, the systematic known protester segmentation approach provides the best model for analyzing preferences for ES provision on private land.

4.5.1. Known Protester Coefficients, Covariates and WTP

Having addressed the appropriate treatment of protesters, I will now turn to assessing the KP model and class composition. As the results have shown, the respondents in the choice model assign a positive WTP for the survey attributes. None of the classes exhibit a positive preference for one attribute while another class exhibits a negative preference for the same thing. Therefore it could be said that the respondents in the survey have similar preferences but different priorities (Table 4.4).

The KP model exhibits similar parameter estimates to the PR model with the added benefit of improved definition between classes (all Wald (=) statistics are significant with p-values lower than 0.05) and an additional significant estimate for wildlife habitat at the 20% level.

The Aquaphiles were most likely to select one of the government programs since they had the highest positive ASC (Table 4.9). Given their high parameter estimates for water quality relative to the other latent classes, the Aquaphiles were most likely selecting the choice sets which provided the highest water quality ratings. The Aquaphiles appear to be willing to trade increases in water quality at the expense of the other attributes given the lower number of significant parameter estimates for wildlife habitat and farmer income relative to the other classes.

The Naturalists respond positively to all attributes and levels. They were likely to choose a government program indicating a positive WTP for improvements to ES in the watershed. Although they regarded all attributes as significant factors in their choice process, wildlife habitat emerged as a priority for this class. Similar to the Aquaphiles, the Naturalists seem to tolerate declines in farmer income between 10% and 15% before the trade-off with wildlife habitat and water quality becomes too great. Water quality for members of the Naturalist class was important and similar to that of the Conservatives.

The Conservatives were the only latent class to prefer the status quo as exhibited by their negative ASC value, reflecting on their disdain for paying higher taxes and for deductions in farmer income, resulting in many respondents choosing the status quo option, the only choice with no tax increase nor reductions in farmer income. However, in cases where scenarios presented positive increases to wildlife habitat and water

quality, while containing 0% decreases to farmer income, the government program was often selected. This response behaviour suggests that Conservatives took the valuation scenario seriously and were not just selecting the status quo as a form for protest.

The Known Protester class is composed of those respondents who selected one of the protest answers and/or serial non-participants. As a result, the parameter estimates are tempered by the competing viewpoints. For example, due to the amalgamated composition of the Known Protester class i.e. there are socially conservative ("I don't trust the government") and socially liberal ("I would pay any cost to protect the environment") perspectives grouped together along with the serial non-participants, estimates for the wildlife habitat are the lowest of the four classes. Water quality estimates for the KP class are show more modest preferences for improvements than the latent classes. None of the parameter estimates for farmer income were significant but their values show similar modest trends.

Table 4.9. Results of the Known Protester Model

Attribute	Level	Aquaphiles (n=119)	Naturalists (n=87)	Conservatives (n=79)	Known-Protester (n=104)	Mean
Wildlife habitat	10%	-0.339	**-0.724****	-0.139	-0.207*	**-0.3665**
	20%	**0.342****	**0.399****	**0.194****	**0.208****	**0.2946**
	30%	0.003	**0.324****	-0.054	-0.002	**0.072**
Water quality	Often	**-3.372****	**-0.592****	**-0.874****	**-0.458****	**-1.4268**
	Some	**0.621****	**0.315****	0.185	0.031	**0.3038**
	Rarely	**2.751****	**0.277****	**0.689****	**0.427****	**1.1229**
Farm Woodlot Income	0%	0.224	**0.253****	**0.819****	-0.108	**0.2342**
	10%	0.251*	**0.244****	-0.016	0.013	**0.1379**
	20%	**-0.475****	**-0.498****	**-0.804****	0.094	**-0.3721**
Tax Linear		**-0.388****	**-0.114****	**-0.849****	-0.080*	**-0.3057**
Tax Quadratic		**-0.110****	**-0.068****	**0.162****	0.012	**-0.0201**
ASC		**2.889****	**2.498****	**-1.258****	**-1.047****	**0.9848**

All attribute wald(=) are significant at 0.05 p-value

**** Significant at 0.05**

* Significant at 0.10

Using the KP model, covariates were assessed using a function in Latent Gold 4.0 to increase model strength and improve the accuracy of class membership within the model (Table 4-10) (Vermunt and Magidson, 2005). The selection of significant covariates is an iterative process since the inclusion of additional covariates to the model will have ramifications for the significance of previously assigned covariates, Wald(=) stats, and the parameter estimates within classes.

Table 4.10. Covariate parameters for the Known Protester model.

Covariate	Class-1 "Aqua"	Class-2 "Natural"	Class-3 "Conserv."	Class-4 "Known Protesters"	Wald (=)	p-value
1. Household income	**0.097****	0.024	-0.057*	**-0.063****	10.65	0.014
2. Future water conditions	0.092	0.409	**-0.49****	-0.012	5.18	0.1
3. Future habitat conditions	**-0.45****	**0.741****	-0.046	-0.244	10.75	0.013
4. Landowners should be good stewards of their land and maintain it for future generations	-0.242	**-0.442****	**0.905****	-0.221	14.63	0.0022
5. Landowners should leave land in better condition than when they acquired it	-0.094	0.129	**-0.401****	**0.366****	10.86	0.013
6. There is too much government regulation of private land use.	-0.087	**-0.191****	0.118	**0.161****	13.78	0.0032
7. PCA1 Question #5– Importance of ES – (Provisioning Services)	**0.261**	0.147	**-0.201****	**-0.206****	5.34	0.1
8. PCA1 - Question #5 – Importance of ES – (Regulating Services)	0.185	0.094	**-0.247****	-0.032	4.68	0.20
9. PCA2 – Question #11 – (Reduce use of chemicals or lower impact on land)	0.306**	-0.01	**-0.424****	0.127	10.22	0.017
10. PCA2 – Question #11 – (Increase provision of ES)	-0.117	0.038	0.017	0.062	1.10	0.78
11. CE tax levels were too high	**-2.492****	-0.733	**2.273****	**0.952****	35.32	1.E-07
12. Not enough info to make choices in CE	**-1.319****	0.199	**0.746****	0.374	9.57	0.023
13. Environment important for future generations	**0.734****	0.05	-0.115	**-0.669****	17.25	0.0006

Class-1 respondents (Aquaphiles) are more likely to belong to a higher income bracket, suggesting that they are more likely able to pay the tax values used in the CE. This assertion is supported by the fact that they did not consider the program payments as onerous. Aquaphiles also found that the information in the survey was adequate to make the decisions being asked of them suggesting that they took the valuation exercise seriously and were confident in their decisions[1]. They are generally not concerned about future habitat conditions which are possibly a reflection of their high preferences for water quality. They are likely to consider ES provisioning services important and expect landowners to behave as responsible stewards of the land and by taking action to improve ES on their land. Lastly, they were likely to agree that the environment is important to pass on in good condition to succeeding generations, reflecting a conscious consideration of the bequest value of nature and a positive attitude toward ES in the Salmon River watershed.

Fittingly, members of Class-2 (Naturalists) were likely to be concerned about the future condition of wildlife habitat in the valley, yet paradoxically they were not likely to agree to the statement "Landowners should be good stewards of their land and maintain it for future generations." Naturalists were also more likely to disagree that "there is too much government regulation of private land," suggesting they would support increased regulations being imposed on private land to protect valuable wildlife habitat.

Members of Class-3 (Conservatives) were less concerned about future water quality in the valley. They were likely to agree that landowners had a an obligation to be good stewards of their land yet that obligation did not require them to leave the land in a better condition than when they found it; a sentiment which was reiterated by their disagreement that landowners should be responsible for taking beneficial actions toward their land. Conservatives were also likely to consider the survey payment levels as too

[1] Following each choice set, respondents were asked to rate the certainty of their responses. This information was used as covariates in the choice model but did not produce any significant parameters (Brouwer et al. 2009).

high and were somewhat likely to consider the survey information provided as inadequate.

Class-4 (Known Protesters) exhibit interesting traits which contribute to the understanding of the general public's preferences for ES provision in the Salmon River watershed. First, Protesters were more likely to belong to the lower income brackets of this study. Second, they were likely to expect landowners to share a strong stewardship ethic but feel that government should not increase regulation of private land. Protesters also felt that ES provisioning services from private land were not an important environmental factor in the Salmon River Watershed. They also felt that the CE tax levels were too high and that they felt little obligation to bequest a healthy environment to the following generations.

With the expanded class definitions by use of covariates complete, I turn to the analysis of the WTP by class. The following values were calculated using equation [12] and are valuable for determining community preferences for ES provision (Table 4.11). The coefficients by which these values were calculated may also be incorporated into a decision support tool (DST). DSTs provide a structured method to assess the impact of marginal changes to ES levels through government programs. This is advantageous since the use of dollar amounts to express community preferences has been shown to improve stakeholder comprehension of complex resource management decisions (MEA, 2005).

Table 4.11. Marginal Willingness to Pay by Class

Attribute	Level	Aquaphiles	Naturalists	Conservatives	Known Protesters	Mean
Wild	10% (SQ)	$0	$0	$0	$0	$ -
	20%	$61.74	$343.79	$13.74	$181.69	$75.69
	30%	$30.42	$320.90	$3.50	$89.53	$50.20
Water	Often (SQ)	$0	$0	$0	$0	$
	Some	$361.44	$277.55	$43.67	$213.67	$198.14
	Rarely	$554.18	$265.99	$64.47	$386.44	$291.92
Income	0% (SQ)	$0	$0	$0	$0	$
	10%	$2.51	-$2.75	-$34.45	$52.57	-$11.03
	20%	-$63.28	-$229.73	-$66.92	$88.18	-$69.42

Compensating variations for the three classes were calculated by using Equation [12] and the mean tax level of $100. The Aquaphiles showed the largest WTP for water quality; the Naturalists had high WTP values for almost all levels of each attribute suggesting they fall into a more liberal subset of the population, while the Conservatives had a negative and significant ASC value meaning that they chose the status quo option at most times. As a result the Conservative parameter estimates for the specified tax level were low resulting in a low WTP for all levels. It is important to note that the quadratic coefficients for the tax levels will cause the WTP values to fluctuate between tax levels. Therefore when using the PWU from this project in any CBA the linear tax levels should be included as a separate calculation and their results compared to the quadratic estimates prior to the inclusion in the CBA.

5. Discussion

Agricultural, industrial and real estate development within the Salmon River watershed is eroding the natural capital that residents depend upon for a vast array of ecosystem services (Gwanikar *et al.* 1998). A combination of effluent runoff from farms, sedimentation in the river from forestry, and declining water levels from irrigation and climate change threaten the water quality in the river. Wildlife habitat is being encroached by real estate development, agricultural expansion, forestry operations, and increased incidences of wildfires. Accordingly, government and private incentive programs have been implemented to increase conservation of vital wildlife habitat, improve water quality and enhance other ecosystem services; however, in the literature there remains a dearth of information on what values the public ascribes to these services resulting in a potential inefficient allocation of resources (Vercammen 2011). Measuring where trade-offs between socio-economic goals and environmental goals are possible is beneficial in formulating appropriate policies for the sustainable use of resources and for use in the growing field of benefit transfer in British Columbia (Vercammen 2011). Given the diversity of stakeholders and their uses of the services that ecosystems provide, valuation methods are needed that account for heterogeneous preferences for ecosystem services

My analysis measured the general public's attitudes regarding stewardship responsibilities of landowners and assessed the willingness to pay for select ES produced by private land in the Salmon River watershed. A choice experiment was conducted, which enabled us to measure the values of our selected ES attributes separately. To improve the interpretability of our results preference heterogeneity of CE responses was explored using latent class analysis, protester segmentation, and the inclusion of socio-demographic and attitudinal covariates.

My survey solicited respondent's attitudes toward the role and responsibilities of landowners as stewards of their land. The responses displayed the general environmental attitudes of the respondents and were remarkably homogenous across the sample population. For example, in response to one question, approximately 80% or more of the sample population agreed that "Landowners should work together if it means the land would be better off," that "what landowners do today on their land will matter in the long run," and that "what landowners do on their land affects people aside from their family." These responses suggest a societal expectation that landowners should make responsible land use decisions that take into account the ES benefits community members receive through positive externalities. Yet, the responses which dealt with specific landowner actions to improve ES provision suggest that landowners should be responsible for the desired improvements on their land. It appears, attitudinally at least, that the general public does not feel obligated to contribute financially or otherwise to improve ES from private land, although they consider ES from private land to be important or very important.

The overall results of survey sections one, two and three, suggest that the general public has similar expectations of landowner stewardship responsibilities. Namely, that ES from private land are important and beneficial to the public yet landowners should be responsible for maintaining and in some cases enhancing it. Clearly this expectation is an unreasonable burden to place on landowners. Therefore, when implementing stewardship incentive programs, policy makers should strive to promote the shard benefit and subsequent shared costs these programs would bring to the watershed.

5.1. The Value of Ecosystem Services in the Salmon River Watershed

For the purposes of this discussion, only the KP model results will be considered. The results of the CE contest the prior conclusion that the general public is reluctant to support private improvements of ES with public investments in the Salmon River watershed. As the CE results indicate, residents have a positive WTP for improvements to ES on private land. Given this finding, the need to evaluate trade-offs

in a structured methodical approach becomes more pressing. Consistent with the results of Zander et al. (2010), the sample population shows positive welfare estimates for ES attribute levels that differ from the status quo, suggesting at a minimum, tacit public support for government incentive programs which pay landowners to improve ES on their land.

Water quality is of great concern for a majority of residents in the watershed. Reinforcing this fact is the positive linear relationship exhibited in the water quality parameters for all classes. In other words, the residents in the watershed have an undiminishing marginal value for increases in water quality, a phenomenon which appears to contravene economic law. Since we used the full spectrum of the CCME water quality index, it is not likely that the linear water quality parameters are a result of poorly scoped attribute levels, i.e. that our water quality parameters represented a small section of the WTP curve. An alternative explanation is that the attribute was valued from a rights and duty based perspective suggesting our results represent an intrinsic or altruistic value for water quality (Cooper, Poe, and Bateman 2004).

Attitudes and motivations aside, if the population of the Salmon River watershed is assumed to have homogenous preferences for water quality, then the value of increasing from the status quo (water quality "often threatened") to the "sometime" and "rarely" levels is $198.14 and $291.92 respectively. These results are significantly higher than those of Colombo *et al.* (2006) who found WTP values for water quality improvements from the status quo to "medium water quality" to be $18.39 and from medium to "high water quality" to be $26.27 for residents in a South Australian watershed. While Zander *et al.* (2010) suggest the general public in Australia values increases from the status quo as $162.00 and $238.00 for "ok" water quality and "good water" quality, respectively. The differences in these estimates arise from any number of variables. The cited studies pertain to regions outside of Canada, varying water quality conditions and pressures on water supply at each respective site, the varying scope of the water quality indicators, and differing analytical models utilized by each study.

Salmon River residents, measured as a homogenous group, value the increased provision of wildlife habitat at $75.69 per person per annum to increase from the status quo to 20% habitat protection, and $50.20 per person per annum to increase from the

status quo to 30% habitat protection. These positive values accord well with other valuation studies of wildlife habitat and are in similar value ranges for improvements to wildlife habitat quality (Boxall and Macnab 2000; Semeniuk et al. 2009; Czajkowski, Buszko-Briggs, and Hanley 2009). For example, in their study valuing biodiversity in Cambridgeshire England, Christie *et al.* (2006) found that WTP values for improvements to habitat ranged from $52.50 to $92.04 per annum.

When asked specifically about farmer income, respondents were generally unaware or not concerned about current economic conditions for farm and woodlot owners. However, when presented with hypothetical declines to farmer income the general public showed a distinct disdain for reductions of 20%. As stated earlier using declines in stakeholder income was not encountered in previous literature, so a comparison with other studies is impossible. Nevertheless, these results offer some initial insight into the role of altruistic attitudes in valuation.

So far respondent preferences were considered homogenous when calculating a composite value for ES. A single value is certainly simple to use by policy makers, however, our model clearly shows that respondent preferences are heterogeneous with implications for policy formation and watershed management decisions.

Similar to Zander *et al*. (2010) and Birol *et al*. (2006) the parameter estimates for each latent class enabled the definition of the classes according to respondent preferences. Members of the Aquaphiles class preferred substantial improvement to water quality at the expense of the other attributes. The Naturalists exhibited a consistent preference for improvements to all three attributes and stood out from the other classes in their preference for improved wildlife habitat characteristics. The Conservatives exhibited lower parameter estimates (preferences) for wildlife habitat, and water quality as the other classes, and differed substantially in their disutility for declines in farmer income. For the Conservatives almost no amount of decline in farmer income was acceptable as a trade-off for improvements in the ES attributes, whereas both the Aquaphiles and Naturalists are willing to trade-off up to 10% of the farmer income for improvements in ES provision.

A thorough investigation of socio-demographic covariates did not improve the definition of the latent classes with the exception of household income. Education, age, sex, and place of residence, were not significant covariates in the CE. Of the four classes, only the Aquaphiles and Known Protesters were defined by their income levels, with the former more likely to be in a higher income bracket than the latter. This observation provides further validation of the choice model results as those in a lower income bracket should have lower WTP values than those of greater means. A comparison of significant WTP estimates for wildlife habitat improvements from the status quo to 20% protection show that Aquaphiles value this change at $61.74 while the Conservatives WTP is $13.74 for the same improvement. Additionally, respondents in a lower income bracket are more likely to avoid additional payments and will tend to select the status quo option, which is expressed by a negative alternative specific constant parameter (ASC). The Known Protesters ASC parameter (-1.0467) was significantly different from Aquaphiles (2.8899), suggesting that the Known Protesters prefer not to pay for ES improvements via government incentive programs.

Another important consideration in the explanation of model parameters is the significance of the intercept in the estimated relationships. The intercept represents all unobserved sources of utility and it was significant and positive for the Aquaphiles, while comparatively the Conservatives intercept values were inverse and weakly significant (i.e. at the 10% level). These contrasting results are not surprising when further comparisons of the explanatory covariates are assessed. Aquaphiles promote the improvement of ES provisioning services, encourage the adoption of farming best management practices, and value the right of future generations to a clean and functioning ecosystem. Conservatives on the other hand, are not concerned about future water quality, promote the rights of landowners to make unilateral decisions affecting their land, and are not likely to consider ES provisioning services as important. It is likely that Conservatives feel that moving away from the status quo will undermine the rural qualities of life that contribute to their identity, while the Aquaphiles make a connection between environmental degradation and development.

In their meta-analysis of protest treatments in choice experiments Meyerhoff and Liebe (2010), show that a majority of researchers consider observations that are counter to applied economic theory as “measurement bias” and “trim” the offending examples.

The presumption of these researchers is that consistent preferences can be uncovered (Vatn 2004). However, work by Spash (2006) using the CV methodology shows that understanding the motives behind responses to stated preference studies is important for improving choice theory and in turn welfare estimates. He confirms that motives that conform to utilitarian neo-classical economic theory are important determinants of WTP, however aspects of rights and duty based motives also contribute significantly to WTP (Spash 2006). In order to incorporate both utilitarian and deontological based motives I segregated protest bids and compared the coefficient and WTP estimates between models. Retaining protesters through known class segmentation in latent class analysis has a number of practical benefits:

- It increases the sample size compared with protest trimming, thereby increasing the number of data points from which to calculate parameter estimates.
- It enables researchers to "hedge their bet" that their protest screening questions are effective.
- It bridges the divide between utility and deontological ethics, thereby expanding the theory from which choice experiments are derived.

Attitudes, perceptions, rights and beliefs have implications for WTP results (Spash 2006; Meyerhoff 2006; Adamowicz et al. 1997; Christie et al. 2006). Understanding public preferences for ES is complicated by differences in attitudes and norms about the environment, differing opinions on the roles that public and private entities play in conservation efforts, and varying perceptions of ecosystem conditions (Milon and Scrogin 2006). Relationships between environmental attitudes and welfare estimates can be confirmed by testing attitudinal covariates in the choice model. Milon and Scrogin (2006) use a composite score of responses to environmental questions, dubbed the general environmental attitude index (GENV) and discover that positive GENV factor scores are significant covariates for class definition. Similarly, attitudinal covariates in our choice model, such as concern for future habitat conditions, the importance of ES provisioning services, and the importance to pass on a healthy environment for future generations were positively associated with the water loving and habitat loving classes.

5.2. Management Implications

A primary goal of this project is to contribute to conservation efforts in the Salmon River watershed by providing policy makers with structured analysis of community preferences for the provision of ES from private land. The results of this project may prove valuable for different government, ENGOS, and industry groups who are looking to implement incentive based conservation programs.

First, segmentation of residents into defined stakeholder groups is valuable information when drafting policy and making land use decisions. Understanding heterogeneous preferences increases the likelihood that resource and land-use management decisions will appeal to a larger body of the populace; as opposed to the homogeneous approach where decisions are made to appeal to an "average" citizen.

Second, any incentive program should focus on improving ES which contribute to improved water quality, since this attribute appears to be sacrosanct for a majority of respondents. One of the best ways in which to improve water quality is to re-establish water course buffers by remediating riparian habitat. Expanding riparian habitat has many symbiotic benefits for other valuable ES, such as improved water quality, fish habitat, bird habitat, aesthetics, and increased recreation opportunities.

Third, although the general public's WTP is positive for ES improvements on private land, their responses from the attitudinal sections suggest the implementation of farming best management practices are predominantly the responsibility of the landowner. Therefore, in implementing incentive programs aimed at improving stewardship best practices and improving ES on private land, administrators should consider public awareness campaigns that recognize farmers for their efforts and which educate the public on the costs incurred by the farmer for improving ES and the benefits they receive from these efforts. The fact that some respondents were sensitive to changes in the Farmer Income attribute suggests that, given the right marketing, the general public would respond positively to programs that compensate farmers for their stewardship efforts.

Fourth, residents appear satisfied that the environmental conditions in the watershed are adequate, despite the current marginal rating for water quality and the

declining numbers of wildlife in the area. Meanwhile, their general level of concern for future ES conditions in the watershed is high. These factors taken together suggest a cognitive dissonance; therefore incentive programs to improve ES in the watershed are not only warranted but would receive public support, in the long run if not in the short term.

Lastly, the inclusion of a known protester class has interesting implications for management decisions. Given that the protesters in this study were an agglomeration of three different types of protesters, definitive recommendations on how to interpret their parameter estimates are difficult. In general, the Known Protester class has similar preferences for water quality and wildlife habitat, while their preferences for farmer income and their WTP are inconclusive.

5.3. Limitations

As noted earlier in this discussion, valuing the environment is challenging and fraught with theoretical pitfalls. Despite the best intentions of researchers, all valuation work contains structural and theoretical weaknesses which may result in the full value of the goods in question being under or overvalued. At the heart of this debate is the theory of random utility and human decision making. Recent work in the fields of behavioural economics casts doubt on utility theory by suggesting our decisions are guided by more nuanced factors like peer pressure and social conformity rather than just the sum of a goods useful attributes such as color, make, model, and cost. In addition to the utility our decisions provide us, they make statements about our ethical makeup, our moral persuasions, and a belief in an unalienable right to certain goods and services. Watersheds provide public goods, without which all other products would be impossible to produce. It stands to reason, that given our reliance upon nature's services any effort to put a price on them may evoke strong perhaps even irrational opinions and responses.

A challenge to acting on the results of this project is the potential for the welfare measures to be misinterpreted. In the context of this project, the implicit prices of the attributes represent the level of support for conservation work to protect and enhance

these assets on private land. Although the estimated values suggest that all of the wildlife habitat and water quality in the watershed is worth $75.69 and $198.14 per household respectively, these values are not representative of the total value of ES produced by the watershed. Since our study had only two ES attributes, it is recommended that further valuation work of more specific ES be undertaken, if the values from this study are going to be used for the setting of incentive payments in future conservation programs.

A central topic of this paper is the practical and theoretical benefits of known class segmentation of protesters. It is important to note that this segmentation approach was developed during the more routine modelling outlined by Louviere (2001) and not prior to the survey design and implementation. Despite placing the proverbial cart before the horse in developing the known protester analysis, I am confident that the results and conclusions are sound and anticipate that further studies which adopt this method will come to similar conclusions as this one.

6. Conclusion

Estimating the contribution of private land to the ecosystem service bottom-line is complex and challenging, but necessary for the efficient management of watershed resources and in determining future land-use plans. Tangible benefits can be reaped by including public preferences into resource and environmental planning, as it is the public who covers the costs of poor management decisions or reap the benefits of good ones. To this end we examined the attitudes and values that the general public place toward ecosystem services produced by the Salmon River watershed. Through the theoretical lens of total economic value and by analyzing survey responses from the randomly sampled population of watershed residents using a Latent Class Choice Model, we were able to calculate the welfare received by the general public from the ES produced by private land.

From a theoretical perspective, it was shown that the segmentation of protesters produced stable comparable results to the current best practice of eliminating them from the data. The Known Protester segmentation approach has a number of theoretical and practical benefits for CE analysis and should be explored in further research.

The results suggest that the general public values good water quality and increased conservation of wildlife habitat, although these values were tempered by concerns for farmer income. According to their survey responses and estimated preferences for the ES attributes, water quality in the Salmon River should be managed until it reaches a state where it is rarely threatened, and conservation of wildlife habitat should reach at a minimum 15% of the land mass, all without affecting the ability of farmers to make a living on their land.

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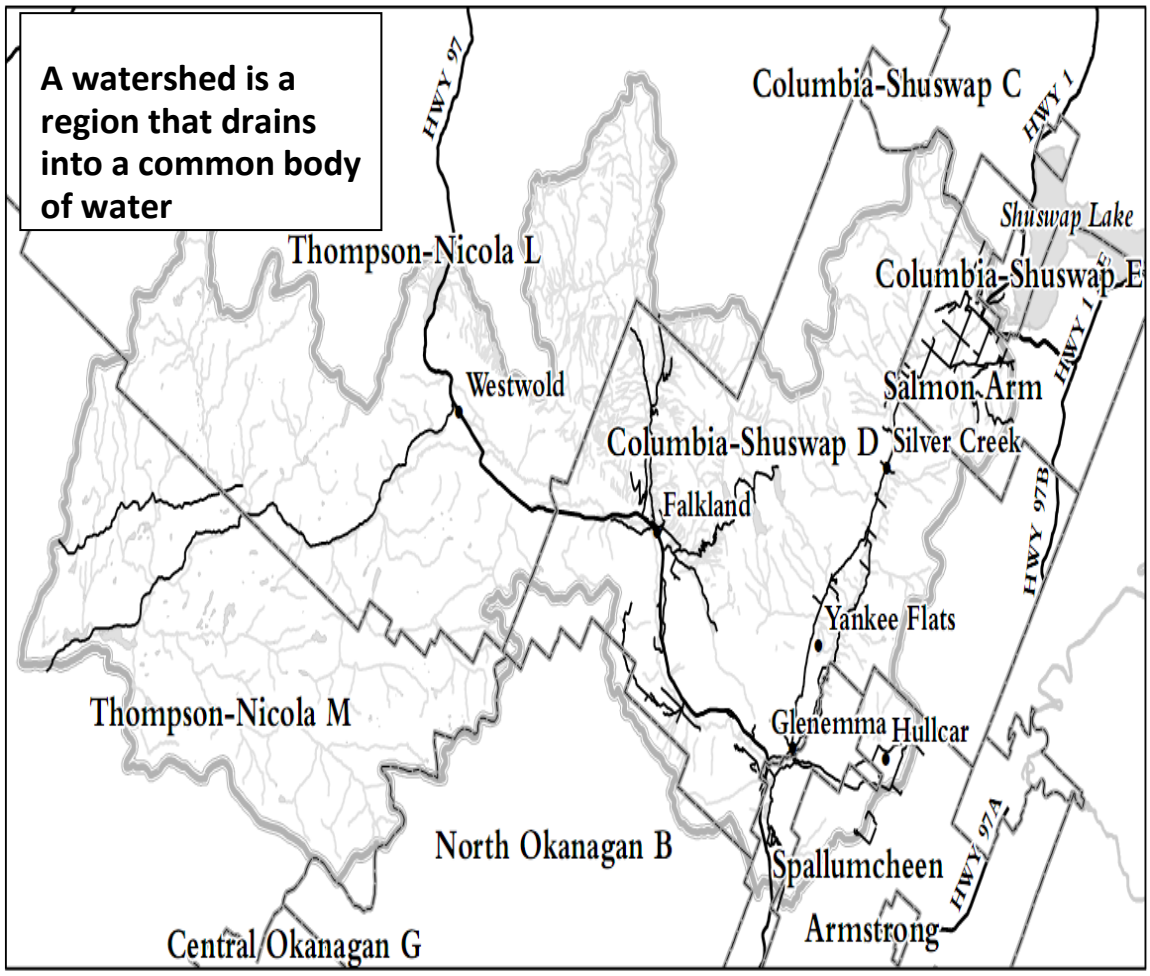
Appendices

Appendix A – Complete Survey Example

Survey of Public Views on the Environment in the Salmon River Watershed, BC



When you have completed this survey, please place it in the postage-paid envelope provided in your package and drop-off in the mail. Thank you!

Section 1: Your Watershed

1. Where do you live in relation to the Salmon River watershed?
Please refer to the map on the back of the letter to help you answer this question, and check one box only.

Within watershed ☐ Outside watershed ☐ I don't know ☐

2. Do you own a farm or a woodlot in the region?
Please check the box that corresponds with your answer.

Farm ☐ Farm and Woodlot ☐
Woodlot ☐ Neither ☐

3. Are you a member of any of the following types of organizations or associations?
Please check all boxes that apply.

Environmental/conservation ☐ ATV/snowmobile ☐
Hunting/fishing ☐ Farm commodity producer ☐
Landowner ☐ Forestry producer ☐

4. Over the past 12 months have you participated in any of the following outdoor activities within the Salmon River Watershed? *Please check all that apply.*

Hunting	☐	Swimming	☐	Snowshoeing	☐
Fishing	☐	Boating	☐	X-Country Skiing	☐
Camping	☐	Berry/Mushroom picking	☐	Snowmobiling	☐
Biking	☐	Bird watching	☐	Other Motor Sports	☐
Running/Walking/Hiking	☐	Horseback riding	☐	Other	☐

5. In your opinion, how important is it to have each of the following in your watershed region? *For each item, please check the box that corresponds with your answer.*

	Very important	Important	Neither important or unimportant	Of little importance	Unimportant	Don't know
Flood/Drought prevention	☐	☐	☐	☐	☐	☐
Soil erosion control	☐	☐	☐	☐	☐	☐
Carbon sequestration	☐	☐	☐	☐	☐	☐
Good water quality	☐	☐	☐	☐	☐	☐
Soil fertility for farming/forestry	☐	☐	☐	☐	☐	☐
Wildlife habitat	☐	☐	☐	☐	☐	☐
Visually pleasing landscapes	☐	☐	☐	☐	☐	☐
Large diversity of plants and animals	☐	☐	☐	☐	☐	☐

Section 2: Your Opinion on Land Management and Land Use Within the Salmon River Watershed

The following questions are about your opinion on landowners and their land use in the watershed. Landowners are people who own at least 10 acres of land and include farmers, woodlot owners, and people who own their land for other reasons.

6. To what extent do you agree or disagree with each of the following statements?
For each statement, please check the box that corresponds with your answer.

	Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly Disagree	Don't know
Private land should provide for the needs of future plant and animal populations	☐	☐	☐	☐	☐	☐
What landowners do on their own land affects people aside from their family	☐	☐	☐	☐	☐	☐
What landowners do today on their land will matter in the long run	☐	☐	☐	☐	☐	☐
Landowners should work together if it means the land would be better off	☐	☐	☐	☐	☐	☐
There is too much government regulation of private land use	☐	☐	☐	☐	☐	☐
Individual properties are unimportant in the big picture of all the land in the region	☐	☐	☐	☐	☐	☐
Rare or endangered species should be protected on private land	☐	☐	☐	☐	☐	☐
Private land provides benefits to society	☐	☐	☐	☐	☐	☐
Sensitive areas on private land should be protected from being altered or damaged	☐	☐	☐	☐	☐	☐
I am aware of my rights with respect to my legal use of other people's land	☐	☐	☐	☐	☐	☐

7. To what extent do you agree or disagree with each of the following statements?
For each statement, please check the box that corresponds with your answer.

Landowners have a responsibility to…	Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly Disagree	Don't know
… be good stewards of their land and to maintain it in a good condition for future generations	☐	☐	☐	☐	☐	☐
… leave the land in a better condition than when they acquired it	☐	☐	☐	☐	☐	☐
… take into account the values and interests of society at large when making decisions about their land	☐	☐	☐	☐	☐	☐

8. To what extent do you agree or disagree with each of the following statements?
For each statement, please check the box that corresponds with your answer.

Landowners have the right to…	Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly Disagree	Don't know
…restrict others access to their land	☐	☐	☐	☐	☐	☐
…transfer ownership of their land to others without restriction	☐	☐	☐	☐	☐	☐
…do whatever they want with their land without regard for others	☐	☐	☐	☐	☐	☐
…do anything with their land so long as their actions do not infringe upon neighbours' rights	☐	☐	☐	☐	☐	☐
…do anything with their land so long as their actions do not conflict with the interests and values of the local community	☐	☐	☐	☐	☐	☐

9. Do you feel the public should be able to use private land for each of the following activities? *Please check one box per item.*

	Yes, it is the public's right	**Yes**, but only with landowner permission	**No**, this use should not be allowed
Walking	☐	☐	☐
Hunting	☐	☐	☐
Gathering berries, mushrooms, etc. for personal use	☐	☐	☐
Gathering berries, mushrooms, etc. for commercial use	☐	☐	☐
Operating recreational motorized vehicles	☐	☐	☐
Accessing water for recreational purposes	☐	☐	☐
Camping	☐	☐	☐

10. To what extent do you agree or disagree with each of the following statements?
For each statement, please check the box that corresponds with your answer.

Landowners should be primarily responsible for…	Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	Don't know
Protecting wetlands from being altered or damaged	☐	☐	☐	☐	☐	☐
Providing wildlife habitat	☐	☐	☐	☐	☐	☐
Reducing the use of fertilizers	☐	☐	☐	☐	☐	☐
Retaining trees in areas vulnerable to soil erosion	☐	☐	☐	☐	☐	☐
Protecting woodlots from being cleared	☐	☐	☐	☐	☐	☐
Reducing the use of pesticides	☐	☐	☐	☐	☐	☐
Establishing watercourse buffers	☐	☐	☐	☐	☐	☐
Providing public access to land for recreation	☐	☐	☐	☐	☐	☐

11. Are there any activities or actions that you would like to be able to prevent landowners in the watershed from doing on their own land*?*
If so, please write them in the space provided below.

Section 3: Your Perspective on the State of the Salmon River Watershed

The Salmon River watershed provides many environmental, social, and economic services. These include fresh water, wildlife habitat, and farm/woodlot owner incomes among others.

However, some citizens are concerned that recent trends in economic activity are threatening the watershed's ability to supply these services.

12. In your opinion, how would you describe the <u>current state</u> of the watershed in terms of each of the statements below? *Please check one box per item.*

	Excellent	Good	Fair	Marginal	Don't know
Water quality is:	☐	☐	☐	☐	☐
Wildlife habitat is:	☐	☐	☐	☐	☐
Recreation opportunities are:	☐	☐	☐	☐	☐
Farm/Woodlot owner incomes are:	☐	☐	☐	☐	☐

13. How concerned are you about the <u>future state</u> of the watershed in terms of the following aspects? *Please check one box per item.*

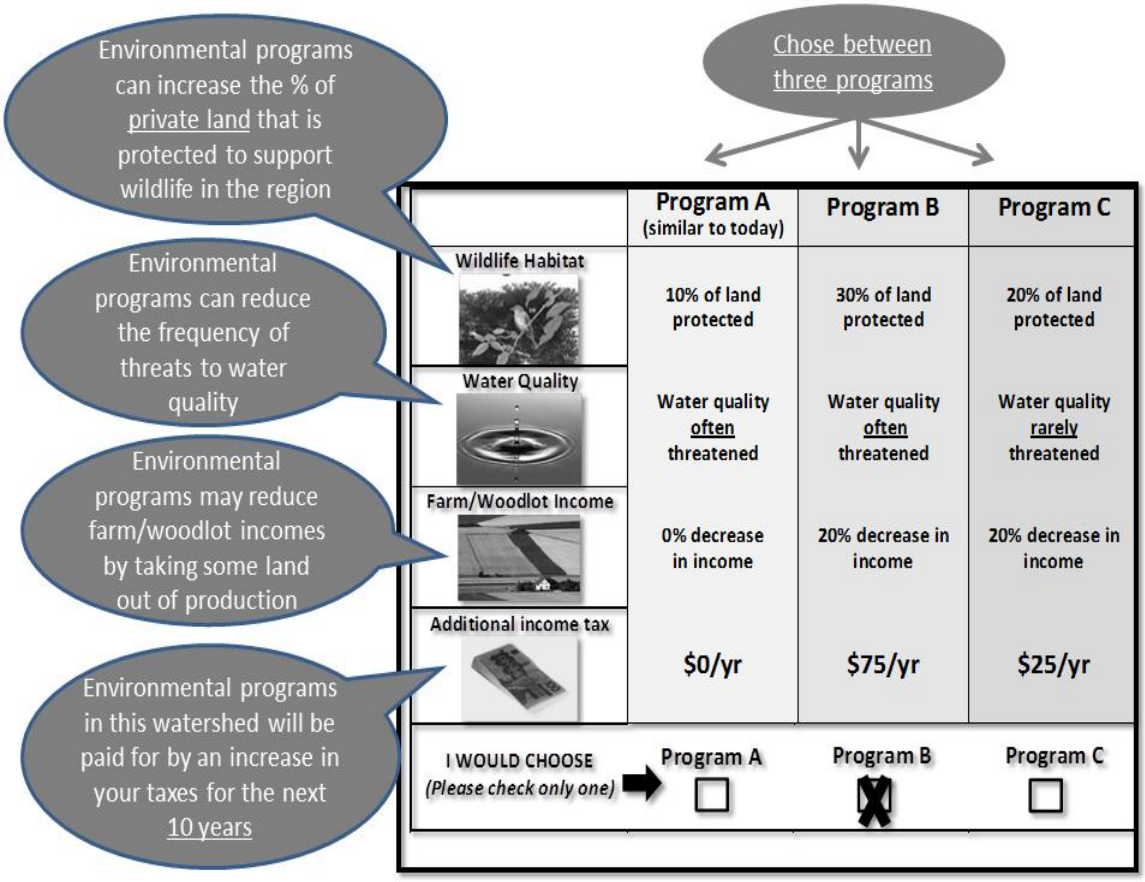
	I'm very concerned	I'm somewhat concerned	I'm not concerned	No opinion
Water quality:	☐	☐	☐	☐
Wildlife habitat:	☐	☐	☐	☐
Recreation opportunities:	☐	☐	☐	☐
Farm/Woodlot owner incomes:	☐	☐	☐	☐

Section 4: Your Preferences for Environmental Stewardship Programs in the Salmon River Watershed

Environmental conditions in the watershed can be maintained and/or improved through various government-funded environmental stewardship programs.

On the following pages, we will ask you to choose between different programs that would improve environmental conditions 10 years from now in the watershed. Each question will ask you to choose 1 of 3 environmental stewardship programs: A, B, or C.

Example:



Please assess each of the following 6 Choice Sets and choose your preferred option.

Consider each set independently and imagine that you would have to actually dig into your household budget and pay the additional taxes.

CHOICE SET 1:

14. If Programs A, B, and C below were the only ones available in the watershed, which one would you choose?
Please check the box that corresponds with your answer.

	Program A (similar to today)	Program B	Program C
Wildlife Habitat 	10% of land protected	30% of land protected	10% of land protected
Water Quality 	Water quality <u>often</u> threatened	Water quality <u>often</u> threatened	Water quality <u>rarely</u> threatened
Farm/Woodlot Income 	0% decrease in income	20% decrease in income	20% decrease in income
Additional income tax 	$0/yr	$75/yr	$25/yr
I WOULD CHOOSE *(Please check only one)* ➡	Program A ☐	Program B ☐	Program C ☐

15. How certain are you about the program choice you made above?

☐	☐	☐	☐	☐
Certain	Somewhat Certain	Somewhat Uncertain	Uncertain	Don't Know

CHOICE SET 2:

16. If Programs A, B, and C below were the only ones available in the watershed, which one would you choose?
Please check the box that corresponds with your answer.

	Program A (similar to today)	Program B	Program C
Wildlife Habitat 	10% of land protected	20% of land protected	10% of land protected
Water Quality 	Water quality <u>often</u> threatened	Water quality <u>rarely</u> threatened	Water quality <u>sometimes</u> threatened
Farm/Woodlot Income 	0% decrease in income	10% decrease in income	0% decrease in income
Additional income tax 	$0/yr	$25/yr	$50/yr
I WOULD CHOOSE *(Please check only one)* ➡	Program A ☐	Program B ☐	Program C ☐

17. How certain are you about the program choice you made above?

☐	☐	☐	☐	☐
Certain	Somewhat Certain	Somewhat Uncertain	Uncertain	Don't Know

CHOICE SET 3:

18. If Programs A, B, and C below were the only ones available in the watershed, which one would you choose?
Please check the box that corresponds with your answer.

	Program A (similar to today)	Program B	Program C
Wildlife Habitat 	10% of land protected	20% of land protected	30% of land protected
Water Quality 	Water quality <u>often</u> threatened	Water quality <u>sometimes</u> threatened	Water quality <u>rarely</u> threatened
Farm/Woodlot Income 	0% decrease in income	20% decrease in income	0% decrease in income
Additional income tax 	$0/yr	$100/yr	$200/yr
I WOULD CHOOSE *(Please check only one)* ➡	Program A ☐	Program B ☐	Program C ☐

19. How certain are you about the program choice you made above?

☐	☐	☐	☐	☐
Certain	Somewhat Certain	Somewhat Uncertain	Uncertain	Don't Know

CHOICE SET 4:

20. If Programs A, B, and C below were the only ones available in the watershed, which one would you choose?
Please check the box that corresponds with your answer.

	Program A (similar to today)	Program B	Program C
Wildlife Habitat 	10% of land protected	20% of land protected	20% of land protected
Water Quality 	Water quality <u>often</u> threatened	Water quality <u>often</u> threatened	Water quality <u>often</u> threatened
Farm/Woodlot Income 	0% decrease in income	0% decrease in income	20% decrease in income
Additional income tax 	$0/yr	$50/yr	$200/yr
I WOULD CHOOSE *(Please check only one)* ➡	Program A ☐	Program B ☐	Program C ☐

21. How certain are you about the program choice you made above?

☐	☐	☐	☐	☐
Certain	Somewhat Certain	Somewhat Uncertain	Uncertain	Don't Know

CHOICE SET 5:

22. If Programs A, B, and C below were the only ones available in the watershed, which one would you choose?
Please check the box that corresponds with your answer.

	Program A (similar to today)	Program B	Program C
Wildlife Habitat 	10% of land protected	10% of land protected	30% of land protected
Water Quality 	Water quality <u>often</u> threatened	Water quality <u>often</u> threatened	Water quality <u>sometimes</u> threatened
Farm/Woodlot Income 	0% decrease in income	20% decrease in income	0% decrease in income
Additional income tax 	$0/yr	$25/yr	$75/yr
I WOULD CHOOSE *(Please check only one)* ➡	Program A ☐	Program B ☐	Program C ☐

23. How certain are you about the program choice you made above?

☐	☐	☐	☐	☐
Certain	Somewhat Certain	Somewhat Uncertain	Uncertain	Don't Know

CHOICE SET 6:

24. If Programs A, B, and C below were the only ones available in the watershed, which one would you choose?
Please check the box that corresponds with your answer.

	Program A (similar to today)	Program B	Program C
Wildlife Habitat 	10% of land protected	20% of land protected	30% of land protected
Water Quality 	Water quality <u>often</u> threatened	Water quality <u>sometimes</u> threatened	Water quality <u>often</u> threatened
Farm/Woodlot Income 	0% decrease in income	10% decrease in income	10% decrease in income
Additional income tax 	$0/yr	$75/yr	$150/yr
I WOULD CHOOSE *(Please check only one)* ➡	Program A ☐	Program B ☐	Program C ☐

25. How certain are you about the program choice you made above?

☐	☐	☐	☐	☐
Certain	Somewhat Certain	Somewhat Uncertain	Uncertain	Don't Know

26. If you chose Program A (similar to today) as an answer for <u>any</u> of the Choice Sets 1 to 6 above, why did you choose so?

Please check <u>the one</u> explanation that most affected your choices above

"The increase in annual income taxes was too high"	☐
"I think tax money could be better spent on other issues"	☐
"I do not have enough information to make this decision"	☐
"The proposed environmental changes were unrealistic"	☐
"I do not think the environment is an important issue"	☐
"I don't trust the government"	☐
Other: _____ _____	☐

27. If you chose either Program B or C as an answer for <u>any</u> of the Choice Sets 1 to 6 above, why did you do so?

Please check <u>the one</u> explanation that most affected your choices above

"I think that this is a small price to pay for the environmental improvements"	☐
"I think we should protect the environment regardless of the cost"	☐
"It is important to invest in protecting the environment for future generations"	☐
"I think our government does not do enough to protect our environment"	☐
"I feel it is the 'right thing' to do"	☐
Other: _____ _____	☐

Section 5: Your Personal Characteristics

This section will assist us with our statistical analysis. Responses to these questions and all other questions will be treated anonymously.

28. What is your gender?

Female ☐ Male ☐

29. In what year were you born? *Please indicate the year in the space provided below.*

_____

30. What is the highest level of education that you have completed?
Please check one box.

31.

Elementary school ☐ Post-secondary (diploma or bachelors degree) ☐
High school ☐ Graduate university degree (Masters or PhD) ☐

31. How would you best describe the place where you grew up and the place where you have lived most of your adult life?
Please check one box only for each item below.

	Urban	Suburban	Rural
Where I grew up:	☐	☐	☐
Where I have lived most of my adult life:	☐	☐	☐

32. Which of the following best describes your present employment status?
Please check one box only.

Working full time ☐ Not currently working ☐
Working part time ☐ Retired ☐

33. What is your best estimate of your total household income over the past 12 months?
Please check one box only.

Less than $10,000 ☐ $30,000 to $49,999 ☐ $75,000 to $99,999 ☐
$10,000 to $29,999 ☐ $50,000 to $74,999 ☐ More than $100,000 ☐

34. Where were you born?
Please check one box only.

Born in Canada ☐
Not born in Canada ☐ ➡ **In what year did you arrive in Canada?**
_____

35. Do you use any of following water saving devices?
Please check all that apply.

Low flow faucets ☐ Efficient sprinkler nozzles ☐
Low flow toilets ☐ Water meter ☐
Other: _____ ☐

36. To what extent do you agree or disagree with each of the following statements?
For each statement, please check the box that corresponds with your answer.

Landowners who irrigate their fields…	Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly Disagree	Don't know
…use water efficiently	☐	☐	☐	☐	☐	☐
…use water efficiently to improve stream and river flows	☐	☐	☐	☐	☐	☐
…use water efficiently to improve their own crops	☐	☐	☐	☐	☐	☐

Comments:

End of Survey, Thank You!!