ESTIMATING WILLINGNESS TO PAY FOR THE PRESERVATION OF THE ALFRED BOG WETLAND IN ONTARIO: A MULTIPLE BOUNDED DISCRETE CHOICE APPROACH

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A Thesis submitted to the Faculty of Graduate Studies and Research in partial fulfillment for the requirements for the degree of Master of Science

September 2002

Your file Votre référence
ISBN: 0-612-85830-8
Our file Notre référence
ISBN: 0-612-85830-8

ABSTRACT

The Alfred Bog wetland is the largest high quality bog ecosystem and one of the most important natural areas in southern Ontario. The 4,200 hectare bog provides habitat to a large number of rare and endangered species and plays an integral role as a natural water filter. This study used the contingent valuation survey method to estimate respondents' willingness to pay for the preservation of the Alfred Bog wetland, which is threatened by the competing activities of drainage, burning, and the extraction of peat. A multiple bounded discrete choice model was used to analyze the survey results. Results indicated that respondents were willing to pay an average of $79.22, in the form of a one-time voluntary contribution to a hypothetical preservation fund, for the preservation of the Alfred Bog wetland. Conservation club membership, visits to the bog, donations to wetland preservation programs, attitudes, distance from the bog, household income, and education level were found to be important predictors of willingness to pay. Aggregate willingness to pay to preserve the bog was estimated to be between $2.2 million to $663,000 depending upon the inclusion or exclusion of protest bids. The survey results suggested that most of this value was nonuse value attributed to option, bequest, and altruistic values. Thus, the failure of policy makers and resource managers to consider nonuse values in decision making processes can understate the value of preserving the Alfred Bog.

RÉSUMÉ

Les terres humides de la Tourbière d'Alfred renferment le plus grand ecosystème de tourbière de qualité du sud de l'Ontario en plus d'être un des plus important site naturel de la région. Les 4,200 hectares de tourbière procurent un habitat pour plusieurs espèces en voie de disparition et sert également de filtre naturel pour l'eau. Cette étude est basée sur un sondage suivant la méthode d'évaluation contingente pour estimer la volonté de payer des répondants pour préserver la Tourbière d'Alfred. Celle-ci est menacée par plusieurs activités comme le drainage et l'extraction de tourbe. Un model a choix multiple limités a été utilisé pour analyser les résultats du sondage. Les résultats indiquent que les répondants étaient disposées à payer une moyenne de $79.22, sous la forme d'une contribution unique et volontaire à un fond de préservation hypothétique pour la conservation de la Tourbière d'Alfred. L'abonnement au Club de Conservation, la fréquence des visites, les dons au programme de conservation, l'attitude, la distance de la tourbière, le revenue familial et le niveau d'éducation se sont tous avérés d'important facteurs affectant la volonté de payer. La volonté de payer totale pour conserver la tourbière a été évaluée entre $2.2 millions et $663,000, tout dépendant sur l'inclusion ou l'exclusion des offres de protestation. Les résultats sugèrent que la majeure partie de cette valeur est attribuable à des valeurs de non-usages tel que des valeurs altruistes ou de legs. Ainsi, l'échec des élaborateurs de politiques et de ceux qui gèrent les resources à considérer ces valeurs dans le procédé de prise de décision peut mener à une sous estimation de la valeur de préservation de la Tourbière d'Alfred.

ACKNOWLEDGEMENTS

I would like to thank my supervisor, Professor Paul Thomassin for his encouragement, academic advice and provision of financial assistance to undertake this research. I would also like to express my gratitude to Professor John Henning for his support, encouragement, and help. Professor Henning was always available for advice and guidance when things seemed a little overwhelming.

I am thankful to Pierre Mercier, Director of Planning and Economic Development in the United Counties of Prescott and Russell, Leo Durocher of the Vankleek Hill Nature Society, Naomi Langlois of the South Nation Conservation, and Maja van der Velden for sharing their resources, knowledge and information about the Alfred Bog wetland.

I extend my gratitude to Jean Francois Dionne, Senior GIS Technician of Planning and Economic Development in the United Counties of Prescott and Russell, for his kindness and provision of GIS maps.

My sincere thanks to Alejandro De Maio for his friendship, support, and provision of econometric programs used for data analysis. Your help and advice was greatly appreciated. A big thank you is also extended to my friend Fadi Balesh for kindly translating the survey instrument and to Simon Jetté-Nantel for translating the abstract.

I would also like to thank Fabrice Rouah and Johanne Thiffault for their help and advice on sampling techniques. I am also thankful to Pat Atkinson for her help with implementing the surveys and for her good cheer.

A special thanks is extended to all my friends who were always there for encouragement and for a good laugh. Thanks for keeping a smile on my face and ensuring that not all my time was spent in the library.

A sincere thank you to my family for their love and support throughout all my studies. Finally, I am especially grateful to Andre for his continual encouragement, understanding, patience, and love. Thank you.

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1. INTRODUCTION

1.1. Overview

Wetlands are one of Ontario's most productive and diverse ecosystems. They are lands that are seasonally or permanently covered by shallow water and occur where the water table is close to or at the surface, often at low-lying inland locations, or along the margins of lakes and rivers (Environment Canada, 1997). Wetlands are found near the banks of rivers and streams, along the edges of lakes and ponds, or in open fields and wooded areas. They occur widely throughout both rural and urban areas and can range in size from a few hectares to thousands of hectares (Environment Canada, 1997).

Ontario wetlands provide a number of benefits (eco-services). They provide habitat to over six hundred wildlife species, including birds, mammals, fish and plant life, many of which are considered to be rare or endangered (Ducks Unlimited Canada, 1997). Waterfowl from across the continent use wetlands for breeding and to rest and feed during migration. Apart from the valuable role as habitat for wildlife species and waterfowl, wetlands also help to purify surface water by breaking down or removing agricultural herbicides, pesticides, organic waste and sediment that is carried to them by runoff water (Ducks Unlimited Canada, 2001). Chemical processes and organisms associated with wetlands break down and retain both nutrients and pollutants, thereby preventing them from traveling downstream.

Wetlands reduce the effects of floods by retaining water and releasing it slowly during periods of drought. They can also protect shorelines from erosion by slowing the flow of water and lowering the crest of rivers and streams during spring and storm runoff peaks. In addition, wetlands recharge groundwater supplies by soaking up surface water and letting some of it seep back into the ground where it is filtered further (Ducks Unlimited Canada, 1997). Wetlands also provide the opportunities to participate in recreational activities, such as fishing, boating, bird watching, outdoor educational activities, and the opportunity to enjoy the aesthetic qualities of wetlands. They also act as carbon sinks.

Although wetlands regulate and improve water quality, reduce soil erosion, and provide habitat for hundreds of animal and plant species, it has been estimated that approximately 80% of the original two million hectares of wetlands in southern Ontario have been lost (Ontario Ministry of Natural Resources, 2001). Many of the wetlands have been drained for agricultural activities, development and peat extraction. In addition, many of the remaining wetlands are severely threatened.

The Provincial Wetland Policy does not have the sufficient regulatory power needed to fully protect wetlands in Ontario (Ontario Ministry of Natural Resources, 2001). The lack of regulatory power became clear in 1999 when the Moose Creek Bog, in the United Counties of Prescott and Russell, was taken off the Ministry of Natural Resources' list of significant wetlands. The existing policies could not halt peat extraction in the bog, which has since become the site of intensified peat extraction as well as a regional landfill. The main threat to bogs is drainage, which is part of the peat extraction process. This threat is made more serious by the fact that presently in Ontario there are no government regulations for peat extraction (Rosenbaum, 2001).

1.2. The Alfred Bog Wetland

1.2.1. The Alfred Bog as a Unique Ecosystem

The Alfred Bog wetland is a peatland that has built up over thousands of years. It includes three types of wetlands; bog (83%), swamp (12%), and marsh (3%). Approximately 9,000 years ago, the retreat of the Champlain Sea left an impermeable layer of clay. This clay lines the bottom of the Alfred Bog and is the base upon which peat has been growing for ninety centuries. Peat depths range from less than one meter at the edges of the bog to over seven meters in parts of the interior (Mosquin, 1991).

The Alfred Bog wetland is located approximately 70 km east of Ottawa and 7 km south-south-east of the town of Alfred (Figure 1.1). It has been identified as the largest high quality bog ecosystem in the region and is an important natural areas in southern Ontario. The Ministry of Natural Resources and Environment Canada (1984) have classified the Alfred Bog as a provincially significant class I wetland. The Ontario Ministry of Natural Resources has designated the bog as an Area of Natural and Scientific Interest (ANSI), which is an area of land and water containing natural landscapes or features that have been identified as being representative of the most significant natural heritage or geological features found in Ontario (Delcan, 1997) Further, the Alfred Bog is currently being considered for the Ramsar List of Wetlands of International Significance.

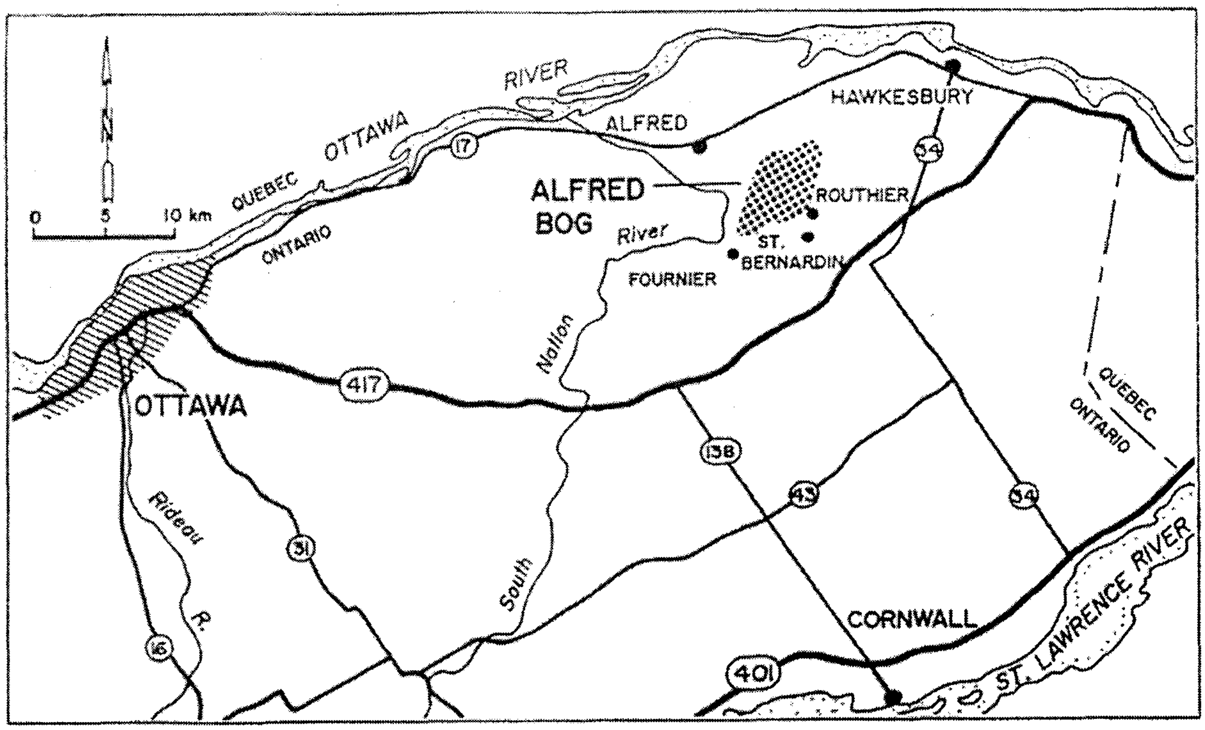

Figure 1.1: A section of eastern Ontario showing the location of the Alfred Bog (Mosquin, 1991).

As the largest bog in southern Ontario, the Alfred Bog is able to provide habitat for a wide variety of local species and migrating wildlife. Furthermore, the Alfred Bog is a unique and vital habitat to a large number of rare and endangered species. These include the continentally rare Bog Elfin butterfly, the nationally rare Fletcher's Dragonfly and Red Shouldered Hawk, and the provincially rare Spotted Turtle. Provincially rare plants include the Rhodora, southern Twayblade, and White-fringed Orchids[1] (Mosquin, 1991).

[1] A list of 46 rare and endangered species found in the Alfred Bog is presented in Mosquin's (1991) study, pp. 57-62.

The Alfred Bog plays an integral role as a natural water filter by removing heavy metals and contaminants by organically attaching them to peat. In addition, it helps control and store surface water and recharges this water to the local ground water. In this way, the bog controls flooding and helps to ensure a healthy supply of groundwater (van der Velden, 2000). Furthermore, the Alfred Bog wetland provides the opportunity to participate in recreational activities, such as bird watching, nature walks along the boardwalk, photography, educational activities, and the opportunity to enjoy and appreciate nature.

1.2.2. Current Status of the Alfred Bog[2]

Although the Alfred Bog wetland is considered to be the single most valuable bog in southeastern Ontario, the competing activities of draining, burning, and the extraction of peat have reduced to the bog to 4,200 hectares, which is less than half of its size a century ago. The bog is currently threatened by peat extraction operations along its' southern, western and northern fringes which continue to reduce its' size and threatens to alter the delicate balance of plants and animals. The extraction of peat eliminates the filtering mechanism of the bog, which could change the water chemistry of the area allowing the release heavy metals and contaminants into the groundwater system (Ministry of Natural Resources, 1992). This continuous loss of the bog led conservation groups to seek its preservation. In 1988, The Nature Conservancy of Canada purchased 1,620 hectares of the bog. The remainder of the bog is privately owned by various landowners.

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[2] The information on the current status of the Alfred Bog presented in section 1.2.2 was gathered in September 2001. In April 2002, both the federal and Ontario governments each contributed about $800,000 to buy and preserve 1,215 hectares of the Alfred Bog. Since the Nature Conservancy of Canada (NCC) owns 1,730 hectares of the bog, the purchase by the governments will result in the protection of approximately 70 per cent of the unique bog.

In August 1999, a Municipal interim control by-law was enacted for two years, after which zoning was to take place by local municipalities (Mercier, 2000). This by-law was enforced to protect approximately 3,000 hectares of the Alfred Bog wetland from any development. The area inside the 3,000 hectare boundary was to be zoned protected wetland where no peat mining or agricultural activity can take place. However, clear-cutting, peat mining and sod farming continues to occur immediately on the periphery of the protected area. It has been argued that peat extraction on the fringe of the protected area undermines the purpose of protecting the bog since the removal of peat along the perimeter also drains the heart of the bog (van der Velden, 2000).

The United Counties of Prescott and Russell are currently trying to acquire the remaining privately owned 1,200 hectares of the bog. However, peat harvesters are appealing the United Counties' measures to preserve the Alfred Bog. Without sufficient means to purchase the remaining privately owned land, the Alfred Bog will continue to be degraded.

1.3. Problem Statement

This study will seek to estimate society's willingness to pay (WTP) for the preservation of the Alfred Bog wetland in southern Ontario, which is currently threatened by peat mining operations. Since wetlands provide a variety of market and non-market goods and services, whereby the value of these goods and services are separated into both use and nonuse values, this study will also seek to measure the total economic value of preserving the Alfred Bog as perceived by the residents of the County. Positive WTP estimates would indicate the value individuals place on preserving the bog in its' existing state.

1.4. Research Objectives

The following objectives will be undertaken in this research study:

1. To estimate individuals' WTP for the preservation of the Alfred Bog wetland.
2. To estimate the total economic value of preserving the Alfred Bog wetland.
3. To determine the effects of individuals' attitudes and socio-economic characteristics on WTP values.
4. To measure the effects of distance on mean WTP values.

1.5. Thesis Structure

The remainder of the study is divided into four chapters: literature review, method of analysis, results and discussion, and conclusion. The literature review is divided into three sections. The first section focuses on the economics of the Alfred Bog wetland. The second section reviews the theory of welfare measures, including Marshallian and Hicksian demand functions, compensating and equivalent variation, and the theory of expenditure functions. The third section presents a discussion on the contingent valuation method. This section is divided into three parts. In the first part, elements of the contingent valuation survey design are discussed. Then elicitation methods, including both discrete and continuous approaches, are reviewed. Finally, the validity of the contingent valuation method is discussed.

The method of analysis is divided into four sections. In the first two sections, elements of the survey design and survey instruments are discussed. The third section specifies the regression models used to estimate individuals' mean WTP for the preservation of the Alfred Bog wetland. Finally, section four examines methods of data analysis.

Chapter four discusses the results obtained from the contingent valuation survey and analyses the different regression models. Both qualitative and quantitative survey statistics are presented.

Chapter five, the conclusion, reviews and summarizes the results of the contingent valuation study. It discusses related policy implications, drawbacks of the study, and potential future areas of research.

2. LITERATURE REVIEW

2.1. Economics of the Alfred Bog Wetland

The Alfred Bog wetland is a private good. The two main characteristics which classify the bog as a private good are rivalry and excludability. The Alfred Bog is a rival good because the ownership of land within the bog by one individual decreases the amount of land available for other individuals. It is an excludable good because the landowners have the right to exclude others from accessing the bog.

The property rights associated with the Alfred Bog are well defined and are held by both private landowners and public organizations. Land within, and on the periphery of the Alfred Bog wetland is freely traded in competitive markets, as are other private goods. The main market output from the bog is peat. The Alfred Bog also produces a number of nonmarket goods. These nonmarket goods have the characteristic of being nonrival and/or nonexclusive. They include water purification, flood control, recreational opportunities, habitat protection and preservation values. Preservation values are public goods as their consumption is both nonrival and nonexclusive, that is, beneficiaries of environmental protection can be added without diminishing the value of the resource to others (Walsh *et al.*, 1984). Since nonuse values, such as option, existence, bequest, and altruistic values may be important for the preservation of the Alfred Bog wetland, the contingent valuation method was chosen for this study as opposed to market techniques. Further discussion on the contingent valuation method is presented in section 2.3.

2.2. Theory of Welfare Measurement

2.2.1. Marshallian and Hicksian Demand Functions

Consumer welfare is typically measured by three theoretical concepts: consumer surplus, compensating variation, and equivalent variation. Each of these measures will be discussed in the following section.

Consumer surplus (CS), which is the traditional measure of consumer welfare, was introduced in the nineteenth century by Dupuit (Mitchell and Carson, 1989). CS is used to measure the welfare (or utility) that individuals derive from the purchase of goods and services. It is the difference between an individual's marginal willingness to pay and the actual market price. The marginal willingness to pay curve is the individual's Marshallian (or ordinary) demand curve. The demand curve is derived from the individual's utility function and budget constraint along with market prices (van Kooten, 1993). The area under the Marshallian demand curve and above the price line is defined as consumer surplus. At price P_0 and quantity level q_0 for commodity q, the consumer surplus is identified by area a (Figure 2.1). The individual places a value of area $(a + b + c)$, the area under the demand curve, for an amount q_0 of the commodity. Since the individual must forego an amount equal to area $(b + c)$ to purchase q_0 of the commodity, the individual gains area a, which is the consumer surplus (van Kooten, 1993).

Analogously, by increasing the purchase of good q from q_0 to q_1, the individual places a value of area $(d + e)$ on the additional purchase however, the individual only pays an amount equal to area e. Therefore, the individual gains a surplus equal to area d. Thus, the change in

CS from a reduction in the price of the good is represented by area (*b* + *d*) while, total CS from purchasing q_1 units at price p_1 is given by area (*a* + *b* + *d*).

However, as noted by Silverberg (1978) and Samuelson (1947), several problems have been identified with consumer surplus as a measure of the benefits resulting from changes in price or quantity. These problems result from the fact that Marshallian demand curves hold income constant rather than utility (Mitchell and Carson, 1989). Since the purpose of consumer surplus is to provide a monetary measure of the change in welfare of consumers due to a change in a policy, the most appropriate measure of welfare change is the difference between income levels (van Kooten, 1993). Compensating and equivalent variation are the two direct theoretical concepts that enable this measurement.

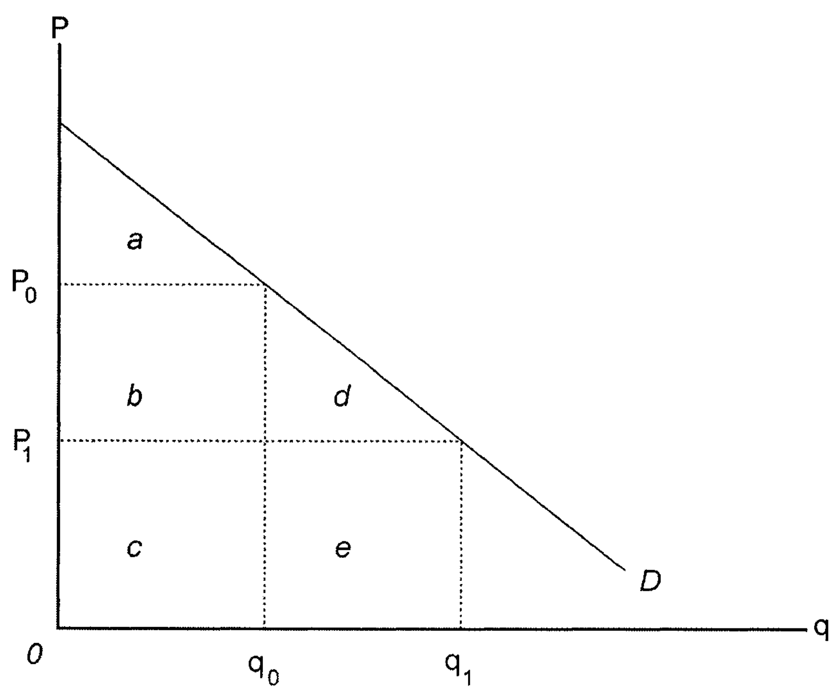

Figure 2.1: Consumer Surplus (van Kooten, 1993)

In order to understand the theory of compensating variation and equivalent variation, it is important to differentiate between Marshallian and Hicksian demand function[3]. The difference between the two demand curves is related to utility and income level. Marshallian demand curves hold income constant and allow utility to change, while Hicksian demand curves hold utility constant and allow income to change. Figure 2.2 illustrates a consumer that allocates their budget between two goods, q and G. Good G is a composite of all other goods except q and its' price is assumed to be fixed.

To derive the Marshallian demand function for q, the budget amount m_0 is held constant and the price of q is changed. An increase in the price of q from P_0 to P_1 leads the consumer to adjust purchases of G and q to achieve a new equilibrium at the lower level of utility U_1 (point x). The individual now consumes q_x units of q. A decrease in the price of q from P_0 to P_2 leads the consumer to adjust purchases of G and q to achieve a new equilibrium at a higher level of utility U_2 (point y). The individual now consumes q_y units of q. The Marshallian demand function is derived by connecting the points x, 0, and y.

The derivation of the Hicksian demand function for q is achieved by holding the level of utility, U_0, constant while altering the price of q. In order to maintain the original level of utility, U_0, the individual is either compensated with additional income or income is taken away. In the case of Hicksian demand, utility is held constant while income changes in order to maintain the original level of utility.

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[3] The following discussion on Marshallian and Hicksian demand functions is drawn from van Kooten (1993).

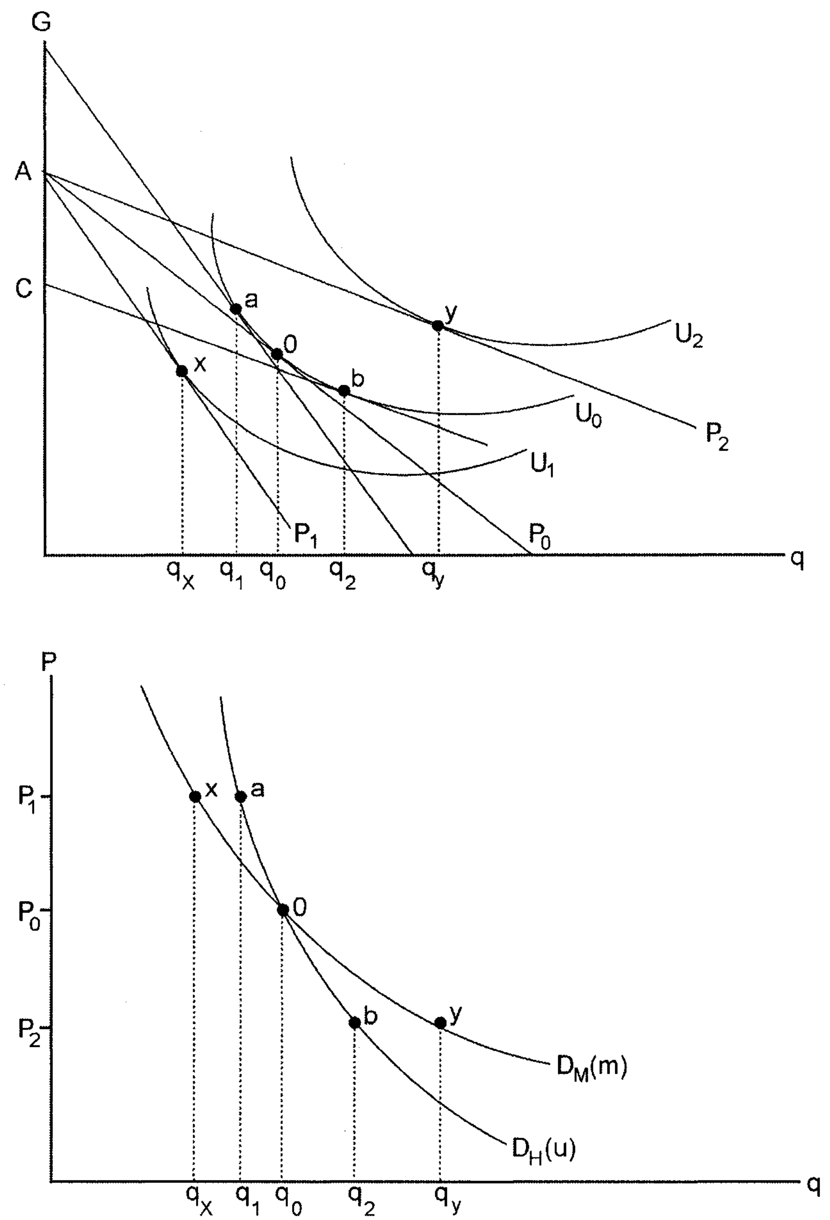

Figure 2.2: Derivation of Marshallian and Hicksian Demand Functions (van Kooten, 1993)

At the higher price, P_1 ($P_1 > P_0$), the budget line is shifted to the right (provision of compensation) so that the original level of utility, U_0, can be attained. At the new price level, P_1, the individual adjusts purchases of G and q to achieve a new equilibrium at point a on U_0. The individual now consumes q_1 units of q. At the lower price, P_2 ($P_2 < P_0$), the budget line is less steep and income must be taken from the individual in order to return to the original level of utility. The amount of income that needs to be taken from the individual is given by the distance AC. A new equilibrium is established at point b with the original level of utility, U_0. The Hicksian demand function is derived by connecting the points a, 0, and b.

2.2.2. Compensating and Equivalent Variation

Bishop and Woodward (1995) state that Hicksian demand curves are more accurate measures of an individuals' welfare than income because the level of utility is held constant. Since utility is a better measure of welfare, the Hicksian demand curves (compensating and equivalent variation) are used to measure the impact of policy changes on individuals' welfare.

Compensating variation (CV) and equivalent variation (EV) are two types of welfare measures that are derived from the utility maximization problem (Mitchell and Carson, 1989; Varian, 1978). In Figure 2.3, U_0, M_0, and P_0 represent the initial levels of utility, income, and price of good q, respectively. The individual maximizes utility subject to the budget constraint M_0P_0. Consider an increase in the price of q from P_0 to P_1 ($P_1 > P_0$). The budget constraint becomes steeper and rotates inward. At the higher price, P_1, the individual faces a lower lever of utility, U_1, on the budget constraint M_0P_1. Compensating variation of the price increase is defined as the amount of income required to compensate the individual for the price increase of q so that the individual is able to maintain the initial level of utility, U_0 (van Kooten, 1993).

By drawing a budget constraint, M_1P_1', parallel to M_0P_1 and tangent to the initial level of utility, U_0, the compensating variation of the price increase can be measured as the distance between m_0 and m_1 (m_0 - m_1). Therefore, compensating variation of a price increase of q is the minimum amount that an individual would accept for the change occurring.

Equivalent variation of the price increase of q is defined as the amount of income that is taken away from an individual in order to provide a level of utility, U_1, at the initial set of prices (van Kooten, 1993). Thus, equivalent variation of a price increase of q is the amount of income that has to be taken away from an individual that is spending at the initial set of prices in order to decrease utility to a level that would be achieved at the new higher set of prices.

An increase in the price of q from P_0 to P_1 leads the individual to a lower level of utility, U_1, where ($U_1 < U_0$). Since equivalent variation assumes that the individual has the right to enjoy the new level of utility at the initial set of prices, a new budget line, M_2P_0', is drawn parallel to M_0P_0 and tangent to the new level of utility, U_1. The equivalent variation can thus be measured as the distance between M_0 and M_2. It is the maximum amount that an individual would pay for the price increase not to occur.

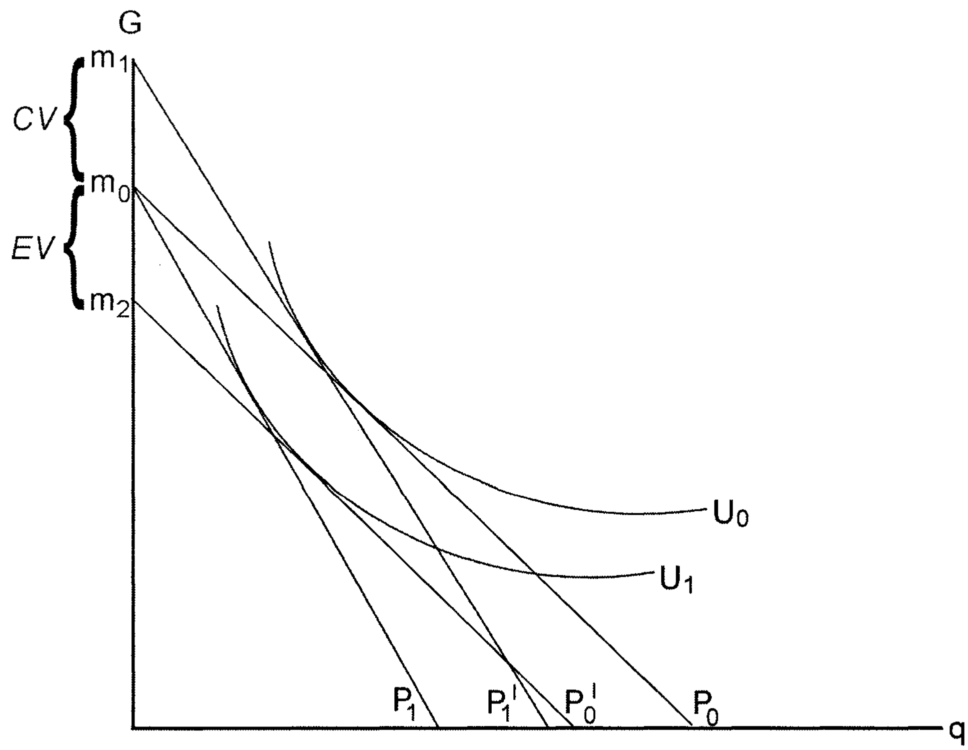

Figure 2.3: Compensating and Equivalent Variation for a Price Increase (van Kooten, 1993)

In the case of the opposite situation (a price decrease), compensating variation would reflect the individual's willingness to pay for the improved situation and equivalent variation would reflect the individual's willingness to accept compensation for the improvement not occurring.

2.2.3. Expenditure Functions[4]

Compensating variation and equivalent variation can also be expressed as the difference between expenditure functions. Consider the following general expenditure function for an individual that lives near the Alfred Bog wetland[5]:

$$M\ (p, Q, U) = Y \tag{2.1}$$

where p is a price vector, Q is the state (quality) of the Alfred Bog wetland, U is the level of utility, and Y is the minimum income necessary to allow the individual to maintain utility level U given prices p and quality level, Q, of the Alfred Bog.

Consider the situation where a policy is established to preserve the Alfred Bog wetland in its' present state. The policy would prohibit all activities which are detrimental to the bog. Individuals are asked what amount they would be willing to pay for the preservation of the bog. The expenditure function is of the form:

$$M\ (p, Q_0, U_0) = Y_0 \tag{2.2}$$

where U_0 is the initial level of utility that the individuals can enjoy given prices p, and Q_0, the initial (current) quality of the Alfred Bog. Y_0 represents the minimum income level required to attain utility level U_0.

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[4] Section 2.2.3 follows the structure of Henn (2000).

[5] The equations in section 2.2.3 are adopted from Mitchell and Carson (1989) and Bishop and Woodward (1995).

The policy is expected to improve the quality of the Alfred Bog wetland. Thus, the new expenditure function is of the form:

$$M\ (p, Q_1, U_0) = Y_1 \qquad (2.3)$$

where Q_1 is the quality of the Alfred Bog after the implementation of the policy and Y_1 represents the minimum income level required to attain utility level U_0 after the policy implementation. The level of utility, U_0, is held constant since Hicksian welfare measures assume utility remains constant.

The individuals' willingness to pay for the preservation of the Alfred Bog is a compensating variation measure since the individual is willing to pay for the improvement to occur. The compensating variation is equal to the difference between Y_1 and Y_0:

$$CV = Y_1 - Y_0 \qquad (2.4)$$

An estimate of the compensating variation can be expressed in terms of the expenditure functions:

$$CV = [M(p, Q_1, U_0)] - [M(p, Q_0, U_0)] \qquad (2.5)$$

For the Alfred Bog wetland, the quality of the bog after the implementation of the policy, Q_1, is greater than the initial quality, Q_0, of the bog. Since utility and prices are held constant, Y_1, (the minimum income level required to attain utility level U_0 after implementation of the policy) is less than Y_0. Therefore, compensating variation will be negative. This implies that the individuals will have to pay for the preservation of the Alfred Bog wetland.

2.3. The Contingent Valuation Method

2.3.1. Total Economic Value and the Alfred Bog Wetland

The Alfred Bog wetland provides individuals with both "use" and "nonuse" values. Use values include direct use and indirect use values. Direct use values are the benefits provided by the Alfred Bog which are of direct use to individuals (as marketable goods that can be traded), such as hunting, peat extraction, and sod farming. Recreation and tourism at the bog are also direct use values. Indirect use values involve functional services and reflect the indirect ecological services provided by the bog, such as water filtration, and flood and erosion prevention (Oglethorpe and Miliadou, 2000).

Some authors include existence value, bequest value, and option value as nonuse values (or passive use values, which are the nonmarket, intangible values which people derive from the preservation of an environmental asset (Thomas *et al.*, 1991; Stevens *et al.*, 1995). These values may be regarded as the well-being that individuals obtain from environmental resources without ever directly using such resources (Walsh *et al.*, 1984). As such, the nonuse values associated with the Alfred Bog wetland include existence values, bequest values, option values, and altruistic values. However, when an individual acts upon these values, the nonuse values become use values.

The Alfred Bog may provide individuals with existence values, which arises from the knowledge that the bog simply exists and will continue to exist independently of any actual or prospective use by the individual. It may provide bequest values, the utility that individuals derive from ensuring that the Alfred Bog wetland will exist for future generations (Loomis and Ekstrand, 1997). It may also provide individuals with option values, which relates to the amount that an individual is willing to pay to guarantee the availability of the bog for future use. Finally, the Alfred Bog wetland may provide altruistic values, the utility that individuals derive for ensuring that the bog is available for others to enjoy (Perman *et al.*, 1999).

Collectively, use and nonuse values make up "total economic value" (Randall and Stoll, 1983; Tietenberg, 2000). Freeman (1993) discusses the economic theory underlying these values. As noted by Bishop and Welsh (1992), the nonuse value component of total economic value is a public good provided by preservation. As such, it can be simultaneously consumed by all individuals, thus small values per household potentially translate into large total values (Loomis and Ekstrand, 1997). Therefore, the exclusion of nonuse values may undervalue the total economic value of preserving the Alfred Bog wetland.

2.3.2. Contingent Valuation and the Alfred Bog Wetland

Although the Alfred Bog wetland has an associated market, the contingent valuation method (CVM) was chosen for this study since individuals may derive nonuse values from the bog, which may be important for the preservation of the Alfred Bog wetland. Other methods used to obtain monetary values of changes in environmental quality include the travel cost method (TCM) and the hedonic pricing method (HPM). These are market-based methods that rely on observed market behavior, that is, they rely on information that is provided by market transactions.

The TCM has been widely used to estimate the demand for recreation sites and from this the value of those sites have been derived (Young and Allen, 1986). However, this method was not chosen to estimate the value of preserving the Alfred Bog wetland based on the relatively small proportion of individuals that visit the bog (Langlois, 2001). This would restrict the study to a small sample size.

The HPM attempts to evaluate environmental services, the presence of which directly affects market prices (Turner *et al.*, 1994). This method was not chosen because it would fail to estimate the total value of the Alfred Bog wetland. The values that would be estimated using this method would be those enjoyed exclusively by the landowners. Further, passive use values cannot be capitalized into property values or rents because individuals can realize them without residing near the Alfred Bog (Breffle *et al.*, 1998).

Although these alternative nonmarket valuation techniques have been used to measure use and nonuse values, these methods have been criticized for not capturing nonuse values adequately (Turner and Brooke, 1988; Willis *et al.*, 1995). Whitehead (1990) argues that neither of these approaches has yet been adapted for measurement of nonuse values. Therefore, the CVM is employed to estimate the value of preserving the Alfred Bog wetland since it can measure both use and nonuse values.

2.3.3. Overview of the Contingent Valuation Method

The CVM is used to estimate values for environmental amenities and other nonmarket goods and services by establishing hypothetical markets for goods that are not traded in private markets. It is a survey-based approach which aims to elicit individuals' willingness to pay (WTP) or willingness to accept (WTA) for specific changes in environmental characteristics (Hanley and Knight, 1992). Further, the CV method is capable of measuring both use and nonuse values.

Contingent valuation is a direct method of eliciting an individuals' compensating or equivalent variation for a change in the availability of a public good. As such, this method is referred to as a direct approach in contrast to the indirect approach of determining the value of nonmarket goods from information about market transactions for other related commodities (van Kooten, 1993).

The CVM was first introduced in 1947 by Ciriacy-Wantrup, who suggested the use of a direct interview method to measure the values associated with natural resources (Mitchell and Carson, 1989). However, it was not until the early 1960's that the first CVM was implemented by Robert K. Davis to measure the benefits of a nonmarket good. His study sought to measure the benefits of a recreational area in Maine (Mitchell and Carson, 1989). By interviewing 121 hunters and recreationists in the Maine woods, Davis was able to estimate a WTP value for a public good.

Shortly after Davis's study, several other economists, including Cicchetti and Smith (1973); Darling (1973); Hammack and Brown (1974); Hanemann (1978); and Binkley and Hanemann (1978) used the CV method to value various recreation areas. Since then, CVM has been used to measure a wide range of nonmarket goods, such as the benefits of wetland preservation. Stevens *et al.* (1995) used the CV technique to estimate the total economic value of wetland preservation in New England, while Whitehead (1990) used this method to measure the economics benefits of preserving the Clear Creek wetland in Kentucky. Similarly, Loomis (1990b) surveyed the general population of California about their willingness to pay for wetland protection in the San Joaquin Valley and Oglethorpe and Miliadou (2000) used CVM in an attempt to identify and evaluate the nonuse values of Lake Kerkini in Greece. Other related studies on wetland preservation include those conducted by Whitehead and Blomquist (1991), Faber and Costanza (1987), and Scodari (1990).

An important use of the CV method is to determine preservation values for such things as scenic amenities, wildlife species, old-growth forests, and water quality. Van Kooten (1993) argues that preservation values can be substantial. For example, a study on water quality in the South Plate River Basin of Colorado indicated that a reduction in water quality due to mining activity resulted in a welfare loss of $61 million per year[6] to residents in Colorado. Another study estimated the preservation benefits for wildlife to be $68 million per year[5] for Alberta residents. These results suggest that ignoring preservation values in the management of natural resources could lead to substantial misallocation of these resources (van Kooten, 1993).

The CVM has also been applied to various other studies in an attempt to value public goods, including the estimation of nonmarket benefits of agricultural land retention (Pruckner, 1995; Bowker and Didychuk, 1994; Drake, 1992; Bergstrom *et al.*, 1985; Halstead, 1984), the nonmarket economic value of urban recreation parks and national parks (Lockwood and Tracy, 1995; Thomas *et al.*, 1991; Gunning Trant, 1996), the benefits of wilderness canoeing (Rollins 1997), the benefits of wildlife protection (Stevens *et al.*, 1994; Stevens *et al.*, 1991), the valuation of endangered species (Kotchen and Reiling, 2000), the nonuse values of wilderness areas (Walsh *et al.*, 1984; Keith *et al.*, 1996), and the valuation of water quality (Desvousges *et al.*, 1987).

CVM has received considerable acceptance as a tool for measuring values to be used in benefit-cost analysis. The method was authorized for the valuation of outdoor recreation in the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* by the U.S. Water Resources Council (1983). It has also been accepted by the U.S. Fish and Wildlife Service for human use and evaluation studies (U.S. Fish and Wildlife Services, 1985). CVM has also been recognized for measuring benefits and damages under the Comprehensive Environmental Response, Compensation,

[6] Both the Colorado and Alberta examples were reported in van Kooten (1993).

and Liability Act of 1980 (Mitchell and Carson, 1989). Further, the US Environmental Protection Agency has contributed substantially to the development of the CV method and it considers it to be one of the four basic methods for valuing the environmental benefits of proposed regulations (U.S. Environmental Protection Agency, 1983). CVM has gained international recognition and is being applied in many countries.

A well-designed contingent valuation study comprises three main components (Mitchell and Carson, 1989, p. 3):

1. "A detailed description of the good(s) being valued and the hypothetical circumstance under which it is made available to the respondent" (Mitchell and Carson, 1989, p. 3). A detailed hypothetical market, which is communicated to the individual in the form of a scenario, is created by the researcher. The market is designed to be as realistic as possible. It describes the good to be valued, the baseline level of provision, the structure under which the good is to be provided, and the payment vehicle.

2. Questions which elicit individuals' WTP for the good(s) being valued. The objective of this step is to ease individuals' valuation process without introducing WTP biases.

3. Questions concerning individuals' characteristics (such as age, income, gender), their preferences towards the good(s) being valued, and their use of the good(s). This information is used to explain the variations in WTP values across individuals.

The individuals' answers to the valuation questions should represent valid WTP responses if the study is well designed. Further, if the sample is selected by means of random sampling procedures and if adjustments are made to compensate for participants that fail to respond and for those that give poor-quality data, the results can be generalized with a known margin of error to the population from which the individuals were sampled (Mitchell and Carson, 1989).

2.3.4. Contingent Valuation Survey Design

2.3.4.1. Population and Sampling

The first step in the design of a CVM study is the identification of the population that is affected by a change in the provision of a good or service. The survey population consists of all units (individuals, households, organizations) to which one desires to generalize survey results (Dillman 2000). It comprises all the individuals that will be affected by a potential policy change.

Once the population has been defined, a random sample needs to be selected. The sample selection is important because the data drawn from this sample will be used to determine the preferences and characteristics of the survey population. Mitchell and Carson (1989) identify two primary ways in which the reliability of CVM sample statistics can be enhanced: i) the use of sufficiently large sample sizes, and ii) the use of robust statistical techniques that reduce the influence of outliers. To obtain an acceptable degree of precision in sample statistics, such as the mean WTP amount, CV studies require large sample sizes because of the large variance in the WTP responses. As explained by Dillman (2000) and Mitchell and

Carson (1989) much of this variance is to be expected and it results from the diversity of opinion in large heterogeneous populations. The variance in contingent valuation WTP amounts are expected to be larger from the general population than from homogeneous subgroups.

Inaccurate sample selection may lead to several types of sampling biases such as sample frame bias and sample selection bias. The sampling frame is the list from which a sample is to be drawn in order to represent the population, however, if the sample frame and the population diverge, sampling frame bias can occur. The sampling frame has to give every member of the population a known and positive probability of being included in the sample (Dillman, 2000). Sample selection bias is a type of nonresponse bias, which occurs when the individuals who do not respond to the survey or the elicitation question hold different expected values for the good than individuals who do respond.

2.3.4.2. Scenario Design[7]

A contingent valuation scenario must be plausible, understandable, and meaningful in order to overcome the hypothetical nature of a scenario. The goal is to create a setting for valuation that is not only understandable to the respondent but also incentive compatible (Bishop *et al.*, 1995). The respondents should be presented with an economic situation that is conducive to revealing their true compensating or equivalent surplus values. An effective and complete scenario should describe four components; i) the description of the good, ii) the hypothetical market, iii) the payment vehicle, and iv) the elicitation method (Mitchell and

[7] Section 2.3.4.2 follows the discussion by Mitchell and Carson (1989).

Carson, 1989). The first three components will be discussed in this section. The fourth component will be discussed in section 2.3.5.

The good must be described with sufficient specificity and accuracy to ensure that respondents clearly understand the characteristics of the good and what they will get for their money if the good is provided (Mitchell and Carson, 1995). Clarity is imperative when describing the good because it can be a difficult task to communicate the scenario to respondents who vary in educational levels and personal backgrounds. Furthermore, technical terms, confusing words, and information overload should be avoided because they can interfere with communication and can also affect respondent understanding (Mitchell and Carson, 1995). Failure to define the good adequately can lead to amenity misspecification bias, where the perceived good being valued by an individual differs from the actual good (Mitchell and Carson, 1989). The use of visual aids such as maps, pictures and diagrams may be used to enhance respondent understanding, attention, and ensure that the good being valued is not confused with other goods.

The second component of the scenario is the description of the hypothetical market, which relies on the definition of property rights. Well defined property rights reduce the chance of protest responses, which individuals may be inclined to exercise if they misunderstand the property rights. Depending on the definition of property rights and the characteristics of the good being valued, markets may be classified as either private or public (Mitchell and Carson, 1989). Public goods are characterized by poorly defined property rights, which are attributed to the good being non-rival and non-excludable. Mitchell and Carson (1989) recommend the use of political markets and referendums when valuing pure public goods, since these methods enhance the understandability, plausibility, and meaningfulness of the scenario.

Private markets are used when property rights are well defined, as is the case with private goods, which are rival and excludable. The appropriate market for valuing quasi-private goods depends on the good being valued and other aspects of the scenario, such as the payment vehicle (Mitchell and Carson, 1989).

The payment vehicle defines the structure or mechanism through which the monetary payment will be transferred. The payment vehicles most often used in CVM studies include utility bills, entrance fees, licensing fees, taxes (such as property taxes or income taxes), and higher prices (Mitchell and Carson, 1989). These vehicles are likely to be familiar with most respondents. Another type of vehicle used to elicit WTP values is a special fund vehicle. Oglethorpe and Miliadou (2000) and Whitehead (1990) used a special fund vehicle to elicit individuals WTP values for the preservation of wetlands. This approach was used to provide a neutral payment vehicle and to minimize the number of protest bids against the method of payment.

Sutherland and Walsh (1985) suggest that the payment vehicle should be neutral with respect to the good so as to not influence the respondents' WTP or WTA values. Fischoff and Furby (1988) propose that the payment vehicle should relate naturally to the amenity or policy issue in question. They stress that the choice of a vehicle that does not compliment the situation may seem artificial to the respondents and therefore lead to confusion. For example, individuals may have negative reactions to higher property taxes. If so, their response to a CVM scenario that uses property taxes as the payment vehicle may be more a reflection of their attitudes toward the tax and less of a reflection of their preferences regarding the intended subject of the study.

2.3.5. Elicitation Method

2.3.5.1. Comparison Between Discrete and Continuous Elicitation Methods

There are several methods to elicit WTP values. Elicitation methods are classified as either continuous or discrete choice methods (Mitchell and Carson, 1989). Continuous methods include open-ended (OE) elicitation questions, the payment card (PC) approach, and the bidding game (BG) approach. The OE method simply asks respondents to state their maximum WTP for the good being valued, whereby the PC approach lists a series of values from which the respondents choose an amount that best represents their maximum WTP. The BG approach begins with an initial bid (starting bid), whereby the respondent can either accept or reject the initial bid. If the respondent is willing to pay the initial bid amount, the bid is increased until a negative response is obtained. If the respondent is not willing to pay the initial bid amount, the bid is decreased until an acceptable amount is achieved. The final bid is a measure of the respondents' Hicksian compensating or equivalent surplus for the good being valued (Boyle *et al.*, 1985). The continuous elicitation methods therefore allow the respondents to choose their maximum WTP value from an entire continuum of values.

In contrast, discrete choice methods provide respondents with a discrete bid amount and asks them whether or not they would be willing to pay the disclosed amount. Discrete choice methods include dichotomous choice (including single bounded and double bounded dichotomous choice methods), polychotomous choice, and multiple bounded. The most popular discrete choice method is the dichotomous choice (DC) format, where respondents determine whether their WTP is greater or less that a set dollar amount. The multiple bounded discrete choice (MBDC) method will be discussed in section 2.3.5.2.

The choice of contingent valuation elicitation method is important because the selection of questioning format can significantly influence estimates of mean and median WTP values (Boyle *et al.*, 1996; Grether and Plott, 1979). Several studies have demonstrated that there are significant differences between values that are elicited using continuous methods and those using discrete choice methods (Brown *et al.*, 1996; Schulze *et al.*, 1996). Although some experts suggest that the discrete choice elicitation method is preferred to continuous elicitation methods, others have argued that "failure to demonstrate consistency across value elicitation methods forms a basis for rejecting the validity of contingent valuation altogether" (Welsh and Poe, 1998, p. 171).

Continuous elicitation methods tend to have an advantage over discrete methods because they elicit more information concerning each respondent's WTP. Further, continuous elicitation questions are statistically more efficient because they generate direct estimates of each respondent's WTP, whereas discrete methods only determine whether WTP is greater or less than the set dollar value (Ready *et al.*, 1996). Although the additional information obtained using a continuous method is advantageous, its quality may be questionable. Due to the unfamiliarity associated with continuous methods, WTP responses may be highly variable and sensitive to unimportant characteristics of the scenario (Arrow *et al.*, 1993). Since the DC format is similar to the decision making task that individuals face in everyday market transactions, DC questions are viewed as being more familiar and easier to answer than continuous valuation questions (Mitchell and Carson, 1989; Arrow *et al.*, 1993).

Loomis (1990a) and Herriges and Shogren (1996) argue that the discrete choice elicitation format places fewer mental demands on respondents than continuous methods because the question format mimics that of a market setting in which respondents engage in price-taking behavior. As a consequence, this reduces the amount of non-response problems. Furthermore, the discrete choice format is incentive compatible, thereby allowing respondents to reveal their true preferences about the good being valued.

In contrast, continuous methods (specifically the OE format) are subject to respondent unfamiliarity, whereby respondents experience difficulty in stating a specific WTP amount. Stating a precise WTP value is a more difficult task since respondents are not provided with any reference point to bound their value judgment. As a consequence, OE formats often result in higher non-response rates or underestimates of WTP (Loomis, 1990a). Another disadvantage of the OE format is the ability of respondents to introduce strategic bias. Strategic bias occurs when respondents deliberately shape their answers to influence the outcome of the study in a manner that serves their personal interests. The form of strategic behavior which has received the greatest attention in the CV literature is "free riding," whereby respondents strategically understate their WTP for a good being valued with the expectation that others will pay enough to provide it regardless (Mitchell and Carson, 1989).

The payment card (PC) approach, on the other hand, provides respondents with more information than the OE approach since it provides a series of bid amounts from which the respondents choose the value that best represents their maximum WTP. However, the PC approach is subjected to various forms of biases, including range bias and centering bias (Rowe *et al.*, 1996; Mitchell and Carson, 1989; and Boyle and Bishop, 1988). Range bias occurs when the information presented on the payment card (the bid amounts) influences the respondents' WTP amount, while centering bias occurs when respondents have the tendency to choose the bid amount in the center of the range of values on the payment card.

Several studies have compared the results of continuous methods with discrete methods when valuing the same good (Kristrom, 1993; Ready *et al.*, 1996; Kealy and Turner, 1993; McFadden, 1994; Johnson *et al.*, 1990; and Bishop *et al.*, 1983). The results consistently showed that discrete methods provide higher WTP estimates than the continuous methods (OE and PC).

Despite the fact that discrete methods have been shown to produce higher WTP estimates, the National Oceanic and Atmospheric Administration (NOAA) panel concluded that contingent valuation studies should be based on the single bounded dichotomous choice (SBDC) approach because this approach more closely resembles familiar market and voting decisions (Arrow *et al.*, 1993; Welsh and Poe, 1998). However, many researchers have expressed concern about this recommendation. First, as discussed above, some researchers worry about the potential for the DC approach to result in overestimates of WTP. Second, relative to continuous methods, the DC approach provides less statistical information per observation, thus, the resulting survey responses reveal little about an individuals' WTP (Herriges and Shogren, 1996). Finally, the SBDC approach requires the researcher to select a distribution of bid amounts, which is a difficult task. An inefficient set of bid amounts may influence mean WTP estimates (Kanninen, 1993). In addition, the SBDC method is inclined to biases, including anchoring effects and "yea-saying". Anchoring occurs when respondents consider the given bid amount to be a good estimate of the true value of the commodity being valued (Mitchell and Carson, 1989). Yea-saying refers to the tendency of some respondents to agree with an interviewers' request regardless of their true views (Arndt and Crane, 1975). This bias results in higher WTP estimates in comparison to OE approaches.

One way to improve the statistical efficiency of the conventional DC contingent valuation format is to include follow-up questions. Rather than asking whether an individuals' WTP is simply above or below a bid value, a sequence of questions is used to narrow the range of the respondents' true WTP. This method, referred to as the double bounded dichotomous choice (DBDC) approach, was first proposed by Hanemann (1985) and was first implemented by Carson *et al.*, (1986). The DBDC format asks respondents to engage in two rounds of bidding, whereby they respond to a first dollar amount and then face a question involving a second dollar amount, higher or lower depending on the response to the first question. The results of a study conducted by Hanemann *et al.* (1991) found that adding a follow-up bid to the conventional SBDC contingent valuation survey substantially improved the statistical information provided by the data. Furthermore, Kanninen (1993) argues that the DBDC approach is advantageous over the SBDC approach because it retains a market type flavor, which improves the reliability of responses.

Although the DBDC model has been shown to be statistically more efficient than the standard SBDC model, Herriges and Shogren (1996) suggest that there are also costs associated with the use of the DBDC questionnaire format. Since the follow-up questioning format resembles a limited form of the traditional bidding game approach, it may also be subject to starting point bias. In addition, a study conducted by Holmes and Kramer (1995) also found evidence of starting point bias. Starting point bias occurs when the initial bid amount influences the respondent's final bid amount. Randall and Brookshire (1978) have suggested that starting point bias may arise when the good being valued is poorly defined or is not distinctly perceived by the respondent. Brookshire *et al.*, (1981) further propose that starting point bias may occur because the initial bid amount may suggest an appropriate range of final bids for the respondent.

All of the approaches (OE, BG, PC, SBDC, DBDC) discussed above assume that respondents have no uncertainty regarding their preferences. This assumption implies that all respondents are certain about their utility functions, thereby allowing them to value with certainty the good in question. However, when dealing with nonmarket goods, Loomis and Ekstrand (1997) suggest that individuals may be uncertain about several issues, including; i) doubts regarding the importance of the goods being valued to society relative to other pressing social issues; ii) uncertainty about their own preferences; and iii) uncertainty regarding the responses of other individuals surveyed.

To allow for respondent uncertainty, Ready *et al.*, (1995) developed the polychotomous choice approach. This approach is similar to the DC approach, whereby respondents are provided with one bid amount, however, instead of asking the respondents to give a yes/no answer, they are allowed to express their degree of certainty. This is achieved by answering "definitely yes," "probably yes," "unsure," "probably no," or "definitely no" to their single bid amount. Although this approach incorporates respondents uncertainty into the analysis, the findings of Ready *et al.*, (1995) suggested that the polychotomous choice method does not produce data reliable enough for estimating WTP values.

2.3.5.2. Multiple Bounded Discrete Choice Method

The multiple bounded discrete choice (MBDC) approach, developed by Welsh and Bishop (1993), is derived from the "return potential" format which is used by sociologists to identify the strength of social norms and to determine satisfaction levels of varying conditions (Jackson, 1965 and Shelby, 1981). The MBDC format is a two dimensional matrix made up of rows and columns, whereby the rows delineate different bid amounts and the columns allow respondents to express their level of certainty associated with each dollar threshold.

The MBDC approach contains elements of both the PC and DC methods. Like the PC method, respondents are provided with a range of bid amounts. However, rather than choosing a single dollar threshold or interval, the respondent is presented with a polychotomous choice response option, as in Ready *et al.* (1995), including, for example, "Definitely Yes," "Probably Yes," "Not Sure," "Probably No," and "Definitely No" (Welsh and Poe, 1998). This response method allows the respondent to reveal the level of certainty in their answers at each of several dollar thresholds.

A study conducted by Welsh and Poe (1998) established that the MBDC method covers the range of WTP values associated with other formats, including the PC, OE, and DC methods. The results also suggested that when respondents to a SBDC question are unsure about their WTP they are likely to respond "yes." This result is consistent with other studies which identified yea-saying and overstatement in DC formats (Kanninen, 1995; Holmes and Kramer, 1995). In addition, Hanemann *et al.* (1991) have shown that the DC CVM results in higher estimates of mean WTP than an interval method such as the MBDC approach. In contrast, the estimated PC and OE response functions demonstrated patterns similar to that of the "Probably Yes" MBDC models. These results imply that respondents to the PC and OE elicitation methods are fairly certain about their WTP statements. This result is consistent with the finding of a study conducted by DuBourg *et al.* (1994) that continuous WTP responses usually lie at the lower end of an individual's value distribution.

An advantage of the MBDC method is that it can incorporate respondents' uncertainty into the analysis (Welsh and Poe, 1998). Once the respondents have expressed their level of certainty associated with each bid amount, statistical analysis can be implemented for varying levels of certainty. For example, consider the following hypothetical response to a WTP question:

Would you be willing to pay the following amounts for the preservation of the Alfred Bog wetland? Check one box in each row.

	Definitely Yes	Probably Yes	Do Not Know	Probably No	Definitely No
$ 5	☒	☐	☐	☐	☐
$ 10	☒	☐	☐	☐	☐
$ 25	☐	☒	☐	☐	☐
$ 50	☐	☒	☐	☐	☐
$ 100	☐	☐	☒	☐	☐
$ 150	☐	☐	☐	☒	☐
$ 200	☐	☐	☐	☒	☐
$ 350	☐	☐	☐	☐	☒

A "Definitely Yes" model for the above example corresponds to modeling the lower end of the switching interval at the highest amount the respondent chose the "Definitely Yes" response and the higher end of the switching interval at the next dollar threshold (Welsh and Poe, 1998). Therefore, the switching interval for the "Definitely Yes" model would be the interval [10, 25]. Analogously, the switching interval for the "Probably Yes" model would be the interval [50, 100] and the switching interval for the "Do Not Know" model would be the interval [100, 150].

Another advantage of the MBDC method is that it offers the opportunity to preserve a discrete choice questioning format, while also allowing for the estimation of a variety of mean WTP values. While maintaining the discrete choice technique, the MBDC approach substantially increases the level of precision of WTP estimates for any given sample size due to the use of bid intervals (Welsh and Poe, 1998). Furthermore, the MBDC approach may avoid the difficulty associated with the DBDC method, whereby the response to the first bid amount is less than perfectly correlated to the response to the second bid (Cameron and Quiggin, 1994). The design of the MBDC approach allows the respondent to see the full range of bids prior to giving any valuation response. This approach "makes it more likely that the respondent may formulate an overall response strategy that is consistently applied when answering all of the valuation questions" (Loomis and Ekstrand, 1997, p. 360).

However, a potential concern with the MBDC approach is whether all respondents interpret the categories in the same way. In other words, do all respondents use the same criteria for choosing the corresponding categories (Loomis and Ekstrand, 1997). In addition, the MBDC method may also be susceptible to some of the same problems that are associated with the PC method, such as range bias. WTP values may be sensitive to the bid amounts presented to the respondent. However, Rowe *et al.* (1996) demonstrated that if the upper end of the range is not truncated, estimated WTP is not sensitive across reasonable ranges of payment card amounts (Loomis and Ekstrand, 1997).

2.3.6. Assessment of Validity

The accuracy of the CV method continues to be a subject of debate. Other valuation methods, including market valuation and applications of nonmarket valuation techniques such as the hedonic pricing method and the travel cost method, depend on preferences that are revealed by respondents through market transactions and other behavior. These types of preferences, which are revealed though actual behavior, have greater credibility in economics (Bishop *et al.*, 1995). Preferences that are revealed under hypothetical circumstances are viewed with greater suspicion. Mitchell and Carson (1989) applied the concept of validity to CVM studies to understand how meaningful WTP values can be elicited for public goods. They define validity in this way:

"The validity of a measure is the degree to which it measures the theoretical construct under investigation. This construct is, in the nature of things, unobservable; all we can do is obtain imperfect measures of that entity. In the contingent valuation context the theoretical construct is the maximum amount of money that respondents would actually pay for the public good if the appropriate market for the public good existed" (Mitchell and Carson, 1989, p.190).

Bishop *et al.* (1995) add that the concept of validity could also be applied to compensation demanded. They argue that the CVM is valid to the extent that it accurately measures the "true values" of the respondents. True values refer to the respondents' compensating and equivalent surplus for changes in environmental resources. Assessing the validity of the CVM would be effortless if true values were observable, however this is difficult in principle[8]. Bishop *et al.* (1995) argue that conclusions about the validity of CVM should be more tentative and dependent on the weight of the combined evidence from all available sources. They maintain that strong dependence on subjective judgment about the weight of evidence makes conclusions about the validity of the CVM difficult to justify and potentially controversial.

CVM studies may yield valid economic values if respondents are both willing and able to reveal their values. Respondents may be unwilling to reveal such values either because they do not take the valuation process seriously or because they perceive strategic responses to be in their best interest (Bishop *et al.*, 1995). Even if the respondents are willing to respond accurately, they may be unable to do so. The respondents may have never been asked to reveal their preferences for nonmarket goods in monetary terms. Although they may be willing to do so, they may be unable to predict how much they would be willing to pay or how much they would demand in compensation if a market or other method of payment was established (Bishop *et al.*, 1995). For all these reasons, many economists are skeptical about values that have been estimated using the CVM.

Mitchell and Carson (1989) recognize a theoretical framework for assessing the validity of the CVM. This framework defines three types of validity: content, construct, and criterion. Each of these concepts involves a different approach to evaluating the validity of a measure. Together these concepts provide a useful framework for assessing the overall validity of CVM.

[8] The difficulty of observing true values is not limited to non market goods and services. True values are unobservable, in principle, even for market goods and services (Bishop *et al.* 1995).

2.3.6.1. Content Validity

Content validity is concerned with whether a measure adequately includes all aspects of the construct's domain (Mitchell and Carson, 1989). The relevant domain in CVM studies is the structure of the market and the description of the good. Content validity differs from construct and criterion validity in that it can only be assessed by subjective judgment based on an examination of the instrument, which is usually the wording of a question (Mitchell and Carson, 1989). In regards to CVM studies, the evaluation of content validity involves qualitative examination of the survey instrument and related materials. Bishop *et al.* (1995) argue that a well defined scenario with clarity and completeness is the main component towards generating a valid CVM measure. A well defined scenario should include the description of the good, the payment mechanism, the market, and the elicitation format. A good description of the scenario will provide individuals with an incentive to state their true WTP values.

In addition to a well defined scenario, Bishop *et al.* (1997) suggest three other methods to assess the content of a CVM questionnaire. First, the CVM study design must be compared to the economic theory underlying WTP values. That is, the design is valid if the information provided in the questionnaire would permit respondents to reveal their WTP values. Second, an evaluation of how well the questionnaire communicates to the respondents must be conducted. And third, the adequacy of the econometrics used to estimate the mean and aggregate WTP values must be assessed.

2.3.6.2. Construct Validity

Construct validity "involves the degree to which the measure relates to other measures as predicted by theory" (Mitchell and Carson, p. 191, 1989). There are two forms of construct validity: convergent and theoretical validity. Convergent validity is concerned with whether CVM measures are correlated with other measures of the same construct. Evidence regarding the convergent validity of a measure would be provided when the measure in question and a second measure "converge" (that is, a correlation exists) in a manner predicted by theory. Convergent validity could be assessed by comparing values estimated from a CVM study to values of the same amenity estimated using nonmarket valuation methods, such as a travel cost model or a hedonic price model (Mitchell and Carson, 1989). If convergence is not observed, then either the CVM measure or the other measure of value is inaccurate. This comparison would therefore not support the validity of the contingent value (Bishop *et al.*, 1995).

Various studies, which compare CVM measures with travel cost and hedonic price measures, found that the correspondence between survey measures and the behavior-based measures are reasonably close. A study conducted by Cummings *et al.* (1986) investigated eight different convergent validation efforts, including four that used travel cost estimates, three that used estimated based on hedonic price measures, and one that used a site-substitution estimate. Additional studies have compared benefits estimated by CVM with benefits for the same good measured by an observed/indirect method: Blomquist (1984) used hedonic pricing estimates of the value of a view of Lake Michigan in Chicago; Loehman (1984) made estimates for air visibility in San Francisco based on a hedonic price analysis of property values, Sorg and Nelson (1986) examined travel cost values for elk hunting; and Walsh, Sanders *et al.* (1985) used travel cost values for forest use. The overall results of these studies suggested a "reasonable strong convergent validity" (Mitchell and Carson, 1989, p. 206).

Theoretical validity, the other form of construct validity, involves examining whether a relationship exists between the CVM measure and the other measures in a manner predicted by theory (Mitchell and Carson, 1989). Theoretical validity differs from convergent validity in that theoretical validity focuses on the determinants of a WTP amount rather that on the relationship between two separate but equal measures of the same construct. One way to assess the theoretical validity of a contingent value would be to examine the signs on variables in a bid equation where the expressed contingent values are regressed against explanatory variables that theory suggests should be related to them in some way (Mitchell and Carson, 1989). Another way to measure theoretical validity is to compare mean WTP values of different conditions for which economic theory predicts different values (Mitchell and Carson, 1989; Bishop *et al.* 1995).

Several studies have estimated bid equations, including Viscusi and Evans (1990); Adamowicz *et al.* (1989), Edwards and Anderson (1987); and Milon (1988). Together, all of these studies showed that hypothesized relationships between value and socioeconomic variables do hold for specific applications. Other studies that have examined theoretical validity include Diamond and Hausman (1992) and Kahneman and Knetsch (1992). These studies provided examples of CVM studies that did not agree with theoretical expectations.

However, Mitchell and Carson (1989) argue that these results are insufficient to conclude that CVM studies lack theoretical validity.

Mitchell and Carson (1989) stress the importance that CVM studies must provide evidence to support their theoretical validity. Therefore, in the case of the Alfred Bog wetland, theoretical validity will be assessed by regressing the WTP amount on a group of independent variables believed to be theoretical determinants of the individuals' WTP for the preservation of the Alfred Bog wetland. The size and sign of the coefficients will then be examined to determine whether or not the results are consistent with economic theory.

2.3.6.3. Criterion Validity

The third type of validity is criterion validity, which is concerned with the relationship between the CVM measure and another measure, which may be regarded as criteria. In regards to CVM studies, Mitchell and Carson (1989) suggest that in order to evaluate the criterion validity of a contingent value it is "necessary to have in hand a criterion which is unequivocally closer to the theoretical construct than the measure whose validity is being assessed" (Mitchell and Carson, 1989, p. 192). An ideal measure for assessing the criterion validity of a CVM study is actual market prices. However, market prices do not usually exist for public goods, such as environmental amenities. One way to establish criteria for judging the validity of CVM is by creating a hypothetical-simulated market (HSM). Simulated markets involve creating situations where individuals have the opportunity to actually pay for an amenity being valued or receive compensation for giving it up (Bishop *et al.*, 1995). The amounts that individuals are willing to pay in such simulated markets should be parallel to the hypothetical market transactions. Since simulated markets involve actual transactions, they should provide values that are more representative of true WTP than contingent values, and thus should be able to serve as criteria for evaluating the validity of CVM (Bishop *et al.*, 1995).

Bohrnstedt (1983) has defined two types of criterion validity: predictive validity and concurrent validity. Predictive validity is "an assessment of an individuals future standing on a criterion variable and can be predicted from present standing on measure" (Bohrnstedt, 1983, p. 97). It can be measured by asking an individual a contingent valuation question at a certain point in time and at a later time present the individual with the opportunity to purchase the good in a simulated market. Concurrent validity is "assessed by correlating a measure and a criterion of interest at the same point of time" (Bohrnstedt, 1983, p. 97). Stated differently, the measure and the criterion against which the measure is to be assessed are measured simultaneously.

Several important studies, including those conducted by Bishop *et al.* (1984) and Dickie *et al.* (1987) have compared simulated markets and hypothetical contingent valuation values for the same goods. Bishop *et al.* (1984) conducted a study in the Sandhill Wildlife Demonstration Area in Wisconsin using both a simulated market and a parallel hypothetical market to estimate individuals' WTP for a deer hunting permit. In the simulated WTP market, 75 hunters were offered the opportunity to buy a permit for a specified price. In the hypothetical market, 75 other individuals were presented with a specified price and they were asked if they would be WTP that amount for a permit if the offer were real.

Two consequences were concluded from the Sandhill study[9]. First, this study demonstrated that hypothetical markets can value goods such as hunting permits with considerable accuracy. This finding is important because it establishes a necessary condition for the validity of contingent valuation studies. However, Mitchell and Carson (1989) argue that this finding is weak evidence that CVM studies can accurately value quantities of goods such as air quality improvement, which are much less well defined to respondents' than hunting permits are to well informed, avid hunters. Second, the data from the study did not support the notion that the hypothetical character of CVM studies lead individuals to give consistently higher or lower values than they would if they had to actually pay for the good being valued. The study demonstrated that sometimes the hypothetical offers are higher or lower than the cash offers.

Similarly, Dickie *et al.* (1987) confirmed the ability of hypothetical markets to produce valid estimates of commodity values. They conducted an experiment to compare the results of hypothetical and simulated markets for strawberries, which is a purely private good. In the simulated market the strawberries were sold for money if the respondents were WTP the offered amount. In the hypothetical market, the respondents were presented with a specified price for a pint of strawberries and were asked if they were WTP the specified amount for the strawberries. The results showed that a comparison of demand curves supported the null hypothesis that the two treatments were statistically identical. Mitchell and Carson (1989) suggest that for this type of well defined good, CV estimate may be capable of accurately predicting individual's real market behavior.

[9] The following discussion is drawn from Mitchell and Carson (1989).

The findings of other simulated market studies, including Bishop *et al.* (1983); Brookshire and Coursey (1987); and Coursey *et al.* (1987) demonstrated that the correspondence between simulated and hypothetical markets was quite strong for goods which are well defined and well understood by individuals. However, because these simulated market - hypothetical market studies are based on a consumer market model, their findings are not directly related to CVM studies that value purely public goods (Mitchell and Carson, 1989).

3. METHODOLOGY

3.1. Survey Design

3.1.1. The Good and the Payment Vehicle

The good valued in this study is the Alfred Bog wetland located in the United Counties of Prescott and Russell in southern Ontario. The Alfred Bog is a private good, whereby the associated property rights are well defined and are held by both private landowners and public organizations.

The payment vehicle is a crucial element in any CVM survey because it provides the context for payment. The payment vehicle affects the way respondents answer the elicitation question (Morrison *et al.*, 2000). Therefore, in order to provide a neutral payment vehicle and to minimize the number of protest bids against the method of payment, this study used a special fund. This type of payment vehicle is expected to enhance the plausibility of the hypothetical scenario. The U.S. Water Resources Council (1979) argues that this method of payment is recommended over alternatives such as entrance fees, sales tax, or electric bills, to avoid emotional reaction or protest against the method. The respondents were informed that their one-time contribution to the hypothetical preservation fund would be used exclusively to compensate landowners for their loss of land.

3.1.2. Survey Sampling

This study used a stratified sample, whereby the set of all households in the United Counties of Prescott and Russell was divided into three non-overlapping subpopulations called strata. These strata are conceptually regarded as separate populations in which sampling can be performed independently (Lehtonen and Pahkinen, 1994). Stratification was used to measure the effect of distance on mean WTP values to preserve the Alfred Bog wetland.

The first strata consisted of individuals living near the Alfred Bog wetland who may have had direct use or contact with it. This group included individuals living within a 15 km radius from the bog (Figure 3.1). The second strata was comprised of individuals living between a 15 km and 30 km radius from the Alfred Bog. This group was chosen because it is likely that many of these individuals may have visited the bog and may therefore be aware of its use values. Further, these individuals might derive some benefits from the nonuse attributes associated with the Alfred Bog wetland. This reasoning is consistent with Oglethorpe and Miliadou (2000). The third strata included individuals living between a 30 km and 55 km radius from the bog. This group may provide important nonuse value information since the majority of them may have never visited the Alfred Bog wetland.

A number of avenues were explored to identify the number of households per strata. Census information was not in a form to allow an easy allocation of households to each stratum and detailed information was not available, therefore, the Select Phone (2001) Canadian Edition database was used to estimate the number of households in each stratum. The database is similar to a telephone directory whereby it lists the names, phone numbers and complete addresses of individuals living in specific regions. The database provided listings of households in each town or village. These listings were then used to estimate the number of households for each of the three stratum. Therefore, with the combined information provided by the GIS map (the identification of towns in Prescott and Russell) and the listings of the number of households per town provided by the database, the number of households in each stratum was estimated.

In stratified sampling, auxiliary information (such as distance) is used to divide the population (the set of households in Prescott and Russell) into *H* non-overlapping subpopulations of size $N_1, N_2, \ldots, N_H$ elements such that their sum is equal to N. A sample is then selected independently from each stratum, where the sample sizes are $n_1, n_2, \ldots n_h$ elements respectively. With this technique, the variance of estimates are based on variances within strata, and are therefore likely to be smaller than those resulting from a random sample of the entire population (Freund and Wilson, 1997).

The formula for the variance of the estimated population mean from a stratified sample (equation 3.1) includes the overall sample size and the individual strata sample sizes, where σ_i^2 is the stratum variance.

$$\text{var}\,(y_{strat}) = 1/N^2 \sum N_i\,(N_i - n_i)\,(\sigma_i^2/n_i) \qquad (3.1)$$

Therefore, the determination of the sample size must be done in two stages (Freund and Wilson, 1997); i) determining the size of the entire sample *n*, and ii) the allocation of the sample to the different strata. The sample size, *n*, for this research study was determined to be 1,000, based on funding restrictions.

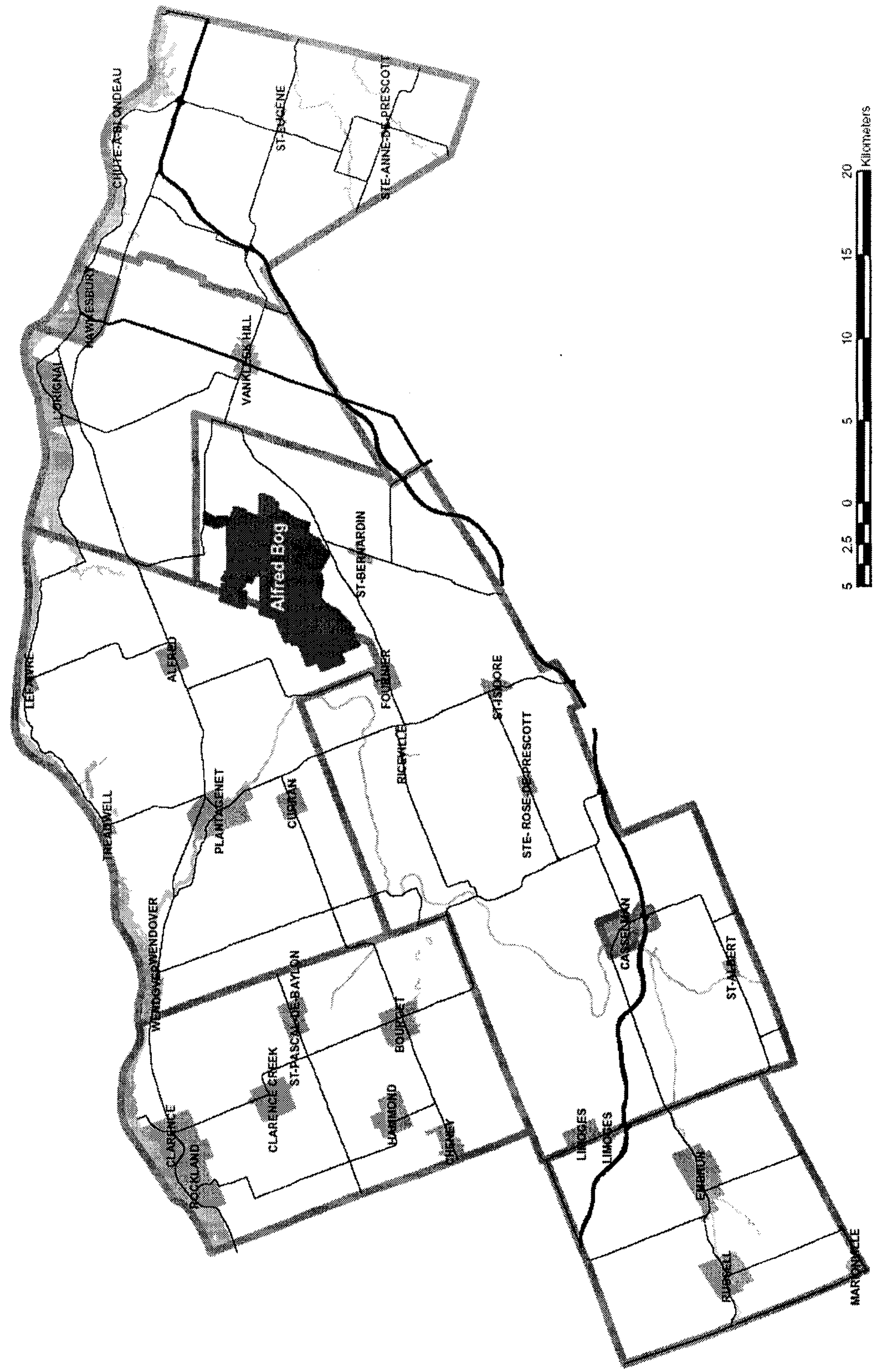

Figure 3.1: Geographic Information System Map of the Alfred Bog Wetland (Dionne, 2001).

By means of stratified random sampling, whereby the design within each stratum is simple random sampling (Thompson, 1992), the sample size for each stratum was determined. A random sample without replacement has been independently selected from each stratum (Thompson, 1992). The total sample size of n = 1,000 was allocated by the stratum weights, where the stratum weight is estimate by:

$$W_h = N_h/N \qquad (3.2)$$

where N_h = number of households per stratum and N = number of households in Prescott and Russell. Thus, the sample size for each stratum was determined by multiplying n by the stratum weights.

Two other sampling approaches were considered for this study. These were proportional allocation and optimum allocation. Both of these approaches were rejected for the following reasons. In the case of proportional allocation, the sampling fraction is the same for all strata (Lehtonen and Pahkinen, 1994), that is:

$$n_i/N_i = n/N, \; i = 1, 2, \ldots, s. \qquad (3.3)$$

Since this approach guarantees an equal share of the sample in all the strata, it can produce less efficient estimates than generally expected. Furthermore, estimation is simplified because the sample is self-weighing, that is, the estimate of the population mean is the simple (unweighted) mean of all observed values;

$$y = 1/n \sum y, \tag{3.4}$$

where the summation is over all sample values. The formula for the variance of the estimated population mean is also simplified (Freund and Wilson, 1997; Cochran, 1977);

$$\text{var}\,(y_{prop}) = (N - n)/N\,(1/n) \sum N_i/N\,(\sigma_i^2). \tag{3.5}$$

Optimum allocation (or Neyman allocation) is an allocation principle that is based on the notion that more precise estimates can be obtained if more sampling units are given to strata having larger within-stratum variance. Optimum allocation causes larger sample sizes relative to proportional allocation for strata exhibiting larger within-stratum standard deviations, however, it does not provide a self-weighting sample. Although this type of allocation provides the most efficient estimates under stratified sampling, this method can only be implemented if the variances for each individual stratum are known (Freund and Wilson, 1997). Since the individual stratum variances are not known, this technique was not chosen for this study.

3.1.3. Survey Technique

Survey instruments may be delivered to respondents by various methods including, personal interviews, telephone interviews, or they may be sent by mail. Although the personal interview survey is the method of choice of most CVM studies (Mitchell and Carson, 1989), this study used a mail survey, which was conducted between August and October 2001.

Schuman and Kalton (1985) argue that the presence of an interviewer motivates respondents to participate completely with an interview and allows the interviewer to probe unclear responses. In addition, personal interviews lend themselves to the use of visual aids to help convey complex ideas or information. However, Bradburn (1983, p. 294) states that "contrary to the common belief favoring face-to-face interviews, there is no clearly superior method that yields better results for all types of questions".

Dillman (2000) and other researchers (Bishop and Heberlein, 1979; Walsh *et al.*, 1984; Bishop *et al.*, 1984) argue in favor of the advantages associated with the mail survey method. The mail survey method has an advantage over telephone surveys in being able to use visual aids and an advantage over both telephone and personal interview surveys in avoiding the possibility of interviewer bias (Mitchell and Carson, 1989). Moreover, the mail survey method is inexpensive to implement in comparison to the other two approaches. The funding constraints of this study did not permit the use of either the telephone or personal survey interview.

3.1.4. Pretesting of Survey Instruments

A pretest of the survey instruments was conducted in Vankleek Hill, Ontario during the month of July 2001, whereby, twenty-one respondents were asked to complete the questionnaire survey. The respondents were asked to comment on the suitability of the questions posed, paying close attention to ambiguities and other anomalies. Mitchell and Carson (1989) argue that pretesting is almost certainly the single most effective way to improve a study's reliability because it allows for survey weaknesses to be examined before taking it into the field.

The retrospective interviewing technique (Dillman, 2000) was implemented, where the respondents were asked to complete the questionnaire as if they received it at home, and to complete it in whatever manner they would if the researcher were not present. While the respondents filled out the questionnaires, the researcher noted any confusing expressions, hesitations, skipped questions, or any other behavior that indicated the presence of comprehension problems. After the questionnaires were completed, the researcher asked questions about each of these potential problems and went through each question on the questionnaire to obtain feedback from the respondents in regards to the wording, clarity, relevance, and interpretation of each question in the survey. The researcher also examined if all questions were interpreted similarly by all respondents.

The range of bids for this study was determined from the mean WTP values calculated from the pretest. The mean WTP for the preservation of the Alfred Bog wetland was calculated to be $92.54. The minimum WTP in the pretest was $5.00 and the maximum WTP was $300.00.

Based on the responses and comments given during the pretest, a final draft of the questionnaire survey was drawn up. The questionnaire was then reviewed prior to mailing by individuals that did not participate with the development or revision of the questionnaire and related material. This final revision was done to detect obvious and elementary problems with the questionnaire. Dillman (2000) suggests that individuals who have worked on several revisions of the questionnaire tend to lose their ability to detect obvious problems.

3.2. Survey Instruments

3.2.1. Survey Implementation

The survey implementation was based on the Tailored Design Method (Dillman, 2000), whereby multiple mailings were employed to increase the overall response rate. Scott (1961), Linsky (1975), and Dillman (1991) argue that multiple contacts are more efficient than other techniques for increasing response to surveys by mail. Moreover, personalization of correspondence and stamped return envelopes were used since these techniques have been shown to have modest effects on response rates, and are usually important for maximizing survey responses (Dillman, 1991). In total, four mailings were sent between the months of August 2001 and October 2001. The four mailings included a prenotice letter, a questionnaire, a reminder letter, and a final contact with an enclosed questionnaire.

The fist mailing, the prenotice letter, was sent out at the end of August 2001. The bilingual letter explained to the residents of Prescott and Russell that a questionnaire for an important study on the Alfred Bog wetland will be sent to them, and they were asked to participate in this study by completing the questionnaire and returning it. The purpose of the prenotice letter was to provide the recipient with a positive and timely notice that they will be receiving a request to help with an important study. Research has consistently shown that prenotice letters have improved response rates for mail surveys (Fox *et al.*, 1988; Dillman, 1991; Dillman *et al.*, 1995)

The second mailing was sent out approximately two weeks after the first mailing. This mailing included a bilingual detailed cover letter, a bilingual questionnaire, and a stamped return envelope. The cover letter explained the significance of the study and why a response is important. Furthermore, a confidentiality statement was included in the letter to convey an ethical commitment to the respondents that the results from the study would be released as summaries so that any individual's responses cannot be identified as their own.

In regards to the return envelope, a stamped return envelope was used for several reasons. First, Armstrong and Luske (1987) have shown that stamped return envelopes have improved response rates over those achieved by sending a business reply envelope. Further, when a postage stamp is placed on a return envelope, something of monetary value has been given to the respondent (Dillman, 2000). Therefore, in an exchange context the stamp may be viewed as a considerate gesture that will help the sender to be viewed positively by the respondent. The stamp may also encourage trust that the questionnaire is important (Dillman, 2000). In addition, Dillman (2000) has also noted that it is culturally difficult for many people to disregard something that has any monetary value. As a result, the enclosure of a stamped return envelope may encourage respondents to return the questionnaire.

The third mailing, the reminder letter, was sent out approximately three weeks after the first questionnaire was mailed. The bilingual reminder letter was sent to all individuals that had not returned their questionnaires. This mailing reminded the respondents of the importance of the study and encouraged them to return the questionnaires in a timely manner. It also stressed the message of how important each recipient is to the success of the study.

The fourth and final mailing was sent out approximately two weeks after the reminder letter. This mailing included a bilingual cover letter, a replacement questionnaire, and a stamped return envelope. The cover letter had a tone of insistence that the previous contacts lacked. The majority of the letter was devoted to a restatement of each respondent's importance to the study. It also conveyed to the recipient that others have responded, as a means of encouraging responses. The importance of the study was reemphasized, implying that the success of the study is dependent on the return of the questionnaire (Dillman, 2000).

Telephone follow-ups were conducted for respondents that returned incomplete questionnaires. The phone numbers for the respondents were obtained through the Select Phone (2001) Canadian Edition database, which contains the telephone numbers of individuals listed in the phone book. Once the respondents were contacted, the researcher explained the reason for calling and asked the respondents to complete the questionnaire over the telephone.

3.2.2. Survey Questions

The survey questionnaire included 26 questions and was divided into three sections[10]. The first section of the questionnaire gathered information on the Alfred Bog wetland, the second section included a description of the hypothetical scenario, and the third section involved questions concerning background information (Appendix II).

The first section of the questionnaire presented the respondents with a definition of wetlands (Keys, 1992) and described the current status of wetlands in Ontario. Furthermore, it gave a

[10] Certificate of Ethical Acceptability for Research Involving Humans is presented in Appendix I.

description of the Alfred Bog wetland, including its' location and functions (Mosquin, 1991). This section was intended to give respondents enough information so as to facilitate their completion of the questionnaire.

Question 1 asked respondents whether or not they were aware of the Alfred Bog wetland prior to reading the information on wetlands and the bog. Questions 2 and 3 asked respondents about visitation experiences at the Alfred Bog. Question 2 asked respondents if they have ever visited the bog. Those who had never visited the bog skipped question 3, which gathered information on the purpose of their visits, and went to question 4, which asked the respondents if they would consider visiting the bog in the future. Question 5 asked respondents about their knowledge of other wetlands in Ontario.

Questions 6 and 7 asked respondents about their attitudes towards the preservation of the Alfred Bog wetland. Question 6 asked respondents about their perceived importance of preserving the Alfred Bog wetland. Six levels of importance were presented, which ranged from "extremely important" to "not important at all." Question 7 asked respondents how much of the Alfred Bog wetland they believed should be preserved. The amounts to be preserved ranged from 100 per cent to 0 percent. It also included a "not sure" response.

The scenario described the functions and goals of the hypothetical preservation fund. The respondents were told that a hypothetical blue ribbon committee introduced a special preservation fund whereby individuals could contribute money to preserve the Alfred Bog wetland in its' present state. The hypothetical scenario then sought to elicit respondents' WTP for the preservation of the Alfred Bog wetland.

Question 8 asked respondents if they have made contributions towards the preservation of Ontario wetlands in the past. Question 9 elicited respondents' WTP for the preservation of the Alfred Bog. It asked respondents if they would be willing to make a one-time contribution towards the preservation fund. Those individuals that were not willing to make a contribution were prompted to go to question 10. A matrix format, based on the multiple bounded model developed by Welsh and Bishop (1993), was used for this question. The rows of the matrix contained eight bid amounts that ranged from $5 to $350. The bid amounts were determined from the pretest. The columns of the matrix contained five levels of certainty, which ranged from "definitely yes" to "definitely no." This allowed the respondents to express their level of certainty associated with each dollar threshold. The respondents were asked to respond to each bid amount. After completion of this question, the respondents were prompted to go to question 11.

Question 10 gathered information on the various reasons why respondents were not WTP to preserve the Alfred Bog wetland. A list of five reasons for not contributing to the preservation fund were given, including, "this is what the Alfred Bog is worth to me," "did not want to place a dollar value on the Alfred Bog," "it is the responsibility of the Government," "peat extractors should pay," and "I choose to spend my money in other ways." This question was implemented to identify protest bids.

Question 11 gathered information about the respondents' attitudes towards the preservation of the Alfred Bog wetland. The question was structured similarly to a Likert scale. A list of nine reasons, including three use values and six nonuse values, for why the Alfred Bog wetland should be preserved were given. The respondents were asked the extent to which they agreed or disagreed with the nine reasons. The scale ranged from "strongly agree" to "strongly disagree."

Question 12, the last question in section two of the questionnaire, asked respondents to reveal which type of payment vehicle they believe is the most appropriate in regards to the preservation of the Alfred Bog wetland. A list of three payment methods were presented, which included a voluntary contribution, a special county assessment tax (an environmental tax), and a land tax. Respondents were also prompted to give payment methods that were not included in the list.

The third section of the questionnaire gathered background information about the respondents. Questions 13 through 17 asked about gender, age, number of children, education, and income respectively. Questions 18 through 23 asked respondents information concerning ownership of land within or on the periphery of the Alfred Bog wetland. Question 18 asked respondents if they own any land within or on the perimeter of the bog. Those that did not own any land skipped all subsequent questions and went to question 24. Question 19 asked respondents for the total area of their land and question 20 asked what type of agricultural activity is practiced on their land. A list of ten agricultural activities was provided, whereby the respondents were asked to indicate the activities practiced on their land.

Questions 21 through 23 gathered information about whether any of the respondents' land was set aside for conservation purposes. Question 24 asked respondents whether or not they participated directly or indirectly in the Alfred Bog peat mining industry. This question was used to identify the possibility of protest bids. Question 25 asked respondents if they are members of any conservation group. The final question, question 26, asked respondents for their city of residence.

3.3. Model Specifications

3.3.1. Explanatory Variables

Bid

The variable BID was defined as the probability that a respondent would not be WTP the bid amount offered for preserving the Alfred Bog wetland. A positive correlation between the bid amount offered and the probability that a respondent would not accept it (i.e.- the respondent will not be WTP the offered bid amount) was expected. Thus, it was hypothesized that an increase in the bid amounts would increase the probability that a respondent would not accept it.

Knowledge

Survey respondents were asked about their knowledge of and visitation experiences with the Alfred Bog wetland. The variable knowledge (KLG) was a dummy variable, which was assigned a value of 1 when a respondent had knowledge of the Alfred Bog and 0 otherwise. It was hypothesized that respondents with prior knowledge of the Alfred Bog wetland may value the bog more highly than uninformed respondents. Thus, a positive correlation between knowledge and WTP was hypothesized.

Visit

The variable visit (VIS) was also a dummy variable, which was assigned a value of 1 when a respondent stated that they have visited the Alfred Bog at least once and 0 otherwise. It was hypothesized that respondents who had visited the Alfred Bog wetland in the past may value the bog more highly than nonusers. Thus, a positive correlation between visit and WTP for the preservation of the Alfred Bog wetland was hypothesized.

Importance

The variable importance (IMP) was a dummy variable, which identified respondents' perceived importance of preserving the Alfred Bog wetland. A value of 1 was assigned to "extremely important" and "fairly important" responses while a zero value was assigned to "not sure," "not really important," and "not important at all" responses. It was hypothesized that this variable was positively related to WTP. Thus, if the resource was of importance to the respondent, then they would be WTP more for its' preservation.

Donation

Respondents were asked about previous donations made towards the preservation of Ontario wetlands. The variable donation (DON) was a dummy variable, which took on the value of 1 when respondents made past donations towards preserving wetlands and 0 otherwise. It was hypothesized that there would be a positive correlation between previous donations and WTP since this variable reflects positive attitudes towards the preservation of the Alfred Bog wetland.

Attitude

Respondents were presented with nine possible reasons for the preservation of the Alfred Bog, including three use values and six nonuse values, and they were asked the extent to which they agreed or disagreed with the reasons. The use values included both direct and indirect use values. The question was structured similarly to a Likert scale, whereby each level of certainty was assigned a numeric value (5 = strongly agree, 4 = somewhat agree, 3 = not sure, 2 = somewhat disagree, and 1 = strongly disagree). Two variables were generated, use value (UVAL) and nonuse value (NVAL) which captured the respondents' attitudes towards the preservation of the Alfred Bog. Therefore, the minimum score for use values (UVAL) is 3 and the maximum score is 15. Similarly, the minimum score for nonuse values (NVAL) is 6 and the maximum possible score is 30. It was hypothesized that respondents who assigned greater use and nonuse values towards the preservation of the bog would be WTP more to conserve the Alfred Bog. Thus, these variables were hypothesized to be positively related to WTP.

Membership

Respondents were asked if they were members of a conservation group. Membership (MBR) was a dummy variable, which was assigned the value of 1 for members and 0 otherwise. Members of conservation groups tend to have positive views and attitudes towards environmental protection, therefore, it was hypothesized that membership would have a positive relationship with WTP.

Distance

The cities within the United Counties of Prescott and Russell were divided into three strata based on their distance from the Alfred Bog wetland. Strata 1 represented individuals living within 15 km from the Alfred Bog, strata 2 represented individuals living between 15 km and 30 km from the bog, and strata 3 represented individuals living between 30 km and 55 km from the bog.

It was hypothesized that WTP would decline with distance since visit rates may decrease with distance from the bog.. It was further hypothesized that nonuse values, such as option values, would also decrease with distance. Therefore, there is an expected negative correlation between WTP and the variable distance (DIS).

Income

Individuals with a higher level of income were expected to have a lower marginal value of money, since it is assumed that money has a decreasing marginal utility. Thus, it was hypothesized that individuals with higher incomes would be WTP more for the preservation of the Alfred Bog wetland than individuals with lower incomes. Therefore, a positive correlation between income and WTP was expected. Dummy variables were generated for each of the eight income categories (IN1-8).

Education

Four levels of education were presented to the respondents, including, primary, secondary, post-secondary, and university. Dummy variables were generated for each of the education levels (ED1-4). The variable ED1 represented the lowest level of education, which was primary education. ED4 represented the highest level of education, which was university education. It was expected that individuals with a higher level of education would have a more comprehensive understanding of and would be more familiar with the notion of hypothetical scenarios and WTP questions. These individuals were also expected to be more aware of wetland preservation issues. Therefore, it was hypothesized that a higher level of education would generate a higher WTP value.

Additional Variables

Several socioeconomic variables were included in the last section of the questionnaire, where background information was gathered on the respondents. The variables included in the models were age, (AGE), gender (GEN), and number of children (CHD). These socioeconomic variables were included to examine their effect on respondents' WTP values.

3.3.2. Regression Models

Three models were used to estimate respondents' WTP for the preservation of the Alfred Bog wetland. Models STRAT1, STRAT2, and STRAT3 were used to measure the effect of distance on mean WTP values. Model STRAT1 represented individuals living closest to the Alfred Bog and model STRAT3 represented individuals living furthest from the bog. Each of the STRATA models used the same form except for model ALL.

Model STRAT$_i$:

$WTP_{strat\,i}$ = *f* (KLG, VIS, IMP, DON, UVAL, NVAL, MBR, IN1-8, ED1-4, GEN, AGE, CHD)

Model ALL:

WTP_{ALL} = *f* (DIS, KLG, VIS, IMP, DON, UVAL, NVAL, MBR, IN1-8, ED1-4, GEN, AGE, CHD)

3.4. Analysis of Data[11]

3.4.1. The Multiple Bounded Discrete Choice Model

The multiple bounded discrete choice (MBDC) approach allows respondents to express their level of WTP certainty for different dollar thresholds. Analysis of WTP data collected using the MBDC method is conducted by using a multiple bounded generalization of double bounded dichotomous choice models. This approach is analogous to the maximum likelihood interval modeling method used for payment card data (Welsh and Poe, 1998).

[11] Sections 3.4.1, 3.4.2, and 3.4.3 follow the structure of De Maio Sukic (2001).

In the MBDC model, an individual's response pattern reveals the interval on the real number line, which contains their true WTP. The respondent's true WTP must be at least equal to the highest value accepted (X_{iL}) but less than the next higher value (X_{iU}). Thus, WTP_i lies somewhere within the switching interval [X_{iL}, X_{iU}] (Harpman and Welsh, 1999). In the multiple bounded logistic model, the probability that a respondent would be WTP the bid amount offered is defined as follows[12]:

$$\text{prob}\ (WTP > X) = F(X; \beta) = [1 + \exp(-\beta'\text{X})]^{-1} \tag{3.6}$$

where β is a vector of coefficients, X is a vector of explanatory variables including the bid (X), and $F(X; \beta)$ represents the cumulative density function. Conversely, the probability that a respondent would not be WTP the bid amount offered is defined as follows:

$$\text{prob}\ (WTP < X) = 1 - F(X; \beta) = 1 - [1 + \exp(-\beta'\text{X})]^{-1} \tag{3.7}$$

The dependent variable is defined as the probability that a respondent would not be WTP the bid amount offered for preserving the Alfred Bog wetland. Thus, a positive correlation between the bid amount offered and the probability that the respondent will not accept it (i.e.- the respondent will not be WTP the offered bid amount) is expected.

By means of maximum likelihood estimation (MLE), the dependent variable is regressed on the offered bid amounts and on a vector of independent variables. The maximum likelihood

[12] Equations in section 3.4.1 are adopted from Poe and Welsh (1995).

estimation method chooses among all possible parameter estimators those values which make the probability of obtaining the observed sample as large as possible (Koutsoyiannis, 1977). It is an iterative algorithm which starts with an initial random estimate of the logit coefficients and determines changes in those coefficients that will maximize the log likelihood of obtaining the best estimators of the parameters. Once the initial function is estimated, the residuals are tested and a re-estimate is made with an improved function. This method is repeated until convergence is reached, that is, until there is no significant change in the log likelihood (Eatwell *et al.*, 1990).

Thus, the probability that WTPi lies between any two price thresholds is:

$$F(X_{iU}; \beta) - F(X_{iL}; \beta) \tag{3.8}$$

which results in the corresponding log-likelihood function:

$$\ln (L) = \sum_{i=1}^{n} \ln [F(X_{iU}; \beta) - F(X_{iL}; \beta)] \tag{3.9}$$

The process of maximum likelihood estimation provides the following output; the vector of variable coefficients, the value of the log likelihood function, and the variance-covariance matrix. This output is then used to calculate the Wald statistic, which tests the null hypothesis that all of the slope terms are equal to zero, the mean WTP value, and the t-statistics for all coefficients. Analysis of the data and regression models were estimated using a program written in GAUSS by Welsh and Poe (1998), which was provided by De Maio Sukic (2001).

3.4.2. Goodness of Fit

Goodness of fit measures are used to evaluate how well an econometric model explains the observed data or how well-fitted values of the response variable compare to the actual values (Kanninen and Khawaja, 1995). McFadden's pseudo R^2 is one method for measuring the overall performance of a model. Kannien and Khawaja (1995) have demonstrated that although McFadden's pseudo R^2 is a standard goodness of fit measure for binary discrete choice models, it cannot be calculated for the multiple bounded logit model used in contingent valuation because the restricted log of the likelihood function is undefined.

An alternative approach to the standard tests of measuring goodness of fit in the case of the double-bounded logit model is the sequential classification procedure developed by Kannien and Khawaja (1995). As discussed in section 2.3.5.1, the double bounded format asks respondents to engage in two rounds of questions, whereby they respond to a first dollar amount and then face a question involving a second dollar amount, higher or lower depending on the response to the first question. In the case of the sequential classification procedure, this measure is used to sequentially count the proportion of "fully, correctly classified cases," that is, the correctly classified cases are counted with respect to the first question, then only those observations that were correctly classified by the first question are used to count the correctly classified cases for the second question. Kannien and Khawaja (1995) proposed that this measure explicitly accounts for the sequential nature of the double bounded questioning format. However, this method is not useful in the MBDC context when responses are obtained simultaneously (Harpman and Welsh, 1999).

The likelihood ratio (LR) test, which is one of three asymptotically equivalent tests (the other two are the Lagrange multiplier test and the Wald test), is used for testing nested hypotheses in the context of maximum likelihood estimation. The likelihood ratio statistic is given by:

$$LR = -2\ \log(L_0/L_1) = (-2\ \log L_0) - (-2\ \log L_1) = -2\ (\log L_0 - \log L_1) \sim \chi^2(r) \qquad (3.10)$$

where r is the number of restrictions, L_0 is the maximum value of the likelihood function if all coefficients except the intercept are zero and L_1 is the value of the likelihood function for the full model (Welsh and Poe, 1998). The computed chi-square value tests the hypothesis that all coefficients except the intercept are equal to zero (Aldrich and Nelson, 1984). However, the LR statistic, as well as the Lagrange multiplier, requires the calculation of the restricted likelihood function. Thus, Harpman and Welsh (1999) propose the use of the Wald test statistic (W), which is based only on the unrestricted model parameters and is therefore calculable for multiple bounded models.

The Wald test is used for testing hypotheses about nonlinear restrictions, as well as linear restrictions. The Wald statistic for linear restrictions is given by equation 3.11.

$$W = [R\beta - r]'\ [R(V)R']^{-1}\ [R\beta - r] \sim \chi^2_m \qquad (3.11)$$

R is a matrix of restrictions with m rows and k columns, where m is the number of restrictions (degrees of freedom) and k is the number of estimated parameters. β is a (k X 1) vector of estimated coefficients, r is a (m X 1) vector of constants, and V is the estimated variance-covariance matrix of β (Harpman and Welsh, 1999).

The Wald test statistic is calculated using the set of hypothesized restrictions (coefficient of all independent variables are equal to zero), the vector of estimated parameters, and the variance-covariance matrix. The Wald statistic has an asymptotic central χ^2 distribution with m degrees of freedom if the null hypothesis that all slope coefficients are simultaneously equal to zero is true (Harpman and Welsh, 1999). Thus, a test based on W rejects the null hypothesis if $W > \chi^2_{(m, \alpha)}$.

3.4.3. Method of Convolutions

The convolution approach, developed by Poe *et al.*, (1994), was used to determine if there was a statistically significant difference in distributional mean WTP values for models STRAT1, STRAT2, and STRAT3. In contrast to previous techniques used to evaluate the significance of difference between distributions, the method of convolutions accommodates any distributional form. It avoids the restrictive assumption of normality and does not employ a non-overlapping confidence interval criterion (Poe *et al.*, 1994).

The convolution approach is used in statistics and mathematics to calculate the distribution of a sum of random variables. It involves calculating the probability of all possible differences (i.e., the convolutions) between discrete values in different distributions (Loomis *et al.*, 1997). The method then tests whether the (1 - α) confidence interval for the convolution or set of differences includes zero. In addition, the convolution approach calculates an alpha level for rejecting the null hypothesis of equality of the two distributions.

The method of convolutions can be demonstrated as follows. Let X and Y be independent random variables with $f_x(x)$ and $f_y(y)$ probability density functions, and the difference ($V = X\text{-}Y$) be a random variable. The probability of event $V = v$ is defined as the union of all the possible combinations of x and y which result in a difference of v (Poe *et al.*, 1994). This relation is expressed by:

$$f_v(v) = \int_{-\infty}^{+\infty} f_x(v+y)\, f_y(y)\, dy \tag{3.12}$$

The corresponding cumulative distribution function $F_v(v)$ for empirical applications with discrete observations is:

$$F_V(v^0) = \sum_{-\infty}^{v^0} f_v(v)\, \Delta v \tag{3.13}$$

To test the null hypothesis H_o: $X - Y = 0$, equation (3.12) can be applied to the information provided by the Krinsky-Robb simulation method proposed by Park *et al.* (1991). The Krinsky-Robb approach was used to calculate confidence intervals to approximate the distribution of mean WTP' for the preservation of the Alfred Bog. The application of confidence intervals allows for a more rigorous comparison of WTP estimates (Park *et al.*, 1991). A (1-α) confidence interval is obtained by ranking the vector of calculated WTP values and dropping the $\alpha/2$ values from each tail of the ranked vector (Park *et al.*, 1991).

The lower and upper bound of the (1-α) confidence intervals for the convolution are respectively defined as (Poe *et al.*, 1994):

$$L_{1-\alpha}(V) = F_V^{-1}(\alpha/2) \quad (3.14)$$

$$U_{1-\alpha}(V) = F_V^{-1}(1 - \alpha/2)$$

The null hypothesis that the difference (*X*–*Y*) equals zero is accepted at the α level of significance if the approximate (1-α) confidence interval of the convolution includes zero, and it is rejected otherwise (Poe *et al.*, 1994). Thus, the null hypothesis that the difference in distributional mean WTP estimated using models STRAT1, STRAT2, and STRAT3 is not significant was tested by the convolution approach. The convolutions were calculated by using a program written in GAUSS by Welsh and Poe (1998).

3.4.4. Treatment of Protest Bids

A significant number of respondents to contingent valuation surveys state a zero bid for reasons associated with the process of valuation (Jorgensen *et al.*, 1999). Protest zero bids are statements of zero WTP by respondents that presumably value the good positively but refuse to pay on the basis of ethical reasons, disagreement with the payment vehicle, or believe that the good should be provided by means other than personal payment (Sagoff, 1988; Mitchell and Carson, 1989). These protest bids are often excluded from analysis because it is assumed that they are not indicative of respondents' "true" values. Halstead *et al.* (1992) argue that the exclusion of protest bids from the contingent valuation sample may bias WTP results.

Protest zero bids are quite common in contingent valuation studies. In a study of black fly control, Reiling *et al.* (1989) identified 24% of zero bids as protest bids while Desvousges *et al.* (1983), in their study on water quality, identified approximately half of the zero bids as protest zero bids. Furthermore, Rowe (1982) has cited several studies with protest bid rates of 50% and greater.

The censoring of protest zero responses has led to the emergence of a definitional controversy (Jorgensen *et al.*, 1999). Syme and Jorgensen (1994) argue that the application of protest response criteria appears to be ad-hoc in practice. Contingent valuation studies have employed several different criteria for censoring protest zero bids. For example, Whittington *et al.* (1992) classified reasons other than the ability to pay or the worth of the public good in question as protest zero responses while Sutherland and Walsh (1985), Lockwood and Tracy (1995), and Bergstrom *et al.* (1985) classified only zero responses associated with a rejection of the payment vehicle as protest zero responses.

In a study conducted by Milon (1989), zero bids were excluded from the sample if respondents indicated that they did not understand the question, rejected the concept of paying for the good, or did not give a reason for their response. In contrast, Edwards and Anderson (1987) reported the censoring of zero bids for the following responses; the government should pay, those causing the pollution should pay, cannot afford to pay anything, and failure to give a reason for not paying. Similarly, in a study which estimates the economic value of preserving a wetland, Oglethorpe and Miliadou (2000) censored zero bids for the following responses; it is the responsibility of the government, I can not afford to pay, and I choose to spend my money in other ways.

As depicted by the above criteria for censoring protest zeros, there does not appear to be any consistency or rationale over what constitutes a protest zero response (Jorgensen *et al.*, 1999). In this respect, two similar CVM analyses conducted independently on the same commodity may lead to different mean and median WTP estimates depending on how the data is organized (Jorgensen *et al.*, 1999). Lindsey (1992) argues that if CV analyses made explicit the rationale used to identify protest responses, then surveys could be evaluated on theoretical grounds.

Therefore, due to the current lack of consistent criteria in CVM research for censoring protest responses, three principal means of dealing with protest zero bids were used in this study. The first approach identified and eliminated all protest zero bids from the data set. The second approach treated the protest zero responses as legitimate zero bids and included them in the data set. The third approach assigned protest zero bidders mean WTP values (Halstead *et al.*, 1992).

4. RESULTS AND DISCUSSION

4.1. Sample Results

4.1.1. Response Rate

In comparison with other studies (Mitchell and Carson, 1989; Bowker and Didychuk, 1994; Lockwood and Tracy, 1995; and Stevens et *al.*, 1995) the overall survey response rate was quite high. A total of 398 questionnaires were returned which represents approximately 57% of the adjusted sample size (Table 4.1). Strata 1 had a response rate of 59%, which was the highest response rate of the three strata. Strata 2 and strata 3 also had notably high response rates of 55% and 58% respectively. Of the 398 questionnaires that were returned, 22% of the questionnaires were returned after the first reminder letter was sent out, thus implying the importance of including a reminder letter when implementing a multiple-mailing approach.

Of the returned questionnaires, 14% were not usable. These questionnaires were identified as not usable either because they were incomplete, blank, or the respondents were incapable of revealing their WTP. The latter refers to respondents who choose the level of certainty "do not know" for the entire range of bids. With regards to blank questionnaires, the main reason that respondents gave for sending back blank questionnaires was that they disliked the notion of being solicited at their place of residence.

In addition to completing the questionnaires, several respondents attached comments at the end of their questionnaires (Appendix III). The majority of the comments stressed the importance of preserving the Alfred Bog due to its' numerous benefits (including groundwater protection, habitat for wildlife, and bequest and option values) to society.

Respondents also commented on the importance of educating the public about the roles and functions of wetlands. Other comments stressed the issue that the Ontario government should be more proactive and should make a greater effort towards preserving the Alfred Bog wetland. As well, telephone calls were received from some respondents asking for further information on the Alfred Bog wetland and for information about becoming more involved with preservation efforts. Together, the comments and telephone calls indicated that respondents took interest in the Alfred Bog while completing their questionnaires.

Table 4.1: Response Rate

	Strata 1	Strata 2	Strata 3	Total
Initial Sample Size	175	408	418	1,001
Wrong Address	21	129	118	268 (27%)
Deceased	12	16	8	36 (4%)
Adjusted Sample Size	142	263	292	697 (100%)
Returned	84	144	170	398 (57%)
Not Usable	11	26	22	59 (14%)
Incomplete	4	13	12	29 (7%)
Inability to Reveal WTP	4	10	9	23 (6%)
Blank	3	3	1	7 (2%)
Usable	73	118	148	339 (86%)

4.1.2. Protest Bids

Fifty-eight percent (n=197) of the survey respondents reported zero bids. However, the majority of those respondents that were not WTP to preserve the Alfred Bog wetland stated that the preservation of the bog was either "extremely" or "fairly" important to them, indicating a clearly positive attitude towards preservation. This suggested that many of the respondents may have reported protest zero bids. As cited in section 3.4.3., similar studies conducted by Reiling *et al.* (1989), Desvousges *et al.* (1983), and Rowe and Chestnut (1982) have reported similar results with protest zero bid rates of 50% and higher.

The main explanation given by 84% of the survey respondents for protest zero bids was that it should be the responsibility of the government to pay for the preservation of the Alfred Bog wetland. Other reasons expressed by the respondents included, "I did not want to place a dollar value on the Alfred Bog," "Peat extractors should pay," and "I chose to spend my money in other ways." The latter reason was censored as a protest response since it did not necessarily represent a zero bid. A value might have been attributable to the Alfred Bog, but a higher value for another cause may have displaced the bid. Only 3% of the reported zero bids were considered legitimate zero responses and were included in the analysis[13].

The high percentage of protest zero bids may have been the result of government failure to enforce preservation efforts for the Alfred Bog. At the time when the questionnaires were sent, extensive media surrounding the Alfred Bog stressed the importance of protecting and saving the bog from further degradation, however neither the Federal nor Provincial

[13] A zero bid was considered to be legitimate only if the respondent stated, "this is all the Alfred Bog is worth to me".

governments enforced measures to protect the bog. The respondents may have felt that the preservation of the bog should not be a direct levy on society but instead should be the responsibility of a higher level of authority, the government. The respondents may have felt that it should be the governments' responsibility to protect and to take care of society's natural resources.

Furthermore, the lack of regulatory power to fully protect wetlands in Ontario has recently been felt by some of the residents of Prescott and Russell when existing policies could not halt peat extraction in Moose Creek Bog, which has since become the site of intensified peat extraction as well as a regional landfill. This may have been another contributing reason for which respondents felt that the preservation of the Alfred Bog should be the sole responsibility of the government.

4.2. Qualitative and Quantitative Survey Statistics

The CVM questionnaire gathered background information about the respondents as well as information about their attitudes and experiences with the Alfred Bog wetland. The questionnaire further gathered information about respondents' perceived importance of preserving the bog, previous knowledge of the bog, and use and nonuse values. This information was used to create the explanatory variables in model STRAT1, STRAT2, STRAT2, and ALL.

The sample consisted of 61% male respondents and 39% female respondents. The average age of the respondents was the third range level, which corresponds to an age of 41 to 50 years old (Table 4.2). However, the age group across all four models was clustered around the second and third range level, indicating that the majority of the survey respondents fell into two age ranges (31 to 40 and 41 to 50). The average number of children per household was 1.9.

Respondents in model STRAT3 had a higher level of education in comparison to individuals in models STRAT1 and STRAT2. Twenty-nine percent of the respondents in model STRAT3 had a university education as compared to 21% and 24% of the respondents in models STRAT1 and STRAT2, respectively. Approximately 44% of the respondents in model STRAT1 had only a secondary education and 23% had post-secondary education. In comparison, 27% and 32% of the respondents in models STRAT2 and STRAT3, respectively, had post-secondary education.

The survey questionnaire identified eight income categories ranging from income 1 (the lowest income category) to income 8 (the highest income category). However, the results suggested that the income categories were too specific. Each of the eight income categories contained a relatively small percentage of the respondents. Therefore, the income categories were combined to form four categories, where income 1 represented the lowest level of income and income 4 represented the highest level of income.

Income levels varied with each model. Respondents in model STRAT3 had a higher level of income than respondents in models STRAT1 and STRAT2. Thirty-seven percent of the respondents in model STRAT3 had incomes in the uppermost income level (level 4), and were clustered around income level 3 and income level 4. Income levels for respondents in model STRAT1 and model STRAT2 were clustered around the middle income ranges (level 2, and level 3).

Table 4.2: General Respondent Characteristics by Strata

		Model STRAT1	Model STRAT2	Model STRAT3	Model ALL
Age		3.15	3.01	2.98	3.03
Children		1.94	1.76	1.95	1.90
Education[a]	1	12%	11%	2%	7%
	2	44	38	36	39
	3	23	27	32	28
	4	21	24	29	26
Income[b]	1	4%	6%	0%	3%
	2	39	36	25	32
	3	36	34	38	36
	4	21	24	37	29

[a] Percentage of respondents in each education range.
[b] Percentage of respondents in each income range.

To determine whether the responses obtained from the survey questionnaires were representative of the population of Prescott and Russell, a comparison was made between the survey responses and the population characteristics. Statistics from the Ontario Municipal Directory (2001) indicated that the survey responses were representative of the population.

Regarding age, the highest percentage of the population eighteen years and older is the age group 30 to 39 years (19.2%) and the age group 40 to 49 years (15.6%) (Table 4.3). Regarding education level, 18.4% of the population has a secondary level education, while only approximately 4% of the population has a university level education. The average household income in Prescott and Russell is $46,858. Concerning gender, the population is split evenly between males and females. However, the statistics obtained in the study indicated that 61% of the survey respondents were male, while only 39 % were female. This resulted from the fact that the majority of the individuals identified for the study through the use of the Select Phone (2001) database were male. Most of the telephone listings provided by the Select Phone (2001) database, as with any telephone directory, contain the names of more male listings than female listings.

Table 4.3: Population Characteristics of Prescott and Russell

	Categories	Percentage of Total Population
Age	0-18	29.9%
	19-29	11.5
	30-39	19.2
	40-49	15.6
	50-59	9.7
	60-69	6.9
	70+	7.2
Gender	Male	49.7%
	Female	50.3
Education	Secondary	18.4%
	Post-Secondary	15.6
	University	3.8
Income	Average	$46,858

Information pertaining to respondents' experiences with and attitudes toward the preservation of the Alfred Bog wetland were gathered. In total, 67% of the survey respondents had prior knowledge of the Alfred Bog wetland (Table 4.4). However, this proportion decreased as distance from the bog increased. Eighty-two percent of the respondents in model STRAT1 had previous knowledge of the bog, while 70% of the respondents in model STRAT2 and 57% of the respondents in model STRAT3 had previous knowledge of the bog. The high percentage of respondents with prior knowledge of the Alfred Bog in model STRAT1 and STRAT2 may be the result of extensive media attention during recent years.

Approximately 59% of the respondents in model STRAT1 have visited the Alfred Bog at one time or another. However, only 11% of the respondents in model STRAT3 have visited the bog in the past. This was an expected result since visit rates decline with distance from the site. Overall, 29% of the survey respondents had used (visited) the Alfred Bog and 71% were pure non-users. The main reasons given by respondents for visiting the Alfred Bog were nature walks, educational outings, and bird watching.

When the respondents were asked about the importance of preserving the Alfred Bog wetland, 86% of the survey respondents considered preservation of the Alfred Bog to be "extremely important," 9% considered preservation to be "fairly important," 3% were "not sure", and only 2% said that the preservation of the Alfred Bog wetland was "not important at all."

Regarding donations towards the preservation of Ontario wetlands, 14% of the respondents said they have made past donations towards wetland preservation efforts. Of the 14% that have made previous contributions, 74% of them have visited the Alfred Bog in the past and 98% of them considered preservation of the Alfred Bog wetland to be 'extremely important'.

Similarly, 9% of the respondents stated that they were members of a conservation group. Of the 9% that are members of a conservation group, 73% of them have visited the Alfred Bog in the past and 97% of them consider preservation of the Alfred Bog wetland to be 'extremely important'.

Regarding use and nonuse values, with a possible minimum score of 3 and a maximum possible score of 15, the mean score for use values was 12.3. The mean score for nonuse values was 24.1, where the minimum possible score was 6 and the maximum possible score was 30. The results suggest that on average the respondents have strong pro-environmental attitudes towards the preservation of the Alfred Bog wetland.

Concerning the preservation question, 62% of the respondents stated that the entire Alfred Bog should be preserved, 19% stated that seventy-five percent of the bog should be preserved, 7% stated that fifty percent of the bog should be preserved, 3% stated that the bog should not be preserved at all, and 9% were unsure about the proportion to be preserved. The result suggests that respondents have positive attitudes towards the preservation of the bog.

Table 4.4: Respondents Attitudes and Experiences by Strata

		Model STRAT1	Model STRAT2	Model STRAT3	Model ALL
Knowledge		82%	70%	57%	67%
Visit		59%	31%	11%	29%
Importance	Extremely	93%	86%	88%	86%
	Fairly	7%	10%	6%	9%
	Not Sure	0%	1%	4%	3%
	Not Important at All	0%	3%	2%	2%
Donation		18%	14%	12%	14%
Member		7%	6%	13%	9%
Use Value		13.8	13.2	13.2	13.2
Nonuse Value		25.5	24.6	24.0	24.6

Information pertaining to the most appropriate method of payment (payment vehicle) was also sought. The majority of the respondents, 54%, stated that the preservation of the Alfred Bog should not be a direct levy on them, but instead should be the responsibility of the government. This result was not surprising in light of the high percentage of protest bids. Twenty-seven percent of the respondents were in favor of voluntary contributions while 16% stated that an environmental tax is the most appropriate method of payment. Three percent of the respondents were in favor of a land tax.

The survey questionnaire elicited information regarding respondents' participation with the peat mining industry. The proportion of respondents that participated in the Alfred Bog peat mining industry was very small (<3%), thus these responses were not included in the data. Furthermore, it was difficult to interpret some the responses given by these respondents. For example, some of the individuals that were involved with the peat mining industry indicated that they would be WTP to preserve the Alfred Bog, however the reasons for which they were WTP were unclear. For instance, some individuals stated that they would be WTP for the preservation of the bog, however when asked the question "how much of the Alfred Bog wetland do you believe should be preserved," they responded "none." Therefore, these responses were excluded from the data.

Similarly, information was gathered on ownership of land and the practice of agricultural activities. The proportion of respondents that owned land and practiced agricultural activities was small, <4% (of which 2% participated in the peat mining industry). Those individuals who participated in the peat mining industry were not included in the data.

4.3. Mean Willingness to Pay for the Preservation of the Alfred Bog Wetland

With protest zero bids excluded from the data, the mean WTP for the preservation of the Alfred Bog was estimated to be $115.85 for model STRAT1, $67.04 for model STRAT2, $59.15 for model STRAT3, and $79.22 for model ALL (Table 4.5). These estimates confirm the hypothesis that respondents are willing to pay less for the preservation of the Alfred Bog the further they live from the bog. Thus, there exists a negative correlation between distance from the Alfred Bog wetland and WTP.

The results indicated that a large portion of this value can be interpreted as nonuse values. Approximately 38% of the survey respondents that were willing to pay for the preservation of the Alfred Bog wetland have visited the bog in the past, while 71% of the respondents that were willing to pay were pure non-users of the bog, that is, they never visited the Alfred Bog. This suggests that nonuse values play an important role in determining WTP for the preservation of the Alfred Bog.

Table 4.5: Mean Willingness to Pay for the Preservation of the Alfred Bog Wetland (Protest Zero Bids Excluded)

		95% Confidence Interval[a]		
Model	Mean	Lower Bound	Median	Upper Bound
STRAT1	115.85 (18.49)[b]	85.78	114.43	154.69
STRAT2	67.04 (9.86)	56.87	66.85	78.19
STRAT3	59.15 (9.06)	46.04	58.86	73.46
ALL	79.22 (5.04)	69.71	79.14	89.48

[a] Based on 10,000 drawings (repetitions) from a multivariate normal distribution (Park *et al.*, 1991).

[b] Standard deviation.

The inclusion of protest zero bids decreased mean WTP substantially across all four models (Table 4.6). As in Table 4.5, mean WTP for the preservation of the Alfred Bog wetland decreased as distance from the bog increased. Similar results were obtained when protest zero bids were assigned the mean WTP values (Table 4.7).

Table 4.6: Mean Willingness to Pay for the Preservation of the Alfred Bog Wetland (Protest Zero Bids Included)

		95% Confidence Interval[a]		
Model	Mean	Lower Bound	Median	Upper Bound
STRAT1	47.38 (9.18)[b]	28.84	46.19	72.71
STRAT2	20.36 (3.74)	13.88	20.03	28.55
STRAT3	17.25 (3.43)	10.06	16.71	27.49
ALL	29.31 (3.15)	23.59	29.16	35.80

[a] Based on 10,000 drawings (repetitions) from a multivariate normal distribution (Park *et al.*, 1991).

[b] Standard deviation.

Table 4.7: Mean Willingness to Pay for the Preservation of the Alfred Bog Wetland (Protest Zero Bids Set at Mean WTP Values)[a]

		95% Confidence Interval[b]		
Model	Mean	Lower Bound	Median	Upper Bound
STRAT1	91.09 (6.83)[c]	78.34	90.92	105.37
STRAT2	75.14 (3.07)	69.09	75.17	81.16
STRAT3	75.73 (2.55)	70.83	75.75	80.71
ALL	80.01 (2.11)	76.03	79.99	84.21

[a] Mean WTP values refer to the mean WTP values obtained when protest zero bids were excluded from the analysis. Therefore, protest zero bids are set at $115.85 for model STRAT1, $67.04 for model STRAT2, $59.15 for model STRAT3, and $79.22 for model ALL.

[b] Based on 10,000 drawings (repetitions) from a multivariate normal distribution (Park *et al.*, 1991).

[c] Standard deviation.

The convolution approach was used to determine if there was a statistically significant difference in distributional mean WTP values using models STRAT1, STRAT2, and STRAT3. The confidence intervals that were calculated using Krinsky-Robb simulations, which uses the vector of estimated parameters and the variance-covariance matrix to generate an empirical distribution of mean WTP, were used to estimate the convolution of difference between models STRAT1, STRAT2, and STRAT3.

The 95% confidence interval for model STRAT1 was wider than the confidence intervals for models STRAT2 and STRAT3 (Table 4.5). This indicated that model STRAT1 had a wider dispersion of mean WTP in comparison to the other models. Model ALL demonstrated a fairly tight confidence interval around the mean WTP amount. A comparison between the 95% confidence intervals for model STRAT1 and STRAT2 indicated that there was no overlap between the upper bound of model STRAT1 and the lower bound of model STRAT2. The 95% confidence interval of the convolution did not include zero (Table 4.8). Thus, the null hypothesis of equality between the distributional mean WTP estimated using models STRAT1 and STRAT2 was rejected at the 5% level. The mean significance of the difference of the distributions was calculated to be 0.07528.

Similarly, the confidence intervals for model STRAT1 and STRAT3 indicated that there was no overlap and the 95% confidence interval of the convolution did not include zero. Therefore, the results indicate that the null hypothesis of equality between models STRAT1 and STRAT3 is rejected at the 5% level. The alpha level of significance was calculated to be (0.00044).

There was a substantial degree of overlap between the confidence intervals for models STRAT2 and STRAT3. Furthermore, the 95% confidence interval of the convolution included zero. Thus, the null hypothesis of equality between models STRAT2 and STRAT3 cannot be rejected. The mean significance of the difference of the distributions was calculated to be 0.10041.

Table 4.8: Difference of Distributions of Mean Willingness to Pay, 95% Confidence Interval (Protest Zero Bids Excluded)

Model	Lower Bound	Upper Bound	α Level of Significance
STRAT1-STRAT2	27.00	64.00	0.07528
STRAT1-STRAT3	18.00	53.00	0.00044
STRAT2-STRAT3	-1.00	19.00	0.10041

Similar results were obtained when the protest zero bids were included in the data (Table 4.9) and when the protest zero bids were assigned mean WTP values (Table 4.10). In both cases, the method of convolution showed that the distributions between models STRAT1 and STRAT2 and the distributions between models STRAT1 and STRAT3 were significantly different. However, the confidence intervals between models STRAT2 and STRAT3 overlapped considerably and the 95% confidence interval of the convolutions included zero. Thus the null hypothesis that the mean WTP distributions between models STRAT2 and STRAT3 were similar could not be rejected.

Table 4.9: Difference of Distributions of Mean Willingness to Pay, 95% Confidence Interval (Protest Zero Bids Included)

Model	Lower Bound	Upper Bound	α Level of Significance
STRAT1-STRAT2	12.00	33.00	0.00011
STRAT1-STRAT3	8.00	29.00	0.00010
STRAT2-STRAT3	-2.00	9.00	0.24340

Table 4.10: Difference of Distributions of Mean Willingness to Pay, 95% Confidence Interval (Protest Zero Bids Set at Mean WTP Values) [a]

Model	Lower Bound	Upper Bound	α Level of Significance
STRAT1-STRAT2	1.00	31.00	0.03381
STRAT1-STRAT3	1.00	30.00	0.03613
STRAT2-STRAT3	-9.00	7.00	0.78368

[a] Mean WTP values refer to the mean WTP values obtained when protest zero bids are excluded from the analysis. Therefore, protest zero bids are set at $115.85 for model STRAT1, $67.04 for model STRAT2, $59.15 for model STRAT3, and $79.22 for model ALL.

4.4. Regression Analysis

4.4.1. Regression Analysis for Willingness to Pay (Model STRAT1)

In this section, three sets of regression analysis results are presented for model STRAT1 based on the three methods which account for protest zero bids described in section 3.4.4. The first set of regression results presented in Table 4.11 excluded all protest zero bids from the data set. The second set of regression results treated the protest zero responses as legitimate zero bids and included them in the data set. The third set of regression results assigned all protest zero bids the mean WTP value.

The specification of the model STRAT1 for the first set of regression results included the variables KLG, VIS, DON, UVAL, NVAL, MBR, IMP, ED2-4, IN2-4, and BID. The overall performance of this model was indicated by the Wald statistic test ($W=39.981\sim\chi^2_{14}$), which rejected the null hypothesis at the 1% level of significance that all the slope coefficients were simultaneously equal to zero.

Most of the coefficients had the expected sign and were significant at the 5% level of significance. The coefficient on the variable BID was positive and significant at the 1% level indicating that there is a positive correlation between the bid amount offered and the probability that a respondent will not be willing to pay the offered amount.

Prior knowledge (KLG) about the Alfred Bog wetland had the expected positive sign, however it was found to have an insignificant influence on WTP. This was an unexpected result since it was hypothesized that respondents with prior knowledge about the Alfred Bog would be WTP more for its' preservation than respondents without prior knowledge. This result suggests that prior knowledge about the Alfred Bog wetland is not an important predictor of WTP for respondents in model STRAT1.

The variable visit (VIS) had a positive coefficient and was significant at the 5% level. This confirmed the hypothesis that respondents who have visited the Alfred Bog would be WTP more to preserve it. This suggests that respondents who had direct use of the bog may derive more utility from it than respondents who are non-users of the Alfred Bog.

Donations (DON) was found to have a significant influence on WTP. The coefficient was positive and significant at the 10% level. This confirms the assumptions that respondents who made previous contributions towards the preservation of Ontario wetlands would be WTP more for the preservation of the Alfred Bog wetland. It may be argued that respondents that made previous donations may have a special appreciation or concern for the protection of wetlands, thus reflecting their positive attitude towards the preservation of the Alfred Bog.

The variables concerning the respondents' attitudes (UVAL and NVAL) towards the preservation of the Alfred Bog both had positive coefficients as hypothesized. The coefficients were both significant at the 5% level, suggesting that respondents who assigned greater use and nonuse values towards the preservation of the bog would be WTP more to conserve the Alfred Bog. Approximately 75% of the respondents in model STRAT1 have visited the bog at one time or another. It may be argued that since these respondents are aware of the bog's characteristics and environmental quality, they may be WTP for the option of visiting it in the future. Furthermore, if the respondents were appreciative of this natural resource, they may also be WTP to preserve the bog for its own sake and for future generations to enjoy.

It had been hypothesized that membership (MBR) to a conservation group would be positively correlated with and would have a significant influence on respondents' WTP since members of conservation groups tend to have positive views and attitudes towards environmental protection. Although the coefficient was positive, it was not a significant predictor of WTP. This result suggests that respondents that are members of a conservation group have the same WTP as respondents that are not members of a conservation group. This result may be explained by the low percentage of respondents (7%) that were members of a conservation group. Since there was a small percentage of respondents that were members of a conservation group in comparison to respondents that were not members of a conservation group, the lack of predictive power to detect a difference between members and non-members may have resulted in the insignificant result.

It was hypothesized that the variable representing the respondent's attitude about their perceived importance (IMP) of preserving the Alfred Bog wetland would have a significant influence on WTP. The coefficient on IMP was positive as predicted, however it was not significant. This result suggests that the respondents' perceived importance of preserving the Alfred Bog is not related to whether or not they would be WTP. This result may be explained by the lack of variability across the five different response levels (extremely important, fairly important, not sure, not really important, and not important at all). Ninety-three percent of the respondents stated that the preservation of the Alfred Bog wetland is "extremely important" while 7% stated that preservation is "fairly important." Thus, since the majority of the respondents fell into category one and the remaining respondents fell into category two, there was not enough variability between the different response levels to produce a significant result.

The coefficients on education level 3 (ED3) and education level 4 (ED4) were both positive and significant at the 5% and 10% level respectively which suggest that a higher level of education has a positive influence on WTP. These results were consistent with the assumption that respondents with a higher level of education would have a more comprehensive understanding of and would be more familiar with the notion of hypothetical scenarios and WTP questions. Although ED2 had the predicted positive sign, it was not significant, suggesting that a significant correlation between education and WTP begins to function at post-secondary and university levels of education.

Household income was found to have a significant impact on WTP values. The coefficients on IN2, IN3, and IN4 were positively correlated with WTP and were significant at the 5% level. These results confirm the hypothesis that WTP increases with increased household income. These results differ from Beasley *et al.*, (1986) who found income to be insignificant in their models. They suggested that income may be irrelevant to CVM studies since money does not actually change hands, thereby allowing low income households to bid as much as high income households. The results of this model do not support these findings since income was found to be a significant determinant of WTP.

Table 4.11: Estimated Bid Function for Model STRAT1

	Protest Zero Bids Excluded			Protest Zero Bids Included			Protest Zero Bids set at the Mean WTP Value		
Variable	Coeff.	t-stat.	P-value	Coeff.	t-stat.	P-value	Coeff.	t-stat.	P-value
KLG	0.797	1.620	0.108	1.387	1.367	0.170	0.190	0.335	0.739
VIS	1.109	2.072	0.040	0.420	0.756	0.452	-0.299	-0.632	0.530
DON	1.499	1.770	0.082	1.365	1.852	0.069	0.581	0.627	0.533
UVAL	1.557	2.986	0.003	-	-	-	0.471	1.741	0.083
NVAL	1.076	2.716	0.010	-	-	-	0.546	1.569	0.122
MBR	1.230	1.169	0.245	0.845	0.761	0.450	1.528	1.311	0.194
IMP	0.562	0.797	0.427	-0.525	-0.599	0.550	0.196	0.434	0.665
ED2	1.369	0.851	0.402	-	-	-	-	-	-
ED3	1.403	2.205	0.029	-	-	-	-	-	-
ED4	1.365	1.852	0.069	-	-	-	-	-	-
IN2	0.714	2.196	0.029	0.424	0.467	0.641	1.642	1.309	0.195
IN3	1.052	2.028	0.043	-3.074	-2.317	0.024	1.184	1.918	0.056
IN4	1.207	2.011	0.045	3.023	2.294	0.025	1.651	1.331	0.188
BID	0.018	6.113	0.000	0.012	6.308	0.000	0.029	8.994	0.000

Protest Zero Bids Excluded	Protest Zero Bids Included	Protest Zero Bids set at the Mean WTP Value
Obs. = 37 d.o.f. = 23	Obs. = 73 d.o.f. = 64	Obs. = 73 d.o.f. = 62
-2 (Log Likelihood): 166.183	-2 (Log Likelihood): 220.483	-2 (Log Likelihood): 317.462
Wald Statistic: 39.981	Wald Statistic: 47.344	Wald Statistic: 84.442
P (larger Wald Stat): 0.000018	P (larger Wald Stat): 0.000000	P (larger Wald Stat): 0.000000

The specification of the model STRAT1 for the second set of regression results included the variables KLG, VIS, DON, MBR, IMP, IN2-4, and BID (Table 4.11). The model was first estimated including the variables corresponding to education level (ED2-4) and use and nonuse values (UVAL and NVAL). The coefficients on education were positive as predicted, however they were insignificant. This was an unexpected result given the hypothesis that respondents with a higher level of education would find it easier to comprehend the notion of hypothetical scenarios. Moreover, a likelihood ratio test also failed to reject the null hypothesis that these three variables were simultaneously equal to zero (LR=0.409~χ^2_3). Therefore, the level of education did not appear to have a significant effect on WTP and was therefore excluded from the model.

The coefficient on NVAL and UVAL were positive as hypothesized, however they were not significant. A likelihood ratio test failed to reject the null hypothesis that these two variables were simultaneously equal to zero (LR=0.338~χ^2_2). Therefore, these two variables were also dropped from the model.

The coefficients on the independent variables member (MBR) and importance (IMP) were insignificant as was the case for the regression results obtained when protest zero bids were excluded from the data analysis. The insignificant result for the variable on MBR may be explained by the low percentage of respondents (6%) that were members of a conservation group in comparison to respondents that were not members of a conservation group. Thus, the lack of variability between these two groups failed to produce significant results.

Similarly, regarding the variable on IMP, the lack of variability across the five different response levels may have resulted in the insignificant result.

The only variables that were significant in this model were BID, donations (DON) and household income (IN). The coefficient on BID was significant at the 1% and had the expected positive sign. The coefficient on DON was positive and significant at the 10% level indicating that previous donations towards the preservation of wetlands in Ontario have a positive influence on WTP. The variables on IN3 and IN4 were positive and significant at the 5% level. This result suggests that WTP increases with increased household income. All remaining variables were found to be insignificant determinants of WTP.

The Wald statistic obtained ($W=47.344 \sim \chi^2_9$) indicated that the null hypothesis that all the slope coefficients were simultaneously equal to zero could be rejected at the 1% level of significance. However, the inclusion of protest zero bids did not improve the overall efficiency of the parameter estimates. A reasonable explanation for the decrease in the efficiency of the parameter estimates may be the low variability across those respondents who were WTP and those who stated protest zero bids. Fifty-one percent of the respondents in model STRAT1 stated protest zero bids. Since all of the protest zero bid responses have the same value (zero), there is not enough variability within the "protest-bidder" group to generate significant results. This group exhibits low variability and is clustered around the mean value, zero.

Similarly, when the protest zero bids were set at the mean WTP value, the overall efficiency of the parameter estimates did not improve in comparison to the parameter estimates obtained when protest zero bids were excluded from the data analysis. In this case, all 51% of the protest zero responses were assigned the mean value of $115.85. Analogous to the case described above, there is not enough variability within this group to produce significant results since all of the bids have the same value.

Halstead *et al.* (1992) suggested the inclusion of protest zero bids either by assigning a zero value or by assigning protest zero bidders the mean WTP value. In the case of the results presented here, neither approach increased the efficiency of the estimated parameters. Perhaps in cases where the proportion of protest zero bids is relatively low, the inclusion of these two approaches during data analysis might be reasonable and they might improve the efficiency of the parameter estimates.

In sections 4.4.2., 4.4.3., and 4.4.4., similar results were obtained for those models including protest zero bids and those models which assigned protest zero bidders mean WTP values. Therefore, the results pertaining to these two sets of regression analysis' for models STRAT2, STRAT3, and ALL will not be discussed since the explanation for the resulting insignificant coefficients was discussed above. However, the three sets of regression analysis results are presented for each of the remaining models (STRAT2, STRAT3, and ALL). In cases where certain variables were not included in the specified model, likelihood ratio tests indicated that the inclusion of those variables failed to reject the null hypothesis that they were simultaneously equal to zero. Therefore, those particular variables were removed from the models.

4.4.2. Regression Analysis for Willingness to Pay (Model STRAT2)

The model STRAT2 for the set of regression results that excluded all protest zero bids included the same variables as those in model STRAT1 to estimate respondents' WTP for the preservation of the Alfred Bog wetland (Table 4.12). The overall performance of this model was indicated by the Wald statistic test ($W=49.994 \sim \chi^2_{14}$), which rejected the null hypothesis at the 1% level of significance that all the slope coefficients were simultaneously equal to zero. In comparison to model STRAT1, the overall significance of this model increased, as noted by the very low probability of obtaining a larger Wald statistic (0.000002). This is due to an increase in the number of observations. The Wald statistic test increased from 39.981 in model STRAT1 to 49.994 in model STRAT2.

Most of the coefficients had the expected sign and were significant at the 5% level of significance. The coefficient BID was positive and significant as expected. The variable on prior knowledge (KLG) about the Alfred Bog wetland had the predicted positive sign, however it was not significant. This suggests that previously acquired knowledge about the Alfred Bog wetland was not a significant predictor of WTP.

Visits (VIS) to the Alfred Bog wetland was found to have a significant influence on WTP. The coefficient was positive and significant at the 5% level. This result confirms the assumption that respondents who had direct use of the bog may derive more utility from it and would be WTP more to preserve it than respondents who are non-users of the Alfred Bog.

The variable concerning previous donations (DON) made towards the preservation of wetlands was significant at the 5% level and had the hypothesized positive sign. This coefficient was larger in size and more significant than the same coefficient in model STRAT1. This result indicates that respondents who live further away from the bog might be more sensitive towards the positive nature of making donations to preserve the bog than respondents who live nearby the Alfred Bog.

The variables concerning the respondents' attitudes towards the use and nonuse values (UVAL and NVAL) associated with the bog were both positive and significant at the 10% level. This indicates a positive correlation between use and nonuse values of the Alfred Bog wetland and WTP. Although both of these coefficients were significant, the level of significance decreased from 5% to 10% in comparison to the same coefficients in model STRAT1. This result suggests that as distance from the bog increases, use and nonuse values decline as well.

Membership (MBR) to a conservation group had the predicted positive sign, however it was an insignificant predictor of WTP. As was the case in model STRAT1, this result may be explained by the low percentage of respondents (4%) that were members of a conservation group. Thus, the lack of predictive power to detect a difference between those respondents that were members of a conservation group and those that were not members of a conservation group may have resulted in the insignificant result.

Table 4.12: Estimated Bid Function for Model STRAT2

	Protest Zero Bids Excluded			Protest Zero Bids Included			Protest Zero Bids set at the Mean WTP Value		
Variable	Coeff.	t-stat.	P-value	Coeff.	t-stat.	P-value	Coeff.	t-stat.	P-value
KLG	0.974	1.321	0.192	0.358	0.635	0.527	-0.225	-0.531	0.597
VIS	1.131	2.148	0.033	0.481	0.980	0.329	0.066	0.165	0.869
DON	2.719	2.656	0.012	2.611	3.394	0.001	1.531	1.954	0.054
UVAL	1.136	1.913	0.061	0.765	0.542	0.592	1.272	1.292	0.209
NVAL	1.277	1.827	0.077	1.231	2.826	0.006	0.636	3.002	0.003
MBR	1.731	1.415	0.164	1.291	1.234	0.220	-0.270	-0.272	0.786
IMP	1.231	1.294	0.201	1.297	1.043	0.306	1.195	1.052	0.304
ED2	0.874	0.509	0.614	1.287	1.135	0.259	-	-	-
ED3	1.447	1.802	0.078	1.524	1.960	0.053	-	-	-
ED4	1.036	1.779	0.082	1.650	1.439	0.153	-	-	-
IN2	1.298	1.093	0.282	-	-	-	1.362	1.514	0.144
IN3	2.316	2.152	0.039	-	-	-	1.977	2.195	0.030
IN4	1.556	2.347	0.025	-	-	-	1.006	1.244	0.216
BID	0.038	6.829	0.000	0.020	6.755	0.000	0.053	9.776	0.000
	Obs. = 47 d.o.f. = 33 -2 (Log Likelihood): 151.767 Wald Statistic: 49.994 P (larger Wald Stat): 0.000002			Obs. = 118 d.o.f. = 107 -2 (Log Likelihood): 256.727 Wald Statistic: 56.992 P (larger Wald Stat): 0.000000			Obs. = 118 d.o.f. = 107 -2 (Log Likelihood): 399.056 Wald Statistic: 141.744 P (larger Wald Stat): 0.000000		

Similarly, the coefficient on importance (IMP) was found to be insignificant as was the case in model STRAT1. The same explanation for the insignificant IMP coefficient in model STRAT1 holds for this situation, whereby the lack of variability across the five different response levels failed to produce significant results.

The coefficients on education level 3 (ED3) and education level 4 (ED4) were both positive and significant at the 5% level. This confirms the assumption that a higher level of education has a positive influence on WTP. Similarly, household income was found to have a significant impact on WTP values. The coefficients on IN3 and IN4 were significant at the 5% level. The positive sign of both coefficients confirms the hypothesis that WTP increases with an increase in household income.

4.4.3. Regression Analysis for Willingness to Pay (Model STRAT3)

The overall performance of model STRAT3 to estimate respondents' WTP for the preservation of the Alfred Bog wetland was good, as indicated by the Wald statistic test ($W=77.392 \sim \chi^2_{12}$), which rejected the null hypothesis at the 1% level of significance that all the slope coefficients were simultaneously equal to zero (Table 4.13). In comparison to models STRAT1 and STRAT2, the overall significance of this model increased, as noted by the very low probability of obtaining a larger Wald statistic. The improvement in the overall performance of the model can be explained by the increase in the number of observations. In model STRAT1 and STRAT 2, the number of observations were 37 and 47, respectively. In model STRAT3, there were 64 observations, thus increasing the degrees of freedom and the significance of the model.

In contrast to the results obtained for the variable knowledge (KLG) in model STRAT1 and STRAT2, prior knowledge about the Alfred Bog wetland was found to be significant at the 5% level. The coefficient was positive as hypothesized. This suggests that the more information that a respondent had in regards to the bog, the more they were WTP for its' preservation. The coefficient on BID was also positive and significant, indicating a positive correlation between the bid amount and the probability that a respondent would refuse it.

It was assumed that respondents who had direct use of the bog would be WTP more to preserve it than respondents who were non-users of the Alfred Bog since users may derive more utility from it. However, in contrast to the results obtained in models STRAT1 and STRAT2, the variable on visit (VIS) was found not to have a significant influence on WTP. This result may be explained by the relatively low proportion of respondents that have visited the bog (9%) in relation to those that have not. Thus, the lack of variability between respondents that have visited the bog and those that have not may have caused the coefficient VIS to be insignificant.

As was the case in models STRAT1 and STRAT2, the variable concerning previous donations (DON) made towards the preservation of Ontario wetlands had the hypothesized positive sign and was significant at the 10% level. This indicates that respondents who have made past contributions towards the preservation of wetlands are WTP more for the preservation of the Alfred Bog wetland than respondents who have not made past contributions.

Table 4.13: Estimated Bid Function for Model STRAT3

	Protest Zero Bids Excluded			Protest Zero Bids Included			Protest Zero Bids set at the Mean WTP Value		
Variable	Coeff.	t-stat.	P-value	Coeff.	t-stat.	P-value	Coeff.	t-stat.	P-value
KLG	0.715	2.197	0.029	0.188	0.481	0.631	0.019	0.058	0.954
VIS	1.081	1.455	0.151	0.714	1.289	0.200	0.394	0.923	0.358
DON	2.232	1.151	0.055	1.029	0.879	0.381	-0.195	-0.161	0.872
UVAL	-	-	-	1.506	0.815	0.421	0.160	0.688	0.493
NVAL	-	-	-	1.962	2.084	0.042	0.336	0.942	0.348
MBR	1.735	2.487	0.014	0.269	0.365	0.717	2.416	2.331	0.021
IMP	0.356	0.986	0.326	1.012	0.727	0.472	1.518	1.138	0.257
ED2	0.282	0.159	0.874	-	-	-	1.277	1.183	0.239
ED3	0.644	0.385	0.097	-	-	-	1.492	1.756	0.086
ED4	0.776	1.875	0.063	-	-	-	1.533	1.417	0.159
IN2	0.872	1.293	0.197	0.738	1.036	0.307	-	-	-
IN3	2.318	2.274	0.027	1.829	2.459	0.017	-	-	-
IN4	2.414	2.829	0.016	-0.454	-1.238	0.221	-	-	-
BID	0.041	8.692	0.000	0.024	8.846	0.000	0.057	9.325	0.000
	Obs.=64 d.o.f. =52 -2 (Log Likelihood): 220.613 Wald Statistic: 76.981 P (larger Wald Stat): 0.000000			Obs.=148 d.o.f.=137 -2 (Log Likelihood): 358.642 Wald Statistic: 94.486 P (larger Wald Stat): 0.000000			Obs.=148 d.o.f.=137 -2 (Log Likelihood): 473.166 Wald Statistic: 179.566 P (larger Wald Stat): 0.000000		

The variables concerning the respondents' attitudes towards the use and nonuse values (UVAL and NVAL) were both found to be insignificant. This result contrasts the results that were obtained for this variable in models STRAT1 and STRAT2, where both use and nonuse values were found to be significant predictors of WTP. A likelihood ratio test failed to reject the null hypothesis that the two coefficients were simultaneously equal to zero (LR = $0.456 \sim \chi^2_2$). Thus, the variable UVAL and NVAL were removed from the model. The low proportion of respondents that visited the Alfred Bog may explain this result. Since visit rates declined with distance from the bog (71% in STRAT1, 40% in STRAT2, and 9% in STRAT3), the associated use values also decreased. Furthermore, since the majority of the respondents in model STRAT3 have never visited the bog, their option of visiting it in the future might also decrease.

Membership (MBR) to a conservation group had the predicted positive sign and unlike the insignificant results that were obtained for this variable in models STRAT1 and STRAT2, MBR was found to be significant at the 5% level. This confirms the hypothesis that a membership to a conservation group is positively correlated with WTP. An increase in the proportion of respondents that were members of a conservation group may explain this result. It may also be argued that members of a conservation group may have positive views and attitudes towards environmental protection, thereby reflecting their concern for the preservation of the Alfred Bog.

The coefficient on importance (IMP) was positive as predicted, however it was not significant. This result is consistent with those obtained in models STRAT1 and STRAT2. As with the results from the previous models, the lack of variability across the five different response levels may be an explanation for this result.

The coefficients on education level 3 (ED3) and education level 4 (ED4) were both positive and significant at the 10% level. This confirms the assumption that a higher level of education has a positive influence on WTP. Similarly, household income was found to be significant at the 5% level. The positive sign of both coefficients confirms the hypothesis that WTP increases with an increase in household income.

4.4.4. Regression Analysis for Willingness to Pay (Model ALL)

The model ALL included all the responses from the survey respondents in model STRAT1, STRAT2, and STRAT3. Willingness to pay for the preservation of the Alfred Bog wetland was estimated using the variables introduced in the previous models (Table 4.14). In addition to these variables, a distance (DIS) variable was included to capture the effect of distance on WTP values.

The overall performance of the model ALL was indicated by the Wald statistic test ($W=172.529 \sim \chi^2_{14}$). According to this test, the null hypothesis that all the slope coefficients were simultaneously equal to zero can be rejected at the 1% level of significance. In comparison to the models STRAT1, STRAT2, and STRAT3, the overall significance of this model increased, as noted by the very low probability of obtaining a larger Wald statistic. The improvement in the overall performance of the model can be explained by the increase in the degrees of freedom caused by the availability of more observations in model ALL (148 observations as compared to 37, 47, and 64 observations in models STRAT1, STRAT2, and STRAT3 respectively).

The coefficient for prior knowledge (KLG) about the Alfred Bog wetland had the expected positive sign, however it was found to have an insignificant influence on WTP. This result suggests that prior knowledge about the Alfred Bog wetland is not an important predictor of WTP.

Consistent with the results that were obtained for the variable visit (VIS) in models STRAT1 and STRAT2, this variable was found to have a significant influence on WTP in model ALL. The coefficient was positive and significant at the 5% level, which confirms the hypothesis that respondents who had direct use of the bog may derive more utility from it and would therefore be WTP more to preserve it than respondents who are non-users of the Alfred Bog.

The coefficient for previous donations (DON) made towards the preservation of wetlands was very consistent across all four models. The coefficient was positive and significant at the 5% level, indicating that donations had a positive influence on WTP. The coefficient BID was also very consistent across all four models. The coefficient had the expected positive sign and was significant at the 1% level, suggesting that there is a positive correlation between the bid amount offered and the probability that a respondent will not be willing to pay the offered amount.

The variables concerning the respondents' use and nonuse values (UVAL and NVAL) towards the preservation of the Alfred Bog both had positive coefficients as hypothesized and were both significant at the 10% level. This result suggests that respondents who assigned greater use and nonuse values towards the preservation of the bog would be WTP more to conserve it than those respondents who assigned low values towards the Alfred Bog.

Table 4.14: Estimated Bid Function for Model ALL

	Protest Zero Bids Excluded			Protest Zero Bids Included			Protest Zero Bids set at the Mean WTP Value		
Variable	Coeff.	t-stat.	P-value	Coeff.	t-stat.	P-value	Coeff.	t-stat.	P-value
KLG	0.990	1.535	0.130	0.332	1.196	0.233	0.126	0.561	0.575
VIS	1.307	20.66	0.041	0.139	0.268	0.605	0.148	0.616	0.538
DON	1.172	2.130	0.035	1.535	3.308	0.003	1.075	1.970	0.050
UVAL	1.503	1.716	0.075	1.775	1.551	0.124	0.182	1.240	0.216
NVAL	1.289	1.701	0.092	1.243	1.098	0.275	0.454	1.237	0.221
MBR	0.581	1.664	0.097	0.797	1.620	0.108	1.258	1.990	0.047
IMP	1.381	1.385	0.171	1.222	1.052	0.295	1.396	1.339	0.186
DIS	-0.236	-1.711	0.088	-1.082	-2.012	0.046	-0.080	-0.603	0.547
ED2	0.611	1.413	0.159	0.698	1.152	0.250	-	-	-
ED3	1.368	2.145	0.034	1.414	2.272	0.024	-	-	-
ED4	0.581	1.688	0.093	0.424	0.467	0.641	-	-	-
IN2	0.938	1.402	0.162	-	-	-	0.061	0.101	0.919
IN3	1.343	1.877	0.062	-	-	-	0.473	0.782	0.435
IN4	1.447	2.129	0.034	-	-	-	1.078	1.843	0.069
BID	0.026	12.926	0.000	0.017	12.717	0.000	0.044	18.050	0.000

Protest Zero Bids Excluded	Protest Zero Bids Included	Protest Zero Bids set at the Mean WTP Value
Obs. = 148 d.o.f. = 133	Obs. = 339 d.o.f. = 327	Obs. = 339 d.o.f. = 327
-2 (Log Likelihood): 601.219	-2 (Log Likelihood): 898.434	-2 (Log Likelihood): 1257.634
Wald Statistic: 172.529	Wald Statistic: 193.029	Wald Statistic: 407.635
P (larger Wald Stat): 0.000000	P (larger Wald Stat): 0.000000	P (larger Wald Stat): 0.000000

Membership (MBR) to a conservation group had the predicted positive sign and was significant at the 10% level. This confirms the hypothesis that a membership to a conservation group is positively correlated with WTP. Although this variable was insignificant in both the models STRAT1 and STRAT2, an increase in the proportion of respondents that were members of a conservation group may explain the significance of this result.

The coefficient on importance (IMP) was insignificant, which was a consistent result across all four models. The coefficient reflected respondents' perceived importance of preserving the Alfred Bog wetland. It was hypothesized that respondents' would be WTP more to preserve the Alfred Bog if the bog was important to them. Thus, a positive correlation between IMP and WTP was assumed. However, the coefficient IMP was found to be insignificant in all four models, suggesting that IMP is not an important predictor of WTP. As with the results from the previous models, the lack of variability across the five different response levels may be an explanation for the insignificant results.

Distance (DIS) from the Alfred Bog wetland had the predicted negative sign and was significant at the 10% level. This confirms the hypothesis that distance is negatively correlated with WTP. The result suggests that respondents that live further away from the Alfred Bog are WTP less for its' preservation than respondent that live close to the bog. It may be argued that respondents that live further away from the bog tend to derive less use value from it than respondents that live closer to the bog, thus they would be WTP less for its' preservation.

The coefficients on education level (ED2-4) were positive and significant across all four models. The positive correlation between education level and WTP suggests that respondents that completed post-secondary or university education may have a more comprehensive understanding of hypothetical scenarios and WTP questions. Furthermore, respondents with a higher level of education might be more aware of wetland preservation issues.

Similarly, income level (IN2-4) was found to have a significant influence on WTP across all four models. The coefficients on income were positive and significant, thus confirming the hypothesis that WTP increases with an increase in household income.

4.5. Aggregate Willingness to Pay for the Preservation of the Alfred Bog Wetland

The stratum weights presented in section 3.1.2 were used to estimate the number of households in each stratum. The values used for N_h and N were obtained from the Select Phone (2001) Canadian Edition database since census information was not in a form to allow an easy allocation of households to each stratum. The database provided 24,619 listings for residents in Prescott and Russell. Since the database is similar to a telephone directory, some listings such as private numbers were not included in the database. Therefore, the stratum weights (N_h/N) were multiplied by the total number of households in the United Counties of Prescott and Russell (28,039 households[14]) to provide a better estimate of the number of households per stratum (N_i). Thus, by multiplying N_i by the mean WTP values for each of the stratum, aggregate WTP per stratum and total aggregate WTP was calculated (Table 4.15). The aggregate household WTP ranged from $2.2 million to $663,000 depending upon the inclusion or exclusion of protest zero bids.

[14] Statistics on the number of households and the population of Prescott and Russell was obtained through the Ontario Municipal Directory (2001).

Table 4.15: Aggregate Household Willingness to Pay per Stratum for the Preservation of the Alfred Bog Wetland

	Protest Zero Bids Excluded[a]	Protest Zero Bids Included[b]	Protest Zero Bids Set at Mean WTP Values[c]
Strata 1	$552,214	$225,843	$434,192
Strata 2	$770,691	$234,058	$863,809
Strata 3	$696,573	$203,143	$891,825
Total Aggregate WTP	$2,019,478	$663,044	$2,189,826

[a] Mean WTP (protest zero bids excluded): strata 1 = $115.85, strata 2 = $67.04, strata 3 = $59.15.
[b] Mean WTP (protest zero bids included): strata 1 = $47.38, strata 2 = $20.36, strata 3 = $17.25.
[c] Mean WTP (protest zero bids are at mean WTP values): strata 1 = $91.09, strata 2 = $75.14, strata 3 = $75.73.

Aggregate WTP for Prescott and Russell was also estimated by using the mean WTP value ($79.22), which was calculated for model ALL when protest zero bids were excluded (Table 4.16). Thus, by multiplying the mean WTP value ($79.22) by the total number of households in Prescott and Russell (28,039) yields an aggregate estimate of $2.22 million. By applying the mean WTP value to the population of Prescott and Russell (53,850 eighteen years and older), aggregate WTP for the preservation of the bog was estimated to be $4.26 million. Both estimates were calculated because the WTP question did not clearly indicate whether the one-time donation to the hypothetical preservation fund would be for the household or the individual. Thus, both household and population estimates were calculated. Aggregate WTP was also measured with the inclusion of protest zero bids (mean WTP = $29.31) and with protest zero bids set at the mean value ($80.01).

In addition, aggregate values were estimated based on the assumption that all non-respondents placed a zero dollar value on the preservation of the Alfred Bog wetland

(Stevens *et al.*, 1995). Thus, multiplying the survey response rate (57%) by the total number of households in Prescott and Russell and by the mean WTP value ($79.22) yields an aggregate WTP estimate of $1.26 million. However, it is difficult to determine the extent to which non-respondents value the Alfred Bog wetland since follow-up conversations with the individuals did not ask valuation questions.

Table 4.16: Aggregate Willingness to Pay for the Preservation of the Alfred Bog Wetland

	Protest Zero Bids Excluded	Protest Zero Bids Included	Protest Zero Bids Set at Mean WTP Values
Households	$2,221,250	$821,825	$2,243,400
28,039[a]	$1,266,170[b]	$468,460[b]	$1,278,800[b]
Population	$4,265,995	$1,578,345	$4,308,540
53,850[c]	$2,431,655[b]	$899,670[b]	$2,455,910[b]

[a] Number of households in the United Counties of Prescott and Russell.
[b] Aggregate WTP based on a 57% response rate.
[c] Population of the United Counties of Prescott and Russell over the age of 18.

A comparison of tables 4.15 and 4.16 suggests that using $79.22 as the baseline mean WTP value to determine aggregate WTP values, overestimates total aggregate values. When protest zero bids were excluded from the data, total aggregate WTP was estimated to be $2,019,478 (Table 4.15) whereas total aggregate WTP in Table 4.16 was estimated to be 9% greater. An even larger overestimation was noted when protest zero bids were included. Aggregate WTP was estimated to be approximately 20% larger when $79.22 was used as the baseline mean WTP value. Similarly, when protest zero bids were set at mean WTP values, an overestimation of approximately 3% was noted for aggregate WTP values in Table 4.16 as compared to total aggregate WTP in Table 4.15.

5. CONCLUSION

The objective of this study was to estimate respondents' willingness to pay for the preservation of the Alfred Bog wetland in southern Ontario, which is threatened by the activities of drainage and peat extraction. The Alfred Bog provides habitat for a wide variety of local and migrating wildlife. It also provides habitat for a large number of rare and endangered species. The bog plays an integral role as a natural water filter by removing heavy metals and contaminants by organically attaching them to peat.

Approximately fifty percent of the Alfred Bog is publicly owned by the Nature Conservancy of Canada and Ducks Unlimited, while the other half is privately owned by various landowners. The goal of the United Counties of Prescott and Russell is to acquire the remaining privately owned portions of the bog, which is being reduced and destroyed by agriculture and peat extraction.

The contingent valuation method was used to estimate respondents' willingness to pay for the preservation of the Alfred Bog wetland. This is a direct method of eliciting an individuals' compensating or equivalent variation for a change in the availability of a public good. Although the Alfred Bog is a private good, the CVM was used because of its' capability to measure both use and nonuse values.

The multiple bounded discrete choice elicitation approach was used, which allows respondents to express their level of certainty associated with each dollar threshold. This elicitation format was chosen over alternative formats due to its' advantage of being able to incorporate respondents' uncertainty into the analysis and its' ability to increase the level of precision of WTP estimates due to the use of bid intervals.

A large proportion of the respondents (58%) reported protest zero bids. Due to the current lack of consistency with the censoring of protest responses, three principal means of dealing with protest zero bids were used in this study. The first approach identified and eliminated all protest zero bids from the data set. The second approach treated the protest zero responses as legitimate zero bids and included them in the data set, and the third approach assigned protest zero bidders mean WTP values.

Mean WTP (based on model ALL) for the preservation of the Alfred Bog wetland was estimated to be $79.22 when protest zero bids were excluded from the data, $29.31 when protest zero bids were included in the data, and $80.01 when protest zero bids were assigned the mean WTP values. Aggregate WTP for the residents of Prescott and Russell was estimated to be between $663,044 and $2,189,826, depending on whether or not protest zero bids were included in the data. In addition to these aggregate WTP results, aggregate values were also calculated using $79.22 as the baseline. These aggregation results suggested that using $79.22 as the baseline mean WTP value to determine aggregate WTP values, overestimates total aggregate values. Aggregate WTP for Prescott and Russell was estimated to be between $821,825 and $2,243,400 when $79.22 as the baseline. On average, these aggregation results are approximately 11% greater than those obtained when individual stratum mean WTP values were used to estimate aggregate values.

A large portion of the mean WTP value was interpreted as nonuse values. Approximately 71% of the respondents that were WTP to preserve the bog were non-users of the bog, suggesting that nonuse values play an important role in determining WTP for the preservation of the Alfred Bog. Thus, failure to consider nonuse values in policy decisions can understate the value of wetland preservation and could lead to inadequate or misdirected management of the environmental resource.

The convolution approach determined that there was a statistically significant difference in distributional mean WTP values between models STRAT1 and STRAT2 and between models STRAT1 and STRAT3. There was no significant difference in distributional mean WTP values between models STRAT2 and STRAT3. The results confirmed that WTP decreased as households are further away from the bog, thus indicating that distance is an important indicator of WTP.

The regression results indicated that respondents' experiences and attitudes, including conservation club memberships, visits to the bog, and donations to wetland preservation programs, had a positive effect on WTP for the preservation of the Alfred Bog wetland. Distance from the bog was also found to be important predictors of WTP. Respondents with post-secondary and university level education were WTP more for the preservation of the bog, as did those with a higher level of income.

The inclusion of protest zero bids in the data analysis did not improve the overall efficiency of the parameter estimates. Similar results were obtained when protest zero bids were assigned mean WTP values. The decrease in the efficiency of the parameter estimates is explained by be the low variability across those respondents who were WTP and those who stated protest zero bids. In cases where the proportion of protest zero bids are relatively low, the inclusion of these two approaches during data analysis might be reasonable, however future research on estimating the proportion (or the limit) of protest zero bids to include in data analysis needs to be investigated.

Further research could also be extended to examine the criteria for the censoring of protest zero bids. The current lack of consistency and rationale with the censoring of protest responses may result in different mean WTP estimates. With the establishment of clear standards used to identify protest responses, contingent valuation surveys could be evaluated on theoretical grounds (Lindsey, 1992).

Another interesting area for future research could be an analysis of the views and attitudes held by the people of Prescott and Russell towards the governments' position on the issue of preserving the Alfred Bog wetland. Approximately 85% of the reported protest zero bidders stated that the preservation of the bog should be the responsibility of the government. Although the respondents stated that the preservation of the bog was an important issue, they believed that the government should be accountable for preservation measures. Thus, it would be interesting to conduct further research on the reasons that prompted these individuals to protest against current government policies and against the hypothetical scenario that required WTP with a one-time contribution to preserve the Alfred Bog.

Although the contingent valuation method has several limitations, the results from this study indicated that this method is a useful approach to valuing the Alfred Bog wetland. Methods other than CVM could undervalue the measurement of WTP for the preservation of the Alfred Bog by failing to include and measure nonuse values.

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APPENDIX II: Survey Instrument

Questionnaire

Wetlands include areas that are seasonally or permanently covered by shallow water and occur at low-lying inland locations, or along the margins of lakes and rivers. In Ontario, less than one-quarter of the original two million hectares of wetlands south of the Canadian Shield remain.

In southern Ontario, the ***Alfred Bog wetland*** consists of about 4,200 hectares, which is less than one-third of its original size. This loss has been attributed to the activities of drainage and peat mining.

The Alfred Bog has been designated as a "Class One Provincially Significant Wetland" and as an "Area of Natural and Scientific Interest" by the Ontario Ministry of Natural Resources. It is the largest of its kind in Ontario and gives refuge to numerous plants and animals, many of which are Provincially and/or Nationally rare. Further, it safeguards water quality, controls floods and erosion, and provides outdoor recreation, such as bird watching and nature walks. The Alfred Bog is also highly valued for its peat resources since it is a domed peat bog.

1. Prior to reading the above description of the Alfred Bog wetland, were you aware of the Alfred Bog in southern Ontario?

Yes ☐
No ☐

2. Have you ever visited the Alfred Bog wetland?

Yes ☐ Go to question 3
No ☐ Go to question 4

3. What was the purpose of your visit(s). Check the appropriate box(es).

Bird watching ……... ☐ Photography………… ☐

Nature walk (on boardwalk)…….. ☐ Educational outing…… ☐

Berry picking………. ☐ Other………………… ☐ ________________

GO TO QUESTION 5

4. Would you consider visiting the Alfred Bog wetland in the future?

Yes ☐
No ☐

5. Are you aware of other wetlands in Ontario?

Yes ☐
No ☐

6. In your opinion, how important is the preservation of the remaining Alfred Bog wetland?

Extremely important ………….. ☐
Fairly important ………………. ☐
Not sure ……………………….. ☐
Not really important ………….. ☐
Not important at all ………… ☐

7. How much of the existing Alfred Bog wetland (4,200 hectares) do you believe should be preserved?

100% .... ☐
75% .... ☐
50% .... ☐
25% .... ☐
0 % .... ☐
Not sure .... ☐

<u>HYPOTHETICAL SCENARIO</u>

Consider the following hypothetical situation. Suppose a blue ribbon committee, comprising of environmental groups, County planners, natural resource managers, and interested citizens, introduces a ***"special preservation fund"*** to which individuals can contribute money to preserve the remaining portion of the Alfred Bog wetland which is currently privately owned. The preservation fund would ensure that the remaining Alfred Bog wetland would be left in its natural state and would prohibit the activities of clear-cutting, drainage, sod farming and peat mining which are detrimental to the Bog.

The contribution would be a one-time donation. The money from this fund would be used *exclusively* to compensate landowners, at a reasonable market value, for their loss of land. The goal of this conservation committee is to ensure that the remaining Alfred Bog wetland is preserved.

8. Have you made contributions towards the preservation of Ontario wetlands wetland in the past?

Yes ☐
No ☐

9. **Would you be willing to pay the following amounts for the preservation of the Alfred Bog wetland?** ***CHECK ONE BOX IN EACH ROW.***

	Definitely Yes	Probably Yes	Do Not Know	Probably No	Definitely No
$ 5	☐	☐	☐	☐	☐
$ 10	☐	☐	☐	☐	☐
$ 25	☐	☐	☐	☐	☐
$ 50	☐	☐	☐	☐	☐
$ 100	☐	☐	☐	☐	☐
$ 150	☐	☐	☐	☐	☐
$ 200	☐	☐	☐	☐	☐
$ 350	☐	☐	☐	☐	☐

Only answer this question if you answered "probably no" or "definitely no" to all of the above questions.

10. **Which of the following reasons best describes why you would "not" be willing to contribute to the special preservation fund.**

*"**I do not** want to contribute to the special preservation fund because ..."*

The Alfred Bog has no value to me............................ ☐

I did not want to place a dollar value on the Alfred Bog...... ☐

It is the responsibility of the Government .... ☐

Peat extractors should pay .... ☐

I choose to spend my money in other ways.................... ☐

Other.. ☐ ________________

11. **Which of the following reasons best describes the extent to which you agree or disagree with the preservation of the Alfred Bog wetland.** ***CHECK ONE BOX IN EACH ROW.***

*"**I think** it is important to preserve the Alfred Bog wetland because…"*	Strongly Agree	Somewhat Agree	Not Sure	Somewhat Disagree	Strongly Disagree
It is a place for *leisure activities* such as bird watching, berry picking, walks on boardwalk, ……….	☐	☐	☐	☐	☐
It is an important *natural habitat* for rare wildlife species…………………….	☐	☐	☐	☐	☐
It *safeguards water quality*………………………	☐	☐	☐	☐	☐
The Alfred Bog is *aesthetically* pleasing…………………….	☐	☐	☐	☐	☐
It is part of my *heritage*……	☐	☐	☐	☐	☐
I would like to *visit* it in the future………………………	☐	☐	☐	☐	☐
Other people (visitors, tourists) should have the opportunity to enjoy it……...	☐	☐	☐	☐	☐
Future generations should have the opportunity to enjoy it…………………………….	☐	☐	☐	☐	☐
It should exist in its natural state…………………………	☐	☐	☐	☐	☐

12. Which of the following payment methods do you think is the most appropriate in regards to preserving the Alfred Bog wetland?

A voluntary contribution.............................. ☐

A land tax.. ☐

A special county assessment tax (an environmental tax).................................. ☐

Other... ☐ ____________________________

BACKGROUND INFORMATION

13. Gender

Male .... ☐
Female .... ☐

14. Age

18 – 30 .... ☐
31 – 40 .... ☐
41 – 50 .... ☐
51 – 60 .... ☐
61 – 70 .... ☐
Over 70 years .... ☐

15. Number of children __________

16. Highest level of education

Primary .... ☐
Secondary .... ☐
Post Secondary..... ☐
University .... ☐

17. Your gross household income for 2000

Less than $10,000	☐	$40,000 - 49,999	☐
$10,000 - $ 19,999	☐	$50,000 - 59,999	☐
$20,000 - $29,999	☐	$60,000 - 69,999	☐
$30,000 - $39,999	☐	Over $70,000	☐

18. Do you own any land *within* or on the *perimeter* of the Alfred Bog?

Yes ☐ Go to question 20
No ☐ Go to question 25

19. What is the total area of your land? (Express the total area in either acres or hectares, 1 hectare = 2.471 acres).

Acres ☐ ______________
Hectares ☐ ______________
Do not know ☐

20. Which of the following agricultural activities are practiced on your land ? Check the appropriate box(es).

Alfalfa production... ☐	Cattle (beef) farming. ☐	Sod farming .... ☐
Corn/Soybean Production .... ☐	Dairy farming .... ☐	Peat extraction .... ☐
Small grain Production .... ☐	Hog farming.......... ☐	Other...................... ☐
Fruit/Vegetable production .... ☐	Poultry farming....... ☐	______________________

21. Of the total area of land that you own, is any set aside for conservation?

Yes ☐ Go to question 22
No ☐ Go to question 23

22. How many acres/hectares are set aside? _________ acr. / _________ hec

GO TO QUESTION 24

23. Would you consider setting aside a portion of your land?

Yes ☐ How many acres/hectares would you set aside? _______acr. / ______ hec
No ☐

24. Do you participate directly/indirectly in the Alfred Bog peat mining industry?

Yes ☐
No ☐

25. Are you a member of a conservation group?

Yes ☐ Which organization ______________________________
No ☐

26. City of residence?

Alfred....................	☐	Marionville................	☐
Bourget..................	☐	Plantagenet..............	☐
Casselman................	☐	Rockland..................	☐
Cheney....................	☐	Russell.....................	☐
Chute a Blondeau.........	☐	St Albert..................	☐
Clarence Creek...........	☐	St Bernardin..............	☐
Curran.....................	☐	St Eugene.................	☐
Embrun....................	☐	St Isidore..................	☐
Fournier....................	☐	Ste Anne de Prescott...	☐
Hammond.................	☐	St Pascal de Baylon.....	☐
Hawkesburry..............	☐	VanKleek Hill............	☐
Lefaivre....................	☐	Wendover..................	☐
Limoges..................	☐	Other.......................	☐ ____________
L'Orignal.................	☐		

Please use the reverse page to express additional comments or questions.
Thank you for helping with this important study.

APPENDIX III : Comments Expressed by Questionnaire Respondents

- "I am pleased to see that a study is being conducted on the Alfred Bog wetland. It is high time that people start being more proactive when it comes to conservation matters."

- "It is unfortunate that the Alfred Bog has been ravaged in a very short period of time... the Provincial government should be doing more to help preserve it."

- "The Bog is more than just a wetland. It is a natural beauty that must remain in its natural state."

- "The Alfred Bog safeguards our water quality... I would definitely be willing to pay to protect that."

- "I strongly believe that the Bog should be preserved, but I am under the impression that both the Provincial and Municipal governments are not collaborating to make preservation of the Bog a priority... it is a shame."

- "The province of Ontario should enforce strict regulations on peat extraction as in Quebec. If regulations and laws on peat harvesting were in place, the Alfred Bog would not be in the state it's in today."

- "If the Alfred Bog wetland is to be preserved then the government should pay for it."

- "The Alfred Bog wetland is a wonderful place to go bird watching. I have been bird watching at the Bog for over twelve years and it saddens me to see that peat extractors are allowed to encroach upon such a delicate ecosystem."

- "Our family derives great pleasure from knowing that such an important wetland is located close to our home. "

- "Congratulations on such an initiative towards the Bog... one only wonders if the government is as keen on preserving the Alfred Bog as your research study is."
- "I have never heard of the Alfred Bog, but I am interested in learning more about it and I am also interested on becoming involved with preserving it."

- "The Alfred Bog wetland which took thousands of years to become a precious natural resource can never be replaced once it is lost. It must be rescued from the brink of extinction."

- "Peat extractors should realize that the Alfred Bog should be left for future generations to enjoy."

- "The Alfred Bog should not only be preserved but it should also be restored. Those who are involved with the degradation of the Alfred Bog and other natural areas must be stopped or else there will be no Alfred Bog left to debate over."

- "People need to be educated on this issue. Few people know of the importance of wetlands."

- "I care about the preservation of the Alfred Bog because I want my grand-children to enjoy it as I have."

- "Any wetland or bog should be left in their natural state completely untouched by man... there should be government laws for landowners of such areas and strict penalties for those who do not comply with the enforced laws."

- "The Alfred Bog wetland should be declared a wildlife reserve and should be preserved in its natural state."

- "It is our duty to preserve something that benefits humanity as well as the environment ... clean, clear water is only possible if we do not disrupt natures natural chemical cleaning sponge- the Alfred Bog and other wetlands."

- "I think that there should be laws against the destruction of natural resources... peat extraction not only destroys the Alfred Bog, but it threatens a rare ecosystem of plants and animals."